



Assets Planning and Delivery Group
Engineering

Strategic Product Specification

SPS 500

ISO End Suction Centrifugal Pumps

VERSION 2
REVISION 0

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FOREWORD

Each Strategic Product Specification has been prepared to inform Water 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 WSAA 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;
- 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 appropriate Clause of 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 Mechanical Engineer, Engineering Advisory, 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.

Head of Engineering

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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REVISION STATUS

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

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Strategic Product Specification

SPS 500

ISO End Suction Centrifugal Pumps

CONTENTS

<i>Section</i>		<i>Page</i>
1	Scope and General	9
1.1	Scope.....	9
1.2	Referenced Documents	9
1.3	Definitions and Notation.....	11
1.3.1	Allowable Operating Pressure (AOP).....	11
1.3.2	Best Efficiency Point (BEP)	11
1.3.3	Certificate.....	11
1.3.4	Certification Body.....	11
1.3.5	Certification Mark.....	11
1.3.6	Certification Scheme.....	11
1.3.7	Compliant Product	11
1.3.8	Corporation	11
1.3.9	Manufacturer	11
1.3.10	Maximum Allowable Working Pressure (MAWP).....	11
1.3.11	Nominal Size (DN)	12
1.3.12	Notation.....	12
1.3.13	Net Positive Suction Head (NPSH).....	12
1.3.14	Officer	12
1.3.15	Pressure Class (PN).....	12
1.3.16	Product	13
1.3.17	Product Appraisal.....	13
1.3.18	Product Assessor.....	13
1.3.19	Product Certification	13
1.3.20	Product Verification Report	13
1.3.21	Product Warranty	13
1.3.22	Pump	13
1.3.23	Pumpset.....	14
1.3.24	Purchasing Schedule	14
1.3.25	Quality System.....	14
1.3.26	Strategic Product.....	14
1.3.27	Supplier	14
1.3.28	Testing.....	14
1.3.29	Water Services Association of Australia (WSAA)	14
1.4	Designation of Size	14
2	Materials and Components	15
2.1	Materials of Construction.....	15
2.2	Highly Corrosive Water and Chemicals	16
2.3	Contamination of Drinking Water	16
2.4	Stainless Steel.....	16
2.4.1	Welding, Heat Treatment and Passivation	16

2.4.2	Graphite Compounds	17
2.4.3	Galling.....	17
2.5	Dezincification-resistant Materials.....	17
2.6	Non-metallic Materials	17
2.7	Immersed Components.....	17
2.8	Elastomeric Materials.....	17
3	Design and Manufacture	18
3.1	General.....	18
3.2	Operating Conditions	18
3.2.1	Standard Parameters.....	18
3.2.2	Special Parameters	18
3.3	Performance	18
3.3.1	Pump Selection	18
3.3.2	NPSH	19
3.3.3	Performance Curves.....	19
3.3.4	Driver Selection	19
3.4	Pump Design.....	19
3.4.1	Pressure Rating	19
3.4.2	Casing	20
3.4.3	Impeller.....	20
3.4.4	Shaft	20
3.4.5	Rotating Element Dynamics	21
3.4.6	Wear Rings.....	21
3.4.7	Bearing Housing	21
3.4.8	Bearings	21
3.4.9	Mechanical Seal	21
3.4.10	Seal Flushing.....	22
3.4.11	Fasteners.....	22
3.5	Manufacture	22
3.5.1	Castings.....	22
3.5.2	Machining	22
3.5.3	Balance of Rotating Elements.....	22
3.5.4	Vibration	22
3.6	Ancillary Equipment.....	23
3.6.1	Flexible Coupling.....	23
3.6.2	Baseplate and Coupling Guard.....	23
4	Protective Coatings	24
4.1	General.....	24
4.2	Pump Internal Coating.....	24
4.3	Pump External Coating	24
4.4	Baseplate and Coupling Guard.....	24
5	Testing.....	25
5.1	General.....	25
5.2	Notification of Testing	25
5.3	Access to the Place of Manufacture.....	25

5.4	Place of Manufacture other than WA	25
5.5	Quality Verification Test	25
5.5.1	Coating	25
5.5.2	Hydrostatic Test	25
5.6	Pump Performance Tests	25
5.6.1	General	25
5.6.2	Tolerance	26
5.6.3	Test Set-up	26
5.6.4	Additional Tests	26
5.6.5	Pump Test Report	27
5.6.6	Acceptance	27
5.6.7	Failure to Meet Efficiency Guarantee	27
6	Marking and Packaging	28
6.1	Marking	28
6.1.1	Body Markings	28
6.2	Packaging	28
6.2.1	General	28
6.2.2	Identification Tag	28
6.2.3	Marking of Packaging	29
6.2.4	Warning Labels	29
7	Manuals	30
7.1	Format and Language	30
7.2	Content	30
8	Spare Parts and Special Tools	31
8.1	Spare Parts	31
8.1.1	Interchangeability	31
8.1.2	Availability	31
8.2	Special Tools	31
9	Transportation, Handling and Storage	32
9.1	General	32
9.2	Preservation of Product in Storage	32
10	Quality Assurance	33
10.1	Certification	33
10.1.1	Certification of Product	33
10.1.2	Quality System	33
10.1.3	Product Re-verification	33
10.2	Compliance and Acceptance	33
10.2.1	Means of Demonstrating Compliance	33
10.2.2	Acceptance Criteria	34
10.3	Non-compliant Product	34
10.3.1	General	34
10.3.2	Manufacturing Repairs (In-process)	34
10.3.3	Product Warranty	34
11	Appendix A: Project Specific Requirements (Normative)	36
11.1	General	36

11.2	Specific Requirements	36
12	Appendix B: Technical Compliance Schedules (Normative)	38
12.1	Compliance Schedules	38
13	Appendix C: Material Master Records (Informative).....	43

1 Scope and General

1.1 Scope

This Specification details the requirements for the manufacture, testing, supply handling and delivery of bare shaft ISO end suction centrifugal pumps which are to be ‘long coupled’, via an intermediate coupling, to the driver. The Specification is generally intended for clearwater (non-solids, non-fibrous) applications, and applies to pumps incorporating suction and discharge flange sizes up to and including DN 200 and DN 150 respectively, having a flange rating of PN16, and which conform to the designation, nominal duty points and dimensions of ISO 2858.

For larger flange sizes the designation, duty points and dimensions will be to the Manufacturer’s standard however the pump design shall comply with the technical requirements of this Specification.

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

NOTES:

1. ISO 2858 standardises: sizes, nominal duties, pump flange, support, shaft and mounting hole - dimensions and locations, such that any alternate pump of similar duty can be directly interchanged.
2. This specification is updated following consultation with the Corporation’s *Mechanical Forum* and general confirmation of pump alignment capability. For end suction ‘close coupled’ centrifugal motor pumps, which must be maintained as a pump/motor unit, the reader should refer to SPS 501.

1.2 Referenced Documents

The following documents are referenced in this Specification:

AS

1111.1	ISO metric hexagon bolts and screws Product grade C - Bolts
1112.3	ISO metric hexagon nuts – Product grade C
1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
1275	Metric screw threads for fasteners
1565	Copper and copper alloys – Ingots and castings
1627.2	Metal finishing – Preparation and pre-treatment of surfaces – Power tool cleaning
1646	Elastomeric seals for waterworks purposes
1830	Grey cast iron
2074	Steel castings
2317	Collared eyebolts
2345	Dezincification resistance of copper alloys
2382	Surface roughness comparison specimens
2417	Rotodynamic pumps – Hydraulic performance acceptance tests- Grades 1 and 2
2550.1	Cranes, hoists and winches – Safe use - General
2550.3	Cranes, hoists and winches – Bridge, gantry and portal (including container cranes), jib and monorail cranes
2550.5	Cranes, hoists and winches - mobile
2550.11	Cranes hoists and winches – Vehicle loading cranes
2625.1	Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – General guidelines
2625.4	Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Industrial machines with nominal power above 15 kW and nominal speeds between 120 rev/min and 15,000 rev/min when measured in situ

2700	Colour standards for general purposes - Swatches
2729	Rolling bearings – Dynamic load ratings and rating life
3894.1	Site testing of protective coating – Non-conductive coatings – Continuity test – High voltage (“brush”) method
3894.3	Site testing of protective coatings – Determination of dry film thickness
4087	Metallic flanges for waterworks purposes

AS/NZS

1594	Hot-rolled steel flat products
4020	Testing of products in contact with drinking water
4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
4331.1	Metallic flanges – Steel flanges
4331.2	Metallic flanges – Cast iron flanges

AS/NZS ISO

9001	Quality management systems - Requirements
9906	Rotodynamic pumps – Hydraulic performance acceptance tests – Grades 1, 2 and 3

ASTM

A276	Standard Specification for Stainless Steel Bars and Shapes
A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems

Corporation Strategic Product Specifications

SPS 501	ISO End Suction Centrifugal Motor Pumps
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Corporation Technical Specifications

A1	Protective Coating on Steel and/or Cast Iron
D1	Epoxy Coating on Steel or Cast iron
WS-1	Metal Arc Welding

ISO

1940/1	Mechanical vibration – Balance quality requirements for rotors in constant (rigid) state Part 1: Specification and verification of balance tolerances
2858	End-suction centrifugal pumps (rating 16 bar) – Designation, nominal duty point and dimensions

ISO/IEC

17025	General requirements for the competence of testing and calibration laboratories
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SAA Guides

HB 18	Guidelines for third-party certification and accreditation
HB 18.2	Guide 2 – General terms and their definitions concerning standardization and related activities
HB 18.22	Guide 22 – Information on manufacturer’s declaration of conformity with standards and other technical specification
HB 18.23	Guide 23 – Methods of indicating conformity with standards for third-party certification systems
HB 18.28	Guide 28 – General rules for model third-party certification system for products
MP 52	Manual of authorization procedures for plumbing and drainage products

WSA Standards

109	Industry standard for flange gaskets and O-rings
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1.3 Definitions and Notation

1.3.1 Allowable Operating Pressure (AOP)

The allowable internal pressure, excluding surge, a component can safely withstand in service.

1.3.2 Best Efficiency Point (BEP)

The flow rate at which a pump exhibits a maximum efficiency (the gradient of the efficiency-flow curve is zero), for a particular impeller diameter and speed.

1.3.3 Certificate

A formal certificate defined in SAA HB 18.2 and operated in accordance with SAA HB 18.22 that, as an outcome of Product Certification, attests Product conformity with the nominated product and test standards and authorizes the use of a Certification Mark.

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 Certification Schemes.

In the case of non-strategic plumbing Product, a Certification Body means an organization approved by Standards Australia to administer the National Certification of Plumbing and Drainage Products (NCPDP) Scheme in accordance with SAA MP 52.

1.3.5 Certification Mark

A trademark or other mark of product conformity with a specified standard defined in SAA HB 18.2 and applied in accordance with SAA HB 18.23 that is issued under the rules of a Certification Scheme.

1.3.6 Certification Scheme

A product certification program or system which is operated in accordance with JAS-ANZ Procedure 15 – General requirements for bodies operating product certification systems and in accordance with the general rules of SAA HB 18.28 and System No. 5 as defined in ISO/ITC publication - Certification - Principles and practice. In the case of a non-strategic plumbing Product, a Certification Scheme means the NCPDP Scheme.

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 nominated by the Corporation.

1.3.8 Corporation

The Water Corporation of Western Australia.

1.3.9 Manufacturer

An entity or combination of entities that is 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 Maximum Allowable Working Pressure (MAWP)

The maximum rated operating pressure of the pump.

1.3.11 Nominal Size (DN)

An alphanumeric designation of size for components of a pipework system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections.

1.3.12 Notation

Statements expressed 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 only 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.

1.3.13 Net Positive Suction Head (NPSH)

NPSH: (Net Positive Suction Head) is the absolute inlet total head above the head equivalent to the vapour pressure relative to the suction eye of the pump impeller:

$$\text{NPSH} = H_1 - Z_D + (p_{\text{amb}} - p_v) / \rho_1 g$$

H_1 = Inlet head

Z_D = Difference between NPSH datum plane and reference plane

p_{amb} = Atmospheric pressure

p_v = Vapour pressure

ρ_1 = specific gravity

g = 9.81 m/s²

NPSHA: (Available NPSH) is the NPSH available as determined by the conditions for a specific flow rate in a particular application.

NPSHR: (Required NPSH) is the minimum NPSH performance provided by the Manufacturer for a pump achieving a specified performance at a specified flow rate, speed and pumped liquid (e.g. the occurrence of visible cavitation, increase of noise and vibration due to cavitation, producing a head or efficiency drop of a given amount, limitation of cavitation erosion).

NPSH3: NPSH required for a drop of the total head of the first stage of the pump as a standard basis for use in performance curves.

The definition of the term NPSHR is further covered in Clause 3.2.2 of this Specification to include a minimum value of NPSHR relative to NPSH3.

1.3.14 Officer

A duly authorized representative or appointed agent of the Corporation.

1.3.15 Pressure Class (PN)

A classification of pressure by PN number, based on the allowable operating pressure (AOP) expressed in Megapascals (PN = 10 x AOP).

1.3.16 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.

NOTES:

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

1.3.17 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 the extent of Product and production systems conformity with nominated standards and specifications. Product Appraisal includes verification of the extent of compliance in accordance with the requirements of a relevant 'Technical Compliance Schedule' Appendix.

1.3.18 Product Assessor

An organization, Officer or other person who, having demonstrated specialist product knowledge and competence acceptable to the Corporation, is nominated by the Corporation, subjects Product to Product Appraisal and issues one or more Product Verification Reports.

1.3.19 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 prescribed product standards and tests, under Certification Scheme rules.

1.3.20 Product Verification Report

A formal report wherein a Product Assessor evaluates the extent of Product compliance with the nominated 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.

1.3.21 Product Warranty

A formal express undertaking by a Supplier or Manufacturer that Product is:

- In conformity with the nominated product specification and referenced standards;
- Fit for the nominated Product end use or application;
- Designed for sustained operation at the nominated service performance levels for the specified design life;
- Adequately packaged for intended transportation, handling and storage conditions;
- Supported by English language installation, operating and servicing instructions;
- Adequately supported by Supplier capacity to provide technical Product support.

NOTE: Where required, a Product Warranty should indemnify the Corporation against claims made or losses suffered as a result of breach of the Warranty by means of Public and Products Liability Insurances as specified in the undertaking.

1.3.22 Pump

The term pump (or pumps) referred to in this Specification shall mean an ISO end suction centrifugal pump (or pumps).

1.3.23 Pumpset

A pumpset generally comprises of one pump and one driver (typically an electric motor), mounted on a common baseplate, and includes a power transmission coupling between the pump and the driver, and other ancillary equipment mounted directly onto the pump, prime mover and baseplate.

1.3.24 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. Table 11.1 of this Specification shall constitute part of the Purchasing Schedule.

1.3.25 Quality System

A management system that establishes, documents, implements and maintains organizational 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.

1.3.26 Strategic Product

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

NOTES:

1. Strategic product is most commonly an element of permanent Corporation infrastructure. Ancillary operational and safety equipment, not intended to form part of this infrastructure, may be considered strategic by virtue of enhanced operational performance or personnel safety.
2. Plumbing products (end-of-line water service fittings DN 32 or smaller) used in strategic services may, by virtue of statutory and regulatory requirements, be considered strategic in Corporation applications.

1.3.27 Supplier

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

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

1.3.28 Testing

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

1.3.29 Water Services Association of Australia (WSAA)

The Water Services Association of Australia of which the Water Corporation is a corporate member.

1.4 Designation of Size

This Specification generally covers pump discharge flanges to DN 200 and pressure classes to PN 16 and flow capacities to 250 L/s.

2 Materials and Components

2.1 Materials of Construction

Each pump shall be constructed from materials detailed in Table 2.2 below. The stated material grades represent the basic or minimum requirements, and materials of equivalent or superior quality may be acceptable subject to being authorised for use by the Corporation. Components which are threaded, interference fit, or may come into sliding contact (e.g. wear rings) shall comply with section 2.4.3.

NOTES:

1. Corrosion resistant materials are now specified in this revision, reflecting the lower expected total (lifetime) cost.
2. Duplex stainless steel with a Pitting Resistance Equivalent Number (PREN) ≥ 30 may be commonly offered by suppliers due to its superior casting properties.

Table 2.2 Materials of Construction

Pump Component	Material	Minimum Grade
Casing volute and back cover	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Bearing housing	Manufacturer Select	
Impeller	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Impeller wear rings	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Casing wear rings	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Shaft	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Shaft sleeves (as applicable)	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Impeller key	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Coupling key	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Impeller nut	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22
Impeller washer	Stainless Steel or Duplex Stainless Steel	PREN ≥ 22

Pump Component	Material	Minimum Grade
Mounting foot	Manufacturer Select	
Mechanical seal:		
• Seal plate	Stainless steel	PREN \geq 22
• Rotating face	Carbon	
• Stationary faces	Solid silicon carbide	
• Drive keys	Stainless steel	PREN \geq 22
• Spring(s)	Hastelloy C®	
Studs, setscrews, cap screws, bolts, pins, nuts	Stainless steel	PREN \geq 22
O-rings and seals	Synthetic elastomer	WSA 109: EPDM or NBR
Plugs (drain, vent)	Stainless steel	PREN \geq 22
Water thrower	Manufacturer select	Corrosion Resistant

2.2 Highly Corrosive Water and Chemicals

Pump materials and components required to handle highly corrosive water (including seawater) or chemicals shall be subject to agreement between the Corporation and the Manufacturer. For these applications the Manufacturer shall recommend materials and components (e.g. mechanical seal and flush type such as external flushing) appropriate for the pumped fluid, its physical and chemical properties and related temperature, as specified in the Purchasing Schedule.

NOTES:

1. Highly corrosive waters could include saline water, seawater or brine;
2. For highly aggressive or exotic chemicals a purpose-built chemical pump should be selected.

2.3 Contamination of Drinking Water

Pump materials and coatings in contact with drinking water shall be certified, by an authorized certification laboratory, as complying with the requirements of one or more of the following standards or authorities:

- Australia - AS/NZS 4020
- UK – BS 6920:2000 and the Water Regulations Advisory Scheme (WRAS)
- USA - ANSI/NSF 61 – Drinking Water System Components
- France - ACS (Attestation de conformité sanitaire).

2.4 Stainless Steel

2.4.1 Welding, Heat Treatment and Passivation

Stainless steel castings, plate and bar subjected to welding during manufacture of any component shall be low carbon or stabilized grade. Stainless steel castings shall be heat treated in accordance with AS 2074. All stainless steel components except fasteners shall be passivated in accordance with ASTM A380.

2.4.2 Graphite Compounds

Graphite greases, graphite packing and graphite compounds shall not be used in contact with stainless steel. Protective or decorative coatings shall not be applied to stainless steel when exposed to moist or corrosive environments.

2.4.3 Galling

Components and fasteners that may be susceptible to galling shall embody mitigating features such as:

- Selection of stainless steel grades with at least 50 HB hardness difference e.g. grade 431 stainless steel bolts (285 HB) fitted with grade 316 stainless steel nuts (217 HB);
- Use of nickel food grade ant-seize lubricant (grease) when fitting stainless steel fasteners;
- Provision of surfaces that do not promote galling e.g. rolled stainless steel threads in lieu of machined threads;
- Selection of close tolerance bolts and nuts;
- Eliminating contaminants (grit) during fitting and operation of susceptible components;
- Adopting material design loads which are below those that would produce galling.

2.5 Dezincification-resistant Materials

Copper alloy materials shall be dezincification-resistant and shall comply with AS 2345.

2.6 Non-metallic Materials

Non-metallic materials used in the components of the Product shall be fit for the intended purpose and shall exhibit dimensional stability when exposed to weather, sunlight and where relevant immersion in water.

2.7 Immersed Components

All continuously immersed components shall be manufactured from corrosion-resistant materials. Components in contact with each other shall be designed to minimise galvanic corrosion, either by insulation or optimal material selection.

2.8 Elastomeric Materials

Elastomeric material shall not be injuriously affected by the fluid, temperature or environmental conditions to which it will be subjected in service.

3 Design and Manufacture

3.1 General

The pump shall be horizontal, end suction, single stage centrifugal type complying with ISO 2858. The pump rotating element including back cover and bearing housing shall be capable of being removed without disturbing the suction and discharge pipework or disturbing alignment of the pump with its driver. The pump shall be suitable for continuous operation outdoors.

The design criteria for the pumps shall be based on a minimum life expectancy of 25 years.

3.2 Operating Conditions

3.2.1 Standard Parameters

The pump shall be selected to operate in accordance with the following conditions:

- (a) Environment - Non-aggressive and non-flammable;
- (b) Ambient temperature range of -5°C to 60°C ;
- (c) Altitude - 0 to 500 m;
- (d) Pumped liquid:
 - Clean water (minimal solid particles) in accordance with Table 2.1;
 - Water temperature range of 10°C to 40°C .

For deviations from the above parameters refer to the Special Parameters Clause below.

3.2.2 Special Parameters

Conditions that have parameters that fall outside the standard parameters above will be specified in the Purchasing Schedule including relevant pumped liquid properties e.g. viscosity and density of the pumped fluid. Accordingly the Manufacturer shall base the selection of the pump in terms of performance, materials and component design on the special parameters specified in the Purchasing Schedule.

3.3 Performance

3.3.1 Pump Selection

Pumps shall meet the duty requirements contained in the Purchasing Schedule.

Pump shall be selected to so that:

- The Primary Guarantee Point stated in the Purchasing Schedule is at, or close to, Best Efficiency Point (BEP) of the pumps;
- Secondary Guarantee Points stated in the Purchasing Schedule are met at the same speed and with the same impeller diameter as the Primary Guarantee Point (the Secondary Guarantee Points are used to define the shape of the pump curve);
- No continuous operating duty point outside the *Preferred Operating Range* (POR), nominally at flow rates greater than 115%, or less than 70%, of the BEP for the operating speed;
- No intermittent operating duty point outside the *Allowable Operating Range* (AOR), nominally at flow rates greater than 120%, or less than 50%, of the BEP for the operating speed;
- The H-Q curve is continuously rising for the operating range specified in the Purchasing Schedule.

The pump shall have proven performance characteristics (i.e. not estimated).

3.3.2 NPSH

The pump shall be selected to have an NPSHR less than the system NPSHA specified in the Purchasing Schedule under all operating conditions.

The NPSHR shall be the numerical sum of the NPSH3 value at BEP provided by the Manufacturer and the NPSH margin. For flow rates greater than BEP, the minimum NPSHR shall be the NPSH3 for that flow, plus the NPSH margin. The NPSH margin shall be the greater of the following:

- (a) One (1) metre head for operation within POR, 1.5m for frequent operation outside POR,
- (b) As recommended by the Manufacturer to ensure the long term satisfactory operation of the pump and longevity of the impeller.

3.3.3 Performance Curves

The Manufacturer shall provide the following performance curves and related information for the pump:

- (c) Head-flow, efficiency and absorbed power curves for the pumps fitted with the impeller diameter and speed to meet the Primary and Secondary Guaranteed Point(s). As part of the selection process the Manufacturer shall superimpose the pump head-flow characteristic curves supplied onto the minimum and maximum system resistance curves or operating envelope;
- (d) Head-flow, efficiency and absorbed power curves for the maximum diameter impeller able to be fitted to the pump;
- (e) NPSH3 curves for the duty and maximum diameter impellers, and superimposed curves for NPSHR and NPSHA.

3.3.4 Driver Selection

Unless explicitly excluded elsewhere in the bid documents, the scope of supply shall include, for each pump being supplied, a Caged Induction Motor Driver, selected to meet The Corporation’s Type Specification: *DS26-6 Type Specification for Standard Caged Induction Motors*.

NOTES:

Type Specification DS26-6 should have the Annexure completed, as far as practical, by an electrical engineer and provided to vendors as part of the pump unit bid package.

3.4 Pump Design

3.4.1 Pressure Rating

Pumps shall be designed and manufactured for the Pressure Class (PN) stated in the Purchasing Schedule and in accordance with the following table.

Table 3.1 – Pressure Classifications

Pressure Class PN	MAWP kPa	Hydrostatic Test Pressure, kPa
16	1600	2400

3.4.2 Casing

The pump casing and back cover shall be designed and manufactured to provide a hydraulically smooth volute flow passage with a surface finish equal or better than Roughness Grade N8 to AS 2382.

The casing and bearing housing shall incorporate footplates for horizontal orientation. The footplates shall be provided with holes to accommodate holding down bolts which are sized and located as required by ISO 2858.

The pump casing shall:

- (a) Be self-venting;
- (b) Have an allowable operating pressure rating the same or less than the suction and discharge flanges;
- (c) Incorporate suction and discharge ports with integral flat faced flanges of the same pressure rating in accordance with AS 4087 (default); or flanges complying with either EN1092.1 or EN1092.2, depending on the flange material;
- (d) Be designed to withstand static and dynamic forces and moments transmitted from the installed suction and discharge pipework;
- (e) Be supplied with maximum permissible nozzle force and moment data;
- (f) Incorporate an integral anti-swirl vane in the suction port;
- (g) Incorporate bosses for all tapping points;
- (h) Be provided with a forcing screw to facilitate dismantling;
- (i) Incorporate eyebolts, lugs or cast holes for lifting the pump. Eyebolts shall comply with AS 2317;
- (j) Be fitted with the following tapping points (BSP preferred, NPT accepted) for:
 - Pressure: Pressure gauge connection on the discharge flange;
 - Casing Drain: A plugged drainage port on the low point of the casing;
 - Seal flushing: A tapping point for seal flushing.

3.4.3 Impeller

The impeller shall be:

- (a) Double shrouded, one piece (excluding wear rings), radial flow type;
- (b) Precision cast, with waterways of consistent profile to prevent hydrodynamic imbalance;
- (c) Fitted and secured to the shaft in a manner that prevents circumferential, axial or angular movement;
- (d) Dynamically balanced to according to G6.3;
- (e) Direction of rotation shall be clockwise when viewed from the driven end.

3.4.4 Shaft

The shaft shall be:

- (a) Amply sized in order to transmit the full driven output;
- (b) Of sufficient stiffness to provide trouble free seal performance and meet the dynamic deflection requirements detailed in the Rotating Element Dynamics Clause below.
- (c) Concentric, with runout not exceeding the seal manufacturer's requirements;

- (d) Manufactured in one piece, machined throughout its entire length with a high degree of finish at the mechanical seal and bearing surfaces;
- (e) Stepped for ease of assembly of components with correctly radiused at all section changes to minimize stress raisers. No sharp corners or undercutting shall be permitted
- (f) Where neck bushes are fitted they shall be manufactured with bearing clearances to provide lateral support to the shaft in lieu of the packed glands;
- (g) Fitted with a water slinger to protect the non-drive end bearing;
- (h) Fitted with an oil slinger for oil lubricated pumps.

3.4.5 Rotating Element Dynamics

The first lateral critical speed of the rotating assembly shall be calculated for the maximum diameter impeller without consideration of any support from the casing or impeller neck rings or seals. The first lateral critical speed shall be greater than 120% of the maximum pump speed.

The total dynamic shaft deflection, at maximum pump speed with maximum impeller at maximum duty head shall be half the diametric clearance at the sealing rings. Bearing support by the neck bush shall not be considered when determining shaft deflection.

3.4.6 Wear Rings

The pump shall be fitted with replaceable casing and impeller wear rings that are mechanically secured to prevent loosening and rotation. Wear ring materials shall be selected to avoid galling.

3.4.7 Bearing Housing

The bearing housing shall be:

- (a) Provided with a drain hole in the seal box area of the housing to allow capture and removal of product leakage;
- (b) Fitted with lubricant retaining, dust and spray excluding seals incorporated in the bearing housing covers;
- (c) Fitted with *sealed for life* bearings or grease nipples in accessible locations, and with provision to release excess grease from the bearing;; or
- (d) Fitted with a breather, oil drain plug and filler level plug for oil lubricated pumps.

3.4.8 Bearings

The bearings shall be:

- (a) Ball or roller type calculated on a minimum L_{10} life of 40,000 hours at the duty point for continuous operation;
- (b) Selected in accordance with ISO 281:2007 and designed to accommodate maximum axial and radial loads over the full operating curve;
- (c) In compliance with ISO standard metric dimensions
- (d) Supplied with the quantity and grade of grease or oil recommended by the bearing manufacturer.

3.4.9 Mechanical Seal

The pump shall be fitted with either:

- (a) A single inside-mounted mechanical seal, or
- (b) A single cartridge type balanced mechanical seal,

Mechanical Seals shall be of standard size design and generally stocked by Australian based suppliers.

Where fitted the cartridge mechanical seal shall be retained by a flange with provision for a flushing water connection.

3.4.10 Seal Flushing

The type of mechanical seal flushing required will depend on whether the water being pumped is clean or dirty (as specified in the Purchasing Schedule) and accordingly shall comply with either of the following:

- (a) For clear water applications an internal discharge recirculation flushing passage connected to the stuffing box, or an externally piped flushing system complying with API Plan 11, shall be provided; or
- (b) For waters containing suspended solids such as sand or grit, an externally piped Cyclone Separator connected upstream of the mechanical seal complying with API Plan 31 shall be provided.

3.4.11 Fasteners

The pump shall be supplied with all fasteners, washers and gaskets. Fastener threads shall comply with AS 1275 and bolts and studs shall be sized so that excessive threads do not protrude past the nut after assembly. Bolts and nuts shall comply with AS 1111.1 and AS 1112.3 respectively.

3.5 Manufacture

3.5.1 Castings

Castings shall exhibit a close, uniform and homogenous grain that is free from blowholes, porosity, shrinkage, cracks and other injurious defects. Castings shall be properly cleaned and fettled with all lumps, fins and rough areas smoothed. No repairs shall be permitted on structural defects however minor defects in steel casings may be repaired providing approval is obtained from the Officer in accordance with Clause 10.3.2 relating to Manufacturing Repairs.

3.5.2 Machining

Machining shall be concentric, square to line and true. All sharp edges and burrs shall be removed. Bolt holes shall be drilled and spot-faced for bolt heads, nuts and washers. Mating and balanced assemblies shall be match marked.

3.5.3 Balance of Rotating Elements

Balancing shall be in accordance with ISO 1940/1. Prior to assembly of the rotating elements, impellers shall be statically and dynamically balanced to achieve balance grade G6.3 at the maximum pump operating speed. Material removed from the impeller shall be near the periphery of the impeller. The material removal process shall maintain a smooth overall surface finish. Where required to meet the vibration limit requirements, additional balancing of the assembled rotating element shall be performed.

3.5.4 Vibration

Vibration limits for pumpsets shall comply with AS 2625.1 and AS 2625.4. The pumpset maximum vibration severity level shall not exceed 2.8 mm/s (rms) in accordance with Table A2 of AS 2625.4 for Group 2, rigid support class (commissioning classification), or 4.5 mm/s (rms) for flexible support class (factory test classification).

3.6 Ancillary Equipment

3.6.1 Flexible Coupling

Pumps shall be coupled to their driver via a spacer type flexible coupling. Couplings shall be radially, angularly and longitudinally flexible. Coupling halves shall be able to be disconnected without removing the hubs from the driver or driven shafts e.g. the driver can be run independent of the pump.

Each flexible coupling shall be:

- Pin and bush type utilising an elastomeric flexible element (s) to transmit the torque from the driver to the pump;
- Capable of transmitting 150% of the full starting torque of the driver;
- Secured against circumferential and axial movement relative to the shafts via a shear key and double locked grubscrews;
- Dynamically balanced with all components together which shall be permanently marked to facilitate correct assembly, and to the same balance quality grade as the pump impeller.

The permissible operating radial, axial and angular misalignment shall not exceed the limits given by the coupling manufacturer. Couplings shall be selected so that the operating conditions and the rigidity of the pump and baseplate are taken into account.

3.6.2 Baseplate and Coupling Guard

Each pump and driver shall be mounted on a common baseplate complying with the following requirements:

- (a) Fabricated from standard rolled steel sections and plate;
- (b) Rigidly constructed and braced to prevent misalignment and flexing under load;
- (c) Fully seal-welded with welding in accordance with Technical Specification WS-1;
- (d) Incorporate foundation bolt holes, and access holes to facilitate grouting and concrete filling;
- (e) Accommodate a flexible coupling guard;
- (f) Incorporate individual mounting pads which shall be machined after hot-dip galvanizing of the baseplate;
- (g) Incorporate 4 jacking screws per driver for direct-coupled electric motors exceeding 15 kW rating, to facilitate driver alignment laterally and longitudinally
- (h) Incorporate specifically designed lifting lugs.

Each baseplate shall be fitted with a fabricated steel coupling guard to protect personnel from exposed rotating components and shall be:

- (a) Designed to support a minimum 150 kg vertical mass (i.e. a person standing on the guard);
- (b) Removable;
- (c) Fabricated from steel plate;
- (d) Hot-dip galvanised in accordance with AS/NZS 4680.

4 Protective Coatings

4.1 General

The external and internal surfaces of pumps and appurtenant fittings shall be prepared and coated in accordance with relevant clauses below. Prior to coating all sharp edges, burrs, slag and other sharp surface irregularities shall be removed. Surfaces to be coated, which will become inaccessible after assembly or erection, shall be cleaned and coated before becoming inaccessible.

4.2 Pump Internal Coating

Pumps with components manufactured from corrosion resistant materials, such as CF8M stainless steel, are not required to be internally coated.

Pumps with Cast Iron or Ductile Iron casings are non-preferred and will only be specified for special applications, such as like for like replacement of historical cast iron pumps that are not available in stainless steel materials. These special applications will be subject to approval by the Corporation.

The internal wetted surfaces of the cast iron components shall be prepared for coating in accordance with Technical Specifications PA and PH. The prepared surface shall be coated with Belzonia 1341 Super Metal Glide, or Chesterton ARC 855, or Epigen 1311 in accordance with the respective coating manufacturer's recommendations.

The Manufacturer shall comply with the specified requirements for:

- (a) Minimum number of coats;
- (b) Dry film thickness;
- (c) Testing and third party certification.

The pump design shall be such that the coating system specified for internal surfaces shall be fully effective for all internally wetted surfaces. All surfaces that cannot be coated shall be of corrosion resistant materials. This shall particularly apply to internal galleries, tapping, drain, vent and flushing waterways which would otherwise be subject to corrosion (refer Note).

NOTE: Immersed cast iron surfaces will corrode and form iron corrosion products (iron tubercles) that will block waterways if they are not effectively coated, or sleeved with a corrosion resistant material.

4.3 Pump External Coating

The external surfaces of pump components shall be prepared for coating in accordance with AS 1627.2 followed by coating in accordance with the Manufacturer's standard coating system to a finish colour of AS 2700 Jade. The total dry film thickness shall be 250 microns minimum.

4.4 Baseplate and Coupling Guard

The baseplate and coupling guard shall be hot dip galvanized in accordance with AS/NZS 4680. The coupling guard shall be finished in bright yellow paint (AS 2700 Y15 – Sunflower PMS 136C, 115U). Fasteners, holding down bolts and foundation bolts shall be hot dip galvanized in accordance with AS 1214.

5 Testing

5.1 General

Product shall be tested in accordance with the test requirements of this Specification. Testing shall be deemed acceptable when test results have been formally verified by a Certification Body or witnessed by a testing Officer. Product for which a test requirement has not been met shall be classified as non-compliant Product.

NOTES:

1. Testing should be carried out by an organisation accredited by NATA or in accordance with ISO/IEC 17025.
2. A testing Officer should normally be an Officer who has specialist knowledge of or training in product or materials testing appropriate to the Product characteristics to be tested.

5.2 Notification of Testing

The Corporation shall be notified in writing of each formal test proposal at least seven (7) days prior to the preparation of Product for testing except where a specified test has been the subject of a current valid Certificate issued by a Certification Body. This notification is required to enable the Corporation to make all necessary arrangements including appointment of a 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: The cost of witnessed testing arranged by the Corporation will normally be borne by the Corporation unless otherwise negotiated.

5.5 Quality Verification Test

5.5.1 Coating

Pumps supplied with an internal coating shall have the internal coating tested in accordance with AS 3894.1 and AS 3894.3 for continuity and dry film thickness respectively.

5.5.2 Hydrostatic Test

Each pump casing shall withstand the hydrostatic test pressure appropriate to its pressure class in accordance with Table 3.1, for a period of 5 minutes without any leakage or permanent distortion.

5.6 Pump Performance Tests

5.6.1 General

Each pump shall be tested by the Manufacturer to prove that the performance meets the Primary and Secondary Guaranteed Duty Points specified in the Technical Compliance Schedules.

Unless otherwise stated in the Purchasing Schedule or later notified by the Officer, the Performance Acceptance Tests shall be witnessed by the Testing Officer.

The Performance Acceptance Tests shall be carried out in accordance with ISO 9906 - 2018, except as otherwise stated in this Specification.

5.6.2 Tolerance

Each Pump shall meet the Primary and Secondary Guaranteed Duty Points within the pump test acceptance grade tolerances defined in Table 5.1 and ISO 9906:2018 Table 8.

Table 5.1 – Acceptance Tolerance

Test Required	Motor Size	
	≤ 100kW	> 100kW
Performance test to ISO 9906 grade:	2B	1B
Rate of flow (τ_Q)	±8%	±5%
Total head (τ_H)	±3%	±3%
Power Input (τ_P)	+8%	+4%
Efficiency (τ_η)	-5%	-3%

NOTE: Less stringent tolerances may be proposed, for Secondary Guarantee Duty Points, but must be accepted and agreed prior to contract award.

5.6.3 Test Set-up

Pumps shall be tested as part of a purpose designed test loop, whereby adjustment of Pump inlet and discharge conditions can be controlled to within the required level of accuracy to meet ISO 9906 test conditions.

Pumps shall be tested with the same orientation (i.e. vertical or horizontal) as the final application.

If the pumps are being supplied as a pumpset package, then the complete pumpset shall be tested by the Manufacturer with motor unit input power being measured by a Wattmeter.

Particular note is to be taken of ensuring NPSHA to the Pumpsets under test is the same or less than that which the Pumpsets will be subjected when operating installed on site.

All instrumentation used in acceptance testing to ISO 9906 shall be certified by the National Association of Testing Authorities Australia (NATA), or an approved equivalent body in an overseas country.

Details of proposed test arrangements, demonstrating compliance with all test requirements, shall be provided to the Officer within 30 days of contract award.

5.6.4 Additional Tests

Pumps shall be tested to determine the head-flow characteristic and efficiency along the full characteristics curve, including the shut-valve flow, extending to at least 120% of the Primary Guarantee Duty Point, or 120% of the Best Efficiency Point, whichever the greater. At least six points along the characteristic curve shall be taken.

Where the tests are to be undertaken for variable speed Pumps, the head-flow characteristic and efficiency shall also be determined for the maximum and minimum intended operating speeds.

Additional tests relating to NPSH3, vibration and noise may be required as specified in the Purchasing Schedule.

5.6.5 Pump Test Report

For the purpose of acceptance the Manufacturer shall provide a Test Report in accordance with ISO 9906 which shall also include as a minimum the following additional documents:

- A pump Test Sheet in accordance with Appendix F of ISO 9906;
- Pump test curves
- Test results relating to NPSH3, vibration, noise and coating tests (as applicable).

Each Test Report shall show the relevant pump serial number. The Pump Test Report shall certify that the Product has complied with the specified test requirements. Three copies of the Pump Test Report shall be supplied to the Officer for acceptance as detailed below.

5.6.6 Acceptance

Product shall not be dispatched from the Manufacturer's works until acceptance of the Pump Test Report by the Officer, or the appointed testing and inspecting authority. Acceptance will be conditional on the Product complying with the test requirements and guaranteed performance.

Any product for which a test requirement has not been met shall be classified as non-compliant Product.

A copy of each approved Pump Test Report shall be provided to the Officer.

5.6.7 Failure to Meet Efficiency Guarantee

In addition to any liquidated damages otherwise applicable under the contract, the *Supplier* shall be liable for liquidated damages for failure of the *Pump* or *Pumpset* to meet the guaranteed efficiency stated by the *Supplier* in the *Technical Compliance Schedule* within the tolerances required by Table 5.1 .

Liquidated damages for low efficiency shall be based on loss to the *Corporation* (in the form of higher than expected operating cost of power consumed) over the expected life of the *Pumpset* (nominally 25 years).

Liquidated damages shall be calculated as an amount for each *Pumpset* that fails to meet the guaranteed efficiency; for each percentage point of actual efficiency (or part there-of) below the guarantee. The amount shall be calculated on a pro-rata basis, on the loss to the *Corporation* (increased operating costs) of each *Pumpset* that falls below the guarantee. i.e. the loss shall not be reduced by other supplied *Pumpsets* exceeding guaranteed efficiency.

NOTE: Industry consultation indicates that maximum cumulative amount for Liquidated Damages (for both late delivery and failure to meet guarantee efficiency) in the order of 10% to 15% of contract amount is the norm. Higher amounts may be negotiated but are likely to delay the agreement process.

6 Marking and Packaging

6.1 Marking

6.1.1 Body Markings

Each pump shall have the following information clearly marked by casting on the body, or displayed by stamping or engraving on a corrosion resistant plate which shall be permanently secured to the pump using corrosion resistant fasteners:

- (a) Manufacturer's name;
- (b) Model/type;
- (c) Inlet and outlet connection size, DN;
- (d) Serial number;
- (e) Duty rate of flow, L/s;
- (f) Duty total head, m;
- (g) Speed of rotation, rev/min;
- (h) Impeller diameter, mm;
- (i) Seal make and model;
- (j) NPSH3 at duty point, m;
- (k) Duty power input (kW);
- (l) Lubricant type e.g. grease or oil
- (m) Year of manufacture.

The pump casing hydrostatic test pressure and serial number shall be stamped on the casing. The direction of rotation of the pump shall be clearly indicated by an arrow cast on the casting (preferably on the front of the volute with ROTATION above the arrow). Cast lettering shall be as large as practicable.

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.

The suction and discharge ports shall have durable covers fitted to their flanges to prevent entry of foreign matter into the pump casing.

6.2.2 Identification Tag

Wherever requested in the Purchasing Schedule each Product item 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 with the following information:

- (a) Material Master Record number (MMR);
- (b) Contract number;
- (c) Purchase order number.

6.2.3 Marking of Packaging

Where requested in the purchasing schedule the Product shall be identified by marking on the outside of any protective packaging the same information as shown on the identification tag.

6.2.4 Warning Labels

The Manufacturer shall attach warning labels to alert the Purchaser to the following requirements:

- (a) That the pump has to be primed with water prior to operation otherwise damage to the mechanical seal will occur;
- (b) For oil lubricated pumps a label shall be attached advising that the pump requires to be filled with oil in accordance with the O&M manual before it is operated.

7 Manuals

7.1 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.

7.2 Content

The manuals shall contain all the relevant information required to commission and maintain the Product in operational 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) Trouble shooting guidelines;
- (g) Complete list of parts and associated exploded views or sectional diagrams and reference part numbers.

8 Spare Parts and Special Tools

8.1 Spare Parts

8.1.1 Interchangeability

All spare parts shall be interchangeable for a manufacturer's Product of the same size and model.

8.1.2 Availability

Spare parts and servicing facilities shall be readily available in Western Australia.

8.2 Special Tools

Any special tools required for service and maintenance of the Product shall be supplied.

9 Transportation, Handling and Storage

9.1 General

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.

9.2 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. 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.

10 Quality Assurance

10.1 Certification

10.1.1 Certification of Product

Wherever this Specification requires compliance with nominated Product and test Standards, conformance shall be certified by means of a Certification Scheme, conducted by a Certification Body. Each Certificate shall expressly attest compliance of all Product items with the nominated Standards. Wherever specified, Certificates shall be submitted to the Officer nominated for this purpose. Product shall be marked in accordance with the requirements of the Certification Body.

NOTE: Compliance of Product including related accessories and services with nominated Standards and specified requirements may be verified by means of a Product Verification Report provided by a Product Assessor. The Product Verification Report should identify all relevant Certificates of Product compliance, duly issued in accordance with Certification Scheme rules.

10.1.2 Quality System

The processes for manufacture, testing, supply, transportation, handling, delivery and storage of Product 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.

10.1.3 Product Re-verification

Product compliance with the Specification shall be subject to re-verification by a Product Assessor when, during the agreed Product supply period, there occurs any:

- Substantive change in Product design, material formulation or performance
- Product failure to perform in operational service to the nominated performance specification.

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

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

10.2 Compliance and Acceptance

10.2.1 Means of Demonstrating Compliance

Compliance with this Specification shall be demonstrated by means of Product Appraisal and issue by a Product Assessor of a Product Verification Report that confirms compliance. Otherwise, Product shall be deemed non-compliant and ineligible for registration as Product authorized for use in Corporation infrastructure.

NOTES:

1. Where a project includes design work including Product design, Product Appraisal may form part of the project design review process and the Product Assessor may be a member of the project design review team.
2. A Product Verification Report should verify the extent of compliance with the Specification including all relevant 'Technical Compliance Schedule' Appendices and the currency of a Certificate where relevant to the Product.

10.2.2 Acceptance Criteria

For acceptance, Product shall be supplied as specified in the Purchasing Schedule.

Prior to the implementation of any arrangement to supply Product, the Supplier shall, in accordance with specified requirements:

- nominate applicable Product Warranty terms; and
- provide documentary verification in the form of a current valid Certificate or Product Verification Report as appropriate to the Product; and
- detail each element of Product that does not comply with the specified requirements together with the extent of non-compliance.

NOTE: Where the Specification includes Technical Compliance Schedules, the nature and extent of all non-compliances should be provided in accordance with the appropriate Schedules.

10.3 Non-compliant Product

10.3.1 General

Product 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', Product 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.

10.3.2 Manufacturing Repairs (In-process)

Welding, the use of fillers and other repairs shall generally not be permissible on "off the shelf" Product which is in the course of production.

Repairs to custom-built Products such as axially-split pumps and large valves may be considered only if determined by the Corporation to be minor casting repair work in non-strategic locations. Accordingly, 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.

For acceptance, a proposal for repair or remedy of Product defects shall not void or otherwise diminish the provisions of the Product Warranty.

The Manufacturer shall make provision in its production Quality System and in the appropriate ITPs for sufficient hold points whenever casting 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 that:

- (a) Repair of the non-compliant components in lieu of their replacement is acceptable; and
- (b) Proposed repair procedures are acceptable; and
- (c) Any proposal to extend the terms of the original Product Warranty as a consequence of the in-process repair is acceptable.

10.3.3 Product Warranty

The Supplier shall replace non-compliant Product with Product that conforms to the acceptance criteria or shall repair or rectify all faults, damage or losses caused by defective Product. Except as may otherwise be specified, the Product Warranty shall indemnify and keep indemnified the Corporation against all losses suffered by the Corporation as a result of non-compliant Product for a period no less than 24 months after Product delivery or 12 months after Product installation, whichever period elapses first.

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. For acceptance, a proposal for repair or remedy of Product defects shall not void or otherwise diminish the provisions of the Product Warranty.

11 Appendix A: Project Specific Requirements (Normative)

11.1 General

Project specific information and requirements not included elsewhere in this Specification shall apply as specified in the following Clauses and shall be taken as forming part of the **Purchasing Schedule**.

The *Corporations* Designer or Design Manager is required to complete the Table 11.1 and include any additional information that is relevant for pump selection or scope of supply that is not indicated elsewhere the specification. This may include items such as site location, details of operating methodologies, system curves, pump station arrangement, special liquidated damages provisions etc.

11.2 Specific Requirements

Notwithstanding the content of sections 1 to 10 of this Specification, the following specific requirements shall apply. This table shall be completed by the Corporations.

TABLE 11.1: SCHEDULE OF PROJECT TECHNICAL REQUIREMENTS

Clause	Project Requirements	Item/Option
N/A	Number of pumps/pumpsets required:	
2.1	Water classification	Standard / Corrosive / Highly Corrosive
2.3	Details of highly corrosive water or chemicals e.g. properties including temperature and concentration ¹	Specify
3.2.2	Special operating parameters ²	
3.3.1	Duty(s):	
	• Primary duty rate of flow:L/s
	• Primary duty total head:m
	• Secondary duty rate of flow (if required):L/s
	• Secondary duty total head (if required):m
	Required Operating Envelope – curves provided	Yes / No
3.3.2	NPSHAm
3.3.4	Scope of supply includes pump bare shaft or complete pumpset?	Specify
3.4.1	Pressure class PN:	
3.4.2	Suction and discharge port flange standard ³ :	
	Suction port and discharges port diameters, mm:/.....mm
3.4.6	Pump will be subjected to high chlorine dosing upstream e.g. > 2 mg/L	Yes/No
3.4.7	Bearing lubrication ⁴ e.g. grease (or oil)	
3.4.9	Standard or cartridge seal required	
3.4.10	Seal flushing ⁵ , clear water (internal recirculation or API Plan 11); or dirty water (API Plan 31)	Clear water/dirty water
4.2	Pump internal coating product ⁶ :	

5.1	Performance testing ⁷ e.g. certified or witness testing:	
5.6.4	Special or additional test requirements ⁸ :	
5.6.7	Liquidated damages for low efficiency	Specify
6.2.2	Identification tag e.g. required or not required:	
6.2.3	Marking of packaging e.g. required or not required:	
7.1	Number of Manuals required ⁹ :	

NOTES:

1. This requirement would only be applicable for pumps requiring special materials in lieu of the materials specified in Table 2.2.
2. Normally would be N/A unless there were changes in the Standard Parameters referred to in Clause 3.2.1.
3. Normally AS 4087 flanges however there may be occasions where AS/NZS 4331.1 (steel) or AS/NZS 4331.2 (cast iron) might be specified e.g. desalination plants.
4. Generally grease lubrication would be specified but either would be acceptable.
5. Specify whether the application is for clean water or dirty water.
6. Not required for pumps with corrosion resistant materials. For cast iron pumps, generally any of the three internal coating products referred to in this Specification would be acceptable.
7. Generally certified Test Reports would be acceptable.
8. Grade 1 in lieu of Grade 2 testing (default) or additional tests may be specified for special circumstances.
9. The asset owner should be consulted to provide this information.

12 Appendix B: Technical Compliance Schedules (Normative)

12.1 Compliance Schedules

Suppliers shall demonstrate Product compliance with the Specification by completing Technical Compliance Schedules below 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 12.1: TECHNICAL COMPLIANCE SCHEDULE 1

ISO End Suction Centrifugal Pumps – Supplier Clause-by-Clause Response					
Section/Clause		Noted	Compliance		Comments
			Yes	No	
1. SCOPE AND GENERAL					
1.1	Scope				
1.2	Referenced Documents				
1.3	Definitions and Notation				
1.4	Designation of Size				
2. MATERIALS AND COMPONENTS					
2.1	Water Classification				
2.2	Materials of Construction				
2.3	Highly Corrosive Water and Chemicals				
2.4	Contamination of Drinking Water				
2.5.1	Welding, Heat Treatment and Passivation				
2.5.2	Graphite Compounds				
2.5.3	Galling				
2.6	Dezincification-resistant Materials				
2.7	Non-metallic Materials				
2.8	Immersed Components				
2.9	Elastomeric Materials				
3. DESIGN & MANUFACTURE					
3.1	General				
3.2.1	Standard Parameters				
3.2.2	Special Parameters				
3.3.1	Pump Selection				
3.3.2	NPSH				
3.3.3	Performance Curves				
3.3.4	Driver Selection				
3.4.1	Pressure Rating				
3.4.2	Casing				
3.4.3	Impeller				
3.4.4	Shaft				
3.4.5	Rotating Element Dynamics				
3.4.6	Wear Rings				
3.4.7	Bearing Housing				
3.4.8	Bearings				
3.4.9	Mechanical Seal				

3.4.10	Seal Flushing				
3.4.11	Fasteners				
3.5.1	Castings				
3.5.2	Machining				
3.5.3	Balance of Rotating Elements				
3.5.4	Vibration				
3.6.1	Flexible Coupling				
3.6.2	Baseplate and Coupling Guard				
4. PROTECTIVE COATINGS					
4.1	General				
4.2	Pump Internal Coating				
4.3	Pump External Coating				
4.4	Baseplate and Coupling Guard				
5. PERFORMANCE TESTS					
5.1	General				
5.2	Notification of Testing				
5.3	Access to the Place of Manufacture				
5.4	Place of Manufacture other than WA				
5.5.1	Coating				
5.5.2	Hydrostatic Test				
5.6	Pump Performance Tests				
5.6.1	General				
5.6.2	Tolerance				
5.6.3	Test Set Up				
5.6.4	Additional Tests				
5.6.5	Pump Test Report				
5.6.6	Acceptance				
5.6.7	Failure to Meet Efficiency Guarantee				
6. MARKING AND PACKAGING					
6.1.1	Body Markings				
6.2.1	General				
6.2.2	Identification Tag				
6.2.3	Marking of Packaging				
6.2.4	Warning labels				
7. MANUALS					
7.1	Format and Language				
7.2	Content				
8. SPARE PARTS AND SPECIAL TOOLS					
8.1.1	Interchangeability				
8.1.2	Availability				
8.2	Special Tools				
9. TRANSPORTATION, HANDLING AND STORAGE					
9.1	General				
9.2	Preservation of Product in Storage				
10. QUALITY ASSURANCE					
10.1.1	Certification of Product				
10.1.2	Quality System				
10.1.3	Product Re-verification				
10.2.1	Means of Demonstrating Compliance				
10.2.2	Acceptance Criteria				
10.3.1	General				
10.3.2	Manufacturing Repairs (In-process)				
10.3.3	Product Warranty				

Name of Supplier:

Signature:

Date:

The Supplier shall provide the information required by Technical Compliance Schedule 2 as shown in **TABLE 12.2**.

TABLE 12.2: TECHNICAL COMPLIANCE SCHEDULE 2

ISO End Suction Centrifugal Pumps			
1.	SUPPLIER'S REPRESENTATIVE		
1.1	Full name		
1.2	Postal address		
1.3	Facsimile number		
1.4	Email address		
1.5	Phone number		
1.6	Mobile phone number		
2.	QUALITY ASSURANCE		
2.1	Extent of third party accreditation of Supplier		
2.2	Extent of third party accreditation of Manufacturer		
2.3	Details of certificates and verification reports attached		(Yes/No)
3.	TECHNICAL INFORMATION		
3.1	Performance curves supplied for specified duty points		(Yes/No)
3.2	Performance curves supplied for maximum diameter impeller		(Yes/No)
3.3	General arrangement and cross sectional drawings supplied		(Yes/No)
3.4	Technical data and dimensions supplied.		(Yes/No)
3.5	Details of servicing facilities in Perth supplied.		(Yes/No)
4.	PUMP DESIGN AND MANUFACTURE		
4.1	Manufacturer's name		
4.2	Place of manufacture		
4.3	Pump model		
4.4	Pump type e.g. ISO end suction		
4.5	Designation e.g. 150/200 - 400		
4.6	Suitable for continuous operation outdoors		(Yes/No)
4.7	Performance Guarantees:	Primary Duty	Secondary Duty
	• Rate of flow, L/s		
	• Total head, m		
	• Efficiency, %		
	• Speed of rotation, rev/min		
	• Power input, kW		
4.8	NPSHR, m		
4.9	NPSH margin, m		
4.10	NOL or Maximum Power, kW		
4.11	Shut off head, m		
4.12	Vibration severity, mm/s rms		
4.13	Maximum sound power, dB(A)		
4.14	Rotating element balance standard and grade		
4.15	Moment of inertia of rotating element, kgm ²		
4.16	Pump casing:		
	• Radially split		(Yes)/(No)
	• Suction flange diameter, mm		
	• Discharge flange diameter, mm		
	• Flange standard and class		
	• Method of fixing casing wear rings		
	• Back pull out		(Yes)/(No)
4.17	Impeller:		
	• Type e.g. one piece closed , open		
	• Diameter, mm		

	<ul style="list-style-type: none"> Maximum diameter for casing, mm Method of fixing to shaft Method of fixing impeller wear ring Impeller static diametral clearance Direction of rotation - viewed from the driven end 			
4.18	Shaft			
	<ul style="list-style-type: none"> First critical speed with max. dia. impeller, rev/min Dynamic deflection at maximum head, mm 			
4.19	Bearings			
	<ul style="list-style-type: none"> Type e.g. antifriction Make Lubrication type e.g. grease or oil L₁₀ life, hrs Grease relief provision Grease nipples provided Oil breather, drain and filler plugs 		(Yes)/(No)	
4.20	Tapping points:			
	<ul style="list-style-type: none"> Gauge points – size and location Casing drain – size and location 			
4.21	Method of taking impeller thrust			
4.22	Mass of pump, kg			
5.0	PUMP MATERIALS	MATERIAL	STANDARD	GRADE
5.1	Casing volute and back cover			
5.2	Bearing housing			
5.3	Impeller			
5.4	Impeller wear rings			
5.5	Casing wear rings			
5.6	Shaft			
5.7	Impeller key			
5.8	Coupling key			
5.9	Impeller nut			
5.10	Impeller washer			
5.11	Mounting foot			
5.12	Studs, setscrews, capscrews, bolts, pins, nuts			
5.13	O-rings and seals			
5.14	Plugs (drain, vent)			
5.15	Water thrower			
6.0	MECHANICAL SEAL			
6.1	Brand			
6.2	Model/Type			
6.3	Materials:			
	<ul style="list-style-type: none"> Stationary face Rotating face Drive keys O-rings Flange 			
6.4	Flushing type or API Plan number			
7.0	FLEXIBLE COUPLING			
7.1	Brand			
7.2	Model			
7.3	Type e.g. flexible, pin and bush, spacer			
7.4	Maximum rating at duty speed, kW			
8.0	BASEPLATE AND COUPLING GUARD			

8.1	Baseplate material	
8.2	Means of adjusting motor alignment	
8.3	Number of foundation bolts	
8.4	Diameter of foundation bolts, mm	
8.6	Coupling guard design load for vertical mass, kg	
8.7	Coupling guard material	
9.0 COATINGS		
9.1	Internal coating product details and thickness μm/.....
9.2	Pump external coating type	
9.3	Baseplate coating	
9.4	Coupling guard coating type and colour	
10.0 TESTING		
10.1	Coating test	(Yes/No)
10.2	Hydrostatic test pressure, kPa	
10.3	Pump test code/class/.....
10.4	NPSHR testing (if requested)	(Yes/No)
10.5	Sound testing (if requested)	(Yes/No)
10.6	Vibration testing (if requested)	(Yes/No)
10.7	Location of tests	

Name of Supplier:

 Signature: Date:

13 Appendix C: Material Master Records (Informative)

The following Material Master Records (MMR) comprise Corporation catalogue numbers that are unique to the particular products described for the purposes of Corporation activities or work.

MMR	PURCHASE ORDER LONG TEXT

END OF DOCUMENT