



Assets Planning and Delivery Group
Engineering

Strategic Product Specification

SPS 507 Submersible Electric Borehole Pumps

VERSION 2
REVISION 1
MAY 2023

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 ‘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.

Enquiries relating to the technical content of this Specification should be directed to the Senior Principal Engineer, Mechanical Section, Engineering to whom all enquiries relating to the technical content of the Specification should be directed. Future Specification changes, if any, will be issued to registered Specification users as and when published.

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.

Users should use and reference the current version of this document.

© Copyright – Water Corporation: This standard and software is copyright. With the exception of use permitted by the Copyright Act 1968, no part may be reproduced without the written permission of the Water Corporation.

REVISION STATUS

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

REVISION STATUS						
SECT.	VER./REV.	DATE	PAGES REVISED	REVISION DESCRIPTION (Section, Clause, Sub-Clause)	RVWD.	APRV.
1	0/0	12.9.02	All	New Edition	EJP	AAK
1	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
1	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
All	2/1	26.05.23	All	Scheduled review, no change required	SE	SE
2	0/0	12.9.02	All	New Edition	EJP	AAK
2	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
2	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
3	0/0	12.9.02	All	New Edition	EJP	AAK
3	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
3	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
4	0/0	12.9.02	All	New Edition	EJP	AAK
4	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
4	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
5	0/0	12.9.02	All	New Edition	EJP	AAK
5	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
5	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
6	0/0	12.9.02	All	New Edition	EJP	AAK
6	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
6	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
7	0/0	12.9.02	All	New Edition	EJP	AAK
7	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
7	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
8	0/0	12.9.02	All	New Edition	EJP	AAK
8	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
8	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
9	0/0	12.9.02	All	New Edition	EJP	AAK
9	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
9	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
10	0/0	12.9.02	All	New Edition	EJP	AAK
10	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
10	2/0	30.5.14	All	Reformatted, revised content	GWR	SE

REVISION STATUS						
SECT.	VER./ REV.	DATE	PAGES REVISED	REVISION DESCRIPTION (Section, Clause, Sub-Clause)	RVWD.	APRV.
11	0/0	12.9.02	All	New Edition	EJP	AAK
11	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
11	2/0	30.5.14	All	Reformatted, revised content	GWR	SE
12	2/0	30.5.14	All	New Section	GWR	SE
12	0/0	12.9.02	All	New Edition	EJP	AAK
12	1/0	1.10.12	All	Reformatted, revised content	EJP	SE
13	2/0	30.5.14	All	Section 12 becomes Section 13 but removed (MMR not applicable)	GWR	SE

Strategic Product Specification

SPS 507

Submersible Electric Borehole Pumps

CONTENTS

<i>Section</i>	<i>Page</i>
1	Scope and General9
1.1	Scope.....9
1.2	Referenced Documents9
1.3	Notation.....12
1.4	Definitions.....12
1.4.1	Allowable Operating Range (AOR).....12
1.4.2	Best Efficiency Point (BEP)12
1.4.3	Certificate.....12
1.4.4	Certification Body.....12
1.4.5	Certification Scheme.....12
1.4.6	Corporation12
1.4.7	Corrosive Water12
1.4.8	Design Duty Point.....12
1.4.9	Guarantee Duty Point.....12
1.4.10	Hydrostatic Test Pressure.....13
1.4.11	Highly Corrosive Water13
1.4.12	Inspection and Test Plan (ITP).....13
1.4.13	Manufacturer13
1.4.14	Maximum Allowable Working Pressure (MAWP).....13
1.4.15	Maximum Operating Pressure (MOP)13
1.4.16	Nominal Size (DN)14
1.4.17	Net Positive Suction Head (NPSH).....14
1.4.18	Oilfield ESP14
1.4.19	Officer14
1.4.20	Preferred Operating Range (POR)14
1.4.21	Pitting Resistance Equivalent Number (PREN).....14
1.4.22	Pressure Class (PN).....14
1.4.23	Product14
1.4.24	Product Appraisal.....14
1.4.25	Product Assessor15
1.4.26	Product Certification15
1.4.27	Product Verification Report15
1.4.28	Product Warranty15
1.4.29	Pump15
1.4.30	Pumpset.....15
1.4.31	Purchasing Schedule15
1.4.32	Quality System15
1.4.33	Specification.....15
1.4.34	Standard Water.....16
1.4.35	Strategic Product.....16
1.4.36	Strategic Product Appraisal Process16
1.4.37	String.....16
1.4.38	Supplier16

1.4.39	Technical Compliance Schedule	16
1.4.40	Technical Response Schedule	16
1.4.41	Water Services Association of Australia (WSAA)	16
1.5	Abbreviations	16
1.6	Designation of Size	17
2	Materials and Components	18
2.1	General.....	18
2.2	Contamination of Drinking Water	18
2.3	Materials of Construction.....	18
2.4	Highly Corrosive Waters.....	20
2.5	Material Certification	21
2.6	Stainless Steel.....	21
2.6.1	Welding, Heat Treatment and Passivation	21
2.6.2	Graphite Compounds and Coatings	21
2.6.3	Galling.....	21
2.7	Dezincification-Resistant Materials.....	21
2.8	Non-Metallic Materials.....	21
2.9	Elastomeric Materials.....	21
3	Design and Manufacture	22
3.1	General.....	22
3.2	Operating Conditions	22
3.2.1	Standard Parameters.....	22
3.2.2	Special Parameters	22
3.2.3	Pump Clearance in Bore	22
3.3	Performance	22
3.3.1	Pump Selection	22
3.3.2	NPSH	23
3.3.3	Guarantee Points	23
3.3.4	Performance Curves.....	23
3.3.5	Driver Selection	23
3.4	Pump Design.....	24
3.4.1	Maximum Allowable Working Pressure and Hydrostatic Test Pressure	24
3.4.2	Stage Casings	24
3.4.3	Inlet Housing.....	24
3.4.4	Outlet Housing	24
3.4.5	Impellers.....	25
3.4.6	Pump Shaft.....	25
3.4.7	Rotating Element Dynamics	25
3.4.8	Wear Rings.....	25
3.4.9	Shaft Bearing Journals	25
3.4.10	Stage Casing Bearings	25
3.4.11	Sand Collar.....	26
3.4.12	Fasteners.....	26
3.4.13	Upthrust.....	26
3.4.14	Non Return Valve	26

3.5	Manufacture	26
3.5.1	Castings	26
3.5.2	Machined Components	26
3.5.3	Fabricated Components	26
3.5.4	Balancing of Impellers	26
3.5.5	Vibration	26
3.6	Electric Motor	27
3.6.1	General	27
3.6.2	Motor Shroud	27
4	Inspection and Testing.....	28
4.1	General.....	28
4.2	Notification of Testing	28
4.3	Access to the Place of Manufacture.....	28
4.4	Place of Manufacture other than WA	28
4.5	Quality Verification	28
4.5.1	Inspection and Testing	28
4.5.1.1	General.....	28
4.5.1.2	Inspection and Test Plans (ITPs).....	28
4.5.2	Hydrostatic Tests.....	29
4.6	Performance Acceptance Tests	29
4.6.1	General.....	29
4.6.2	Test Set-up	29
4.6.3	String Testing – VVVF Testing	30
4.6.4	Guarantee Points	30
4.6.5	Tolerances	30
4.6.6	Scope of Tests	31
4.6.7	Additional Testing.....	31
4.6.7.1	NPSH3 Testing	31
4.6.7.2	Vibration Testing	32
4.6.7.3	Noise Testing (Booster Applications Only).....	32
4.6.7.4	Endurance Testing.....	32
4.6.8	Performance Test Report.....	32
4.6.9	Acceptance.....	32
4.6.10	Failure to Meet Efficiency Guarantee	33
5	Marking and Packaging	34
5.1	Nameplate Marking	34
5.2	Packaging.....	34
5.2.1	General.....	34
5.2.2	Identification Tag.....	34
5.2.3	Marking of Packaging	34
5.2.4	Warning Label.....	35

6	Manuals.....	36
6.1	Format and Language	36
6.2	Structure	36
6.3	Content.....	36
7	Spare Parts, Special Tools and Servicing.....	37
7.1	Spare Parts.....	37
7.1.1	General.....	37
7.1.2	Spare Parts.....	37
7.1.3	Spare Parts List	37
7.2	Special Tools	37
7.3	Servicing.....	37
7.3.1	General.....	37
7.3.2	Service Exchange Unit Prices	37
8	Transportation, Handling and Storage	39
8.1	General.....	39
8.2	Preservation of Product in Storage	39
8.3	Shock Sensor.....	39
9	Quality Assurance	40
9.1	Certification.....	40
9.1.1	Certification of Product.....	40
9.1.2	Quality System	40
9.1.3	Product Re-Verification	40
9.2	Compliance and Acceptance	40
9.2.1	Means of Demonstrating Compliance.....	40
9.2.2	Acceptance Criteria.....	40
9.3	Non-compliant Product	41
9.3.1	General.....	41
9.3.2	Manufacturing Repairs (In-process)	41
9.3.3	Product Warranty	41
9.3.4	Product Repair.....	41
10	Appendix A: Project Specific Requirements – Purchasing Schedule (Normative).....	42
10.1	General.....	42
10.2	Specific Requirements	42
11	Appendix B: Technical Schedules (Normative).....	44
11.1	Compliance Schedule.....	44
11.2	Pumpset Technical Response Schedule.....	48
11.3	Electric Motor Technical Response Schedule.....	51
12	Appendix C: Inspection and Test Plan (Informative).....	52

1 Scope and General

1.1 Scope

This *Specification* details the requirements for the design, manufacture, inspection, testing, handling and delivery of single or multistage, centrifugal type, submersible electric borehole pump and motor assemblies (termed *Pumpsets*).

These *Pumpsets* are intended for use by the *Corporation* in water supply systems primarily for source water pumping and pressure boosting of raw water, treated water and clear effluent.

This *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*:

ANSI/HI	Title	Equivalent Standard
14.6	Rotodynamic pumps for hydraulic performance acceptance tests	

API	Title	Equivalent Standard
11S8 Ed. 2	Recommended practice on electric submersible system vibrations	

AS	Title	Equivalent Standard
1055	Acoustics - Description and measurement of environmental noise	
1081	Acoustics - Measurement of airborne noise emitted by rotating electrical machinery	ISO 1680
1565	Copper and copper alloys – Ingots and castings	
1646	Elastomeric seals for waterworks purposes	
1833	Austenitic Cast Iron	ISO 2892:1973
2074	Steel castings	
2345	Dezincification resistance of copper alloys	
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	
4037	Pressure equipment – Examination and testing	
4087	Metallic flanges for waterworks purposes	

AS/ISO	Title	Equivalent Standard
7.1	Pipe threads where pressure-tight joints are made on the threads – Dimensions, tolerances and designation	ISO 7.1-2008

AS/NZS	Title	Equivalent Standard
1269	Occupational noise management	
1567	ISO metric hexagon bolts and screws – Product grade C - Bolts	
1568	ISO metric hexagon nuts - Product grade C	
4020	Testing of products for use in contact with drinking water	ISO 281:1990

AS/NZS/ISO	Title	Equivalent Standard
9001	Quality management systems	ISO 9001:2008

ASTM	Title	Equivalent Standard
A 182M	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service	
A 240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications	
A 276	Standard Specification for Stainless Steel Bars and Shapes	
A 351M	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts	
A 380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems	

BS	Title	Equivalent Standard
6920	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water	

EN	Title	Equivalent Standard
10204	Metallic materials – Types of inspection documents	
10088-3	Stainless steels, technical delivery conditions for semi-finished products, bars, rods, sections and bright products of corrosion resisting steels for general purposes	

ISO	Title	Equivalent Standard
1940-1	Mechanical vibration – Balance quality requirements for rotors in constant (rigid) state Part 1: Specification and verification of balance tolerances	
9906	Rotodynamic pumps - Hydraulic performance acceptance tests – Grades 1, 2 and 3	
10816-1	Mechanical vibration – Evaluation of machine vibration by measurement on non-rotating parts – Part 1: General Guidelines	
ISO/IEC	Title	Equivalent Standard
17000	Conformity assessment – Vocabulary and general principles NOTE: This Standard is not referenced in the document but is included for information	
17025	General requirements for the competence of testing and calibration laboratories	
NSF/ANSI	Title	Equivalent Standard
61	Drinking water system components – Health effects	
Standards Australia Guides	Title	Equivalent Standard
HB 18.23	Guidelines for third-party certification and accreditation - Guide 23- Methods of indicating conformity with standards for third-party certification systems (ISO/IEC Guide 23)	
HB 18.28	Conformity assessment - Guidance on a third-party certification system for products (ISO/IEC Guide 28)	
Corporation Documents	Title	Equivalent Standard
DS 26.15	Type Specification -High voltage submersible borehole cage induction motor	
DS 26.20	Type Specification - Low voltage submersible borehole cage induction motors	
Manual	Strategic Product Appraisal Process Manual – Product Appraisal and Authorization	
SPS 515	Strategic Product Specification - Axially-Split Casing Centrifugal Pumps	
WS-1	Welding Specification - Metal Arc Welding	

1.3 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.

Words in this *Specification* written in italics identify terminology defined in 1.4.

1.4 Definitions

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

1.4.1 Allowable Operating Range (AOR)

The range of flow nominated by the *Manufacturer* and expressed as % BEP, within which the *Pump* is designed to operate on an intermittent basis without reduction in reliability.

1.4.2 Best Efficiency Point (BEP)

The flow rate at which the *Pump* exhibits a maximum efficiency (the gradient of the efficiency-flow curve is zero), for a particular speed.

1.4.3 Certificate

A formal certificate issued by a *Certification Body* in accordance with a *Certification Scheme*, including associated product licence schedules.

1.4.4 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*.

1.4.5 Certification Scheme

A third party product certification system operated in accordance with HB 18.28.

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.

1.4.6 Corporation

The Water Corporation of Western Australia.

1.4.7 Corrosive Water

Water or effluent with significantly corrosive properties defined in Table 2.1.

1.4.8 Design Duty Point

A flow/head point nominated by the designer or design manager which the *Manufacturer* uses in the *Pump* selection process.

1.4.9 Guarantee Duty Point

A flow/head point nominated by the *Manufacturer* and agreed to with the *Corporation*, for which the *Manufacturer* guarantees the *Pumpset* to achieve during performance acceptance tests, to within a specified tolerance. In addition to flow and head the *Guarantee Duty Point* also included guarantees on efficiency, input power and can be extended to include guarantees on NPSH3, vibration and noise.

1.4.10 Hydrostatic Test Pressure

The pressure to which the *Pump* stage casings, outlet housing and NRV are required to be tested during production.

1.4.11 Highly Corrosive Water

Seawater or brine with highly corrosive properties defined in Table 2.1.

1.4.12 Inspection and Test Plan (ITP)

A document prepared by the *Manufacturer* which is used as a basis for monitoring *Product* conformity with specified requirements. As a minimum, ITPs identify the inspection and test activities required, the criteria for acceptance of each activity and a record of each activity outcome.

The following terms and definitions apply when referring to ITPs:

Approve (or Accept)	Documents and drawings shall be ‘approved’ for adequacy by the <i>Manufacturer</i> prior to use, and where indicated ‘accepted’ by the <i>Corporation</i>
Hold	A step in design, manufacture or testing beyond which the process may not proceed without checking, inspection and authorization by the authority that imposed the hold point
Witness	A step in design, manufacture or testing where the authority that imposed the witness point performs an inspection or surveillance. If such inspection or surveillance is not performed at the agree time, after proper notification that the witness point will occur, or if such inspection is waived, processing may continue
Review (or Verification)	A step in design, manufacture or testing where the authority who imposes the verification point reviews documentation applicable to the surveillance point to ensure correct compilation and acceptability of such documentation. Such activities take place at the same time as Hold and/or Witness activities or else during other routine visits. No specific notification is required.
Monitoring (or Surveillance)	A step in design, manufacture or testing where the inspection authority conducts a general review during visits without delaying the activity. Monitoring of such activities may take place at the same time as Hold and/or Witness activities or else during other routine visits. No specific notification is required.

1.4.13 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 results in manufactured *Product*.

1.4.14 Maximum Allowable Working Pressure (MAWP)

The maximum working pressure, including surge, at which a *Pump* is designed to operate.

1.4.15 Maximum Operating Pressure (MOP)

The maximum pressure to which a *Pump* will be subject during its operating life.

1.4.16 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.

1.4.17 Net Positive Suction Head (NPSH)

Definitions in relation to NPSH, NPSHA, NPSH3 and NPSH Datum Plane are as provided in ISO 9906- 2012.

The definition of the term NPSHR has been expanded further by 3.3.2 to include a minimum value of NPSHR relative to NPSH3.

1.4.18 Oilfield ESP

An electric submersible Pump (or Pumpset) primarily designed to serve the oil and gas industry. Oilfield ESPs shall only be used on Corporation water supply systems in instances where the installation of conventional water industry Pumpsets is not possible i.e. high flow, small bore casing applications.

1.4.19 Officer

A duly authorised representative or appointed agent of the *Corporation*.

1.4.20 Preferred Operating Range (POR)

The range of flow nominated by the manufacturer and expressed as % BEP, within which the *Pump* is designed to operate on a continuous basis without reduction in reliability.

1.4.21 Pitting Resistance Equivalent Number (PREN)

For ferritic and martensitic stainless steel grades, $PREN = \%Cr + 3.3(\%Mo)$ where the concentrations are in weight (%).

For austenitic and duplex stainless steel grades, $PREN = \%Cr + 3.3(\%Mo) + x(\%N)$ where:

$x = 16$ for duplex stainless steels; and

$x = 30$ for austenitic stainless steels.

1.4.22 Pressure Class (PN)

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

1.4.23 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.

In this *Specification*, *Product* shall refer to *Pumpsets* and any associated items included in the *Purchasing Schedule*, including but not limited to motor drop cables, columns and VVVF drives.

1.4.24 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*.

1.4.25 Product Assessor

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

1.4.26 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.

1.4.27 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*.

1.4.28 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 *Product Warranty* by means of Public and Products Liability Insurances as specified in the undertaking.

1.4.29 Pump

The pump end of the submersible electric borehole *Pumpset*, including the NRV detailed in 3.4.14.

1.4.30 Pumpset

The complete submersible electric borehole pump and motor assembly. For *Oilfield ESPs*, *Pumpsets* shall also include the seal unit and data collector.

1.4.31 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* in part will include Table 10.1 Schedule of Project Specific Requirements.

1.4.32 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.

1.4.33 Specification

Corporation Strategic Product Specification SPS 507

1.4.34 Standard Water

Water or effluent with mildly corrosive properties defined in Table 2.1.

1.4.35 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 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.

1.4.36 Strategic Product Appraisal Process

The process described in the Strategic Product Appraisal Process Manual whereby manufactured products and equipment are evaluated and, where they comply with specified requirements, authorised for use in *Corporation* infrastructure.

1.4.37 String

The entire equipment set, consisting of a *Pumpset* together with a VVVF drive.

1.4.38 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.

1.4.39 Technical Compliance Schedule

A schedule whereby a *Supplier* demonstrates *Product* compliance with the *Specification*. In this document this shall specifically refer to Table 11.1.

1.4.40 Technical Response Schedule

A schedule in which a *Supplier* records technical data for *Product* in response to an enquiry for proposal or purchase. In this document this shall specifically refer to Table 11.2.

1.4.41 Water Services Association of Australia (WSAA)

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

1.5 Abbreviations

The following abbreviations are referred to in this *Specification*:

AOP:	allowable operating pressure
AOR:	<i>Allowable Operating Range</i>
BEP:	<i>Best Efficiency Point</i>
BTOC:	below top of casing
DN:	<i>Nominal Size</i>
η_{grG}:	guaranteed <i>Pumpset</i> efficiency
η_{strG}:	guaranteed <i>String</i> efficiency
gr:	combined motor/pump unit (i.e. <i>Pumpset</i>)

H_G:	guaranteed <i>Pump</i> total head
ITP:	<i>Inspection and Test Plan</i>
kW:	kilowatt(s)
MAWP:	<i>Maximum Allowable Working Pressure</i>
MOP:	<i>Maximum Operating Pressure</i>
MCR:	maximum continuous rating
NPSH:	<i>Net Positive Suction Head</i>
NPSH3:	Net positive suction head for a drop of 3% of total head of first stage
NPSHA:	Net positive suction head available
NPSHR:	Net positive suction head required
NPSH3G:	guaranteed net positive suction head for a drop of 3% of total head of first stage
NRV:	non return valve
PN:	<i>Pressure Class</i>
POR:	<i>Preferred Operating Range</i>
PREN:	<i>Pitting Resistance Equivalent Number</i>
P_{grG}:	guaranteed pump motor unit input power
P_{strG}:	guaranteed <i>String</i> input power
PWM:	pulse width modulation
rms:	root mean squared
Q_G:	guaranteed flow
S:	NPSH margin
SOH:	shut off head
str:	the complete equipment <i>String</i> (i.e. <i>Pumpset</i> and VVVF drive)
VVVF:	variable-voltage variable-frequency
WPL:	water pumping level
WRL:	water rest level

1.6 Designation of Size

This *Specification* generally covers (but is not restricted to) *Pumpsets* with *Pump* discharge size up to DN 350 and flow capacities up to 300 L/s for installation into boreholes up to size DN 700 and flow capacities up to 25 MLD.

2 Materials and Components

2.1 General

All components shall be manufactured from corrosion-resistant and abrasion-resistant materials as further specified below. Materials in contact with each other shall be designed so as to minimise galvanic corrosion and galling potential via insulation or optimal selection.

The materials and components used in the manufacture of *Pumpsets* shall be selected on the basis of the type of water being pumped. Water quality data shall be as specified in the *Purchasing Schedule*.

The following classifications of water shall apply for the purposes of selecting the appropriate materials of construction:

Table 2.1 – Classification of Water Corrosivity

Water Classification	Water Type	pH	Chlorides mg/L	Alkalinity mg/L	Free Chlorine mg/L	Max Water Temp °C	Sand Content mg/L
Standard	Water or effluent	6 - 9	<500	>20	<5	<30	<5
Corrosive	Water or effluent	5 - 9	<3000	<20	<5	<45	
Highly Corrosive (refer 2.4)	Saline water, seawater or brine	5 - 9	>3000	<20	<1	-	

Note: The free chlorine levels decrease with higher chloride levels as these act synergistically to increase the corrosive properties of the water.

It is the responsibility of the designer / design manager to gather all available water quality information from the *Corporation* and complete the water quality details in Table 10.1 of the *Purchasing Schedule*.

2.2 Contamination of Drinking Water

Materials for construction of components and coatings in contact with drinking water shall be certified, by an authorized certification laboratory, as complying with the requirements for such materials, to 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 – NSF/ANSI 61
- France - ACS (Attestation de conformité sanitaire).
- Italy – DM174

2.3 Materials of Construction

Each *Pumpset* shall be constructed from materials suitable for the water quality details provided in the *Purchasing Schedule*. The materials detailed in Table 2.2 represent the basic or minimum requirements, and materials of equivalent or superior mechanical, wear and corrosion resistance may be acceptable. The *Manufacturer* shall provide documentary evidence of material properties (e.g. PREN, hardness) to clearly demonstrate compliance with relevant requirements (refer to *Technical Response Schedule*).

Table 2.2 – Materials of Construction

Pumpset Component	Standard Waters		Corrosive Waters	
	Material	Standard: Grade	Material	Standard: Grade
Stage casings and Inlet/outlet housings	Phosphor bronze	AS 1565: C90250	Nickel aluminium bronze	AS 1565: C95810
	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
			Austenitic cast iron ⁽¹⁾	AS 1833: L-NiCuCr 15,6,3
Impellers	Phosphor bronze	AS 1565: C90250	Nickel aluminium bronze	AS 1565: C95810
	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
			Austenitic cast iron ⁽¹⁾	AS 1833: L-NiCuCr 15,6,3
Shaft	Stainless steel	ASTM A 276: 431 ⁽²⁾ , or Recognised standard: Grade with PREN ≥ 22	Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
Collet, impeller key	Stainless steel	ASTM A 276: 431 ⁽²⁾ , or Recognised standard: Grade with PREN ≥ 22	Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
Impeller wear rings	Manufacturer Select ⁽³⁾		Manufacturer Select ⁽³⁾	
Casing wear rings	Manufacturer Select ⁽⁴⁾		Manufacturer Select ⁽⁴⁾	
Shaft bearing journals ⁽⁶⁾	Zirconia ceramic ⁽¹⁾		Zirconia ceramic ⁽¹⁾	
	Tungsten carbide ⁽¹⁾		Tungsten carbide ⁽¹⁾	
Stage casing bearing ⁽⁶⁾	Phosphor bronze	AS 1565: C90250	-	
	Rubber		Rubber	
	Zirconia ceramic ⁽¹⁾		Zirconia ceramic ⁽¹⁾	
	Tungsten carbide ⁽¹⁾		Tungsten carbide ⁽¹⁾	
Sand collar	Phosphor bronze	AS 1565: C90250	Nickel aluminium bronze	AS 1565: C95810
Strainer	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Super duplex stainless steel	Recognised standard: Grade with PREN ≥ 40
Fasteners ⁽⁵⁾	Stainless steel	ASTM A 276: 431 ⁽²⁾ , or Recognised standard: Grade with PREN ≥ 22	Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
Non return valve housing (NRV)	Phosphor bronze	AS 1565: C90250	Nickel aluminium bronze	AS 1565: C95810

Pumpset Component	Standard Waters		Corrosive Waters	
	Material	Standard: Grade	Material	Standard: Grade
Non return valve housing (NRV) –cont.	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
			Austenitic cast iron ⁽¹⁾	AS 1833: L-NiCuCr 15,6,3
NRV disc	Phosphor bronze	AS 1565: C90250	Nickel aluminium bronze	AS 1565: C95810
	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Austenitic cast iron ⁽¹⁾	AS 1833: L-NiCuCr 15,6,3
NRV stem	Stainless steel	ASTM A 276: 431 ⁽²⁾ , or Recognised standard: Grade with PREN ≥ 22	Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
NRV sealing ring	Synthetic elastomer	AS 1646: EPDM, NBR	Synthetic elastomer	AS 1646: EPDM, NBR
Pump to motor coupling	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Nickel aluminium bronze	AS 1565: C95810
			Duplex stainless steel	Recognised standard: Grade with PREN ≥ 30
Cooling shroud	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Super duplex stainless steel	Recognised standard: Grade with PREN ≥ 40
Cooling shroud adaptor	Stainless steel	Recognised standard: Grade with PREN ≥ 22	Super duplex stainless steel	Recognised standard: Grade with PREN ≥ 40

NOTES:

1. These components are noted as having a particularly high degree of abrasion resistance.
2. Whilst grade 431 has a PREN <22 it has proven satisfactory in service
3. Impeller wear ring materials shall have equal or superior corrosion and abrasion resistance to that of the impeller, and shall be non-galling with the casing wear ring. Refer 3.4.8.
4. Casing wear ring materials shall be of equal or superior corrosion resistance to, and be non-galling with, the impeller wear ring. The material shall also have a high degree of abrasion resistance and be electrochemically compatible with both the casing and impeller wear ring. Refer 3.4.8.
5. Stage casing and inlet housing to motor fasteners shall incorporate locknuts or lock washers.
6. A journal bearing consists of a rotating shaft component concentrically supported by a static bush component. In this *Specification* the rotating component is termed the ‘shaft bearing journal’ and the static component is termed the ‘stage casing bearing’. Some pumps do not have separate shaft bearing journals, but rather the shaft runs directly in the stage casing bearing.

2.4 Highly Corrosive Waters

The basic or minimum *Pumpset* materials and components required to handle *Highly Corrosive Water* are not defined in this *Specification* and shall be subject to agreement between the *Corporation* and the *Manufacturer*. For these applications the *Manufacturer* shall recommend materials and components appropriate for the pumped fluid, its physical and chemical properties and related temperature, as specified in the *Purchasing Schedule*.

NOTE: As a guide materials for *Highly Corrosive Waters* would typically relate to those contained in Tables 2.1 and 2.2 of SPS 515.

2.5 Material Certification

Material certificates shall be provided for the stage casings, inlet and outlet housings, impellers, shaft, wear rings and sleeves to the requirements of EN 10204 and the following:

- < 100 kW motor size = Certificate Type 2-2 (batch)
- ≥ 100 kW motor size = Certificate Type 3.1 (specific item)

2.6 Stainless Steel

2.6.1 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 A 380.

2.6.2 Graphite Compounds and Coatings

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.

2.6.3 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 HBW 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.

2.7 Dezincification-Resistant Materials

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

2.8 Non-Metallic Materials

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

2.9 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

Pumpsets shall be vertically orientated and designed for the operating requirements specified in the *Purchasing Schedule* and the following.

Where specified in the *Purchasing Schedule*, *Pumpsets* shall be capable of operating in a horizontal orientation (booster applications).

The design criteria for *Pumpsets* shall be based on a minimum life expectancy of 25 years (excluding normal wear parts such as wear rings and gaskets) and at least 3 years of uninterrupted operation. It is recognized that these are design criteria and that service or duty severity, incorrect operation or improper maintenance can result in *Pumpsets* failing to meet these criteria.

3.2 Operating Conditions

3.2.1 Standard Parameters

Pumpsets and associated equipment shall be selected to operate in accordance with the following conditions:

- (a) Environment: Non-aggressive and non-flammable;
- (b) Ambient air temperature range of -5°C to 60°C ;
- (c) Altitude range of 0 to 500 m; Submergence up to 200m
- (d) Pumped liquid: *Standard Water* in accordance with Table 2.1;

For deviations from the above parameters refer to the 3.2.2.

3.2.2 Special Parameters

Conditions that have parameters that fall outside the standard parameters above will be specified in the *Purchasing Schedule*. Accordingly the *Manufacturer* shall base the selection of *Pumpsets* in terms of performance, materials and component design on the parameters specified in the *Purchasing Schedule*.

NOTE: Bore water temperatures in excess of 30°C may be critical in determining correct selection of the submersible electric motor by the *Supplier*.

3.2.3 Pump Clearance in Bore

Pumpsets shall readily fit into the bore casing inside diameter and at the setting as specified in the *Purchasing Schedule*. Where a different *Pumpset* setting is recommended by the *Manufacturer* than that contained in the *Purchasing Schedule* this shall be nominated in the *Technical Response Schedule*.

The clearance within the bore casing (taking into account the motor cable protector) shall allow an acceptable *Pumpset* clearance and an acceptable water velocity flow past the motor in order to satisfy permissible motor cooling.

3.3 Performance

3.3.1 Pump Selection

Pumps shall aim to meet the *Design Duty Points* contained in the *Purchasing Schedule* with the number of stages selected to match the *Design Duty Points* as closely as possible. Trimming of the impellers to achieve the *Design Duty Points* is not preferred and shall only be conducted subject to agreement with the *Corporation*.

Pumps shall be selected so that:

- the Primary *Design Duty Point* is at, or close to, the *Best Efficiency Point* of the *Pumps*;

- any Secondary *Design Duty Points* are met with the same impeller diameters as the Primary *Design Duty Point* (and preferably at the same speed).
- no continuous operating duty point lies outside the *Preferred Operating Range* for the operating speed.
- no intermittent operating duty point lies outside the *Allowable Operating Range* for the operating speed.

3.3.2 NPSH

NPSHA shall be stated in the *Purchasing Schedule*.

The *Pump* shall be selected to have an NPSHR less than the system NPSHA under all operating conditions. NPSHR shall include appropriate margin over NPSH3 as required to ensure the long term satisfactory operation of the *Pump* and longevity of the impellers.

The NPSH margin (S) shall be the greater of the values determined as follows:

- 1m for operation within *POR*, 1.5m for frequent operation outside *POR*
- As recommended by the *Manufacturer* in the *Technical Response Schedule*.
- $S = (0.75 \times \text{NPSH3}) - 3$

3.3.3 Guarantee Points

Following the *Pump* selection process described in 3.3.1 the *Manufacturer* shall nominate the *Guarantee Duty Points*. The *Guarantee Duty Points* shall be derived from and close to the *Design Duty Points* nominated in the *Purchasing Schedule*. The *Guarantee Duty Points* should be recorded in the *Technical Response Schedule*.

Where system curves are provided the *Guarantee Duty Points* shall be determined by the intersection of the system curves with the *Pump* curve. Where system curves are not provided the *Manufacturer* shall derive approximate system curves based on the *Design Duty Points* and use the intersection of these curves with the *Pump* curve as the basis for determining the *Guarantee Duty Points* (refer note).

NOTE: As a guide approximate system curves may be based on taking the WPL provided in the *Purchasing Schedule* as the static head and then plotting a basic quadratic curve ($H = kQ^2 + \text{WPL}$) passing through this point and the *Design Duty Points*.

3.3.4 Performance Curves

The *Manufacturer* shall provide the following performance curves and related information.

- (a) Head-flow, efficiency and absorbed power curves for the *Pumps* operating at the required speed(s) and fitted with number of stages to match as closely as possible the Primary and any Secondary *Design Duty Points*. Where minimum and maximum system curves have been provided as part of the *Purchasing Schedule* the *Manufacturer* shall superimpose the *Pump* head-flow characteristic curves supplied onto the system curves. The *Manufacturer* shall also clearly identify the Primary and Secondary *Guarantee Duty Points*.
- (b) NPSH3 curves and superimposed curves for NPSHR and NPSHA.
- (c) For variable speed applications a set of performance curves for the complete duty range showing separate curves in 10 Hz increments covering the operating envelope.

3.3.5 Driver Selection

Electric motor sizing and selection for *Pumpsets* shall be in accordance with the following.

- (a) Generally the electric motor duty rating for *Pumps* with a ‘non-overloading’ power demand curve, the motor MCR kW rating shall not be less than 110% of the *Pump* maximum ‘non-overloading’ kW demand (refer note).

- (b) Where winding over temperature protection is provided, the S1R rating of the motor shall exceed only 110% of the *Pump* maximum duty demand kW, should this be less than the value determined in accordance with (a) above.
- (c) The maximum duty kW should make due allowance for:
 - possible errors in the design versus actual system curve; and
 - maximum duty kW requirements for minimum head conditions.

NOTE: The 10% margin specified above provides for a:

- (i) 5% margin of error in respect to load requirements;
- (ii) 5% derating if the motor is to be connected directly to the supply mains to allow for a phase voltage unbalance up to 2%;
- (iii) 5% derating if the motor is to be connected to a PWM variable speed controller to allow for the harmonic currents generated by the controller.

3.4 Pump Design

3.4.1 Maximum Allowable Working Pressure and Hydrostatic Test Pressure

Pumps shall be designed such that the *Maximum Allowable Working Pressure* (MAWP) is greater than the *Maximum Operating Pressure* (MOP).

The *Pump* stage casings and outlet housing shall be designed to withstand the *Hydrostatic Test Pressure*, when tested in accordance with 4.5.2. The *Hydrostatic Test Pressure* shall be:

Hydrostatic Test Pressure => 1.3 x MAWP OR
=> 1.5 X MOP (whichever produces the highest value)

3.4.2 Stage Casings

Stage casings shall:

- Be one piece (excluding wear rings) cast or fabricated (pressed) incorporating an axial diffuser designed to efficiently convert discharge flow from the impeller to axial flow;
- Incorporate an integral bearing housing featuring a positive method of retaining the casing bearing;
- Positively connect with mating components e.g. via clamped, bolted or screwed connections;
- Incorporate casing wear rings in accordance with 3.4.8;

3.4.3 Inlet Housing

The inlet housing shall be designed to allow smooth entry of water into the impeller eye in order to minimize vortex formation. Where applicable (refer note) the inlet housing motor mounting flange and coupling shall be compatible with the relevant NEMA standard flange and shaft connection for the motor. The inlet shall be fitted with an inlet strainer which shall also act as a safety guard. The housing shall be designed to prevent entry of particles which could block the impeller and inlet bearing.

NOTE: NEMA standard is applicable up to 10” motors. Sizes larger than this should be as per *Manufacturer’s* standard.

3.4.4 Outlet Housing

Unless otherwise specified in the *Purchasing Schedule*, screwed outlets shall incorporate an internal sealing thread complying with AS ISO 7.1 and flanged outlets shall comply with AS 4087.

Both screwed and flanges outlet connections shall have a *Pressure Class* (PN) greater than the *Pump* MAWP.

3.4.5 Impellers

Impellers shall be:

- Double shrouded, one piece (excluding wear rings) cast or fabricated (pressed), radial or mixed-flow type;
- Mechanically secured to the shaft in a manner that prevents circumferential and axial movement;
- Incorporate impeller wear rings in accordance with 3.4.8;
- Hydro-dynamically balanced.

3.4.6 Pump Shaft

The *Pump* shaft shall be:

- Amply sized in order to transmit the full driven output;
- Of sufficient stiffness to provide trouble free performance and meet the dynamic deflection requirements detailed in 3.4.7;
- Concentric with runout not exceeding the *Manufacturer's* requirements;
- Fitted with a drive coupling which is mechanically secured to the *Pump* shaft at the inlet end and incorporating an internal spline or keyway for connection to the external splined or keyed shaft of either a seal unit (*Oilfield ESPs* only) or an electric motor.

3.4.7 Rotating Element Dynamics

The total dynamic shaft deflection at maximum *Pump* speed with maximum diameter impellers shall be such that contact between the impeller (or impeller wear rings) and the casing (or casing wear rings) does not occur between zero flow and the upper limit of the *Allowable Operating Range*.

3.4.8 Wear Rings

Pumps shall be fitted with replaceable casing and impeller wear rings that are mechanically secured to prevent loosening. Machined recesses shall be provided in the impellers and stage casings to provide smooth internal contours with the fitted wear rings.

Mating wear ring materials shall have a difference in Brinell hardness number of at least 50HB unless both the stationary and the rotating wear surfaces have a Brinell hardness number of at least 400HB.

Wear ring material selection and design shall ensure:

- The tolerance of these parts to the presence of sand during start-up, run-down and normal operation – without seizure of the rotating element
- A high level of abrasion resistance and long service life
- Corrosion resistance appropriate to the specified water quality data contained in the *Purchasing Schedule*.

3.4.9 Shaft Bearing Journals

Where *Pump* designs include fitted shaft bearing journals these shall mate and operate smoothly with the stage casing bearings.

3.4.10 Stage Casing Bearings

The *Pump* inlet and outlet housings and each stage casing shall be fitted with water lubricated bearings to provide radial support to the *Pump* shaft. The bearings should incorporate sand flush channels or flutes to allow the passage of small amounts of abrasives.

3.4.11 Sand Collar

The *Pump* shall incorporate a sand collar.

3.4.12 Fasteners

Bolts and studs shall be in accordance with industry standards and be sized so that excessive threads do not protrude past the nut after assembly.

3.4.13 Upthrust

The *Pumpset* shall incorporate upthrust protection.

3.4.14 Non Return Valve

The *Pump* outlet shall incorporate a poppet type NRV (*Oilfield ESPs* excepted, refer note).

In cases where a NRV is not provided the *Pump* shall be capable of operating without it for the maximum run back head developed in the column. The run back head shall be taken from the bore top of casing to the WPL.

NOTE: The exception given for *Oilfield EPSs* relates to availability of a suitable NRV rather than preference.

3.5 Manufacture

3.5.1 Castings

Cast components shall be precision formed with smooth waterways.

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 9.3.2.

Stainless steel castings shall comply with the relevant part of 2.6.1.

3.5.2 Machined Components

Machining of components shall be accurate, 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.

The *Pump* shaft shall be manufactured in one piece, machined throughout its entire length with a high degree of finish at bearing surfaces. It shall be radiused at all section changes to minimize stress raisers. No sharp corners or undercutting shall be permitted.

3.5.3 Fabricated Components

Pressed stainless steel components that are fabricated by welding shall be manufactured in accordance with 2.6.1 and Corporation Technical Specification WS-1.

3.5.4 Balancing of Impellers

Balancing shall be in accordance with ISO 1940-1 and relevant certificates shall be supplied.

Impellers shall be statically and dynamically balanced to achieve balance grade G2.5 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.

3.5.5 Vibration

The vibration of *Pumpsets* shall not exceed the limits in Table 3.1.

Table 3.1 – Vibration Limits

Operating within:	Vibration Velocity Limit - mm/s (rms)
Preferred Operating Range (POR)	5.0
Allowable Operating Range (AOR)	6.2

Where specified in the *Purchasing Schedule* a vibration test shall be performed. The evaluation of *Pumpset* and component vibration shall be in accordance with 4.6.7.2.

NOTE: Vibration testing should only be specified for *Pumpsets* with an input power $\geq 100\text{kW}$.

3.6 Electric Motor

3.6.1 General

This *Specification* includes the supply of submersible electric motors. Motors shall comply with the relevant specification as defined in Table 3.2

Table 3.2 – Motor Specifications

Motor Voltage	Applicable Specification
< 1000V	Electrical Type Specification DS 26.20 - Low voltage submersible borehole cage induction motor
$\geq 1000\text{V}$	Electrical Type Specification DS 26.15 – High voltage submersible borehole cage induction motor

Pumpsets shall be fitted with stainless steel motor cable guards. Where specified in the *Purchasing Schedule* or as required by the *Manufacturer*, *Pumpsets* shall be fitted with a motor shroud in accordance with the 3.6.2.

3.6.2 Motor Shroud

Where specified in the *Purchasing Schedule* or as required by the *Manufacturer*, a motor shroud assembly (shroud) shall be provided. The shroud shall comprise an adaptor fitting and fasteners, and a shroud tube. The shroud tube shall be fabricated from stainless steel sheet of minimum thickness 3 mm and shall be slightly shorter (e.g. 25 to 50 mm) than the motor bottom end to allow the *Pumpset* to stand upright without damaging the shroud. The shroud shall be removable from the motor end of the *Pump*. The shroud shall incorporate centralizing spacers towards the bottom end of the motor.

The shroud shall be provided in order to either:

- Direct flow over the motor for cascading bores (note 1), or
- Provide the minimum water flow velocity past the motor to ensure adequate motor cooling in accordance with the motor manufacturer’s requirements (note 2).

NOTES:

1. Where water flow originates from above the *Pump*.
2. Required where the bore size is too large to induce the minimum flow velocity past the motor.

4 Inspection and Testing

4.1 General

Product shall be inspected and tested in accordance with the requirements of this *Specification*. Inspection and testing shall be deemed acceptable when test outcomes have been formally verified by a certification or witnessed by a testing *Officer*. *Product* for which an inspection or test requirement has not been met shall be classified as non-compliant *Product*.

NOTES:

1. Inspection and 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.

4.2 Notification of Testing

The *Corporation* shall be notified in writing of each formal test proposal, allowing as a minimum the period nominated in the *Purchasing Schedule*, 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.

NOTE: As a minimum, travel approval may take 7 days for travel within Australia or 3 weeks for overseas travel.

4.3 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.

4.4 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 be borne by the *Corporation* unless otherwise negotiated.

4.5 Quality Verification

4.5.1 Inspection and Testing

4.5.1.1 General

The *Manufacturer* shall manage all inspection and test activities in such a way as to be able to demonstrate that sufficient inspection and testing has been performed and that specified requirements have been met.

The *Manufacturer* shall maintain a schedule of required inspection and testing and shall maintain records of all inspection and test activities, including results of inspection.

4.5.1.2 Inspection and Test Plans (ITPs)

Where specified in the *Purchasing Schedule* (refer note), the *Manufacturer* shall prepare and submit an *Inspection and Test Plan* (ITP) for *Corporation* review and acceptance. ITPs shall be submitted prior to the commencement of work.

ITPs must include the following information as a minimum:

— Preliminaries, including:

- Determination and review of requirements
- Documentation in accordance with the requirements of the Purchase Order
- Description of each operation, inspection or test;
- Frequency of each operation, inspection or test;
- Personnel responsible for each operation, inspection or test;
- Controlling document(s), eg management standards/procedures or test procedures
- Acceptance Criteria, e.g. reference specific clauses of applicable *Product* standards/specifications or specific values/limits
- Hold, Witness, Approve, Review and Monitor points (refer to 1.4.10)
- Verifying document (record) of each test and/or inspection, e.g. complete Inspection checklist, Inspection Report of Test Report

The format of the ITP shall be at the discretion of the *Manufacturer*. However for guidance on format and content a sample ITP has been included in Appendix C.

The *Manufacturer* shall review the *Purchasing Schedule*, this *Specification* and all applicable specifications, standards and regulatory requirements, etc. to determine the full extent, type, frequency, acceptance criteria, required personnel competencies and required records.

The *Manufacturer* shall incorporate in the ITP all inspection and test activities performed as part of the *Manufacturer's* normal controls as well as those specified in the *Purchasing Schedule* and this *Specification*.

For the purpose of acceptance, each ITP shall, as a minimum bear the relevant *Product* item serial number and shall certify that the *Product* item has complied with the inspection test requirements.

NOTE: Normally ITPs are only requested for *Corporation* review and acceptance where *Pumpset* input power is $\geq 100\text{kW}$

4.5.2 Hydrostatic Tests

Where *Pumpset* input power is $\geq 100\text{kW}$, each *Pump* stage casing and outlet housing shall be subjected to a hydrostatic test to the requirements of ANSI/HI 14.6 2011 – Appendix B. No artificial structural support shall be provided to the stage casings or outlet housing during the test.

The *Hydrostatic Test Pressure* shall be in accordance with 3.4.1.

4.6 Performance Acceptance Tests

4.6.1 General

Each *Pumpset* shall be tested by the *Manufacturer* to prove that the performance meets the *Guarantee Duty Points*.

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 - 2012, except as otherwise stated in this *Specification*.

4.6.2 Test Set-up

Pumpsets shall be tested at the speed stated by the *Manufacturer* to achieve the Primary and any Secondary *Guarantee Duty Points* (i.e. reduced speed testing is not acceptable, notwithstanding the provisions of ISO 9906).

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

Pumps shall be tested by the *Manufacturer* as a complete *Pumpset*, 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 for testing shall be certified by the National Association of Testing Authorities Australia (NATA), or an approved equivalent body in an overseas country, as complying with the required measurement tolerance for that instrumentation as stipulated in ISO 9906.

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

4.6.3 String Testing – VVVF Testing

Where specified in the *Purchasing Schedule*, *Pumpsets* shall be performance acceptance tested by the *Manufacturer* as a *String* (that is tested together with its VVVF drive). The *Manufacturer* shall bear responsibility of the handling, set-up, accommodation, management, removal and dispatch of the speed control equipment within the delivery schedule.

NOTES: *String* testing of *Pumpsets* with drives usually involves significant time and cost. It should only be requested where there is significant benefit in doing so. It should also only be requested in cases where a single *Supplier* is supplying the entire *String* (i.e. both the *Pumpset* and the VVVF).

4.6.4 Guarantee Points

Guarantee Duty Points shall be defined at the rated speed by:

- a guaranteed flow, Q_G ;
- a guaranteed head, H_G ;
- the minimum *Pumpset* efficiency, η_{grG} ;
- the maximum pump motor unit input power, P_{grG} ;

Where a *Pumpset* is tested as part of a *String* test, the efficiency and power consumption guarantees shall be extended to include the entire equipment string. The guarantee points for a *String* test shall be defined at the rated speed by:

- a guaranteed flow, Q_G ;
- a guaranteed head, H_G ;
- the minimum String efficiency, η_{strG} ;
- the maximum VVVF Drive input power, P_{strG} ;

Where additional testing is included, such as NPSH3, vibration and noise tests, these points shall also form part of the guarantee.

NOTES:

1. Since *String* testing requires the *Manufacturer* to guarantee the efficiency and input power of the overall *String*, it should only be requested in cases where a single *Manufacturer* is supplying the entire *String* (i.e. both the *Pumpset* and the VVVF)
2. The rationale for extending the guarantee of efficiency and power to cover the entire *String* is based on guidance provided in ISO 9906 -Annex E.

4.6.5 Tolerances

Pumpsets shall meet the *Guarantee Duty Points* within the pump test acceptance grade tolerances defined in Table 4.1 and ISO 9906:2012, Table 8.

Table 4.1 – Acceptance Tolerance

Motor Input Power	Guarantee Duty Point	Acceptance Grade	Guarantee Points
<10kW	Primary Duty Point	3B	$\tau_Q \pm 9\%$, $\tau_H \pm 7\%$, $\tau_P + 9\%$, $\tau_\eta - 7\%$
	Secondary Duty Points	None	None
≥ 10 kW and <100kW	Primary Duty Point	2B	$\tau_Q \pm 8\%$, $\tau_H \pm 5\%$, $\tau_P + 8\%$, $\tau_\eta - 5\%$
	Secondary Duty Points	3B	$\tau_Q \pm 9\%$, $\tau_H \pm 7\%$, $\tau_P + 9\%$, $\tau_\eta - 7\%$
≥ 100 kW	Primary Duty Point	1E	$\tau_Q \pm 5\%$, $\tau_H \pm 3\%$, $\tau_P + 4\%$, $\tau_\eta \geq 0\%$
	Secondary Duty Points	1B	$\tau_Q \pm 5\%$, $\tau_H \pm 3\%$, $\tau_P + 4\%$, $\tau_\eta - 3\%$

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

4.6.6 Scope of Tests

Performance acceptance tests shall include, and test curves generated for the following:

- Determination of the head-flow characteristic, 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. The number of test points taken, in determining the head-flow characteristic curve, shall be in accordance with Table 4.2

Table 4.2 – Minimum test points required along characteristic curve

Motor Input Power	Minimum test points required
<100kW	5
≥ 100 kW	10

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

- Determination of the power absorbed by the *Pumpset*, and the *Pumpset* efficiency calculated, for each of the above-stated test points. Where a *String* test is conducted the power and efficiency of the *String* shall also be determined.

4.6.7 Additional Testing

4.6.7.1 NPSH3 Testing

Where specified in the *Purchasing Schedule* (refer note), each *Pumpset* shall undergo NPSH3 testing. Where NPSH3 testing is specified, *Pump* NPSH3 shall be guaranteed by the *Manufacturer*.

Testing shall be conducted in accordance with ISO 9906-2012, using test method 5.8.2.11 - Type I Test. The number of readings taken shall be as necessary to determine the shape of the individual ‘horsetail’ curve.

An NPSH3 characteristic curve shall be determined, extending from 80% of the *Best Efficiency Point* to at least 120% of the *Primary Guarantee Duty Point*, or 120% of the *Best Efficiency Point*, whichever the greater. At least four (4) points along the characteristic curve shall be taken.

NOTE: NPSH3 testing is not normally specified and should only be specified where a tight margin exists between NPSHA and NPSHR. A tight margin is more likely in booster applications than borehole application, as for borehole applications the *Pumpset* setting can generally be lowered to improve NPSHA.

4.6.7.2 Vibration Testing

Where specified in the *Purchasing Schedule* (refer note), each *Pumpset* shall be tested for vibration severity performance. Vibration testing shall be conducted in accordance with API 11S8 Ed. 2, Section 5.2, with the recommendations of that document being applied as mandatory requirements. Vibration testing shall also be in accordance with the general guidelines for vibration measurement provided in ISO 10816.1.

Pump vibration test values shall comply with 3.5.5 or the value guaranteed in the *Technical Response Schedule*, whichever is lower, when tested at the *Manufacturer's* premises under full operating conditions.

NOTE: Vibration testing should only be specified for *Pumpsets* with an input power $\geq 100\text{kW}$.

4.6.7.3 Noise Testing (Booster Applications Only)

Where specified in the *Purchasing Schedule* indicative sound power level performance shall be tested at the *Manufacturer's* premises when under full operating conditions. Testing shall (within the practical limitations of the test-bay environment), comply with the procedures contained in AS 1055, AS 1081, and AS/NZS 1269. *Pump* noise values shall comply with the value guaranteed in the *Technical Response Schedule*, when tested at the *Manufacturer's* premises under full operating conditions.

NOTES:

1. This optional test has been included in order to accommodate ground level booster pump stations. Noise testing should only be specified for booster applications which are installed in noise sensitive areas.
2. The noise emitted by the installed *Pumpset* should comply with the Environmental Protection (Noise) Regulations (1997).

4.6.7.4 Endurance Testing

Where specified in the *Purchasing Schedule* (refer note), each *Pumpset* shall be run for a minimum period of 4 hours at the *Guarantee Duty Point* measuring vibration and motor winding temperatures every 20 minutes.

NOTE: Endurance testing should only be specified for *Pumpsets* with an input power $\geq 100\text{kW}$ and where an additional level of reliability confidence is required.

4.6.8 Performance Test Report

For the purposes of acceptance the *Manufacturer* shall provide a Performance Test Report comprising:

- A Performance Test Report in accordance with ISO 9906 Annex F, including test curves. The curves shall be in metric units with flow in L/s, head in m and power in kW.
- NPSH3, Vibration, Noise and Endurance Test Reports (where applicable)

The Pump Test Report shall certify that *Product* has complied with the specified test requirements. Copies of all Test Reports shall be supplied to the *Officer* for acceptance.

4.6.9 Acceptance

Product shall not be dispatched from the *Manufacturer's* works until acceptance by the *Officer* or the appointed testing and inspecting authority of:

- the *Manufacturer's* completed ITP and;
- the Performance Test Report ,

Acceptance will be conditional on *Product* complying with the test requirements and guaranteed performance.

Copies, in both electronic and printed form, of each approved Performance Test Report and ITP shall be provided to the *Officer*.

4.6.10 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 *Pumpset* or *String* to meet the guaranteed efficiency stated by the *Supplier* in the *Technical Response Schedule* to the tolerance required by 4.6.5 and as further detailed below.

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* or *String* 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* or *String* that falls below the guarantee. i.e. the loss shall not be reduced by other supplied *Pumpsets* or *Strings* exceeding guaranteed efficiency.

NOTE: Industry consultation indicates that total 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.

5 Marking and Packaging

5.1 Nameplate Marking

Each *Pumpset* 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 *Pumpset* using corrosion resistant fasteners:

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

Where a hydrostatic test has been conducted the *Hydrostatic Test Pressure* shall be stamped on the stage casings, outlet housing and NRV. The direction of rotation of the *Pump* shall be clearly indicated by an arrow cast on the stage casings. Cast lettering shall be as large as practicable.

Where provided the motor shroud shall be identifiable by being permanently marked with the appropriate *Pump* serial number.

An additional nameplate shall be provided for mounting in the switchboard.

5.2 Packaging

5.2.1 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 *Pumpset* shall be rigidly supported over its length to resist forces and moments that may result during transport. The discharge port shall be fitted with a durable cover to prevent entry of foreign matter into the *Pump*.

5.2.2 Identification Tag

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 corrosion resistant metal wire with the following information:

- (a) Contract number;
- (b) Purchase order number.

5.2.3 Marking of Packaging

The *Product* shall be identified by marking on the outside of any protective packaging the same information as shown on the identification tag.

5.2.4 Warning Label

The *Manufacturer* shall attach a label warning the user to comply with the requirements of the installation, operation and maintenance manual prior to use of the *Pumpset* otherwise damage could occur.

NOTE: For example, Warning - Damage to motor if the *Pumpset* is operated whilst not immersed in water or with the correct flow past the motor, or if the motor is not filled with fluid etc.

6 Manuals

6.1 Format and Language

Product shall be supplied complete with appropriate installation, operation and maintenance instructions or manuals, in clear diagrammatic and text format, in English. Manuals shall be available in hard and electronic form and shall be supplied as specified in the *Purchasing Schedule*.

6.2 Structure

The structure and format of the manuals shall be at the discretion of the *Supplier*. For guidance the following identifies the *Corporation's* recommended structure and section headings:

1. Introduction and Guide
2. Health and Safety
3. General Description
4. Operating Procedures
5. Maintenance Procedures
6. Equipment and *Supplier's* Schedules
7. *Manufacturer's* Literature
8. Commissioning data
9. Drawings

6.3 Content

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

- Details of *Product* features
- Operational adjustments
- Installation and commissioning instructions
- Preventative maintenance requirements and intervals
- Testing procedures
- Trouble shooting guidelines
- Complete list of parts and associated exploded views or sectional diagrams and reference part numbers

7 Spare Parts, Special Tools and Servicing

7.1 Spare Parts

7.1.1 General

All spare parts shall be interchangeable for *Manufacturer's Product* of the same size and model. Spare parts and servicing facilities for *Product* shall be readily available in Western Australia.

Replacement spare parts identical to the equipment supplied in accordance with this *Specification*, shall be held preferably in Perth Western Australia, or if not at least within Australia. The turn-around time for supply of replacement spare parts shall not exceed 2 days from the placement of order or service request by the *Corporation*.

7.1.2 Spare Parts

Spare parts are generally only required for large borehole pumpsets. Where spare parts are requested as part of the *Purchasing Schedule*, the following items shall be provided:

- A full set of impellers and locking collars or key(s);
- A set of stage casing bearings.
- A pump shaft.

NOTES:

1. 'Set' shall mean the number of items required for the particular pump.
2. Wear rings are not required as they are manufactured in-house.

7.1.3 Spare Parts List

Where specified in the *Purchasing Schedule* a comprehensive priced list of consumable spares shall be provided e.g. wear rings etc for:

- Motor;
- Pump;
- Seal Unit (*Oilfield ESPs* only);
- Variable speed drive.

In the event that local servicing of pump components and ancillaries is required, it is the prerogative of the *Officer* to inspect a component or components once dismantled, to assess the service option recommended by the *Supplier*.

7.2 Special Tools

All special tools required for service and maintenance of *Product* shall be supplied.

7.3 Servicing

7.3.1 General

Service exchange units, identical to the equipment supplied in accordance with this *Specification*, shall be held preferably in Perth Western Australia, or if not at least within Australia. The turn-around time for supply of service units shall not exceed 2 days from the placement of order or service request by the *Corporation*.

7.3.2 Service Exchange Unit Prices

Where required in the *Purchasing Schedule*, the *Supplier* shall provide prices, lead times and locations for the following service exchange units:

-
- (a) Complete *Pumpset* comprising motor, seal unit (*Oilfield ESPs* only), pump and drop cable.
 - (b) Individual components:
 - (i) Motor;
 - (ii) Pump;
 - (iii) Seal unit (*Oilfield ESPs* only);
 - (iv) Step up transformer;
 - (v) Phase shifting transformer;
 - (vi) Drop cable.

8 Transportation, Handling and Storage

8.1 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 eg 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.

8.2 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 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.

8.3 Shock Sensor

Where specified in the *Purchasing Schedule*, shock sensors or impact indicators shall be mounted on the outside of *Product* packaging. *Product* shall not be accepted by the *Corporation* where the sensor indicates improper handling during transportation. Such *Product* shall be returned to the *Manufacturer* and shall undergo a thorough inspection before being resent.

NOTE: Shock sensors deter mishandling and reduce damage related costs by indicating when mishandling has occurred. Generally only requested for large, expensive *Pumpsets* (input power $\geq 100\text{kW}$).

9 Quality Assurance

9.1 Certification

9.1.1 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.

9.1.2 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.

9.1.3 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:

- (c) Substantive change in *Product* design, material formulation or performance
- (d) *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*

9.2 Compliance and Acceptance

9.2.1 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* authorised 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*.

9.2.2 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:

- (a) nominate applicable *Product Warranty* terms ; and
- (b) provide documentary verification in the form of a current valid *Certificate* or *Product Verification Report* as appropriate to the *Product*; and
- (c) 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.

9.3 Non-compliant Product

9.3.1 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* of the *Specification*.

9.3.2 Manufacturing Repairs (In-process)

Welding, the use of fillers and other repairs shall generally not be permissible on *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*.

The *Manufacturer* shall make provision in its production *Quality System* and in the appropriate ITP's 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:

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

9.3.3 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.

9.3.4 Product Repair

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*.

10 Appendix A: Project Specific Requirements – Purchasing Schedule (Normative)

10.1 General

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

10.2 Specific Requirements

Table 10.1 details project specific requirements for the *Pumpset(s)* to be procured. This table shall be completed by the designer, design manager or purchasing *Officer*, as should the relevant electric motor Annexure to Specification contained in DS 26-15 or DS 26-20 as applicable (refer 3.6.1 and 11.3).

TABLE 10.1 - PROJECT SPECIFIC REQUIREMENTS

Submersible Electric Borehole Pumps

APPLICABLE TO: <input type="checkbox"/> PROPOSAL <input type="checkbox"/> PURCHASE <input type="checkbox"/> AS BUILT																			
FOR :	JOB NO. / ENQUIRY NO. _____																		
NO. OF PUMPSETS :	PURCH. ORDER NO. _____																		
MATERIALS AND COMPONENTS (2)																			
<ul style="list-style-type: none"> • LIQUID TYPE <input type="checkbox"/> BORE / RAW <input type="checkbox"/> DRINKING <input type="checkbox"/> EFFLUENT <input type="checkbox"/> SEAWATER 																			
<ul style="list-style-type: none"> • CLASSIFICATION OF WATER (2.1) <input type="checkbox"/> STANDARD <input type="checkbox"/> CORROSIVE <input type="checkbox"/> HIGHLY CORROSIVE 																			
<ul style="list-style-type: none"> • WATER QUALITY DETAILS (2.1) <input type="checkbox"/> PREDICTED VALUES <input type="checkbox"/> TEST VALUES 																			
MAX WATER TEMP. _____	°C																		
pH _____																			
ALKALINITY (as CaCO ₃) _____	mg/L																		
BICARBONATE _____	mg/L																		
CALCIUM _____	mg/L																		
CARBONATE _____	mg/L																		
CHLORIDE _____	mg/L																		
FREE CHLORINE _____	mg/L																		
IRON _____	mg/L																		
MAGNESIUM _____	mg/L																		
NITROGEN _____	mg/L																		
POTASSIUM _____	mg/L																		
SILICA _____	mg/L																		
SODIUM _____	mg/L																		
SULPHATE _____	mg/L																		
TOTAL SOLUBLE SALTS _____	mg/L																		
DESIGN AND MANUFACTURE (3)																			
<ul style="list-style-type: none"> • SERVICE <input type="checkbox"/> CONTINUOUS <input type="checkbox"/> INTERMITTENT <input type="checkbox"/> FIXED SPEED <input type="checkbox"/> VARIABLE SPEED 																			
<ul style="list-style-type: none"> • PUMP STATION (3.1) <input type="checkbox"/> BOREHOLE <input type="checkbox"/> BOOSTER ORIENTATION, IF BOOSTER APP. <input type="checkbox"/> HORIZONTAL <input type="checkbox"/> VERTICAL 																			
<ul style="list-style-type: none"> • SPECIAL PARAMETERS OR CONDITIONS (3.2.2) IF ANY DEVIATIONS FROM (3.2.1) LIST HERE: _____ _____ _____ 																			
<ul style="list-style-type: none"> • BORE DETAILS (3.2.3) 																			
INSIDE DIAM. _____	mm																		
SCREEN LOC. - BTOC _____	m																		
WRL - BTOC _____	m																		
WPL - BTOC _____	m																		
DRAWDOWN _____	m																		
PUMP INLET SET. BTOC (IF KNOWN) _____	m																		
FLOW DIRECTION TO PUMPSET <input type="checkbox"/> FROM ABOVE																			
<input type="checkbox"/> FROM BELOW																			
BORE LOG ATTACHED <input type="checkbox"/> YES <input type="checkbox"/> NO																			
DESIGN AND MANUFACTURE CONT. (3)																			
<ul style="list-style-type: none"> • DESIGN DUTY POINTS (3.3) PRIMARY DUTY <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>PRIMARY DUTY</th> <th>UNITS</th> </tr> </thead> <tbody> <tr> <td>FLOW</td> <td></td> <td>L/s</td> </tr> <tr> <td>HEAD</td> <td></td> <td>m</td> </tr> <tr> <td>NPSHA (IF KNOWN)</td> <td></td> <td>m</td> </tr> </tbody> </table>			PRIMARY DUTY	UNITS	FLOW		L/s	HEAD		m	NPSHA (IF KNOWN)		m						
	PRIMARY DUTY	UNITS																	
FLOW		L/s																	
HEAD		m																	
NPSHA (IF KNOWN)		m																	
SECONDARY DUTIES, IF APPLICABLE																			
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">SECONDARY</th> <th rowspan="2">UNITS</th> </tr> <tr> <th>DUTY 1</th> <th>DUTY 2</th> </tr> </thead> <tbody> <tr> <td>FLOW</td> <td></td> <td></td> <td>L/s</td> </tr> <tr> <td>HEAD</td> <td></td> <td></td> <td>m</td> </tr> <tr> <td>NPSHA (IF KNOWN)</td> <td></td> <td></td> <td>m</td> </tr> </tbody> </table>			SECONDARY		UNITS	DUTY 1	DUTY 2	FLOW			L/s	HEAD			m	NPSHA (IF KNOWN)			m
	SECONDARY		UNITS																
	DUTY 1	DUTY 2																	
FLOW			L/s																
HEAD			m																
NPSHA (IF KNOWN)			m																
SYSTEM CURVES ATTACHED <input type="checkbox"/> YES <input type="checkbox"/> NO																			
<ul style="list-style-type: none"> • PUMP DESIGN (3.4) OUTLET HOUSING (3.4.4) <input type="checkbox"/> SCREWED TO STANDARD: _____ <input type="checkbox"/> FLANGED TO STANDARD: _____ 																			
<ul style="list-style-type: none"> • ELECTRIC MOTOR (3.6) MOTOR TYPE (3.6.1) <input type="checkbox"/> HV <input type="checkbox"/> LV SHROUD REQUIRED (3.6.2) <input type="checkbox"/> YES <input type="checkbox"/> NO 																			
TESTING (4)																			
<ul style="list-style-type: none"> • GENERAL NOTIFICATION REQUIRED. (4.2) _____ DAYS 																			
<ul style="list-style-type: none"> • QUALITY VERIFICATION (4.5) <input type="checkbox"/> ITP WATER CORP REVIEW REQ. (4.5.1.2) 																			
<ul style="list-style-type: none"> • PERFORMANCE ACCEPTANCE TESTS (4.6) <input type="checkbox"/> PERF. WITNESS TESTING REQ. (4.6.1) <input type="checkbox"/> STRING TESTING - REQ. (4.6.3) 																			
<ul style="list-style-type: none"> • ADDITIONAL TESTS REQUIRED (4.6.7) <input type="checkbox"/> NPSH3 (4.6.7.1) <input type="checkbox"/> VIBRATION (4.6.7.2) <input type="checkbox"/> NOISE (4.6.7.3) <input type="checkbox"/> ENDURANCE (4.6.7.4) 																			
MANUALS (6)																			
<ul style="list-style-type: none"> • IOM MANUAL FORMAT (6.1) <input type="checkbox"/> HARDCOPIES REQUIRED NUMBER OF HARDCOPIES REQ.: _____ <input type="checkbox"/> ELECTRONIC COPY REQUIRED 																			
SPARE PARTS, SPECIAL TOOLS AND SERVICING (7)																			
<ul style="list-style-type: none"> • SPARE PARTS (7.1) <input type="checkbox"/> SPARE PARTS REQ. (7.1.2) <input type="checkbox"/> SPARE PARTS LIST REQ. - PRICED (7.1.3) 																			
<ul style="list-style-type: none"> • SERVICING(7.3) <input type="checkbox"/> SERVICE EXCHANGE UNIT PRICES REQ. (7.3.2) 																			
TRANSPORTATION, HANDLING AND STORAGE (8)																			
<ul style="list-style-type: none"> • SHOCK SENSOR (8.3) <input type="checkbox"/> SHOCK SENSOR REQUIRED (8.3) 																			

11 Appendix B: Technical Schedules (Normative)

11.1 Compliance Schedule

Suppliers shall demonstrate *Product* compliance with the *Specification* by completing *Technical Compliance Schedule* as shown in **TABLE 11.1** 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 11.1 – TECHNICAL COMPLIANCE SCHEDULE						
Submersible Electric Borehole Pumps						
Section/Clause		Noted	Compliance			Comments
			Yes	No	N/A	
1. SCOPE AND GENERAL						
1.1	SCOPE					
1.2	REFERENCED DOCUMENTS					
1.3	NOTATION					
1.4	DEFINITIONS					
1.5	ABBREVIATIONS					
1.6	DESIGNATION OF SIZE					
2. MATERIALS AND COMPONENTS						
2.1	GENERAL					
2.2	CONTAMINATION OF DRINKING WATER					
2.3	MATERIALS OF CONSTRUCTION					
2.4	HIGHLY CORROSIVE WATERS					
2.5	MATERIAL CERTIFICATION					
2.6	STAINLESS STEEL					
2.6.1	WELDING, HEAT TREATMENT AND PASSIVATION					
2.6.2	GRAPHITE COMPOUNDS AND COATINGS					
2.6.3	GALLING					
2.7	DEZINCIFICATION-RESISTANT MATERIALS					
2.8	NON METALLIC MATERIALS					
2.9	ELASTOMERIC MATERIALS					
3. DESIGN AND MANUFACTURE						
3.1	GENERAL					
3.2	OPERATING CONDITIONS					
3.2.1	STANDARD PARAMETERS					
3.2.2	SPECIAL PARAMETERS					
3.2.3	PUMP CLEARANCE IN BORE					
3.3	PERFORMANCE					
3.3.1	PUMP SELECTION					
3.3.2	NPSH					
3.3.3	GUARANTEE POINTS					
3.3.3	PERFORMANCE CURVES					
3.3.4	DRIVER SELECTION					
3.4	PUMP DESIGN					
3.4.1	MAXIMUM ALLOWABLE WORKING PRESSURE AND HYDROSTATIC TEST PRESSURE					
3.4.2	STAGE CASINGS					
3.4.3	INLET HOUSING					
3.4.4	OUTLET HOUSING					
3.4.5	IMPELLERS					
3.4.6	PUMP SHAFT					
3.4.7	ROTATING ELEMENT DYNAMICS					
3.4.8	WEAR RINGS					
3.4.9	SHAFT JOURNAL BEARINGS					
3.4.10	STAGE CASING BEARINGS					
3.4.11	SAND COLLAR					
3.4.12	FASTENERS					
3.4.13	UPTHRUST					
3.4.14	NON RETURN VALVE					
3.5	MANUFACTURE					
3.5.1	CASTINGS					
3.5.2	MACHINED COMPONENTS					
3.5.3	FABRICATED COMPONENTS					
3.5.4	BALANCE OF IMPELLERS					
3.5.5	VIBRATION					
3.6	ELECTRIC MOTOR					

3.6.1	GENERAL					
3.6.2	MOTOR SHROUD					
4. INSPECTION AND TESTING						
4.1	GENERAL					
4.2	NOTIFICATION OF TESTING					
4.3	ACCESS TO PLACE OF MANUFACTURE					
4.4	PLACE OF MANUFACTURE OTHER THAN WA					
4.5	QUALITY VERIFICATION					
4.5.1	INSPECTION AND TESTING					
4.5.1.1	GENERAL					
4.5.1.2	INSPECTION AND TEST PLANS (ITPS)					
4.5.2	HYDROSTATIC TESTS					
4.6	PERFORMANCE ACCEPTANCE TESTS					
4.6.1	GENERAL					
4.6.2	TEST SET-UP					
4.6.3	STRING TESTING – VVVF TESTING					
4.6.4	GUARANTEE POINTS					
4.6.5	TOLERANCES					
4.6.6	SCOPE OF TESTS					
4.6.7	ADDITIONAL TESTING					
4.6.7.1	NPSH3 TESTING					
4.6.7.2	VIBRATION TESTING					
4.6.7.3	NOISE TESTING (BOOSTER APP. ONLY)					
4.6.7.4	ENDURANCE TESTING					
4.6.8	PERFORMANCE TEST REPORT					
4.6.9	ACCEPTANCE					
4.6.10	FAILURE TO MEET EFFICIENCY GUARANTEE					
5. MARKINGS AND PACKAGING						
5.1.	NAMEPLATE MARKING					
5.2	PACKAGING					
5.2.1	GENERAL					
5.2.2	IDENTIFICATION TAG					
5.2.3	MARKING OF PACKAGING					
5.2.4	WARNING LABEL					
6. MANUALS						
6.1	FORMAT AND LANGUAGE					
6.2	STRUCTURE					
6.3	CONTENT					
7. SPARE PARTS, SPECIAL TOOLS AND SERVICING						
7.1	SPARE PARTS					
7.1.1	GENERAL					
7.1.2	SPARE PARTS					
7.1.3	SPARE PARTS LIST					
7.2	SPECIAL TOOLS					
7.3	SERVICING					
7.3.1	GENERAL					
7.3.2	SERVICE EXCHANGE UNIT PRICES					
8. TRANSPORTATION, HANDLING AND STORAGE						
8.1	GENERAL					
8.2	PRESERVATION OF PRODUCT IN STORAGE					
8.3	SHOCK SENSOR					
9. QUALITY ASSURANCE						
9.1	CERTIFICATION					
9.1.1	CERTIFICATION OF PRODUCT					
9.1.2	QUALITY SYSTEM					
9.1.3	PRODUCT RE-VERIFICATION					
9.2	COMPLIANCE AND ACCEPTANCE					
9.2.1	MEANS OF DEMONSTRATING COMPLIANCE					
9.2.2	ACCEPTANCE CRITERIA					
9.3	NON-COMPLIANT PRODUCT					
9.3.1	GENERAL					
9.3.2	MANUFACTURING REPAIRS (IN-PROCESS)					
9.3.3	PRODUCT WARRANTY					

9.3.4	PRODUCT REPAIR					
10. APPENDIX A: PROJECT SPECIFIC REQUIREMENTS (NORMATIVE)						
10.1	GENERAL					
10.2	SPECIFIC REQUIREMENTS					
11. APPENDIX B: TECHNICAL SCHEDULES (NORMATIVE)						
11.1	COMPLIANCE SCHEDULES					
11.1	RESPONSE SCHEDULES					
11.1	ELECTRIC MOTOR TECHNICAL RESPONSE SCHEUDLE					
12. APPENDIX C: ITP (INFORMATIVE)						

Name of Supplier:

Signature:

Date:

11.2 Pumpset Technical Response Schedule

When requested by the *Corporation*, the *Supplier* shall provide the information required by *Technical Response Schedule* as shown in **TABLE 11.2**.

TABLE 11.2 - PUMPSET TECHNICAL RESPONSE SCHEDULE

Submersible Electric Borehole Pumps (Page 1 of 2)

PROJECT REFERENCE NAME:		PROJECT REFERENCE NO.:																																											
PROJECT LOCATION:		QUOTATION REFERENCE NO.:																																											
CONTACT DETAILS		SUPPLIER	MANUFACTURER																																										
FULL NAME																																													
POSTAL ADDRESS																																													
EMAIL ADDRESS																																													
FACSIMILE NUMBER																																													
PHONE NUMBER																																													
MOBILE NUMBER																																													
PUMPSET DETAILS																																													
PUMP MAKE & MODEL		MOTOR MAKE & MODEL																																											
MANUFACTURING LOCATIONS:																																													
ACCESSORIES INCLUDED/FITTED																																													
<input type="checkbox"/> SHROUD <input type="checkbox"/> SPARE PARTS <input type="checkbox"/> SPECIAL TOOLS <input type="checkbox"/> VSD <input type="checkbox"/> SEAL SECTION (OILFIELD ESPs ONLY)																																													
<input type="checkbox"/> DATA COLLECTION TOOL <input type="checkbox"/> OTHER, PLEASE SPECIFY: _____																																													
MATERIALS AND COMPONENTS (2)		DESIGN AND MANUFACTURE (3)																																											
<ul style="list-style-type: none"> ● DRINKING WATER MATERIAL COMPLIANCE (2.2) MAT. SUITABLE FOR USE WITH DRINKING WATER <input type="checkbox"/> YES, STANDARD: _____ <input type="checkbox"/> NO 		<ul style="list-style-type: none"> ● DIMENSIONS OF DOWNHOLE COMPONENTS (3.2.3) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">LENGTH (m)</th> <th style="text-align: center;">DIA. (mm)</th> <th style="text-align: center;">MASS (kg)</th> </tr> </thead> <tbody> <tr><td>PUMP</td><td></td><td></td><td></td></tr> <tr><td>MOTOR</td><td></td><td></td><td></td></tr> <tr><td>SEAL SEC</td><td></td><td></td><td></td></tr> <tr><td>DATA COL.</td><td></td><td></td><td></td></tr> <tr><td>SHROUD</td><td></td><td></td><td></td></tr> <tr><td>OVERALL</td><td></td><td></td><td></td></tr> </tbody> </table>			LENGTH (m)	DIA. (mm)	MASS (kg)	PUMP				MOTOR				SEAL SEC				DATA COL.				SHROUD				OVERALL																	
	LENGTH (m)	DIA. (mm)	MASS (kg)																																										
PUMP																																													
MOTOR																																													
SEAL SEC																																													
DATA COL.																																													
SHROUD																																													
OVERALL																																													
<ul style="list-style-type: none"> ● MATERIALS OF CONSTRUCTION (2.3) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">COMPONENTS</th> <th style="text-align: left;">MATERIAL / STANDARD / GRADE</th> </tr> </thead> <tbody> <tr><td>STAGE CASINGS</td><td></td></tr> <tr><td>INLET HOUSING</td><td></td></tr> <tr><td>OUTLET HOUSING</td><td></td></tr> <tr><td>IMPELLERS</td><td></td></tr> <tr><td>SHAFT</td><td></td></tr> <tr><td>IMPELL. COLLET / KEY</td><td></td></tr> <tr><td>WEAR RINGS, IMPELL.</td><td></td></tr> <tr><td>WEAR RINGS, CASING</td><td></td></tr> <tr><td>BEARINGS, SHAFT</td><td></td></tr> <tr><td>BEARINGS, CASINGS</td><td></td></tr> <tr><td>SAND COLLAR</td><td></td></tr> <tr><td>STRAINER</td><td></td></tr> <tr><td>FASTENERS</td><td></td></tr> <tr><td>NRV HOUSING</td><td></td></tr> <tr><td>NRV STEM</td><td></td></tr> <tr><td>NRV DISC</td><td></td></tr> <tr><td>NRV SEAL RING</td><td></td></tr> <tr><td>MOTOR COUPLING</td><td></td></tr> <tr><td>SHROUD ADAPTOR</td><td></td></tr> <tr><td>SHROUD CYLINDER</td><td></td></tr> </tbody> </table>		COMPONENTS	MATERIAL / STANDARD / GRADE	STAGE CASINGS		INLET HOUSING		OUTLET HOUSING		IMPELLERS		SHAFT		IMPELL. COLLET / KEY		WEAR RINGS, IMPELL.		WEAR RINGS, CASING		BEARINGS, SHAFT		BEARINGS, CASINGS		SAND COLLAR		STRAINER		FASTENERS		NRV HOUSING		NRV STEM		NRV DISC		NRV SEAL RING		MOTOR COUPLING		SHROUD ADAPTOR		SHROUD CYLINDER		<ul style="list-style-type: none"> ● DRAWINGS ATTACHED <input type="checkbox"/> GENERAL ARRANGEMENT DRAWINGS <input type="checkbox"/> CROSS SECTION DRAWINGS ● INLET HOUSING (3.4.3) PUMP/MOTOR FLANGE STANDARD: _____ ● OUTLET HOUSING (3.4.4) <input type="checkbox"/> SCREWED TO STANDARD: _____ <input type="checkbox"/> FLANGED TO STANDARD: _____ ● IMPELLERS (3.4.5) <input type="checkbox"/> KEY FITTED <input type="checkbox"/> COLLET FITTED NO OF STAGES _____ IMPELLER DIAMETERS, DUTY _____ mm IMPELLER DIAMETERS, MAX. _____ mm ● PUMP SHAFT (3.4.6) PUMP SHAFT COUPLING <input type="checkbox"/> KEYED <input type="checkbox"/> SPLINED ● FASTENERS (3.4.12) FASTENER STANDARD USED: _____ ● MOTOR DETAILS (3.6) RATED POWER _____ kW VOLTAGE _____ V COOLING FLOW REQ (MIN/MAX) _____ m/s COOLING FLOW ACTUAL _____ m/s MOTOR SHROUD REQUIRED <input type="checkbox"/> YES <input type="checkbox"/> NO 	
COMPONENTS	MATERIAL / STANDARD / GRADE																																												
STAGE CASINGS																																													
INLET HOUSING																																													
OUTLET HOUSING																																													
IMPELLERS																																													
SHAFT																																													
IMPELL. COLLET / KEY																																													
WEAR RINGS, IMPELL.																																													
WEAR RINGS, CASING																																													
BEARINGS, SHAFT																																													
BEARINGS, CASINGS																																													
SAND COLLAR																																													
STRAINER																																													
FASTENERS																																													
NRV HOUSING																																													
NRV STEM																																													
NRV DISC																																													
NRV SEAL RING																																													
MOTOR COUPLING																																													
SHROUD ADAPTOR																																													
SHROUD CYLINDER																																													
ALT. MAT. EQUIV. OR SUPERIOR TO SPECIFICATION. <input type="checkbox"/> YES <input type="checkbox"/> NO																																													
<ul style="list-style-type: none"> ● MATERIAL CERTIFICATES (2.4) EN10204 MATERIAL CERTIFICATES PROVIDED: <input type="checkbox"/> TYPE 2.2 – (BATCH) <input type="checkbox"/> TYPE 3.1 – (SPECIFIC ITEM) 																																													

TABLE 11.2 - PUMPSET TECHNICAL RESPONSE SCHEDULE
 Submersible Electric Borehole Pumps (Page 2 Of 2)

DESIGN AND MANUFACTURE CONT. (3)		INSPECTION AND TESTING (4)		
<ul style="list-style-type: none"> ● PERFORMANCE DATA (3.3) RATED SPEED _____ RPM MAX. ALLOWABLE SPEED _____ RPM MIN. ALLOWABLE SPEED _____ RPM BEP - FLOW _____ L/s AOR _____ L/s POR _____ L/s SHUT OFF HEAD _____ m MAXIMUM POWER PUMP _____ kW MAX. PUMP DOWNTHRUST _____ N MOMENT OF INERTIA OF ROTATING ELEMENT INCL. COUPLING AND WATER _____ kg/m² 		<ul style="list-style-type: none"> ● ITPS (4.5.1) <input type="checkbox"/> SAMPLE ITP ATTACHED 		
<ul style="list-style-type: none"> ● ATTACHMENTS PERFORMANCE CURVES (3.3.4) <input type="checkbox"/> HEAD, FLOW, EFFIC, POWER CURVES <input type="checkbox"/> NPSH3, NPSHR, NPSHA CURVES <input type="checkbox"/> VARIABLE SPEED CURVES (IF APPLICABLE) <input type="checkbox"/> TECHNICAL DATA 		<ul style="list-style-type: none"> ● PRESSURE RATINGS (4.5.2) MOP _____ bar MAWP _____ bar <input type="checkbox"/> HYDROSTATIC TEST INCLUDED HYDROSTATIC TEST PRESSURE _____ bar 		
		<ul style="list-style-type: none"> ● PERFORMANCE ACCEPTANCE TEST (4.6) <input type="checkbox"/> PUMPSET TEST <input type="checkbox"/> STRING TEST – PUMPSET AND VVVF DRIVE (4.6.3) 		
		<ul style="list-style-type: none"> ● ADDITIONAL TESTS INCLUDED (4.6.7) <input type="checkbox"/> NPSH3 TEST (4.6.7.1) <input type="checkbox"/> VIBRATION TEST (4.6.7.2) <input type="checkbox"/> NOISE LEVEL TEST (4.6.7.3) <input type="checkbox"/> ENDURANCE TEST (4.6.7.4) <input type="checkbox"/> OTHER, PLEASE SPECIFY _____ 		
PERFORMANCE DATA – GUARANTEE DUTY POINTS (4.6.4)				
		PRIMARY DUTY	SECONDARY	
			DUTY 1	DUTY 2
TEST STANDARD AND ACCEPTANCE GRADE:				
SPEED	RPM			
FLOW, Q_G	L/s			
HEAD, H_G	m			
% OF BEP	%			
PUMP POWER	kW			
PUMP EFFICIENCY	%			
PUMPSET POWER, P_{grG}	kW			
PUMPSET EFFICIENCY, η_{grG}	%			
NPSH3, $NPSH3_G$	m			
NPSH MARGIN	m			
NPSHR	m			
WHERE STRING TEST APPL.				
STRING TEST POWER, P_{strG}	kW			
STRING TEST EFFICIENCY, η_{strG}	%			
WHERE ADDITIONAL TESTS APPL.				
PUMPSET VIBRATION LIMIT, V_G	mm/s (rms)			
PUMPSET NOISE LIMIT, dB_G	dB(A)			
SPARE PARTS, SPECIAL TOOLS AND SERVICING (7)		QUALITY ASSURANCE (9)		
<ul style="list-style-type: none"> ● SPARES (7.1.1) SPARES HOLDING LOCATION _____ SPARES AVAILABILITY _____ DAYS 		<ul style="list-style-type: none"> ● AS/NZS ISO 9001 CERTIFICATION (9.1.2) THIRD PARTY CERTIFICATION <input type="checkbox"/> SUPPLIER; DETAILS _____ <input type="checkbox"/> MANUFACTURER; DETAILS _____ CERTIFICATES ATTACHED <input type="checkbox"/> YES <input type="checkbox"/> NO 		
<ul style="list-style-type: none"> ● SERVICING (7.3.1) SERVICING FACILITIES IN PERTH <input type="checkbox"/> YES <input type="checkbox"/> NO DETAILS ATTACHED <input type="checkbox"/> YES <input type="checkbox"/> NO 				

Name of Supplier: _____

Signature: _____

Date: _____

11.3 Electric Motor Technical Response Schedule

Suppliers shall additionally complete the Tender Technical Response Schedule contained in Electrical Type Specifications DS 26-15 or DS 26-20 as applicable.

12 Appendix C: Inspection and Test Plan (Informative)

Issued by		Signature		Date	
WC Approved by		Signature		Date	

Equipment Serial Number:

Purchase Order No.:

Rev No.:

Key: H=Hold Point M=Monitor A=Approve/Accept W=Witness R=Review

Reference	Applicable Specifications and Procedures	Quality Assurance Activity	Hold Points		Acceptance Criteria	Verifying Document
			Supplier	W.C.		
1. Preliminaries						
1.1	SPS507	Check material corrosion resistance	H	M	2.1, 2.2	
1.2	SPS507	Check material compliance	H	M	2.4 to 2.9	
1.3	SPS507	Check drawings	H	M	3.1	
1.4	SPS507	Check minimum flow passed motor	H	M	3.6.2	
1.5	PO ##	Check purchase order requirements	H	M		
2. Design/Documentation						
2.1	SPS507	Drawings review and approval, check critical dimensions	H	A	3.5.2	
3. Procurement						
3.1		Check component availability and order required components	H	M		
4. Manufacture						
4.1	SPS507	Material Checks – Component A	H	M	3.5.1	
4.2	SPS507	Material Checks – Component B				
..		etc				
4.3	SPS507	Pump Component Dimension Conformance Inspection	H	M	3.5.1	
4.4	SPS507	Pump Assembly				

5. Testing						
5.1	SPS507	Hydrostatic test	H	R	4.5.4	
5.2	SPS507	Performance test	H	W	4.5.5	
5.3	SPS507	Additional tests	H	W	4.5.6	
6. Marking						
6.1	SPS507	Check marking	H	M	5.1	
7. Final Documentation and Acceptance						
7.1		Produce Manufacturer's Data Book or Report	H	A		
8. Packing and Transportation						
8.1	SPS507	Check Packaging and Shipping Requirements	H	M	5.2.1	

END OF DOCUMENT