



# **Sydney Water Supplement to Industry Standard for Submersible Pumps for Sewage Pumping Stations WSA 101 - 2008**

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## Revision details

Version No.	Clause	Description of revision	
3	All	Whole document reformatted.	
	1.3.2	Optional ancillary equipment clarified and expanded.	
	3.9.13	New clause added for pump head and cable entry.	
	4.4	Whole clause re-written.	
	5.2.2	New clause added for hydrostatic test.	
	Appendix A	Deleted reference to SW document ACP0166.	
	Table SW2	'MAS 711' replaced with 'MAS 801'. Added Note 2.	
	2	Whole document	Reformatted.
Cl. 1.3.1(b)		Added reference to SW2.	
Cl. 1.3.1, Note		Added requirement for adaptors.	
Cl. 1.3.2(b)		Added reference to SW2.	
Cl. 1.3.2		Added lifting chain and cable stocking (items c and d) to ancillary equipment.	
Cl. 1.5.1		Deleted '(SWC)' and note.	
Cl. 1.5.7		Deleted 'electric' in heading.	
Cl. 2.1		Minor amendments to last paragraph.	
Cl. 2.4		Amended lead in and added last sentence.	
Cl. 3.3		Added tapped holes for pump mounting on support stand in 1st paragraph and corrected spelling in last paragraph.	
Cl. 3.7.3		New clause.	
Cl. 3.7.6		New clause.	
Cl. 3.7.6		Deleted.	
Cl. 3.9.1		Amended reference to Figure C to SW1.	
Cl. 3.9.2		New clause.	
Cl. 3.9.3		New clause.	
Cl. 3.9.7		Amended 2nd sentence.	
Cl. 3.9.8		Changed material, added coating and the requirement for inspection port on smaller suction bends.	
Cl. 3.9.11		Minor amendment.	
Cl. 3.9.12		New clause.	
Cl. 4.4		New clause.	
Appendix A		Complete revision.	
Figure SW1		added units for degrees,	
Table SW2		New table.	
1		N/A	First issue

## Introduction

This Supplement must be read in conjunction with Water Services Association of Australia's (WSAA) Industry Standard for Submersible Pumps for Sewage Pumping Stations WSA 101 – 2008.

Clause numbers in this Supplement correspond to the clause numbers in WSA 101 – 2008.

WSA 101 – 2008 clauses that are not referred to in this Supplement must remain unchanged.

Pumping units must meet all the requirements of WSA 101-2008 except where noted otherwise in this Supplement.

Informative text, where provided is in red and italicised.

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# 1 Scope and General

## 1.2 Scope

*Replace 1<sup>st</sup> paragraph with the following:*

This Standard is for the design, manufacture, inspection, testing, packaging, transportation and delivery of electrically driven wet and dry mounted submersible type centrifugal pumps and ancillary equipment for use in sewage pumping stations and other wastewater applications.

## 1.3 Scope of Supply

*Replace the whole clause with the following:*

### 1.3.1 Wet mounted submersible pumps

The supply of a pumping units must include:

- a) the pumping unit, including all integral equipment required for the operation of the pump in the intended service, including drive motor and instruments
- b) power and instrumentation cables and sensors as per Table SW2.

The following optional ancillary equipment that must also be supplied if specified:

- a) pump pedestal and discharge connection<sup>1)</sup>
- b) grade 316 stainless steel guide rails
- c) grade 316 stainless steel top guide rail bracket
- d) grade 316 stainless steel intermediate guide rails bracket(s)
- e) grade 316 stainless steel lifting chain
- f) grade 316 stainless steel cable stocking(s)
- g) hydraulic flushing valve.

The pumping unit must be supplied completely assembled, with the ancillary equipment supplied separately.

NOTE:

- 1) Sydney Water's past and current practice for submersible pump discharge bends is based on WSA 101-2005 standard discharge bends (see Figure SW1). For interchangeability reasons, the pumps must be capable of being mounted on these standard discharge bends. Where necessary, the pumps must be supplied with suitable adaptors.

### 1.3.2 Dry mounted submersible pumps

The supply of a pumping units must include:

- a) the pumping unit, including all integral equipment required for the operation of the pump in the intended service including drive motor and instruments
- b) power and instrumentation cables and sensors as per Table SW2.

The following optional ancillary equipment that must be supplied if specified:

- a) pump support stool for vertically installed or pump support frame for horizontally installed pumps

- b) pump suction bend (for vertically installed pumps only)
- c) grade 316 stainless steel lifting chain (for vertically installed pumps only)
- d) grade 316 stainless steel cable stocking(s)
- e) pump head cable entry cover plate
- f) cable entry assembly cover.

The pumping unit must be supplied completely assembled, with the ancillary equipment supplied separately.

## 1.5 Definitions

*Replace 1<sup>st</sup> sentence with the following:*

For the purpose of this Standard, the definitions given in AS 60529, ISO 9906, WSA 101-2008 and those below apply.

### 1.5.1 Asset Owner

*Replace the whole clause with the following:*

The asset owner is Sydney Water Corporation.

*Add new clauses 1.5.7 and 1.5.8:*

### 1.5.7 Dry mounted submersible pumping unit

A dry mounted submersible electric pumping unit is one which is installed in a dry configuration in normal operation but may operate submerged under abnormal conditions.

### 1.5.8 Wet mounted submersible pumping unit

A wet mounted submersible electric pumping unit is one which is completely or partially submerged in sewage or wastewater, whereby the non-submerged part of the unit may be exposed to sewage gases.

## 2 Material and components

### 2.1 Materials

*Add the following sentence at the end of 1<sup>st</sup> paragraph:*

Unless specified otherwise, materials must be in accordance with Table 2.1 of WSA 101- 2008 (basic materials).

*amend Note to:*

NOTE:

Material equivalence may be considered by Sydney Water.

*and add the following new paragraph after the Note:*

The Supplier must advise if other better options are available, especially for arduous operating conditions subject to heavy loadings of salty water and/or sand in the sewage (i.e. hardened impellers or impellers with a resilient coating etc.).

### 2.3 Stainless steel

*Replace 2<sup>nd</sup> sentence in 1<sup>st</sup> paragraph with the following:*

Stainless steel castings must be heat treated in accordance with ASTM A743

### 2.4 Protective coatings

*Add the following to the end of the NOTE:*

The Supplier must provide details of their standard protective coating systems for Sydney Water's review and acceptance. As an alternative, the protective coating system must comply with WSA 201 System EHB-SF.

*In Table 2.1 delete superscript '3' and the associated note 3.*

## 3 Design and manufacture

### 3.1 General

*Replace item (d) with the following:*

- d) be suitable for operating continuously with the motor unsubmerged or partially or fully submerged up to 20m and without external cooling supply:

*and replace the last sentence with the following:*

The design criteria of the pumping units and ancillary equipment must be based on a minimum life expectancy of 25 years.

### 3.3 Arrangement

*Delete the last paragraph and add the following:*

Wet and dry mounted submersible pumps must be identical and interchangeable. For this purpose, the pump suction and discharge flanges must be drilled / tapped, as appropriate, regardless of how the pump is intended to be initially installed. Likewise, tapped holes must be provided in all pumps for the installation of the guiderail claw and pump mounting on a support stand. All tapped holes must be plugged with plastic plugs.

Provision must be made on the pump casing for the mounting of a Flygt model 4901 hydraulic flush valve, or equivalent.

The pumps must be 'back pullout' design so that the motor assembly, mechanical seal chamber and impeller can be easily removed from the pump casing and, for dry well mounted submersible electric pumping units, without the need to disconnect the suction and discharge pipework.

### 3.7 Pump

#### 3.7.3 Casing

*Replace the lead in sentence in 2<sup>nd</sup> paragraph with the following:*

As specified by the asset owner, the pump casing must incorporate either a:

#### 3.7.6 Shaft seal and seal chamber

*Insert the following sentence before the last sentence in 1<sup>st</sup> paragraph:*

Springs or bellows must be made from materials resistant to chloride stress corrosion.

#### 3.7.7 Electric motors

##### 3.7.1.1 General

*Replace (d) and (f) with the following:*

- d) be rated IP68 in accordance with AS 60529 for continuous submerged operation at minimum 20m water depth
- f) have the power rating 115% of the maximum power required by the pump at 110% of the nominated duty flow rate and be non-overloading at minimum head ('flood-head') condition



### 3.7.7.6 Motor cables and entry glands

*Replace the last sentence with the following:*

Unless otherwise specified by the Purchaser, a continuous length of 20 m motor power and instrumentation cables must be provided.

## 3.8 Pump pedestal and discharge connection

### 3.8.4 Standard dimensions

*Replace the whole clause with the following:*

Submersible pump discharge bends must be based on WSA 101-2005 Figure SW1 - Dimensions of Pump Pedestals. All pumps must be capable of being mounted on these standard discharge bends.

## 3.9 Ancillary items

### 3.9.1 Guide rails

*Replace 1<sup>st</sup> sentence in 1<sup>st</sup> paragraph with the following:*

Where specified, twin guide rails to suit the standard dimensions for the pump pedestal (Figure SW1) must be supplied with each pump.

### 3.9.2 Lifting chains

*Replace the whole clause with the following:*

Unless otherwise specified by the Purchaser, each wet mounted submersible pumping unit must be fitted with a suitable length of lifting chain with a Working Load Limit (WLL) in excess of the combined pumping unit and motor cables weight. Where specified, dry mounted pumping units must also be supplied with a short lifting chain.

Lifting chains, shackles, lifting rings and tags must be made from grade 316L or equivalent stainless steel and comply with AS4797.

Lifting chains must be designed such that the pumping unit, when suspended from the motor housing lifting bracket or bridle [see Clause 3.7.7.2 (b)], hangs vertically plumb and does not rotate.

Lifting chains must:

- a) have intermediate lifting rings at 1.5 m intervals
- b) be fitted with a shackle suitable for hook entry at the top end and just below the wet well cover
- c) be tagged with the information required by AS4797 and AS3775.1.

All lifting chains must comply with Table 2.1 and the testing requirements of AS4797.

### 3.9.3 Bolts, screws and dowels

*Replace 1<sup>st</sup> sentence in 2<sup>nd</sup> paragraph with the following:*

All bolts, screws, stud bolts, dowels, roll pins and nuts must be manufactured from stainless steel in accordance with Table 2.1.

*Add clauses 3.9.6 to 3.9.13:*

### 3.9.6 Guide rail / pedestal adaptor

Guide rail/pedestal adaptors must be supplied with all wet mounted submersible pumps and can be either:

Type 1 – Bolted directly to the pump discharge flange or

Type 2 – Bolted to the pump volute at another location than the discharge flange.

Both the wet and dry mounted versions of the submersible pumps must be capable of being fitted with the pump guide rail / pedestal adaptors.

### 3.9.7 Pump support stand

The dry mounted pumping units must be mounted on a hot-dip galvanised steel support stands to meet site installation requirements. The stand must be as short as possible. Its design must ensure that the complete pumping unit's natural frequency is at least 25% above the pump maximum operating speed and must provide for easy access to pump suction bend connection, wear plate adjustment screws, pump mounting bolts and suction bend inspection cover. The design must eliminate areas for water to accumulate.

### 3.9.8 Pump suction bend

Suction bend design must provide for smooth flow transition from the suction pipework to the pump inlet. It must be manufactured from ductile cast iron to AS1831 and coated in accordance with Cl. 2.4, or fabricated from Grade 316 stainless steel. For pump with suction sizes DN300 or greater the suction bend must be provided with a minimum  $\varnothing 150$  mm inspection port and cover to enable cleaning and access to the pump impeller. Smaller size suction bends must be provided with suitable smaller inspection ports.

### 3.9.9 Pump suction connection

All pumps (both wet and dry mounted) must be suitable for direct connection to suction and discharge pipework.

### 3.9.10 Pump discharge connection

Pumps with Type 1 pump guide rail/pedestal adaptors must have manufacturers standard flanges.

Pumps with Type 2 pump guide rail/pedestal adaptors must have discharge flanges drilled to AS 4087 PN16.

### 3.9.11 Pump holding down bolts

Both wet and dry mounted submersible pumps must include provision for mounting the pump to the pump support stand.

### 3.9.12 Pump and motor sensors

Each pumping unit must be fitted with the sensors specified in Table SW2.

### 3.9.13 Pump head and cable entry assembly covers

Dry mounted submersible pumps with motors 70kW or larger must be supplied with pump head cable entry cover plate and cable entry assembly cover structure to facilitate the disconnection of the power and sensor cables prior to pump removal.

## 4 Performance requirements

*Add clause 4.4:*

### 4.4 Vibration severity

Vibration severity of dry and wet mounted submersible pumping units measured at the manufacturer's test facility and in situ must comply with the requirements of ANSI/HI 11.6. Where pumps operate outside their POR but within the allowable operating region (AOR), as specified by the manufacturer, their vibration limits may be increased by 30%. Fixed speed pumps must be tested at their nominal speed. Variable speed pumps must be tested over the whole speed range, from the minimum operating speed to their full speed at 50 Hz. Vibration severity of variable speed pumps must not exceed the above limits over the whole speed range.

## 5 Testing

### 5.2 Performance (Works Acceptance) tests

#### 5.2.1 General

*Replace the whole clause with the following:*

All pumps must be factory performance tested in accordance with ISO 9906. The following tolerances must apply:

- a) Grade 3B - for pumping units  $\leq 10\text{kW}$
- b) Grade 2B - for pumping units  $> 10\text{kW}$  and  $< 50\text{kW}$
- c) Grade 1B – for pumping units  $\geq 50\text{kW}$

#### 5.2.2 Hydrostatic Test

*Replace 'Clause 1.6.4 of ANSI/HI 11.6' in 2nd paragraph with 'Clause 11.6.6 of ANSI/HI 11.6'.*

# Appendix A Referenced documents

(Normative)

*Replace the whole Appendix with the following:*

## **ANSI**

- HI 9.6.3 Rotodynamic Pumps - Guideline for Operating Regions
- HI 11.6 Rotodynamic Submersible Pumps: for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Tests  
(NOTE: Available from the Hydraulic Institute [www.pumps.org](http://www.pumps.org))

## **AS**

- 1111.1 ISO metric hexagon bolts and screws – Product grade C – Bolts
- 1111.2 ISO metric hexagon bolts and screws – Product grade C – Screws
- 1112.1 ISO metric hexagon nuts – Style 1 – Product grades A and B
- 1112.2 ISO metric hexagon nuts – Style 2 – Product grades A and B
- 1112.3 ISO metric hexagon nuts – Product grade C
- 1237.1 Plain washers for metric bolts, screws and nuts for general purposes – General plan
- 1237.2 Tolerances for fasteners – Washers for bolts, screws and nuts – Product grades A, C and F
- 1359 Rotating electric machines – General requirements
- 1442 Carbon steels and carbon manganese steels – Hot-rolled bars and semifinished products
- 1444 Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
- 1565 Copper and copper alloys – Ingots and castings
- 1646 Elastomeric seals for waterworks purposes
- 1830 Grey cast iron
- 1831 Ductile cast iron
- 1939 Degrees of protection provided by enclosures for electrical equipment (IP Code)
- 2074 Cast steels
- 2317 Collared eyebolts
- 2321 Short link chain for lifting purposes
- 2345 Dezincification resistance of copper alloys
- 2660 Hose and hose assemblies – Air/water – For underground coal mines
- 2741 Shackles
- 2768 Electrical insulating materials – Evaluation and classification based on thermal endurance
- AS4797 Stainless steel chain for lifting purposes
- AS60529 Degrees of protection provided by enclosures (IP Code)

## **AS/NZS**

- 1214 Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
- 5000.1 Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1kV
- 4087 Metallic flanges for waterworks purposes

- 4158 Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
- 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
- 60947.8 Low-voltage switchgear and controlgear – Control units for built-in thermal protection (PTC) for rotating electrical machines

**ASTM**

- A276 Standard Specification for Stainless Steel Bars and Shapes
- A380 Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems
- A480 Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip
- ASTM A743 Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
- D3187 Standard Test Methods for Rubber-Evaluation of NBR (Acrylonitrile-Butadiene Rubber)
- F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- F594 Standard Specification for Stainless Steel Nuts
- F844 Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
- A743 Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

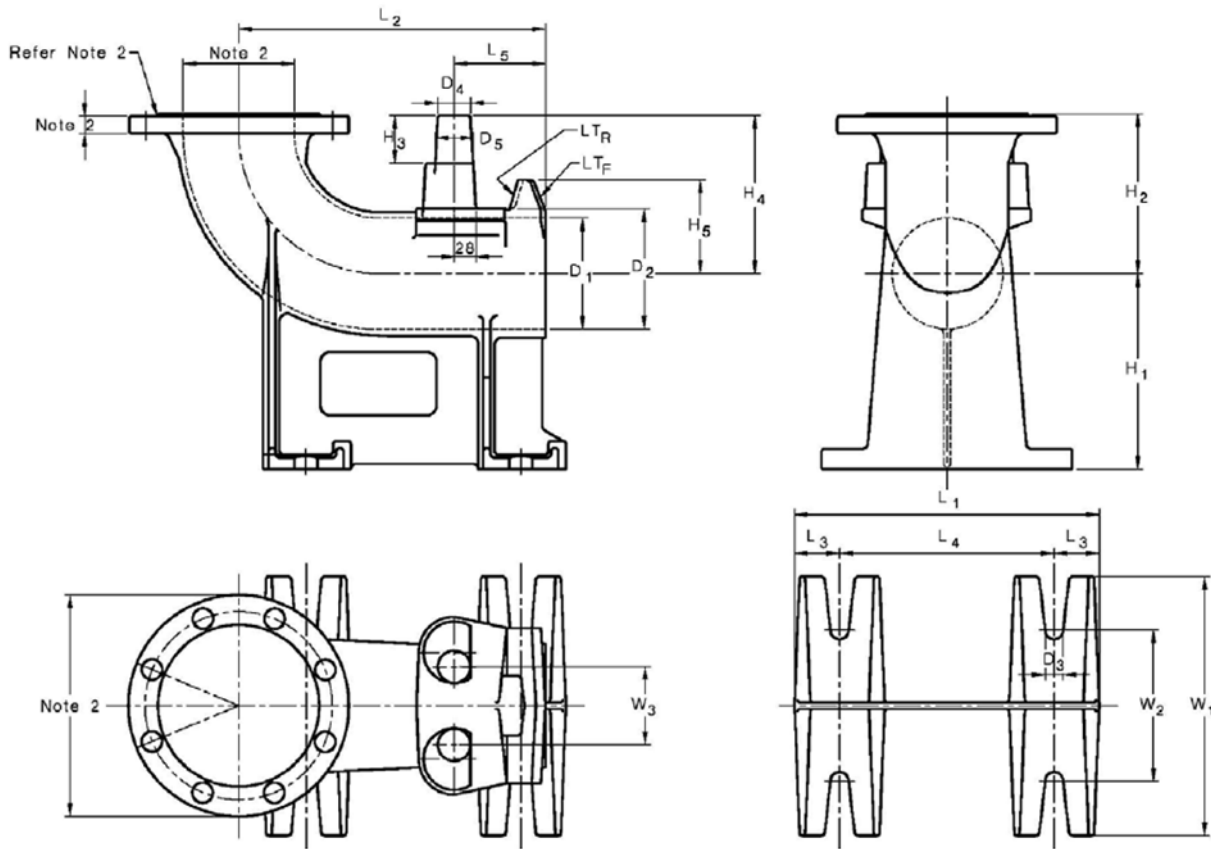
**ISO**

- 1940-1 Mechanical vibration - Balance quality requirements of rigid rotors - Part 1 - Determination of permissible residual unbalance
- 9906 Rotodynamic pumps – Hydraulic performance tests – Grades 1, 2 and 3
- 10816-7 Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts - Part 7: Rotodynamic pumps for industrial applications, including measurements on rotating shafts
- 21988 Abrasive-resistant cast-irons – Classification

**WSA**

- 109 Flange gaskets and O-rings
- 201 Manual for selection and application of protective coatings

# Figure SW 1 - Dimensions of pump pedestals



All dimensions are in millimeters except where dimensions shown

Nominal Size	Overall Dimensions					Seating Face		Anchor Points					Guide Rail Boss					Locating Taper			
	H <sub>1</sub>	H <sub>2</sub>	L <sub>1</sub>	L <sub>2</sub>	W <sub>1</sub>	D <sub>1</sub> (dia.)	D <sub>2</sub>	No.	W <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>5</sub>	H <sub>3</sub>	H <sub>4</sub>	W <sub>3</sub>	L <sub>5</sub>	L <sub>T<sub>F</sub></sub>	L <sub>T<sub>R</sub></sub>	H <sub>5</sub>
50 X 50	100	60	185	97	140	50	57	4	105	20	100	23	44	50	36	57	38	22	20°	15°	62
80 X 80	200	200	300	355	270	80	90	4	150	70	250	23	44	50	60	118	100	116	20°	15°	90
100 X 100	200	200	390	365	270	100	110	4	200	70	250	23	44	50	60	180	100	116	20°	15°	100
150 X 150	275	175	408	395	310	150	150	4	250	64	280	23	44	50	60	200	124	116	20°	15°	97
150 X 200	257	193	390	425	310	150	160	4	200	57.5	280	23	44	50	60	209	100	116	20°	15°	125
200 X 200	260	190	390	425	310	200	215	4	200	55	280	23	44	50	60	175	100	116	20°	15°	155
200 X 250	225	225	610	475	310	200	214	4	200	62.5	500	23	44	50	60	235	100	116	20°	15°	152
250 X 250	225	225	610	475	310	200	273	4	200	66	500	23	44	54	60	197	124	116	20°	15°	152
250 X 300	500	300	610	475	620	250	266	4	460	85	500	23	44	54	60	200	124	116	20°	15°	152
300 X 300	500	300	610	550	620	300	322	4	460	85	500	23	44	72	60	215	124	116	20°	15°	203
300 X 350	300	300	750	650	700	300	330	4	600	50	650	30	65	72	70	240	124	174	20°	15°	222
350 X 350	300	300	770	650	700	350	380	4	600	55	650	30	65	72	70	265	124	174	20°	15°	246

**NOTES:**

1. Tolerances ±1.0 mm for all dimensions except D<sub>3</sub> where a tolerance of 0, +1.0 mm must be applied and L<sub>T<sub>F</sub></sub> and L<sub>T<sub>R</sub></sub> where a tolerance of ±0.5° must be applied.
2. Dimensions of the discharge flange must be in accordance with Figure B2 of AS 4087.
3. 50 x 50 has a screwed outlet.

# Table SW2 - Sydney Water submersible pump standard sensor requirements <sup>1)</sup>

Type	XYLEM (FLYGT)				SULZER (ABS)				
	Small Pumps models 3085, 3102, 3127, 3152 (MiniCAS II)	Medium Pumps models 3153, 3171, 3202, 3301, 3315 (MiniCAS II)	Larger Pumps drive unit types 6X5, 7X5 (MAS 801)	Larger Pumps drive unit types 8X5, 9X5 (MAS 801)	PE1, PE2 (MiniCAS II)	PE3 (MiniCAS II)	PE4 (MiniCAS II)	PE5 (MAS 801)	PE6 (MAS 801)
Power range (kW)	1.3-5.9	7.5-105	40-180	80-680	1.3-11	9-25	15-45	30-110	90-300
Upper (Support) Bearing Bimetallic									
Lower (Main) Bearing Bimetallic									
Upper (Support) Bearing PTC									
Lower (Main) Bearing PTC									
Upper (Support) Bearing PT-100				✓					✓
Lower (Main) Bearing PT-100			✓	✓				✓	✓
Stator Winding Bimetallic 1 <sup>st</sup> Winding	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stator Winding Bimetallic 2 <sup>nd</sup> & 3 <sup>rd</sup> Windings	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stator Winding PTC 1 <sup>st</sup> Winding									
Stator Winding PTC 2 <sup>nd</sup> & 3 <sup>rd</sup> Windings									
Stator Winding PT-100 1 <sup>st</sup> Winding			✓	✓				✓	✓



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Type	XYLEM (FLYGT)				SULZER (ABS)				
	Small Pumps models 3085, 3102, 3127, 3152 (MiniCAS II)	Medium Pumps models 3153, 3171, 3202, 3301, 3315 (MiniCAS II)	Larger Pumps drive unit types 6X5, 7X5 (MAS 801)	Larger Pumps drive unit types 8X5, 9X5 (MAS 801)	PE1, PE2 (MiniCAS II)	PE3 (MiniCAS II)	PE4 (MiniCAS II)	PE5 (MAS 801)	PE6 (MAS 801)
Power range (kW)	1.3-5.9	7.5-105	40-180	80-680	1.3-11	9-25	15-45	30-110	90-300
Stator Winding PT-100 2 <sup>nd</sup> & 3 <sup>rd</sup> Windings				✓					✓
Bottom of Stator Housing (Separation Chamber) DI						✓	✓	✓	✓
Water in Oil (Oil Housing) CLS/DI <sup>2)</sup>			✓	✓	✓				
Junction Box (Connection Chamber) FLS/DI			✓	✓					✓
Stator housing FLS/DI		✓	✓	✓					✓
Pump Memory			✓	✓					
Vibration Sensor			✓	✓					✓

**NOTES:**

- 1) Subject to change to comply with revised Sydney Water monitoring system and new pump supply contract(s).
- 2) Optional mechanical seal leakage (in inspection chamber) FLS/DI where internal closed-loop cooling system employed.

# Ownership

## Ownership

Role	Title
<b>Group</b>	Engineering and Technical Support
<b>Owner</b>	Manager, Engineering
<b>Author</b>	Milan Rubcic, Lead Engineer

## Change history

Version No.	Prepared by	Date	Reviewed by	Approved by	Issue date
3.0	Milan Rubcic	25/01/2022	M. Pathirana, L. Gupta, B. Maunder	Norbert Schaeper	25/01/2022
2.0	Milan Rubcic	20/03/2020	B. Maunder, L. Gupta, W. Legg, N. Keong	Steve Keevil-Jones	16/3/2020
1.0	Milan Rubcic	27/10/2017	Bruce Maunder	Ken Wiggins	27/10/2017