



Assets Planning and Delivery Group
Engineering

DESIGN STANDARD DS 30-01

Glossary - Mechanical

VERSION 1
REVISION 9
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FOREWORD

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of the Western Australia's Work Health and Safety (General) Regulations 2022 to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

[Overview of Western Australia's Work Health and Safety \(General\) Regulations 2022 \(dmirs.wa.gov.au\)](https://dmirs.wa.gov.au)

Enquiries relating to the technical content of a Design Standard should be directed to the Senior Principal Engineer, Mechanical Section, Engineering. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

Head of Engineering

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REVISION STATUS

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

REVISION STATUS						
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8	1/6	12.03.13	66-75	New Section transferring in Australian and International	JP	SE
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				standards which were subject to general updating		
8	1/7	14.06.16	71	AS1359.0 title updated	BV	SE

DESIGN STANDARD DS 30-01

Glossary - Mechanical

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1 SCOPE AND GENERAL

1.1 Scope

DS 30-01 is the second part of a three part standard which provides mechanical engineering information with a water industry bias to aid designers in the mechanical design process and use of the Corporation's DS 30 series of mechanical standards. The other parts of the Standard comprise

- DS 30 Mechanical Design Process,
- DS 30-02 General Mechanical Design Criteria.

The Engineering Definitions and Relationships, Preferred Terminology and Acronyms & Symbols sections have been arranged in alphabetical order with cross referencing to related items where relevant. The Preferred Terminology section was included to assist designers in providing standardized engineering terminology in Corporation designs and to reduce the possibility of confusion.

1.2 Purpose

The Corporation's mechanical design standards are documented in its DS 30 Standards series. Designers shall comply with these standards for the design and specification of mechanical components of assets being acquired for the Corporation.

The purpose of the DS 30 Standards series is to provide:

- (a) Standards and guidelines applicable in the design of Corporation assets,
- (b) Explanatory or specific design information,
- (c) Information relating to Corporation preferences and practices which have evolved from over a century of experience in the water industry.

1.3 Design Process

The mechanical design process to be followed by Designers is documented in the Corporation's Engineering Design Process and DS 30.

1.4 Standards

All materials and workmanship shall comply with latest revisions of the relevant codes and standards.

Water Corporation Strategic Product Specifications (SPS), or in their absence the latest editions of Australian Standards, or Water Services Association Australia (WSAA) Codes, shall be referenced for design and specification. In the absence of relevant Australian or WSAA Codes, relevant international or industry standards shall be referenced.

1.5 Referenced Documents

Standards and documents referred to in the DS 30 Standards series are listed in Appendix A of this Standard.

1.6 Mandatory Requirements

The use of the imperative "shall" denotes a mandatory requirement. Use of verbs other than "shall" such as "will", "should", "may" indicates recommended practice.

1.7 Nomenclature

1.7.1 Engineering Definitions and Relationships

Definitions relating to terminology used in the DS 30 Standard series are contained in Section 2 “Engineering Definitions and Relationships” of this Standard.

1.7.2 Preferred Terminology

Preferred mechanical terminology used in the DS 30 Standard series is contained in Section 3 “Preferred Terminology” of this Standard.

1.7.3 Abbreviations

Acronyms and symbols used in the DS 30 Standard series are contained in Section 4 “Acronyms and Symbols” of this Standard.

1.7.4 Standard Units and Relationships

The units and relationships to be used for mechanical designs shall be in accordance with those specified in Section 5 “SI Units, Relationships and Prefixes” of this Standard.

1.7.5 Drawing Symbols

The drawing symbols to be used for mechanical designs shall be in accordance with Section 6 “Drawing Symbols” of this Standard.

1.8 Feedback

The mechanical standards are live documents that require regular review and revision in accordance with changes in associated standards, latest knowledge, operational experience and technology. Users of these standards are encouraged to provide feedback on their content to the Principal Engineer Mechanical Section, Infrastructure Design Branch.

2 ENGINEERING DEFINITIONS AND RELATIONSHIPS

The following represents definitions of terminology and relationships referred to in this Standard and generally in the water industry. The terminology is arranged in alphabetical order to assist the reader and alternative phraseology where applicable is cross-referenced.

Abrasion/Corrosion:	<i>Refer to erosion-corrosion.</i>
Absolute pressure:	Is the pressure relative to absolute zero, and is the sum of the barometric pressure plus gauge pressure.
ACME thread:	A square-cut thread form with a 29 degree thread angle as per ASME/ANCI B1.5 and 1.8.
Actuator:	A power driven device that provides the force and motion to operate a valve.
Aerobic:	Organisms living or active only in the presence of free oxygen. <i>See also Anaerobic.</i>
Affinity laws:	Are fundamental laws governing the theoretical performance of a centrifugal pump in terms of capacity, head and power for different speeds or impeller diameters under dynamically similar conditions e.g. (a) Pump flow rate (Q) varies directly with speed (N) i.e. $Q_1 / Q_2 = N_1 / N_2$ (b) Pump head (H) varies with the square of the speed i.e. $H_1 / H_2 = (N_1 / N_2)^2$ (c) Power (P) required varies with the cube of the speed i.e. $P_1 / P_2 = (N_1 / N_2)^3$ (d) Impeller diameter reductions can be calculated for a constant speed based on the affinity laws as follows: $Q_1 / Q_2 = D_1 / D_2$ $H_1 / H_2 = (D_1 / D_2)^2$ $P_1 / P_2 = (D_1 / D_2)^3$
	NOTES: (i) Efficiency is assumed constant however it would be slightly less in reality (ii) Reduction in impeller diameter is approximate because of the resulting geometry changes that would occur in the impeller
Air compressor:	A rotodynamic machine designed to produce compressed air or gas.
Air cushion:	Is a tank fitted with a large air valve incorporating a large and small orifice. The air valve allows rapid air admission followed by similarly rapid air

expulsion of air during transients. The air valve provides controlled air expulsion during the final stages of the cycle to prevent water hammer. They are used for preventing negative pressures on isolated high elevations that occur on a long pipeline similar to surge tanks but for a lesser volume. *See also Surge Tank.*

Air gap:	The unobstructed vertical distance through the free atmosphere between the lowest opening of a water service pipe or fixed outlet supplying water to a fixture or receptacle and the highest possible water level of such fixture or receptacle.
Air valve:	Is a valve that allows the automatic entry and/or release of air.
Air release and vacuum break valves:	Are double acting air valves that allow the automatic release and intake of air as well as bleeding of air under pressure.
Air release valves:	Are valves that only discharge small volumes of pressurised air.
Aquifer:	An underground water bearing strata from which water may be extracted via a borehole pump (for a sub-artesian bore).
Allowable operating pressure:	Is the allowable internal pressure, excluding surge that a component can safely withstand in service.
Allowable maximum operating pressure:	Is the maximum internal pressure, including surge that a component can safely withstand in service.
Allowable operating range:	Is the operating range of a pump spanning either side of the BEP that provides optimal performance. Operation outside these limits may cause reduction in hydraulic performance and service life associated with pump recirculation, cavitation, shaft deflection and vibration. For practical purposes the allowable operating range covers approximately 50% to 120% of the BEP, with 70% to 110% being preferred for typical centrifugal type pumps.
Altitude valve:	Is an automatic control valve fitted at the inlet of a tank and configured for the purpose of controlling the tank water level.
Ambient conditions:	The conditions existing in the surrounding atmosphere e.g. temperature, barometric pressure.
Anaerobic:	Organisms requiring the absence of free oxygen, or not destroyed by its absence. <i>See also Aerobic.</i>
Anode:	In an electrolytic cell the electrode which is attached to the +ve terminal of the battery becomes the anode. The anode produces electrons by the oxidation of an ions or molecules. Accordingly the anode will corrode or become sacrificial with respect to the cathode thus providing protection. <i>Refer also to cathode and cathodic protection.</i>

Anoxic:	Pathological deficiency of oxygen.
Anti-friction bearing:	Utilise the low friction characteristics of balls and rollers as their principle of operation. Ball or roller bearings are lubricated with grease or oil. <i>Refer also sleeve bearings and babbitt bearings.</i>
Atmospheric Vacuum Breaker:	A device to prevent backflow caused by back siphonage, which incorporates a ventilation valve, which operates automatically to admit air into the downstream chamber of the valve whenever the pressure in the chamber reduces to or falls below atmospheric pressure.
Austenitic stainless steel:	<p>Is one of the two stainless steel classifications that is used in ~95% of all stainless steel applications. Common grades include 304, 304L, 321, 316 and 316L.</p> <p>The basic composition of austenitic stainless steel is 18% chromium and 8% nickel which is Grade 304. Grade 316 is produced with the addition of 2% - 3% molybdenum (Mo) to give a higher corrosion resistance than Grade 304.</p> <p>Low carbon or 'L' grades (0.03% versus 0.08%) are required to prevent corrosion in the zone adjacent to a weld e.g. 304L or 316L.</p> <p>Features of austenitic stainless steels are excellent corrosion resistance, non-magnetic, formability and fabrication. Used in pumps, valves, fasteners, tanks, and pipework. <i>Refer also duplex, ferritic, martensitic and stainless steels.</i></p>
Australian height datum:	Is a level datum, uniform throughout Australia, derived from mean sea level observations at 30 tide gauge locations along the Australian coastline, used as a base reference for "derived" datum levels throughout Australia; replaces "Australian Leveling Survey".
A-weighted:	A frequency weighting that closely approximates the frequency response of the human ear.
Axial fan:	<i>Refer to Fans</i>
Axially-split casing pump:	A centrifugal pump which has its casing axially split along the pump shaft centreline and the axis of rotation determines whether the pump is horizontal-shaft or vertical-shaft. An axial split pump allows removal and replacement of the pump rotating element without having to disturb the pump body which is connected to the suction and discharge pipework. <i>Refer also horizontal-split, vertical-split and radial-split casing pumps.</i> Note – contemporary split case pumps with mechanical seals are more frequently removed to workshops when disassembly is required.
Babbitt alloy	Is a metallic alloy often used as the bearing surface in a plain or solid bearing.
Babbitt bearing:	Is a sleeve bearing with steel or cast iron backing lined with Babbitt alloy and oil lubricated.

Typical applications would be precision automotive type bearings. *Refer also antifriction and sleeve bearings.*

- Backflow:** In the context of this standard relates to the unintended reverse flow of water to the intended direction of flow from a potentially polluted source into a potable water supply, due to either back-siphonage or back-pressure.
- Backflow prevention device:** Is a device installed in potable water pipework to prevent backflow from a non-potable water source. Devices are back siphonage, back-pressure or combined back siphonage/back pressure types.
- Back-pressure:** The differential between the pressure within any water service and a higher pressure within any downstream vessel or pipework to which it is connected.
- Back pullout pump:** Is a radially split centrifugal pump that is designed to allow removal and replacement of the pump rotating element comprising bearing housing assembly, shaft and impeller without removing the pump casing.
- Back-siphonage:** Backflow that occurs when the upstream supply pressure falls below atmospheric pressure.
- Balance holes:** Are small holes incorporated from the suction eye through the impeller back shroud for the purpose of balancing hydraulic thrust and reducing the size of the thrust bearing. There is a small efficiency penalty associated with this feature. *Refer also pump-out vanes.*
- Balanced mechanical seal:** *Refer mechanical seal*
- Ball valve:** Is a spherical plug valve in which the plug is in the form of a ball that incorporates a circular hole through it. The hole is either full or reduced bore and concentrically aligns with the valve inlet and outlet ports in the open position and is fully shut when rotated 90° to the port. They are used for isolating and control functions.
- Bar:** The international standard unit of pressure defined as 100 kPa (approximate to standard pressure).
- Barometric pressure:** Is the atmospheric pressure at the location where it is measured.
- Baseplate:** A fabricated steel base designed to accommodate the pump and pump driver and generally bolted to a concrete foundation block. The term baseplate is preferred in lieu of bedplate. *Refer also bedplate, motor stool and pump stool.*
- Bedplate:** *See baseplate.*
- Bellmouth:** Is the entry pipe for an intake structure or pump suction pipework and has a larger flared diameter at its inlet compared to its downstream connecting pipe diameter. It can be oriented horizontally

	or downturned 90° vertically. It is also referred to as a suction bell.
Best efficiency capacity:	The discharge rate at which a pump exhibits a maximum efficiency (the gradient of the efficiency-flow curve is zero with a corresponding negative definite Hessian matrix), for a particular impeller diameter and speed.
Best efficiency point:	The best efficiency point (BEP) occurs when the discharge rate of a pump for a specific diameter impeller, rotating at a particular speed, operates at maximum efficiency. <i>See Best efficiency capacity.</i>
Blower:	Is a ducted centrifugal fan whose primary purpose is to move large volumes of gas. Often associated with small increases in pressure (e.g. <2 bar(g)). <i>See also Fan.</i>
Blue water:	<i>Refer cuprosolvency and microbiological influenced corrosion.</i>
Bolt:	Is a form of threaded fastener having a head integral with the shank and having an external male thread intended for a nut at the opposite end.
Bonnet:	The top casing enclosing the stem of a non-rising stem type valve.
Bore (1):	Internal diameter of a pipe, tube or fitting.
Bore (2):	A bore or borehole is a hole drilled into the ground that may be equipped with a pumpset for the purpose of abstracting water from an aquifer. A naturally flowing bore is artesian whereas one that requires pumping is sub-artesian.
Borehole:	<i>Refer bore (2).</i>
Brinell hardness:	A designation of the hardness of materials denoted by XXX HBW e.g. 300 HBW. Unless otherwise subscripted it implies a Brinell Hardness Number of 300 to which a test load of 3000 kgf applies. The higher the Brinell number, the higher is the relative hardness of a material. <i>Refer also Hardness, Rockwell Hardness and Vickers Hardness.</i>
Brinelling:	Is damage that can occur to machinery antifriction bearings that are in a stationary mode that are subject to the effects of transport or external vibrations that causes the point contact of the balls or rollers to indent the bearing races. The resulting indentations cause premature failure of the bearing when the machine is operated.
Butterfly valve:	Is a valve in which a circular sealing disc rotates on a transverse shaft through 90° from the fully open to fully closed positions within the valve body. Resilient seated valves incorporate a resilient seal fitted to either the body or disc e.g. seal in body, seal on body and

seal on disc. Metal seated valves are referred to in ‘triple eccentric butterfly valves’ below.

Lenticular blade butterfly valves

- The lenticular style blade comprises a solid or slab disc that whilst suitable for medium heads and flows has limitations for high operating heads and high flows e.g. limited to 6 m/s for continuous flow – refer also lattice blade butterfly valve below.

Lattice blade butterfly valve –

The lattice construction of the disc provides a rigid structure which allows water to flow through and around it without the consequent headloss, cavitation and higher hydrodynamic torques associated with the thicker, solid disc (lenticular). These valves are engineered to suit a wide range of sizes and operating heads and are particularly suitable for high operating heads and high flow velocity e.g. above 6 m/s for continuous flow - refer also lenticular blade butterfly valve above.

Wafer style butterfly valve –

designed so that the body is sandwiched between flanges and located within the flange bolt circle except for locating lugs at the top of the valve. Wafer butterfly valves are not suitable for termination or dead-end service.

Lugged style butterfly valve –

the valve body is drilled and tapped to suit the adjacent flange bolt holes. Lugged butterfly valves are suitable for termination or dead-end service.

Concentric butterfly valve –

the valve is configured so that the shaft and disc seating edge coincide with the centre of the valve body waterway requiring relatively high seating torques e.g. resilient seated seal-on-body butterfly valves

Eccentric (Offset) butterfly

valve – the valve is configured so that the shaft coincides with the centre of the valve body waterway but is offset from the seating edge of the disc e.g. resilient seated seal-on-disc butterfly valves

Double eccentric (Double-offset) butterfly valve –

a resilient seal on disc butterfly valve, which is configured so that the shaft is offset from the centre of the valve body waterway and also from the seating edge of the disc. This produces a cam type motion of the disc facilitating entry and exit of the seat with reduced interference, less wear and reduced breakaway torque. Used for high performance, high flow and/or high pressure conditions e.g. guard valve (high flow).

Triple eccentric (Triple-offset)

butterfly valves – the valve is configured as for the double eccentric but in addition the valve seat is cone-shaped and also offset so that one of the sides is parallel with the waterway. Allows the use of a metal-seat for higher

	temperatures and pressures than for resilient seated types, but characteristically has a high seating torque.
Bypass:	An alternative flow path to the main flow path.
Bypass valves:	Are valves fitted into a bypass around a main valve to allow balanced head conditions to be achieved before the main valve is operated. They also allow pipelines to be filled through the bypass at an acceptable rate.
Cascading aquifer:	Is an aquifer that discharges water from above a borehole pumpset. <i>Refer also aquifer.</i>
Casing (1):	Refers to a pump impeller housing that directs water into the impeller and then into a gradually expanding discharge nozzle that converts the velocity imparted by the impeller into head. The casing also incorporates the suction and discharge connections e.g. flanges. It is also known as the volute. <i>See also Volute.</i>
Casing (2):	Refers to the lining used in a bore e.g. bore casing.
Casing wear rings:	A replaceable metal ring fitted to the pump casing suction that provides seal clearance with a closed impeller neck in order to reduce high pressure leakage from the discharge to the suction. They are also known as wear rings and are designed to be replaced when wear clearances are sufficiently large to degrade the pump performance. It is also known as a casing ring. <i>Refer also impeller wear ring.</i>
Cathode:	In an electrolysis cell the electrode which is attached to the negative terminal of the battery becomes the cathode. At the cathode an ion or molecule undergoes reduction by accepting electrons. <i>Refer also to anode and cathodic protection.</i>
Cathodic protection:	A method of inhibiting corrosion by designing system components to be cathodic and confining corrosion to a sacrificial anode e.g. zinc or magnesium anodes in a water tank.
Cavitation:	Is the formation of vapour bubbles in a liquid, This occurs in regions when the liquid pressure drops below the fluid vapour pressure. When subject to higher pressures these bubbles rapidly implode (condense) generating intense shockwaves which can cause damage to equipment if the occurrence is near a surface. In pumps, cavitation often occurs due to a significant drop in pressure on the suction i.e. $NPSHr > NPSHa$. <i>See also Cavitation wear, NPSH, NPSHr and NPSHa.</i>
Cavitation Wear	Is the wear due to cyclic stress due to the occurrence of cavitation. <i>See also Cavitation.</i>
Centrifugal fan:	<i>Refer to Fans</i>
Centrifugal pump:	Consists of a fixed casing or volute containing an impeller and drive shaft which when rotated

imparts energy to a fluid due to the action of centrifugal force. The fluid is forced by atmospheric pressure (generally) into the impeller suction eye at low velocity. The fluid exits the impeller periphery at a higher velocity that is transformed into pressure energy or head by the volute *See also casing and volute.*

Characteristic curve:	A pump performance curve comprising total developed head in metres versus discharge capacity in litres per second.
Check valve:	In the context of these standards, relates to backflow prevention devices. <i>Refer non-return valve.</i>
Choked flow:	Occurs when the flow rate through a valve cannot be increased by increasing the pressure differential. For liquid, choked flow occurs when cavitation or flashing causes vapour bubbles to form in the vena contracta, which disrupts the flow passage to the extent that increased flow is not possible.
Class (Pressure Class):	Is the allowable operating pressure of a pump or pipework component expressed in hundreds of kilopascals. <i>Redundant – refer Pressure Class</i>
Close coupled:	Is the arrangement of a pumpset such that a flanged motor mounts either directly onto a pump casing or via a casing adaptor. The motor-shaft on small pumpsets often accommodates the impeller. On larger pumpsets the motor shaft is connected to the pumpshaft via a solid coupling. <i>See long coupled.</i>
Closed impeller:	An impeller, which has vane shrouds, or sidewalls that totally enclose the impeller waterways from the suction eye to the discharge vane edge. Closed impellers are normally used for pumps that handle clear water. <i>Refer also to open, semi-open and vortex impellers).</i>
Coating:	A corrosion-inhibiting medium applied to the internal or external surface of an item of equipment e.g. pump or valve.
Cock (Stop cock):	A generic description of a small isolating valve.
Coefficient of velocity:	<i>Refer to flow factor.</i>
Compressor:	<i>Refer to air compressor.</i>
Compressed air (service):	Is the delivery of high pressure air from an air compressor and generally encompasses service air, instrument air or supply air (surge vessels).
Cone of depression:	Is the shape of the hydraulic profile of the water in an aquifer between the WRL and PWL when it is subjected to abstraction.
Control valve:	In the context of this standard generally refers to a cast iron globe valve which is automatically controlled by the setting of hydraulic pilot controls. The configuration of the pilot controls determines valve functionality e.g. pressure reducing,

	pressure sustaining etc. whilst the pilot settings determine operating control parameters.
Connection:	A pipework joint.
Corporation:	Water Corporation (of Western Australia)
Coupling:	A rigid or flexible power transmission device connecting a driver and driven machine. <i>Refer also flexible coupling.</i>
Coupling guard:	Is a rigid transmission guard, which is designed to prevent accidental contact by persons with moving components. Most often, coupling guards protect personnel against the contact with rotating shafts.
Crevice corrosion:	Is caused by a difference in potential within an electrolyte or differential aeration in contact with a single corrosion resistant or homogeneous metal. It has the effect of producing localised cells that produce pitting of the metal. Crevice corrosion can affect a small component such as a fastener or a large item such as a pipeline that may be subject to alternative moist or dry environments or varying soil resistivity. <i>Refer also stress corrosion cracking.</i>
Critical speed:	Is the rotational speed that either coincides with or excites the natural or resonance frequencies of the translational vibration of rotating elements. Critical speeds are related to the physical properties of the rotating element. The lowest critical speed is called the first critical speed; the next higher speed is the second critical speed and so on. <i>Refer also natural frequency, flexible shaft and rigid shaft.</i>
Cross connection:	Pipework connecting a potable water supply to a non-potable supply.
Cuprosolvency:	Is the presence of elevated levels of copper in water which can produce bitter taste as well as a blue or green staining. It is usually associated with water with high alkalinity. It is not normally considered a health problem or deleterious to the copper pipe. <i>Refer also microbiological influenced corrosion (MIC)</i>
Cutwater:	Is the internal leading edge of the volute casing that separates the volute from the discharge nozzle of the pump and provides minimum clearance between the impeller and volute. The cutwater clearance is critical to the performance of the pump Corrosion or erosion can also alter it.
Dead band:	Is the range through which an input signal to a controllable piece of equipment (e.g. valve) may be altered without initiating a response.
Dead head	<i>Refer to Shutoff-head.</i>
Dealumination:	Is the corrosion of aluminium alloy whereby the aluminium component is leached out leaving behind a porous matrix of the remaining alloy constituents.

Delivery:	<i>Refer to discharge.</i>
Delivery offtakes:	<i>Refer to Discharge offtake.</i>
Density:	The density of a fluid is the mass of the fluid in per unit volume. Preferred units are kg/ m ³ .
Designer:	The engineer charged with the responsibility for the design.
Dezincification:	Is the corrosion of brass whereby the zinc component of the alloy is leached out leaving behind a soft, porous copper-rich matrix, which crumbles under load.
Diaphragm valve:	Is an isolating valve that utilises an actuator driven diaphragm to seal against a valve body in either a weir or straight-through flow way body type. The diaphragm serves not only as the sealing mechanism for a process fluid but also prevents fluid contact with the bonnet internal components that could otherwise be subject to corrosion.
Direct coupled	<i>Refer long coupled</i>
Disc:	Refers to the disc shaped dynamic sealing component of a valve as distinct from a plug, ball, etc. shaped component.
Discharge:	Refers to the environment or equipment on the output side of a pump e.g. discharge head, discharge pipework etc.
Discharge manifold:	Pipework between the discharge offtakes and the discharge or pressure main. <i>See also Discharge and Pressure main.</i>
Discharge nozzle:	Terminal outlet of a discharging item of equipment to which pipework is connected.
Discharge offtake:	Is the pipework between the pump discharge flange and the discharge manifold.
Discharge flange:	The pump discharge nozzle flange. <i>See also Discharge nozzle.</i>
Discharge head:	The discharge component of total developed head (TDH). <i>See also Total developed head.</i>
Discharge recirculation:	Is the reversal of flow at the discharge tips of impeller vanes as a result of recirculation. The shear rate between inward and outward relative velocities produces vortices that cavitate and usually attack the pressure side of the vanes. <i>Refer also recirculation and suction recirculation.</i>
Double check valve:	A device to prevent backflow caused by back-pressure, and which has two independently operating force loaded non-return valves and incorporates specific test points for in-service testing.
Double suction:	Is a water pump that incorporates a double suction impeller such that water enters from both

sides of the impeller e.g. two suction eyes. This improves suction performance and produces minimal thrust on the bearings.

Double volute pump:

Is a pump which incorporates a secondary or double volute section in the discharge nozzle that unlike a single volute pump produces approximately balanced radial thrust conditions outside the BEP. The double volute also significantly improves casing stiffness over a single volute pump. *Refer also radial force and single volute pump.*

Downstream:

A reference point in a hydraulic conduit which is located further away from another reference point in the direction of fluid flow e.g. a discharge non-return valve is downstream of pump discharge flange. *Refer also to upstream.*

Downsurge:

A low pressure fluctuation occurring during transient event. *Refer also upsurge and pressure surge.*

Draft tube:

Is a particular pipework design used in large dry well sewage pump intakes. The intakes are typically vertically cast-in, as part of the pump station concrete structure incorporating bends to direct into the pump suction. They are generally provided with a plate vortex suppressor at the entry.

Drawdown:

Is the vertical distance that the water level in a bore descends during pumping e.g. the difference between the WRL and the PWL. *Refer also pumping water level, water rest level and zone of influence.*

Drinking water:

Water that is suitable for human consumption. *Refer also potable water.*

Driven:

Is a machine or an ancillary component that is being driven by a prime mover or driver e.g. pump or its flexible coupling half is rotated by an electric motor.

Driver:

Is a prime mover or its ancillary component that drives a machine e.g. an electric motor or its flexible coupling half, that drives a pump.

Drop cable:

The electric cable that connects a borehole pumpset motor down the hole to the starter cubicle at the surface.

Dry well:

A below-ground pump station structure in which the pumps and pipework are installed and the fluid to be pumped is contained within them. *Refer also wet well.*

Dry well pump:

Is a pump installed in a dry well that is designed to operate with a flooded suction.

Dual check valve:	A device to prevent backflow caused by back-pressure, which incorporates two independently operating force loaded non-return valves.
Dual check valve with atmospheric port:	A device to prevent backflow caused by back-siphonage or back-pressure, which incorporates a ventilation port and two independently operating force loaded non-return valves. The non-return valves prevent back-pressure when operative, and the ventilation port automatically admits air to the chamber between the non-return valves, when the upstream non-return valve becomes inoperative.
Dual flap non-return valve:	Is a compact non-return valve comprising two spring loaded semi-circular flaps hinged from a central spindle mounted in a wafer or double flanged spool type body. As well as being compact, this valve offers low slam characteristics. It is also known as a dual plate non return valve.
Ductile iron:	Is a form of cast iron that exhibits at least 18% ductility and the graphite is of spheroidal form. Also known as spheroidal graphite cast iron e.g. SG iron.
Duplex stainless steels:	<p>Are ferritic-austenitic stainless steels. Common grades are S31803, S32304, S32550, S32750 and S32760 and;</p> <p>Are composed of approximately equal proportions of austenite and ferrite. Chromium content varies from 18% - 28% and nickel varies from 4.5% - 8% with most grades containing 2.5% - 4%.</p> <p>Features of duplex stainless steels are high resistance to stress cracking corrosion under the influence of high chlorides, good weldability and formability, high tensile and yield strength. Used for fabricated components for high chlorides and sea water applications. <i>Refer also austenitic, ferritic, martensitic and stainless steels.</i></p>
Duty:	Can refer to either the pump station duty or the pump duty expressed in quantity or flow in ML/d or L/s (respectively) versus head in m.
Dynamic closure:	Dynamic closure is a phenomenon whereby the float in an air valve closes prematurely due to high velocity air producing a low pressure downstream of the ball causing it to rise into the closed position. <i>Refer also kinetic air valve.</i>
Eccentric plug valve:	<i>Refer plug valve.</i>
Efficiency:	<p>Is a measure of a piece of equipment's ability to transform input energy into useful output energy taken as a ratio of these two measures. That is, $\eta = P_{Out}/P_{In}$ where η is the total efficiency, P_{Out} and P_{In} are energy output and input respectively.</p> <p>Most commonly, this term relates to pump efficiency. <i>Refer pump efficiency.</i></p>

Effluent (Final):	Is the clear liquid outflow from a wastewater treatment process.
Ejector	Is a device working on the venturi principle to induce flow of one fluid into another. Ejectors are commonly used to introduce chlorine gas into water.
End suction centrifugal pump:	Is a radially split pump incorporating an overhung single suction impeller, and a casing suction that is axially aligned with and located on the opposite side of the pump bearing housing.
Engineered pumps:	Are pumps that are ‘custom built’ for a particular application. The pumps are not available ‘off the shelf’ and generally have a significant lead time for supply. <i>Refer also production pumps.</i>
Erosion-corrosion:	Occurs on susceptible materials under the influence of either abrasive particles or high fluid velocities, or a combination of both such that the protective or passivating layer is removed or is unable to reform. This causes erosion-corrosion of the material. Copper in particular is susceptible to this phenomenon particularly where fluid velocities exceed 1.0 m/s. The presence of air increases the corrosion rate.
Extended spindle:	Is the single or double extension of a swing type non-return valve spindle for the purpose of fitting levers and counterweights for assisted closure, indication, or control functions.
Fans:	<p>A propeller fan consists of a propeller, which operates within a housing, and is either direct-coupled to or belt driven by an electric motor.</p> <p>An axial fan is either direct-coupled to or belt driven by an electric motor and consists of either:</p> <ul style="list-style-type: none">- A propeller that is located at the inlet end of a tubular housing known as a tube-axial fan, or;- A propeller that is located at the inlet end of a tubular housing which is fitted with straightening vanes upstream or downstream of the propeller and is known as a vane-axial fan. <p>A centrifugal fan is direct-coupled to or belt driven by an electric motor and consists of either:</p> <ul style="list-style-type: none">- An inline flow type with mixed flow blades that operates in a tubular housing that incorporates curved straightening vanes to provide axial flow along the tube, or;- A drum type that produces radial flow and operates in a volute type housing to convert dynamic pressure to static pressure. Centrifugal fans can have backward curved vanes, forward curved vanes or straight radial vanes, which can be flat or aerofoil shaped.

Ferritic stainless steel:	<p>Is one of the two stainless steel classifications that is used in ~95% of all stainless steel applications. Common grades include 430, 409 and 444.</p> <p>Ferritic stainless steel is nickel free and contains varying chromium from 12% - 18%.</p> <p>Features of ferritic stainless steels are moderate to good corrosion resistance depending upon chromium content, magnetic, non hardenable with poor weldability. Used industrially for tanks, launders, walkways and chutes. <i>Refer also austenitic and martensitic stainless steel.</i></p>
Flange gasket:	<p>Is a flexible membrane that is clamped between two flange faces and provides a seal to eliminate fluid leakage between the two faces of the joint under its normal operating conditions.</p>
Flexible coupling:	<p>Is a device that is used to connect driver and driven transmission shafts which has the capability of accommodating small amount of axial, longitudinal and angular misalignment. <i>Refer also to spacer coupling.</i></p>
Flexible shaft:	<p>Is a shaft designed to operate at a speed higher than the critical speed. <i>Refer also critical speed, natural frequency and rigid shaft.</i></p>
Flooded suction:	<p>Is a condition when the low water level on a pump suction is situated above the top of the volute.</p>
Flow factor Kv:	<p>Flow factor or flow coefficient is a constant, related to the geometry of a valve for a given opening that is used to determine the optimal valve size to pass a required flow rate whilst providing stability to the process.</p> <p>The Kv factor is also known as valve coefficient and relates to the number of litres per second of water at 15°C that a valve will pass for a 1 kPa pressure drop. It is represented by the relationship:</p> $K_v = Q/\sqrt{\Delta P},$ <p>Where: K_v = No. of L/s of water at 1 kPa differential</p> <p> Q = Flow rate in L/s</p> <p> ΔP = Pressure drop in kPa</p> <p>K_v relates to the metric designation and C_v is the equivalent imperial flow coefficient.</p> $K_v = 0.853 C_v \text{ and } C_v = 1.16 K_v$
Flush water line:	<p>Is the feedwater pipework that connects water or reclaimed effluent to a sewage pump mechanical seal for the purpose of flushing.</p>
Follow the flow:	<p>Is a system of sewage pumping whereby the incoming sewer connects directly to the suction distributor in a dry well pump station and thence</p>

into individual pump suction without utilising a wet well. Pumps are required to continuously follow the incoming flow rather than operate at set control levels as in a wet well.

Foundation block:	Is the concrete support base provided to accommodate the pumpset baseplates and is normally tied into the pump station floor. It provides a critical mass, which is important in providing structural rigidity and vibration damping.
Free air delivery:	Free air delivery (FAD) of a compressor is the volume of air delivered measured at atmospheric pressure. Increasing the delivery pressure produces a corresponding reduction in FAD. To compensate, two or more stages of compression may be used with intercooling provided between each stage and/or aftercooling. The requirement to provide staging is determined by the volumetric efficiency of the compressor, which is defined as the ratio of the free air delivery to the swept volume.
Frequency:	Is the inverse of the time taken for a particle in a vibrating system to complete a full cycle of motion.
Friction head:	Is the equivalent head that is required in order to overcome friction losses in pipework.
Fundamental frequency:	Is the mode of vibration of a system that has the lowest natural frequency.
Galling:	Occurs when materials of similar hardness in contact with each other and subject to relative motion 'pick up', 'seize' or weld together.
Galvanic corrosion:	Is the bi-metallic corrosion that occurs when two dissimilar metals are in contact and immersed in an electrolyte. The two metals form an electrolytic cell in combination with the electrolyte with the less noble or anodic metal being subject to corrosion. The rate of corrosion is dependent on the relative position of each metal in the galvanic series. The greater the difference the higher the rate of corrosion of the anodic metal. The anodic metal will corrode until it disappears and only then will the other metal be subject to corrosion. This is the principle used for cathodic protection e.g. zinc anodes in a hot water system protecting the steel water heater shell. <i>Refer also cathodic protection.</i>
Galvanizing:	Is a generic term for the application of either zinc plating or hot dip (zinc) galvanizing to ferrous items. <i>Refer zinc plating and hot dip galvanizing.</i>
Gasket:	<i>Refer flange gasket.</i>
Gate valve:	Is a copper alloy or ductile iron isolating valve with a rising or non-rising stem that employs a guided metal or resilient wedge onto a body seat to effect a seal. <i>Refer also globe and sluice valves.</i>

Gauge pressure:	Is the pressure registered by a pressure gauge and is represented by the pressure above the atmospheric pressure at the particular site altitude.
General purpose butterfly valve:	Is a wafer or lugged light-to-medium duty butterfly valve that the Corporation uses on non-critical above ground applications. <i>Refer also butterfly valve.</i>
Globe valve:	Is an isolating or stop valve, which is configured so that the axis of the stem is at right angles to the seat faces. The stem and disc assembly has a relatively short movement from open to closed and has a very positive seating action. This allows accurate regulation and throttling service. Immediately the disk lifts away from the seat all contact between components is eliminated so that mechanical wear is minimised.
Graphitic corrosion:	Is the corrosion of grey cast iron or ductile iron whereby the iron component of the metal is leached out to leave a soft porous graphite matrix that, whilst it appears sound, is soft and has lost its inherent strength. The corrosion products form tubercles which in small waterways can restrict flow and reduce hydraulic efficiency. When dislodged can cause dirty water.
Green water:	<i>Refer cuprosolvency and microbiological influenced corrosion.</i>
Harmonic:	Is an integral multiple of a fundamental frequency e.g. 256, 512, 768 Hz are the first, second, and third harmonics of 256 Hz.
Hardened washer:	Is a washer of similar hardness to a fastener, designed to resist the effects of galling at high preloads, which would otherwise occur, due to the head of the bolt or nut bedding into the clamped material, resulting in preload loss.
Hardness of materials:	Is the ability of a material to resist permanent penetration by a much harder body. Various methods are used to determine the hardness of metals including Brinell, Vickers and Rockwell. The material is indented by a hardened steel ball, diamond pyramid or cone under a prescribed load and the size of the resulting impression is then measured and this equates to a hardness number. There is an empirical relationship between hardness and tensile strength of steel and the hardness number is often used as a guide to the tensile strength e.g. 229 Brinell = 772 MPa. <i>Refer also Brinell Hardness, Rockwell Hardness and Vickers Hardness.</i>
Header:	Compressed air or gas main distribution pipe.
Head loss	The irreversible energy (as pressure) lost in the process of transporting a fluid through pipe, channel, ductwork, or associated fittings due to the frictional forces acting on the fluid. For fluids flowing with high Reynolds number additional losses are experienced

	due to the occurrence of turbulence. <i>See also Reynolds Number.</i>
High performance butterfly valve:	Is a flanged heavy duty butterfly valve that the Corporation uses on critical above and below ground locations generally on high velocity applications e.g. dam guard valves etc. <i>Refer also butterfly valve.</i>
High recovery factor:	The flow characteristic of a valve that allows it to pass flow without incurring a large pressure drop, thus allowing the downstream pressure to recover close to the upstream pressure e.g. gate, sluice, plug, ball, butterfly have high recovery factors. <i>Refer also pressure recovery.</i>
Horizontal pump:	Is a pump with a horizontally oriented pump shaft.
Horizontal-split casing pump:	Is an axially split centrifugal pump with a horizontal shaft. <i>Refer also axial-split, vertical-split and radial-split casing pumps...</i>
Hose connection vacuum breaker:	A device fitted to a hose tap to prevent backflow in a water reticulation system caused by either back-siphonage or back-pressure, which operates automatically to admit air into the system under back-siphonage conditions and vents the system to atmosphere under back-pressure conditions.
Hot dip galvanizing	A process of immersing ferrous products into a bath of molten zinc to provide a corrosion inhibiting coating. <i>Refer also galvanizing and zinc plating.</i>
H-Q characteristic curve:	<i>Refer characteristic curve.</i>
Hydrant:	Is a form of isolating valve that is fitted to distribution pipelines to allow ready access to the water via a standpipe for firefighting and other purposes. <i>Refer also to screw down hydrant and spring type hydrants.</i>
Hydraulic efficiency:	<i>Refer pump efficiency.</i>
Hydro-dynamic torque:	The torque required to operate a butterfly valve disc during operation as a function of the dynamic flow conditions and the valve disc position.
Hysteresis:	Is the maximum difference in output value for any single input value during a calibration cycle, excluding errors due to dead band.
Impeller:	Is the hydrodynamic component of a pump that imparts velocity to the fluid. <i>Refer also to closed, open, semi-open and vortex impeller types.</i>
Impeller eye:	<i>Refer suction eye.</i>
Impeller wear rings:	A replaceable metal ring fitted to the impeller neck at the suction that provides seal clearance with the pump casing wear ring in order to reduce high pressure leakage from the discharge to the suction. They are also known as wear rings and are designed to be replaced when wear clearances are sufficiently large to degrade the pump performance (refer also casing wear ring). It is also known as an impeller seal ring.

Impeller shroud:	The outside surfaces of a centrifugal pump impeller that enclose the impeller vanes.
Impressed current system:	Is a cathodic protection system that utilises an electric current passing through a bonded metallic system for corrosion mitigation.
Incipient cavitation:	Is initial or minor cavitation that is unlikely to cause serious damage.
Inflatable packer:	Is a special packer fitted to a borehole pump that can be inflated from the surface to seal and lock between the pump and bore casing to provide a columnless pumping system. <i>Refer also packer.</i>
Inferential meter:	<i>Refer turbine meter.</i>
Inlet:	Is the upstream nozzle of a pipework component e.g. flowmeter, valve or fitting. <i>Refer also suction.</i>
Instrument air:	Is compressed or service air of instrument quality used for operating instrumentation and associated pneumatic devices.
Intake:	<i>Refer suction</i>
Interconnecting pipework:	Pipework running from the compressor outlet to the header.
Intergranular corrosion:	Occurs in stainless steel where the grain boundaries are depleted of chromium. Heating and cooling during welding using high or medium carbon stainless steels produces chromium carbides that precipitate at the grain boundaries thus depleting chromium and leaving the boundaries vulnerable to corrosion. Use of low carbon stainless steels ($\leq 0.03\%$) or those containing titanium or niobium will mitigate against intergranular corrosion. <i>Also referred to as weld decay or weld sensitisation.</i>
Journal Bearing:	<i>Refer to sleeve bearings.</i>
Kinetic air valve:	Is an air valve that is able to discharge air at high velocity and high differential pressure without suffering dynamic closure. A kinetic air valve only closes when differential air pressure exceeds 20 kPa, or water enters the valve chamber and buoys the float into the closed position.
Knife gate valve:	Is an isolating valve used for low head applications where the fluid contains solids e.g. sewage. The valve comprises a sliding plate with a bevelled semi-circular leading edge that can cut through solids that may be fouling the seat during closing.
Lattice blade butterfly valve:	<i>Refer to Butterfly valve.</i>
Lenticular blade butterfly valve:	<i>Refer to Butterfly valve.</i>
Lift non-return valve:	Is a non-return valve in which the disc and body seat is configured similar to a globe valve except that the disc, which is guided, is free to move axially.

Lomakin effect:	A self-centering hydrodynamic effect caused by water flowing through small annular areas.
Long coupled:	Is a pumpset configuration whereby the pump is direct coupled to a driver e.g. electric motor using a flexible or spacer coupling requiring mounting on a common baseplate.
Low water level:	Low water level (LWL) is the lowest operating level that applies to a tank, reservoir, dam or other water body. <i>Refer also to top water level.</i>
Major pump station:	<i>Refer pump station.</i>
Manifold:	<i>Refer suction manifold and discharge manifold.</i>
Martensitic stainless steels:	Were the first industrial stainless steels developed. Common grades include 410, 420 and 431. Martensitic stainless steel contains varying chromium from 12% - 18% and with a high carbon content. Features of martensitic stainless steels are moderate corrosion resistance, hardenable by heat treatment with high strength and hardness available but with poor weldability. Used industrially for shafts, fasteners, impellers, spindles and springs. <i>Refer also austenitic, duplex, martensitic and stainless steel.</i>
Mechanical seal:	An assembly comprising separate rotating and stationary elements having optically ground mating faces that are fitted to a pump shaft and casing respectively for the purpose of sealing-in the pumping fluid. A balanced mechanical seal solves the high pressure fluid problem that normally produces excessive sealing forces at the seal faces on an unbalanced seal. They are configured so that the fluid pressure acting on the rotating seal half limits the magnitude of the bearing load that is applied to the seal faces.
Microbiological influenced corrosion:	Is bacteria caused corrosion mechanism in copper, stainless steel and other metal pipe. MIC produces cuprosolvency or blue water in copper pipe. It occurs in cold water applications where water disinfection is below levels that can control it. – <i>Refer also cuprosolvency.</i>
Minimum tension:	Is the theoretical minimum tension the required tightening torque should achieve for a bolted joint design and should be approximately 65% of proof load of the bolt.
Minor pump station:	<i>Refer pump station.</i>
Mixed flow pump:	A centrifugal pump with an impeller that imparts combined centrifugal and axial flow to the fluid.
Motor efficiency:	Is a ratio of the power output developed by a motor versus the power input to the motor for that particular output.

Motor shroud:	Is a corrosion resistant casing that is fitted over a borehole submersible electric pumpset in order to direct flow over the motor at an acceptable cooling velocity.
Motor stool:	A fabricated steel base used to support a vertical motor and generally bolted to a concrete foundation block. <i>Refer also bedplate, and pump stool.</i>
Multistage:	Is the assembly of two or more pump casings or impellers on a common shaft operating in series, the second and subsequent impellers taking their suction flow from the discharge of the preceding impeller. Pumps can have a single casing or multiple stage casings.
Natural frequency (of a shaft):	Occurs when a component of elastic material rotates at a speed which coincides with its natural period of vibration or resonance frequency. At this speed minor imbalance will be magnified causing vibration and if unrestrained could cause failure. This speed is also called the critical speed. A finely balanced shaft could operate satisfactorily at the critical speed. <i>Refer also critical speed, rigid shaft and flexible shaft.</i>
Needle valve:	Is a type of globe valve designed to provide precise flow control. The disc or plug, which is generally integral with the stem, is tapered to a needle-point and is moved accurately into the body seat via a fine thread pitch in order to provide precise flow regulation. They are only available in small sizes.
Net positive suction head:	<p>NPSH is the absolute inlet total head above the head equivalent to the vapour pressure relative to the NPSH datum plane:</p> $\text{NPSH} = H_1 - Z_D + (p_{\text{amb}} - p_v) / \rho_1 g$ <p>where H_1 = inlet head Z_D = NPSH datum and ref. plane differential p_{amb} = inlet pressure at ambient temperature p_v = vapour pressure ρ_1 = density g = gravity</p> <p><i>Refer also net positive suction head available (NPSHA) and required (NPSHR).</i></p>
Net positive suction head available:	NPSHA as determined by the conditions of the installation for a specified flow rate. That is, NSPHA is NPSH minus head loss up to the suction of the pump. <i>Refer also NPSH, NPSHR and Head loss.</i>
Net positive suction head required:	NPSHR is the minimum NPSH given by the manufacturer/supplier for a pump achieving a specified performance at a specified flow rate, speed and pumped

	liquid (occurrence of visible cavitation, increase of noise and vibration due to cavitation, beginning of head or efficiency drop of a given amount, limitation of cavitation erosion). <i>Refer also NPSH and NPSHA.</i> $NPSHR = NPSH3$ plus a margin determined by the manufacturer
Net positive suction head 3:	NPSH required for a drop of the total head of the first stage of the pump as a standard basis for use in performance curves.
Nominal diameter:	An ISO standards 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.
Nominal pressure:	Is an ISO standards alphanumeric designation for pressure rating which is used for reference purposes. It comprises the letters PN (nominal pressure) followed by a dimensionless whole number, which is directly related to the pressure rating of a pump or pipework component e.g. PN 16 is equivalent to 1600 kPa.
Non-clog pump:	A centrifugal pump designed to pump liquids containing suspended solids and stringy material such as would be present in sewage without clogging.
Non-kinetic air valve:	Is an air valve that tends to close prematurely at low pressure differentials e.g. $< 7\text{kPa}$ due to dynamic closure. Non-kinetic air valves should not be used in Corporation applications. <i>Refer also kinetic air valve.</i>
Non-overloading power:	Is the maximum power requirement for a pump or machine over its operating range for a particular speed and impeller diameter.
Non-return valve:	A pipeline valve that prevents reverse flow. Non-return valve is the preferred terminology for this Standard in lieu of check valve.
Nozzle check valve:	<i>Refer rapid response non-return valve</i>
One way tank:	<i>Refer surge tank.</i>
Open impeller:	Is an impeller that in theory has no shrouds or sidewalls with only vanes attached to a central hub. In reality this would lead to a very weak structure so a partial shroud is generally incorporated. The pump casing sideplates are used to control the impeller clearances. Open impellers are normally used in small pumps to handle abrasive fluids. <i>Refer also to closed, semi-open and vortex impellers.</i>
Orifice:	Is a hole in a pipework fitting through which fluid can flow in a hydraulic system.
O-ring:	An elastomeric ring that is used to seal a joint or to seal two dynamic pressure conditions.

Outlet:	Refers to the downstream nozzle of a pipework component e.g. flowmeter, valve or fitting. <i>Refer also to discharge.</i>
Outlet dropper:	Compressed air pipework running from the header to the point of use.
Overall efficiency:	Is the combined efficiency of the pump and driver and represents the product of the pump efficiency and the driver efficiency.
Packed gland:	Is an adjustable assembly comprising seal packing between a casing and pump shaft which is compressed axially to prevent leakage of pumped fluid. A small amount of leakage is required to provide lubrication and cooling of the packing. It is also referred to as a packing gland or stuffing box. Packed gland is the Corporation preferred term.
Packer:	Is a borehole fitting generally used to seal between the bore casing and borehole screen. <i>Refer also inflatable packer.</i>
Parallel pumping:	Occurs when two or more centrifugal pumps discharge into the same delivery manifold. The combined characteristic curve is obtained by adding the flows for each pump for a given head.
Passivation (Stainless Steel):	<p>Passivation of stainless steel is a chemical treatment process that is used to remove contaminants from the surface of the material and to accelerate restoration of the natural corrosion inhibiting passive film of the cleaned surface.</p> <p>Passivation involves treatment of the surface of the stainless steel with acid solutions or pastes e.g. nitric acid.</p> <p>Contamination results from fabrication and machining processes or mechanical damage whereby carbon steel or other particles may become embedded into the stainless steel surface e.g. turning, grinding etc.</p>
Penstock:	Is a single faced valve comprising a sliding rectangular or circular gate or door that moves vertically or horizontally between guides attached to a frame. They are used for controlling large volumes of water or sewage in channels and tanks.
Pickling:	<p>Is a chemical treatment process used for the removal of high temperature scale and adjacent layers of low chromium that may be present in stainless steel as a result of the application of heat.</p> <p>Welding and heat treatment of stainless steel sufficient to present a coloured oxide layer in the heat affected zone produces depletion of chromium in this surface layer.</p> <p>Accordingly lower chromium levels produce lower corrosion resistance in the stainless steel surface.</p> <p>It is necessary to remove the heat affected layers to restore the original quality of the surface and this is done either by</p>

the application of pickling solutions or pastes or by electropolishing.

Pickling pastes are commonly used to treat chromium depleted oxide layers in heat affected zones associated with welds. Pickling pastes contain a mixture of nitric and hydrofluoric acids.

Pinch valve: Is a type of valve that utilises a flexible tube that is pinched together to close it.

Pilot valve: Is a small valve used to control the supply to a large valve for the purpose of controlling the operation of the large valve.

Pipe schedule: For a pressure pipe is a number used to designate wall thickness. The larger the number the thicker the pipe wall and therefore higher the pressure rating e.g. DN300 sch 40 pipe has a 324 and 10 mm outer diameter and wall thickness respectively whereby a DN300 sch 10 has the same outer diameter, it has a 4.57 mm wall thickness instead.

Pipework: Refers to pipe, fittings, valves and other appurtenances.

Pitting corrosion: Occurs in stainless steels in the presence of chlorides and halides often initiated as a result of manganese sulphide inclusions. The resulting microscopic pit is subject to rapid and destructive propagation if the rate of attack does not allow passivating of the surface to establish. Low manganese stainless steels ($\leq 0.3\%$) offer a corrosion mitigation option that can be as effective as a higher grade and therefore more expensive stainless steels.

Pitting resistance equivalent number: Is a measurement of the relative resistance particular stainless steel variants have to corrosion. Generally, the higher the PREN value the more corrosion resistant a flavor of stainless steel. Determination of the PREN is specified by ASTM G48 but can be estimated by;

1. For ferritic and martensitic stainless steel grades,

$$PREN = \%Cr + 3.3(\%Mo)$$

Where the concentrations are in weight (%).

2. For austenitic and duplex stainless steel grades,

$$PREN = \%Cr + 3.3(\%Mo) + x(\%N)$$

Where x = 16 for duplex stainless steels,

x = 30 for austenitic stainless steels

Plant air:	Air supplied by a blower as an integral part of a process such as backwash air and diffused aeration in wastewater treatment plants.
Plug valve:	Is a derivation of the simple cock that incorporates a cylindrical or tapered plug which can be rotated relative to the body inlet and outlet ports to control or isolate flow. The plug rotates a quarter turn (90°) from fully open to fully closed. They are available in concentric and eccentric plug designs.
Podger spanner:	Spanners that are graded in length in relation to bolt size and strength, and are for example, are of the order of 450 mm long for M20 high strength structural bolts, and 600 mm long for M24 high strength structural bolts.
Point (efficiency):	Is a single percentage of efficiency of a pump e.g. 1 point = 1%, 2 points = 2 % etc.
Port:	Is an opening in a valve through which fluid flows when the valve is in the open position.
Positioner:	Is a device for varying and maintaining the actuator position in control valve.
Potable water:	<i>Refer to drinking water.</i>
Precipitation hardening stainless steel:	Is a type of stainless steel containing typically 17% (min) chromium that can be strengthened through precipitation hardening heat treatment.
Preload (fasteners):	Preload is the tension induced in a fastener when first tightened, and tends to reduce after a period of time due to embedding and other factors.
Pressure class (pression nominal):	A classification of pressure by PN number, based on the allowable operating pressure (AOP) expressed in bars.
Pressure recovery:	Is the difference between the minimum pressure at a valve's vena contracta and the maximum pressure at the valve's outlet. <i>Refer also high recovery factor.</i>
Pressure reducing valve:	Is a valve that automatically reduces its upstream pressure to a set downstream pressure and maintains the set pressure irrespective of long-term steady state fluctuations in the upstream pressure or changes in the flow rate. There are two types of valves e.g. direct acting and pilot controlled. <i>Refer also control valve.</i>
Pressure surges:	Are rapid fluctuations of pressure in a pipework system caused by sudden changes of fluid velocity e.g. shut down or startup of a pump, rapid valve operation, venting of air from pipelines during filling, power failure causing pump shut down etc. <i>Refer also slow closure.</i>
Pressure sustaining valve:	Is a valve that automatically maintains its upstream pressure to a set point irrespective of changes in the flow rate. The valve increasingly opens with higher upstream pressure and progressively closes with falling upstream

	<p>pressure. There are two types of valves e.g. direct acting and pilot controlled. <i>Refer also control valve.</i></p>
Pressure type vacuum breaker:	<p>A device to prevent backflow caused by back-siphonage. It incorporates a force loaded ventilation valve, which operates automatically to admit air into the downstream chamber of the valve whenever the pressure in the chamber reduces to 7 kPa.</p>
Prime:	<p>Is the required condition for a centrifugal pump to operate where the suction pipework and pump casing are full of water. Centrifugal pumps will not pump when air is present in the eye of the impeller. <i>See flooded suction.</i></p>
Prime mover:	<p><i>Refer driver.</i></p>
Process and instrument diagrams:	<p>Are the schematic representations of a pump station or flow process which are used to define or specify:</p> <ul style="list-style-type: none">(a) the functionality and control of each system in the process(b) pipework sizes and components e.g. valves, control and monitoring equipment(c) equipment rating and power requirements(d) control methodology
Process flow diagram:	<p>Is a schematic outline of the overall processes relating to a plant which includes the major control instrumentation and equipment to be used. The process flow diagram does not normally include the pipework sizes or detailed instrumentation.</p>
Product grade:	<p>Refers to the quality of the product (specifically relating to fasteners) and the size of the tolerances - product grade A is the most precise and product grade C is the least precise.</p>
Production pump:	<p>Is a pump that is produced as a standard production item and is therefore generally available 'off the shelf' from a supplier with a relatively short delivery time. <i>Refer also to engineered pump.</i></p>
Proof load (fastener):	<p>The proof load of a bolt, screw or stud is the specified load the product must withstand without permanent elongation and the test point for actual proof load testing. Proof load of a nut is the axially applied load the nut must withstand without thread stripping or rupture.</p>
Propeller fan:	<p><i>Refer to Fans.</i></p>
Property class:	<p>A designation system which defines the strength of a bolt or nut. For metric fasteners, property classes are designated by numbers where increasing numbers generally represent increasing tensile strengths. The designation symbol for bolts consists of two parts:</p> <ol style="list-style-type: none">1. The first numeral of a two digit symbol or the first two numerals of a

three digit symbol approximates 1/100 of the minimum tensile strength in MPa.

2. The last numeral approximates 1/10 of the ratio expressed as a percentage between minimum yield stress and minimum tensile stress.

Hence a fastener with a property class of 8.8 has a minimum tensile strength of 800 MPa and a yield stress of $0.8 \times 800 = 640$ MPa.

The designation system for metric nuts is a single or double digit symbol. The numerals approximate 1/100 of the minimum tensile strength in MPa. For example a nut of property class 8 has a minimum tensile strength of 800 MPa. A bolt or screw of a particular property class should be assembled with the equivalent or higher property class of nut to ensure that thread stripping does not occur.

Pump:

Is a driven machine that imparts kinetic and potential energy to a fluid entering causing it to discharge or flow from the machine. The most common type of pump is the centrifugal type. *See also centrifugal pump.*

Pump duty power:

Is the actual power required (at the pump driven shaft) to meet the pump duty and is a function of water power divided by the pump efficiency e.g. In pump/motor units the Pump duty power is often designated P_2 to differentiate from electrical motor input power P_1

$$P_d = \rho QgH/1000 \eta_p$$

Where: P_d = pump duty power in kW

Q = flow in L/s

g = gravitational constant in m/s^2

H = head in m

η_p = pump efficiency

ρ = fluid density

See also water power and pump efficiency.

Pump efficiency:

Is the ratio of water power versus the actual pump duty (shaft) power e.g.

$$\eta_p = P_w / P_d$$

Where: η_p = pump efficiency

P_w = water power in kW

P_d = pump duty power in kW

See also water power.

Pumping water level:

Pumping water level (PWL) is the constant water level that the water in a bore draws down to during

pumping. *Refer also to drawdown, water rest level and zone of influence.*

Pump-out vanes:

Are vanes incorporated on the back shroud of an impeller to reduce pressure at the back hub due to hydraulic imbalance and thereby reduce the thrust bearing size. There is a small efficiency penalty in this feature. They can be used as an alternative to impeller balance holes. They also serve the dual function of expelling grit and solids from the back hub thus protecting the gland or seal area. *Refer also balance holes.*

Pump performance curves:

Are plots of various pump performance parameters against quantity for a given speed e.g.:

- (a) Head
- (b) Efficiency
- (c) Power
- (d) NPSHr

See also characteristic curves.

Pumpset:

Is a generic term for the pump, pump driver (e.g. motor) and baseplate.

Pump station:

An engineered structure containing pumps and pipework for the purpose of delivering water or sewage. Pump stations are separated into major and minor types. A major pump station is normally defined as having one or more of the following:

- (a) pumps that are engineered or custom built (not off the shelf items); or
- (b) a maximum flow greater than or equal to 100 litres per second; or
- (c) a maximum total dynamic head greater than or equal to 160 metres; or
- (d) the product of the head (m) and flow (l/s) greater than 12000.

NOTE: Table 1.1 contained in DS30-02 is provided as a guide to allow differentiation between major and minor pump stations.

Pump stool:

A fabricated steel base used to support a vertical pumpset and generally bolted to a concrete foundation block. *Refer also bedplate and motor stool.*

Pump unit:

Refer pumpset.

Quantity:

The pump discharge or flow expressed as ML/d or L/s.

Radial-split casing pump:

A centrifugal pump, which has its casing radially split i.e. at right angles to the pump shaft centreline. The axis of rotation determines whether the pump is horizontal-shaft or vertical-shaft. *Refer also axial-split, horizontal-split and vertical-split casing pumps.*

Radial thrust:	Is the hydraulic force exerted by an impeller onto a pump shaft. For a single volute pump the hydraulic forces are balanced at the BEP. However as the pump is increasingly operated away the BEP so the radial thrust progressively increases on the pump shaft, causing bending and increased radial load on the bearings. <i>Refer also double volute pump and single volute pump.</i>
Raised-face flange:	Is a flanged end connection for a valve or pipe that is in the form of a hub surrounding the bore which protrudes beyond the rest of the flange face.
Rapid response non-return valve:	Is a high performance non-return valve with high dynamic response specifically designed to minimise slamming on closure. Also referred to as nozzle check valve.
Raw sewage:	Is sewage that has not been subject to treatment apart from perhaps maceration or screening.
Recirculation:	Is an undesirable condition that occurs when a pump is operated too far to the left of its BEP producing suction or discharge recirculation. Flow reverses within the impeller that can produce cavitation-forming vortices, which can damage the impeller and cause noise and vibration. <i>Refer also discharge recirculation and suction recirculation.</i>
Reduced pressure zone device:	A device designed to prevent backflow caused by either back-siphonage or back-pressure in a water reticulation system. It incorporates two independently operating force loaded non-return valves and automatically drains to waste, whenever the pressure in the system between the upstream and downstream non-return valves reduces to a pressure not less than 14 kPa below the pressure at the inlet to the upstream non-return valve.
Reflux valve:	<i>Refer non-return valve.</i>
Resistivity:	Is the level of resistance to electrical current flow in a soil and is also referred to as soil resistivity.
Resonance:	Is a phenomenon whereby a vibrating system develops maximum amplitude under the influence of an exciting force. Resonance only occurs at the vibrating system's natural frequencies.
Resistance coefficient <i>K</i> :	Is the number of velocity heads lost during the flow of fluid through a valve or pipe fitting. The head loss in straight pipe for a pump station is small compared with the losses caused by flow direction changes and turbulence produced by pipework valves and fittings. <i>K</i> is generally considered to be independent of the friction factor or Reynolds number and therefore can be considered constant for valves and fittings for all flow conditions including laminar. The relationship is expressed as follows: $h_f = K V^2 / 2g$

Where: h_f = friction head in m
 K = resistance coefficient - dimensionless
 V = pipe velocity in m/s
 g = acceleration due to gravity in m^2/s

Reverse rotation:

Is caused by the reverse flow of water through a pump so that it acts like a water turbine. The water turbine action will:

- (a) cause reverse rotation in electric motors
- (b) not normally cause reverse rotation of internal combustion engines
- (c) produce a maximum speed in an electric motor that will be a function of net head and runaway speed of the pump.

Refer also runaway speed.

Reynolds number:

Is a dimensionless number used to define the type of flow e.g. laminar, unstable or turbulent. The relationship is expressed as follows:

$$Re = 1000vd/\nu$$

Where: Re = Reynolds number
 v = velocity in m/s
 d = diameter in mm
 ν = kinematic viscosity in centistokes

For $Re < 2000$ – laminar; $2000 < Re < 4000$ – unstable; $Re > 4000$ turbulent.

Rigid shaft:

Is a shaft designed to operate at a speed below the critical speed. *Refer also critical speed, natural frequency and flexible shaft.*

Rockwell hardness:

Is the specific hardness of a material measured by comparing the size of an indentation against a standard scale. Rockwell hardness values are expressed as a combination of a hardness number and a scale symbol representing the indenter and the minor and major loads. The indenter may be either a diamond cone or steel ball, depending upon the characteristics of the material being tested.

There are 30 different scales. The majority of applications are covered by two hardness scales namely Rockwell B (HRB) and Rockwell C (HRC) for testing steel, brass, and other metals. *Refer also Brinell Hardness, Hardness and Vickers Hardness.*

Rotating element:

Comprises the pump rotating components that can be removed or replaced as an assembly from the pump casing without the need to disturb the volute.

For axial-split casing pumps it includes the shaft, impellers, wear rings, bearings, packed glands or mechanical seals and driven half of the flexible coupling as a complete assembly.

For radial-split back pull out pumps it includes the bearing housing, shaft, bearings, impeller and wear rings as a complete unit.

- Runaway speed: Is the maximum speed generated by a pump during reverse rotation and is dependent on the specific speed of the pump. Higher specific speeds have higher runaway speeds. Generally the runaway speed of the pump for a specific installation does not exceed the safe operating speed of the pump. *Refer also reverse rotation.*
- Screen: Is a corrosion resistant borehole fitting that is located in an aquifer to facilitate inflow of water into a bore to optimise abstraction. The screen is constructed with a spiral wound wire over vertical bars. The wire has a horizontal trapezoidal section with the larger of the parallel sides located to the outside surface. This provides a non-clog profile to the surrounding sand allowing grain sizes smaller than the designed slot width to pass into the screen during bore development.
- Screw-down hydrant: The Corporation hydrant is a valve used principally for fire fighting purposes that incorporates a screw and large jumper valve assembly as the actuating and sealing components respectively. The screw is operated to open the hydrant. *Refer also hydrant and spring hydrant.*
- Seat: Is a valve sealing face that the dynamic mating seal element closes towards in providing flow control or shut off.
- Semi-open impeller: Comprises vanes and a back shroud that also may incorporate pump-out vanes. *Refer also open and closed impellers.*
- Semi-positive meter: *Refer volumetric chamber meter.*
- Series pumping: Is where two pumps are configured so that the discharge piping of the first pump is connected to suction of the second producing a combined curve in which the individual heads are added for a given flow. The second pump must be rated to handle the increased discharge head.
- Service air: Is compressed air used in a facility for operating pneumatic equipment.
- Service factor: A multiplier applied in order to adjust the rating of a machine or ancillary component to cater for specific conditions, e.g. a different factor for light, medium or heavy duty service.

Set point:	Is an input value that determines the best desired position of a controllable device.
Sewage:	Is normally ascribed to domestic wastewater but also can contain industrial wastewater.
Sewerage:	Relates to the scheme whereas sewage relates to the waste product.
Shaft sleeve:	A cylindrical component that is fitted to the pump shaft in the area of the packed gland to act as a wearing surface in order to protect the shaft. <i>Refer also packed gland.</i>
Shaft stiffness ratio:	<p>Is a value that uses ratio of a pump shaft length to its diameter to specify its resistance to deflection and is defined by the following relationship:</p> $S_r = L^3/D^4 \text{ mm}^{-1}$ <p>Where:</p> <p>S_r = stiffness ratio</p> <p>L = Distance from the impeller centreline to the bottom bearing in mm</p> <p>D = Pump shaft diameter to the bottom bearing in mm</p> <p>Ideally S_r should be less than 0.1 mm⁻¹ for large sewage pumps e.g. > 1500 L/s.</p>
Shut-off head:	The head developed by a centrifugal pump at zero flow i.e. as would occur when pumping against a closed discharge valve.
Single spring-flap non return valve:	The single-spring flap type non-return valve is a compact valve that employs a spring loaded disc that is hinged at the top of the valve allowing it to swing away or towards a vertical body seat.
Single volute pump:	Is a pump with a volute configuration in which the radial thrust on the shaft is zero at BEP but progressively increases as the pump duty moves away from it. <i>Refer also double volute pump and radial thrust.</i>
Sleeve bearings:	Are plain cylindrical journal bearings that are normally oil lubricated. Generally only used for special applications e.g. very large shafts, high speed duties and water lubricated lineshafting. <i>Refer also antifriction and babbitt bearings.</i>
Slow closure:	Relates to a valve closing time that may or may not cause undesirable pressure surges or water hammer. Valves with desirable closures are those that comply with the following relationship:
	$t_c = 2L/C_p$ <p>Where: t_c = Critical closing time in secs</p> <p>L = Length of pipe in m</p>

C_p = Velocity
(Celerity) of pressure wave in the fluid
m/s

For instantaneous valve closure in non elastic pipe carrying water $C_p \sim 1440$ m/s.

For more realistic non instantaneous closure in elastic pipe $C_p \sim 600$ m/s to 1200m/s.

The pressure rise ΔP can be expressed for a valve closure causing a change in velocity of the water flow Δv as:

$$\Delta P = C \Delta v / g$$

Where ΔP = Pressure change in m

C = Celerity in m

Δv = Change in water velocity in m/s

g = Gravitational constant m/s²

For $C = 1440$ m/s ΔP can be ~ 140 times initial velocity if the water velocity is reduced to zero ($\Delta v = v$) instantaneously. For more realistic situations ΔP can still be of significant magnitude.

If $t_c \leq 2L/C_p$ then the pressure wave will reach a maximum.

If $t_c > 2L/C_p$ then the pressure wave will have returned to the valve before the valve is fully closed considerably reducing ΔP .

Sluice valve:

A ductile cast iron waterworks isolating valve with a non rising stem that employs either a resilient or metal wedge which contacts either the body waterway or metal seats to effect a seal. AS 2638 formerly referred to ‘sluice valves’ but changed terminology to ‘gate valves’ with the inclusion of general purpose gate valves into the standard which can be either rising or non-rising stem. *Refer also gate valve.*

Snug tight:

The full effort of a fitter on a standard podger spanner, or the point at which there is a change in the note or speed of rotation when a pneumatic impact wrench begins impacting solidly on a fastener.

Soil resistivity:

Refer resistivity.

Sound power level:

Sound power is the integral of the intensity at some point in space over a surface area that is perpendicular to the flow of sound energy. i.e.: energy radiated per unit time in the form of sound waves.

$$\Pi = \int_S \vec{I} \cdot d\vec{S}$$

Where Π is sound power

I is intensity

S is any closed surface

The sound power of an acoustic source is independent of distance and essentially independent of location - in some instances, the effects of reflecting surface have to be accounted for, i.e.: sound power is largely independent of acoustic properties of its surroundings, it is particular to its source.

$$L_{\Pi} = 10 \log_{10} \frac{\Pi}{\Pi_0} \text{ dBre}\Pi_0$$

Where:

L_{Π} is the sound power level of sound source relative to the reference sound power

Π is the radiated sound power

Π_0 is the reference sound power

$$\Pi_0 = 10^{-12} \text{ W} = 1\text{pW}$$

Sound pressure level:

Sound pressure is the magnitude of small negative and positive fluctuations, i.e. amplitude, occurring at atmospheric pressure.

To define the intensity of a sound source, sound pressure, acoustic properties of the surroundings and the distance from the sound source must be known.

$$L_p = 10 \log_{10} \frac{p^2}{P_{ref}^2} \text{ dBre}P_{ref}$$

Where

L_p is the sound pressure level of sound source relative to the reference sound pressure

p is the radiated sound pressure

P_{ref} is the reference sound pressure

$$P_{ref} = 2 \times 10^{-5} \text{ Nm}^{-2} = 20\mu\text{Pa}$$

Spacer coupling:

Is a flexible coupling that incorporates a removable spool fitted between the driving and driven halves to facilitate removal of the bearing housing and rotating element on a back pullout pump without disturbing the driver e.g. electric motor. *Refer also to flexible coupling.*

Spring hydrant:

Is a valve used principally for fire fighting purposes that incorporates a spring loaded valve assembly as the actuating and sealing components respectively. A screw incorporated in the standpipe is operated to open the hydrant. *Refer also hydrant and screw-down hydrant.*

Specific weight:

Is the weight per unit volume and is expressed in $\text{kg/m}^2\text{s}^2$.

Specific volume:

Is the reciprocal of density and is expressed in m^3/kg .

Specific speed:

The characteristic differences between pumps operating under similar conditions, being the speed

of an ideal pump geometrically similar to the actual pump which when running at this speed will raise a unit of volume in a unit of time through a unit of head. Whilst a specific speed can be calculated for any point on the characteristic curve, it is usually the 'type specific speed' which is used in order to classify or type a particular centrifugal pump. It is calculated for the point on the characteristic curve corresponding to the BEP of the pump operating at its design speed.

Specific Speed $N_s = NQ^{1/2} H^{-3/4}$

Where

Q = Flow rate corresponding to maximum efficiency (m³/s)

H = Total head per stage in m

N = rpm

- (a) For low N_s e.g. <30, Q is low and H is high e.g. radial flow impellers
- (b) For intermediate N_s e.g. 30 to 80, Q and H are of intermediate value e.g. mixed flow impellers
- (c) For high N_s e.g. >80, Q is high and H is low e.g. axial flow (propeller)
- (d) For a double suction impeller half the best efficiency flowrate should be used
- (e) For a multistage pump the best efficiency conditions for the first impeller only should be used

Split case:

Refer axially-split casing pumps.

Spool piece:

A short section of double flanged pipe used as a make up piece or as a spacer to separate ancillary equipment such as pumps and valves.

Stable characteristic curve:

Is a pump characteristic curve where the maximum head occurs at shut-off. *See unstable characteristic curve.*

Stainless steel:

Stainless steel is a generic term referring to corrosion resistant steels containing a minimum composition of 10.5% chromium. All stainless steels have a high resistance to corrosion because of the inherent chromium rich oxide film covering the surface of the material. The oxide film is characterised by rapid self-healing when damaged. Stainless steels however are not indestructible materials and can be subject to corrosion attack. *Refer also austenitic, ferritic and martensitic stainless steels.*

Static head:

Static head is the difference in elevation between the surface of the suction water source and the surface of the discharge destination water body. *Refer also total static head.*

Static suction head:	The vertical distance between the pump casing centreline and the surface of the suction water source when the pump casing is located below the water level.
Static suction lift:	The vertical lift between the pump casing centreline and the surface of the suction water source when the pump casing located above the water level.
Stem:	Is the operating spindle of a gate valve.
Stop log:	Are rectangular structural members constructed generally from metal or timber that are individually fitted into a vertical guide structure to provide bulkhead sealing upstream of a penstock, dam radial gate or other appurtenance.
Stress corrosion cracking:	Occurs in stainless steel and under circumstances whereby the components are either in tension or have residual tensile stresses resulting from its manufacturing process e.g. cold forming, and be subject to immersion in a corrosive fluid. Under these conditions cracking initiates and propagates rapidly in the presence of chlorides that concentrate at the apex of the crack. This further increases the attack increasing the crack or pit size. The process becomes self sustaining until the stress crack is sufficiently large to cause component failure. <i>Refer also crevice corrosion.</i>
Stud bolts:	Is a fastener intended for flanges which threaded at both ends, or threaded for the whole of its length intended for use with a nut at each end.
Stuffing box:	<i>Refer packed gland.</i>
Submersible pump:	A pump or pumpset that has been designed for operation fully submerged in the fluid to be pumped.
Suction bell:	<i>Refer bellmouth.</i>
Suction bend:	Generally refers to the elbow fitted to the suction flange of a vertical sewage pump installed in a dry well.
Suction elbow:	<i>Refer suction bend.</i>
Suction eye:	Is the impeller inlet area immediately upstream of the impeller vanes.
Suction head:	The suction component of total developed head (TDH).
Suction lift:	<i>Refer static suction lift</i>
Suction manifold:	Pipework between the incoming suction main or pipeline and the suction offtakes.
Suction offtake:	The section of pipework between the suction manifold and the pump suction flange.
Suction recirculation:	Is the reversal of flow at the impeller eye due to recirculation and is generally associated with flow significantly below BEP. The high shear rate between the

rotating annulus and the axial flow in the core produces vortices, which form and collapse, producing noise and cavitation in the suction of the pump. *Refer also discharge recirculation and recirculation.*

Suction specific speed:

Is an index used to predict the suction performance limits of various types of centrifugal pumps. The suction performance limits can be used where the pump designed for one application can be examined for use in another application with different inlet conditions i.e.

$$N_{ss} = NQ^{1/2}(NPSHr)^{-3/4}$$

Where: N_{ss} = Suction specific speed

N = Rotational speed rpm

Q = Flow rate in m^3/s

$NPSHr$ = Net positive suction head required in m

Surge:

Refer pressure surges.

Surge tank:

Is a surge mitigating device employing a tank water level at atmospheric pressure. It is used to prevent negative pressures where isolated high elevations occur on a long pipeline. Also known as a one-way tank.

Surge vessel:

Is a surge mitigating device employing a hydro pneumatic pressure vessel. It uses the energy available in the compressed air to maintain flow after a surge.

Swing check non-return valve:

Is a non-return valve that employs a disc that is hinged at the top of the valve allowing it to swing away or towards an angled body seat.

System head curve:

Is a plot of total developed head in m versus flow in L/s to the maximum capability of the pump station and is normally plotted for both maximum and minimum system head conditions.

Taconite seal:

Is a multi-labyrinth seal used for sealing grease lubricated anti-friction bearings from the effects of dust and moisture. The multi-labyrinth section is filled with grease and provides an effective barrier from external contaminants.

Tapping points:

Are drilled and tapped points of attachment on a pump casing or adjacent pipework that allow condition monitoring functions to be achieved. The tapping points are normally provided with integral bosses in the pump casing.

Thermoplastic:

Is a plastic material that characteristically can be repeatedly transformed under the influence of heat and solidifies on cooling. *Refer also thermoset.*

Thermoset:	Is a plastic that characteristically hardens when heated by virtue of an initial chemical reaction but can not be later transformed under the influence of heat. <i>Refer also thermoplastic.</i>
Throttling:	Is when a valve is closed to provide varying degrees of flow, preferably without creating excessive frictional losses or cavitation damage to the valve and downstream pipework. Only valves designed for throttling should be used for long-term throttling service.
Throughlet:	Is the maximum size of solid that a sewage pump impeller can pass. It is normally based on a solid sphere of 75 mm nominal diameter for small pumps. Large pumps can have impeller throughlets of 250 mm diameter, which is more a factor of impeller size than a requirement for larger impeller throughlet.
Tilting disc non-return valve:	Is a type of swing check non-return valve that has its disc pivoted in front of the centre of pressure and is counterweighted on the shaft to close. The disc pivots in the valve waterway and incorporates an aerofoil shape that lifts or floats it, thus providing minimum resistance to flow.
Top water level:	Top water level (TWL) is the highest operating level that is achievable in a tank, reservoir, dam or other water body. <i>Refer also to low water level.</i>
Torque speed curve:	<p>Is the plot of the torque requirement of a pump versus speed during its run up from zero revolutions per minute to operating speed.</p> <p>For low-to-medium specific speed pumps the power, and hence torque requirements at zero or low flow conditions are generally less than the power or torque required at the operating speed duty point.</p> <p>For high specific speed pumps the power, and hence torque requirements at zero or low flow conditions are generally considerably in excess of the power or torque required at the operating speed duty point. As a result the method of starting high specific speed pumps normally requires special consideration.</p> $T = 9549P/N$ <p>Where: T = Torque in Nm P = Power in kW N = Speed in rpm</p> <p>As mentioned, the maximum torque requirement depends on the specific speed of the pump and can be at shut-off or the duty point. The minimum torque requirements during starting are influenced by the system resistance curve and valve operation during starting.</p>

Torque wrench:	A manual wrench which incorporates a gauge or other method to indicate the amount of torque transferred to the nut or bolt.
Torsional vibration:	Is the vibration of a rotating shaft that is magnified when the torsional exciting frequency is close to the shaft torsional natural frequency. Torsional exciting frequencies are created by the shaft rotational speed, the pump impeller vanes passage frequency and drive shaft universal joints. Torsional vibration problems are not as common as translational vibration problems but can be significant should they occur. <i>Refer also vibration, translational vibration and critical speed.</i>
Total developed head:	Total developed head (TDH) is the total head in m that a pump develops for any particular discharge rate in L/s. It comprises the static, friction and velocity head components for the pump suction and delivery system elements.
Total static head:	Is the difference in elevation between the LWL of the suction water source and the TWL of the discharge destination water body.
Transducer:	Is the sensor element of a device that requires a transmitter to convert to a 4 – 20 mA signal e.g. pressure or temperature transducer. <i>Refer also transmitter.</i>
Transients:	<i>Refer pressure surges.</i>
Translational vibration:	Is the lateral deflection or vibration of a rotating shaft away from its “stationary” or “rest” centreline causing “shaft whip” due to shaft or coupling misalignment or imbalance. Translational vibration is significantly magnified at the shaft critical speed. <i>Refer also vibration, torsional vibration and critical speed.</i>
Transmitter:	Is either a separate device that converts output from a transducer to a 4 – 20 mA signal or a generic term for a combined transducer and transmitter e.g. pressure or temperature transmitter. <i>Refer also transducer.</i>
Trim:	Is the material type used in the control or replaceable components of a valve such as the disc or plug and seat.
Turbine meter:	Is a mechanical water meter incorporating a rotor or propeller used for accurate measurement for revenue purposes. They are also known as Woltmann or inferential type meters. Available in sizes from DN 40 to DN150. <i>Refer also to volumetric chamber meter.</i>
Unbalanced mechanical seal:	<i>Refer to mechanical seal.</i>
Unstable characteristic curve:	Is a pump characteristic curve where the maximum head occurs other than at shut-off or where a given head value occurs more than once in the plot.

Upstream:	A reference point in a hydraulic conduit which is located before another reference point in the direction of fluid flow e.g. a pump discharge flange is upstream of a discharge non-return valve. <i>Refer also to downstream.</i>
Upsurge:	A high pressure fluctuation. <i>Refer also to downsurge.</i>
UV embrittlement:	Relates to the degradation of PVC pipe when exposed to ultra-violet (UV) light which causes them to become more brittle. Painting the pipe will eliminate the problem.
Vacuum:	Is a pressure below atmospheric and is represented by a negative pressure gauge reading.
Vacuum sewage valve:	Is an automatic isolating valve that interfaces between a sewage collection chamber and a vacuum sewage collection system. It incorporates a sensor that detects the sewage level in the chamber. At a preset level the detector fires (opens) the valve so that the upstream vacuum empties the chamber. The valve then closes and is ready to fire again when the collection chamber level is reached.
Valve:	Any device, which operates mechanically to control the pressure or flow of fluids.
Valve coefficient:	<i>Refer to flow coefficient.</i>
Velocity:	For a pipe is the average velocity and is a function of the quantity of flow divided by the cross sectional area of the inside of the pipe e.g. $V = Q/A$ Where : V = velocity in m/s Q = quantity in m ³ /s A = m ² .
Velocity head:	Is the kinetic energy of a fluid in motion e.g. $V^2/2g$.
Vena contracta:	Is the position in the fluid flow stream of a control valve where the cross sectional area is at its smallest, the velocity at its highest and the pressure at its lowest.
Ventilation:	For the purpose of this Standard relates to the cooling air requirements of personnel or a driver.
Vertical pump:	A pump with vertical shaft orientation.
Vertical split casing pump:	Is an axial-split pump with vertical pump shaft orientation. Refer also to axial-split, horizontal-split and radial-split casing pumps.
Vickers pyramid hardness:	Is the hardness of a material determined by measuring the size of an indentation utilising a square-based diamond pyramid for a particular load. The Vickers test, which can be used for all metals has one of the widest scales among hardness tests. The test unit of hardness

calculated from the indentation is known as the Vickers Pyramid Number (HV). *Refer also Brinell Hardness, Hardness and Rockwell Hardness.*

Volumetric chamber meter:

Is a mechanical water meter incorporating a rotating piston used for accurate measurement for revenue purposes. It is also known as a semi-positive meter as it has virtually positive displacement characteristics providing a relatively high degree of accuracy. Available in sizes from DN 20 to DN 40. *Refer also to turbine meter.*

Volute:

Refer to casing.

Vortex:

In the context of this Standard, refers to the undesirable fluid rotation on the suction side of a pump, which has the potential to admit trails of air bubbles into the pump. *Refer also to closed, open and semi-open impeller types.*

Vortex impeller:

Is an impeller that is recessed into the pump casing that creates a vortex to induce flow. The fluid passes over the impeller not through it and provides a non-clog characteristic but with lower efficiency than for a channel impeller.

Vibration:

Is the dynamic force created by operating machinery that manifests into translational or rotational shaking forces. Vibration may be magnified at the critical speed of the machine or when one of the machine's driving frequencies coincides with a surrounding structure's resonance frequency.

Vortex plate:

Is a vortex mitigating device fitted at the inlet of a suction pipe.

Wafer:

For Corporation purposes refers to a flangeless valve, which in non-terminating and is fitted between a circle of bolts.

Wastewater:

Is a general term relating to water containing wastes e.g. sewage, commercial and industrial waste.

Water hammer:

Refer pressure surges.

Water power:

Is the theoretical power required to drive a pump e.g.

$$P_w = \rho Q g H / 1000$$

Where

P_w	=	water power
Q	=	flow in l/s
g	=	gravity (9.81 m/s ²)
H	=	head in metres
ρ	=	Fluid density

Water rest level:

Water rest level (WRL) is the stationary water level returned to in a bore after pumping has ceased. *Refer also drawdown, pumping water level and zone of influence.*

Water supply:	Refers to a treated potable water system or part thereof e.g. water supply pump station.
Waterworks:	Refers to all water industry related activities e.g. water, sewerage and drainage.
Waterworks butterfly valve:	Is a flanged heavy duty butterfly valve that the Corporation uses on critical above and below ground pipework. <i>Refer also to butterfly, general-purpose and high performance butterfly valves.</i>
Wear rings:	<i>Refer casing wear rings and impeller wear rings.</i>
Weld decay:	<i>Refer to Intergranular corrosion.</i>
Weld sensitisation:	<i>Refer to Intergranular corrosion.</i>
Welding:	The permanent joining of two pieces of material into a homogenous single piece.
Wet well:	Is a below ground structure which receives sewage from which it is pumped either by submersible pumps or via suction pipework to pumps in an adjacent drywell. <i>Refer also to dry well.</i>
Witnessed pump tests:	Pump tests conducted by a manufacturer at the factory that are witnessed either by the Corporation or by an independent authorised representative.
Yatesmater:	A pump testing device that utilises a thermodynamic method based on the conservation of energy i.e. mechanical shaft power applied to a hydraulic machine is converted into hydraulic energy and thermal energy loss. $Q = P_{gr} \cdot \eta_m / \rho (gH + \Delta T \cdot C_p)$ Where: Q = Flow in L/s P_{gr} = Motor input power in kW η_m = Motor efficiency ρ = Density of fluid g = Gravitational acceleration H = Head in m ΔT = Change in temperature in °C C_p = Specific heat of fluid
Zero Q speed:	The pump minimum operating speed at which the pump can no longer maintain flow against the static head and is pump and site specific. $N_{zq} = N_1 \sqrt{H_{zq} / H_1}$ Where: N_{zq} = zero Q speed e.g. pump speed at zero flow

N_1 = H-Q pump
characteristic curve speed

H_{zq} = Head at zero flow e.g. static

H_1 = Shut off head from H-Q characteristic curve

Zinc plating

The electrolytic application of zinc coating by immersion of ferrous products into a bath of zinc salt solution and application of an electric current. The pure zinc coating which results can vary in thickness from a few microns up to 15 microns. Zinc plated products are not suitable for outdoor applications and will only provide protection for some 12 months in a coastal urban environments before breaking down. *Refer also galvanising and hot dip galvanizing.*

Zone of Influence:

Is where adjacent boreholes interfere with each other's cone of depression when both are being pumped. This causes a higher drawdown than would otherwise occur if only a single bore was operating. *Refer also to drawdown, pumping water level and water rest level.*

3 PREFERRED TERMINOLOGY

The following represents the preferred terms the Designer shall use in Corporation mechanical designs. These terms are referred to throughout the DS 30 series of mechanical standards and also generally in the water industry.

Table 3.1 Preferred Terminology

Preferred Terminology/Units	Non Preferred
Baseplate	Bedplate, foundation plate
Bellmouth	Suction bell
Bend	Elbow
Discharge (pump)	Delivery, outlet
Drinking water	Potable water
Ejector	Injector
Generating set	Alternating set, alternator set, generator set
GRP	FRP
Impeller	Impellor
L/s	l/s
ML/d	MLD, MI/d
Nominal diameter – DN	ND
Non return valve	Check valve ¹ , reflux valve
Packed gland	Packing gland, stuffing box
Pressure main	Rising main
Pumpset	Pump unit, pumping unit
Pump station	Pumping station
Rapid response non-return valve	Nozzle check valve, non-slam NRV
Sewage pump station	Wastewater pump station
Suction (pump)	Inlet, intake
Transmitter	Transducer (which is purely the sensor element)
Wear rings, casing wear rings, impeller wear rings	Seal rings, casing seal ring, impeller seal ring, neck ring, casing ring, impeller ring
Water rest level (WRL)	Standing water level, rest water level

NOTES:

1. The term ‘check valve’ in these standards is generally confined to backflow prevention devices (valves) e.g. double check valve, dual check valve etc.

4 ACRONYMS & SYMBOLS

The following represents the acronyms and symbols referred to in the DS 30 series of mechanical standards and in the water industry.

NOTE: Various services and chemical abbreviations associated with water and wastewater treatment are contained in the Pipework sections of DS 33, DS 34 and in Table 1, Part C - Appendix E of DS 80.

A

A	Area in m ²
AAC	Annual assessed charge
ABS	Acrylonitrile – Butadiene – Styrene (pipe and fittings)
AHD	Australian height datum
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
APVB	Anti-spill pressure vacuum breaker
AS	Australian Standards
ASM	American Society of Metals
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
AVB	Atmospheric vacuum breaker

B

BDDC	Beverage dispenser dual checkvalve with atmospheric port
BEC	Best efficiency capacity
BEP	Best efficiency point
BFJ	Butt-fusion joint
BJ	Butt joint (plain ends)
BS	British Standard
BSP	British Standard Pipe
BSI	British Standards Institution

C

CBJ	Convex band welded joint
CI	Cast iron
CIP	Clean in place
CJ	Capillary/braze welded joint
CML	Cement mortar Lined
CR	Polychloroprene rubber

CS	Carbon steel (pipe)
CSA	Canadian Standards Association
©	Copyrighted
Cv	Flow coefficient, flow factor or valve coefficient (imperial)
D	
D	Major diameter
d	Minor diameter
DB	Dry bulb
dBA	Decibel – A weighted scale
DCAP	Dual check valve with atmospheric port
DCV	Double check valve
DD	Drawdown
DI	Ductile Iron (pipe and fittings)
DICL	Ductile iron cement lined
DIN	Deutsches Institut fur Normung (Germany)
DND	Daily noise dose
DS	Corporation Design Standards prefix
Du CV	Dual checkvalve with intermediate vent
Dual CV	Dual check valve
°C	Degrees Celsius
DN	Nominal diameter
e.g.	For example
E	
EFJ	Electro-fusion joint
EPDM	Ethylene propylene diene monomer rubber
EN	Europäische Norm
ESJ	Elastomeric seal joint
F	
FAD	Free air delivered
FBE	Fusion bonded epoxy
FBJ	Flat band welded joint
FDA	Food and Drug Administration (USA)
FJ	Flange joint (bolted)
FPM	Vinylidene fluoride copolymer rubber
FRP	Fibreglass reinforced plastic

G

g	Acceleration due to gravity – 9.81 m/s ²
GDA	Geocentric datum of Australia
GL	Gigalitres
GL/yr	Gigalitres per year
GRP	Glass reinforced plastic (pipe)

H

HBW	Brinell hardness number
HCVB	Hose connection vacuum breaker
HDPE	High density polyethylene
HGL	Hydraulic grade line
H	Head of water in m
Hz	Hertz (cycles per second)
h	Hour
hf	Friction head loss
H-Q	Head versus quantity curve
HRB	Rockwell B (hardness)
HRC	Rockwell C (hardness)
HV	Vickers Pyramid Number (hardness)

I

i.e.	That is
IEC	International Electrotechnical Commission
IFJ	Flush joint
I/O	Input/Output
IRHD	International rubber hardness degree
ISO	International Standards Organisation

J

JIS	Japanese Industrial Standard
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K

k	Absolute pipe roughness
K	Resistance coefficient
kg	Kilograms
kN	Kilonewton
kPa	Kilopascals
Kv	Flow coefficient, flow factor or valve coefficient (metric)
kW	Kilowatt or 1000 watts

L

L	Litre
LCC	Life cycle costing
L/s	Litres per second
LWL	Low water level e.g. tank (metres)

M

m	Metre
m ²	Square metres
m ³	Cubic metres
mm	Millimetre
m/s	Metres per second
MCJ	Mechanical compression joint
MCR	Maximum continuous rating (motor kW)
MDPE	Medium density polyethylene
MEN	Multiple-earthed neutral (system)
MIC	Microbiological influenced corrosion
MIL	Specifications US Military Specifications and Standards
Mil (US)	25.4 µm
ML/d	Mega litres per day
ML/yr	Mega litres per year
MMAW	Manual metal-arc welding
MSCL	Mild steel cement lined (pipe and fittings)
MTBF	Mean time between failure
MTTR	Mean time to repair

N

N	Speed in revolutions per minute
NACE	National Association of Corrosion Engineers
NATA	National Association of Testing Authorities
NBR	Nitrile rubber
NDT	Non destructive testing
NEMA	National Electrical Manufacturers Association
NLGI	National Lubricating Grease Institute
NFPA	National Fire Protection Association (USA)
Nm	Newton metres
NPSH	Net positive suction head
NPSHA	Net positive suction head available to the pump in metres

NPSHR	Net positive suction head required by the pump in metres
NPSH3	Net positive suction head for cavitation induced 3% drop in total differential head
NPT	National pipe taper
NR	Natural rubber
N_s	Specific speed
NZS	New Zealand Standards
N_{zq}	Zero Q speed
O	
OEM	Original equipment manufacturer
OH&S	Occupational health and safety
O & M	Operations and maintenance
OHETC	Overhead electric travelling crane
P	
P	Power in kW
PB	Polybutylene (pipe)
PE	Polyethylene (pipe)
PES	Polyethylene sleeve
P&ID	Process and instrumentation diagram
PFD	Process flow diagram
PLC	Programmable logic controller
PN	Nominal pressure
ppm	Parts per million
PREN	Pitting resistance equivalent number
PS	Pump station
PTFE	Poly tetra fluoro ethylene rubber
PU	Polyurethane
PVB	Pressure type vacuum breaker
PVC	Polyvinyl chloride
PVC-M	Polyvinyl chloride - modified
PVC- O	Polyvinyl chloride - oriented
PVC-U	Polyvinyl chloride - unplasticized
PWM	Pulse width modulation
PWL	Pumping water level
Q	
Q	Flowrate, capacity or discharge rate

R

®	Registered
RCD	Residual current device
<i>Re</i>	Reynolds number
rpm	Revolutions per minute
RPZD	Reduced pressure zone device
RRJ	Rubber ring joint
RRNRV	Rapid response non return valve
RTD	Resistance temperature detector

S

s	Second
SANZ	Standards New Zealand
SBR	Styrene butadiene rubber
S_r	Shaft stiffness in mm^{-1}
SCADA	Supervisory control and automated data acquisition
SI	Systems International d' Unites
SPS	Strategic Product Specification
SS	Stainless steel
SSJ	Spherical slip-in welded joint
SWL	Safe working load (now replaced by WLL or rated capacity)
SWJ	Solvent welded joint

T

TD	Tangential discharge
TJ	Threaded joint
TOBC	Top of bore casing
TOC	Top of casing (bore)
TDH	Total developed head in m
TM	Trade mark
TWL	Top water level of a tank in metres

U

UL	Underwriters Laboratories
UNS	Unified numbering system standards
uPVC	Unplasticized Polyvinyl Chloride (pipe and fittings)
UV	Ultra violet radiation

V

V	Victaulic groove joint
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V	Volts
VBCV	Vacuum breaker check valve
VSD	Variable speed drive
VVVF	Variable speed drive
W	
WB	Wet bulb
WLL	Working load limit (or rated capacity for cranes, replacing SWL)
WPL	Water pumping level
WRL	Water rest level
WSAA	Water Services Association of Australia
WTIA	Welding Technology Institute of Australia
Y	
Y	Wye shape (pipe fitting)

5 SI UNITS, RELATIONSHIPS AND PREFIXES

5.1 SI Units

Engineering designs shall utilize the international system of units (SI) complying with AS/ISO 1000.

5.2 Standard Units and Relationships

Following standard units and relationships are used by the Corporation:

Table 5.1 Standard Units and Relationships

Quantity	Unit	Relationship
Flow	L/s	Rate of flow
Annual pumped quantity	m ³ /yr	$\frac{\text{m}^3/\text{yr} \times 1,000}{\text{h/yr}^{\text{Note}} \times 3,600} = \text{L/s}$
	GL/yr	$\frac{\text{GL/yr} \times 1,000,000,000}{\text{h/yr}^{\text{Note}} \times 3,600} = \text{L/s}$
Megalitres per day	ML/d	$\frac{\text{ML/d} \times 1,000,000}{24 \times 3,600} = \text{L/s}$

NOTE: Require station annual running hours to provide h/yr

5.3 SI Prefixes and Symbols

The following abridged list of SI unit prefixes and symbols are provided for reference purposes:

Table 5.2 Prefixes and Symbols for SI Units

Fraction or Multiple	Prefix	Symbol
10 ⁻¹	Deci	d
10 ⁻²	Centi	c
10 ⁻³	Milli	m
10 ⁻⁶	Micro	μ
10 ⁻⁹	Nano	n
10	Deka	da
10 ²	Hector	h
10 ³	Kilo	k
10 ⁶	Mega	M
10 ⁹	Giga	G

NOTES:

1. Prefixes and symbols for fractions smaller than 10⁻⁹ and multiples greater than 10⁹ are rarely used but are listed in AS/ISO 1000 should the reader wish to refer to them.
2. Refer also to AS 2900 series of standards.

6 DRAWING SYMBOLS

A detailed list of the mechanical drawing symbols used by the Corporation can be found in DS 80 Water Corporation WCX CAD Standard.

7 APPENDIX A: CORPORATION STANDARDS

The following Corporation engineering design standards, specifications, manuals and documents are either reference or related material associated with Corporation mechanical designs.

7.1 Infrastructure Design Branch Standards

7.1.1 Design Process Standards

The following represents the Corporation design process standards.

- Engineering Design Manual

7.1.2 Electrical Design Standards

The following represents a complete list of Corporation electrical design standards

DS

- 20 Design Process for Electrical Works
- 21 Major Pump Station - Electrical
- 22 Ancillary Plant and Small Pump Stations – Electrical
- 23 Pipeline AC Interference and Substation Earthing
- 24 Electrical Drafting
- 25-01 Field Instrumentation
- 25-02 Typical Instrument Data Sheets
- 26 Type Specifications – Electrical Index (Refer below for individual Type Specifications)
- 28 Water and Wastewater Treatment Plants – Electrical

7.1.3 Electrical Type Specifications

- 26-01 Type Specification – Electrical – Introduction
- 26-02 Type Specification for 22 kV to 433 kV Kiosk Substation
- 26-03 Type Specification for High Voltage Slip Ring Induction Motor
- 26-04 Type Specification for Large Cage Induction Motor
- 26-05 Type Specification for Stand Alone Generating Set
- 26-06 Type Specification for Standard Cage Induction Motors
- 26-07 Type Specification for Major Electrical Installation
- 26-08 Type Specification for High Voltage Switchboards
- 26-09 Type Specification for Low Voltage Switchboards – General Requirements
- 26-10 Type Specification for Minor Low Voltage Switchboards $>100\text{ A} \leq 200\text{ A}$
- 26-11 Type Specification for Extended Range Minor Low Voltage Switchboards $>200\text{ A} \leq 440\text{ A}$
- 26-12 Type Specification for Pump Control Panel
- 26-13 Type Specification for Step Down Transformer in Kiosk Enclosure
- 26-14 Type Specification for High Voltage Variable Speed Controller
- 26-15 Type Specification for High Voltage Submersible Bore Hole Cage Induction Motors

26-16	Type Specification for Dry Type Step Down Transformer in Kiosk Enclosure
26-17	Type Specification for Large Low Voltage Switchboard
26-18	Type Specification for Large Low Voltage Output Variable Speed Controller
26-19	Type Specification for Small Low Voltage Output Variable Speed Controller
26-20	Type Specification for Low Voltage Submersible Bore Hole Cage Induction Motors
26-21	Type Specification for Current Transformers and Sensors
26-22	Type Specification for Rheostatic Rotor Starter
26-23	Type Specification for Low Voltage Slip Ring Induction Motor
26-24	Type Specification for Low Voltage Control Centre Type Switchboard
26-25	Type Specification for Low Voltage Electronic Soft Starter
26-26	Type Specification for Area Control Cubicle
26-27	Type Specification for Treatment Plant Alternator
26-28	Type Specification for Large Distribution Transformers
26-29	Type Specification for Small Pole Mounted Distribution Transformers
26-30	Type Specification for Double Conversion Low Voltage Uninterruptible Power Supply
26-31	Type Specification for Line Interactive Low Voltage Uninterruptible Power Supply
26-32	Type Specification for Class II Low Voltage Single Phase Surge Diverters
26-33	Type Specification for Pressure Booster Pump Station Electrical Equipment
26-34	Type Specification for High Voltage System Active Filter
26-35	Type Specification for Low Voltage System Active Filter
26-36	Type Specification for Minor Low Voltage Switchboard ≤ 100 A
26-37	Type Specification for High Voltage Distribution Switchgear for Kiosk Enclosure
26-38	Type Specification for Distribution Board < 200 A
26-39	Type Specification for Low Voltage Power Factor Controlgear Assembly
26-40	Type Specification for Variable Speed Drive Systems
26-41	Type Specification for an Electric Actuator for a Waterworks Valve
26-43	Type Specification for Small Low Voltage Electronic Soft Starter
26-44	Type Specification for Minor Electrical Installation

7.1.4 Mechanical Design Standards

The following represents a complete list of Corporation mechanical design standards.

DS

30	Mechanical Design Process
30-01	Glossary – Mechanical
30-02	General Design Criteria - Mechanical
31-01	Pipework - Mechanical
31-02	Valves and Appurtenances - Mechanical
32	Pump Stations – Mechanical

- 32-01 Pump Stations – Borehole – Mechanical
- 32-02 Pump Stations – High Level Area Booster – Mechanical (Draft)
- 33 Water Treatment Plants - Mechanical
- 34 Wastewater Treatment Plants - Mechanical
- 35 Ancillary Plant – Mechanical
- 35-01 Surge Vessels
- 36 Strategic Product Specifications and Product Atlas – Mechanical (Complete list of Water Services and Mechanical Strategic Product Specifications shown below)
- 38-01 Installation – Mechanical
- 38-02 Flanged Connections

7.1.5 SCADA Design Standards

The following represents a complete list of Corporation SCADA design standards.

- ISK Manual

DS

- 40 SCADA General
- 41 SCADA Masters
- 42 Communication Standards
- 43 SCADA Protocols

7.1.6 Civil Design Standards

The following represents a complete list of Corporation civil and drawing standards.

- Dam Safety Management Guidelines
- Geotechnical Drilling Standard

DS

- 50 Design and Construction Requirements for Gravity Sewers DN 150 to DN 600
- 51 Design and Construction of Wastewater Pumping Stations and Pressure Mains 4 to 90 Litres per Second Capacity
- 52 Pipe Repair Standard
- 53 Vacuum Sewerage Standard
- 60 Water Supply Distribution - Pipelines other than Reticulation
- 61 Water Supply Distribution - Tanks
- 62 Site Security Treatments
- 63 Water Reticulation Pipelines DN 250 and Smaller
- 63-01 Water Reticulation Standard – Supplement – Dual Water Supply Systems
- 65 Pipe Fittings Standard Drawings
- 66 Urban Main Drainage Standard
- 100 Suspended Flooring (Grid Mesh and Chequer Plate)

7.1.7 Chemical Design Standards

The following represents a complete list of Corporation chemical design standards.

DS

70-01 Chlorine Buildings

70-02 Chlorine Leak Detectors

70-03 Emergency Shutoff Devices for use of Chlorine Containers

70-04 Emergency Safety Showers and Eyewash Stations

70-05 Chlorine Container Floor Scales

70-20 Small Chlorination Systems (Water) – Control Function Description

70-30 Small Chlorination Systems (Wastewater) – Control Function Description

71-01 Fluorosilicic Acid Storage and Dosing System – Basis of Design

71-02 Fluorosilicic Acid Storage and Dosing System – Control Function Specification

72-01 Lime Storage Mixing & Dosing Systems – Basis of Design

72-02 Lime Storage Mixing & Dosing Systems – Control Functional Specifications

73-01 Bulk Sodium Hypochlorite Storage and Dosing Systems – Basis of Design

73-02 Bulk Sodium Hypochlorite Storage and Dosing Systems – Control Function Specification

79 Design of Chemical Systems – Legislative Requirements and General Principles

79-02 Emergency Safety Showers and Eyewash Stations

79-03 Chemical Barrier Protection

7.1.8 Drawing Standard

DS

80 WCX CAD Standard

7.1.9 Treatment Standards

DS110 Ultraviolet Disinfection Systems

DS111 Microfiltration and Ultrafiltration Systems

S393 Desalination and Membrane Technology

7.1.10 Strategic Product Specifications

Strategic Product Specifications have been developed by the Corporation in order to specify products of strategic importance that are used with reasonable frequency. Strategic Product Specifications reference Australian Standards where they exist, or failing that WSAAs Standards, or have been developed in their own right where no applicable standards exist. A full list of the strategic product standards are shown below:

7.1.10.1 Water Services

SPS

100 Steel Pipe for Waterworks Purposes

106 Ductile Iron Pipe Fittings for Pressure Applications

115 Unplasticized Polyvinylchloride (PVC-U) Pipe for Pressure Applications

- 116 Modified Polyvinylchloride (PVC-M) Pipe for Pressure Applications
- 117 Oriented Polyvinylchloride (PVC-O) Pipe for Pressure Applications
- 125 Polyethylene and Polypropylene Pipe and Fittings
- 130 Glass-reinforced Plastic Pipe and Pipe Fittings
- 152 Stainless Steel Repair Clamps for Waterworks Purposes
- 802 Prototype Assisted Lift Access Covers

7.1.10.2 Mechanical

SPS

- 155 Metered Standpipes
- 200 Air Release and Vacuum Break Valves
- 201 Sewage Air Release and Vacuum Break Valves
- 214 Double Check Valves
- 215 Reduced Pressure Zone Devices
- 220 Metallic Non-Return Valves
- 223 Ductile Iron Swing Check Non-Return Valves
- 226 Dual Plate Non-Return Valves
- 230 Rapid Response Non-Return Valves
- 240 Hydraulically Operated Automatic Control Valves
- 241 Inline (Axial) Control Valves
- 245 Vacuum Interface Valves
- 249 Bladder Surge Vessels
- 251 Mains Tapping Ball Valves
- 252 Metallic Ball Valves for General Purposes
- 254 Meter Ball Valves
- 255 Copper Alloy Gate Valves
- 259 Knife-Gate Valves
- 260 Wafer and Lugged Butterfly Valves
- 261 Double Flanged Butterfly Valves for Waterworks Purposes
- 262 High Performance Butterfly Valves
- 263 Butterfly Guard Valves
- 271 Gate Valves for Waterworks Purposes - Metal Seated
- 272 Gate Valves for Waterworks Purposes - Resilient Seated
- 292 Screw-Down Fire Hydrants
- 295 Penstocks for Waterworks Purposes
- 499 HDPE Storage Tanks for Sodium Hypochlorite
- 500 ISO End Suction Centrifugal Pumps
- 501 ISO End Suction Centrifugal Motor Pumps

- 503 Submersible Sewage Pumps
- 506 Vertical Multistage Electric Centrifugal Pumps
- 507 Multi-Stage Submersible Electric Borehole Pumps
- 515 Axially-Split Casing Centrifugal Pumps
- 525 Progressive Cavity Pumps

7.1.10.3 Treatment

- Specification for the Selection of Appropriate Turbidity Analysers

7.1.11 Modular Specifications

The modular specification system is intended to develop and maintain individual specification sections that are suitable to assemble together into individual tender specifications. These specifications are targeted to the everyday. For further description see the Modular Specification User Guidelines (GU).

The modular specifications available for use are listed below:

- GU User Guidelines
- PSP Project Specifics Preliminaries
- GP General Preliminaries
- EP Excavation pipelines
- ETF Embedment and Trenchfill
- PL Pipes and Pipelaying
- PLpvc Pipes and Pipelaying - PVC
- PLs Pipes and Pipelaying - MSCL
- PLpe Pipes and Pipelaying - PE
- ET Testing of Foundation, Embedment, Trenchfill and Earthworks
- PT Pipeline pressure testing and disinfection
- CON Concrete General
- CPL Plastic Lining of Concrete Works
- MI Mechanical Installation
- FI Flange Installation
- PQA Quality assurance
- EI Electrical Installation
- TT Trenchless Techniques
- MW Metalwork
- CPP Corrosion protection pipelines
- CAPT Cathodic protection pipelines
- CAL Concrete Access chambers and Liners
- RR Restoration and Roadwork
- COM Commissioning
- AP Appendices

7.2 Mechanical and Electrical Services Branch Standards

7.2.1 Cathodic Protection

DS 91 Cathodic Protection Standard

7.2.2 Biogas Facilities

DS

92 Design, Installation, Commissioning, Operations and Maintenance of Biogas Facilities

7.2.3 Protective Coatings

DS

95 Standard for the Selection, Preparation, Application, Inspection and Testing of Protective Coatings on Water Corporation Assets (List of Procedures shown below)

7.2.3.1 Group A: Surface Preparation

- A1 Surface Preparation for the Application of Protective Coatings on Steel or Cast Iron
- A2 Surface Preparation for the Application of Protective Coating on Stainless Steel
- A3 Surface Preparation for the Application of Protective Coating on Galvanised Steel
- A4 Surface Preparation for the Application of Protective Coating on Aluminium
- A5 Surface Preparation for the Application of Protective Coating on Concrete
- A6 Surface Preparation for the Application of Protective Coating on Plastics
- A7 Surface Preparation for the Application of Protective Coating on Fusion Bonded Polyethylene (Sintakote®)

7.2.3.2 Group B: Coating Specifications - Inorganic Zinc Silicate

- B1 Inorganic Zinc Silicate Coating on Steel or Cast Iron
- B2 Inorganic Zinc Silicate, Epoxy Primer Tie-Coat, Acrylic Top Coating on Steel or Cast Iron

7.2.3.3 Group C: Coating Specifications - Zinc Rich Epoxy Primer

- C1 Zinc Rich Epoxy Primer Coating on Steel or Cast Iron December 2012
- C2 Zinc Rich Epoxy Primer, Epoxy Mastic Coat, Polyurethane Top Coat on Steel or Cast Iron
- C3 Zinc Rich Epoxy Primer, Epoxy Mastic Coat on Steel or Cast Iron
- C4 Zinc Rich Epoxy Primer, Polyurethane Top Coat on Steel or Cast Iron

7.2.3.4 Group D: Coating Specifications - High Build Epoxy

- D1 High Build Epoxy Coating on Steel or Cast Iron
- D2 High Build Epoxy Coating on Butterfly Valves
- D3 High Build Epoxy Epoxy Coating on New and Old Concrete

7.2.3.5 Group E: Coating Specifications - Epoxy Mastic

- E1 Epoxy Mastic Coating on Steel or Cast Iron December 2012
- E2 Epoxy Mastic Coating on Non-Return, Control Valves (New and Existing Valves)
- E3 Epoxy Mastic, Polyurethane Top Coat on Steel or Cast Iron
- E4 Epoxy Mastic, Polyurethane Top Coat on Galvanised Steel

E5 Epoxy Mastic, Polyurethane Top Coat on Fusion Bonded Polyethylene (Sintakote®)

7.2.3.6 Group F: Coating Specifications - Mineral Filler Epoxy

F1 Glass Flake Epoxy Mastic Coating

F2 High Build Ceramic Filled Epoxy Coating on Existing Control Valves

F3 High Build Ceramic Filled Epoxy Coating on New and Existing Pumps

7.2.3.7 Group G: Coating Specifications - Thermal Bonded Powder

G1 Thermostatically Applied Polyester Powder Coating For Aluminium Sheet Metal Cabinets

G2 Thermal Bonded Polymeric Coating On Valves And Fittings For Water Industry Purposes

7.2.3.8 Group H: Coating Specifications - Galvanising

H1 Repair of Galvanised Coating

H2 Galvanised Coating of Steel Structures

7.2.3.9 Group I: Coating Specifications - Elastomeric Polyurethane

I1 Elastomeric Polyurethane Protective Coating on Concrete

7.2.3.10 Group J: Coating Specifications - Anti-Graffiti

J1 Anti-Graffiti Coating on New and Old Steel Structures

J2 Anti-Graffiti Coating on New and Old Concrete Structures

7.2.3.11 Group K: Coating Specifications - Water Based Acrylic

K1 Aesthetic Finish Coating on above Ground PVC Pipes and Fittings

7.2.3.12 Group L: Coating Specifications - Wrapping and Heat Shrink Sleeve

L1 Tape Wrapping Procedure

L2 Heat Shrink Sleeve

7.2.3.13 Group M: Coating Specifications - Miscellaneous

M1 Coating Procedure for Pipe Transition (Below to Above Ground)

M2 Coating Procedure for Sintakote Pipe and Steel Pipe Joints

M3 Coating Procedure for Clean Skin Pipe Permanently Exposed to Atmosphere

M4 Coating Procedure for Coupling Jointed Pipes

M5 Coating Procedure for Steel Pipe at the Concrete Interface

M6 Coating Procedure for Sintakote Pipe at the Concrete Interface

M7 Coating Procedure on galvanised steel for the decorative purposes

M8 Cement Mortar Lining Requirement

7.2.4 Fibre Reinforced Plastics

- FRP or GRP Structural Material

7.2.5 Welding

WS-1 Metal Arc Welding

WS-2 Welding and Joining Specification Thermoplastics

WP Plastic Lining Audit

7.2.6 Grouting Convex Bands in Pipelines

- GCB - Grouting Convex Bands in Pipelines

7.2.7 Hazardous Area Classification Standards

- HA-MS-00 HAMS Overview
- HA-ST-01 EEHA Management Plan Standard
- HA-ST-02 Hazardous Area Classification Standard
- HA-ST-03 EEHA Selection and Installation Standard
- HA-ST-04 EEHA Competency Standard
- HA-ST-05 EEHA Inspection Standard
- HA-ST-06 EEHA Testing Standard
- HA-ST-07 EEHA Maintenance Standard
- HA-ST-08 EEHA Overhaul and Repair Standard
- HA-ST-09 EEHA Portable Electrical Equipment Standard
- HA-ST-10 EEHA Verification Dossier Standard
- HA-ST-11 EEHA Assessment of Non-AUS/ANZ/IECEX Equipment Standard

7.2.8 Concrete Repair Standards

- CR1 Concrete repair procedure using Chemical Resistant Epoxy
- CR2 Concrete crack repair procedure using Polyurethane Injection
- CR3 Concrete repair procedure using epoxy mortar followed by Chemical Resistant Coating
- CR4 Concrete repair procedure Cementitious Mortar
- CR5 Application of chemical resistant protective coating on concrete bunds in Water and Wastewater Treatment Plants
- CR6 Concrete repair procedure using Calcium Aluminate Cement
- CR7 Concrete repair procedure using Hypalon membrane product
- CR 8 Concrete repair procedure using Polyurethane Sealant

7.3 OH&S Safety Standards

- S 151 Prevention of Falls Standard
- WC-OSH 108 Safe Working in Confined Space
- WC-OSH 109 Tagging and Isolation

8 APPENDIX B: AUSTRALIAN AND INTERNATIONAL STANDARDS

The following Australian and International standards, codes and specifications are either referenced in the Mechanical DS 30 Series of design standards or represent related material associated with Corporation mechanical designs.

8.1 Water Services Association of Australia Standards

8.1.1 Codes

The following codes are referred to in the Design Standards and are available from Standards Australia.

WSA

- 02 Sewage Code of Australia
- 03 Water Supply Code of Australia
- 04 Sewage Pumping Station Code of Australia
- 06 Vacuum Sewerage Code of Australia
- 109 Industry Standard for Flange Gaskets and O-rings

8.1.2 Product Specifications

WSAA have a large range of Product Specifications on their website <http://www.wsaa.asn.au> which are available for download at no charge.

8.2 Australian Standards

The following Australian Standards are applicable or are referred to in the DS 30 series design standards and are available from Standards Australia.

AS

- 681.1 Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Vulcanized rubber
- 681.2 Elastomeric seals – Material requirements for pipe joint seals used in water and drainage applications – Thermoplastic elastomers
- 1019 Internal combustion engines – Spark emission control devices
- 1055.1 Acoustics – Description and measurement of environmental noise – General procedures
- 1074 Steel tubes and tubulars for ordinary service
- 1081.1 Acoustics – Measurement of airborne noise emitted by rotating electrical machinery – Engineering method for free-field conditions over a reflective plane
- 1081.2 Acoustics – Measurement of airborne noise emitted by rotating electrical machinery – Survey method
- 1110.1 ISO metric hexagon bolts and screws – Product grades A and B – Bolts
- 1110.2 ISO metric hexagon bolts and screws – Product grades A and B – Screws
- 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
1170.4	Structural design actions – Earthquake actions in Australia
1191	Acoustics – Methods for laboratory measurement of airborne sound transmission insulation of building elements
1210	Pressure vessels
1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
1237.1	Plain washers for metric bolts, screws and nuts for general purposes – General plan
1237.2	Plain washers for metric bolts, screws and nuts for general purposes – Tolerances
1271	Safety valves, other valves, liquid level gauges, and other fittings for boilers and unfired pressure vessels
1275	Metric screw threads for fasteners
1277	Acoustics – Measurement procedures for ducted silencers
1318	Use of colour for the marking of physical hazards and the identification of certain equipment in industry (known as the SAA Industrial Safety Colour Code) (incorporating Amdt 1)
1319	Safety signs for the occupational environment
1345	Identification of the contents of pipes, conduits and ducts
1349	Bourdon tube pressure and vacuum gauges
1359.0	Rotating electrical machines – General requirements Introduction and List of Parts
1379	Specification and supply of concrete
1397	Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinc and zinc alloyed with aluminium and magnesium
1403	Design of rotating steel shafts
1418.1	Cranes, hoists and winches – General requirements
1418.18	Cranes, hoists and winches – Crane runways and monorails
1418.3	Cranes, hoists and winches – Bridge, gantry, portal (including container cranes) and jib cranes
1420	ISO metric hexagon socket head capscrews
1432	Copper tubes for plumbing, gasfitting and drainage applications
1442	Carbon steels and carbon-manganese steels - Hot-rolled bars and semi-finished products
1443	Carbon steels and carbon-manganese steels – Cold-finished bars
1444	Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
1448	Carbon steels and carbon-manganese steels – Forgings (ruling section 300 mm maximum)
1450	Steel tubes for mechanical purposes
1470	Health and safety at work – Principles and practices

1548	Fine grained weldable steel plates for pressure equipment
1565	Copper and copper alloys - Ingots and castings
1572	Copper and copper alloys – Seamless tubes for engineering purposes
1579	Arc-welded steel pipes and fittings for water and waste-water
1627.0	Metal finishing - Preparation and pretreatment of surfaces – Method of selection guide
1627.1	Metal finishing - Preparation and pretreatment of surfaces – Removal of oil, grease and related contamination
1627.2	Metal finishing - Preparation and pre-treatment of surfaces – Power tool cleaning
1627.4	Metal finishing - Preparation and pre-treatment of surfaces – Abrasive blast cleaning of steel
1627.5	Metal finishing - Preparation and pre-treatment of surfaces – Pickling
1628	Water supply – Metallic gate, globe and non-return valves
1646	Elastomeric seals for waterworks purposes
1654.1	ISO system of limits and fits – Bases of tolerances, deviations and fits
1654.2	ISO system of limits and fits – Tables of standard tolerance grades and limit deviations for holes and shafts
1657	Fixed platforms, walkways, stairways and ladders – Design, construction and installation
1668.2	The use of ventilation and airconditioning in buildings – Mechanical ventilation in buildings
1682.1	Fire dampers - Specification
1683.15.1	Methods of test for elastomers – International rubber hardness
1692	Steel tanks for flammable and combustible liquids
1710	Non-destructive testing – Ultrasonic testing of carbon and low alloy steel plate and universal sections – Test methods and quality classification
1722.2	Pipe threads of Whitworth form – Fastening pipe threads
1796	Certification of welders and welding supervisors
1830	Grey cast iron
1831	Ductile cast iron
1832	Malleable cast iron
1833	Austenitic cast iron
1834.1	Materials for soldering – Solder alloys
1874	Aluminium and aluminium alloys – Ingots and castings
1939 Supp 1	Degrees of protection provided by enclosures for electrical equipment (IP Code) – Wallchart 1 (Supplement 1 to AS 1939 -1990)
1939 Supp 2	Degrees of protection provided by enclosures for electrical equipment (IP Code) – Wallchart 2 (Supplement 2 to AS 1939 -1990)
1940	The storage and handling of flammable and combustible liquids
1960.1	Motor vehicle brake fluids – Non-petroleum type

2027	Abrasive-resistant cast irons
2074	Cast steels
2129	Flanges for pipes, valves and fittings
2205.10.1	Methods for destructive testing of welds in metal – Corrosion test for welded austenitic stainless steel
2317	Collared eyebolts
2321	Short-link chain for lifting purposes
2345	Dezincification resistance of copper alloys
2369.2	Materials for solar collectors for swimming pool heating – Flexible or plasticized polyvinyl chloride
2382	Surface roughness comparison specimens
2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
2550.1	Cranes, hoists and winches – Safe use – General requirements
2550.3	Cranes, hoists and winches – Safe use – Bridge, gantry, portal (including container cranes), jib and monorail cranes
2550.5	Cranes, hoists and winches – Safe use – Mobile cranes
2550.11	Cranes, hoists and winches – Safe use – Vehicle loading cranes
2574	Non-destructive testing – Ultrasonic testing of ferritic steel castings
2625.1	Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – General guidelines
2625.4	Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15,000 r/min when measured in situ
2700	Colour standards for general purposes
2729	Rolling bearings – Dynamic load ratings and rating life
2738	Copper and copper alloys – Compositions and designations of refinery products, wrought products, ingots and castings
2741	Shackles
2784	Endless wedge belt and V-belt drives
2845.2	Water supply – Backflow prevention devices – Registered air gaps and registered break tanks
2845.3	Water supply – Backflow prevention devices – Field testing and maintenance of testable devices
2865	Confined space
2900.0	Quantities and units – General principles
2913	Evaporative air-conditioning equipment
2938	Gears-Spur and helical - Guide to specification and rating
2971	Serially produced pressure vessels
3518	Acronitrile butadiene styrene (ABS) pipes and fittings for pressure applications
3565.1	Meters for cold and heated drinking water supplies – Technical requirements

- 3570 Automotive diesel fuel
- 3571.1 Plastic piping systems - Glass filament reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure drainage and sewerage (ISO 10467:2004 MOD)
- 3571.2 Plastic piping systems - Glass filament reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure water supply (ISO 10639:2004 MOD)
- 3680 Polyethylene sleeving for ductile iron piping
- 3688 Water supply – Metal fittings and end connections
- 3776 Lifting components for Grade T chains and slings
- 3894.0 Site testing of protective coating – Introduction and list of test methods
- 3894.1 Site testing of protective coating – Non-conductive coatings – Continuity testing – High voltage (“brush”) method
- 3894.2 Site testing of protective coating – Non-conductive coatings – Continuity testing – Wet sponge method
- 3894.3 Site testing of protective coatings – Determination of dry film thickness
- 3952 Water supply – Spring hydrant valves for waterworks purposes
- 3959 Construction of buildings in bushfire-prone areas
- 4024.1 Safety of machinery (Series)
- 4037 Pressure equipment – Examination and testing
- 4041 Pressure piping
- 4087 Metallic flanges for waterworks purposes
- 4100 Steel structures
- 4177.1 Caravan and light trailer towing components – towbars and towing brackets
- 4177.2 Caravan and light trailer towing components – 50 mm towballs
- 4177.3 Caravan and light trailer towing components – Coupling body for ball couplings
- 4177.4 Caravan and light trailer towing components – Safety chains up to 3500 kg capacity
- 4177.5 Caravan and light trailer towing components – Electrical connectors
- 4254 Ductwork for air-handling systems in buildings
- 4291.1 Mechanical properties of fasteners made of carbon steel and alloy steel – Bolts, screws and studs
- 4310 DN 80 Piston type vacuum interface valve for municipal sewer systems
- 4458 Pressure equipment - Manufacture
- 4594.0 Internal combustion engines – Performance - Application
- 4594.1 Internal combustion engines – Performance – Standard reference conditions, declarations of power, fuel and lubricating oil consumption and test methods
- 4594.3 Internal combustion engines – Performance –Engines for land, rail-traction and marine use – Test measurements
- 4594.4 Internal combustion engines – Performance –Engines for land, rail-traction and marine use – Speed governing

- 4794 Non-return valves – swing check and tilting disc
- 4795.1 Butterfly valves for waterworks purposes - Wafer and lugged
- 4795.2 Butterfly valves for waterworks purposes - Double flanged
- 4796 Water supply – Metal bodied and plastic bodied ball valves for property service connections
- 4809 Copper pipe and fittings – Installation and commissioning
- 4956 Air valves for water supply
- 5081 Hydraulically operated control valves for waterworks purposes
- 5830.1 In-line ball valves for use in plumbing water supply systems – Metal-bodied
- 5830.2 In-line ball valves for use in plumbing water supply systems – Plastic-bodied
- 6401 Knife gate valves for waterworks purposes
- 60034.1 Rotating electrical machines – Rating and performance (IEC 60034-1, Ed. 11(2004) MOD)
- 60529 Degrees of protection provided by enclosures (IP Code)
- 60947.8 Low-voltage switchgear and controlgear – Control units for built-in thermal protection (PTC) for rotating electrical machines

AS/NZS

- 1163 Cold-formed structural steel hollow sections
- 1167.1 Welding and brazing – Filler metals – Filler metals for brazing and braze welding
- 1167.2 Welding and brazing – Filler metals – Filler metals for welding
- 1170.2 Structural design actions - Wind actions
- 1200 Pressure equipment
- 1252 High strength steel bolts with associated nuts and washers for structural engineering
- 1269.2 Occupational noise management – Noise control management
- 1477 PVC pipes and fittings for pressure applications
- 1554 Structural steel welding set
- 1554.1 Structural steel welding - Welding of steel structures
- 1554.6 Structural steel welding – Welding stainless steels for structural purposes
- 1559 Hot-dip galvanized steel bolts with associated nuts and washers for tower construction
- 1567 Copper and copper alloys – Wrought rods, bars and sections
- 1568 Copper and copper alloys – Forging stock and forgings
- 1571 Copper – Seamless tubes for air-conditioning and refrigeration
- 1572 Copper and copper alloys – Seamless tubes for engineering purposes
- 1594 Hot-rolled steel flat products
- 1595 Cold-rolled, unalloyed, steel sheet and strip
- 1665 Welding of aluminium structures
- 1677.1 Refrigeration systems – Refrigerant classification
- 1734 Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate

1960.2	Motor vehicle brake fluids – Silicone type
2032	Installation of PVC pipe systems
2033	Installation of polyethylene pipe systems
2280	Ductile iron pipes and fittings
2566.1	Buried flexible pipelines – Structural design
2566.2	Buried flexible pipelines – Installation
2574	Non-destructive testing – Ultrasonic testing of ferritic steel castings
2638.1	Gatevalves for waterworks purposes – Metal seated
2638.2	Gatevalves for waterworks purposes – Resilient seated
2642.1	Polybutylene (PB) plumbing pipe systems - Polybutylene (PB) pipe extrusion compounds
2642.2	Polybutylene (PB) plumbing pipe systems - Polybutylene (PB) pipe for hot and cold water applications
2642.3	Polybutylene (PB) plumbing pipe systems – Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications
2738	Copper and copper alloys – Compositions and designations of refinery products, wrought products, ingots and castings
2845.1	Water supply – Backflow prevention devices – Materials, design and performance requirements
3000	Electrical installations (known as Australian/New Zealand Wiring Rules)
3500	Plumbing and drainage Set
3518	Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications
3678	Structural steel – Hot-rolled plates, floorplates and slabs
3679.1	Structural steel – Hot-rolled bars and sections
3679.2	Structural steel – Welded I sections
3690	Installation of ABS pipe systems
3775.1	Chain slings – Grade T – Product specification
3823.1.2	Performance of electrical appliances – Air conditioners and heat pumps – Ducted airconditioners and air-to-air heat pumps – Testing and rating for performance (ISO 13253.2011, MOD)
3879	Solvent cement and priming fluids for PVC (PVC-U and PVC-M) and ABS and ASA pipes and fittings
3992	Pressure equipment – Welding and brazing qualification
4020	Testing of products for use in contact with drinking water
4129	Fittings for polyethylene (PE) pipes for pressure applications
4130	Polyethylene (PE) pipes for pressure applications
4131	Polyethylene (PE) compounds for pressure pipes and fittings
4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes

4291.2	Mechanical properties of fasteners – Nuts with specified proof load values – Coarse thread
4441	Oriented PVC (PVC-O) pipes for pressure applications
4534	Zinc and zinc/aluminium-alloy coatings on steel wire
4671	Steel reinforcing materials
4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
4765	Modified PVC (PVC-M) pipes for pressure applications
4791	Hot-dip galvanized (zinc) coatings on ferrous open sections, applied by an in-line process
4792	Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialized process
4859.1	Materials for thermal insulation of buildings – General criteria and technical provisions

AS/ISO

7.1	Pipe threads where pressure-tight joints are made on the threads – Dimensions, tolerances and designation
1000	The international system of units (SI) and its application

AS/NZS ISO

9001	Quality management systems - Requirements
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ATS

4747.1	Meters for non-urban water supply – Glossary of terms
4747.2	Meters for non-urban water supply – Technical requirements for closed conduit meters fully charged
4747.5	Meters for non-urban water supply – Installation and commissioning of closed conduit meters fully charged
4747.8	Meters for non-urban water supply – In-service compliance for non-urban water meters
5200.042	Technical specification for plumbing and drainage products –Rolled-grooved jointing systems

SAA

HB18.22	Guidelines for third party certification and accreditation – General criteria for supplier’s declaration of conformity
HB18.23	Guidelines for third party certification and accreditation – Guide 23 – Methods of indicating conformity with Standards for third-party certification systems
HB18.28	Conformance assessment – Guidelines on a third-party certification system for products

8.3 International Standards

The following international standards are referred to in the Design Standards and are available from Standards Australia.

ANSI

B16.34	Valves – Flanged, Threaded, and Welding End
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B36.10	Welded and Seamless Wrought Steel Pipe
B36.19	Stainless Steel Pipe
ASTM	
A182M	Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A269	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A276	Standard Specification for Stainless Steel Bars and Shapes
A312M	Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes
A313M	Standard Specification for Stainless Steel Spring Wire
A350	Standard Specification for Carbon and Low-Alloy Steel Forgings Requiring Notch Toughness Testing for Piping Components
A351M	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems
A403M	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
A480M	Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
A484M	Standard Specification for General Requirements for Stainless Steel Bars, Billets and Forgings
A494M	Standard Specification for Castings, Nickel and Nickel Alloy
A536	Standard Specification for Ductile Iron Castings
A632	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Service
A743	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
A890M	Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Applications
B127	Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet and Strip
B163	Standard Specification for Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes
B164	Standard Specification for Nickel-Copper Alloy Rod, Bar and Wire
B165	Standard Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube
B209	Standard Specification for Aluminium and Aluminium Alloy Sheet and Plate
B729	Standard Specification for Seamless UNS N8020, UNS N8026 and UNS N8024 Nickel-Alloy Pipe and Tube

D3187	Standard Test Methods for Rubber-Evaluation of NBR (Acrylonitrile-Butadiene Rubber)
F 593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
BS EN	
5135	Acoustics – Determination of sound power levels of noise from air – terminal devices, air terminal units, dampers and valves by measurement in a reverberation room
60751	Industrial platinum resistance thermometers and platinum temperature sensors
EN	
1092-1	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Steel flanges
1092-2	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Cast iron flanges
1514-1	Flanges and their joints – Dimensions of gaskets for PN-designated flanges – Part 1: Non-metallic flat gaskets with or without inserts.
10088-3	Stainless steels, technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
ISO	
1940-1	Mechanical vibration – Balance quality requirements for rotors in constant (rigid) state Part 1: Specification and verification of balance tolerances
3506.1	Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs
3506.2	Mechanical properties of corrosion-resistant stainless steel fasteners – Part 2: Nuts
5752	Metal valves for use in flanged pipe systems – face-to-face dimensions and centre-to-face dimensions
7089	Plain washers – Normal series – Product grade A
9906	Rotodynamic pumps – Hydraulic performance acceptance 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

END OF DOCUMENT