

Engineering Standard I-SPE-STD-015

Instrumentation

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1. Purpose

This document is part of a suite of Seqwater Engineering Standards which are in alignment with the Seqwater Quality Management System. Their purpose is to provide a consistent approach to the development, modification, and management of Seqwater infrastructure that is fit for purpose and safe so far as is reasonably practicable. Advice must be sought from Seqwater to clarify any ambiguities in relation to this document.

This Standard Specification provides the minimum requirements and recommendations for instrumentation.

This document must be used in conjunction with the documents it references to assist in ensuring a fit for purpose asset. This Standard is not intended to be relied on solely for design, supply, and installation works; advice from specialist engineers and/or manufacturers may be required on a case-by-case basis.

2. Scope

This Standard Specification applies to all Seqwater workers, as well as suppliers, contractors and consultants working for or on behalf of Seqwater unless otherwise stated. It applies to all new assets and to all existing assets undergoing refurbishment or modification. It must be used in conjunction with other relevant Seqwater Engineering Standards and project specific documents to define the technical requirements for infrastructure design and construction.

Seqwater Engineering Standards detail Seqwater's minimum requirements and recommendations to provide infrastructure that will be fit for purpose, and safe to operate and maintain. However, at all times the designer remains responsible for ensuring infrastructure designed is fit for purpose and safe to construct, operate, maintain, and demolish. In doing so the designer must exercise appropriate due diligence to identify and manage hazards so far as is reasonably practicable.

Designers must also ensure compliance with relevant Australian Legislation, Standards, Codes and Guidelines (including those produced by WSAA). Where no Australian Standard exists for a particular application, work must conform to the most current version of an industry accepted international standard.

Deviation from meeting the minimum requirements in this standard requires written agreement from Seqwater as per the deviation process detailed in Procedure *X-PRO-STD-008 Asset Standards Management and Application*. That process includes completion of an *X-TMP-STD-022 Asset Standards Deviation Request* form and submission by the Seqwater Project Representative to the Seqwater Engineering Mailbox.

Where noted in this Standard Specification that Seqwater approval or acceptance shall/must be sought, approval or acceptance must be gained through the Seqwater Asset Standard Deviation process, as identified above.

Responsibility for ensuring compliance with Seqwater Engineering Standards lies with those engaged in the management and execution of design, construction, and modification of Seqwater assets. This includes modifications to the functional design of the asset including technical changes made which would extend an asset outside of its design operating envelope and/or approved operation and maintenance practices.

In the case that it is identified that a specific requirement within this Engineering Standard does not meet the requirements of project specific documents, another Seqwater Engineering Standard or Australian Legislation, Standards, Codes or Guidelines, the conflict must be brought to the attention of the Seqwater Principal

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Engineering Standards and Assurance (or their delegate) via the Engineering Mailbox, and written agreement must be gained prior to application of the requirement.

Advice must be sought from Seqwater to clarify any ambiguities regarding this Engineering Standard.

Seqwater undertakes regular updates of its Standards. Before utilising this Engineering Standard, the complete list of Seqwater Engineering Standards should be reviewed, to ensure currency and applicability of standards to be applied to the works.

Instrumentation is defined as equipment that measures physical quantities.

This instrumentation standard includes all aspects of the design, construction, testing and commissioning of instrumentation equipment that are used at Seqwater facilities. Specifically measuring instruments used for the monitoring and control of Seqwater assets, with exclusions as listed below:

- Building services equipment (Elevators, building access, security systems, fire protection systems, PA systems).
- Hand-held portable instruments.
- Standalone laboratory equipment that is not connected to plant process streams or plant monitoring and control systems.

3. Design Criteria

3.1. Operating Conditions

All instrumentation and associated equipment will be required to operate continuously, for 24 hours per day and 365 days per year, under the climatic conditions detailed in *E-SPE-STD-001 Electrical Design and Construction*.

All instrumentation shall be designed for automatic restart and monitoring functionality after power supply interruption, without the need for any manual intervention at the site.

3.2. Safety in design

All instrumentation and associated equipment shall be designed to perform its intended duty safely and without being attended.

All instrumentation and associated equipment shall be designed to eliminate risks to health and safety so far as is reasonably practicable (including construction, end use and demolition phases); and if elimination of those risks is not reasonably practicable, to minimise those risks so far as is reasonably practicable.

3.3. General Design Requirements

Designs shall be robust and practicable having regard to all constraints. The designs shall be carried out using current water industry best practice design procedures in common use in Australia and using, wherever applicable, codes and standards published by Standards Australia. Where no appropriate Australian Standard exists, the most current version of an industry accepted international standard must be used.

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Any materials that may contact drinking water, water that is to become drinking water, or drinking water chemicals must comply with the requirements for Potable Water Compatibility as set out in *M-SPE-STD-001 General Mechanical Standard Specification*.

Any instrumentation installed within a hazardous area shall be designed as per AS/NZS 60079 and *E-SPE-STD-001 Electrical Design and Construction*.

Design services shall be performed under the control and direct supervision of a Registered Professional Engineer/s of Queensland (RPEQ). The Contractor shall ensure that the RPEQ performs professional engineering services compliant with the *Professional Engineers Act 2002*, Queensland.

Designs for implementation of instrumentation shall comply with *X-PRO-STD-009 Engineering Design, Construction, Operation and Maintenance*.

3.4. Design Life, Reliability and Availability

The design life of instrumentation supplied shall be specified in the specific scope of works for the project specific requirements and environmental conditions. The instrumentation supplied shall be fit for purpose and meet all the product specification information described by the supplier.

Where design life is not specified in project documentation, a minimum design life of 10 years is required.

Individual instruments shall be selected and installed to achieve reliability and availability suitable for the application and overall system design.

The design availability target shall be >99% as a minimum for the entire system. Where this requires redundant instruments, care should be taken to avoid single points of failure for the system and there should be no hidden failures.

3.5. Seqwater Preferred Equipment

For categories of instrumentation listed in the *X-LST-STD-001 Seqwater Preferred Equipment List*, the Contractor shall use only instrumentation with the corresponding manufacturer, supplier and model.

Seqwater will not accept "Equivalent" or alternative models to those that are specified.

3.6. Warranty & Service

All equipment shall be supplied new, with guaranteed service and spares support for a minimum of ten years after the installation date. Superseded / demo models of equipment shall not be acceptable.

All instruments and associated devices supplied shall be fully supported by spare parts and technical service, with availability within Australia.

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4. Instrumentation Equipment

4.1. Instrumentation General Requirements

Unless specified otherwise, all instrumentation equipment supplied and installed shall contain the necessary hardware to provide the operator with local monitoring functions (local display, indicators, etc). Additionally, the equipment will have the ability to be configured via local or remote interface, as well as facilitate input to the PLC for computing purposes and remote monitoring through the SCADA system.

All instruments and associated devices supplied under the Contract shall be of proven design and in common usage in similar plant installations. The design of the instruments shall be such that the replacement of any parts may be rapidly executed to minimise non-availability of any control or measuring loop.

Additional requirements are as listed below:

- a. Equipment shall be selected for reliability and inter-changeability of component parts, based on a uniform design concept.
- b. The contractor shall guarantee to install instrumentation and metering equipment for the duties specified.
- c. The contractor shall accept full responsibility for the instrumentation calibration.
- d. Instruments in below ground pits shall be IP68 rating.
- e. All instrument transmitters shall operate from 24VDC supply where loop powered devices are not installed. If 24VDC powered instruments are not available for the application, they can be 230V AC 50Hz.
- f. Power to instrument transmitters shall be a dedicated circular 1.5mm² (minimum) cable, fed from a circuit breaker.
- g. All spare cable cores shall be terminated (both ends of the cable).
- h. All instruments shall have solid state circuitry of robust design. Analogue signal transmission shall be linear, 4-20mA DC proportional to the range of measured variable.
- i. All instrument loops shall perform reliably under the site conditions at the water treatment plant and associated sites.
- j. All instruments shall have appropriate selection of materials for chemical compatibility, pressure and flow requirements, and to prevent corrosion and chemical reaction.
- k. All indicating transmitters shall be provided with adjustable signal damping, and non-interacting span and zero adjustment.
- l. Instrument Calibration Certificates shall be submitted to Seqwater for all installed instruments. The purpose of this is for accuracy assurance and compliance. Calibration Certificates shall also be submitted for all test and measurement equipment used to calibrate field instruments.

4.2. Field Instruments

The Contractor shall procure, works test (as applicable), deliver to site, install, site test and commission all field instruments, and then confirm required performance by means of site acceptance testing.

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Field instruments not suitable for direct termination of ordinary circular cable shall be connected using a stainless-steel junction box close to the instrument where the ordinary circular cable is terminated and connected through to the final instrument cable.

Field instruments for monitoring & control shall comply with the requirements detailed in the following sections:

4.3. Flow Metering

Refer to the following specifications, for general flow meter requirements:

- *M-SPE-STD-009 Flow Meters.*
- *M-SPE-STD-006 Bulk Supply Meters for Potable Water.*
- *M-SPE-STD-007 Meters for Non-Urban Water Supply.*

The following requirements are specific to electrical and instrumentation for flow meters:

- a. All necessary cabling shall be installed and terminated at the flow meter and the PLC / RIO / control panel. The flow meter transmitter shall be of the indicating and integrating type and shall provide readout of both instantaneous flow and total flow.
- b. Provide output from transmitter for totalised flow. Totalised flow held in the transmitter for display on the LCD screen is to be available on the SCADA system such that interruption of SCADA services does not result in loss of totalised flow records.
- c. Unless specified otherwise, display units for instantaneous flow shall be litres per second and totalised flow in Megalitres. The totaliser shall be able to display a minimum of 999,999 Megalitres (or where specified by Seqwater, 999,999 litres or 999,999 kilolitres) following which the totaliser shall reset to zero and commence totalisation again.
- d. Primary element and indicating transmitter shall be labelled with corresponding instrument tag number.
- e. Nameplates and instrument tag number labels shall be readily viewable without the need to enter a confined space.

The following items are specific to electromagnetic flowmeters:

- f. Provide 316 grade stainless steel earthing rings for both upstream and downstream flanges for all installations, where required by the manufacturer.
- g. Interconnecting cable between flow tube and transmitter shall be shielded type cable, as specified by the flowmeter manufacturer, and shall be provided connected to the flow tube. Surge protection can impact accuracy and if required, must be approved by the flowmeter OEM. Zener barriers not permitted on this cable.

The following items are required for pipelines with cathodic protection:

- h. A shunt connection, to bypass CP current upstream and downstream of the flowmeter (unless flowmeter is the CP isolation point).
- i. Insulated bolts / sleeves, to insulate the flowmeter from the pipeline.
- j. Flowmeter earthed as per manufacturer requirements and AS/NZS 3000.

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4.4. Level Transmitter (Pressure Type)

Pressure transmitter type level instruments are preferred for water applications due to reliability and safe access. The following shall be adhered to:

- a. The level sensing units shall be hydrostatic pressure sensing types complete with integrated or remote transmitter, with a 4 - 20mA signal.
- b. Pressure transmitters shall have a local display and be suitable for the liquid and conditions for which they are installed. The sensor shall include overvoltage varistors and overpressure limiter/stop to ensure integrity and reliability of the sensor. The units shall have an accuracy of $\pm 0.5\%$ of span.
- c. Sensing or impulse lines should be taken near the bottom of the tank/reservoir with double block and bleed isolation valves. The sensing lines shall not be taken from the scour/drain line to avoid any possible blockage. Valving in the sensing line needs to consider ease of calibration / maintenance.
- d. If used for a closed tank/ positive pressure tank, an additional sensing line needs to be used from the top of the tank to get differential pressure to convert to the level. Diaphragm seal, where used for the transmitter, shall be compatible with the chemical. It is important that specific gravity of the liquid is known for calibration and set-up.
- e. If the liquid is turbulent, a stilling well shall be used to increase accuracy.

4.5. Level Transmitter (Ultrasonic or Radar Type)

Non-contact type level instruments are preferred where contact instruments would create operational or maintenance issues. The selection between ultrasonic and radar level sensing types shall be based on the application. As per the liquid chemical standard, radar is preferred for chemical applications.

Ultrasonic level sensors have some limitations that make them less suitable for certain applications. Radar type level sensors are recommended instead of ultrasonic sensors where the process environment includes any of the following factors:

- Dust.
- Heavy vapours.
- Tank obstruction.
- Surface turbulence.
- Presence of foaming in measured material.

For ultrasonic level transmitters, temperature compensation is required to achieve the desired accuracy.

The level transmitter shall comprise of a sending and receiving detector head and a converter unit.

The converter shall be fitted with field accessible zero, span and range adjustments, two (2) field adjustable differential relay output contacts, a three (3) digit local indicator representing percentage level of liquid and a 4 – 20mA D.C. output proportional to the level of the liquid. The receiver signal shall be software conditioned to eliminate extraneous signals.

Stilling tubes shall be supplied and mounted in such a way as to stop movement of the transducer unit due to turbulence. Where the sensor is installed in chemical tanks or other potentially corrosive environments, a suitable protective diaphragm is required.

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Level Transmitters shall meet the requirements as set out in Table 1 below:

Table 1 Level Transmitter Requirements (Ultrasonic & Radar)

Detail	Value
Minimum Accuracy	±1 % of span
Minimum Repeatability	±0.5 % of span
Minimum Converter enclosure rating	IP56
Minimum Detector head enclosure rating	IP66D
Converter power supply	24VDC. If not available, then 230 VAC.

4.6. Level Switches

4.6.1. General Requirements

Level switches are generally installed for level alarm indication in the relevant tanks and bunds. They are a point level detection device, rather than continuous measuring. Alarm level switches are generally connected to the control system as a digital input.

The designer, in consultation with Seqwater, needs to select the most appropriate level switch for the application. Level switches in use at Seqwater include float, conductivity, vibration fork, magnetic switches, and non-contact capacitance.

The following shall be adhered to:

- Mercury level switches are not permitted.
- The switch shall be provided with sufficient length of heavy-duty flexible cable to allow a generous adjustment of the operating level. The cable length allowed for adjustment is to be neatly coiled and tied.
- Level switches shall be suspended from dedicated stainless-steel brackets. Level switches shall be appropriately labelled as shown on the drawing by engraved aluminium or plastic tags or discs attached to the flexible cable sheath.
- Flexible cables shall be terminated in gland entry IP66 junction boxes with DIN-rail mounted terminals for connection to the fixed wiring. Flexible cables shall be installed in open-ended heavy duty rigid PVC conduit between suspension brackets and junction boxes for easy replacement of switches.
- Positions of switches and junction boxes shall be confirmed onsite by Seqwater.

4.6.2. Level Switch (Float Type)

Electromechanical float type level switches are a simple design and proven technology but require regular inspections and maintenance. Float type switches are not to be used for chemical systems.

4.6.3. Level Switch (Conductivity Type)

Conductivity level switches shall consist of an electrode (or probe), and an electronic signal converter. An earth electrode (or probe) shall be provided as necessary for correct operation.

Where more than one electrode (or probe) is suspended at the same point, provide insulators at suitable spacings, to maintain an acceptable clearance.

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The sensitivity of the switch shall be suitable for the application.

The electronic signal converter shall be mounted either in the head of the probe or mounted separately within a suitable panel. Signal converter shall be 24VDC.

A junction box shall be provided adjacent to the probe flange, to ensure the probe can be extracted from the vessel without damage to the cabling.

4.6.4. Level Switch (vibration fork, magnetic, and non-contact capacitance)

Vibration fork, magnetic switches, and non-contact capacitance level switches can be used, to achieve a fit-for-purpose design.

4.7. Level Controllers

Level controllers shall consist of an analogue level sensor and a system to provide control switching at multiple levels. Level sensors shall be suitable for potable water applications. The level sensor shall include all fixing equipment. Any exposed metal part shall be corrosion proof to prevent galvanic reaction.

A multi-core cable shall be provided with the level sensor which will be submersed within the well. The cable shall be of sufficient length to allow direct connection to associated equipment in the control switchboard or an intermediate field control cubicle. The cable shall be terminated in accordance with manufacturer's instructions.

The level sensing system shall supply an output of 4 - 20mA analogue signal. The range of the sensor shall cover the full range of measurement from low level to overflow.

4.8. Loss of Head

Loss of head instruments are typically used to monitor filter head loss in water treatment plants, to determine when backwash is required.

The Loss of Head measuring device shall consist of a Differential Pressure transmitter with indicator.

The pressure transmitter shall have all welded parts, connection flanges, bolts nuts and washers manufactured from 316 grade stainless steel.

Impulse lines from take-off points to the transmitter shall be minimum 6mm ID tubing with quick connect fittings (SMC TM or Swagelok TM). All impulse lines shall drain to the pipeline connection and have isolation valves for maintenance, using a double block and bleed manifold.

The overall accuracy of the transmitter and sensor shall be better than 2% of reading.

4.9. Air Scour Flow Rate

The flow measuring device shall consist of an Orifice plate and Differential Pressure transmitter with indicator.

The pressure transmitter shall have all welded parts, connection flanges, bolts nuts and washers manufactured from 316 grade stainless steel.

Impulse lines from take-off points each side of the Orifice plate to the transmitter shall be minimum 10mm diameter 316 grade stainless steel with 316 grade stainless steel dual cone type compression fittings to suit connections. Orifice plates shall have the orifice diameter, including units, clearly engraved externally. All impulse lines shall drain to the pipeline connection.

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The overall accuracy of the transmitter and sensor shall be better than 2% of reading.

4.10. Pressure Transmitter

All welded parts, connecting flanges, nuts bolts and washers shall be manufactured in 316 grade stainless steel, (unless specified otherwise due to exposure to chemicals incompatible with 316 stainless steel.)

Impulse line from pipe work to the transmitter shall be minimum 10mm diameter 316 grade stainless steel with 316 grade stainless steel dual cone type compression fittings to suit connections (unless specified otherwise due to exposure to chemicals incompatible with 316 stainless steel.)

All impulse lines shall drain to the pipeline connection and have isolation valves for maintenance, using a double block and bleed manifold.

For chemical and slurry systems, a diaphragm barrier is required compatible with the chemical.

4.11. Water Quality Online Monitoring Instrumentation

Water quality instruments measure a range of physical, chemical, and biological parameters to assess the condition and safety of water.

4.11.1. Water Quality Instrument/Analyser Specifications

Specifications for the following instruments/analysers shall be defined in the project specific scope of works. Seqwater standard specifications for particular categories of instrument/analyser also apply where these exist.

- Chlorine Residual Conductivity
- Density
- Dissolved Oxygen
- Fluoride
- Monochloramine & Free Ammonia - Standard *I-SPE-STD-017 Monochloramine & Free Ammonia*
- pH / ORP (Oxygen Reduction Potential)
- Sludge Blanket Level
- Total Suspended Solids
- Temperature
- Turbidity – Standard *I-SPE-STD-016 Turbidity Analysers*
- Total Organic Carbon (TOC)
- UV254 absorbance/transmittance

4.11.2. Water Quality General Requirements

- a. All online water quality monitoring instrumentation shall comply with Seqwater preferred equipment suppliers list, where listed.
- b. All Water Quality Online Monitoring instruments shall be capable of providing an 'instrument fault' signal. Project specific requirements will define as to whether the signal is required to be connected into the site wide SCADA system.
- c. Refer to standard drawing *B-DWG-STD-044 P&ID Water Quality Monitoring Analyser Panel* for further notes on water quality monitoring analyser panels.

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- d. Prior to Proof of Performance Testing the Contractor shall organise a suitably qualified instrumentation technician from or endorsed by the original instrumentation supplier/s to complete onsite calibrations of all water quality monitoring instrumentation. The Contractor shall also organise training for Seqwater Operations and Maintenance personnel by this technician/s in the operation, maintenance, and calibration of all the water quality instrumentation.
- e. The Contractor shall submit all calibration certificates of the online water quality instrumentation prior to starting Proof of Performance Testing. Proof of Performance Testing shall not proceed without the Contractor providing Seqwater all calibration certificates of the online water quality instrumentation.

4.11.3. Water Quality Instrument Sampling Systems

To ensure that the sample to the water quality instrument is appropriately representative the following guidelines shall be adhered to:

- a. Sample points are to be taken from the side of the pipe (+/- 45°). Samples are not to be taken from the bottom (due to sediment) or top (due to possible air entrainment) of the pipe. In pipes greater than 200 mm a sample quill / spear is to be used to ensure that representative samples are collected. Where a sample quill is used, the sample quill can be mounted from the top.
- b. The sample line is to be as short as practicable (i.e., the analyser should be located as close to the sample point as practicable considering the need for maintenance, climate control etc.).
- c. The sample travel time must not exceed 2 minutes (120 seconds). Preferably lower.
- d. Sample lines are to be opaque, and if exposed to weather are to be lagged.
- e. For rigid sample lines greater than 10 m length, the sample line must be designed to enable pigging of the pipe as part of normal maintenance.
- f. Sample lines require mechanical supports and protection from direct sunlight. UV stabilised material preferred.
- g. Gravity supply of sample is preferred. If pumped supply of the sample is required, then centrifugal (or approved equivalent) pumps are to be used.
- h. The instrumentation fittings for small bore hydraulic pipework and tubing shall be stainless steel Swagelok quick connect or SMC one touch fittings, stainless steel series KG to suit application.
- i. All sampling systems for Water Quality Online Monitoring instruments shall be supplied with flow monitoring such that when sample flow ceases, a 'No sample water flow' signal is available. Project specific requirements will define as to whether the signal is required to be connected into the site wide SCADA system.

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5. Instrumentation Installation

5.1. General Requirements

Install instrumentation and associated equipment in accordance with Seqwater standards and manufacturer's instructions. Refer to standard P&ID drawings for minimum layout and individual instrument requirements.

Location, arrangement and mounting of all instrumentation and associated equipment shall be as per approved IFC drawings.

Cables and mechanical protection of cables shall meet the requirements of *E-SPE-STD-001 Electrical Design and Construction*.

Where instrumentation is required below ground level, install within a suitably sized pit with self-drainage.

All instruments shall include the following features where applicable to the application:

- Temperature compensation
- Isolation valve / double block & bleed
- Valving to permit maintenance, testing and calibration without the disconnection of piping
- Ease of replacement of sensing element
- Facilities for manual sampling
- Local display of the process variable in engineering units.

5.2. Location

Instruments shall be located to facilitate ease of operation, inspection, and maintenance; including, but not limited to, the following requirements:

- a. Instrumentation shall be serviceable and replaceable without requiring portable ladder or scaffolding.
- b. Field mounted transmitters shall be mounted 1500 mm above ground or platform level.
- c. Dial thermometers and instrument gauges shall be plainly visible and accessible from the ground or platform level.
- d. Mounting instruments on process piping shall be as per approved IFC drawings.
- e. Instrumentation and associated equipment shall not be supported from handrails.
- f. Instrumentation shall not be supported from structural steel work or plant which may be subject to vibration, unless this is required due to the nature of the process being measured and the instrumentation is rated for this purpose.
- g. Instrumentation and associated equipment shall not be fixed to building cladding.
- h. Wet components (such as flow through sensor cells) shall not be installed above electrical components (i.e. the instrument head).
- i. Sufficient clearance shall be allowed for between instrument components to allow for the withdrawal of sensors from cells for maintenance purposes.

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- j. Where an instrument is required to sit over media, which is out of reach, a davit arm arrangement should be provided to swing the instrument back to a safe area where it can be maintained.

5.3. Stands

Instrument stands shall be located as close as practicable to the process tapping points but must remain clear of handrails and walkways; including, but not limited to, the following requirements:

- a. Stands shall be sized to fit the number of transmitters they are designed for.
- b. Stands shall not be affixed to floor gratings or handrails.
- c. Where stands are not located on paved areas, a concrete plinth typically 300 mm square by 400 mm deep, shall be cast in the ground with no more than 100 mm projecting above the grade level and the stand bolted to this with the stand base grouted as per *M-SPE-STD-001 General Mechanical*.

5.4. Enclosures

Instrument enclosures and fittings shall be suitable for the prevailing environment and hazardous area classification of its intended installation area.

The use of instrument enclosures is not mandatory where the instrument is located within a dedicated electrical room.

The following instruments shall be installed in an IP56 aluminium or grade 316 stainless steel enclosure, constructed in accordance with the requirements for LV control panels (*E-SPE-STD-009 Low Voltage Switchboards*):

- Water quality analyser instruments.
- All instruments with an IP rating of less than IP56.

Additional requirements for IP56 enclosures:

- a. Enclosures exposed to direct sunlight shall include a sun protective hood. The hood shall extend past the sides and front of the enclosure by a minimum of 20mm. Where the rear or sides of the enclosure are exposed to direct sunlight, shielding shall be used without obstructing the gland plate / cable glands.
- b. An earth bar shall be installed in each instrumentation enclosure. Earthing and bonding of instrument enclosures shall be as per AS/NZS 3000.
- c. A means to isolate the power supply shall be provided within each enclosure, if low voltage is present.

All other instrument transmitters shall be enclosed by covers complete with sides, drip hood and back with pitched or skillion roof and:

- The enclosures shall have at least 100mm clearance around the transmitter and provide ample space for easy maintenance and replacement of the instrument.
- The sides and top shall protrude at least 100mm in front of the transmitter.
- The covers shall be constructed from 3mm thick marine grade aluminium.

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5.5. Mounting

The following shall be adhered to when mounting instrumentation:

- a. Drilling or welding of brackets on pressure vessels or metal structures is not permitted.
- b. Column mounted stands shall be clamped. Welding may be allowed under certain situations but requires approval from Seqwater.
- c. All mounting brackets and hardware for field sensors shall be 316 grade stainless steel.
- d. All mounting brackets for instrument stands shall be heavy duty hot dip galvanised or stainless steel. Any damage to the galvanised coating shall be touched up with a zinc rich epoxy coating, as per M-SPE-STD-004.
- e. All brackets and supports shall be constructed such that vibration from wind and surrounding equipment is negligible.
- f. Stainless steel mechanical anchors may be used for securing stands to the concrete pavement. Preferred method as per *M-SPE-STD-001 General Mechanical* clause 6.4.6 masonry anchors.
- g. Spacers shall be used to permit concrete grouting to take place after installation.

5.6. Tubing and cabling

All tubing and cabling shall meet the following requirements:

- a. All male and female screwed connections shall be of the same size and form.
- b. The use of spring girder clips is not permitted.

5.7. Lightning & Surge Protection Devices

Instrumentation installations shall be designed and constructed to reduce the risk of lightning and surge damage to an acceptable level in accordance with AS 1768.

Surge Protection Devices shall meet the following requirements:

- a. SPDs shall be used for all field mounted instruments with analog I/O, installed at the PLC/RIO end.
- b. Surge Protection Devices shall be installed as per the manufacturer's guidelines.
- c. SPDs shall be bonded directly to earth (minimum 4mmsq) using the shortest possible path (no daisy chaining).

5.8. Earthing

Earthing shall be in accordance with manufacturer guidelines, *E-SPE-STD-001 Electrical Design and Construction* and AS/NZS 3000.

Instrument earthing shall meet the following requirements:

- a. Earthing points shall be provided for all enclosures.
- b. All non-current carrying exposed metallic parts, within the enclosure, shall be effectively earthed.
- c. Metallic enclosures and metallic enclosure doors shall be bonded to earth, using the dedicated earthing point provided.

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- d. All metallic gland plates shall be earthed.
- e. Glands fitted to plastic or painted metal gland plates shall be earthed.
- f. All metallic components of field instrumentation shall be bonded together.

5.9. Settings and commissioning

Settings of equipment and instruments shall be in accordance with manufacturer's instructions, project design and site specific data obtained from the Seqwater representative.

All installed position limit switches shall be adjusted for proper functioning.

Complete commissioning as per *B-SPE-STD-003 Commissioning Requirements*. Provide Inspection & Test Plans and Test Reports, as required.

5.10. Labels

Equipment and instrument numbering for labels shall be in accordance with the requirements listed in *X-PRO-STD-006 Equipment Numbering and Naming Convention*.

All apparatus shall have fitted, to non-detachable parts of equipment, conspicuous labels conforming to the following requirements (Table 2):

Table 2 Label Requirements

Equipment	Type of label	Function
Junction Boxes, Distribution Boards, Marshalling Boxes and instrument enclosures	Indoor or exposed to chemicals: Engraved W-B-W UV-stabilised ABS laminated plastic. Outdoor: Etched 316 stainless steel.	Equipment number, and circuit identification as applicable
Instruments	Indoor or exposed to chemicals: Engraved W-B-W UV-stabilised ABS laminated plastic. Outdoor: Etched 316 stainless steel.	Instrument tag number per instrument list.
Control Cable cores	Ferrules with black lettering on white background	Core number of connection diagrams
Cable number tags	Non-ferrous	Cable number as on cable schedule

Colours shall be permanent and free from fading.

Labels shall have bevelled edges and slotted fixing holes to allow for differential expansion of the label and base without distortion of the label. Label retaining screws shall leave the label free to slide as it expands.

Equipment and enclosure labels shall be securely fixed to the equipment/enclosure, using not less than two stainless steel fastenings. Label fixings shall be such as to allow ready replacement without damage to the label or fixing. Instrument labels can be attached using stainless steel wire and crimp.

The labels shall not be mounted on the instrument, but as close to it as possible. Each instrument and piece of equipment shall have a tag number or equipment number as identified on the equipment schedule or drawing.

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6. Definitions and Abbreviations

Table 3 Definitions

Term	Definitions
Employees	Means persons employed directly by Seqwater in a permanent, temporary, or casual capacity.
Worker(s)	Includes all permanent, temporary, and casual employees of Seqwater, and: • vocational and work experience placements • volunteers • contractors and consultants employed by another entity but temporarily assigned to do work for or on behalf of Seqwater.
Seqwater Approval / Acceptance	Written sign-off gained via the deviation process, as detailed in X-PRO-STD-008 Asset Standards Management and Application Procedure.
Contractor	An entity engaged by Seqwater to undertake work in accordance with an agreed contract and defined scope of work.
Engineering Standard	Includes Seqwater Engineering Standard Procedures and Standard Specifications and associated supporting documents such as Standard Drawings, Guidelines, Lists, Manuals, Registers, and Templates.
Instrumentation	Equipment that measures physical quantities.
Manufacturer / Supplier / Vendor / Original Equipment Manufacturer (OEM)	The entity that manufactures or supplies equipment to meet the specifications of the Contractor.
Owner / Principal / Seqwater	The entity that engages the Contractor to undertake the work and takes custody of the outcome. The Owner may delegate responsibilities to other entities to act on its behalf (e.g., a consultant).
REX	Seqwater Electronic Document and Records Management System.
shall / must	Indicates a mandatory requirement.
Should	Indicates a recommendation

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Table 4 Abbreviations

Term	Definitions
ABS	ABS plastic (Acrylonitrile Butadiene Styrene)
AM	Asset Management
AC	Alternating Current
ANSI	American National Standards Institute
AS or AS/NZS	Australian Standards or Australian / New Zealand Standards
CPU	Central Processing Unit
DC	Direct Current
Hz	Hertz
ID	Inside Diameter
IP	Ingress Protection
IEC	International Electro-technical Commission
IFC	Issued For Construction
ISA	Instrumentation Systems and Automation society
ISO	International Standards Organisation.
LCD	Liquid Crystal Display
l/s	Litres per second
MCC	Motor Control Centre
ORP	Oxygen Reduction Potential
P&ID	Piping and Instrumentation Diagram
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition.
SPD	Surge Protection Device
TOC	Total Organic Carbon
W-B-W	White-Black-White

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7. References and Related Materials

The documents listed in Table 5 below, and the requirements therein, are relevant to this Standard Specification. In their latest editions, these documents form a part of this document. Note that this is not an exhaustive list of documents relevant to the works.

Seqwater undertakes regular updates of its Engineering Procedures and Standards. Before utilising this document, the complete list of Seqwater Engineering Procedures and Standards should be reviewed to ensure currency and applicability for the proposed works.

Table 5 References and Related Materials

Description	Location
REG-01074 X-LST-STD-001 Seqwater Preferred Equipment Register	REX
PRO-01873 X-PRO-STD-001 Asset Standards Document Classification and Naming Structure Procedure	REX
PRO-01872 X-PRO-STD-002 Engineering Drawing Numbers Procedure	REX
PRO-01874 X-PRO-STD-004 Development and Review of Asset Standards Procedure	REX
PRO-02190 X-PRO-STD-006 Equipment Numbering and Naming Convention Procedure	REX
PRO-02187 X-PRO-STD-007 Drawing and Spatial Data Standards Procedure	REX
PRO-02205 X-PRO-STD-008 Asset Standards Management and Application Procedure	REX
PRO-01617 X-PRO-STD-009 Engineering Design, Construction, Operation and Maintenance Procedure	REX
TEM-00224 X-TMP-STD-022 Asset Standards Deviation Request Template	REX
SPE-00346 B-SPE-STD-003 Commissioning Requirements	REX
SPE-00352 E-SPE-STD-001 Electrical Design and Construction	REX
SPE-00367 M-SPE-STD-001 General Mechanical	REX
SPE-00348 M-SPE-STD-004 Protective Coatings	REX
SPE-00434 M-SPE-STD-009 Flow Meters	REX
SPE-00356 I-SPE-STD-005 High Priority Alarms and Interlocks Management	REX
SPE-00357 I-SPE-STD-006 Alarm and Event Management	REX
SPE-00361 I-SPE-STD-013 Control Systems Design and Construction	REX
SPE-00503 I-SPE-STD-016 Turbidity Analysers	REX
SPE-00432 I-SPE-STD-017 Monochloramine and Free Ammonia Analyser	REX
ISO 80000 Quantities and units	Intertek Inform
AS/NZS 4680 Hot dip galvanized (zinc) coatings	Intertek Inform
AS 1768 Lightning protection	Intertek Inform

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Description	Location
AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)	Intertek Inform
AS/NZS 3008.1.1 Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions	Intertek Inform
AS/NZS 3017 Electrical installations - Verification guidelines	Intertek Inform
AS/NZS 3111 Approval and test specification - Miniature overcurrent circuit-breakers	Intertek Inform
AS/NZS 4020 Testing of materials that contact drinking water	Intertek Inform
AS 4024.1 Safety of Machinery	Intertek Inform
AS/NZS 4836 Safe Working on low-voltage Electrical Installation	Intertek Inform
AS/NZS 5000.1 Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1 (1.2) kV	Intertek Inform
AS/NZS ISO 9001 Quality Management Systems	Intertek Inform
AS/NZS 60079 Explosive atmospheres	Intertek Inform
AS/NZS 60529 Classification of Degrees of Protection Provided by Enclosures for Electrical Equipment	Intertek Inform
AS 61386.1 Conduit systems for cable management	Intertek Inform
AS/NZS 61439 Low-voltage switchgear and controlgear assemblies	Intertek Inform

8. Changes from previous version

Changes made from the previous version are summarised in Table 6 below.

Table 6 Changes from Previous Version

Section Number	Change
All	The Asset Standards Document Number has been changed from E-SPE-STD-002 to I-SPE-STD-015, to meet requirements of <i>PRO-01873 X-PRO-STD-001 Asset Standards Document Classification and Naming Structure Procedure</i> .
All	Rewritten to align with new Seqwater Engineering Standard Specification Template. Sections rearranged.
All	Grammar and formatting corrections.
All	Minor technical improvements and corrections throughout document.
4.3	Major overhaul of flow metering section. All duplication with M-SPE-STD-009 now removed.
5.7	Lightning and surge protection section added.

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