

Engineering Standard I-SPE-STD-016 Turbidity Analysers

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This Engineering Standard was endorsed by an RPEQ on behalf of Seqwater.

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This document is the property of Seqwater. It must not be copied or reproduced in any way whatsoever without the authority of Seqwater. This document is uncontrolled when printed. An electronic database manages and stores the controlled version.

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, economic over the life of the asset, and meets Seqwater's risk appetite and compliance requirements including Work Health and Safety obligations.

This Standard Specification provides the minimum requirements and recommendations for the design, supply and installation of new or replacement plumbed turbidity analysers suitable for continuous online turbidity monitoring within a water treatment plant and Seqwater network systems.

This Engineering Standard provides guidance on standard operating and physical requirements of the turbidity analyser. The battery limits are:

- The sample lines into and out of the analyser
- Incoming power supply terminals of the analyser indicating transmitter
- Control and communication cable terminals of the analyser indicating transmitter for connections to plant control system

Separate inlet and outlet sample lines is the normal configuration for turbidity analysers under this standard specification. Contact Seqwater Engineering for requirements for immersion/insertion applications.

This Standard Specification was the basis for an open market procurement process to select Seqwater preferred equipment for turbidity analysers. Refer to *X-LST-STD-001 Seqwater Preferred Equipment Register* ([REG-01074](#)) for the current preferred turbidity analyser models, part numbers, manufacturers and suppliers.

This document must be used in conjunction with the documents it references to assist in ensuring fit for purpose infrastructure. This Standard Specification 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, including employees, contractors, suppliers 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.

Where single or discrete components of an existing non-compliant system are to be replaced, refurbished or modified, this standard should not automatically be applied to the entire system retrospectively, however consideration should be given, in consultation with relevant stakeholders, to the extent of the application of the standard outside of the components requiring replacement, refurbishment or modification, to ensure safe, economic, and fit for purpose infrastructure.

Seqwater Engineering Standards include Standard Specifications, Drawings, Procedures, Templates, Forms and Preferred Equipment Lists. Together they detail Seqwater's minimum requirements and recommendations to provide infrastructure that will be fit for purpose, safe, and cost effective to operate and maintain. However,

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compliance with these requirements and recommendations does not remove, and cannot be relied on as meeting, the designer's overarching responsibility for ensuring infrastructure designed is fit for purpose and safe to construct, operate, maintain, and demolish. 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 Water Services Association of Australia). 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 Specification requires written agreement from Seqwater as per the deviation process detailed in *Procedure X-PRO-STD-008 Asset Standards Management and Application* ([PRO-02205](#)). That process includes completion of an *X-TMP-STD-022 Asset Standards Deviation Request Form* ([TEM-00224](#)) together with relevant supporting documentation, and submission by the Seqwater Project Representative to the Seqwater Engineering Mailbox. Where noted in this Standard Specification that Seqwater approval, agreement, or acceptance shall/must be sought, such approval, agreement or acceptance must be gained through the Seqwater Asset Standard Deviation process, as outlined 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 infrastructure. This includes modifications to the functional design of the infrastructure including technical changes made which would extend an asset outside of its design operating envelope and/or approved operation and maintenance practices.

Any ambiguities or conflicts identified between specific requirements within this Standard and project documents, another Seqwater Engineering Standard or Australian Legislation, Standards, Codes or Guidelines, must be brought to the attention of the Seqwater Document Owner as listed in the document footer, via the Engineering Mailbox, for clarification. Where it is proposed to proceed without meeting the requirements of this standard, agreement must be obtained via the Deviation Process, as outlined above.

Seqwater undertakes regular updates of its Engineering 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. These can be accessed on the Waternet [Seqwater Engineering Standards & Framework](#) page or from your Seqwater project manager, design manager, or engaging officer. Standards suitable for publication are also available on the [Engineering standards](#) page on the Seqwater website.

3. Technical Requirements

3.1. General Analyser Requirements

The turbidity analyser may be a single or multi-channel analyser and shall be suitable for measuring turbidity in treated water, filtered water, raw water, settled water and supernatant return water as per the application specified, and shall be compliant with ISO 7027-1 Nephelometric Method or US EPA Method 180.1. The analyser shall be made up of components commonly used for the application and represent current water industry best practice.

Spare parts that may reasonably require replacement, light source, detector assembly and tubing / connection components shall be readily available in Australia and be supported as a minimum for the duration of the design life in accordance with Clause 3.2 of this specification. Lead time for the delivery of spare parts to a nominated Seqwater site shall be a maximum of three working days after receipt of order.

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All components and ancillary equipment shall be designed to withstand washdown with a handheld, mains pressure water hose.

Refer to *Standard Specification I-SPE-STD-015 Instrumentation* ([SPE-00353](#)) for general requirements related to instrument assets.

3.2. Design Life, Reliability and Availability

The minimum design life of the turbidity analyser shall be 10 years from the date of purchase unless otherwise specified and approved by Seqwater.

Each analyser should achieve a reliability and maintainability target, MTBF of 8750 hours minimum, resulting in an availability of 99.9%. The design of the analyser shall be such that the replacement of any parts may be rapidly executed to minimise non-availability.

3.3. Operating Conditions

All components of the analyser must be suitable for the design, minimum and maximum flow, pressure, temperature, duty cycle and other operating conditions. They must have compatibility with the process medium with all wetted components designed using corrosion and wear resistant materials suitable to achieve the specified design life without the need for replacement. Components that are designed to be replaced do not fall under the design life requirements as documented in section 3.2.

The analyser must be suitable for operating within the Southeast Queensland environment, including exposure to potential liquid or gaseous chemicals used within a water treatment plant. At a minimum, the analyser must be capable of operating in an open, fully exposed environment with ambient operating temperatures of 0 to +45°C and relative humidity of 10 to 95%. For further details, refer to *Standard Specification I-SPE-STD-015 Instrumentation* ([SPE-00353](#)).

3.4. Safety in Design

Seqwater's expectations relating to safety in design are outlined in the *Safety in Design* section of *X-PRO-STD-009 Engineering Design, Construction, Operation and Maintenance Procedure* ([PRO-01617](#)).

All equipment must be designed to perform its intended duty safely and without being attended. Wherever practicable, health and safety risks shall be fully mitigated ("designed out") during the design phase for both the construction and end use phases.

Where the analyser is being installed in a Classified Hazardous Area, it must comply with the requirements of the *Hazardous Area Application* section of *Engineering Standard E-SPE-STD-001 Electrical Design and Construction* ([SPE-00352](#)), and the *Hazard Management* section of *Engineering Standard M-SPE-STD-001 General Mechanical* ([SPE-00367](#)).

3.5. Electrical Compliance Requirements

The turbidity analyser shall be certified by the manufacturer as compliant with *AS 61010.1 Safety requirements for electrical equipment for measurement, control and laboratory use – General Requirements* or *IEC 61010-1* or *EN 61010-1*.

3.6. Drinking Water Compatibility

The Turbidity Analyser must conform to the Potable Water Compatibility section of *Engineering Standard M-SPE-STD-001 General Mechanical* ([SPE-00367](#)). Where certification to AS/NZS 4020 cannot be provided, the supplier

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must demonstrate that the components which make up the Turbidity Analyser do not introduce substances which result in deterioration of water quality or cause physical harm to the public.

3.7. Physical and Operating Requirements

3.7.1. General Requirements

Turbidity analyser shall be continuous flow, continuous reading and must provide direct measurement turbidity reading in NTU.

A means for convenient mess free cleaning and flushing of instruments shall be provided.

An individual analyser indicating transmitter must be provided for each turbidity analysing element, except where the design demonstrates that multiple turbidity analysing elements sharing a transmitter will provide acceptable overall system reliability and this is accepted by Seqwater.

3.7.2. Calibration and Verification Requirements

The means shall be provided by the manufacturer for the primary calibration of the instrument using certified standard solutions preferably in sealed vials to avoid inhouse preparation and exposure.

Secondary verification standard/s shall be provided which shall be solid matrix (non-liquid standard) and be representative of the instruments measurement range/s. When measured the instrument reading shall be within $\pm 10\%$ of the certified NTU value of the verification standard.

3.7.3. Ingress Protection Requirements

Enclosures for the turbidity analyser shall provide a minimum degree of protection of IP56. For further details, refer to *Engineering Standard I-SPE-STD-015 Instrumentation* ([SPE-00353](#)).

All analyser vents and overflows shall be vermin proof.

3.7.4. Air Bubble Trap

An internal/external air bubble trap or bubble rejection feature must be available with the analyser.

3.7.5. Analyser Performance Requirements

The analyser performance must be maintained without manual intervention for a minimum period of 30 days.

The following range, accuracy, repeatability and resolution requirements shall be met for the specified process application (Table 1):

Table 1 - Analyser Range, Accuracy, Repeatability and Resolution Requirements

Process Application	Range	Accuracy (% of reading)	Repeatability (% of reading)	Resolution
Treated Water	0-10 NTU	$\pm 2\%$	$\pm 1\%$	0.01 NTU
Filtered Water	0-5 NTU	$\pm 2\%$	$\pm 1\%$	0.01 NTU
Settled Water	0-20 NTU	$\pm 2\%$	$\pm 1\%$	0.01 NTU
Raw Water Type 1	0 – 1000 NTU	$\pm 5\%$	$\pm 1\%$	0.1 NTU
Raw Water Type 2 Low range	0 – 1000 NTU		$\pm 1\%$	0.1 NTU

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Process Application	Range	Accuracy (% of reading)	Repeatability (% of reading)	Resolution
High range	0–9999 NTU	±5% ±10%	±1%	1 NTU
Supernatant Return Water	0-50 NTU	±2% (0-40 NTU) ±5% (>40 NTU)	±1%	0.1 NTU

Note: The ranges listed here are the standard analyser capabilities required for the specified process application. The calibration range and 4-20mA output range may vary between sites.

A maximum T90 response time of 60 seconds shall not be exceeded. Shorter response time using minimum flow is preferred.

3.7.6. Dual Range

For Type 2 raw water applications (raw water turbidity may exceed 1000 NTU), the analyser must be capable of having two separately configurable 4-20mA analogue outputs to allow measurement at the specified resolutions whether the value is low range or high range, without manual intervention to reprogram the range.

3.7.7. Analysing Element Requirements

The sensor shall use a light source with colour compensation suitable for use in highly coloured water with a temperature range of 0 to 45°C. An automatic self-cleaning facility for the optical surfaces shall be provided where frequent maintenance is required, or the optical windows are in direct contact with the sample. The frequency of self-cleaning shall be user set.

3.7.8. Analyser Power Requirements

All analysers shall operate from 24VDC supply.

3.7.9. Analyser Local Control Interface

The analyser shall be based on microprocessor technology with all programming/parameterising undertaken locally via the front panel keypad. Parameterising shall have the capability of being password protected.

A minimum of four-digit backlit display shall be provided which must show the measurement value. Where a multi-channel analyser is used, the measurement parameter in addition to the measurement value must be shown.

The display shall include automatic decimal point positioning where required to indicate the turbidity reading to the specified resolution.

3.7.10. Analyser Outputs - Digital

The analyser shall have as a minimum the following signals via relay contacts, fully configurable for:

- Analyser fault
- Sample flow fault.

The 'Analyser Fault' signal must be configurable as a fail-safe contact which remains closed under normal operating conditions and opens upon power loss or an analyser fault.

The 'Sample flow fault' output shall operate independently of the general "Analyser fault" output to provide the status of the sample flow rate (healthy / unhealthy), with user choice of normally open or normally closed contacts.

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3.7.11. Analyser Outputs – Analogue

The analyser shall have a minimum of one 4-20mA output which must be fully scalable for turbidity indication. For raw water Type 2 applications a minimum of two fully scalable 4-20mA outputs shall be provided to achieve dual range capability as specified in section 3.7.6.

An additional 4-20mA output for analogue sample flow rate is desirable.

3.7.12. Analyser Hold Function

Analysers which have the maintenance/hold function shall have the capability of being disabled and password protected. The maintenance/hold function will be managed by site SCADA.

3.8. Protective Coatings

The protective coating shall be suitable to achieve the design life (refer Section 3.2), without the need for re-application. A minimum C3-Medium corrosivity category (as per AS 4312), will apply for all external surface protection requirements. A C4-high or C5-very high corrosivity category shall be assigned to equipment that will be installed in the specific environments, including those specified by *Engineering Standard M-SPE-STD-004 Protective Coatings* ([SPE-00348](#)).

3.9. Markings

In addition to the manufacturers name plate, labelling must be in accordance with the Labelling and Nameplate section of *Engineering Standard I-SPE-STD-015 Instrumentation* ([SPE-00353](#)) and *X-PRO-STD-006 Asset and Equipment Identifier Procedure* ([PRO-02190](#)). Equipment Field Labelling is to be added when the analyser is installed.

4. Definitions and Abbreviations

Table 2 - Definitions and Abbreviations

Term	Definitions
AC	Alternating Current
Analyser	A Turbidity Analyser. Equipment used for measuring fluid turbidity and providing local indication and control system interfaces, consisting of the combination of the Analyser Indicating Transmitter and the Analysing Element.
Analyser Indicating Transmitter	Digital programmable controller which connects to the analysing element, provides local control, local monitoring and communications (fieldbus and/or relay) signals for interface with an external control system, and the turbidity value as a 4-20mA signal output for interface with an external control system.
Analysing Element	A device which measures the physical property of turbidity.
AS	Australian Standards
Contractor	An entity engaged by Seqwater to undertake work in accordance with an agreed contract and defined scope of work.
DC	Direct Current

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Term	Definitions
Employees	Means persons employed directly by Seqwater in a permanent, temporary or casual capacity.
Fit for purpose	Suitable for the intended purpose and meets the performance requirements set out in this standard and other project documents.
IP	Ingress Protection
LCD	Liquid Crystal Display
Leader	Means any Level 1, 2, 3 and 4 Leader with responsibility for managing a functional area of the business, including people management responsibilities within their functional area.
Maintained Command	A command that is held for as long as the effect is required i.e., if the equipment is sent a maintained run command, it will operate for as long as the run signal is held.
Manufacturer / Supplier / Vendor / Original Equipment Manufacturer (OEM)	The entity that manufacturers or supplies equipment to meet the specifications of the Contractor.
MTBF	Mean Time Between Failures
NTU	Nephelometric Turbidity Unit
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).
PLC	Programmable Logic Controller
Pulsed Command	A momentary change in state i.e. equipment receives a pulsed run command, it will continue to run until it receives a subsequent stop command.
REX	Seqwater Electronic Document and Records Management System.
Sample Inlet	A location where the sample is introduced into the analyser
SCADA	Supervisory Control and Data Acquisition
SEQ	South East Queensland
Seqwater Approval / Acceptance	Written sign-off gained via the deviation process, as detailed in X-PRO-STD-008 Asset Standards Management and Application Procedure.
Seqwater Engineering Standard	Includes Standard Procedures and Standard Specifications and associated supporting documents such as Standard Drawings, Guidelines, Lists, Datasheets, Manuals, Registers, and Templates.
Shall / must	Indicates a mandatory requirement
Should	Indicates a recommendation
Standard	Includes a Standard Specification, Standard Code of Practice or other Standard issued by a recognised association or body set up for the purpose

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Term	Definitions
T90 response time	Is the time required for the instrument's output to reach 90% of its final value after a step change in the measured variable.
Worker	Includes all permanent, temporary, and casual employees of Seqwater, and: • vocational and work experience placements • volunteers • suppliers, contractors, and consultants temporarily engaged to do work for or on behalf of Seqwater.
WSAA	Water Services Association of Australia

5. Roles and Responsibilities

Table 3 Roles and Responsibilities

Role	Responsibility
Leaders	In addition to the responsibilities of a worker, ensure compliance with this Standard Specification by those they lead.
Workers / Employees	Be aware of and comply with this Standard Specification

6. References and Related Materials

The documents listed in Table 4 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 Standards. Before utilising this document, the complete list of Seqwater Engineering Standards should be reviewed to ensure currency and applicability for the proposed works.

Table 4 References and Related Material

Description	Location
AS 4312 Atmospheric corrosivity zones in Australia	Intertek Inform
AS 61010.1 Safety requirements for electrical equipment for measurement, control and laboratory use – General Requirements	Intertek Inform
AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)	Intertek Inform
AS/NZS 4020 Testing of products for use in contact with drinking water	Intertek Inform
ISO 7027-1 Water quality – Determination of turbidity – Part 1: Quantitative methods	Intertek Inform
USA EPA Method 180.1 Determination of Turbidity by Nephelometry	Intertek Inform
PRO-01617 X-PRO-STD-009 Engineering Design, Construction, Operation and Maintenance Procedure	REX

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Description	Location
PRO-01872 X-PRO-STD-002 Engineering Drawing Numbers Procedure	REX
PRO-01873 X-PRO-STD-001 Asset Standards Document Classification and Naming Structure Procedure	REX
PRO-01874 X-PRO-STD-004 Development and Review of Asset Standards Procedure	REX
PRO-02140 X-PRO-STD-013 Engineering Technical Hazard Study Procedure	REX
PRO-02187 X-PRO-STD-007 Drawing and Spatial Data Standards Procedure	REX
PRO-02190 X-PRO-STD-006 Asset and Equipment Identifier Procedure	REX
PRO-02205 X-PRO-STD-008 Asset Standards Management and Application Procedure	REX
PRO-02234 X-PRO-STD-015 Management of Change (Technical) Procedure	REX
REG-01074 X-LST-STD-001 Seqwater Preferred Equipment Register	REX
SPE-00342 I-LST-STD-001 Control Systems Prescribed Equipment	REX
SPE-00348 M-SPE-STD-004 Protective Coatings	REX
SPE-00352 E-SPE-STD-001 Electrical Design and Construction	REX
SPE-00353 I-SPE-STD-015 Instrumentation	REX
SPE-00361 I-SPE-STD-013 Control Systems Design and Construction	REX
SPE-00367 M-SPE-STD-001 General Mechanical	REX
TEM-00224 X-TMP-STD-022 Asset Standards Deviation Request Template	REX

7. Changes from previous version

This Standard Specification will be regularly reviewed in accordance with the requirements of the Seqwater Controlled Document Management Procedure. Reviews will include consideration of suggestions for alteration or improvement made in accordance with Seqwater Procedure X-PRO-STD-004 *Development and Review of Asset Standards* ([PRO-01874](#)). Changes made from the previous version are summarised in Table 5 below.

Table 5 Changes from previous version

Section Number	Change
All	Update to the latest template.
3.1	Clarified the compliant standards. ISO 7027-1 nephelometric method or US EPA Method 180.1.
3.2	Merged Design Life, Reliability and availability, consistent with Engineering Standard <i>I-SPE-STD-015 Instrumentation</i> .
3.7.5	Added Raw Water Type 1 & 2 definitions.
3.7.8	Removed 230VAC power supply. All analysers supplied from 24VDC.
Appendix A	Preferred Equipment requirements added.

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Appendix A – Preferred Equipment Requirements

To establish preferred equipment for turbidity analysers, a procurement process and trial was undertaken in 2023 to 2025 with Commercial Services reference 05241. The evaluation report is held at REX document D25/240945.

Refer to *Engineering Standard X-LST-STD-001 Seqwater Preferred Equipment Register* ([REG-01074](#)) for the current preferred turbidity analyser models, part numbers, manufacturers and suppliers.

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