

Engineering Standard

M-SPE-STD-010

Chemical Dosing Skids

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Contents

1	Purpose	4
2	Application of Engineering Standard	5
3	Definitions	6
4	Abbreviations	7
5	Reference Documents	7
6	Technical Requirements	9
6.1	General	9
6.2	Design Life	10
6.3	Operating Conditions	10
6.4	Safety in Design	11
6.5	Drinking Water Compatibility	11
6.6	Physical and Operating Requirements	11
6.6.1	Dosing Skid Components – General	11
6.6.2	Dosing Skid Cabinet	13
6.6.3	Sizing	13
6.6.4	Valves	13
6.6.5	Pipework	14
6.6.6	Calibration Cylinder	14
6.6.7	Dosing Pumps	15
6.6.8	Pulsation Damper	15
6.6.9	Flow Meter	15
6.6.10	Pressure Relief Valve	15
6.6.11	Electrical Requirements	15
6.7	Protective Coatings	16
6.8	Markings	16
6.9	Execution	17
7	Changes from previous version	18
8	Verification	18
9	Further Information	18

Table of Tables

Table 3-1 – Definitions	6
Table 4-1 – Abbreviations	7
Table 5-1 – Reference Seqwater Documentation	7
Table 5-2 – Reference External Standards, Specifications and Codes	8
Table 6-1 – Asset Design Life	10
Table 8-1 – Changes from Previous Revisions	18

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement

1 Purpose

Seqwater Engineering Standards 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.

This Engineering Standard provides the minimum requirements and recommendations for Seqwater works relating to the design, supply, installation, testing and commissioning of new Chemical Dosing Skids and/or end of life Chemical Dosing Skid replacement. This document must be used in conjunction with the documents it references to assist in ensuring a fit for purpose asset.

This Engineering Standard is not intended to be relied upon solely for design, supply, and installation works; advice from specialist engineers and/or Manufacturers may be required on a case-by-case basis.

This Engineering Standard is applicable to all Chemical Dosing Skids that are to be used to control and meter the transfer of chemicals from bulk storage systems to the dosing point. Chemical Dosing Skid applications include, but are not limited to, water treatment plants and network dosing facilities for potable, recycled and irrigation water where chemical dosing is required.

Combining all necessary chemical metering pumps, valves, instruments, manifolds, flushing points and associated piping into a single, contained skid provides safety, operational, and maintenance advantages. Operators and maintenance can access all equipment in one easily accessible place and the construction of the skid with safety screens/see through panels provides protection against spills and ruptures. When required, the modularity of the skid enables easy disconnection and removal of the skid from service as a complete package.

The skid concept is most suited to diaphragm dosing pump applications due the compact size of the pumps, however the principal can be applied to peristaltic, progressive cavity and centrifugal pump dosing systems where all valves, instruments, manifolds, flushing points and associated piping can be mounted on a back board with the pumps mounted nearby, providing the convenience of the skid concept.

All diaphragm dosing pump application of liquid chemicals, in particular hazardous liquid chemicals, shall be designed and constructed as a modular Chemical Dosing Skid, and other dosing pump applications should combine all valves, instruments, manifolds, flushing points and associated piping using the principals of the dosing skid concept where practicable.

This Engineering Standard applies to, but is not limited to, the metered dosing of the following chemicals:

- Aluminium Sulphate (Alum)
- Aqueous Ammonia
- Ammonium Sulphate (Liquid)
- Ascorbic Acid
- Calcium Hydroxide (Lime – slurry/water)
- Polyacrylamide (Poly, PolyDADMAC, Magnasol)
- Potassium Permanganate (Pot Perm)
- Powder Activated Carbon (PAC – slurry)
- Sodium Bicarbonate
- Sodium Carbonate
- Sodium Fluoride solution
- Sodium Fluorosilicate
- Sodium Hydroxide (Caustic)
- Sodium Hypochlorite (Hypo)
- Sulphuric Acid

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 4 of 19

Where a chemical that is not referenced above is used within a dosing skid application, the requirements of this Engineering Standard shall apply as far as practicable.

The battery limits of a Chemical Dosing Skid are the connection points of the suction pipe, flushing water, discharge pipe and carrier water, if included, at the extremity of the skid enclosure. All equipment within the skid enclosure is considered part of the skid.

This Engineering Standard is not intended to cover:

- Supply and discharge tanks, pipes, valves, and nozzles,
- Bunding,
- Electronic Control systems.
- Gauges, displays or instrumentation that is not specifically detailed within.

Refer to the applicable standards, references, or P&ID documents for these details.

This Engineering Standard forms the minimum requirements for the selection of preferred equipment for Chemical Dosing Skids for use within Seqwater.

2 Application of Engineering Standard

This Engineering Standard applies to all Seqwater employees, 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 Asset 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 the 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. This process includes completion of an Asset Standards Deviation Request Form and submission via the Seqwater Project Representative (for external parties) or via Seqwater's Engineering Mailbox (engineering@seqwater.com.au) (for internal parties).

Where noted in this Engineering Standard 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 Asset Standard or Australian Legislation, Standards, Codes or Guidelines, the conflict must be brought to the attention of the Seqwater Principal Engineering Standards and Assurance (or

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 5 of 19

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

3 Definitions

The following definitions (Table 3-1) apply to this Engineering Standard.

Table 3-1 – Definitions

Term	Definitions
B-DWG-STD-XXX	Standard P&ID Drawings B-DWG-STD-012 – 034 as listed in Table 5-1 – Reference Seqwater Documentation
B-SPE-STD-XXX	Engineering Standards / Standard Specifications B-SPE-STD-009 - 013 as listed in Table 5-1 – Reference Seqwater Documentation
Contractor	An entity engaged by Seqwater to undertake work in accordance with an agreed contract and defined scope of work.
Chemical Dosing Skid	Chemical Dosing Skid is a modular system to support pumps, piping, instruments, and valves for applications that require metered chemicals. The Chemical Dosing Skid is defined by the extremities of the skid frame and the inlet and outlet connection points.
Designer	The person or entity that has design responsibility for a new or modified Chemical Dosing Skid
Manufacturer / Supplier / Vendor / Original Equipment Manufacturer (OEM)	The entity that manufacturers 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.
Scope of Works	The scope of works document forming part of the contract including supporting design documentation
Seqwater approval / acceptance	Written sign-off gained via the deviation process, as detailed in X-PRO-STD-008 Asset Standards Management and Application.
Shall / must	Indicates a mandatory requirement
Should	Indicates a recommendation
Seqwater Representative	The person empowered by Seqwater to administer the contract, or their nominated representative
This Engineering Standard	Engineering Standard <i>M-SPE-STD-010, Chemical Dosing Skids</i>
dosing skid	Chemical Dosing Skid

4 Abbreviations

The following abbreviations (Table 4-1) apply to this Engineering Standard.

Table 4-1 – Abbreviations

Abbreviation	Description
AS	Australian Standard and New Zealand Standard (AS/NZS)
DN	Nominal diameter (mm)
IP	Ingress Protection as per AS 60529
P&ID	Piping and Instrumentation Diagram
PN	Nominal pressure (Bar)
WSAA	Water Services Association of Australia

5 Reference Documents

Table 5-2, and the requirements therein, are relevant to this Engineering Standard. In their latest editions, these documents form a part of this Engineering Standard. Note that this is not an exhaustive list of documents relevant to the works.

Table 5-1 – Reference Seqwater Documentation

Asset Standard Document Number	Document Title	REX / Controlled Documents Reference
B-DWG-STD-012	Standard Drawing – Minimum Requirements, P&ID – Alum, Caustic Soda, Sulphuric Acid and Hypo Unloading, Storage and Dosing System. Sheet 2 of 2	D19/166682
B-DWG-STD-014	Standard Drawing – Minimum Requirements, P&ID – Aqueous Ammonia Unloading, Storage and Dosing. Sheet 2 of 2	D19/166685
B-DWG-STD-016	Standard Drawing – Minimum Requirements, P&ID – Liquid Chemical Ring Main Dosing System	D19/166687
B-DWG-STD-022	Standard Drawing - Piping and Instrumentation Diagram (P&ID), Lime Storage, Mixing/Batching and Dosing System, Sheet 2 of 6 (Lime Saturator System)	D21/173119
B-DWG-STD-023	Standard Drawing - Piping and Instrumentation Diagram (P&ID), Lime Storage, Mixing/Batching and Dosing System, Sheet 3 of 6 (Lime Water Dosing System)	D21/173108
B-DWG-STD-024	Standard Drawing - Piping and Instrumentation Diagram (P&ID), Lime Storage, Mixing/Batching and Dosing System, Sheet 4 of 6 (Lime Slurry Pumped Dosing System)	D21/173110
B-DWG-STD-028	Standard Drawing – Minimum Requirements, P&ID – Polymer, PAC, Pot Perm and Soda Ash, Storage, Batching and Dosing System (Sheet 2 of 2)	D21/151
B-DWG-STD-034	Standard Drawing – P&ID – Fluoride Storage, Mixing, and Dosing Systems (Sheet 4 of 5)	D22/334011
B-SPE-STD-003	Engineering Standard – Commissioning Requirements	SPE-00346

Asset Standard Document Number	Document Title	REX / Controlled Documents Reference
B-SPE-STD-009	Standard Specification – Liquid Chemical Storage and Dosing Standard	SPE-00445
B-SPE-STD-011	Engineering Standard - Polymer, PAC, Pot Perm, and Soda Ash systems	SPE-00481
B-SPE-STD-012	Engineering Standard - Lime Storage, Mixing and Dosing system	SPE-00496
B-SPE-STD-013	Engineering Standard – Fluoride Storage, Mixing and Dosing	SPE-00519
E-SPE-STD-001	Engineering Standard – Electrical Design and Construction	SPE-00352
I-SPE-STD-015	Standard Specification – Instrumentation	SPE-00353
I-SPE-STD-013	Engineering Standard – Control Systems Design and Construction	SPE-00361
M-SPE-STD-001	Engineering Standard – General Mechanical	SPE-00367
M-SPE-STD-002	Standard Specification – Fixed Platforms, Walkways, Stairways and Ladders	SPE-00366
M-SPE-STD-003	Engineering Standard – Valves for Water Applications	SPE-00323
M-SPE-STD-004	Engineering Standard – Protective Coatings	SPE-00348
M-SPE-STD-009	Standard Specification – Flow Meters	SPE-00434
M-SPE-STD-012	Engineering Standard – Chemical Dosing Pumps	SPE-00430
M-SPE-STD-013	Standard Specification – Chemical Dosing Piping	SPE-00355
X-LST-STD-001	List - Seqwater Preferred Equipment	REG-01074
	Work Health and Safety Procedure - Hazardous Chemicals	PRO-00008
X-PRO-STD-001	Procedure - Asset Standards Document Classification and Naming Structure	PRO-01873
X-PRO-STD-002	Procedure – Engineering Drawing Numbers	PRO-01872
X-PRO-STD-004	Procedure - Development and Review of Asset Standards	PRO-01874
X-PRO-STD-006	Procedure - Equipment Numbering and Naming Convention	PRO-02190
X-PRO-STD-007	Procedure - Drawing & Spatial Data Standards	PRO-02187
X-PRO-STD-008	Procedure - Asset Standards Management & Application	PRO-02205
X-PRO-STD-009	Procedure - Engineering Design, Construction, Operation and Maintenance	PRO-01617
X-TMP-STD-022	Template - Asset Standards Deviation Request	TEM-00224

Table 5-2 – Reference External Standards, Specifications and Codes

Document Reference	Document Title
AS 1110	ISO metric hexagon bolts and screws
AS 1112	ISO metric hexagon nuts
AS 1237	Plain washers for metric bolts, screws, and nuts for general purposes
AS 1318	Industrial safety colour code

Document Reference	Document Title
AS 1319	Safety signs for the occupational environment
AS 1345	Identification of the contents of piping, conduits, and ducts.
AS 1477	PVC pipes and fittings for pressure applications
AS 1796	Certification of welders and welding supervisors
AS 3000	Electrical Installations. (Wiring Rules)
AS3500	Plumbing and Drainage
AS 3760	In service safety inspection and testing of electrical equipment
AS 4020	Testing of products for use in contact with drinking water
AS 4024	Safety of Machinery. (series)
AS 4041	Pressure Piping
AS 4087	Metallic flanges for waterworks purposes
AS 4130	Polyethylene pipes for pressure applications
AS 4312	Atmospheric Corrosivity Zones in Australia
AS 4458	Pressure equipment – Manufacture
AS 60529	Degrees of protection provided by enclosures (IP Code)
E.P Act	Environment Protection Act (QLD)
-	Queensland Fluoridation Regulation 2008
-	Queensland Fluoridation Code of Practice
WHS Act	Work Health and Safety Act
WSA 109	Industry standard for flanged gaskets and O-rings

6 Technical Requirements

6.1 General

Refer to *M-SPE-STD-001 General Mechanical* for general requirements related to mechanical assets and *E-SPE-STD-001 Electrical Design and Construction* for general requirements related to electrical assets.

The requirements of *B-SPE-STD-XXX*, as listed in Table 5-1, *M-SPE-STD-012, Chemical Dosing Pumps*, and *M-SPE-STD-013, Chemical Dosing Piping* shall apply to this specification.

This Engineering Standard provides guidance on standard operating and physical requirements. It is noted that for some specific applications, i.e. small treatment plants, the requirements specified herein may be over designed, and more cost effective or innovative solutions may provide more appropriate solutions. It is important that these aspects are identified, and alternate solutions brought to the attention of Seqwater for deviation approval.

Chemical Dosing Skids, and their constituent components, shall be suitable for the intended application and have a proven chemical compatibility that will meet the specified requirements for the life of the asset. The specific application details include, but are not limited to, operational and maintenance requirements, operating environment, chemical quality, and treated water quality.

The dosing skid should be made up of components commonly used for the application. Spare parts for components that may reasonably require replacement should be readily available with a maximum lead time of three working days, after receipt of order, for the delivery to the nominated Seqwater site.

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement

Where materials or components are not nominated within this Engineering Standard, the Contractor shall suggest materials or components best suited to achieve the operating, environment and life cycle requirements and gain approval from Seqwater for these materials or components.

All components and structures within the dosing skid should be free of voids and pockets that may facilitate moisture ponding. Given the nature of the chemicals being dosed, moisture ponding may cause premature failure of the component or structure.

Lifting attachments shall be in accordance with the relevant section of *M-SPE-STD-001*.

6.2 Design Life

The minimum design life of the assets supplied as part of Chemical Dosing Skids shall be as per table 6-1, unless otherwise specified or approved by Seqwater. It is understood that mechanical equipment of the system may require overhaul / maintenance to reach the desired asset life.

Table 6-1 – Asset Design Life

Asset	Minimum Design Life (years)
Pumps	15 years
Valves	15 years
Pipework	15 years
Motors	15 years
Instrumentation	10 years
Electronics	10 years
Protective Coatings	15 years
Non-specified items	15 years

6.3 Operating Conditions

All components must be suitable for the design, minimum and maximum flow, pressure, temperature and duty conditions and these conditions shall be stated in the specific project statement of work.

All components must have compatibility and suitability with the specific dosing chemical specified in the project specific scope of works to achieve the specified design life.

All components must be suitable for the external environment, including exposure to any potential liquid or gaseous chemical. As a minimum, all components must be capable of operating within an open roofed environment with ambient operating temperatures of -5 to 40°C, relative humidity of 10 to 95% and sustained fluid temperatures of 5 – 32°C, with bulk Alum delivered to site at temperatures up to 60°C.

A minimum of 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 may be assigned on a case-by-case basis dependant on the installation location of the equipment. Specific site classifications are specified in *M-SPE-STD-004, Protective Coatings Engineering Standard*.

The dosing skid is required to operate continuously at full duty, 24 hours per day, 7 days a week under the defined operating conditions.

Where the dosing skid is designed for automatic remote operation, it must include remote function monitoring and be capable of remote reset and restart in the advent of a power supply interruption.

6.4 Safety in Design

Seqwater's expectations relating to safety in design are outlined in Procedure *X-PRO-STD-009*.

All equipment must be designed to perform its intended duty safely with and without operator attendance. In line with the WHS Act, wherever reasonably practicable, health and safety risks shall be fully mitigated ("designed out") during the design phase for both the construction and end use phases. A full set of warning signs must be supplied in and around the dosing skid, giving warnings and instructions of the actions to be taken if an accident spillage, or leak occurs. Signs and colour coding shall comply with *AS1319*, *AS1318* and *AS1345* as appropriate.

Specific consideration must be given to the structural integrity and failure mechanisms of proposed pipework, especially on the pump discharge side (high pressure). It is noted that in some high-pressure applications, the use of plastic pipe and ancillary equipment can lead to unacceptable exposure risks. The design must account for the pressure de-rating due to elevated operating fluid temperatures, and reduced ductility at low temperatures.

If identified as a credible risk for a specific site, design considerations for dosing skids must include adequate controls for:

- Leak detection and prevention
- Splash and pipe burst protection for personnel and equipment
- Cross contamination of incompatible chemicals

6.5 Drinking Water Compatibility

All components of the dosing skid must conform to the Potable Water Compatibility section of *M-SPE-STD-001*.

6.6 Physical and Operating Requirements

6.6.1 Dosing Skid Components – General

Where the dosing chemical is classified "dangerous," as per [PRO-00008](#), *Work Health and Safety Hazardous Chemicals*, all dosing skid equipment shall be contained within an enclosed cabinet.

The dosing skid shall include a minimum of one duty and one standby dosing circuit operating in duty/standby mode. Additional dosing circuits may be added to achieve the required dosing rate, configured to operate in duty/assist/(assist)/standby mode. Very small dosing plants may be configured with only one dosing circuit if a dosing skid failure does not present a risk to supply. Individual dosing circuits may be supplied from a common suction manifold and outlet manifold. There may be instances where the project SOW requires duty/standby dosing lines, dosing to a common dosing point. In this case, the dosing skid outlets must be configured such that either dosing line can operate as the duty line with the standby line suitably isolated.

Where required, a suitably sized duty and bypass strainer shall be provided on the common pump suction line to protect the dosing pumps from any solid contaminants. Isolation valves and a drain valve are required on each strainer such that continuous operation can be achieved without having to stop the dosing pumps to access each strainer. Refer to the standard chemical dosing system P&ID Standard Drawings *B-DWG-STD-XXX* as per Table 5-1, for the chemical applications that require inlet strainers.

The dosing skid suction side pipework shall disperse the dosing chemical to each dosing pump. This section of pipework shall include a branch to a suitability sized calibration cylinder(s) and, where required, a DN25 (min) vent line for dosing chemicals that are prone to gassing (e.g., for sodium hypochlorite and ammonia) is to be installed to the supply line and vented back to the top of the bulk storage tank.

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 11 of 19

The pumped chemical shall be fed at the required dosing rate into a discharge line incorporating an adjustable pressure relief valve, an inline flow meter conforming with the requirements of *M-SPE-STD-009, Flow Meters*, pressure sustaining valve, non-return valve, pulsation dampener, sampling point and pressure gauge/transmitter, as specified by the standard P&ID drawings, B-DWG-STD-XXX per Table 5-1, for each chemical. Typically, dosing systems with Peristaltic and Progressive Cavity pumps do not require pressure sustaining or check valves, but pressure relief valves must be included. The pressure gauge/transmitter will include a chemical seal, have a range suitable for the maximum operating pressure of the system and installed upstream of the pressure sustaining valve (if included).

Dependant on the plant dosing requirements, the discharge line of each pump may merge via a suitably sized discharge manifold, contained within the skid cabinet.

All equipment must be safely and ergonomically accessible for operation and maintenance, without the need for temporary access devices.

The skid shall be constructed in a manner that enables easy removal and replacement of each component. All inlet, outlet, return and vent lines shall include a flange or union joint at the skid boundary to enable removal. All adjustable equipment within the dosing skid must be adjustable without the need to dismantle, disconnect or remove any non-protective portion of the device or skid. Set limits for any constrained device shall be clearly labelled on, or near the device. This includes, but not limited to, pressure relief and pressure sustaining valve.

Each dosing skid will be provided with flushing points, complete with isolation valves and covers, on the suction and discharge lines in accordance with the P&ID Standard Drawing relevant to the dosing chemical. These points shall allow flushing water to be connected and flushed to waste, plumbed to a suitable bund or waste collection container for proper disposal.

A full flow return line with an isolation valve, plumbed back to the dosing supply tank, shall be fitted in the skid outlet line, after the pressure sustaining valve, to enable offline dosing skid, component testing, and full and partial pump flow setup and calibration. The return line can be a permanent installation or a temporary arrangement with appropriate isolation valves and hose connectors at each end. To enable proper testing and calibration, dosing skid outlet should be isolated and the return line restricted to achieve the required test/calibration operating pressure so operating pressure pump calibration can be achieved. Caution must be taken not to over pressurise the system and all restrictions must be removed after testing/calibration is complete.

Dosing skids should be installed in a suitably bunded area, compliant with the requirements of [PRO-00008](#) preferably within the applicable bulk storage tank bund area. For small dosing installations, a [PRO-00008](#) compliant portable bund may be used. The dosing skid must be designed and installed such that any possible spillage or outflow from the dosing skid will flow through the dosing skid and be contained within the dosing skid bund without any areas of pooling within the dosing skid.

The dosing skid must be installed in accordance with the requirements of Seqwater procedure [PRO-00008](#), *Work Health and Safety Hazardous Chemicals* and *M-SPE-STD-002, Fixed Platforms, Walkways, Stairways and Ladders*. In particular, the dosing skid needs to be securely attached to the ground with a minimum of 600mm clearance to neighbouring equipment, and evacuation routes/walkways a minimum of 1m wide, bunding, warning signage, labelling, safety shower, eyewash and hazardous area requirements must conform to the relevant standards.

The dosing skid must be designed and installed such that any components that cannot be submerged (i.e. electrical components) are above the bund 110% full line.

All equipment displays should be easily viewable in daylight and shaded from possible sunlight exposure.

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 12 of 19

If practicable to do so, carrier water control equipment, valving and flow meter may be incorporated into the dosing skid, utilising the control system terminal connection box within the dosing skid.

Note: Unless otherwise specified, refer to the standard chemical dosing system P&ID Standard Drawings, *B-DWG-STD-XXX*, as per Table 5-1 – Reference Seqwater Documentation, for the minimum required standard dosing systems and specific dosing skid requirements for each respective dosing system/chemical.

6.6.2 Dosing Skid Cabinet

The dosing skid cabinet shall be suitably designed to mitigate the risk of chemical exposure to personnel where multiple dosing systems are contained in a single dosing skid. Dividing walls within the cabinet shall be included to mitigate the risks to operations/maintenance personnel while work is being performed on an isolated section of an operating dosing skid.

The dosing skid cabinet shall be manufactured from materials that are compatible with the specific dosing chemical and the specified environmental conditions, without degradation, for the asset design life. The choice of materials will be the most suitable for the chemical being dosed and may include 316 SS, powder coated 316 SS, or HDPE frames. Where the frame material is not fully resistant to the dosing chemical, the frame should be coated with an appropriate coating so the dosing skid frame will achieve the specified design life without the need to re applying the coating.

The dosing skid cabinet shall include suitably rated and positioned lifting lugs, preferably one on each corner at the top of the frame. The lifting lugs must be of sufficient size to accept lifting hooks rated for the mass of the dosing skid or have a 40mm diameter centre hole, whichever is greater. Alternatively, or in addition, the dosing skid frame can include suitable forklift tine pockets incorporated into the base of the dosing skid frame for lifting and transport of the dosing skid.

The cabinet shall include a backboard for piping, valves and instrumentation mounting. The backboard and wall materials shall be selected to be suitable for the application. For chemicals that may cause harm to operators, clear Polycarbonate or Acrylic hinged front doors shall be provided to allow visual inspection without the need to open the cabinet. The doors shall be designed in such a way that they can be easily removed for maintenance purposes.

6.6.3 Sizing

Dosing system sizing and control methodology is dependent on the project specific requirements. The relevant project statement of work, Functional Specification, and Process Flow Diagram documents will specify the actual dosing rate requirements for each specific application.

6.6.4 Valves

All valves shall comply with the requirements of Seqwater Engineering Standard *M-SPE-STD-013, Chemical Dosing Piping* where applicable.

Suitable lockable isolation valves shall be provided throughout the dosing skid. These shall be positioned to provide safe isolation of individual components for maintenance, and to ensure that the ability to utilise redundancy is maintained during maintenance works. Refer to the P&ID Standard Drawings for valve locations for each chemical type.

All valves shall be suitable for the application. Full bore ball valves with the provision to be locked in position are preferred for all applications with the following exceptions. Vented ball valves shall be used for chemicals prone to gassing such as Sodium Hypochlorite and Ammonia, installed with the vent on the up-stream side. Diaphragm valves shall be used for slurries and chemicals prone to crystallisation such as Lime and Sodium Hydroxide.

All manually operated, ¼ turn valves are to be installed with their levers in the direction of the pipe when in the open position. All valves shall have an anti-clockwise direction of closure.

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 13 of 19

A suitable pressure sustaining valve shall be provided, where required, on the discharge side of the dosing skid. It shall maintain a pre-set minimum dosing back pressure across the full range of dosing pressures. The pressure sustaining valve shall incorporate a provision to protect the setting adjuster to avoid unintentional change of the pressure setting.

Anti-syphon functionality shall be included to prevent chemical siphoning if the dosing point head pressure is lower than the chemical level in the bulk tank. Where required, Seqwater recommends using an actuated valve close to the dosing point to prevent siphoning of chemicals into the process.

Each permanent operating element or spindle cap of the valve shall be clearly and indelibly marked 'CLOSE' with an arrow to indicate the direction of closure.

All valves fitted with automatic actuation should include position feedback capability to the SCADA system.

6.6.5 Pipework

The material selection for the dosing system pipe work will be based on the most suitable material for each chemical application per *M-SPE-STD-013, Chemical Dosing Piping*. Pipework diameter, material and rating shall be selected based on the application and to maintain a fluid velocity as specified in *B-SPE-STD-XXX*, per Table 5-1.

The inlet and outlet pipes will be the same material as the dosing skid pipe and be connected to the dosing skid pipe work by suitably rated flange, union, or cam lock fittings. Internal pipe work, including dismantling joints, will be hard plumbed by glued, fusion or welded joints as appropriate for the pipe material.

Sufficient dismantling joints shall be provided to enable the removal of valves, pumps, etc. from the pipework for maintenance. Dismantling shall be via barrel unions or flanges. Flanges shall be in accordance with *AS 4087* and shall be fitted with suitable stainless-steel backing plates, where required, and gaskets compliant with *WSA 109*.

Unless there is a chemical compatibility issue, all fastener components (e.g. studs, bolts, nuts, washers) shall be 316 stainless steel class A4-70 (minimum) and shall be in accordance with *AS 1110*. Higher class fasteners (with an appropriately rated flange gasket) may be required for some applications. All fasteners shall have anti-seize paste applied to threads prior to assembly.

Clips, support brackets, hangers, etc. used to support pipe work shall be 316 stainless steel with a protective sleeve to protect the pipe, unless this material is not appropriate for the application. PVC clips may be used for PVC pipe installations.

All pipe work shall be coloured and marked in accordance with *AS 1345* requirements.

6.6.6 Calibration Cylinder

Where specified in *B-DWG-STD-XXX* per Table 5-1, a graduated, transparent and calibrated cylinder shall be provided on the suction side of the pumps.

The cylinder shall be arranged so that it is available for each pump individually. Appropriate isolation valves shall be provided to allow the calibration of each pump to be checked. The isolation valves on each pump suction line and the isolation valve(s) for the calibration cylinder shall be in close proximity to enable simultaneous switching by the operator.

The cylinder shall have a minimum capacity of 1-minute operation for the maximum flow rate of a single dosing pump and graduated with black markings for the full volume of the cylinder with large graduations for every 10% of volume, medium graduation for every 5% of volume and small markings for every 1% of volume.

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 14 of 19

The cylinder shall be fixed and supported to an interior wall of the dosing skid at a level that will enable gravity filling for the majority of the bulk supply tanks' fluid level. The top of the calibration cylinder shall be fitted with an overflow/vent line, extending at least 500 mm above the overflow pipe of the bulk chemical storage tank and returned, with a downward gradient, into the top of the storage tank with an air gap to the maximum tank liquid level, to prevent siphoning.

6.6.7 Dosing Pumps

Dosing pumps shall comply with the requirements of *M-SPE-STD-012, Chemical Dosing Pumps* and be suitable for the chemical being dosed and sized according to the required dosing capacity specified in the specific project scope of works. Peristaltic pumps shall be sized to minimise the discharge acceleration loss to < 10% of the pumps rated pressure at the maximum dosing rate, whilst maintaining the minimum discharge fluid velocity at > 0.5 m/sec.

Dosing pumps shall be installed in a flooded suction arrangement for chemicals that are prone to gassing, and it is preferred for all other chemical applications i.e., pump level below the low tank level, to minimise the potential for gas binding and running the pumps dry.

The pump mounting arrangement shall allow easy, safe access to the dosing pumps. Unless there is a chemical compatibility issue, grade 316 stainless steel shall be used for all dosing pump mounting brackets and fixing.

6.6.8 Pulsation Damper

A suitably sized inline or diaphragm pulsation damper shall be provided on the discharge side of each dosing pump, as recommended by the pump manufacturer, to minimise fluid pressure pulsations. Inline, hose type, pulsation dampers are preferred for peristaltic pumps.

Pulsation damper shall include a pressure gauge fitted to the air cushion and diaphragm dampers shall include an isolating valve on the branch from the discharge line.

Pulsation Dampers shall be manufactured from materials that are compatible with the chemicals being dosed and to achieve the required service life. Provision for recharging the accumulator's air cushion via a standard 8 mm Schrader valve must be provided.

6.6.9 Flow Meter

A suitably sized and rated flow meter shall be provided within the dosing system as detailed in B-DWG-STD-XXX per Table 5-1. Where approved by Seqwater, the flow meter may be replaced by a flow switch for some applications. Refer to *M-SPE-STD-009 Flow Meters* for specific requirements related to process flow meters.

6.6.10 Pressure Relief Valve

A suitably sized pressure relief valve shall be fitted on a branch from the discharge pipe of each dosing pump with an adjustable pressure range to suit the dosing skid operating pressure. The pressure relief valve shall be fitted with a relief line, extending at least 500 mm above the overflow pipe of the bulk chemical storage tank and returned into the top of the storage tank. The fitting of a flow sensor in the return line is recommended. The pressure relief valve shall incorporate a provision to protect the setting adjuster to avoid unintentional change of the pressure setting.

6.6.11 Electrical Requirements

The dosing skid shall comply with the requirements of AS 3000 and enable successful simple earth continuity testing to AS 3760. The dosing skid shall operate on an independent single phase, or 3 phase power input without the need for transformers to modify the input power source.

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 15 of 19

All electrical requirements must comply with the requirements of *E-SPE-STD-001 Electrical Design and Construction*, *I-SPE-STD-015 Instrumentation* and *I-SPE-STD-013 Control System Design and Construction*.

The electrical supply to each pump shall be hard wired or, if operational needs warrant, supplied via a special purpose outlet. The installation shall be within a weather protective enclosure with a clear lid and locking provision. The outlets are to be clearly labelled to indicate the dedicated supply/duty, as per AS3000.

Electrical enclosures shall be suitable for the installation environment and shall have an IP rating that meets or exceeds the minimums specified below, in accordance with AS 60529.

All electrical enclosures for Powder Activated Carbon (PAC) dosing skids shall be rated at IP66 minimum. For other chemicals, electrical enclosures shall be rated in accordance with *E-SPE-STD-001*.

If the dosing skid is installed in a classified hazardous area where there is a risk of fire or explosion, all electrical equipment must be suitably rated for inclusion in these areas.

The dosing skid shall include a terminal box (with IP rating as specified above for electrical enclosures) with all dosing skid control signals suitably terminated and available for connection to the plant control system.

Designers shall complete a machine safety risk assessment in accordance with AS/NZS 4024 and provide a copy to Seqwater. Designers should seek input from Seqwater Operations, Maintenance and Engineering personnel where relevant to the risk assessment.

The design shall provide a means for emergency stopping of the equipment if and as required by AS/NZS 3000, AS/NZS 4024 and the risk assessment. Designers shall position the emergency stop device(s) where required to be readily accessible and capable of non-hazardous actuation, considering access constraints and hazards internal and external to the dosing skid.

The dosing skid control system shall be capable of restricting/preventing operation of the dosing skid if the associated carrier water flow meter/switches do not indicate flow.

6.7 Protective Coatings

All protective coatings shall be per *M-SPE-STD-004, Protective Coatings*. The protective coating shall be suitable to achieve the design life as specified in Section 6.2, without the need for re application. Refer to Section 6.3 for the expected operating environment, including minimum corrosivity category.

6.8 Markings

The dosing skid shall include enough permanent markings to allow effective identification of the dosing skid, each valve function, the setting point of each adjustable valve, and other equipment for the purpose of operation and maintenance.

In addition to the manufacturers name plate, labelling in accordance with the *Labelling and Nameplates* section of *M-SPE-STD-001*, and *X-PRO-STD-006, Equipment Numbering and Naming Convention* is required. All pipework shall be coloured and/or labelled as per AS1345, *Identification of the contents of pipes, conduits, and ducts*.

The following information shall be provided on a name plate, permanently attached to the frame of dosing skid in a visible position after installation:

- Manufacturer
- Dosing skid number and description (including designed dosing chemical)
- Model Number
- Serial Number
- Duty

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement

A second name plate containing the dosing skid number and description only should be affixed to the dosing skid backboard.

A third name plate containing the following piping details shall be attached to the dosing skid back board:

- Piping Material, i.e., UPVC, PE100, Hastelloy, etc
- Piping specification, AS1477, Schedule 80, etc
- Piping pressure rating
- System design pressure
- Joint method, i.e., glue, welded etc
- Glue, primer, filler rod used, manufacturer and code (as applicable)

Individual name plates displaying the equipment number as per the associated P&ID, shall be provided adjacent each component (on dosing skid backboard if appropriate).

All labels and plates shall be made of a material in accordance with *X-PRO-STD-006* which will not fade or otherwise degenerate over the life of the asset (considering potential chemical exposure). Lettering will be Plain Ariel font with 5 mm high characters, minimum.

Note: the above requirements are in addition to the manufacturer's detailed equipment name plates, which should be affixed onto specific equipment, including but not limited to, pumps and flow meters.

6.9 Execution

All approvals, supply, assembly, testing, submission, installation, and commissioning requirements shall be as per *M-SPE-STD-001 General Mechanical* and *B-SPE-STD-003 Commissioning Requirements*.

Ver. no.	Doc No.	Doc Owner	Version Date	Doc Approver	
2	PRO-01872	Principal Engineering Standards and Assurance	19/12/2022	Manager Technical Support & Improvement	Page 17 of 19

7 Changes from previous version

This Engineering Standard will be regularly reviewed and updated, including the consideration of requested alterations, in accordance with Seqwater Procedure X-PRO-STD-004, *Development and Review of Asset Standards*. Changes from the previous version of this document are summarised in Table 8-1 below.

Table 8-1 – Changes from Previous Revisions

Section Number	Change
All	Reformatted according to current template
Various	Updates as a result of supplier feedback as detailed below:
1	Dosing skid concept, advantages and application added
3	Chemical Dosing Skid definition added
6.3	Design Reliability Target section removed
6.7.1	Purpose of return line and PSV clarified
6.7.2	Lifting devices added
6.7.4	Ball valves, vented ball valves and diaphragm valve requirement clarified. Anti-syphon requirement updated
6.7.7	Maximum discharge acceleration loss for peristaltic pumps defined
6.7.9	Flow meter placement and requirement updated.
6.7.10	PRV return line flow switch changed to recommended
6.7.11	Electrical IP rating requirements and E Stop requirements updated

8 Verification

Compliance with this document may be verified by internal audit.

9 Further Information

For further information please contact the owner of this document

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