DESIGN STANDARD DS 79-03

Chemical Barrier Protection

VERSION 1
REVISION 1
DECEMBER 2018
FOREWORD

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

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

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of WA OSH Regulations 1996 (Division 12, Construction Industry – consultation on hazards and safety management) to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:


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

Head of Engineering

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## REVISION STATUS

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1 Introduction

1.1 Purpose

The purpose of this document is to describe methods of chemical splash risk mitigation and to provide examples of corrosive liquid chemical barrier protection that are acceptable to the Water Corporation for new assets. All Water Corporation dosing facilities that include “corrosive chemicals” are required to comply with this standard.

1.2 Background Information

This standard has been written to improve the design of chemical barrier protection installed at Water Corporation chemical facilities and complements S022 Personal Protective Equipment and Clothing. Chemical barrier protection is a requirement of the Dangerous Goods Safety (Storage & Handing of Non-explosives) Regulations 2007 (Reg 58).

1.3 Regulations and Standards

This design standard makes reference (directly or indirectly) to the following legislation and standards:

1.3.1 Department of Mines, Industry Regulation & Safety – Dangerous Goods

Dangerous Goods Safety Act 2004
Dangerous Goods Safety (Storage & Handing of Non-explosives) Regulations 2007

1.3.2 Worksafe Western Australia

Occupational Safety and Health Act 1984
WA Occupational Safety and Health Regulations 1996

1.3.3 Water Corporation Standards

DS 79-01  Design of Chemical Systems (Legislative Requirements and General Principles)
DS 79-02  Emergency Safety Showers and Eyewash Stations
S022  Personal Protective Equipment and Clothing
S399  Dangerous Goods Safety Signage, Labels and Markers

1.3.4 Australian Standards

AS/NZS 3780  The Storage and Handling of Corrosive Substances
## 1.4 Abbreviations and Terminology

| Corrosive Chemicals | A chemical where the Safety Data Sheet (SDS) indicates it to be corrosive to people through having at least one of the following risk phases: R34 (Causes Burns), R35 (Causes Severe Burns), R36 (Irritating to the eyes), R38 (Irritating to skin) or R41 (Risk of Serious Damage to Eyes)  

or  

A chemical where the Safety Data Sheet (SDS) indicates it to be corrosive to people through having at least one of the following Health Hazard Statements: H314 (Causes Severe Skin Burns and Eye Damage), H315 (Causes Skin Irritation), H318 (causes Serious Eye Damage), H319 (causes serious Eye Irritation).  

NOTE: These definitions include chemicals not classified as Dangerous Goods and therefore represent a larger scope. |
|---------------------|-------------------------------------------------------------------------------------------------|
| Dangerous Goods     | Dangerous Goods are materials classified by the Australian Dangerous Goods Transport Code, on the basis of immediate physical or chemical effects.  

NOTE: The applicability of this design standard is for Corrosive Chemicals which may, or may not also be classified as Dangerous Goods |
| DMI RS              | The Department of Mines, Industry Regulation and Safety (the Dangerous Goods Regulator) |
2 Chemical Barrier Protection – System Risk Assessment

DS79, Section 4.5, requires pipework containing chemicals to be assessed for risk and then provided with appropriate risk treatment.

A typical chemical dosing system consists of the following elements:

1. Chemical tank filling pipework and ancillaries

The risk with this pipework is mitigated by the fact that deliveries are an infrequent activity. The activity is subject to safe job planning that requires the delivery room and unloading area to be evacuated of personnel. Personnel associated with the delivery activity must wear maximum personal protective equipment in accordance with S022 and remain at distance from the tanker unloading panel. Water Corporation therefore does not require additional barrier protection around the chemical tank filling pipework.

2. Tank outlet/pump suction pipework and ancillaries

This risk is mitigated by the fact that the pipework is only subject to tank static head. As such, the Water Corporation does not require additional barrier protection around this pipework. Note: the risk posed by this pipework to the environment is minimized by Water Corporation’s design standards that require this pipework to be within a bund.

3. Pump discharge pipework and dosing panel(s)

This pipework is considered to be potentially high risk due to (typically) higher operating pressure and the number of fittings present (historically, these fittings have had comparatively high failure rates compared to piping). Examples of such fittings are elbows, valves, pressure gauges, instruments, etc. Such pipework and fittings shall be barrier protected through use of enclosures that mitigate the possible failure points in the pipework system. Examples of appropriate enclosures are detailed in Section 3.

4. Transition pipework (from dosing panel to dose point)

Where this pipework leaves an enclosure and travels through a building or across a site, appropriate barrier protection shall be provided if indicated by the risk assessment. For pipework running underground, double containment may not be necessary if the ground cover is sufficient and the chemical poses minimal risk to the environment. Examples of appropriate barrier protection are detailed in Section 3.

5. Dose point pipework

The risk posed by dose point pipework or fittings shall be risk assessed and appropriate barrier protection or enclosures provided if indicated by the risk assessment. Examples of appropriate barrier protection are detailed in Section 3.

6. Other infrastructure not specified above

Any other chemical infrastructure that cannot be classified in any of the categories above shall be risk assessed by a competent person to determine the risks to environment and personnel and then identify the need for double containment, shielding or other appropriate barrier protection.
3 Chemical Barrier Protection Types

3.1 Enclosures

Enclosures shall:

- Be constructed of robust long life components that are compatible with the chemical being contained.
- Be designed and constructed to resist the possible forces associated with a release (i.e. burst/spray) event and shall be completely impervious (all joints and necessary gaps sealed to prevent spray leakage).
- Be designed to safely contain and manage any chemical released in an incident. This may involve discharge to a bund or to a waste holding tank.
- Include spray proof ventilation where the chemicals contained are potentially able to generate fumes following a leak
- Be designed to not obstruct access to Emergency Safety Showers, Eyewash Stations and egress routes.
- Not include electrical junction boxes or other termination points that require periodic maintenance access. The aim here is to minimise the amount of maintenance work that has to be undertaken with the doors of the enclosure having to be opened.
- Provide sufficient access around valves, fittings and the back of pumps to allow personnel to easily operate valves, bleed points or undo fittings.

Dosing panels shall be isolated from each other (i.e. each dosing pump located in a separate enclosure) to allow maintenance to occur without shutting down both duty and standby systems, unless otherwise agreed as a project specific deviation (non-critical, intermittently operated systems are a typical exception).

The following example enclosures represent Water Corporation best practice. Any enclosure design shall provide an equivalent or better performance (in terms of safety, access and asset life) than these examples;

1) Cabinet with doors (see Appendix 1)

This design is suitable for indoor or outdoor facilities and shall be used for chemicals that can cause severe burns to personnel on contact; e.g. Fluorosilicic Acid, Sulphuric Acid, Sodium Hydroxide (Caustic Soda).

Door hinges shall be robust and made of long life materials, and facilitate ready removal of the doors to allow full maintenance access to equipment in the enclosure.

This type of enclosure can be designed with security enhancements (e.g. locks, external metal grilles, etc.) where there is a risk of intruders entering a site and attempting to operate valves etc.

2) Cabinet with curtains (see Appendix 2)

This design is suitable only for indoor facilities and only where the cabinets are below 1.5m in height (Water Corporation experience is that long curtains are prone to breaking their tracks and hangers due to their weight). This design shall not be used for chemicals that can cause severe burns to personnel on short contact e.g. Fluorosilicic Acid, Sulphuric Acid, Sodium Hydroxide (Caustic Soda) at commercial concentrations.

The restriction on use of curtains is due to their relatively more opaque nature even when clear (compared to perspex sheets) which may make it difficult to spot any chemical adhering to its
surface, potentially allowing transfer onto PPE and then onto personnel during later PPE removal.

The PVC curtains have been previously tested\textsuperscript{1} and confirmed to resist sprays of up to 1000 kPa without buckling or allowing passage of chemical. The design shown in Appendix 2 incorporates overlap of the enclosure by the curtain to ensure that sprays cannot get past the curtain edge (top, bottom or sides).

PVC curtains shall be clear/transparent, at least 1mm thick and be held up by hangers made of a long lasting material that is suitable for any possible chemical fumes that might be released during the life of the asset. The curtain hanger track shall likewise be made of a long lasting material that is suitable for any possible chemical fumes that might be released during the life of the asset.

\textsuperscript{1} A test was successfully conducted at Gwelup GWTP in May 2014 on an existing curtain at the Sodium Hypochlorite facility using an industrial water jet at 1000kPa pressure.

3) Removable cabinet/“box” that provides localized barrier protection (see Appendix 3)

This approach is intended for low complexity systems where there are minimal components (including dose points), which therefore allows the use of a light and easily removable (by one person) perspex box to provide risk protection. Where heavier perspex boxes are employed, they shall include access points (e.g. tear drops) for valves that may need to be operated regularly and be designed to be easily removable (to allow maintenance activities) by two persons. Fixing of the box to walls or other structures shall not require dozens of bolts or screws to be undone.

3.2 Pipe Barrier Protection

Section 2 outlines the situation where pipe barrier protection is necessary and it can take the form of spray protection systems (which don’t contain the resultant leak) or double containment systems that prevent any escape of chemical to the environment.

Spray protection systems may include the simple running of a pipe within another pipe, flexible hose or duct, etc. Spray connection boxes etc. shall:

1) Not rest on pipework and instead be supported by brackets attached to walls, floors or other weight-supporting points.

2) Be designed to allow removal of segments no longer than 1.5m in length. Hence, for long runs of pipework, it may be necessary to overlap segments to achieve effective spray/splash protection and removability. An alternative would be to use ducts with removable lids.

Double containment systems may include proprietary pipe-in-pipe systems (including those that can take pump pressure) and other fully sealed encapsulation methods (including sealed ducts that redirect leaks to bunds).

Whichever system is chosen the barrier protection shall possess the following attributes:

1) It prevents personnel from being sprayed in the event of a pipe or fitting failure (this doesn’t mean that the containment system needs to be rated for the process pressure, just that it, and its fittings/connections, can withstand a burst of the dosing pipe within it),

2) It incorporates a visible means of identifying that a leak has occurred. This may simply consist of low point(s) that have a section of transparent pipe or drainage to an alarmed bund or tank. Low points shall be able to be drained using manual valving that can be used to direct collected chemical to a suitable waste collection tank.
3) Where tubing is double-contained, the design shall incorporate an easy means of replacing it once it has reached the end of its service life – this can be as short as 12 months for some tubing material-chemical combinations.
4 Appendix 1: Enclosures with Doors or Removable Panels – Examples

Figure 1.1 Enclosure example
Figure 1.2 Enclosure example
Figure 1.3 Enclosure example
Fig 1.4 Retrofitted enclosure for a small dosing system. Side panels are small enough (i.e. light enough) for one person to lift off if access is required.
Fig 1.5 Enclosure retrofit – enclosure will prevent spray (acid will spread across concrete flooring, but, this is presents a lower level of hazard)
5 Appendix 2: Enclosures with Curtains – Examples

Fig 2.1 Curtain Enclosure General Arrangement Drawing
Fig 2.2 Low enclosure with curtains
Fig 2.3 Curtain Hangers
Fig 2.4 Curtain Hanger Track
6 Appendix 3: Localised Enclosures – Examples

Fig 3.1 Dosing Pumps: Perspex box covers pressurised fittings on pump discharges – pipework passes through the panel itself
Fig 3.2 Dose Point: Hatches provided allow operator access to valves frequently operated without having to remove perspex box
Fig 3.3 Local dose point enclosure: covers the pipework and fittings at the dose point. Tear-drops allow access to valves.
Fig 3.4 Local dose point enclosure: covers the pipework and fittings at the dose point despite a change in direction. Tear-drop allows access to main isolation valve.
Appendix 4: Pipe Covers

Fig 4.1 Pipe cover is segmented.
Dose Point: Tear drop allows operator access to isolation valve without having to remove perspex box. Valve can be accessed by removing 4 wing nuts.
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