



Assets Planning and Delivery Group  
Engineering

# **DESIGN STANDARD DS 38-01**

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## **Installation - Mechanical**

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VERSION 1  
REVISION 6

JUNE 2023

## FOREWORD

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

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

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

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

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## Head of Engineering

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## REVISION STATUS

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

REVISION STATUS						
SECT.	VER./REV.	DATE	PAGES REVISED	REVISION DESCRIPTION (Section, Clause, Sub-Clause)	RVWD.	APRV.
1	1/0	01.05.07	All	New standard	EJP	AAK
	1/2	01.06.10	11	Clause 1.1, 1.5 amended	EJP	AAK
	1/4	03.08.16	11	General clause amended	BV	SE
All	1/6	26.06.23	N/A	Scheduled review, no changes required	SE	SE
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	1/2	01.06.10	16	Clause 7.2 amended	EJP	AAK
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9	1/0	01.05.07	All	New standard	EJP	AAK
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13	1/0	01.05.07	All	New standard	EJP	AAK
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14	1/0	01.05.07	All	New standard	EJP	AAK
	1/1	01.07.07	20	Clause 14.1.4 amended	EJP	AAK
	1/2	01.06.10	18	Clause 14.1.3 amended	EJP	AAK
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15	1/0	01.05.07	All	New standard	EJP	AAK
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17	1/0	01.05.07	All	New standard	EJP	AAK
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	1/2	01.06.10	21, 22	Clause 18.3, 18.4.11 amended	EJP	AAK
19	1/0	01.05.07	All	New standard	EJP	AAK
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20	1/0	01.05.07	All	New standard	EJP	AAK
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21	1/0	01.05.07	All	New standard	EJP	AAK
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23	1/0	01.05.07	All	New standard	EJP	AAK
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24	1/0	01.05.07	All	New standard	EJP	AAK
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25	1/0	01.05.07	All	New standard	EJP	AAK
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# DESIGN STANDARD DS 38-01

## Installation - Mechanical

### CONTENTS

<i>Section</i>	<i>Page</i>
<b>1 SCOPE AND GENERAL .....</b>	<b>11</b>
1.1 Scope.....	11
1.2 Purpose.....	11
1.3 Design Process .....	11
1.4 Standards .....	11
1.5 Referenced Documents .....	11
1.6 Mandatory Requirements .....	11
1.7 Nomenclature .....	12
1.7.1 Engineering Definitions and Relationships.....	12
1.7.2 Preferred Terminology .....	12
1.7.3 Abbreviations .....	12
1.7.4 Standard Units and Relationships .....	12
1.7.5 Drawing Symbols.....	12
<b>2 ALIGNMENT OF MACHINERY.....</b>	<b>13</b>
2.1 General.....	13
2.2 Minimum Alignment Requirements.....	13
2.2.1 Horizontal and Vertical Alignment Tolerances .....	13
<b>Table 2.1 – Alignment Tolerance .....</b>	<b>13</b>
<b>NOTES: 13</b>	
2.2.2 Runout.....	13
<b>3 ANCILLARY PLANT AND EQUIPMENT.....</b>	<b>14</b>
3.1 General.....	14
3.2 Supply.....	14
3.3 Installation .....	14
3.4 Pre-commissioning .....	14
3.5 Commissioning .....	14
<b>4 BACKFLOW PREVENTION DEVICES.....</b>	<b>14</b>
<b>5 BOLTED FLANGED JOINTS .....</b>	<b>15</b>
<b>6 BOLTED STRUCTURAL JOINTS .....</b>	<b>15</b>
6.1 General.....	15
6.2 Factors Affecting Joint Integrity .....	15
6.3 Tightening Methods .....	15
6.3.1 Torque Control.....	15

6.3.2	Part-Turn Tightening.....	15
6.3.3	Direct-Tension Indicator Tightening.....	15
6.3.4	Fastener Elongation.....	15
<b>6.4</b>	<b>Fastener Design and Quality .....</b>	<b>16</b>
<b>6.5</b>	<b>Bolting .....</b>	<b>16</b>
6.5.1	Assembly and Fitting Tensioned Bolts .....	16
6.5.2	Bolt Tightening .....	16
<b>6.6</b>	<b>Practices to Avoid.....</b>	<b>16</b>
<b>7</b>	<b>COATING REPAIR .....</b>	<b>16</b>
<b>7.1</b>	<b>General.....</b>	<b>16</b>
<b>7.2</b>	<b>Preparation and Application.....</b>	<b>17</b>
<b>7.3</b>	<b>Finish.....</b>	<b>17</b>
<b>7.4</b>	<b>Machinery.....</b>	<b>17</b>
<b>7.5</b>	<b>Pumps.....</b>	<b>17</b>
<b>7.6</b>	<b>MSCL Pipework.....</b>	<b>17</b>
7.6.1	Lining Restoration.....	17
7.6.2	Painted Above-Ground Coatings .....	17
<b>7.7</b>	<b>Coating PVC Pipework and Fittings .....</b>	<b>17</b>
<b>7.8</b>	<b>Hot-dip Galvanized Coating Repair.....</b>	<b>18</b>
<b>8</b>	<b>COMMISSIONING .....</b>	<b>18</b>
<b>9</b>	<b>CONFINED SPACE .....</b>	<b>18</b>
<b>10</b>	<b>CORROSION MITIGATION .....</b>	<b>18</b>
<b>11</b>	<b>ENVIRONMENT.....</b>	<b>18</b>
<b>12</b>	<b>FLANGES.....</b>	<b>18</b>
<b>12.1</b>	<b>Flange Design Standards .....</b>	<b>18</b>
<b>12.2</b>	<b>Flange Fasteners.....</b>	<b>18</b>
<b>12.3</b>	<b>Flange Gaskets.....</b>	<b>18</b>
<b>12.4</b>	<b>Flange Bolting Procedures .....</b>	<b>18</b>
<b>13</b>	<b>FENCING .....</b>	<b>18</b>
<b>14</b>	<b>FLOWMETERS.....</b>	<b>19</b>
<b>14.1</b>	<b>Magnetic Flowmeters.....</b>	<b>19</b>
14.1.1	General.....	19
14.1.2	Buried Service.....	19
14.1.3	Installation Practices .....	19
14.1.4	Insulation and Earthing .....	19
<b>14.2</b>	<b>Mechanical Flowmeters .....</b>	<b>19</b>
14.2.1	General.....	19
14.2.2	Volumetric Chamber.....	19
14.2.3	Helical Vane Meters.....	20
14.2.4	Bridging Cables.....	20
<b>15</b>	<b>FOUNDATION BLOCKS.....</b>	<b>20</b>



<b>16</b>	<b>GROUTING .....</b>	<b>20</b>
<b>16.1</b>	<b>General.....</b>	<b>20</b>
<b>16.2</b>	<b>Placing.....</b>	<b>20</b>
<b>16.3</b>	<b>Grout Material .....</b>	<b>21</b>
<b>16.4</b>	<b>Post Grouting.....</b>	<b>21</b>
<b>16.5</b>	<b>Manufacturer’s Recommendations .....</b>	<b>21</b>
<b>17</b>	<b>GUARDS.....</b>	<b>22</b>
<b>18</b>	<b>INSTALLATION.....</b>	<b>22</b>
<b>18.1</b>	<b>General.....</b>	<b>22</b>
<b>18.2</b>	<b>Workmanship and Materials .....</b>	<b>22</b>
<b>18.3</b>	<b>Occupational Safety and Health .....</b>	<b>22</b>
<b>18.4</b>	<b>Machinery .....</b>	<b>22</b>
18.4.1	General.....	22
18.4.2	Foundation Block Preparation.....	22
18.4.3	Packers and Shims .....	23
18.4.4	Placement of Baseplates.....	23
18.4.5	Baseplate Alignment and Leveling .....	23
18.4.6	Tightening of Foundation Bolts .....	23
18.4.7	Final Grouting.....	23
18.4.8	Additional Grout Filling.....	23
18.4.9	Machinery Connections .....	23
18.4.10	Transmission Coupling Alignment .....	23
<b>18.5</b>	<b>Verification .....</b>	<b>23</b>
<b>19</b>	<b>LUBRICATION.....</b>	<b>23</b>
<b>20</b>	<b>MATERIALS .....</b>	<b>24</b>
<b>21</b>	<b>NOISE .....</b>	<b>24</b>
<b>21.1</b>	<b>General.....</b>	<b>24</b>
<b>21.2</b>	<b>Daily Noise Dose for Personnel .....</b>	<b>24</b>
<b>22</b>	<b>PACKERS AND SHIMS .....</b>	<b>24</b>
22.1.1	General.....	24
22.1.2	Packers.....	24
22.1.3	Shims.....	24
<b>23</b>	<b>PIPEWORK .....</b>	<b>25</b>
<b>23.1</b>	<b>General.....</b>	<b>25</b>
<b>23.2</b>	<b>Related Standards .....</b>	<b>25</b>
<b>23.3</b>	<b>Mandatory Use of Bridging Cables .....</b>	<b>25</b>
<b>24</b>	<b>PIPEWORK PITS.....</b>	<b>25</b>
<b>25</b>	<b>PREVENTION OF FALLS.....</b>	<b>25</b>
<b>26</b>	<b>PUMPS.....</b>	<b>25</b>
<b>26.1</b>	<b>Supply.....</b>	<b>26</b>
<b>26.2</b>	<b>Installation .....</b>	<b>26</b>

26.2.1	General .....	26
26.2.2	Pre-Installation .....	26
26.2.3	Baseplate Placement .....	27
26.2.4	Grouting .....	27
26.2.5	Pipework .....	27
26.2.6	Coupling Alignment .....	27
<b>26.3</b>	<b>Pre-commissioning .....</b>	<b>27</b>
<b>26.4</b>	<b>Commissioning .....</b>	<b>27</b>
<b>27</b>	<b>QUALITY .....</b>	<b>27</b>
<b>28</b>	<b>SECURITY .....</b>	<b>27</b>
<b>29</b>	<b>SIGNAGE AND LABELS.....</b>	<b>28</b>
<b>30</b>	<b>VALVES .....</b>	<b>28</b>
<b>30.1</b>	<b>General.....</b>	<b>28</b>
<b>30.2</b>	<b>Termination and Operating Heights (Note 30.2.1 and 30.2.2 transferred to DS 31-02).....</b>	<b>28</b>
30.2.1	Spindle Caps for Buried Valves .....	28
30.2.2	Handwheels .....	28
<b>30.3</b>	<b>Labelling of Valves.....</b>	<b>28</b>
<b>30.4</b>	<b>Butterfly Valves.....</b>	<b>29</b>
30.4.1	Supply .....	29
30.4.2	Extended Spindle Identification .....	29
30.4.3	Extended Spindle Site Assembly .....	29
30.4.4	Installation.....	29
30.4.5	Pre-commissioning.....	30
30.4.6	Commissioning .....	30
<b>30.5</b>	<b>Gate Valves .....</b>	<b>30</b>
30.5.1	Supply .....	30
30.5.2	Installation.....	30
30.5.3	Pre-commissioning.....	30
30.5.4	Commissioning .....	30
<b>30.6</b>	<b>Miscellaneous Valves .....</b>	<b>30</b>
30.6.1	Supply .....	31
30.6.2	Installation.....	31
30.6.3	Pre-commissioning.....	31
30.6.4	Commissioning .....	31
<b>31</b>	<b>VIBRATION.....</b>	<b>31</b>
<b>32</b>	<b>WELDING.....</b>	<b>31</b>

# 1 SCOPE AND GENERAL

## 1.1 Scope

Design Standard DS 38-01 details the Corporation's mechanical installation standards, guidelines and preferred engineering practices for its water supply, wastewater and drainage assets. It is intended to guide the designer in understanding and prescribing the minimum requirements governing mechanical equipment installation. These requirements are further elaborated within the Mechanical Installation (MI) module of the Modular Specification series. These specifications are intended for the procurement, engagement and management of contractors undertaking mechanical installation works on behalf of the Corporation.

**Where modular specifications are to form a component of the contract for Mechanical Installation, the MI module must be referenced on all relevant design drawings.**

Topics within this standard have been arranged in alphabetic order to assist the reader. Information residing in other DS30 Series Mechanical Design Standards is referenced accordingly herein.

## 1.2 Purpose

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

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

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

## 1.3 Design Process

The mechanical design process to be followed is documented in the Engineering Design Process Manual.

## 1.4 Standards

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

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

## 1.5 Referenced Documents

The full reference list of Australian, International, and Corporation standards and codes referenced in the DS 30 series of standards is contained in Appendix A Referenced Documents section of DS 30-01.

## 1.6 Mandatory Requirements

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

## **1.7 Nomenclature**

### **1.7.1 Engineering Definitions and Relationships**

For definitions of the terminology and relationships referred to in this Standard the reader is referred to the Glossary in DS 30-01.

### **1.7.2 Preferred Terminology**

Preferred mechanical terms to be used in Corporation designs are detailed in the Preferred Terminology section of DS 30-01.

### **1.7.3 Abbreviations**

For abbreviations referred to in this Standard the reader is referred to the Abbreviations section of DS 30-01.

### **1.7.4 Standard Units and Relationships**

The units and relationships used for mechanical designs shall be in accordance with those specified in the SI Units, Relationships and Prefixes section of DS 30-01.

### **1.7.5 Drawing Symbols**

A comprehensive list of mechanical drawing symbols for pipework and valves is referenced in DS 80.

## 2 ALIGNMENT OF MACHINERY

### 2.1 General

All long-coupled rotating machinery being supplied to the Corporation shall be accurately aligned. The machinery shall be aligned at the works as part of the works testing and again re-aligned (or the alignment confirmed) after completion of installation and prior to initial startup and commissioning. Alignment shall be conducted using either laser alignment or dial indicator equipment. Subsequent to the completion of any alignment a written report (certificate) shall be provided which details the final state of the machine and any conditions that were discovered or rectified during the course of the alignment.

**NOTES:**

1. Generally, it is a relatively simple matter for laser alignment equipment to provide the required final alignment condition of the machine and for this reason it is preferred. All rotating machinery greater than 10kW should be laser aligned.
2. Baseplate motor mounting pads are normally machined to allow the motor shaft height to be 3 mm below a pump (or other item of plant) shaft height when mounted on the pads with no shims. Accordingly to achieve the required alignment shims should only be placed under the motor feet.
3. For requirements regarding shims refer to the Packers and Shims section of this Standard.

### 2.2 Minimum Alignment Requirements

The following alignment tolerances should be used on machinery supplied to the Corporation except where manufacturers require tighter tolerances in which case the manufacturer’s tolerances shall apply. Manufacturer’s alignment tolerances applicable shall be to the tighter tolerance of either the driver (e.g. motor) or the driven machine (e.g. pump). Coupling alignment tolerances shall not be used.

#### 2.2.1 Horizontal and Vertical Alignment Tolerances

The following table details the minimum acceptable horizontal or vertical alignment tolerances for Corporation machinery:

**Table 2.1 – Alignment Tolerance**

RPM	Parallel	Angular (Note 1)
600	0.1270mm, (5 thou)	0.015mm per 10mm, (1.5 thou per inch)
900	0.1026mm, (4 thou)	0.010mm per 10mm, (1 thou per inch)
1200	0.0762mm, (3 thou)	0.007mm per 10mm, (0.7 thou per inch)
1800	0.0508mm, (2 thou)	0.005mm per 10mm, (0.5 thou per inch)
3600	0.0254mm, (1 thou)	0.003mm per 10mm, (0.3 thou per inch)

**NOTES:**

1. The tolerances given here for angular alignment, mm per 10mm (thou per inch), are in relation to the coupling diameter.
2. Some operators use the abbreviation “mils” in their alignment procedure and documentation. This notation should not be confused with mm.  
 1 mil = 1 thousandth of an inch (‘thou’) = 0.0254mm.

#### 2.2.2 Runout

- (a) No more than 0.0762 mm (3 ‘thou’) for critical or high speed machines.

- (b) No more than 0.152 mm (6 'thou') for less critical machinery.

## **3 ANCILLARY PLANT AND EQUIPMENT**

### **3.1 General**

Ancillary plant and equipment shall refer to items of plant associated with pump stations and treatment plants and also plant contained in DS 35 relating to the following:

- (a) Air compressors.
- (b) Air conditioning.
- (c) Blowers.
- (d) Cranes Diesel engines.
- (e) Fans.
- (f) Generating sets.
- (g) Surge vessels.

### **3.2 Supply**

Transport, handling and storage of ancillary plant and equipment shall comply with the manufacturer's recommendations and where relevant the Corporation's strategic product specification.

### **3.3 Installation**

Installation shall comply with the following:

- (a) Foundation blocks shall comply with the Foundation Blocks section of DS 30-02.
- (b) Installation of the ancillary plant and equipment shall comply with the manufacturer's recommendations, and the Installation section of this Standard.

The manufacturer's recommendations shall take precedence over any other requirements contained in this Standard.

### **3.4 Pre-commissioning**

Full pre-commissioning tests on the plant and equipment shall be conducted prior to the formal commissioning.

### **3.5 Commissioning**

Commissioning shall comply with the Commissioning section of this Standard.

## **4 BACKFLOW PREVENTION DEVICES**

Backflow prevention devices shall comply with the requirements contained in the Backflow Prevention Devices section contained in DS 31-02. Devices which shall comply with AS/NZS 2845.1 shall be installed in accordance with the requirements of AS/NZS 3500 and AS/NZS 2845.2, and shall be commissioned and maintained in accordance with AS/NZS 2845.3.

## 5 BOLTED FLANGED JOINTS

Installation of bolted flanged joints shall comply with DS 38-02 Flange Bolting.

**NOTE:**

Structural bolting is covered separately in the Bolted Structural Joints section below.

## 6 BOLTED STRUCTURAL JOINTS

### 6.1 General

The following guidelines cover the procedures that should be followed for bolting structural joints designed in accordance with AS 4100. These guidelines should be used in conjunction with the Structural Fasteners section of DS 30-02 which details the relevant fastener standards applicable and also specific design aspects applicable.

**NOTE:** Flange bolting is covered separately in this Standard in the Bolted Flanged Joints section above.

### 6.2 Factors Affecting Joint Integrity

The integrity of the structural joint depends upon:

- (a) Correct design and construction of the jointing system.
- (b) Preparation of the joint.
- (c) Selection of fasteners appropriate for the application in accordance with the relevant Australian Standard, as detailed in the Fasteners for Structural Applications section of DS 30-02.
- (d) Correct bolt tightening.

Items (b) to (d) are covered in these guidelines.

### 6.3 Tightening Methods

#### 6.3.1 Torque Control

Torque control is not recognised as a valid method of tightening in AS 4100 other than for secondary inspection of bolt tightness as contained in Appendix CK of Supplement 1.

#### 6.3.2 Part-Turn Tightening

Part-turn tightening is one of the first of the two recommended methods of tightening covered in detail in AS 4100.

#### 6.3.3 Direct-Tension Indicator Tightening

Direct-tension indicator tightening is the second recommended method of tightening covered in detail in AS 4100.

#### 6.3.4 Fastener Elongation

Involves direct measurement of the amount of stretch along with strain gauges attached to the bolt shank to give a high degree of accuracy, but would only be justified economically in the most critical of circumstances.

## 6.4 Fastener Design and Quality

As previously mentioned these guidelines should be used in conjunction with the Structural Fasteners section of DS 30-02 which details the relevant fastener standards applicable and specific design aspects.

- (a) Fasteners shall be of the correct property class for the application.
- (b) External fasteners shall be hot-dip galvanised (unless otherwise specified).
- (c) Properly certified fasteners shall be supplied e.g. complying with relevant Australian or international standards.
- (d) Fasteners shall be clearly and properly marked in accordance with the relevant Australian standard.
- (e) Fastener components shall be of sound manufacturing quality being free from manufacturing or coating defects and nuts should run freely on the threads.
- (f) Bolts shall be of the correct length such that a minimum of 2 and a maximum of 5 threads protrude past the nut after fitting.
- (g) At least one flat washer (for fitting under the turned fastener component) shall be supplied with the fastener assembly. The washers shall be a similar hardness to the fastener.

## 6.5 Bolting

### 6.5.1 Assembly and Fitting Tensioned Bolts

Assembly and fitting of fasteners shall comply with section 15 of AS 4100 and the following:

- (a) Ensure the joint faces are clean and free from defects.
- (b) Apply lubricant to fastener threads and bearing surfaces.
- (c) Where a painted protective coating has been applied to the surface a washer shall be fitted under the bolt head and nut to prevent damage to the coating.

### 6.5.2 Bolt Tightening

Tightening of fasteners shall comply with section 15 of AS 4100.

## 6.6 Practices to Avoid

Normal high strength nuts should not be galvanised and tapped oversize as the resulting threads may be of insufficient tensile strength. Only higher strength galvanised nuts in accordance with AS/NZS 1252 shall be used.

# 7 COATING REPAIR

## 7.1 General

This section covers the minor repair of various types of product coatings. Generally products delivered to site will have been coated by the manufacturer.

Due care shall be taken with product during transportation, handling and installation to ensure that protective coatings and linings are not damaged. However in the event of minor coating damage it shall be repaired in accordance with the requirements detailed in the following.

For extensive coating repair or where full coating of product is required the coating shall comply with DS 95.



## 7.2 Preparation and Application

Preparation of surfaces and the application procedures for the repair of painted coatings shall be in accordance with the relevant Corporation coating standards (a full list is contained in DS30-01) and the manufacturer's requirements.

## 7.3 Finish

The finished coating repair shall be of uniform thickness, colour and appearance. The coating repair shall be fully cured, adherent, coherent and free from holidays, laps, sags, checking, overspray, patchiness and any other defect that may impair the performance and/or appearance of the coating.

## 7.4 Machinery

Coating repair for machinery and equipment not subject to immersion shall be in accordance with Surface Preparation A1 and Coating Specification B2 using matching decorative coating colours in accordance with AS/NZS 2700 to the client's requirements.

## 7.5 Pumps

Pumps shall be coated in accordance with the specific requirements detailed in the relevant parts of DS 30-02, DS 32 and DS 95 unless otherwise stated.

## 7.6 MSCL Pipework

### 7.6.1 Lining Restoration

Site welded joints or pipework smaller than DN 600 (where the lining cannot be readily reinstated), shall have a convex profile steel band welded over the joint, and the cavity cement grout filled in accordance with the relevant detail contained in Drawing AY58-19-1.

For piping greater than DN 500 the lining shall be internally reinstated at welded joints in accordance with the relevant detail contained in Drawing AY58-19-1.

### 7.6.2 Painted Above-Ground Coatings

The extent of coating damage shall be assessed for the above-ground pipework as outlined in Criteria for Assessment and Repair section in DS 95. If the coating damage is extensive i.e. if the rust percentage is 50% and greater, it may be more cost effective to completely recoat the structure.

Pipe specials and portions of pipe specials exposed to the atmosphere shall be cleaned and coated in accordance with Surface Preparation A1 and Coating Specification B1, if no coloured top coat is required. If a coloured top coat is required then Coating specification C2 shall be followed.

If the coating damage is very minor that is, if the rust percentage is up to 20% (Refer: Measles Chart in DS 95), then mechanical wire brush or power tool cleaning is sufficient to clean the surface area. This is followed by the application of Coating Specification.

## 7.7 Coating PVC Pipework and Fittings

- (a) PVC-U pipe is particularly susceptible to UV embrittlement and shall be coated with Coating Specification K1. PVC-U pipes and fittings shall be stored so that they are not exposed to direct or indirect sunlight in order to minimise UV embrittlement.
- (b) Paint colour shall be in accordance with Section 5 Standard Colour Coding for Pipework contained in DS 80 (Drg EG71-1-1).

## **7.8 Hot-dip Galvanized Coating Repair**

Hot dip galvanising shall comply with the Australian Standard AS/NZS 4680. For more information on the coating requirements refer to Coating Specifications H1 and H2.

## **8 COMMISSIONING**

Commissioning of machinery and plant shall be conducted on new plant and machinery prior to project completion, for all Corporation projects in accordance with the Corporation Asset Handover Guidelines.

## **9 CONFINED SPACE**

Personnel working in confined space shall comply with the requirements contained in the Confined Space section of DS 30-02.

## **10 CORROSION MITIGATION**

Installation practices shall minimize the potential for corrosion by utilising the strategies contained in the Corrosion section of DS 30-02 relating to Corrosion Mitigation.

## **11 ENVIRONMENT**

All work shall comply with the requirements of the Environment section contained in DS 30-02.

## **12 FLANGES**

Installation of pipework flanges shall comply with the following requirements:

### **12.1 Flange Design Standards**

Pipework flanges shall comply with the Flanged Connections section of DS 31-01.

### **12.2 Flange Fasteners**

Pipework flange fasteners shall comply with the Flange Fasteners section of DS 38-02.

### **12.3 Flange Gaskets**

Pipework flange gaskets shall comply with the Flange Gaskets section of DS 31-01.

### **12.4 Flange Bolting Procedures**

Pipework flange bolting procedures shall comply with DS 38-02 Flange Bolting.

## **13 FENCING**

Where required, facility perimeter security fencing shall comply with the Security section of this Standard.

## **14 FLOWMETERS**

### **14.1 Magnetic Flowmeters**

#### **14.1.1 General**

For general and design information relating to magnetic flowmeters refer to DS 31-02 and DS 25-01.

#### **14.1.2 Buried Service**

Magnetic flowmeter sensors located in buried service conditions shall be supported underground by a concrete support and backfilled and compacted in stages with sand. Steel bollards should be located at the surface level to indicate the position of the flowmeter and to prevent traffic access over the site. To minimise ingress of moisture the buried cable should be a continuous length without connections or joints. Accordingly the required cable length shall be determined and specified.

All cables are to be pre-fitted.

#### **14.1.3 Installation Practices**

The following installation practices shall be observed:

- (a) Installation of magnetic flowmeters shall comply with Section 2.14 of DS 25-01.
- (b) Installation of mechanical flowmeters shall be undertaken strictly in accordance with the manufacturer's instructions, which would override Corporation standards in the event of conflict. Accordingly contractors shall be supplied with installation manuals as part of the installation contract.
- (c) Prior to installing or removing a water flowmeter (or any fitting) from metallic service pipework a bridging cable shall be fitted in accordance with the Pipework section of this Standard.

#### **14.1.4 Insulation and Earthing**

Where a pipeline is cathodically protected the flowmeter tube shall be electrically isolated from the pipework using insulating gaskets either side of the earthing ring (potential equalization ring) at the flanges and isolating sleeves and washers on the flange fasteners. Insulation is required to prevent interference from stray currents. In addition to the insulating kit washers (comprising the insulating washers and thin galvanized steel backing washers) the fasteners shall have a hardened steel washer fitted under the bolt head and the nut in accordance with the requirements contained in DS 38-02.

Earthing of magnetic flowmeters shall be in accordance with the manufacturer instructions and with DS 25.

### **14.2 Mechanical Flowmeters**

#### **14.2.1 General**

For general and design information relating to mechanical flowmeters refer to the Mechanical Flowmeters section of DS 31-02.

#### **14.2.2 Volumetric Chamber**

Installation of volumetric chamber (semi-positive) water meters shall comply with the manufacturer's recommendations.

### 14.2.3 Helical Vane Meters

Helical vane meters (also referred to as turbine or inferential) may be installed in the horizontal, inclined or vertical positions without loss of accuracy. Installation of turbine water meters shall comply with the manufacturer's recommendations.

### 14.2.4 Bridging Cables

Prior to installing or removing a water meter (or any fitting) from metallic service pipework a bridging cable shall be fitted in accordance with the Pipework section of this Standard.

## 15 FOUNDATION BLOCKS

Foundation blocks shall comply with the Foundation Blocks section of DS 30-02 and the Drawings.

## 16 GROUTING

### 16.1 General

Grout shall be used to set machinery baseplates and steelwork structures which are to be installed onto concrete foundation blocks and shall be provided as a means of:

- (a) Accurately positioning and leveling baseplates or footplates.
- (b) Taking up irregularities in the foundation block surface.
- (c) Preventing lateral movement, reducing vibration and reducing moisture accumulation (and therefore corrosion) when filled within a machinery or pumpset baseplate.

Pipework or other connections to machinery or pumpsets shall be made after final grouting of the baseplate prior to coupling alignment in accordance with the Alignment of Machinery section of this Standard.

Grout shall not be used as a pressure seal for large gaps e.g. gaps <15 mm for structural frames for valves, penstocks, gates and etc.

Alternate methods shall be approved in writing by the Water Corporation representative prior to being carried out. Dry packed and/or partially filled bases are not acceptable.

### 16.2 Placing

- (a) All bonding surfaces shall be cleaned prior to grout filling.
- (b) Formwork should be erected around the base of the structure to a height of 75 mm or more above the lower flange of the structure to produce a slight head (pressure) on the grout after filling. A suitable sealant such as silastic should be used between the formwork and the sides of the foundation block to prevent grout leakage.
- (c) A grout allowance of 20 - 40 mm between the top of the foundation and the bottom of the structure level should be used. Prior to grouting, the foundation shall be clean and wetted to help prevent excessive moisture loss from the grout interface.
- (d) The form shall be set on a 45° angle to create a tapered edge. If this is not possible due to spacing restraints then a straight edge is acceptable.
- (e) Commence grouting paying particular attention to proper filling of the foundation bolt blockout holes whilst maintaining vertical alignment of the foundation bolts. Grouting of the foundation bolts to within 25mm of the top of the foundation block should occur before final grouting of the base of the structure is commenced. This helps to provide a key for the final

grouting. The foundation bolt grouting should be allowed to set hard (normally 72 hours) before final grouting is commenced.

- (f) The final grout shall be mixed according to the manufacturer's specification and to a flowable consistency. It shall fill all the cavities between the baseplate lower channel or section and the foundation to a level of at least half the channel or section depth, and shall not shrink after curing.

### 16.3 Grout Material

The grout should be a commercial non-shrink type and should be used strictly in accordance with the manufacturer's directions. A high strength epoxy grout shall be used for foundation bolts and a "flowable" grout used for final grouting of the base plate. Alternatively, if a commercial grout is not available the grout material should comprise one part Portland cement and two parts sand (no aggregate) and be mixed with as little water as possible to prevent shrinkage.

### 16.4 Post Grouting

After the grout is poured, the exposed surface shall be covered to effect slow drying and prevent cracking. If the structure is installed outdoors, care should be taken to ensure that extremes of ambient temperatures do not adversely affect the curing of the grout. Once the grout has set, normally after 48 hours, the formwork should be removed and a smooth finish given to the grout and foundation surfaces.

The grout shall be given at least 72 hours to cure before the hold down bolts are tightened.

**NOTES:**

1. After curing the packers can be removed or left in place for centrifugal type plant, but must be removed for reciprocating type plant.
2. The recommended grout thickness determined should be sufficient to minimize cement grout shrinkage or synthetic grout thermal cracking during curing.
3. It may be appropriate to use a curing agent to facilitate curing but would be subject to approval by the Corporation.
4. In some cases it may be necessary to fill areas of the base plate with extra grout for aesthetic reasons, or to eliminate traps for water and/or dirt to collect, or extra stiffness etc. This action should be carried out separately and after the final grout referred to above has set.

### 16.5 Manufacturer's Recommendations

The manufacturer's recommendations with respect to grouting (where provided) shall take precedence over the above requirements except where it is considered the Corporate standards are more stringent. Under these circumstances the matter should be resolved by agreement between both parties.

## 17 GUARDS

All machinery safety guards, protection controls (e.g. interlocks) and emergency stop devices shall be fitted and fully operative prior to commissioning of machinery. Guards shall comply with the Guards section of DS 30-02.

## 18 INSTALLATION

### 18.1 General

Installation and commissioning of machinery shall comply with the manufacturer's requirements and the relevant sections of this Standard.

### 18.2 Workmanship and Materials

Workmanship and materials used during the installation shall comply as follows:

- (a) All mechanical work shall be carried out by qualified mechanical tradesmen under the supervision of suitably qualified supervisors.
- (b) All materials used in the installation shall be new and, where applicable, material and workmanship shall be in accordance with the relevant standard of the Standards Association of Australia or, in their absence, recognised International standards.
- (c) Workmanship shall also comply with the relevant sections of this Standard.

### 18.3 Occupational Safety and Health

A safe work site shall be maintained, which shall comply with the requirements of the Occupational Safety and Health section contained in DS 30-02. Prevention of falls shall be in accordance with the prevention of falls section of this Standard.

### 18.4 Machinery

#### 18.4.1 General

This section covers the placing, leveling and grouting of machinery baseplates onto their foundation blocks. Positioning, alignment, leveling and grouting of the baseplate shall be carried out before any pipework or other connections to the machinery are made. Prior to commencement of installation, the baseplate dimensions shall be subject to verification to confirm manufacture, in order to facilitate correct alignment of the equipment. A trial alignment should be carried out to verify this.

#### 18.4.2 Foundation Block Preparation

The machine foundation block shall comply with DS 30-02, which requires block-outs to accommodate base plate the foundation bolts, and sufficient height allowance to facilitate leveling and grouting of the base plate.

The top surface of the foundation block shall be clean and flat, and scabbled to promote grout adhesion. The surface either side of the block-outs shall be free from any surface imperfection where packers and shims are to be placed. The blockouts shall be thoroughly cleaned and free of loose material. The final top surface shall be swept clear of any loose material.

### **18.4.3 Packers and Shims**

Packers and shims shall comply with the Packers and Shims section of this Standard. Sets of packers and shims, of the combined approximate thickness to set the base plate at the required height, shall be placed at both sides of each block-out, and as close to the block-out as possible.

### **18.4.4 Placement of Baseplates**

The base plate shall be placed so as to rest on the pre-positioned packers, with the foundation bolts hanging in the block-outs, with a nut and washer on each bolt, and the nuts adjusted to have the correct number of threads showing.

### **18.4.5 Baseplate Alignment and Leveling**

After placement of the baseplate it shall be aligned and leveled to the required position and height by adjusting the packers/shims accordingly. The baseplate shall be positioned correctly to facilitate pipework connection. Shims shall be fitted such that they are in contact with the underside of the base plate and sharing the load. The baseplate level shall be adjusted so that it is level (e.g. bubble centered) for both the longitudinal and lateral axis, using an engineering quality spirit level of suitable length to suit the baseplate. The pump flanges may be used as a reference aid to leveling.

### **18.4.6 Tightening of Foundation Bolts**

After the required curing period (72 hours), the base plate shall be subject to a final check to determine that it is level and that all shims are correctly fitted. The foundation bolts shall be tightened sufficiently to ensure bearing on the packers and not cause deflection of the base plate flange.

### **18.4.7 Final Grouting**

Final grouting shall comply with the relevant parts of the Grouting section of this Standard. If possible any adjacent machinery that could transmit vibration shall be isolated during the grout curing process to minimize movement of the grout and subsequent cracking.

### **18.4.8 Additional Grout Filling**

Carry out any additional filling of base plate cavities as required with all surfaces properly finished.

### **18.4.9 Machinery Connections**

The foundation bolt torque shall be checked, and pipework and other connections shall be made after the grouting is complete and cured, and prior to the transmission coupling alignment.

### **18.4.10 Transmission Coupling Alignment**

Align the transmission coupling using two dial gauges or a laser alignment machine in accordance with the tolerances and shim requirements specified in the Alignment of Machinery section of this Standard.

## **18.5 Verification**

Verification of the quality of installation shall be conducted during commissioning.

# **19 LUBRICATION**

Information relating to lubrication is contained in the Lubrication section of DS 30-02.

Prior to any trials or commissioning all machinery shall be lubricated in accordance with manufacturer's recommendations.

## 20 MATERIALS

Materials used during construction and installation of the project shall meet the requirements relating to factors such as contamination of drinking water, compatibility with the operating environment, galling, corrosion mitigation, welding, pickling and passivation etc. contained in the Materials section of DS 30-02. For seawater applications refer to the Materials for Seawater Applications section of DS 30-02.

## 21 NOISE

### 21.1 General

Proximity of nearby residences and the potential impact of noise and frequency of noise generated shall be considered to ensure that the noise emissions from the facility and during installation and commissioning do not cause inconvenience to residents. Noise emissions shall comply with the requirements of the Noise section of DS 30-02.

### 21.2 Daily Noise Dose for Personnel

The Daily Noise Dose for Personnel working on site shall comply with the requirements of the Noise section of DS 30-02.

## 22 PACKERS AND SHIMS

### 22.1.1 General

Where required to be fitted, packers and shims shall comply with the following.

- (a) Each set of packing and shims shall contain the smallest practical number of pieces.
- (b) Exposed edges of packers and shims subject to corrosion shall be coated using an epoxy zinc rich paint.

### 22.1.2 Packers

- (a) Packers shall be flat, level and free of rust.
- (b) Packers shall be of mild steel flat bar of thickness 3 – 20 mm.
- (c) The minimum packer length shall be equal to the baseplate flange width plus 10 mm and the packer width shall be a minimum of 65 mm.

### 22.1.3 Shims

- (a) All shims shall be steel, brass or stainless steel. Galvanised plate or aluminium stock is not acceptable. Shims shall be flat without kinks or buckles and free from rust.
- (b) Shims shall be hard rolled and should cover the full foot print of the motor feet. Stepped shims shall not be used.
- (b) Maximum allowable shimming shall be 20 mm.
- (c) Shims shall individually not exceed 3.5 mm in thickness unless machined on both faces. Shims having thickness below 0.6 mm shall be brass. Shims of all other thicknesses shall be steel.
- (d) Not more than three un-machined steel shims shall be used at any one bearing point.



## 23 PIPEWORK

### 23.1 General

Pipework installation shall be conducted using appropriate controls such as safe working procedures including consideration of:

- (a) Tagging and isolation of valves and equipment in accordance with WC-OSH-109;
- (b) Safe working in confined space (refer DS 30-02);
- (c) Environmental factors such as storm conditions (flooding and electric shock potential), wearing appropriate PPE and use of safety devices such as bonding straps (refer Mandatory Use of Bridging Cables below);
- (d) Engineering design factors e.g. removal of pipe sections downstream of an isolating valve utilizing rubber ring jointed valves, or valves not suitable for end of line service.

### 23.2 Related Standards

Pipework installation shall include the following as required:

- (a) Pump dismantling pipe couplings and restraints in accordance with DS 31-01.
- (b) Dismantling joints for pipework installed in pits in accordance with DS 31-01.
- (c) Supports under valves and appurtenances in accordance with DS 31-01.
- (d) Thrust blocks shall be installed where required to prevent pipework movement induced by forces from flow dynamics.
- (e) Flange bolting in accordance with DS 38-02.

### 23.3 Mandatory Use of Bridging Cables

Prior to installing or removing a water meter, valves (or any fitting) from metallic service pipework a bridging cable shall be fitted in accordance with OSH Instruction “Using Bridging Cables and Managing Electrified Water Services”.

## 24 PIPEWORK PITS

External pipework pits or chambers shall be provided with handrails and ladders as required in accordance with DS 30-02. Pits and chambers shall be designed so that they are not subject to flooding from rain events and above-ground run-off.

## 25 PREVENTION OF FALLS

Any job that requires personnel to work at heights and/or where there is a risk of falling, requires that hazards are identified and appropriate control measures are agreed with the personnel involved. Installers shall comply with Prevention of Falls Standard – S151.

## 26 PUMPS

Supply, installation and commissioning of pumps shall comply with this section.

For the purpose of this standard the term “pumpset” comprises pump, motor, coupling, coupling guard and baseplate.

## 26.1 Supply

Transport handling and storage of the pumps shall comply with the manufacturer's recommendations and to the relevant the Corporation strategic product specification.

The Contractor shall complete a supplier verification of the pumpset as per Water Corporation standard ITP documentation referencing manufacturers accepted drawings (general arrangement, pump, motor and baseplate drawings) and datasheets.

Ensure that any non-compliance issues or remedial actions are completed. Confirm dimensions are as per the accepted manufacturers drawings.

## 26.2 Installation

### 26.2.1 General

Installation of pumps shall comply with the following:

- (a) Foundation blocks shall comply with the Foundation Blocks section of DS 30-02.
- (b) Installation of the pump shall comply with the manufacturer's recommendations, and the requirements of the installation section of this Standard.
- (c) Placing, leveling and grouting of the pumpset baseplate shall be in accordance with the relevant Installation and Grouting sections of this Standard.
- (d) All work is to be carried out and supervised by trained and competent trade personnel.
- (e) All materials/equipment shall be fit for purpose, calibrated and compliant with current Water Corporation national and international standards as appropriate.

### 26.2.2 Pre-Installation

Prior to the commencement of installation works, the contractor shall review I&OM manuals issued by the manufacturer paying particular attention any special installation instructions including but not limited to:

- (a) Safety considerations.
- (b) Tolerances.
- (c) Equipment weights (especially relating to lifting plans).

The contractor is to take all reasonable steps to implement all applicable requirements.

The contractor shall review all detailed design drawings to confirm:

- (a) Height and position of pumpset relative to suction and discharge manifolds or other datum's/reference points within the pump station.
- (b) Foundation blocks and plinths have been constructed as per drawings which shall include verifying height and width to suit the pumpset base and incorporating block outs for all hold down bolts

If a risk analysis has determined a lift study is required then it shall be completed prior to any lifting. Generally, this will only be required for larger pumpsets. The pumpset may be principally supplied as separate individual components or fully assembled.

Note the base plate may not be designed to be lifted fully assembled. In this instance the baseplate would be placed first and then pump and motor thereafter.

### **26.2.3 Baseplate Placement**

The placement of the baseplate shall be in accordance with Section 18.4.4 of this Standard.

### **26.2.4 Grouting**

The grouting of the baseplate shall be in accordance with Section 18.4.6 of this Standard.

### **26.2.5 Pipework**

The following pipework requirements shall apply:

- (a) Pipework installation shall comply with the Pipework section of this Standard
- (b) The pipework and valves shall be independently supported and anchored against pipe thrusts from hydraulic or thermal cause.
- (c) Pump and pipework flanges shall be parallel and should mate together without effort and with bolt holes in proper alignment.
- (d) Drifts shall not be used to force alignment of the bolt holes.
- (e) There shall be no loads applied to the pump branches during final closure joints.
- (f) The coupling alignment shall be used as a datum when the pump flanges are tightened (closure joints) to note any changes which will indicate application of loads to the pump branches.
- (g) Final coupling alignment checking and adjustment shall be performed after completion of the pipework assembly.

### **26.2.6 Coupling Alignment**

Alignment shall be undertaken using two dial gauges or a laser alignment machine in accordance with the tolerances and shim requirements specified in the Alignment of Machinery section of this Standard.

## **26.3 Pre-commissioning**

Full pre-commissioning pump tests shall be conducted prior to formal commissioning.

Once the pump set is installed correctly the Construction Verification ITP shall be completed. This is to be submitted to the Commissioning manager and incorporated into the project specific CAMEL.

Pre-commissioning shall include uncoupled motor direction tests and motor no load tests.

Prior to commissioning, the pump shall be coupled ready for testing.

## **26.4 Commissioning**

Commissioning shall comply with the manufacturer's recommendations and the Corporation Asset Handover Guidelines.

## **27 QUALITY**

Quality Assurance shall comply with the Quality section of DS 30-02.

## **28 SECURITY**

Design of Corporation facilities shall be in accordance with the Water Corporation's Site Security Treatments Standard. All requirements of this standard should, in the first instance be directed to the Corporation's Security Program Manager, Steve MacCarthy, on 9420 3879, mobile 0427 195 536, fax 9420 2656 or at [steve.maccarthy@watercorporation.com.au](mailto:steve.maccarthy@watercorporation.com.au).

## 29 SIGNAGE AND LABELS

Signage and labeling of facilities and machinery shall be provided prior to commissioning commencing and shall be in accordance with the requirements of the Signage and Labels section of DS 30-02.

## 30 VALVES

### 30.1 General

Installation and commissioning of valves shall comply with the Commissioning and Installation sections of this Standard and the manufacturer's requirements.

Prior to installing or removing a valve (or any fitting) from metallic service pipework a bridging cable shall be fitted in accordance with the Pipework section of this Standard.

Supply, installation and pre-commissioning verification of the valves shall comply with the relevant Corporation Valve Inspection and Test Report documents referenced in the following (also refer Appendix A Referenced Documents).

### 30.2 Termination and Operating Heights (Note 30.2.1 and 30.2.2 transferred to DS 31-02)

#### 30.2.1 Spindle Caps for Buried Valves

Buried bypass gate valves and manually operated butterfly valves fitted with spindle cap operators, shall terminate a minimum of 125 mm  $\pm$ 25mm below the valve box cover underside (finished surface level). Gate valves spindle caps shall be provided with a cast iron cover set at the finished surface level. Butterfly valve spindle cap and position indicator assemblies shall be housed in a cast iron hinged metal cover and service chamber. Covers shall be rated to suit trafficable and non-trafficable paved areas as appropriate.

Where bypass gate valves and manually operated butterfly valves fitted with spindle cap operators are not intended for installation in valve boxes the extended spindle tube shall terminate a minimum of 250 mm above the finished ground level (refer note).

**NOTE:** This requirement is to prevent sand and water from entering and filling the enclosure tube. It also raises the torque limiting device and position indicator (butterfly valves) to minimise the potential of their immersion from local flooding.

#### 30.2.2 Handwheels

The operating height of valve actuator handwheels shall be set a standard distance above the finished ground level of 900 mm  $\pm$ 150 mm. Above ground valve actuator handwheels e.g. within pump stations should ideally be set at the same height however factors such as the pump pipework configuration may preclude this. Operating platforms shall be provided as required to provide the previously specified operating height. Valve handwheels should be horizontal orientation.

### 30.3 Labelling of Valves

All valves shall be properly identified and labeled in accordance with the Signage and Labels section of DS 30-02. This particularly includes key operated buried service bypass gate valves and buried service butterfly valves, which shall have the relevant Water Corporation Valve Number incorporated on top of their respective valve covers.

## 30.4 Butterfly Valves

### 30.4.1 Supply

- (a) Transport handling and storage of the valves shall comply with the manufacturer's recommendations and the relevant Corporation strategic product specification.
- (b) Supply verification of the valve shall comply with document WC-SV-M-001-R.

### 30.4.2 Extended Spindle Identification

For extended spindle valves the manufacturer shall permanently attach an identification plate onto the valve body and also onto the enclosure tube (near the top) containing the following information:

- (a) Valve size DN;
- (b) Operator type e.g. EBV or BV (electric BV or manual BV);
- (c) Water Corporation Valve Number.

**NOTE:** These identification plates are required to facilitate correct matching of the body to the enclosure tube and extended spindle assembly.

### 30.4.3 Extended Spindle Site Assembly

Where the extended spindle and enclosure tube have been removed for transportation, it is essential that the valve component reassembly and installation complies with the manufacturer's requirements and specifically note the following.

Manufacturers are required to attach a warning label to the position indicator in order to alert the valve installer that:

- (a) The position indicator must be synchronized with the valve disc position before operating the valve otherwise the valve may be damaged.
- (b) Assembly of the enclosure tube and associated components shall be in accordance with the manufacturer's installation instructions.

### 30.4.4 Installation

- (a) Installation of the valves shall be in accordance with the manufacturer's recommendations and where relevant the requirements of this Standard.
- (b) Flange bolting shall comply with DS 38-02.
- (c) Construction verification of the valve shall comply with document WC-CV-M-001-R.
- (d) Waterworks and high performance butterfly valves shall be installed with the shaft in the horizontal position so that the lower half of the disc opens in the direction of the flow.

**NOTE:**

This requirement takes advantage of the natural flushing action with respect to any debris present in the bottom of the valve. Opening against the direction of flow would tend to force the debris between the disc and the seat with the potential to cause seat damage. This configuration also allows even distribution of the disc and shaft mass over the seat which tends to reduce wear.

- (e) The gearbox orientation for a waterworks butterfly valve, where possible shall be specified as being located on the left hand side of the valve when looking in the direction of the flow.

**NOTE:**

This represents the Corporation's preferred orientation in order to rationalise the gearbox configuration for supplier stocking and to minimise valve build times. If space limitations require the gearbox to be located on the right hand side of the valve that is acceptable however a gearbox of this configuration may not be stocked and consequently delivery times may be longer.

- (f) Butterfly valve installations shall be designed so that the valves are readily and safely accessible for operation and maintenance.
- (g) Waterworks butterfly valves are double flanged or to a lesser extent tapped ring type and therefore should be suitable as termination points providing they are rated for this purpose and the correct fasteners are used. In that event each pipe flange shall be separately bolted to its mating valve flange or ring e.g. long through bolts shall not be used.

**NOTE:**

There is a potential risk involving ring bodied valves as terminating valves if incorrect length setcrews (e.g. shorter than required) are used.

- (h) Gearboxes lubrication shall be grease packed for the life of the valve (e.g. Shell Alvania EP RO grease) and would not normally require re-lubrication unless lubricant leakage was evident. Submerged valve gearboxes shall be packed with water-resistant grease which should not break down (e.g. Castrol APXT).

### **30.4.5 Pre-commissioning**

Pre-commissioning verification of the valve shall comply with document WC-PC-M-001-R.

### **30.4.6 Commissioning**

Commissioning shall comply with the manufacturer's recommendations and the Corporation Asset Handover Guidelines.

## **30.5 Gate Valves**

### **30.5.1 Supply**

- (a) Transport handling and storage of the valves shall comply with the manufacturer's recommendations and the relevant Corporation strategic product specification.
- (b) Supply verification of the valve shall comply with document WC-SV-M-001-R.

### **30.5.2 Installation**

- (a) Installation of the valves shall be in accordance with the manufacturer's recommendations.
- (b) Flange bolting shall comply with DS 38-02.
- (c) Construction verification of the valve shall comply with document WC-CV-M-001-R.

### **30.5.3 Pre-commissioning**

Pre-commissioning verification of the valve shall comply with document WC-PC-M-001-R.

### **30.5.4 Commissioning**

Commissioning shall comply with the manufacturer's recommendations and the Corporation Asset Handover Guidelines.

## **30.6 Miscellaneous Valves**

Miscellaneous valves (in particular large control valves) shall comply with the following.

### **30.6.1 Supply**

Transport handling and storage of the valves shall comply with the manufacturer's recommendations and the relevant Corporation strategic product specification.

### **30.6.2 Installation**

- (a) Installation of the valves shall be in accordance with the manufacturer's recommendations and where relevant the requirements of this Standard.
- (b) Flange bolting shall comply with DS 38-02.

### **30.6.3 Pre-commissioning**

Pre-commissioning verification of the valve shall be conducted prior to formal commissioning.

### **30.6.4 Commissioning**

Commissioning shall comply with the manufacturer's recommendations and the Corporation Asset Handover Guidelines.

## **31 VIBRATION**

As part of the commissioning procedure and where relevant rotating machinery shall be checked to ensure that their vibration levels are acceptable. Vibration shall comply with the requirements contained in the Vibration section of DS 30-02.

## **32 WELDING**

Site welding shall comply with the requirements of the Welding section contained in DS 30-02 and WS-1.

**END OF DOCUMENT**