# STANDARD SPECIFICATION

## PIPING FABRICATION AND INSTALLATION

### SPEC – 00 – P – 02

<table>
<thead>
<tr>
<th>REV</th>
<th>DATE</th>
<th>DESCRIPTION</th>
<th>BY</th>
<th>APPROVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>17/07/97</td>
<td>Issued for comment</td>
<td>I.B.</td>
<td></td>
</tr>
<tr>
<td>T-0</td>
<td>11/01/2000</td>
<td>Minor revision</td>
<td>T&amp;R</td>
<td>JAC</td>
</tr>
<tr>
<td>T-1</td>
<td>14/01/2000</td>
<td>Issued to KCGM</td>
<td>T&amp;R</td>
<td></td>
</tr>
</tbody>
</table>


# TABLE OF CONTENTS

1.0 SCOPE ....................................................................................................................... 3

2.0 CODES AND STANDARDS........................................................................................... 3

2.1 AUSTRALIAN STANDARDS (AS)....................................................................................... 3

2.2 BRITISH STANDARDS ..................................................................................................... 3

2.3 AMERICAN STANDARDS (ANSI)...................................................................................... 3

3.0 DEFINITIONS ................................................................................................................. 3

4.0 ABBREVIATIONS .......................................................................................................... 4

5.0 ENVIRONMENTAL CONDITIONS................................................................................. 4

6.0 DESIGN DETAIL ............................................................................................................ 4

6.1 GENERAL ...................................................................................................................... 4

7.0 FABRICATION/MANUFACTURE.................................................................................. 4

7.1 GENERAL ...................................................................................................................... 4

7.2 SHOP FABRICATION ................................................................................................... 5

7.3 PREPARATION FOR WELDING ......................................................................................... 7

7.4 THREADDED CONNECTIONS ............................................................................................. 8

7.5 FLANGED CONNECTIONS ................................................................................................ 8

7.6 BRANCH CONNECTIONS ................................................................................................. 9

7.7 COLD BENDING ............................................................................................................. 9

7.8 MITRE BENDS ............................................................................................................... 9

7.9 PREHEAT AND HEAT TREATMENT ................................................................................. 10

7.10 PIPE SUPPORTS .......................................................................................................... 10

7.11 MATERIAL AND PIPE SPOOL IDENTIFICATION ................................................................. 10

7.12 STORAGE AND HANDLING OF PIPING MATERIALS AND PIPING SPOOLS .......11

8.0 FACTORY ACCEPTANCE, INSPECTION AND TESTING......................................... 12

8.1 INSPECTION ................................................................................................................ 12

8.2 REPAIR OF DEFECTS ................................................................................................... 12

8.3 SHOP TESTING ............................................................................................................ 12

9.0 INSTALLATION, ERECTION, CONSTRUCTION........................................................ 12

9.1 GENERAL REQUIREMENTS ........................................................................................... 12

9.2 INSTALLATION OF VALVES .......................................................................................... 13

9.3 PIPING FOR ROTATING EQUIPMENT .............................................................................. 14

9.4 FLANGED JOINT BOLT TORQUE .................................................................................... 14

9.5 PIPE SUPPORTS .......................................................................................................... 15

9.6 INSULATED PIPING ....................................................................................................... 15

9.7 STAINLESS STEEL PIPING ............................................................................................ 15

9.8 PLASTIC PIPING............................................................................................................. 16

9.9 LINED PIPING (RUBBER, POLURETHANE AND PTFE LINING) ......................................... 16

9.10 UNDERGROUND PIPING ............................................................................................. 17

9.11 GALVANISED PIPING ................................................................................................ 18

9.12 MINING HOSE ............................................................................................................ 18

10.0 COMMISSIONING (INCLUDES INSPECTION AND TESTING) ................................. 18

10.1 PRESSURE TESTING ................................................................................................... 18

10.2 CLEANING AND RE-instatement ................................................................................. 22
1.0 SCOPE

This specification defines the general requirements for shop and site fabrication, installation and testing of piping for all Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) plants.

2.0 CODES AND STANDARDS

All materials and workmanship shall comply with the applicable provisions of the latest issue of the relevant codes and standards which shall include the following.

2.1 Australian Standards (AS)

- AS1281 Cement Mortar Lining of Steel Pipes and Fittings
- AS1554 SAA Structural Steel Welding Code
- AS1650 Hot Dipped Galvanised Coatings on Ferrous Articles
- AS1722 Pipe Threads
- AS2032 Code of Practice for Installation of UPVC Pipe Systems
- AS2033 Installation of Polyethylene Pipe Systems
- AS2129 Flanges for Pipes, Valves and Fittings
- AS2634 Chemical Plant Equipment made from Glass-fibre Reinforced Plastics (GRP) Based on Thermosetting Resins
- AS2832.1 Guide to Cathodic Protection of Metals: Pipes, Cables and Ducts
- AS4041 Pressure Piping
- AS4130 Polyethylene Pipes for Pressure Applications

2.2 British Standards

- BS6374 Part 5: Lining of Equipment with Polymetic Materials for the Process Industry

2.3 American Standards (ANSI)

- ANSI/ASME B16.5 Butt Welding Ends
- ANSI/ASME B31.3 Chemical Plant and Petroleum Refinery Piping
- ANSI/ASME B1.20.1 Pipe Threads General Purpose (Inch)

Fabrication of piping in the shop and at work sites shall comply with the Local Government Regulations including Safety and Health (DOMEWA) requirements. Fabrication and installation of piping at work sites shall also comply with the KCGM Supersafe and Mines Act requirements.

3.0 DEFINITIONS

- Piping or Pipework: Shall mean all pipe lengths, fittings, supports, clamps, valves, flanges and in-line speciality items such as strainers.
- Shop Fabrication: The fabrication of pipe spools in a workshop which may be located on the Contractor’s premises or at the work site.
4.0 ABBREVIATIONS

ANSI American National Standards Institute
AS Australian Standards
ASME American Society of Mechanical Engineers
ASTM American Society for Testing Materials
BS British Standards
FRP Fibre Reinforced Plastic
GRP Glass fibre Reinforced Plastic
GTAW(TIG) Gas Tungsten Arc Welding (Tungsten Inert Gas)
NPT National Pipe Taper Threads
P&ID’s Process and Instrument Diagrams
PE Polyethylene
ppm Parts Per Million
PTFE Polytetrafluoroethylene
UPVC Unplasticised Polyvinyl Chloride

5.0 ENVIRONMENTAL CONDITIONS

The ambient temperature, relative humidity and other climatic conditions shall be as notified for the Kalgoorlie-Boulder district. Refer to KCGM Specification 00-G-04 for Site conditions.

6.0 DESIGN DETAIL

6.1 General

Any detailed design eg., marking of spools on the piping plan drawings, shall be completed prior to fabrication of spools.

7.0 FABRICATION/MANUFACTURE

7.1 General

Work shall be carried out in accordance with AS4041 and good engineering practice by qualified trades persons.

The work shall be properly documented and records prepared and continuously updated as necessary, for the proper execution and control of fabrication and installation, in accordance with this specification.

All materials shall be in accordance with Specification 00-P-01 and the piping class specified.
The linear dimensional tolerances for pipe fabricated spools shall be as follows:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>LINEAR TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length Less than 1.5m</td>
</tr>
<tr>
<td>End to End</td>
<td>±1.5mm</td>
</tr>
<tr>
<td>Centre to End</td>
<td></td>
</tr>
<tr>
<td>Centre to Flange Face</td>
<td></td>
</tr>
<tr>
<td>Flange Face to Flange Face</td>
<td></td>
</tr>
</tbody>
</table>

These tolerances apply to each stated drawing dimension and are not cumulative.

### 7.2 Shop Fabrication

#### 7.2.1 Workshop Requirements

Adequate under cover workshop facilities shall be provided. Ample storage, handling, machining and testing facilities shall be provided to ensure a safe, efficient and continuous piping spool fabrication of high quality under all weather conditions for the preparation for welding, assembly and testing. The surface preparation and painting of the piping spools shall be done in a separate area.

An area shall be provided for non-destructive testing. The area shall be located at a safe distance from the piping spool fabrication area to conduct radiographic inspection without interrupting the piping spool fabrication. The area shall comply with all statutory and safety requirements.

#### 7.2.2 Stainless Steel

Direct contact between carbon steel and stainless steel is not permitted. Tools containing carbon steel and grinding discs containing carbon steel particles shall not be used on stainless steel.

Tools used for fabrication of stainless steel shall be clearly identified.

Tools to be used only for fabrication of stainless steel piping and piping components shall be stored separately to avoid accidental switching with tools previously used on carbon steel fabrication work.

#### 7.2.3 Progress Control

Progress control and planning documentation shall be maintained to plan, control and report all facets of the piping spool fabrication and shall include but not be limited to the following:

- Preparation of piping spool drawings
- Material availability per spool
- Surplus and/or shortages per spool
- Shop fabrication progress per spool
- Lining of spools, if required
- Inspection
- Testing of spools, if required
- Non-destructive examination
- Weld repair and rework
- Revisions to isometric drawings
- Hot dipped galvanising
- Surface preparation and coating
- Shipping records

Procedures and documentation for the control, reporting and recording of spool fabrication shall be submitted to the Owner’s Representative for approval prior to commencement of the work.

### 7.2.4 Spool Sizes

Length, height and width of the completed spools shall be within the limits of road transport unless specifically requested otherwise by the Owner’s Representative.

### 7.2.5 Galvanised Piping

Galvanised piping and fittings DN 80 and larger shall be fabricated as flanged spools then hot dipped galvanised in accordance with AS1650. Pipe spools shall be pressure tested prior to galvanising.

Pipe fittings shall be abrasive blasted internally prior to fabrication and galvanising.

Piping spools shall be easily identifiable by drawing and spool number.

### 7.2.6 Painting the Spools

Shop fabricated spools, except galvanised and stainless steel spools shall be shop painted in accordance with Specification 00-G-05.

Prior to welding, remove supplier applied coating for a margin of 50mm from each shop weld joint. Paint all uncoated surfaces of the spool immediately after all non-destructive testing of the welds has been completed. Stainless steel shall not be painted.

Flange gasket faces shall be protected against damage and paint deposits during blasting, cleaning, surface preparation and painting.

Pipe spools shall remain identifiable at all times during blasting, cleaning, surface preparation and painting.
7.3 Preparation for Welding

7.3.1 General Requirements

Welding shall be in accordance with AS4041.

Cutting of pipe may be done either by mechanical means or by flame cutting, depending on the type of material to be cut. For carbon steel, flame or arc cutting and bevelling is acceptable only if the cut is reasonably smooth and true, and all oxides are removed from the flame cut surfaces by grinding. After flame cutting, the bevel end preparation shall be ground back to bright and sound metal.

For stainless steel pipe, plasma cutting and grinding back to bright sound metal is required if the pipe ends cannot be machined. Flame cutting is not allowed.

All welding areas shall be adequately protected against inclement weather conditions such as rain, wind, dust and the like.

All weld end preparations and adjacent areas 50mm either side of the weld shall be thoroughly cleaned and degreased prior to welding.

Welding procedures and qualification tests shall be submitted to the Owner’s Representative for approval.

Use of permanent backing rings is prohibited. Consumable inserts shall not be used.

End preparation for butt welding shall be in accordance with AS4041.

A straight run of pipe shall contain the minimum number of welds.

Defective or damaged weld ends (bevels) shall be examined and repaired. Use of hot or cold hammering as a means for repair is prohibited.

The root pass of all groove welds, of compressor suction and lube oil piping which is accessible from one side only, shall be welded using GTAW.

7.3.2 Misalignment Tolerance

All piping fit-ups shall be subjected to the following bore misalignment tolerance.

Components with Equal and Unequal Inside Diameters

(1mm difference)

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>Misalignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 150 and smaller</td>
<td>1mm</td>
</tr>
<tr>
<td>DN 200-300</td>
<td>2mm</td>
</tr>
<tr>
<td>DN 350 and larger</td>
<td>2.5mm</td>
</tr>
</tbody>
</table>

NOTE: Misalignment should be minimised wherever possible by rotating the pipe/fitting for best fit and/or by grinding the bore as required.
7.3.3 **Slip on Flanges**
Slip on flanges shall be positioned so that the end of the pipe is recessed from the flange, a distance equal to the pipe wall thickness plus 1.5mm, or 6.4mm, whichever is the lessor. Seal welding for slip on flange shall be carefully applied in order to avoid refacing the flange.
Pipes for insertion in slip-on flanges shall be cut square, within 0.5mm.

7.3.4 **Socket Weld**
Pipe for insertion in a socket weld joint shall be cut square within 0.5mm. A minimum gap of 1.6mm shall be maintained between the end of the pipe and the bottom of the socket.

7.3.5 **Valves**
Because of the possibility of seat distortion due to welding heat, valve stems shall be in the open position prior to commencement of welding. This is applicable to all valve types and sizes except large swing check valves.

7.4 **Threaded Connections**
Unless otherwise specified, all threads shall be in accordance with AS1722 (taper threads).
Inside ends of threaded pipes shall be deburred by reaming.
All threaded connections shall be gauge-checked or chased after galvanising.
Threaded connections shall not be seal welded.
Threaded joints in piping system shall be made up using PTFE pipe tape or thread seal compound installed on the male thread.

7.5 **Flanged Connections**
Unless otherwise indicated on the drawings, the bolt holes of all flanges shall be offset to vertical and horizontal centre lines. The maximum angular deviation of bolt holes shall not exceed 1.5mm measured across the bolt pitch circle.
The flange faces shall be square to the pipeline in which they are fitted. Maximum deviation of flange face alignment measured at flange outside diameter from the design plane shall not exceed the following, when measured in any radial direction.

<table>
<thead>
<tr>
<th>Pipe Diameter Nominal</th>
<th>Maximum Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN up to 100mm</td>
<td>1.0mm</td>
</tr>
<tr>
<td>DN 150mm to 500mm</td>
<td>1.5mm</td>
</tr>
<tr>
<td>DN 600mm to 900mm</td>
<td>2.5mm</td>
</tr>
<tr>
<td>DN 950mm and over</td>
<td>3.0mm</td>
</tr>
</tbody>
</table>

Flanged connections to equipment supplied with raised face flanges shall have raised faced mating flanges and flat-faced flanges shall have flat faced mating flanges.
Shop fabrication of flanged spool pieces for connection to existing pipework or equipment, shall have the mating flange tack welded to the spool and an additional allowance of 100mm of pipe shall also be provided for the correct field fitment.

7.6 Branch Connections

Branch connection requirements shall be in accordance with AS4041.

Branch reinforcement shall be as indicated on the drawings. Reinforcement material shall be made from the same pipe material as specified by the relevant piping class and subject to the same specification requirements as the piping to which it is attached.

All cuts shall be carefully bevelled and accurately matched to form a suitable preparation for welding and to permit full penetration of welds between the branch and the run pipe at all points.

All reinforcement pads for pressure openings, or each segment of built-up type reinforcement pads for pressure openings, shall be provided with 6mm NPT threaded hole for testing and venting. The vent hole shall be sealed after completion of the pressure test with grease or silicon sealant to prevent ingress of moisture.

Branch connections, vent nozzles, trunnions and other attachments including reinforcing pads shall not be welded over or near longitudinal or circumferential welds in the piping. The minimum distance from a longitudinal or circumferential weld to the next weld shall be 50mm measured between the heat affected zones. For reinforcing pads, the minimum distance measured between the heat affected zones of the weld in the pipe and fillet weld of the pad shall be 25mm.

7.7 Cold Bending

Pipe DN 40 and smaller shall be bent only where cold bending is indicated on the piping drawings. In all other cases, butt weld, socket weld or screwed elbows shall be used depending on the piping class.

Cold bending shall be carried out using pipe bending machines, or presses provided that dies are employed to prevent flattening.

Unless otherwise noted, the centre line radius of bends shall be five (5) nominal pipe diameters. Butt welds in the arcs of bends or for the addition of pulling legs shall not be permitted.

Bending shall not reduce the pipe wall thickness below the minimum wall thickness required for the design temperature and pressure plus any corrosion allowance.

All bends shall be smooth, free from cracks and surface defects, without buckles and they shall be within tolerance limits allowed by AS4041.

7.8 Mitre Bends

Segmented bends shall be manufactured by butt welding together segments of pipe, shaped to produce the required bend. Wherever possible, the segments shall be taken from the same length of pipe. However, the use of segmented bends shall be limited to applications detailed on the piping drawings.
The change of centreline at butt welds in segmented bends shall not exceed 30°.

7.9 Preheat and Heat Treatment
Preheat and interpass temperature control and heat treatment shall be in accordance with AS4041.

7.10 Pipe Supports
Install all pipe supports, anchors, guides and other support attachments in accordance with the details on the drawings. Pipe supports shall also be fabricated in accordance with the drawings whenever required.

Welding preparations for the pipe to pipe supports shall be in accordance with AS4041. Structural steel welding for pipe supports shall be in accordance with AS1554.

All pipe supports shall be individually identified by number and this number shall be marked on the piping layout plans.

All pipe supports and attachment welds to the pipe shall be welded in accordance with the same welding procedure as used for the piping class.

Temporary supports shall be used during pipework installation to prevent overstressing the pipe work. These temporary supports are to be removed from site after completion of installation.

7.11 Material and Pipe Spool Identification
All pipes and fabricated fittings shall be marked on their outside with letters and numbers defining their respective locations and duties.

Markings by welding shall not be allowed. Markings shall be done by permanent ink markers that are not health hazardous. Chloride free markers shall be used for stainless steel.

Piping spools shall be marked/stamped after fabrication and prior to corrosion protection.

Drawing number and spool number shall be hard stamped on the rim of the flange of a flanged fabricated spool. For non-flanged fabricated spools, markings shall be hard stamped on the bevel edge of the fitting for thick walled fittings and at least 50mm away from the bevel edge for thin walled fittings. All markings shall be hard stamped using a low stress die.

In addition, metal tags stamped with drawing number and spool number shall be securely tied to each spool.

Stampings on the spools shall be suitably masked prior to blasting.

After painting, the drawing number and spool number shall be stencilled on the outside surface of the spool with a permanent ink marker that is compatible with the paint on the spool and is not a health hazard. For stainless steel spools, markers shall be chloride free.

For pipework where traceability is to be maintained, piping materials shall be marked and identified by heat number and material specification throughout fabrication and installation. Identifications shall be maintained both on the pipe sections used for fabrication as well as on pipe off-cuts. Identifications for spool components and spools shall be as described earlier.
Material identification shall be maintained throughout the fabrication, installation and up to and including final inspection.

7.12 Storage and Handling of Piping Materials and Piping Spools

7.12.1 General Storage Requirements

All piping components shall be stored in a clean area away from the fabrication and construction activities and handled such that no damage nor mixing of materials occurs. Materials shall be stored on pallets and not on the ground. End caps shall be kept on all components. Threaded ends shall be protected by end caps.

Surfaces of piping components shall be kept free of foreign materials such as grease, paint, oil and the like.

Hooks or chains shall not be used for lifting. Pipes shall not be rolled off transport vehicles, dropped onto the ground, or dragged over the ground.

Valves shall be stored with spindles in vertical positions. Relief valves shall be stored upright in a clean area.

Flange facings shall be protected from damage. Covers shall be securely fastened to flange facings during handling, transportation and storage at site.

Partly installed piping components and spools shall be protected at all times from ingress of moisture or foreign matter, by covering and taping.

7.12.2 Stainless Steel Materials

Storage and handling of stainless steel piping components shall be as follows:

- Stainless steel materials shall be stored on non-metallic pallets.
- End caps shall be kept on piping components.
- All flanges and flanged connections shall be sealed with blinds to prevent ingress of water, moisture and foreign matter. Threaded ends shall be capped with plastic cap and sealed.
- Stainless steel piping and components shall be stored in separate areas away from storage areas for carbon steel and other materials to avoid direct contact between carbon steel and stainless steel.
- Steel wire slings shall not be used for handling and transportation of stainless steel pipes. Canvas or nylon slings shall be used.
- The surfaces of components shall be cleaned with ‘acetone’ and then rinsed with demineralised water to remove deposits of foreign materials.

7.12.3 Lined Steel Pipes

Storage and handling of lined steel pipes requires special arrangements and shall be as follows:

- Pipes and piping components shall be handled in such a way that the lining and other materials are not damaged.
- Lined pipe shall be stored under cover to protect it from high atmospheric temperatures (40°C and over).
• Provide 20mm bolted plywood flange covers.

8.0 FACTORY ACCEPTANCE, INSPECTION AND TESTING

8.1 Inspection
All fabrication shall be inspected in accordance with AS4041 and this specification.

Inspection and Test Plan (ITP) shall be submitted for written approval of the Owner’s Representative.

Inspection shall include 100% visual examination and any other additional examination necessary to ensure compliance with this specification. NDT and pressure test records shall be submitted to the Owner’s Representative for approval.

Inspection and testing shall be carried out before any painting or coating is applied.

Non-destructive test of welds shall be carried out after any final heat treatment is completed.

Tolerances specified in Section 7 for Fabrication and Section 9 for Installation work shall be complied with.

8.2 Repair of Defects
Repairs to welded joints, defective or damaged pipe and fittings or any other pressure part shall not be carried out without written approval of the Owner’s Representative and shall be shown as a hold point in the ITP.

Repair procedures shall be approved by the Owner’s Representative prior to commencement of work.

If repairs or modifications are carried out after heat treatment has been completed, the areas affected by the repair or modification shall be heat treated again.

8.3 Shop Testing
Pressure testing in the shop shall be carried out in accordance with Section 10.1 of this specification.

9.0 INSTALLATION, ERECTION, CONSTRUCTION

9.1 General Requirements
All piping shall be installed in accordance with the drawings. Flanges or unions shall be installed to allow installation, removal or maintenance of equipment or valves.

Modifications to pipe routing may be necessary at site to avoid interference. These modifications shall be carried out in accordance with AS4041 and Section 8 of this Specification in a neat and workmanlike manner and shall be reflected on “as-built” drawings.

Straight run pipe shall not be pulled through the pipe racks, unless supported on rollers.

Extreme care shall be taken during handling and erection of expansion joints. Shipping rods shall remain in place until erection is complete but
must be removed immediately after the expansion bellow is installed. Proper care shall be taken to prevent ingress of moisture or dirt into the expansion joint during erection.

A straight run of pipe shall contain the minimum number of welds. The use of off-cuts in straight piping runs shall be avoided. Piping butt welds shall be spaced a minimum of 50mm or four times the thinnest wall thickness measuring between the heat affected zones, whichever is greater.

Cold springing or forcing of piping for the purpose of joint make up is not permitted unless specified on the drawings.

Misalignment beyond acceptable tolerances in straight pipe runs shall not be permitted. Seam orientation of welded straight pipe and pipe to fittings shall be such that at circumferential welds, the longitudinal welds shall be staggered over the top of the centre line, preferable 30° left and 30° right of the Centre line. The minimum distance between the staggered joints shall be 50mm or six times the thinnest pipe wall thickness measured between heat affected zones, whichever is greater. Care shall be taken to ensure that longitudinal welds clear branch connections.

Pipes passing through concrete walls or floors shall not be cast in. Pipe shall be passed through cast in sleeves or standard weight pipe having an internal diameter large enough to give 12mm radial clearance to the passing flange, including its lagging, where applicable, and shall have a light infill if air passage is to be restricted.

Where pipework passes through floor plate floors and grid mesh, a 75mm high collar having an internal diameter large enough to give minimum 25mm clearance to passing flange shall be welded to the floor plate/mesh to prevent chaffing and promote safety.

Erection of pipework using Victaulic couplings or similar shall be in accordance with the Supplier’s recommendations.

A methodology statement shall be provided for site fabrication and installation of piping to the Owner’s Representative for approval.

### 9.2 Installation of Valves

Valves shall be installed with stems orientated as indicated on piping drawings. Hand wheels and levers shall be easily accessible for operation from grade or platform.

Valves shall not be installed with their stems projecting into walkways. All valves located underground or in trenches shall be provided with valve boxes and extension stems as shown on drawings.

Relief valves shall be installed in an upright position and accessible from a platform or grade. Relief valves or scour valves discharging hazardous liquids or gases, shall be piped to a safe and environmentally acceptable location.

Chain wheel operators shall be provided for valves with handwheels more than 2,050mm above the operating level. Chains shall clear operating floors by 900mm and shall not hang in access areas.
9.3 **Piping for Rotating Equipment**

Pump and compressor piping shall be installed up to a break point between the nearest pipe support and the equipment. The remainder of the piping shall be site measured, fabricated and properly fitted between the equipment nozzle and its break point. It is essential that this is done accurately in order to avoid any external loadings on the equipment connections.

Piping shall be disconnected from the equipment after installation to demonstrate that no stress has been transferred from piping to equipment, and then reinstalled.

Carbon steel compressor suction lines shall be pickled to ensure the internal surfaces of the pipework are free from rust.

The following procedure shall be applied for the alignment of flanges to rotating equipment:

- Install, bolt down on shims and grout rotating equipment level on the foundation. Driver to equipment alignment to be set within manufacturer’s tolerances.

- Align pipework to equipment flanges to within the Supplier’s tolerance and in accordance with this specification.

Recheck the coupling alignment during the bolting and tensioning of the pipe flanges to the equipment flanges. The bolting up and tensioning of the flanges shall not affect the coupling alignment between the driver and driven equipment.

9.4 **Flanged Joint Bolt Torque**

When bolting gasketed flanged connections, the gasket shall be uniformly compressed to the minimum torques as per table below:

<table>
<thead>
<tr>
<th>RECOMMENDED BOLTING TORQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOLT SIZE inch</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>1/2</td>
</tr>
<tr>
<td>5/8</td>
</tr>
<tr>
<td>3/4</td>
</tr>
<tr>
<td>7/8</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1 1/8</td>
</tr>
<tr>
<td>1 1/4</td>
</tr>
<tr>
<td>1 3/8</td>
</tr>
<tr>
<td>1 1/2</td>
</tr>
<tr>
<td>1 5/8</td>
</tr>
<tr>
<td>1 3/4</td>
</tr>
<tr>
<td>1 7/8</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Stud bolts of diameter 40mm and larger shall be tightened by torque wrenches or other tightening methods which result in uniform tightening of the flanges.
Bolt torques for valves and lined piping shall be in accordance with the Suppliers recommendations.

Flanged connections shall be tightened sequentially diagonally opposite in a clockwise or anticlockwise order so that an even gasket seating results.

Flanged spools mating with equipment flanges shall be site fitted for correct alignments to ensure that no stress or load is placed on the equipment and the spool flange shall then be fully welded in accordance with the requisite welding procedure.

Before flanged pipe spools are connected to pressure vessels, heat exchangers and flanged equipment, inspections shall be carried out by loosening up to 10% of flanged or union joints to the equipment to ascertain that no stress is placed on equipment due to misalignment.

The finish of gasket faces shall be in accordance with AS4041. The surface of flange gasket face shall be free from rust, weld spatter, scars, paint, dents, arc strikes, corrosion pitting and other imperfections.

All flange connections shall be made using fully threaded stud bolts and nuts. A minimum of one and a maximum of three complete threads shall protrude from the nut after completion of tightening.

Insulating gaskets shall be installed when shown on the piping drawings. Care shall be taken not to damage the bolt sleeve and gaskets when installing insulation gaskets.

Bolts and nuts shall be protected by an anti seize compound.

9.5 **Pipe Supports**

Piping shall be supported, guided and anchored, as per the piping and support detail drawings. Temporary supports are permitted to facilitate piping installation provided they shall be completely removed upon completion. Attaching temporary supports to pipes by welding is not permitted.

Piping shoes and sliding pipe support attachments shall be centred over the concrete or steel support beams before any field welding or bolting to the pipe is carried out.

9.6 **Insulated Piping**

For pre-insulated piping or piping with shop applied insulation every precaution shall be taken that insulated parts remain weatherproofed at all times during storage, handling and erection to prevent moisture from entering behind or into the insulation materials.

9.7 **Stainless Steel Piping**

Special precautions shall be taken during stainless steel piping erection in close vicinity of carbon steel piping. Direct contact between stainless steel and carbon steel is not permitted. Carbon steel blinds, spades and caps shall not be used for stainless steel pipe and components.

Stainless steel clamps and U-bolts shall be used for supporting stainless steel piping.

Stainless steel or PTFE spacer strips of adequate size shall be installed in areas where stainless steel piping rests on carbon steel supports.
9.8 **Plastic Piping**

The installation and testing shall be in accordance with the following:

- Polyethylene Pipe (PE) for pressure applications to AS2033, AS4130
- UPVC piping to AS2032
- FRP/GRP piping to AS2634

The installation and testing of all other plastic piping shall be in accordance with this specification.

Polyethylene pipe connections shall be made using compression fittings or butt weld fittings or using mechanical joint fittings in accordance with Specification 00-P-01. Backing rings shall be installed when plastic (PE) pipe flanges are connected to valves. PE spacers shall be used when wafer type butterfly valves are used, to ensure free movement of the disc.

PE piping shall be laid so that it is capable of operating between the maximum and minimum service temperatures. There shall be sufficient excess length between anchors to allow for expansion and contraction. Adequate allowances shall ensure that no excessive residual stresses remain in the piping prior to or after start up of plant operations. Where excessive expansion is expected, adequate flexibility shall be allowed.

Piping shall be suitable anchored in accordance with the standard drawings. Anchoring plastic pipes by clamping with saddles or U-bolts is not acceptable.

U-bolt guides with two lock nuts shall be loosely clamped to allow free movement of the pipe during expansion and contraction.

UPVC pipe connections of the socket cement current type shall be made using solvent cement as recommended by the Supplier. Threaded joints shall use teflon tape or thread seal compound on male threads only.

In slurry service, pipes shall be flanged at least every twenty (20) metres. In solution service, pipes shall be flanged at least every forty (40) metres, unless specified otherwise. Spools may be prefabricated in convenient lengths for installation.

All fittings in the slurry service shall be flanged. Spools in solution service may be prefabricated in convenient lengths. Piping shall be protected against chafing.

9.9 **Lined Piping (Rubber, Polyurethane and PTFE Lining)**

Flanged spools shall be fabricated and lined in accordance with the relevant Codes and Supplier’s recommendations. The lining shall cover the face of the flange. Rubber lining shall cover full face of flange and polyurethane lining shall extend up to the inside of bolt holes. Bends and elbows shall have flanged ends. Flanged spools shall be transported to the work site and erected in accordance with the Supplier’s recommendations and relevant codes. Refer to drawings for rubber, polyurethane and PTFE lined pipes and fittings.

Make up pieces shall be site measured, fabricated, lined and then erected at site ensuring that no external loadings are exerted on the equipment or mating flanges.
For rubber lined flanged joints, gaskets shall not be used. However, for frequently dismantled joints 1mm PTFE full-face gaskets shall be used to prevent bonding of rubber. For polyurethane and PTFE lined flanged joints, gaskets shall not be used.

Bolt torque for flanged joints shall be in accordance with the Supplier’s recommendations.

Repairs to damaged lining shall be done by cutting the affected area to the base metal and relining the affected area in accordance with the procedure employed for the original lining. Repair procedure shall be a hold point of the ITP and shall be submitted to the Owner’s Representative for approval prior to commencing work.

9.10 Underground Piping

All exterior surfaces of underground steel piping, fittings and valves shall be coated and wrapped.

The external surfaces of steel pipe and fittings to be coated and wrapped, shall be clean, dry and free of any oil and grease.

Wrapping material shall be polyvinyl chloride pressure sensitive tape or approved equivalent 0.5mm thick. Widths shall be 50mm for pipe diameter up to 50mm; 100mm for pipe diameter 8mm to 200mm and 150mm for pipe diameter 250mm and larger.

Tape shall be spirally wrapped on the steel pipe and fittings starting on the mill coating 80mm from the edge using 12mm overlap and extending 80mm over the adjacent mill coating.

Underground pipework shall be laid in trenches. Trenches shall be of suitable width and generally 300mm deep except at vehicle traffic locations where the trench shall be 600mm deep. Pipe shall be laid on a sand bed and backfilled with suitable back filling material approved by the Owner’s Representative.

Piping and fittings shall be inspected for defects prior to lowering into the trench.

Coated and wrapped steel pipes shall be laid directly on the trench bottom by lowering the pipe carefully into the trench using canvas or leather slings to ensure protective coating is not damaged.

Any damage to the coating during installation shall be repaired immediately. When repairing damaged coatings the wrapping in the defective area shall first be removed and the pipe re-wrapped in accordance with the coating and wrapping procedure.

After inspection (visual and electronic) and all testing is complete, the trench shall be back filled and compacted in accordance with the Owner’s Representative’s instructions.

Recommended voltage for the detector shall be approximately 400 volts for each 100 microns thickness.

Cathodic protection, if required, shall be provided in accordance with AS2832.1.
9.11 **Galvanised Piping**

Pipe and fittings DN 50 and below shall be supplied galvanised with screwed ends in accordance with Specification 00-P-01 and shall be site run.

Pipe DN 80 and larger shall be shop fabricated and hot dipped galvanised in accordance with AS1650.

If any modifications are required to galvanised spool DN 80 and over during installation, the spool shall be modified and hot dipped galvanised again. For minor modifications and repairs, the spool may be cold galvanised. Procedure for cold galvanising shall be submitted for the Owner’s Representatives approval and shall be a hold point.

9.12 **Mining Hose**

The hoses shall be stored in a cool dry location away from direct sun light and high temperatures.

Mine hoses shall be handled carefully. Nylon slings shall be used and properly placed while handling mining hoses in order to support the hose properly. The hose shall not be kinked while handling and erecting. A minimum bend of 10 D shall be used. The hose shall not be dragged over sharp or abrasive surfaces.

10.0 **COMMISSIONING (INCLUDES INSPECTION AND TESTING)**

10.1 **Pressure Testing**

10.1.1 **Test Requirements**

Pressure testing shall be carried out in accordance with the requirements of AS4041, AS4130 and this specification.

Pressure piping includes all piping designed to convey or contain process or utility fluids at either a positive or negative internal pressure and shall be tested as follows:

- Shop hydrostatic testing of piping spools shall not be required, unless specified on the drawings.
- Shop hydrostatic testing is required for galvanised piping spools. The spools shall be hydrostatically tested prior to galvanising.

Pressure piping shall be either hydrostatically or pneumatically tested in accordance with this specification.

The test pressures shall be 1.5 times the normal working pressures which are designated for the class of piping in Specification 00-P-01.

Open-ended vent, drain and similar piping systems operating at atmospheric pressure are not considered as pressure piping and shall not be pressure tested but shall be leak tested by filling the lines with water.

Piping systems to be tested shall be divided into sections referred to as ‘test sections’.
‘Test sections’ documentation shall contain isometrics or relevant sections of pipework related to the section of piping system that is being tested and shall include the following information:

- Limit of test as illustrated on the P&ID’s
- Location and thickness of test spades
- Test medium
- Test pressure
- Location of vents and drains
- Requirements for isolation or removal of in-line equipment and instruments.

Testing procedure shall be submitted to the Owner’s Representative for approval.

Reinforcing pads shall be tested with air at 34 kPa gauge (5 psig). All weld surfaces on the inside and outside shall be swabbed with a leak testing solution. After testing is complete, the vent hole shall be plugged with grease or silicon sealant. A record of all reinforcing pad tests shall be maintained.

Short pieces of pressure piping which must be removed to permit installation of test blinds shall be tested separately.

Flanged connections at points where blinds are used during pressure tests do not require separate tests after test blinds have been removed. Screwed and socket weld connections shall be inspected thoroughly after make-up to assure tightness.

Re-testing of any ‘cut in’ or repair work into a line already tested, shall generally be carried out to the same procedure and test pressure as the original test.

Testing shall be carried out in the presence of the Owner’s Representative. Records of all pressure tests shall be maintained.

Ensure that the insides of all pipes, valves, fittings and other associated equipment are clean and free from loose foreign matter prior to commencement of the pressure test.

Normally, equipment shall be isolated from the test section. However, where equipment which could be damaged by foreign debris is included in a test section, temporary in-line strainers shall be installed.

The bench testing of pressure relief valves is not covered by this specification.

10.1.2 Test Media

For hydrostatic testing of carbon steel piping systems, test medium shall be potable water at ambient temperature with pH value between 6 and 7.

For hydrostatic testing piping systems of austenitic stainless steel test medium shall be demineralised water with a chloride content of maximum 1ppm and pH between 6 and 7. Water shall be drained immediately after completion of hydrostatic testing and the system dried out to avoid concentration of chlorides. For hydrostatic testing of piping systems with
high nickel content, the water used shall be checked for possibility of
generation of hydrogen sulphide (H₂S) during the test.
A report on water analysis including the chloride content and pH value of the
water shall be attached to the test report at all times when austenitic
stainless steel systems are hydrotested.
Saline water can be used for testing of PE or UPVC pipework.

10.1.3 Pneumatic Testing

Pneumatic testing of a piping system is not permissible unless prior approval
is obtained from the Owner’s Representative.
Pneumatic test shall be performed in accordance with AS4041 and the
additional requirements of this specification.
- Test medium: Dry nitrogen or clean and dry oil free air.
- Area of test to be roped off and access into the area to be limited.
- The minimum metal temperature during a pneumatic test of piping shall
not be less than the temperature required by the engineering design.
- Piping system to be tested shall be protected by a relief valve.
  Set pressure of relief valve: Test pressure plus the lesser of 70 kPa
  or 7% of the test pressure.
- Weak soapy water shall be used for testing leaks in the joints.

10.1.4 Test Duration

Unless otherwise specified, test pressure shall be held for a minimum period
of one (1) hour to enable thorough inspection of the piping system of piping
components for leaks.

10.1.5 Preparation for Testing

All joints in a test section shall be accessible during tests and shall not be
painted, insulated, backfilled or otherwise covered until satisfactory
completion of testing in accordance with this specification.
All vents and other connections which can serve as vents shall be open
during filling so that all air is vented prior to applying test pressure to the
system. Test vents shall be installed at high points.
Equipment which is not to be subjected to pressure test shall be either
disconnected from the piping or blocked off during the test. Safety valves
and control valves shall not be included in site pressure testing.
Temporary spades and blanks installed for testing purposes shall be
designed to withstand the test pressure without distortion. Presence of
spades shall be clearly visible during testing.
All control valves shall be removed or replaced with temporary spools or
blinded off during pressure testing.
Check valves shall have the flap or piston removed for testing, where
pressure can not be located on the upstream side of the valve. The locking
device of the flap pivot pin shall be reinstated together with the flap and a
new cover gasket shall be installed after completion of the test.
Spring supports shall be restrained or removed and expansion bellows removed during hydrostatic testing.

Drain points for fluid disposal after testing, shall be provided.

Care shall be taken to avoid overloading any parts of the supporting structures during hydrostatic testing.

Piping which is spring or counterweight supported shall be blocked up temporarily to a degree sufficient to sustain the weight of the test medium. Holding pins shall not be removed from spring supports until testing is completed and the system is drained.

Pressure in the system shall be introduced gradually until the pressure is the lesser of one-half of the test pressure or 170 kPa gauge. Maintain pressure for 10 minutes and then gradually increase pressure in steps of one tenth of the test pressure until the test pressure is attained.

10.1.6 Test Equipment

Equipment to be used during testing shall have suitable capacity for the range of test pressures required. All pressure gauges and chart recorders shall have been calibrated within 60 days prior to testing and shall have current calibration certificates. The gauges shall be of a minimum face size of 150mm in diameter and ranged to approximately twice the test pressure.

A minimum of two gauges shall be provided for each test system. One gauge shall be located at the highest point and the other at the pump or at grade.

10.1.7 Completion of Testing

Pressure test shall be considered complete when:

- All defective welds, defective materials, flange leaks, valve gland leaks or other such defects have been corrected and accepted by the Owner's Representative.
- All documentation and ‘test section’ information is complete and accepted by Owner’s Representative.
- All temporary test blinds or spades and strainers have been removed, new gaskets installed and the piping system reinstated.

Sealing materials shall not be used to correct leaks at joints. Valve glands shall not be tightened to the extent that the valve cannot be operated. If necessary, valves shall be repacked.

After hydrostatic testing of the system is complete and approved by the Owner’s Representative, all lines and equipment shall be completely drained of the test fluid. Piping systems vents shall be opened while draining to avoid a vacuum. Care shall be taken when draining the test fluid to avoid damage to other items of equipment. Special attention shall be given to points where water may be trapped, such as in valve bodies or low points.
10.1.8 Test Records

Records for piping which require that pressure be held for a specified period of time shall include any corrections of test pressure due to temperature variations between the start and finish of the test.

Records of all tests carried out and approved by the Owner’s Representative shall be retained in the job records.

10.2 Cleaning and Re-instatement

10.2.1 Cleaning

Completed systems shall be internally cleaned to remove all remaining foreign matter by water flushing or blowing with air.

Flushing shall be done with clean water using hydrostatic test water. Water used for flushing and cleaning austenitic stainless steel shall contain less than 1ppm chlorides. Instruments shall not be flushed through.

Where special conditions exist such as cleaning compressor suction and lube oil piping, a separate cleaning procedure shall be prepared and submitted to the Owner’s Representative for approval.

Piping and equipment shall be dried if required.

10.2.2 Re-instatement

After successful completion of pressure testing, the system shall be returned to a state of commissioning readiness.