## CONTENTS

1. Foreword  
2. Transport  
3. Handling and unloading  
   3.1 Single pipes  
   3.2 Unitised loads  
   3.3 Nested pipes  
4. Storage  
5. Inspection  
6. Installation  
   6.1 Standard trench  
   6.2 Embedment Zone  
   6.3 Excavation  
   6.4 Bedding  
   6.5 Inadvertent over-excavation  
   6.6 Temporary trench support systems  
   6.7 Backfill materials  
   6.8 Backfilling  
   6.9 Compaction  
   6.9.1 Compaction above pipe  
   6.10 Minimum Cover  
   6.11 Pipe Deflections  
   6.12 Bending the pipeline  
7. Joining pipes  
   7.1 Double O-ring bell and spigot couplings  
   7.2 Double Bell Couplings  
   7.3 Flanged  
   7.4 Other  
   7.4.1 Mechanical steel coupling  
8. Thrust restraints  
   8.1 Thrust block  
   8.2 Cement encasement  
   8.2.1 Pipe anchoring  
   8.3 Rigid structures  
   8.3.1 Rigid structures – basic  
   8.3.2 Rigid structures – replacement  
   8.4 Casing tunnels  
9. Other installations  
   9.1 Multiple pipes in the same trench  
   9.2 Cross overs  
   9.3 Unstable trench bottom  
   9.4 Flooded trench  
   9.5 Construction in rock  
   9.6 Slopes
10. Alternate instillations

10.1 Wider trench

10.2 Perpetual protection board trench

10.3 Cement stabilised backfill

11. Post Installation

11.0 Checking the pipe

11.1 Field Adjustments

11.1.1 Length adjustments

11.1.2 Field Adjustments

11.1.3 Field Closures with Couplings

11.2.1 Pressure testing

11.2.2 Non pressure pipelines – leakage testing

11.2.1 Deflection testing

12. Installation of saddle pieces

12.1 Hole cutting prior to attaching saddle piece

12.2 Installation with adhesive
This document is part of the Blue Tongue™ GRP Pipe documentation package. It is to be read and used in conjunction with the product specifications, installation plans, geotechnical reports and applicable Australian Standards including AS/NZS 2566.6:2002 Buried flexible pipelines Part 2: Installation.

It is intended to provide general information on the installation of Blue Tongue™ GRP pipes. For detailed installation information and all technical advice, contact the consulting Engineer.

1.2: SAFETY

All operations associated with the installation of Blue Tongue™ GRP Pipes must be planned and conducted in accordance with the health and safety Regulations and Codes of Practice applicable to the jurisdiction where the installation is being undertaken. Safety requirements will be communicated to all personnel, sub-contractors and other people engaged in or affected by the installation.
2: TRANSPORT

Blue Tongue™ GRP Pipes will be transported as unitised loads placed in containers preventing excessive distortion of the pipe cross section. Unitised loads will be stacked on flat timbers with chocks to maintain separation and stability. Ensure all supports and end treatments are protected from damage. Use the original shipping dunnage to transport pipes whenever possible. Do not use steel cables or chains without padding.

The maximum stack height is 2.2 metres (Shall be limited). Secure with pliable straps and rope ensuring the maximum diametrical deflection does not exceed the values shown in table 2.1.

![Figure 2.1 Transporting pipes](image)

<table>
<thead>
<tr>
<th>Stiffness class (SN)</th>
<th>Maximum deflection (% of diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>2.0%</td>
</tr>
<tr>
<td>10000</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

Table 2.1 Maximum deflection
3: HANDLING AND UNLOADING

Pipes, fittings and accessories shall be handled in a way that avoids any damages that may arise through the delivery process of handling or unloading pipes. Pipes and fittings shall be handled in a safe manner and shall not be knocked against adjacent obstacles or dropped ensuring no damage is incurred. To mitigate such damage, pipes shall not be rolled, pushed or dragged during the handling and unloading process.

3.1 SINGLE PIPES

Use soft slings or pliable straps and a guide rope for unloading and handling of single pipes. Two lift points is the preferred method of handling, although one may be used. Do not use steel cables, chains, hooks placed in the ends of the pipe or ropes passed through the pipe.

3.2 UNITISED LOADS

Unitised loads shall be securely choked to prevent any rolling and shall be lifted and handled using two soft slings or pliable straps and a guide rope. Non-unitised pipes should not be lifted or handled as a single bundle ensuring such pipes are handled separately, as required. When unloading from containers, remove load with a forklift with the tines placed under the timber supports.
3.3 NESTED PIPES

De-nesting is best undertaken at a de-nesting station. Lift and handle nested bundles as detailed in Section 3.2 Unitised loads. Remove smaller diameter pipes first using a padded boom. Store and transport nested bundles in the original packaging.

![Diagram showing lifting nested bundles](image1)

**Figure 3.4 Lifting nested bundles**

![Diagram showing de-nesting nested bundles](image2)

**Figure 3.5 De-nesting nested bundles**
Storage sites should be appropriate to the size of pipes to be stored, shall be positioned to ensure no obstruction to pedestrian routes or property access areas and provide unrestricted access for handling plant. The area should be free of combustible material or have appropriate fire-fighting measures in place. Storage areas shall be a minimum of two metres from open trenches.

Store pipes flat on firm level ground. Where necessary, support pipes above the ground on sand bags, mounds of earth or timber bolsters to make pipe stacks level. Support structures shall be spaced to prevent longitudinal distortion. When storing pipes in a nested formation, the number of supports shall be increased accordingly to prevent longitudinal distortion. Pipes with end treatments shall be stacked in a manner to provide protection to end treatments.

Ensure pipe stacks use flat timbers at both quarter points and the stack height is limited to prevent distortion of the bottom layers of pipes. All single pipes and stacks of pipes shall be chocked to prevent movement. Apply securing ropes or straps as required.

Where pipes are stored in crates, ensure the crates are stacked with bottom and side timbers touching and the lighter crates on top of heavier crates. In circumstances where pipes are distorted during the storage processes, remove pipes from stacks and re-round prior to installation. Avoid heat build-up in stacks by storing away from heat sources in areas with adequate ventilation.

In circumstances where storage times may exceed 12 months, provide coverage areas or store elastomeric seals according to the criteria detailed in AS 1646-2007 Elastomeric seals for water-work purposes.

If elastomeric seals are to be adopted and are to be located at the end of a string of joint restrained pipes, measures to ensure the joint is braced from forces that may cause the joint to be pulled apart shall be equipped, such as anchorage installations. If pipeline restraints are not constructed in accordance with the specified design or if elastomeric seals are adopted for joint restrained pipelines, those joints shall contain the appropriate capacity to account for potential axial movements that may arise due to pressurization.
5: INSPECTION

The contractor is responsible for the inspection of all pipes, fittings and pipeline accessories in accordance with their inspection and test plans. Internal and external inspections shall be completed upon delivery and prior to installation to ensure pipes, fittings and pipeline accessories are free from damage and are compliant with product and project specifications. These inspections are to be carried out in accordance to the standards outlined within AS/NZS 2566.2:2002.

The contractor shall inspect pipes, fittings and pipeline accessories for:

- Compliance with project specifications – i.e: lengths, diameters, pressure, stiffness ratings, joint and fitting types and accessories
- Compliance with use-by dates
- Integrity of seals and gaskets. Ensure no cuts, weather damage, potentially damaging material or dislodgements that may impact performance
- Damage to joint surfaces, coatings and wall structures that may impact performance

Pipes, fittings and components that do not comply with product specifications, project specifications or standards defined within AS/NZS 3571.2:2009, shall not be installed in the pipeline. Contact Blue Tongue™ Pipe to notify of damaged or non-compliant pipes, fittings and pipeline accessories and for replacement or rectification.

Final acceptance or rectification of defects or damage to any pipeline components shall be reflective of the methods approved by the specifier, which ensure a service performance equivalent to that of an undamaged component.
6: INSTALLATION

The installation technique for Blue Tongue™ GRP pipe varies according to pipe stiffness, cover depth, native soil characteristics and trench depth and width. For detailed information on excavation and installation, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation or the consulting Engineer.

Any temporary struts that may be used to protect pipes from deflection and damages during transport shall be removed before pipes are laid, as required. Pipelines shall be laid with gradients, levels and alignments within the appropriate tolerances. Jointing methods shall comply with the detailed jointed procedures outlined in section 7.0.

6.1 STANDARD TRENCH

Figure 6.1 shows the configuration of a standard trench.

Distance A must always be of a dimension to allow backfilling and compaction with mechanical equipment in the haunch area. Where pockets for pipeline projections are required, they shall be installed in the embedding material ensuring embedment requirements are met full support of the pipeline is applicable. Over excavation of pockets should be avoided.

6.2 EMBEDMENT ZONE

The trench width in the embedment zone at the springline shall be of a width to enable the making and inspection of joints and the placement and compaction of embedment material according to the criteria listed in table 6.1. Where there is a possibility of migration of fines between the native soil and embedment zone, a compliant geotextile fabric shall be equipped in order to ensure any supports to the pipe are not compromised. Alternatively, an appropriate embedment material may be graded as required.

<table>
<thead>
<tr>
<th>DN</th>
<th>Minimum dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb</td>
<td>A</td>
</tr>
<tr>
<td>≥75, ≤150</td>
<td>75</td>
</tr>
<tr>
<td>&lt;150, ≤300</td>
<td>100</td>
</tr>
<tr>
<td>&lt;300, ≤450</td>
<td>100</td>
</tr>
<tr>
<td>&lt;400, ≤900</td>
<td>150</td>
</tr>
<tr>
<td>&lt;900, ≤1500</td>
<td>150</td>
</tr>
<tr>
<td>&lt;1500, ≤4000</td>
<td>150</td>
</tr>
</tbody>
</table>

De = external diameter of pipe  
lb = depth of bedding below of pipe  
A = horizontal distance between the pipe wall and the trench wall or permanent trench support (not distance to temporary trench support)  
lo = depth of overlay

Note, A may provide insufficient areas in certain circumstances where minimum work space areas are required for installation or maintenance works.
Materials in embedment zones may consist of cohesionless soils, controlled low strength materials or stabilized soils in accordance with Appendix G, K and L of AS/NZS2566.2 respectively.

Trench widths above the embedment zone are determined by the stability of the trench wall and requirements for trench support. In the case that the embankments are constructed from materials unsuitable for contact with the pipeline, embedment material shall be placed and compacted to comply with minimum specified embedment zone dimensions listed in table 6.1. Within trenches, pipes are to be positioned to allow for embedment material compaction as required. If adjustments to the alignment of the pipe are necessary, this shall be done by re-lifting the pipe to the correct position without causing damages to the pipe or surrounding area. For details on trench widths above the embedment zone, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation or the consulting Engineer.

The embedment material shall be compacted to obtain a quantified relative compaction or stiffness between the pipe and the interface with native soil, as required. In certain circumstances, the replacement of the embedment material by a substitute structural support may be required. Such situations include pipes being laid on steep grades, the inadequate foundation of pipeline, a deteriorated embedment material or native soil and uncontrollable forces.

6.3 EXCAVATION

Prior to excavation, the identification of the soil and ground water conditions are to be determined in the soil beneath the pipe, or where the pipe is to be laid to a depth of DN + Lo. Additionally, services of a close proximity shall be marked and identified to prevent on site hazards. Trench support systems are to be chosen in order to avoid any potential disturbances to adjacent structures and services.

An effective and efficient methodology for excavation shall be implemented which minimizes environmental impact. From the commencement of excavation, trenches shall be monitored and controlled to ensure no movement or collapse is to take place. The length of trench openings at any one time shall be minimized with the trench centre line aligned with the design centreline or within acceptable tolerances. Where the required density of embedment compaction is unattainable due to the absence of side containment, the embankment shall be constructed first to top of the pipe followed by a cut trench for installation of the pipeline. The condition of existing services exposed by any excavation during the installation shall be checked and regularly monitored, after the service owner has been notified of any potential damages.

Additional excavation shall be undertaken to ensure provision for:

• Concrete pads that may be necessary for valve systems or heavier structures.
• Bulkheads or trenchstops when required.
• Thrust anchor blocks when required.
6.4 BEDDING

The bedding material shall be classified as embedment material which is placed and compacted to the required relative compaction and hence able to sufficiently support the pipeline. The bedding material surface shall be graded to the appropriate tolerance level ensuring continuous support of the pipeline. After the completion of grading, and where required, room for necessary components such as flanges shall be excavated within the in the bedding material. Additional excavation may be required for joint treatment.

Bedding shall be placed over a firm and stable trench bottom. The minimum width of a trench in the bedding zone shall be sufficient to:

- Compact bedding materials to < 150mm and the desired density
- Provide level and uniform pipe support
- Provide pockets for pipeline projections
- Accommodate and facilitate inspection of joints and fittings

Embedment material shall not be considered an option for providing thrust resistance and shall not be considered capable of providing such resistance. Minimum particle sizes and grading limits for embedment material are to established in accordance to AS/NZS2566.2 Appendix G. For additional information, contact the consulting engineer. Figures 6.2 and 6.3 show correct and incorrect bedding

6.5 INADVERTENT OVER-EXCAVATION

Inadvertent over-excavations of the foundation in a trench wall, trench bottom, and bed or pipe zone should be repaired and compacted with embedment material and compacted according to Section 6.8 Compaction. The finished level will ensure compliance with specified depths and gradients and contain an evenly modified slope between differences in gradients.

Where the embedment zone width differs from specified levels at springline, the installation of pipeline shall stop until the structural design has been reviewed in order to determine whether a more substantial side support compaction and larger pipe stiffness is necessary.

6.6 TEMPORARY TRENCH SUPPORT SYSTEMS

Installation, use and removal of temporary trench supports shall be undertaken in a controlled manner abiding by excavation requirements and be removed in stages to allow all voids to be filled with embedment material and compacted. Care should be taken during the removal of trench shoring to ensure the integrity of the pipe and embedment zone. The placement of side support and overlay material shall be in a manner to ensure; uniform compaction of embedment material under haunches of the pipeline, consistent material relative compaction throughout design, the minimization of pipeline distortion and the pipeline grade level and alignment is constant.

For details on removal of trench support systems, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation or the consulting Engineer.
6.7 BACKFILL MATERIALS

Requirements for backfill material depend on dead and live loadings and the maximum allowable settlement of the material. If the settlement of the surface is required to be controlled, a known fill material that will allow for a required compaction density should be implemented. Where shields have to be used in the side support zone or where over excavation has resulted in a space behind shield walls, the space behind the walls shall be filled with a quality embedment material preventing loose uncompacted debris, as required. For detailed information on backfill material, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation or the consulting Engineer.

The maximum particle sizes for embedment material is shown in table 6.2

<table>
<thead>
<tr>
<th>DN (mm)</th>
<th>Maximum particle size mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 100</td>
<td>10</td>
</tr>
<tr>
<td>100 – 150</td>
<td>14</td>
</tr>
<tr>
<td>&gt; 150</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 6.2 Aggregate particle size of embedment material

Where the possibility of migration of fines between native soil and the embedment zone exists, install a geotextile filter fabric in compliance with appendix J of AS/NZS 2566.2:2002 or embedment material with an appropriate grading ration to ensure the integrity of the side support to the pipe. Where free draining material is available as embedment material, soil migration into voids shall be prevented by implementing the required particle size grading as explained within Appendix G of AS/NZS 2566.2:2002. In contrast, such embedment materials may be overlapped with a compliant geotextile filter fabric as discussed above, ensuring a 300mm overlap as required. For additional guidelines on migration control, refer to Appendix I. See AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation for geotextile filters fabric and embedment material specifications.

6.8 BACKFILLING

If required, ensure dewatering is completed according to the requirements of AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation prior to commencing backfilling.

Backfilling should be undertaken immediately following the joining of pipes to prevent floating and thermal movement. If backfilling is delayed following placement of pipes in the trench, prevent floating by backfilling the centre section of the pipe or filling it with water.

To control vertical deflection of the pipe, avoid mechanical compaction of fill material above the pipe until the cover above the pipe is of sufficient depth to prevent damage to the pipe. The material in haunch area between the pipe and the bedding must be compacted prior to the remaining backfill being placed in the trench.

For details on backfill materials and processes, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation or the consulting Engineer.
6.9 COMPACATION

The selection of compaction equipment, number of passes and thickness of layers will be determined by the material to be compacted and the pipe characteristics. Compaction equipment and methods that place horizontal and vertical pressures on the pipeline with potential to cause damage should be avoided. Compaction of trench fill materials including embankment fill materials are required not to cause deflections greater than that specified. Side support and overlay materials shall be placed in appropriate layers of thickness to ensure the desired relative compaction is achieved. Measurement methods for the compaction selected shall be appropriate to the type of compaction material. Direct methods shall be used to control compaction unless indirect methods are appropriate. If the minimum relative compaction has not been specified, compaction requirements shall be in accordance to Table 6.3 for direct methods.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Test method</th>
<th>Travel areas</th>
<th>Non-travel areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Embedment material</td>
<td>Trench fill material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Cohesive</td>
<td>Standard dry density ratio (Rd)</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Cohesionless</td>
<td>Density index</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

Table 6.3 Minimum relative compaction

One or more methods shall be used to control relative compaction in agreement to the soil type and details specified in AS1289.5 in accordance with AS/NZS 2566.2:2002 5.6.3.2.

Compaction trials should be undertaken prior to commencing compaction or where changes occur in the procedure of compaction including cases where the embedment material does not meet specified requirements. Ensure compaction of trench or embankment filling material does not cause unacceptable pipe deflections. Locations and frequency of compaction control testing shall be in accordance to those specified for the specific project. Additional information is provided in Appendix H of AS/NZS2566.2 for guidance on potential compaction performances of embedment materials. For details on compaction technique and allowable vertical deflections, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation or the consulting Engineer.

6.9.1 COMPACATION ABOVE PIPE

The requirements for compaction above pipes vary according to pipe stiffness, backfill material and load requirements. For detailed information of compaction above pipe requirements, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2 Installation or the consulting Engineer.

6.10 MINIMUM COVER

The minimum pipeline cover shall be of a depth to:
- Ensure surcharge loadings (traffic, construction equipment etc. are distributed over an adequate area)
- Provide clearance to overlaying layers requiring heavy mechanical compaction
- Ensure pipe and side support is appropriate for proposed land use

For detailed information of coverage above the pipe, refer to AS/NZS 2566.2:2002 Buried flexible pipelines Part 2 Installation or the consulting Engineer.
6.11 PIPE DEFLECTIONS

Short term vertical deflections shall be measured according the methods detailed in AS/NZS 2566.2:2002 Buried flexible pipelines Part 2 Installation and not exceed the values shown in Table 6.4.

Angular deflections of a pipe or fitting at a joint in a pipeline resulting from a straight alignment shall be limited by an appropriate maximum angular deflection, as required. Such joints shall be constructed with the mating pipes or fittings in a relative straight alignment with the corresponding pipe or fitting before moving it out of alignment to achieve the necessary angular deflection. If this is to occur, the deflected pipe or fitting shall be embedded to a level ensuring minimal movement prior to the joining of the next pipe.

<table>
<thead>
<tr>
<th>Deflection % of diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large diameter (DN ≥ 300) initial</td>
</tr>
<tr>
<td>Small diameter (DN ≤ 250) initial</td>
</tr>
</tbody>
</table>

Table 6.4 Allowable initial vertical deflection

The diametric deflection shall be checked upon completion of required backfilling operations and shall lie within acceptable short term deflection limits, as required.

6.12 BENDING THE PIPELINE

Bending a pipeline is dependent on the pipe size and material, wall thickness and permissible joint deflections. Pipe line joints will be made in a straight line prior to bending to the desired radius. The curvature shall be uniformly distributed along the full length of the pipe, see Table 6.5 for maximum allowable deflections. To avoid localised damage, replace temporary pegs and stakes with backfill material after laying the pipe.

Figure 6.6 Join in a straight alignment and then turn into the required angle.
6.12 BENDING THE PIPELINE CONTINUED

<table>
<thead>
<tr>
<th>Pipe diameter (mm)</th>
<th>Allowable deflection angle</th>
<th>OFFSET (mm)</th>
<th>RADIUS OF CURVATURE (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3m</td>
<td>6m</td>
</tr>
<tr>
<td>&lt;500</td>
<td>3</td>
<td>157</td>
<td>314</td>
</tr>
<tr>
<td>500-900</td>
<td>2</td>
<td>105</td>
<td>209</td>
</tr>
<tr>
<td>900-1800</td>
<td>1</td>
<td>52</td>
<td>105</td>
</tr>
<tr>
<td>&gt;1800</td>
<td>0.5</td>
<td>26</td>
<td>52</td>
</tr>
</tbody>
</table>

Table 6.5 Maximum allowable deflection angle at the Double Pipe diameter coupling joint
7: JOINING PIPES

Blue Tongue™ GRP piping systems use the following joining methods:
1. Double O-ring bell and spigot couplings
2. Double Bell Couplings
3. Flanged joint
4. Other joints

In all circumstances, ensure the embedment zone is excavated to the required level to ensure continuous pipe support without pressure on the joint.

7.1 DOUBLE O-RING BELL AND SPIGOT COUPLINGS

Join Double O-ring bell and spigot couplings as follows:

- Clean the bell coupling grooves and lubricate with non-acidic, non-resolvable grease (Vaseline, silicone)
- Insert the rubber gasket into the grooves evenly ensuring the gasket extends evenly above the top of the entire groove
- Clean the spigot ensuring no dirt of grease is present and inspect for damage
- Align pipes and insert spigot into bell
- Apply clamps and travelling blocks and tighten the joint until limitation marks align
- Do not allow metal chain or cable touch pipe directly

Nylon locking bars for Double O ring bell and spigot couplings can be supplied upon request.

7.2 DOUBLE BELL COUPLINGS

Join Double Bell Couplings as follows:

- Clean double bell grooves and rubber gaskets
- Push gasket into each groove leaving several loops outside the groove. Do not lubricate the gasket at this stage
- Push gasket into the groove evenly
- Pull gasket radially to evenly distribute compression of the gasket in groove
- Ensure the gasket extends equally above the groove around the circumference
- Lubricate gasket
- Clean the pipe spigot to remove dirt and grease and inspect for damage
- Apply a thin layer of lubricant to spigot between the pipe end and alignment mark. Ensure the bell and spigot remain clean before insertion
- Mount coupling onto spigot
- Align pipe with coupling and second pipe
- Apply clamps and travelling blocks and tighten the joint until limitation marks align. Ensure chains do not come into contact with pipes

Figure 7.1 Double bell coupling
7.3 FLANGED

Flanged joints are primarily used for connecting pumps, valves, filters and different material pipes.

GRP flanges should be joined as follows:

- Thoroughly clean the flange face and seal groove
- Ensure the sealing gasket and O-ring is clean and undamaged
- Position the sealing gasket in the groove
- Align the flanges to be joined
- Insert bolts, washers and nuts. The hardware must be clean and lubricated to avoid incorrect tightening. Always use washers on the flanges.
- Using a torque wrench, tighten bolts in 7Nm increments until their recommended torque is reached (Table 7.1)
- Inspect the torque of bolts after one hour and adjust if necessary

<table>
<thead>
<tr>
<th>SIZE OF BOLTS</th>
<th>NON-LUBRICANT</th>
<th>LUBRICANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12</td>
<td>59</td>
<td>49</td>
</tr>
<tr>
<td>M16</td>
<td>69</td>
<td>48</td>
</tr>
<tr>
<td>M20</td>
<td>123</td>
<td>86</td>
</tr>
<tr>
<td>M24</td>
<td>220</td>
<td>154</td>
</tr>
<tr>
<td>M27</td>
<td>309</td>
<td>216</td>
</tr>
<tr>
<td>M30</td>
<td>412</td>
<td>288</td>
</tr>
<tr>
<td>M33</td>
<td>515</td>
<td>360</td>
</tr>
<tr>
<td>M36</td>
<td>686</td>
<td>480</td>
</tr>
<tr>
<td>M39</td>
<td>823</td>
<td>576</td>
</tr>
<tr>
<td>M45</td>
<td>1235</td>
<td>865</td>
</tr>
<tr>
<td>M48</td>
<td>1578</td>
<td>1105</td>
</tr>
</tbody>
</table>

Table 7.2 Bolt torques

7.4 OTHER

7.4.1 MECHANICAL STEEL COUPLING

Mechanical steel couplings are used when joining pipes of different materials and sizes to adapt flange outlets. Refer to the manufacturer and supplier for recommendations on coupling size, material, bolt size, torques and fitting instructions.
When a pipe line is pressurised, unbalanced thrust forces may occur at bends, tees, reducers, wyes and bulkheads and other directional changes. These forces must be restrained to prevent joint separation. Thrust restraint is achieved through the use of thrust blocks, stress restraint, cement encasement and fixed anchors. Refer to the technical specifications for the appropriate method of restraint.

Bulkheads and trench stops - For pipe materials at gradients of 5% and above, bulkheads and trench stops are required to be installed in accordance with table 7.2, unless native fill embedment is used or otherwise specified. (AS/NZA2566.2:2002)

<table>
<thead>
<tr>
<th>Grade %</th>
<th>Requirement</th>
<th>Spacing (m) =</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-14%</td>
<td>Trenchstop</td>
<td>100/(grade %)</td>
</tr>
<tr>
<td>15-29%</td>
<td>Concrete bulkhead</td>
<td>80 x pipe length/(grade %)</td>
</tr>
<tr>
<td>30-50%</td>
<td>Concrete bulkheads + Concrete encasement (continuous)</td>
<td>100/(grade %)</td>
</tr>
<tr>
<td>&gt;50%</td>
<td>Special Design</td>
<td></td>
</tr>
</tbody>
</table>

Table 8.1 – When to use bulkheads and trenchstops

### 8.1 THRUST BLOCK

Where a joint in a pressurised pipeline is not designed to resist axial loading, thrust blocks of an appropriate size and form shall be installed to resist the forces from hydrostatic thrust and hydrodynamic pressures. Blocks shall be installed at all pipeline fittings with changes of direction and closed ends; including valves, reducers and tees when the branch pipe is concentric to the header pipe centreline. They shall be constructed on non-excavated soil and backfilled with native soil, with bearing surfaces positioned roughly normal to the executed forces. Temporary supports may be necessary where the pipeline is to be tested before its completion.
Figure 8.1 Typical thrust block configurations
8.2 CONCRETE ENCASEMENT

When pipes are encased in concrete for various reasons i.e. to act as an alternate embedment material where gradients exceed 30%, for additional embedment stiffness when required, if trench foundation is inadequate, if excessive uplift forces are present or if there is a high risk or erosion, the concrete is for thrust restraint or to carry other unusual loads. Additions to the installation procedures must be followed. See pipe anchoring, rigid structures and casing tunnels for details. Deformation of the pipeline shall be avoided when concrete encasements are used in addition to a means of accommodating for differential settlement. When used, construction joints within a concrete encasement is required to align with pipe joints where a compliant elastomeric seal joint is being implemented. Efforts to ensure hydrostatic buckling pressures of the pipe are within tolerable limits are required.

8.2.1 PIPE ANCHORING

The pipe must be restrained against the movement when cement is moulded. This is normally accomplished by securing strapping over the pipe to a base slab or other anchor. The thickness of each layer is determined by the nominal stiffness, if pipe anchoring is recommended, contact your supplier or consulting engineer for assistance or additional information.

8.3 RIGID STRUCTURES

Where a pipeline enters or exits a structure (walls or flanged to a pump), two methods are used to minimize the development of high discontinuity stresses in pipes:

- Basic
- Replacement

8.3.1 RIGID STRUCTURES – BASIC

The preferred method is to cast a joint coupling in the exit of the cement; Figure 8.3. This ensures the pipe outside the cement has complete freedom of movement (within the limits of the joint). Ensure:

- roundness of the coupling
- minimal vertical deflection of the pipe
- short section of the pipe (length between rigid stricture and adjacent soil) has at least the larger of 1m or DN and a maximum length of 2m or 2DN.
8.3.2 RIGID STRUCTURES – REPLACEMENT

In circumstances where the Standard method is not possible, wrap the coupling with rubber so that the rubber protrudes 25mm from the cement.

For PN larger than 16, this method is not recommended.

Figure 8.4 Replacement connections – rubber wrap in cement

8.4 CASING TUNNELS

When a pipe is installed in a casing or tunnel, the pipe should be equipped with a wooden skid for ease of insertion and to protect from damage during sliding (figure 8.5)

Figure 8.5 Typical skid arrangements

The spacing between the pipe and tunnel should be filled with the appropriate material. Care must be taken to not overstress and collapse the pipe, especially when grouting. When grouting, ensure the grouting pressures do not cause damage to the pipe. Contact your supplier or consulting engineer for assistance or additional information.
9: OTHER INSTALLATIONS

9.1 MULTIPLE PIPES IN THE SAME TRENCH

When two or more pipes of the same diameter are installed in parallel in the same trench, the clear spacing between the pipes shall be as shown in Table 9.1. and shall be appropriate to ensure the support of the side structure and the required compaction is achieved. The spacing between the pipe and the trench wall will be in accordance with requirements of section 6.2 Bedding.

<table>
<thead>
<tr>
<th>External diameter De</th>
<th>Minimum spacing mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compactable embedment material</td>
</tr>
<tr>
<td>≥75, ≤150</td>
<td>100</td>
</tr>
<tr>
<td>&lt;150, ≤300</td>
<td>150</td>
</tr>
<tr>
<td>&lt;300, ≤450</td>
<td>200</td>
</tr>
<tr>
<td>&lt;400, ≤900</td>
<td>300</td>
</tr>
<tr>
<td>&lt;900, ≤1500</td>
<td>350</td>
</tr>
<tr>
<td>&lt;1500, ≤4000</td>
<td>De/4</td>
</tr>
</tbody>
</table>

Table 9.1 Minimum spacing between pipes in the same trench

Note: Minimum spacing requirements may provide insufficient clearances in certain circumstances where minimum work space areas are required for installation or maintenance works.

If different diameter pipes are laid in the same trench, the minimum spacing will be the sum of the diameters divided by two. It is recommended that the bottom of both pipes be on the same plane. If this is not possible, the space between the lower trench bottom and the higher trench bottom must be filled with backfill material and compacted to the same density.
With respect to this drawing, it is necessary to ensure:

- For a depth of cover up to 4m, $S \geq (D1 + D2)/6$ but not less than 150mm or the required amount of room to place compact backfill material as required.
- For a depth of cover over 4m, $S \geq (D1 + D2)/4$ but not less than 150mm or the required amount of room to place compact backfill material as required.

### 9.2 CROSS OVERS

When two pipes cross, the minimum vertical spacing will be the sum of the two pipes divided by four or 100 mm, whichever is greater. The respective area of clearance distance shall be filled with compacted embedment material as required. The installation method of the bottom pipe should be as shown in figure 6.2.

Note, with respect to figure 6.2, $H \geq (R1 + R2)/2$ however it shall never fall below 150mm. It is appropriate that the underlay material is gravel with a relative density of 70% or sand with 90% proctor density.

![Figure 9.2 Pipe crossover](image)

In circumstances when it is necessary to lay one pipeline under an existing pipeline, ensure there is the specified distance between the two pipes. The existing pipe should be protected by fastening it to a steel beam and wrapping with padding to protect from impact damage and point loading. When the new pipe is laid, backfill and compact manually in order to ensure the clearances around the two pipes are fully filled and the required density of backfill is achieved.

### 9.3 UNSTABLE TRENCH BOTTOM

Trench bottoms with soft, loose or highly expansive soil must be stabilised or a trench bottom foundation constructed to minimize differential settlement. The foundation will be a minimum of 150mm.

When crushed stone is used as foundation material, the use of filter cloth may be required to surround the foundation to prevent foundation and bedding material migrating into one another causing the loss of pipe support. The maximum pipe section length between two flexible joints is 6m.
9.4 FLOODED TRENCH

When the underground water table is higher than the trench bottom, the water table must be lowered to the trench bottom as a minimum (preferably at least 200mm below the trench bottom). Where free-draining material is apparent as the specific embedment material, migration of soil into the voids shall be avoided by using appropriate particle size grading’s identified within Appendix G of AS/NZS2566.2:2002 as discussed. Compliant geotextile filter fabrics that overlap by 300mm are also compatible. Flotation shall be avoided before any additional pipe laying procedures by the placement of an appropriate compaction material over the pipeline or by filling the pipeline with water, as required. Common drainage systems used are well-points leading to a header pipe and pump or sub drains.

The preferred system of drainage will be indicated by the technical specifications of the pipeline. If the water table cannot be maintained below the bed, filter cloth such as a compliant geotextile mattress should be use to surround the embedment and pipe zones to prevent contamination by native material. When gravel and crushed stone is used for trench and backfill, the following precautions must be observed when dewatering:

1. Avoiding pumping long distance through backfill material and native soil. This can cause the loss of support to previously installed pipes through removal of material and the migration of soil.

2. Do not turn off the dewatering system until a sufficient cover depth has been reached to prevent pipe flotation.

9.5 CONSTRUCTION IN ROCK

The minimum dimensions for a rock trench are the same as for a standard trench. Irregular or fragmented rock in addition to other unsuitable foundations should be avoided when constructing foundations. If it is not deemed possible for such avoidance, adequate draining of the foundation or the removal of unsuitable materials is required. Flexible joints in rock trench and soil trench must be installed as shown in figure 9.3. The trench must be managed in the method appropriate to the characteristic of the native soil.

9.6 SLOPES

Risks associated with installation of pipelines on unstable sloping ground increase with the degree of the slope. Generally, pipe lines should not be installed on slopes exceeding 15 degrees and a thorough geotechnical evaluation of the ground should be undertaken prior to installation commencing. If installation on sloping ground is going to be undertaken, the preferred method of installation is above ground. For buried pipelines with a slope exceeding 15 degrees, ensure:

- Stability of the ground during excavation and installation
- Stability through a good geotechnical design
- Backfill with cement stabilised or SC1 soil
- Install an anchor rib in the centre of each pipe
- Protect the surface from erosion and puddle formation
- Long term movement of backfill shall not exceed 20mm
- Install and backfill each pipe prior to commencing the next
10: ALTERNATE INSTALLATIONS

10.1 WIDER TRENCH
Wider trenches are used to keep incompatible native soils away from the pipe and to create greater burial depths.

10.2 PERPETUAL PROTECTION BOARD TRENCH
The use of a perpetual protection board minimises any potential loading at the sides of the pipe. Backfill procedures and the maximum burial depth are according to standard trench procedures. For additional information, or for situations where it is likely such protection boards are required, contact your consulting engineer.

10.3 CEMENT STABILISED BACKFILL
A sand and cement mix is generally used when reinforced backfill is required. For reinforced cement backfill material requirements contact the consulting engineer.

Generally, the maximum initial cover thickness is:

- Stiffness SN5000-10000 - 1.5m

Pipe must be surrounded by reinforced backfill material according to the method shown in figure 10.2. For maximum cover thickness requirements corresponding to nominal pipe stiffness classes not mentioned, refer to your consulting engineer.

Trenches that are over-excavated to accommodate joins and fittings must be filled and compacted with backfill material. When the trench supports and temporary protection boards are removed, mend and compact with reinforced backfill material. For burial depth requirements contact the consulting engineer.

Figure 10.1. Cement backfill
11: POST INSTALLATION

11.0 CHECKING THE PIPE

At completion of the installation procedures, conduct a full inspection of the pipeline for compliance with design and installation specifications.

11.1 FIELD ADJUSTMENTS

11.1.1 LENGTH ADJUSTMENTS

Pipes supplied by Blue Tongue™ producers require the outside diameter of the barrel of the pipe to be specified in order to supply pipe within the tolerance range of the calibrated spigot. If pipes fall within the tolerance range they may be marked as adjustment pipe. The following procedures will assist in correctly making the length adjustment.

1.) Ensure the pipe diameter is within the Spigot tolerance range for the desired connection.

2.) Determine the length required and mark a square cut on the selected pipe if a cut is necessary. Fitments may prove difficult if a non “make-up” pipe is used. In some situations, pipe may be provided at the required length. Contact your consulting engineer or the supplier for additional information.

3.) If necessary, square cut the pipe at the appropriate location using a circular saw with a diamond coated blade. Ensure adequate personal protective equipment is in use. For additional information, consult the pipe supplier or your consulting engineer.

4.) After a cut is made, clean the surface in the jointing area and sand smooth any rough spots. With a grinder, bevel grind the pipe end to ensure an adequate chamfered edge is achieved. Additionally, apply the necessary amount of the required lubricant to ease assembly. See Figure 10.2.

Figure 11. Detail of pipe with bevel ground chamfered edge
For a connection procedure, the contractor needs to ensure the OD is within tolerable limits allowing jointing between the pipe and the connection. It is recommended that for bell and spigot connections, a make-up pipe is used. If there are any questions regarding the OD requirements, contact the appropriate consulting engineer. Blue Tongue™ will provide for what is required to suit the tolerance range of joining components with tolerance ranges and tables for bell and spigot, ductile iron, PVC and a range of other connections provided upon request.

11.1.2 FIELD ADJUSTMENTS

It should be understood that the outside diameter depends on the PN and SN ratings for each specific pipe. Where a specific OD is required, it can be provided upon request in the form of a “make-up” pipe, i.e. have the OD controlled throughout the length of the pipe. If cutting a “make-up” pipe in the field, you may cut it to size and then cut a chandler edge and lubricate it for the desired fitting. With prior notice, Blue Tongue™ will manufacture a controlled pipe which is then ground down to fit into the desired coupling if it is reasonable. Due to such manufacturing, all couplings or connections will fit if the right pipe is chosen. After field cuts are conducted, the interior edge shall be chamfered as required.

In some situations, where a make-up pipe is not being used, a substitute pipe that is not controlling the OD may cause on site complications if cut due to the slightly varied OD incurred upon manufacture. In the case of such situations, consult your supplier or consulting engineer for recommendations.

Based on current design, pipes do not require any sealing of the spigot ends after field cutting however we recommend cut sections are sealed with an appropriate resin. For detailed specifications, consult your consulting engineer or contact Blue Tongue™ for detailed recommendations upon request.

11.1.3 FIELD CLOSURES WITH COUPLINGS

It is possible to use Blue Tongue™ couplings for field closures or repairs if required. In the case of such a scenario, the length of the closure pipe should not fall below 1m and should not be connected to a rocker pipe. The procedure involves adjusting the adjacent pipes to the required distance to allow for the closure pipe. Once measured, the closure pipe may be placed accordingly provided it is approximately 20mm shorter than the required spacing distance. An appropriate pipe should be chosen based on the spigot dimensional tolerance limit. The contractor is responsible in selecting the appropriate pipe to suit. Contact Blue Tongue™ or your consulting engineer for further recommendations. If a cut is necessary, mark the pipe where the cut is to be made and make a square cut in accordance to the section titled “length adjustments” with all sharp sections sanded to a smooth finish. Ensure a bevel is grinded on the pipe end with the remaining thickness no less than half of the original pipe thickness. For additional information on bevelling and recommended specifications, contact your consulting engineer.

The Installation procedure is as follows;

• Select the required couplings clean them and remove centre registers while leaving the gaskets in place ensuring the gasket groove is free of material that will cause restricted deformation.

• Lubricate the gasket and spigot ends with the appropriate lubricant to ensure a smooth connection.

• Place a coupling square onto the end of the closure pipe allowing a 360-degree connection between the gasket. With reasonable force, connect the coupling onto the closure pipe so that the entire coupling is on contact with the spigot end.

• In order to control the uniform backward movement of the coupling, mark base lines onto the spigot ends at a distance equal to the sum of half the width of the coupling minus half the width of the closure gap.

• Ensure the pipes are aligned with equal distance on either side.

• The close pipe shall be kept centred while the couplings are pulled over each side simultaneously. The coupling is considered in place when its edge touches the base line described above. For clarification or additional information, contact your consulting engineer.

• Following the closure, compaction is to be undertaken in accordance to the section titled “compaction”.

For further information regarding coupling connections refer to the section titled “joining methods” or contact the relevant supplier or consulting engineer.
11.2.1 PRESSURE TESTING

Regular testing should be conducted during construction at consistent and safe intervals, with a maximum distance between test intervals of 150m. Where saddles have been included in the pipeline, testing shall be conducted on every saddle.

For most circumstances using GRP pipes, vacuum testing is preferred however it is necessary to select an appropriate test method and conduct tests according to the criteria listed in AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation.

11.2.2 NON PRESSURE PIPELINES – LEAKAGE TESTING

Generally, leakage testing shall be carried out by vacuum testing. The appropriate testing methodology shall be conducted based on Dn requirements specified within Appendix N of AS/NZS2566.2:2002. Select an appropriate testing technique and conduct tests according to the criteria listed in AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation.

11.3 DEFLECTION TESTING

For non-pressure pipelines and when structural verification for pressure pipelines is required, deflection testing shall be conducted. Deflections shall comply with the criteria listed within table 6.5 and be corrected to the criteria listed in AS/NZS 2566.2:2002 Buried flexible pipelines Part 2: Installation. Deflections shall be carried out in accordance to Appendix O of AS/NZS 2566.2:2002

A General procedure includes the following:

- Check the pipe for damage and repair as needed
- Compact the backfill soil at the haunch ensuring native soil is not mixed
- Fill the pipe zone with the correct backfill soil by layering and compact each layer
- Backfill to standard height and check the deflection values are less than the maximum allowable
12: INSTALLATION OF SADDLE PIECES

Blue Tongue™ GRP piping systems allow for branches to be connected using saddle pieces of various sizes with 90º and 45º options. These saddles are used to join a GRP main to another GRP, clay or PVC branch pipe. Saddle fittings must be glued using a one-part polyurethane adhesive like SikaBond T2 after an appropriate hole has been cut in the main pipe.

12.1 HOLE CUTTING PRIOR TO ATTACHING SADDLE PIECE

To cut a hole at the branch location, the saddle piece can be used as a template. Place the saddle piece on the main pipe and using the saddle piece as a template inscribe a circle on the pipe with a marker corresponding with the sideline diameter. Increase the marking by the wall thickness of the exit pipe. For example a 100mm diameter connecting piece would require a hole of 118 – 122mm. See diagram 12.1. Also mark the outline of the saddle plate on the main pipe. See figure 11.1. Remove the saddle and position the pilot drill of the hole-saw at the centre of the circle and cut the hole using a high-speed jigsaw or cutting disc. The inside edge of opening needs to be roughened before gluing.

12.2 INSTALLATION WITH ADHESIVE

Ensure the surface of the pipe on which the saddle will be located is dry, clean and roughened. Apply adhesive to both the marked pipe surface and the contact surface of the underside of the saddle. SikaBond can be used immediately.

Locate the saddle on the pipe and use tensioned straps or belts to ensure the saddle is held in place until the adhesive has cured. While adhesive is hardening, look through the saddle opening and check any small gaps between the saddle and the pipe are filled with adhesive. Remove any residual adhesive before it hardens, using Sika® Remover-208 if necessary. Avoid loads during hardening times.

<table>
<thead>
<tr>
<th>Connecting piece diameter (mm)</th>
<th>Hole diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 100</td>
<td>118 – 122 mm</td>
</tr>
<tr>
<td>DN 150</td>
<td>170 – 174 mm</td>
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<tr>
<td>DN 200</td>
<td>220 – 226 mm</td>
</tr>
<tr>
<td>DN 250</td>
<td>274 – 278 mm</td>
</tr>
<tr>
<td>DN 300</td>
<td>326 – 330 mm</td>
</tr>
</tbody>
</table>

Table 12.1 Diameter Saddle Holes

<table>
<thead>
<tr>
<th>SikaBond T2 handling &amp; curing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling Time</td>
</tr>
<tr>
<td>Fixing Time</td>
</tr>
<tr>
<td>Working Temperature</td>
</tr>
<tr>
<td>Load Bearing</td>
</tr>
</tbody>
</table>

Table 12.2 SikaBond curing

Figure 12.1 Marking saddle position and hole

Figure 12.2: 90 and 45º Saddle Piece Glued