Installation Of Buried Polyethylene And Bosspipe Pipelines

Installation of polyethylene piping and Bosspipe underground is based on general principles of installation of any buried flexible pipelines (including polyethylene, polypropylene, polyvinyl chloride, steel, ductile iron and other pipes). Requirements to the installation of buried flexible pipelines are given in AS/NZS 2566.2, and for polyethylene (PE) pipe systems, in AS/NZS 2033.

Polyethylene and polypropylene pipes are tough, lightweight and flexible. Installation does not usually require high capacity lifting equipment; solid wall pipe may be bent in situ and installed in large lengths.

During installation safe work practices must be observed directed to protection of persons and property from danger due to the work. The basic safeguards include:

- protection of traffic, installers and the public from danger due to the work;
- location in advance and protection of existing services in close proximity to the work;
- employing of safe handling and construction practices;
- preservation of hygienic conditions (including water quality, if applicable);
- safe use of machinery.

Polyethylene pipelines are installed underground using both excavation and trenchless techniques. This Technical Guide refers to general principles of installation of solid wall pipes and Bosspipe in trenches.

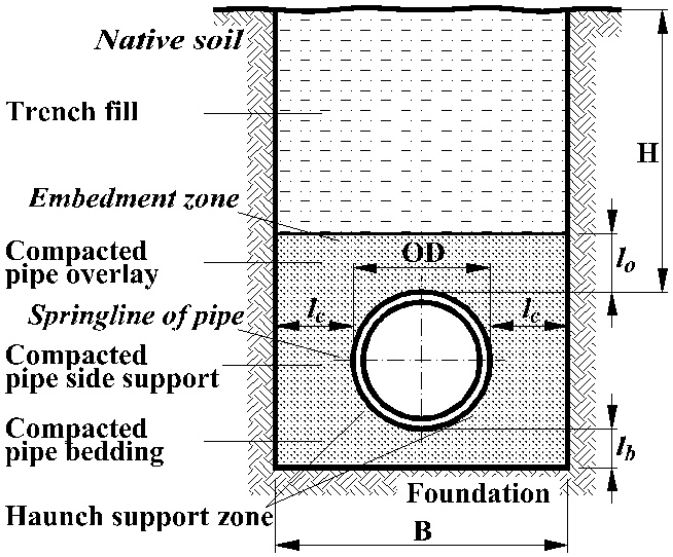

Fig. 1: Typical installation in a trench

Trench (Fig. 1) is excavated as narrow as practicable, taking into account the native soil type and installation needs. Where required, trench width shall be sufficient for use of wall supports, jointing, placement and compaction of embedment materials, particular in haunch support zone, and for inspection. Trenches must be trimmed to the required grade and maintained in a stable condition to prevent movement or collapse throughout the work. Good drainage of the trench should be ensured to avoid ponding or flooding at all stages.

The minimum trench and embedment dimensions as well as spacing between adjacent pipelines (l_p) given in Table 1 are based on requirements of AS/NZS 2566.2. To minimise the load on the pipe, the trench width should be kept as close to the specified minimum as possible. Narrow trenches may be used where the system design permits and person access is not required.

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For bitumen, asphalt and concrete surfaces, neat straight lines shall be cut at least 50 mm beyond the outer limits of the excavation.

Table 1. Minimum embedment zone dimensions (see Fig. 1)

millimetres

Pipe outside diameter (**OD**)	Minimum dimension				
	l_b	l_c	l_o	**B = OD + 2l_c**	l_p
≥75, ≤150	75	100	100	275 - 350	100
>150, ≤300	100	150	150	450 – 600	150
>300, ≤450	100	200	150	700 – 850	200
>450, ≤900	150	300	150	1050 – 1500	300
>900, ≤1500	150	350	200	1600 – 2200	350

The minimum embedment zone dimensions given in Table 1 may be reduced by 50% when controlled low strength materials are used for pipe embedment.

Flexible pipelines are installed at a design depth exceeding **minimum pipeline cover H** (see Fig. 1) requirements given in Table 2 (requirements of AS/NZS 2566.2), unless specified otherwise due to service conditions. Maximum pipeline cover depends on soil type, bedding material, degree of compaction, as well as on pipe characteristics and design loads.

Table 2. Minimum cover (H)

Loading condition	**H***, m
Not subject to vehicle loading	0.30
Land zoned for agricultural use	0.60
Subject to vehicular loading –	
(a) no carriageway;	0.45
(b) sealed carriageways; and	0.60
(c) unsealed carriageways	0.75
Pipelines in embankments or subject to construction equipment loads	0.75

* Under cultivated agricultural land **H** should not be less than 0.6 m. Railway crossings are covered by other requirements.

Depending upon soil stability and depth, trench sides above the pipe crown may need to be sloped, stepped or widened. Where required for safety consideration (unstable trench walls, significant trench depth), sidewall bracing (trench shields) should always be used (see AS/NZS 2566.2 for more details).

The trench bottom must support the pipe continuously and be free from ridges, hollows, lumps, large stones and the like. For pressure pipelines, the grade of the trench bottom is not critical, it may even undulate. For gravity drainage systems, the trench bottom must be constructed to the required grade. Where native trench bottom does not provide a firm working platform, or the necessary uniform and stable support for the pipeline, a foundation should be installed underneath the pipe bedding.

Thrust blocks should be installed for joint anchorage at pipeline direction changes and at dead ends. When installed, thrust block anchors should bear directly on undisturbed native soil with their bearing surfaces approximately normal to the direction of the imposed forces. Thrust block may be concrete or hardwood.

Thrust blocks installed at polyethylene fittings should fully encapsulate the fitting to distribute stresses over the body of the fitting. When concrete blocks are used, the contact area between polyethylene fitting/pipe and concrete block shall be protected (e.g. with elastomeric sheeting) to prevent damage to the polyethylene pipe.

Where valves within the pipeline may convey heavy torque loads on the polyethylene pipeline, the valves (and the like) should be independently supported by proper anchorage. Anchorage should not interfere with the accessibility of any bolts and nuts, and operation of the valve.

Pipes laid on steep grades, on inadequate foundation, or in unstable soil may require installation of bulkheads and trenchstops, up to continuous concrete encasement and concrete bulkheads.

The embedment materials in normal soil should be granular (cohesionless) materials, controlled low strength materials, or stabilized soils. The particle size and grading of the embedment material should allow achievement of the specified relative compaction. The recommended maximum particle size is 10 mm for solid wall pipes of outside diameter less than 100 mm, or 14 mm for larger pipes and Bosspipe (based on recommendations of AS/NZS 2566.2), 20 mm being the maximum allowed size. For better compaction, content of fines should be less than 5%, and we do not recommend use of materials with more than 12% of fines. When crushed rock and similar materials are used, the particles should be free of sharp edges.

Where there is possibility of migration of fines between the native soil and the embedment zone, or free-draining material is used as embedment material, a geotextile filter fabric may be used to envelope the embedment material.

Bedding shall be placed and compacted to the specified relative compaction, and shall uniformly support the pipeline along its length. The requirements of AS/NZS 2566.2 regarding levels of compaction, types of compacting equipment and compaction measurements must be thoroughly followed. Haunch, side support and overlay materials shall be compacted in layers not greater than 150 mm (AS/NZS 2033). It is essential for the performance of the pipeline that the specified level of compaction is achieved.

Following compaction, the bedding should be accurately trimmed and leveled off, as necessary. Pockets for sockets, flanges and other fittings should be made (excavated) in the bedding to allow the pipe barrel to rest firmly on the bedding over its entire length.

Joining polyethylene pipes may be performed on ground level or in the trench, Bosspipe is usually joined in the trench. Pipes to be joined should be properly aligned; usually no offset of the pipe/fitting axes is allowed, maximum angle between axes should not exceed 1 degree. Care shall be taken to avoid contamination of the joint interface. Access of water or other fluids to the joint interface during fusion welding of polyethylene pipes and fittings must be prevented. See appropriate standards and procedures as well as fitting/welding machine manufacturer's recommendations regarding joining procedures.

We recommend pre-construction destructive testing of fusion welds made of polyethylene pipe/fittings to be used during construction by welders performing the joining using intended for the job welding machine(s), as well as random testing of field welds, to ensure quality of the joints in the pipeline.

Pipes are to be lowered into position without being dropped, dumped, pushed, or rolled; care being taken to avoid straining the pipes or pipe joints. Suitable lifting equipment may be used to lower the pipes in the trench with a nylon sling (chains shall not be used).

Polyethylene pipe supplied in coils or on spools (particularly of outside diameter above 63 mm) may be unwound on ground near the trench allowing it to relax for at least 2 hours prior to lowering the pipe in the trench. All welds should be allowed to cool to ambient temperature prior to placing the pipe string in the trench.

Pipe laid in the trench should be properly aligned. The pipes should be positioned along the centreline of the trench unless specified otherwise. Bosspipe should be laid with socket end facing upstream.

Polyethylene pipe may be bent in horizontal plane during installation to follow the alignment of a road or footpath. The minimum advisable bend radius is dependent on the pipe outside diameter (OD) and SDR - Standard Dimension Ratio (Table 3 is based on recommendation of PE100+ Association). When a fitting is present within the bend, the allowable minimum bending radius is increased depending on rigidity of the connection (value given in Table 3 may be used as a guidance). When pipe string is installed at a temperature below 20°C, the bend radius shall be increased (e.g., at 0°C the minimum bend radius given in Table 3 should be increased by 50%).

The pipe shall be bent evenly (preferably supported over the full length) to avoid kinking. All welds should be allowed to cool to ambient temperature prior to bending the pipe string.

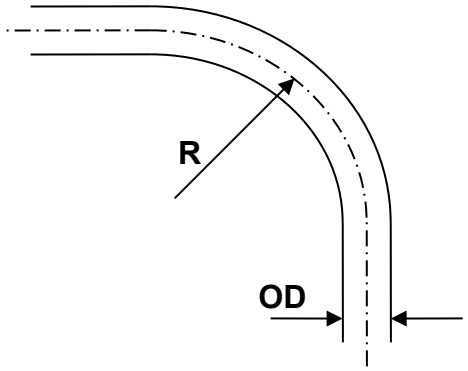

Table 3. Minimum field bend radius (pipe without ovality at 20°C)

Pipe SDR	Minimum field bend radius (**R**)
9	12 × **OD**
11	15 × **OD**
13.6	21 × **OD**
17	25 × **OD**
21	35 × **OD**
26	45 × **OD**
33	65 × **OD**
Electrofusion fitting present in bend	100 × **OD**

Pipe side supports and pipe overlay are constructed by placing and uniformly distributing the embedment material. Initially, the haunch support zones of the pipe and clearances made for joints underneath the pipeline should be filled in and compacted. The haunch, side support and overlay material is placed and compacted in layers usually not greater than 150 mm (or one half of the pipe outside diameter) - see AS/NZS 2566.2 for more details and for information regarding relative compaction, types of compacting equipment, and compaction measurements.

Proper placement and compaction of the pipe side support and overlay material are essential to long-term performance of the pipeline. The placement and compaction of the embedment material must not damage or distort the pipe, or change alignment, level or grade of the pipeline. The pipe side supports and overlay should be leveled and compacted without use of heavy machinery.

Care should be taken that all leveling and alignment pegs, temporary packing and restraints, etc. are removed from pipeline embedment. Where trench support shielding was used, its removal shall be done in stages. All voids shall be filled by adding embedment material and allowing for additional compaction to achieve the required relative compaction over the whole embedment zone.

Trench fill material requirements depend on loadings on the pipeline and the maximum allowable settlement of the material. Where pipeline is installed in areas of heavy loads or under paved surface, a fill material that can be compacted to the required density should be used. Otherwise the excavated material free from large rocks, organic matter, or contaminated materials, may be placed on the pipe overlay and compacted. Mechanical compaction of the fill material shall not be commenced until the total depth of cover above the top of pipeline is adequate to prevent damage to the pipeline (e.g. at least 200 mm for hand-held or walk-behind equipment, and significantly more for larger machines).

Where ground water level is higher than the crown of the pipe, dewatering systems shall be operated until placement and compaction of a height of fill material sufficient to prevent floatation of the pipeline.

Field testing of pipelines is performed on fully assembled pipelines or its sections for the purpose of determining pipeline acceptability. The testing is conveyed in compliance with procedures and requirements given in AS/NZS 2033 and AS/NZS 2566.2 (see also Waters & Farr Technical Guide). Destructive testing of randomly/regularly cut fusion joints may predate the field pressure testing.

The actual short-term vertical deflection of a pipeline (deformed “elliptically”) shall not exceed 5% of pipe diameter when measured in 30 days from completion of placement and compaction of all fill material. Method of determination of 30-day deflection is given in Appendix O of AS/NZS 2566.2:2002 (see also Waters & Farr Technical Guide).