INFRAPIPE™

SUSTAINABLE SOLUTIONS FOR GENERATIONS TO FOLLOW

HANDLING, STORAGE, INSTALLATION, TESTING & REPAIR GUIDE

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INFRAPIPE™

SUSTAINABLE SOLUTIONS FOR GENERATIONS TO FOLLOW

FABRICATING FOR A BETTER TOMORROW

CONTENTS

OVERVIEW

This guideline specifies the requirements for handling, storage, and installation of Infrapipe™ in accordance with industry best practice and AS/NZS 2566.2:2002 – Buried flexible pipelines Part2: Installation.

Infrapipe™ is designed in accordance with AS/NZS 2566.1:1998 – Buried flexible pipelines Part1: Structural Design and manufactured in accordance with AS/NZS5065:2005 – Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications and should be referenced as 'Type B – ID Series' pipes. These pipes are primarily reliant upon side support to resist and transfer vertical loads to the soil around them without excessive deformation.

This document applies to the handling, storage, and installation of all Infrapipe™ pipes that are supplied by Infrapipe™, specifically buried flexible pipelines. It does not apply to above ground pipelines, access chambers, bored/jacked pipes, relining of pipes, and submarine pipelines. For information regarding any other installation methodology please contact Infrapipe™.

This document outlines the preferred methodology for testing rubber ring pipelines, extrusion welded pipe joints and electrofusion welded pipe joints.

This document provides insight into repair methodology that is approved by Infrapipe™ and the three approved methodologies for adding in lateral connections which include the HAS connection, Fernco Qwik Seals, and extrusion welding.

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TRANSPORTATION, HANDLING & STORAGE

SCOPE

This section specifically outlines the requirements for the transportation, handling and storage of Infrapipe™ pipes and fittings.

LOADING & UNLOADING

All Infrapipe™ pipes shall be handled in a manner that avoids damaging them. It is important that the operation of loading shall be carried out in a manner that:

- Ensures stability of the loading vehicle e.g. forklift or crane
- Ensures the transport vehicle is level prior to loading
- Prevents damage to any pipes or fittings

Pipes shall not be dragged or pushed. Pipes shall be lifted onto trucks using any of the following methodologies:

- Use of a carpet pole down the middle of the pipe (when lifting EF pipe make sure to lift in a manner that does not damage the EF wire)
- Side loading with a forklift or telehandler
- Using the lifting lugs that have been extrusion welded to the pipe
- Using two strops choked around the pipe with a best practice lift angle of 60 degrees. A lift angle should not be less than 45 degrees

It is important to ensure the socket or spigot ends of the pipe are not supporting any of the pipes weight when loaded as this can impact the reliability of the pipe joint.

USE OF LIFTING LUGS

Infrapipe™ can supply and weld on HDPE liftings that are tested and certified for the lifting of pipes and fabricated items. The lifting lugs are extrusion welded to the pipe, manhole, bend or fitting for ease of lifting and handling.

These HDPE lifting lugs are for loading, unloading and for lowering pipes into the trench. It is important to ensure for the safe use of the lifting lugs are followed. The points are:

- Do not use them if it is not stamped with a punch tool to identify it has been tested,
- Do not side or shock load,
- Do not use to pull or drag the pipe,
- Do not use when the lifting equipment is moving e.g. an excavator tracking with a pipe. If you do wish to move then choke stropping the pipe is preferable,
- Do not use for lifting at angle that is less than 45 degrees, and
- Do not use them to push the pipes together.

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TRANSPORTATION, HANDLING & STORAGE

TRANSPORTATION

All Infrapipe™ pipes shall be supported and secured in a way that prevents excessive deformation to the pipe cross section and shall minimise the risk of bowing or twisting the pipes.

Infrapipe™ will supply wooden dunnage that the pipes will sit on in transit to mitigate the risk of pipes deforming during transport. This dunnage is to be taken off the truck and used for storing the pipes onsite.

It is important to note that the height of the stack shall be limited if there is a risk of damaging or over deforming that pipes. Nesting of pipes inside each other is encourage as this is not only an economical way of transporting Infrapipe™, but an advantage of the lightweight profile pipe system.

Figure 1: Ratchet tie downs with safety latches are the preferred method of restraint for transportation

All supports, restraints and packing will be transported in a manner to prevent point loading, scrapping, shock or any other damage during transit. Infrapipe™ is best tied down using nylon ratchet tie downs and if chains are used, they should never come into direct contact with the pipes and fittings.

STORAGE

Suitable storage sites are to be chosen that have enough area to store any pipes that will not be in use throughout the installation project. When selecting a storage area, it is important to consider:

- The site is level and firm,
- Clear of combustible materials to minimise the risk of fire damage,
- If long term storage is required (6 months or more) the pipes may need to be covered,
- There is no obstruction to vehicles, pedestrians, and property access, and
- All pipes are stored 2m away from a trench or excavation.

Infrapipe™ will supply flat timber dunnage for the Infrapipe™ pipes in transport and this is to be used at the same intervals when storing the pipes onsite. It is important to check that the pipes are stored correctly. Important aspects to check are:

- The sockets, spigots or ends of the pipes are free from any load and all ends are clear of debris
- The bottom layer of pipes that are stored in stacks are not going to deform over time under load
- Pipes are supported in a manner that will limit longitudinal deformation

If unsure, please check with the Project Manager allocated by Infrapipe™.

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INSTALLATION

THIS SECTION OUTLINES THE INSTALLATION PROCESS FOR INSTALLING INFRAPIPE™ PIPES AND COVERS OFF SOME KEY POINTS THAT IF FOLLOWED WILL MAKE SURE THE INSTALLATION WILL GO AHEAD WITH NO ISSUES.

It is important that all the points outlined in the loading & unloading, handling and storage sections are followed as these are critical to how the pipe will perform during the installation.

PRE-INSTALLATION INSPECTION

This section is about inspecting the pipes and managing any defects or damages that may have happened onsite prior to installation and is written in accordance with Section 3 of AS/NZS 2566.2.

Pipeline components which include, pipes, bends and manholes, shall be inspected, internally and externally, on delivery and immediately prior to installation, for compliance with product specifications and to ensure no damage has occurred. However, the rubber rings supplied by Infrapipe™ in sealed packaging shall not be removed for inspection until immediately prior to installation. Acceptance criteria for pipes, bends and manholes on delivery and immediately prior to installation shall be as follows:

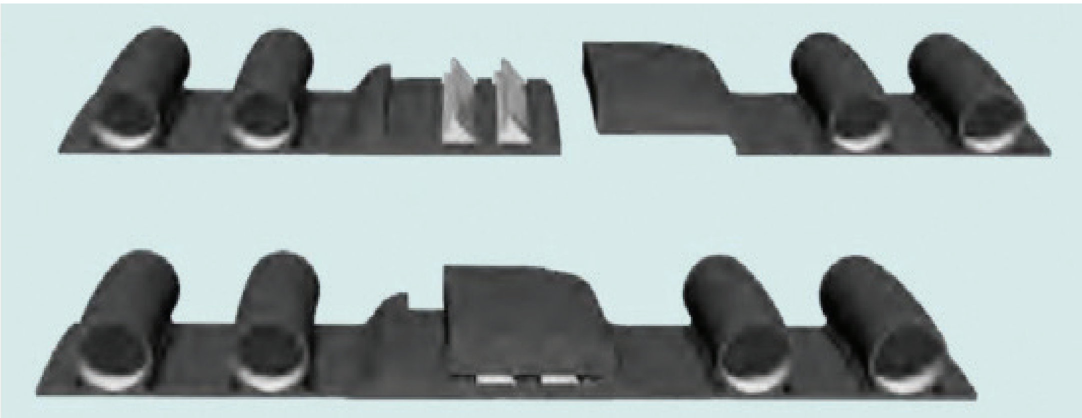
- All product materials, diameters, lengths, pressure & stiffness ratings, joint types, fitting types and accessories shall comply with project specifications.
- Rubber rings are to have no cuts, weather damage, or dislodgement that could affect their overall performance.
- All pipeline jointing/connections, coatings and wall structures shall have no defects or damage that could affect their overall performance.
- Significant cuts or scratches on pipes, bends or manholes are to be photographed and sent to Infrapipe™ by the contractor so sign off or repair methodology can be advised. It is important that Infrapipe™ is notified of any damaged pipes that are found during the pre-installation inspections so sign off to continue or advise of the preferred repair methodology.

CONNECTION DETAILS & PUSHING PIPES TOGETHER

This section will cover off the preferred methodology for pushing together Infrapipe™ pipes onsite. If there is any questions that arise from this section, please contact Infrapipe™ directly.

Connection Types

Infrapipe™ pipes are typically male (spigot) to female (socket) connections. The spigot end can have one groove for single rubber ring (SRR), grooves for double rubber rings (DRR) or no grooves which is for an electrofusion (EF) connection. The socket dimensions stay the same as they are fixed on the mandrel that the pipes are made from.



Electrofusion connections are also a plug-in connection, but the socket is equipped with a brass electrofusion wire. Spigots are not equipped with electrofusion wire.

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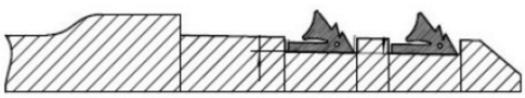
Pushing Pipes Together

When manufacturing Infrapipe™ pipes it is extremely hard to get the pipes the exact length, so when installing a pipeline it is important to lay the pipes in the correct order, as provided by Infrapipe™, that way the position of manholes and any laterals is correct. For sizes greater than DN1200 this is also important because these pipes are test fitted into each other prior to dispatch.

These steps outline the correct way to push Infrapipe™ pipes together while in a trench and they are:

1. Before lifting the pipes into the trench, position the pipes so that the pipe ends are easily accessible. Ensure the bedding material is laid at the correct grade before putting the pipe in.
2. Check the socket and spigot end for any damages that may have occurred onsite while wiping them free of debris and dirt. There will be 'Top' written on the pipe to identify the top of the pipe as it should be in the trench. This ensures that pipes are installed in the same position as they were test fitted – this applies to DN1200 pipes and above.
3. On the spigot, identify the witness mark which indicates the depth the spigot is to be pushed into the socket.
4. At this point the rubber rings can be installed (unless EF) onto the cleaned spigot end and position them in the grooves (note the picture as the only correct way to fit the rubber rings to the spigots).



5. Ensure to wipe out any debris from the socket end of the pipe that the prepared spigot is going to be connected to.
6. Apply pipe lubricant to the socket. Do not apply lubricant to the spigot ends as it can cause the rubber rings to slide out of their grooves. Infrapipe™ can supply this if necessary.
7. Lift the pipe into the trench. Place it into position and ensure the alignment is correct. It is important to make sure the pipes are correctly aligned to each other to prevent jamming.
8. Place a 100mm by 100mm wooden post (or railway sleeper) at the end of the pipe and use either an excavator bucket or track an excavator with a blade against the wood to push the spigot inside the socket up to the witness mark.
9. The connection must be tested for leakage with a pneumatic air bellows pressure tester before back filling the trench. Please refer to the Infrapipe™ pipe joint testing procedure.

MINIMUM COVER & EMBEDMENT ZONE GEOMETRY

This section is about the minimum cover, embedment zone geometry and requirements and is written in accordance with Section 4 of AS/NZS 2566.2.

Minimum Cover

The minimum pipeline cover is specified to:

- Ensure surcharge loadings are, e.g., construction loading or design loading, are not concentrated and are distributed over an appropriate area
- It is important to provide sufficient cover clearance to overlying layers that require heavy mechanical compaction, e.g., road sub-bases
- Ensure the pipe embedment or side support is appropriate in regard to the proposed land use and any foreseeable lowering of finished surface levels.

Minimum cover heights on pipes are available in Table 4.1 from AS/NZS 2566.2:2002, which states:

LOADING	MINIMUM COVER
No vehicle loading	300mm
Agricultural use zoned land	600mm
Non-carriageway vehicle loading	450mm
Sealed carriageway vehicle loading	600mm
Unsealed carriageways	750mm

Embedment Zone Geometry

The minimum width of a trench, measured at the springline, shall comply with Table 4.2 from AS/NZS 2566.2:2002 and shall be sufficient for:

- The placement and compaction of the designated embedment materials, particularly below the pipeline springline in the haunching area. It is important that the material is compacted to the specified relative compaction rate
- Connection and inspection of joints.

Infrapipe™ can make design consideration for narrower trenches, but this needs to be made known as a requirement during the structural design stage. The trench width above the embedment zone shall be determined by considering the stability of the trench wall material and any trench support that is required for installation.

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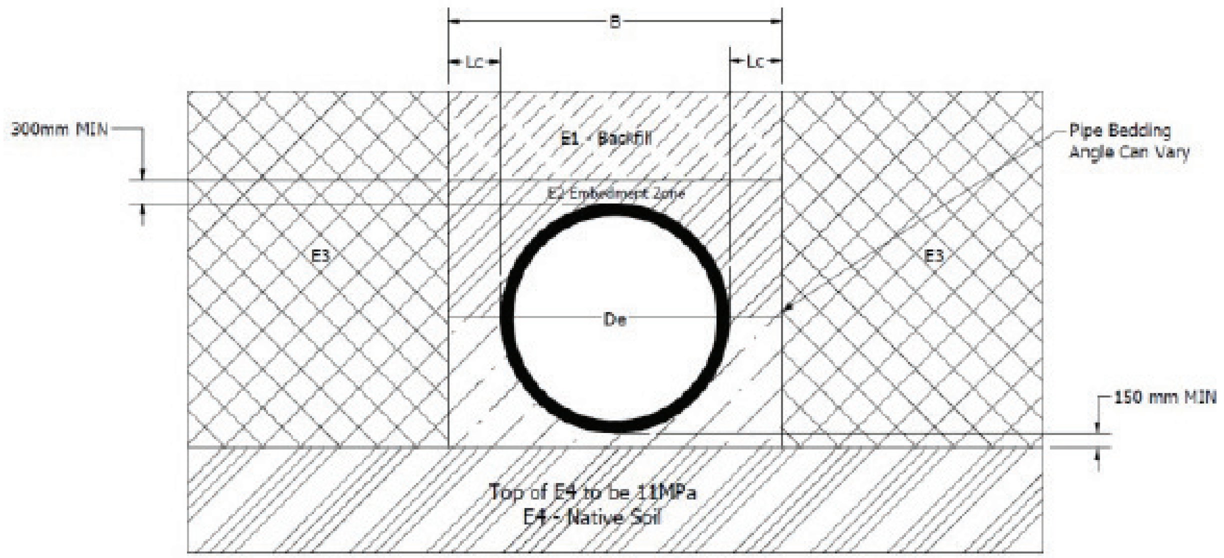
INSTALLATION

The minimum trench zone dimensions are displayed in Table 4.2 from AS/NZS 2566.2:2002, see below:

PIPE OUTSIDE DIAMETER (DE)	MINIMUM DIMENSIONS REQUIRED			
	Lb	Lc	Lo	B = De + (2LC)
>450mm – >900mm	150mm	300mm	150mm	1,050-1,500mm
>900mm – <1,500mm	150mm	350mm	200mm	1,600-2,200mm
>1,500mm – <4,000mm	150mm	0.25De	300mm	2,250-6,000mm

Key: B = Overall trench width at pipe springline & Lc = gap either side of the pipe to edge of trench

Trench Installation Zones and Dimensions



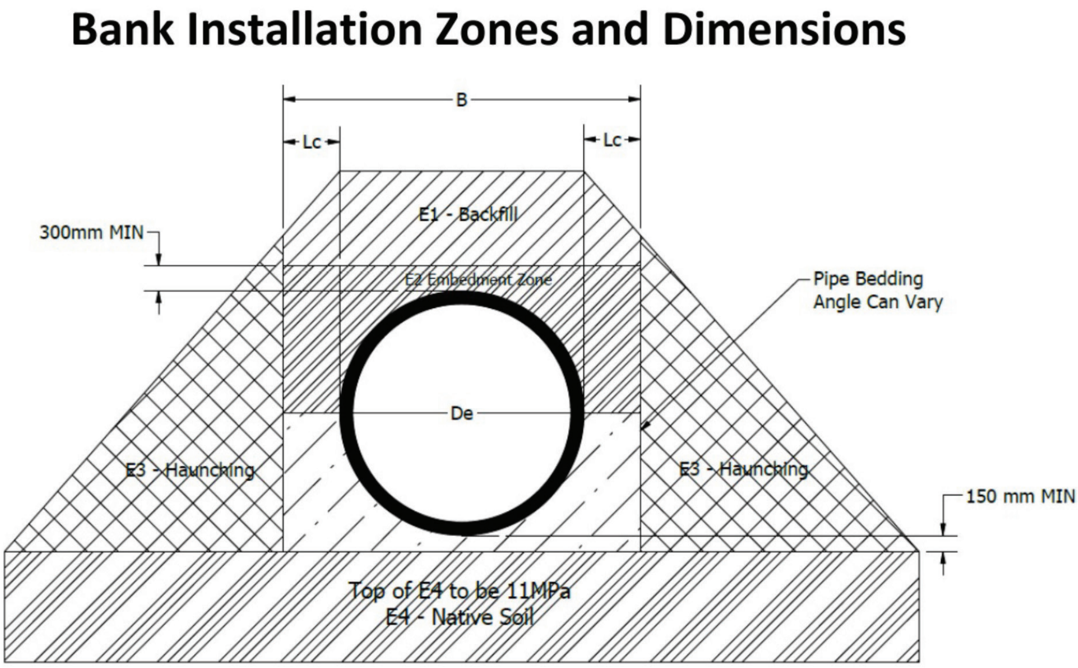
Embedment (E2) Zone Materials

For the minimum embedment spacing between parallel pipelines refer to table 5.1 from AS/NZS2566.2:2002 (below).

PIPE OUTSIDE DIAMETER (DE)	COMPACTABLE EMBEDMENT MATERIAL	CONTROLLED LOW STRENGTH MATERIAL (CLSM)
>450mm – >900mm	300mm	150mm
>900mm – <1,500mm	350mm	175mm
>1,500mm – <4,000mm	De/4	200mm

MATERIALS AND COMPACTION REQUIREMENTS

This section is about the materials used for embedment and compaction rates required to be used during installation and is written in accordance with Section 5 of AS/NZS 2566.2:2002. The trench drawing below is to be used to reference pipe zones E1, E2, E3 & E4.



Embedment (E2) Zone Materials

It is important to identify if there is a possibility of migration of fines between the native soil and the embedment zone material, a geotextile filter fabric should be considered, as long as it complies with Appendix J of AS/NZS2566.2:2002. The geotextile filter fabric shall be a non-woven fabric made from filaments of synthetic fibres, which meets the requirements specified in Table J1.

TABLE J1: SPECIFICATION FOR GEOTEXTILE FILTER FABRIC

PROPERTIES	TEST METHOD	UNITS	VALUE
Mean Values of Mechanical Properties			
Mass per unit area	AS 3706.1	g/m²	≥140
Trapezoidal tear strength	AS 3706.3	N	≥180
'G' Rating	*	G*	≥1,000
Grab Tensile Strength	AS 2001.2.3	N	≥400
Mean Hydraulic Properties			
Pore size – dry sieving O95	AS 3706.7	µm	≤250
Permittivity	AS 3706.9	g-1(reciprocal seconds)	≥0.5
Flow rate under 100mm of head	AS3706.9	L/m².s	≥50

*G rating (geotextile robustness rating) $G = \sqrt{(L * hse)}$, where L = plunger failure load (N) determined by AS 3706.4 and hse = Normalised drop height determined by AS 3706.5

Native soils, particularly cohesionless soils with gradings no finer than those specified in Table G1, may be suitable where approved by the engineer and/or the manufacturer. It is important to avoid sands that are prone to 'bulk' when moist. Where they are used, ensure that the required density will be achieved.

TABLE G1: COHESIONLESS NATIVE SOILS ACCEPTABLE FOR EMBEDMENT MATERIAL

SIEVE SIZE (MM)	MASS OF SAMPLE PASSING (%)
19.0	100
2.36	75 ± 25
0.6	55 ± 35
0.3	35 ± 25
0.15	≤25
0.075	≤10

Imported cohesionless embedment material with gradings specified in Table G2 and Table G3 will facilitate the achievement of the soil moduli given in Section 3 of AS/NZS 2566.1:1998: Buried flexible pipelines - Structural design.

Note: Compaction equipment will be required for all embedment materials except for coarse aggregates.

TABLE G2: PROCESSES AGGREGATES ACCEPTABLE FOR EMBEDMENT MATERIALS

SIEVE SIZE (MM)	MASS OF SAMPLE PASSING (%)						
	Nominal Size of Aggregate (mm)		Nominal Size of Single-Size Aggregates (mm)				
	20	14	20	14	10	7	5
75.0	-	-	-	-	-	-	-
53.0	-	-	-	-	-	-	-
37.5	-	-	-	-	-	-	-
26.5	100	-	100	-	-	-	-
19.0	85-100	100	85-100	100	-	-	-
13.2	-	85-100	-	85-100	100	-	-
9.50	25-55	-	0-20	-	85-100	100	-
6.70	-	25-55	-	0-20	-	85-100	100
4.75	0-10	-	0-5	-	0-20	-	85-100
2.36	0-5	0-10	-	0-5	0-5	0-20	0-40
0.075	0-2	0-2	0-2	0-2	0-2	0-2	0-2

TABLE G3: OTHER MATERIALS ACCEPTABLE FOR EMBEDMENT MATERIALS

SIEVE SIZE (MM)	MASS OF SAMPLE PASSING (%)			
	Crushed Rock Dust	Well graded crushed rock (mm)		Sand
		20mm	14mm	
26.5	-	100	-	-
19.0	-	85-100	-	-
13.2	-	-	100	-
9.5	100	60-80	90-100	-
6.7	85-100	55-72	-	-
4.75	-	42-62	60-80	100
2.36	0-20	30-48	40-65	100-90
1.18	-	22-36	25-50	85-100
0.60	-	16-28	16-38	70-100
0.30	-	10-20	9-30	50-100
0.15	-	6-15	5-24	0-40
0.075	0-2	4-12	2-20	0-5
Liquid limit Plasticity Index		25 4	25 6	

Note: Tolerances on aggregates are generally ±10% for sieve sizes above 2.3mm (see AS 2758.1-1998 for details)

Table G4 should be used where gravel/sand gradings meeting the requirements of Table H1 for cement-stabilized embedment material are required (the gravel gradings in Table G2 and Table G3 do not meet the criteria).

TABLE 4: EMBEDMENT MATERIAL SUITABLE FOR CEMENT STABILISATION

SIEVE SIZE (MM)	MASS OF SAMPLE PASSING (%)	
	20mm	14mm
26.5	100	-
19.0	80-100	-
13.2	-	100
9.5	58-80	-
6.7	55-72	90-100
4.75	44-65	60-80
2.36	32-54	40-65
1.18	24-45	30-50
0.60	18-36	20-38
0.30	15-30	15-30
0.15	8-24	5-24
0.075	5-20	2-20
Liquid limit Plasticity Index	35 15	25 6

Notes: 1. These gravel/sand gradings meet the requirement of table K1 for cement-stabilised embedment materials and tolerances are generally ±10% for sieve sizes above 2.3mm (see AS 2758.1-1998 for details)

The material in the embedment zone may also consist of:

- Selected cohesionless soils (see Appendix G of AS/NZS2566.2:2002)
- Controlled low strength materials (CLSM) (see Appendix K of AS/NZS2566.2:2002)
- Stabilised soils (see Appendix L of AS/NZS2566.2:2002).

Backfill (E1), Trench Sides (E3) & Native Soil (E4) Zone Accepted Materials
The zones E1, E3 & E4 can be backfilled with excavated material if this is allowed for during the structural design stage. The material still must be compacted to meet the specified compaction (typically 95% MDD) or soil moduli.

E1 & E3 Compaction Requirements & Methodology
Infrapipe™ carry out structural design analysis accordance with AS/NZS2566.1:1998 – Buried Flexible Pipelines - Structural Design and allow for compaction of 95% MDD for all pipe zones E1, E2, E3 & E4 (unless specified otherwise by the designer or customer). Table H1 (below) covers compaction methods for all soil types. It is sequenced in order of the increasing compaction effort required to achieve a given soil stiffness or modulus that is required, the materials at the top of Tables H1 & H2 are the easiest to compact.

TABLE H1: TYPICAL COMPACTION AND CONTROL METHODS FOR ALL SOIL TYPES

DESCRIPTION	SYMBOL	TYPICAL RELATIVE COMPACTION CONTROL METHODS
Gravel – Single Size	**GP**	Gravels provide high moduli regardless of moisture content during or after compaction with minimal effort. Being highly permeable, they are often used for ground water control. They must be used in conjunction with geotextile filter fabric where particle migration is a possibility. For gravels, sands, and coarse-grained soils with ≤5% fines, the required relative compaction can usually be achieved by dumped placement. After placement, the material should be worked to ensure all voids, especially at haunches are filled. Where compaction is required use hand tampers, surface plate vibrators, vibratory rollers or internal vibrators. Compacted lift thickness should not exceed 300 mm. Where hand tampers or internal vibrators are used, the lift thicknesses should not exceed 150 mm, the length of the vibrator, or half the pipe diameter Density determination for low fines soils should be by density index (ID). Density determination for well-graded gravel/sand mixtures (GW) may also be determined using dry density ratio (RD)
Gravel – Graded ≤15% and sand fine ≤5% and 12% fines (i.e. some fines)	GM, GC, SC, SM and GM-SC, GC-SC	

TABLE H1 CONTINUED...

DESCRIPTION	SYMBOL	TYPICAL RELATIVE COMPACTION CONTROL METHODS
Coarse-grained soil with ≥12% fines (i.e. significant fines)	GM, GC, SC, SM and GM-SC, GC-SC	For sands and coarse-grained soils with 5% to 12% fines, which may grained soil with and GM-GL, behave as where they are either high or low fines content, methods of between 5% and GC-SC compaction and density determination should be those that give the12% fines (i.e., higher in-place density. That is for SW and SP soils with higher fines 'some' fines) content, standard dry density ratio (RD) may be used where test results show a well-defined compaction curve. Alternatively, the Hilf density ratio (RDH) is a rapid compaction control test method that will give results numerically similar to the dry density ratio, i.e., RD ≈ RDH within 1 h of sampling. See also Notes to Clause 5.6.3.3 for indirect test methods. Layer thickness should not exceed 150 mm or half the pipe diameter, whichever is the greater. These materials cannot be used where water in the trench will prevent the specified placement and relative compaction being achieved. They are more difficult to place and compact in the haunch zone and should only be considered for shallow pipelines not subject to superimposed live loads. Where the soil has a significant amount of fines, compaction using impact tampers or sheepsfoot rollers (in embankments) is required. Layer thickness should not exceed 150 mm or half the pipe diameter, whichever is the greater. Moisture content needs to be within 2% of the optimum for satisfactory relative compaction. Standard dry density ratio (RD) may be used for compaction control in conjunction with a nuclear density gauge or dynamic cone penetrometer counts which require calibration for site control of embedment material density. Alternatively the Hilf density ratio (RDH) is a rapid compaction control test method which will give results numerically similar to the standard dry density ratio i.e. RD≈RDH within 1 hour of sampling. See also Notes to Clause 5.6.3.3 for indirect test methods.
Fine Grained soil (LL≤50%) medium to no plasticity with more than 30% coarse-grained particles	CL, ML, and mixtures ML-CL and ML-MH	These materials cannot be used where water in the trench will prevent proper placement and compaction. They are more difficult to place and compact in the haunch zone and should only be considered for shallow pipelines not subject to imposed live loads. Where the soil has a significant amount of fines, compaction using impact tampers or sheepsfoot rollers is required. Layer thickness should not exceed 150 mm or more than half the pipe diameter, whichever is the greater. Moisture content needs to be within 2% of the optimum for satisfactory compaction. Standard dry density ratio (RD) may be used for compaction control in conjunction with a nuclear density gauge or dynamic cone penetrometer counts which require calibration for site control of embedment material density. DH within 1 h of sampling. See Notes to Clause 5.6.3.3 for indirect test methods

TABLE H1 CONTINUED...

DESCRIPTION	SYMBOL	TYPICAL RELATIVE COMPACTION CONTROL METHODS
Fine Grained soil (LL≤50%) medium to no plasticity with more than 30% coarse-grained particles	CL, ML, and mixtures ML-CL and ML-MH	Alternatively, the Hilf density ratio (RDH) is a rapid compaction control test method, which will give results numerically similar to the standard dry density ratio, i.e., RD≈RDH within 1 h of sampling. Notes to Clause 5.6.3.3 for indirect test methods.
Fine Grained soil (LL ≤50%) medium to no plasticity with ≤30% coarse-grained particles	CI, CL, ML and mixtures ML-CL, CL-MH, and ML-MH	Under special circumstances these soils may be accepted as embedment material for shallow trunk water mains in open country where cohesionless materials are not readily available. They are difficult to use at higher relative compaction such as under roadways or at greater cover heights. That is, they have to be compacted at a moisture content close to the optimum for satisfactory results. Compaction methods are as for the fine-grained soils above,
Fine Grained soil (LL≥ 50%) medium to high plasticity	OL, OH, CH, MH and CH-ML	Not suitable for embedment material in normal installation circumstances

NOTE: The Clegg impact soil tester may offer an alternative to relative compaction monitoring as the Clegg impact value (CIV) can be correlated directly with the soil stiffness modulus. It is not suitable for coarse aggregates.

TABLE H2: GUIDING PARAMETERS FOR COMPACTION OF MECHANICALLY STABLE SOIL

SOIL PARAMETERS (%)			
Ease of Compaction	**Good**	**Intermediate**	**Fair**
Liquid Limit	≤25	≤28	≤35
Plasticity Index	≤5	≤8	≤12
Linear Shrinkage	-	≤4	≤8

NOTE: Soils that can be categorized as 'Fair' or 'Intermediate' in accordance with this Table may prove to be worthy of higher ranking, where the percentage passing the 0.425 mm test sieve is low. Such soils may be acceptable in the 'Good' category of this Table, subject to determination by the specifier and geotechnical specialists, as appropriate.

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DEFLECTION CRITERIA

Infrapipe™ pipes deflection requirements are 5% short-term and 7.5% long-term as per AS/NZS2566.1:1998 – Buried Flexible Pipelines - Structural Design. The short-term vertical deflection is to be measured in accordance with Appendix O around 30 days after installation and backfilling has been completed to the required compaction rates.

Appendix O states for pipes less than 750mm the procedure shall be:

1. Clean the pipeline.
2. Determine the allowable short-term deflection, which is 5%.
3. Before installation, determine the minimum mean internal diameter of pipes and fittings by measurement on site.
4. Determine the external diameter for a rigid prover. The external diameter shall be equal to the allowable minimum deflected internal diameter of pipeline components in the test section, including any allowance for ovality, less 2 mm to 3 mm. Vaned provers shall have a minimum of 8 vanes. The length of a vaned or cylindrical portion of the prover shall be (1.0 to 1.3) internal pipe diameter. The equation for calculating the prover overall outside diameter is as follows: $Od = d_{v1}\left(1 - \left(\frac{\Delta_{y\,sall}}{100}\right)\right) - 2.5$
5. Pull the rigid prover through the pipeline by hand or by using a hand winch.

Appendix O states for pipes greater than 750mm the procedure shall be:

1. Measure and record the minimum vertical internal diameters of every pipe, between indelible marking a the mid lengths and, where considered necessary, at the pipe joints, at the following times.
2. Immediately after the particular pipe is properly laid and before the side support is placed and compacted (dv1). Alternatively, the mean internal diameter for a circular pipe may be taken as dv_1.
3. At a specified agreed time after completion of the placement and compaction (dv_2).
4. The diameters shall be measured between indelible markings on the crown and invert, which provide a vertical measurement. The diameter shall be measured at the mid-length of each pipe or as specified. The measuring device shall have an accuracy of measurement to within ±2 mm.

NOTE: Where the diameters before and after backfilling are not measured at exactly the same point the diameter change is less accurate. Experience has shown from continuous traces of the vertical diameter that the diameter can vary substantially along a pipe length both before backfilling and after backfilling.

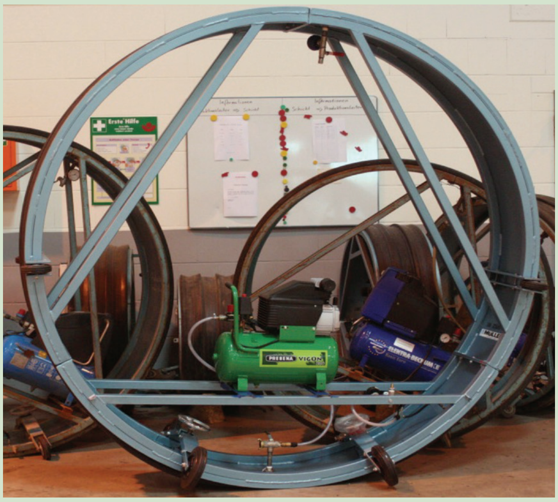
5. Calculate the actual short-term vertical pipe percentage deflection by use of the following equation: $\Delta_{y\,sact} = \frac{d_{v1} - d_{v2}}{d_{v1}} * 100(\%)$
6. The pipeline shall be acceptable, where the actual short-term vertical pipe deflection, calculated from Equation O(2), is less than 5%.

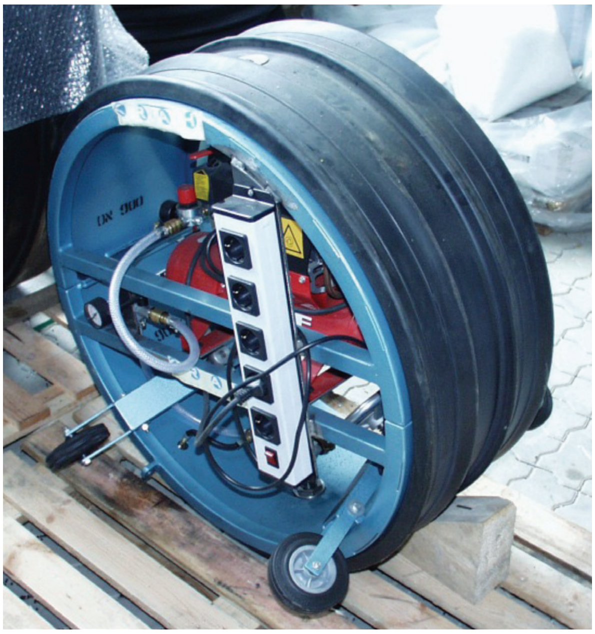
JOINT TESTING METHODOLOGY

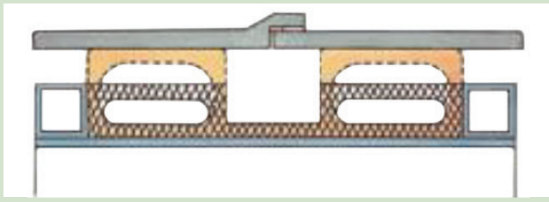
INFRAPIPE™ PIPES ARE BEST TESTED THROUGHOUT THE INSTALLATION PROCESS AS IT IS A QUICK AND EASY PROCESS USING THE INTERNAL AIR TESTERS.

The methodology is the same for both rubber ring and electrofusion joints.

1. The Internal Air Testers are individually suited to each pipe size so ensure that the correct air tester is being used.
2. At the start of each day, it is important to test the Internal Air Tester on a middle section of pipe to ensure there is no leaks and the testing unit is operational.
3. Before testing a welded joint, it is important that it is allowed to cool for 30- 40 minutes. The inside of the pipe should be cleaned 500mm either side of the joint to ensure there is no debris or anything that may damage or cause the bellows not to seal. Ensure that the rubber outside of the bellows are also clean and free of debris before testing. This is best done with isopropyl alcohol and lint free rags.
4. The Internal Air Tester is then rolled over the joint using the adjustable wheels.
5. If it is a rubber ring joint, the end of the pipe that has just been added to the pipeline will need restrained with an excavator or a weight as the pipes will push apart with the air pressure if this is not completed.







6. The centre of the bellow tester is put over the joint (as above) and the outside bellows are pumped up to 150kpa, 1.5bar or 21.75psi.

7. The centre of the bellow tester is pumped up to 50kpa, 0.5bar or 7.25psi.

8. The joint is subject to a test pressure of 0.5 bar for a minimum of 5 minutes and a maximum of 10 minutes, the allowable pressure drop over this period is 10kPa, 0.1bar or 1.45psi.

9. If the Internal Air Tester drops pressure suddenly during testing, check to ensure that the rubber bellows are getting an adequate seal on the pipe surface. This can be fixed by checking for any debris or by rotating the bellows slightly.

10. All weld tests are to be recorded on a daily testing document.

11. Leave the Internal Air Tester inside the pipeline while the next pipe is being installed. This is to minimise handling which will lower the risk of damaging the Internal Air Tester.

Air testing is the approved methodology for the Infrapipe™ electrofusion joints as they are typically for gravity systems only. Destructive testing does not apply to Infrapipe™ electrofusion joints.

INFRAPIPE™

REPAIR METHODOLOGY

THE METHOD OF REPAIRING DAMAGED HDPE PROFILE PIPE IS DEPENDENT UPON THE DEGREE OF DAMAGE SUSTAINED.

Localised damage may be repaired by use of an EF saddle or 2-piece coupler or patches extrusion welded around the damaged area. Information and supply of parts & labour can be obtained from Infrapipe™.

More extensive damage will require the section of pipe to be cut out and replaced. This is a relatively simple process, firstly isolating the damaged section using HDPE Sheet patches, cutting out the section and replacing with new pipe using extrusion welding and patches/ couplers to tie-in the sections. It is important that the replacement section is of suitable diameter and SN rating to maintain the integrity of the pipeline.

In all cases reference should be made to the manufacturer and all health and safety procedures should be closely followed.

The methodology for repair is assessed on a feasibility and risk structure that is determined using static loading, wastewater or stormwater and time. Infrapipe™ will work with the customer/asset holder to determine what is to be done.

EXTRUSION WELDED REPAIR EXAMPLE

Step 1: Determining the Size of the Damage

It is important to expose as much of the damaged pipe as possible so ensure that excavation is done extremely carefully and where possible use hand tools. To determine the size of the damage by taking measurements and photographs that can be sent to the Infrapipe™ appointed Project Manager. They will quickly determine the appropriate methodology for repairing the damage.

For the damage shown to the left, a HDPE patch repair is the most appropriate repair methodology as the damage is easily accessible.

Step 2: Starting the Repair

The damaged area will need to be removed and then the area where welding will take place is to be cleaned with isopropyl alcohol and lint free rags. As a watertight weld is required it is important to remove any potential contaminants from the weld zone. Once the hole is cut a final measurement of the patch will be taken. It is important prior to welding that the inside layers of the HDPE pipe are bevelled with a router or a hand scraper to minimise the potentially for any debris to get caught on it in the pipeline.

Step 3: Extrusion Welding the Patch

To carry out extrusion welding repairs on site there needs to be a constant power source, no moisture in the weld zone and the work is to be carried out by a competent extrusion welder and preferably a Infrapipe™ employee.

THE PATCH IS MADE FROM HDPE SHEET WHICH CAN BE HEATED TO FORM THE DIAMETER OR CAN BE FABRICATED PRIOR WITH CUTS AND WELDS TO HAVE THE SAME RADIUS AS THE PIPE THAT REQUIRES REPAIRING.

INFRAPIPE™

REPAIR METHODOLOGY

THERE ARE THREE WELDS THAT NEED TO BE COMPLETED TO ENSURE THE WELD IS WATERTIGHT AND THEY ARE:

1. A tack weld to hold it in place,
2. A 'V' block weld that will create a watertight weld, and
3. A 'Block' weld which adds to the watertightness and increases the strength of the weld.

All the extrusion welds will be completed in accordance with *Technical Code DVS 2207-4 Welding Thermoplastic Materials – Extrusion Welding of Pipes, Piping Parts, Fittings and Panels* including supplement 2.

IF INFRAPIPE™ EMPLOYEES CARRY OUT THE REPAIR THEN CERTIFICATION OF THE WELDS CAN BE SUPPLIED UPON REQUEST.

EXTRUSION WELDED REPAIR EXAMPLE

Step 4: Adding the Stiffening Ribs

Once the patch is fitted in place and all 3 welds have been completed it is time to add the stiffening ribs to ensure the patch piece exceeds the required pipe strength.

The stiffening ribs are also made from HDPE and are extrusion welded onto the exterior of the patch. After the welds have cooled the pipe can be backfilled in accordance with AS/NZS 2566.2:2002 – Buried flexible pipelines Part 2: Installation.

If the pipe is a solid wall or twin wall structure pipe the repair is still the same, but a pipe section of a similar strength can be manufactured and used as opposed to HDPE sheet.

INFRAPIPE™

FUTURE CONNECTIONS

THERE ARE THREE METHODS OF ADDING IN FUTURE CONNECTIONS INTO INFRAPIPE™ PIPES THAT ARE RECOMMENDED BY INFRAPIPE™ THEY ARE: THE **HAS CONNECTION**, **FERNCO QWIK SEALS**, AND **EXTRUSION WELDING**.

1

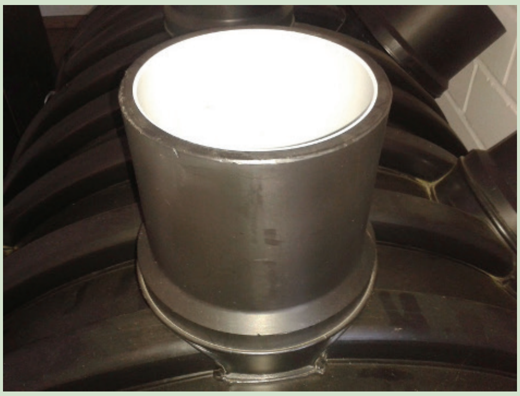
HAS Connection

The Infrapipe™ system fulfills the highest requirements of water tightness and longevity when it comes to HDPE pipe systems. It is important when adding in future connections that these requirements are accounted for and the HAS Connection methodology meets these high demands.

The HAS system installation process is similar to butt welding two pipes together. It uses heat, time, and pressure to ensure a durable connection.

For more information visit: https://www.krah.net/index.php/en/krah-machines/equipment

The HAS Connection system is suitable for a new installation as well as a later integration in an open construction.



The connection pipes and lateral pipes up to 400mm in diameter can easily, quickly, and economically be welded to the main line.

2

Fernco Qwik Seals

Fernco Qwik Seals are a rubber coupler that meet the requirements of *AS/NZS 4327:1995 – Metal-banded flexible couplings for low-pressure applications (Reconfirmed 2020)* and are ideal for connecting pipes ranging from 100mm to 200mm pipes into existing lines.

Fernco Qwik Seals are approved by multiple councils around New Zealand as an acceptable coupler for lateral connections.

FERNCO QWIK SEALS ARE EASY TO USE AND EXTREMELY COST EFFECTIVE.

3

Extrusion Welding

Infrapipe™ can provide site welding services for a PE lateral connection to be extrusion welded into an existing pipe.

Extrusion welding is how Infrapipe™'s manholes and tanks are fabricated therefore it is more than acceptable for providing a fully welded PE connection.

The upside to extrusion welding lateral connections is that the size of the lateral can be the same size or smaller than the existing mainline.

However, it can only be carried out on twin wall or solid wall structure pipes and not the profile wall.

Fabricating for a better tomorrow

Infrapipe's Vision is "Fabricating for a Better Tomorrow".

We sustainably manufacture infrastructure solutions in PE and PVC for the people of New Zealand, focusing on values that help to conserve and protect our planet whilst always watching over our whanau.

Now that's standing for better...

INFRAPIPE™
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