

# ACS710 Pipeline construction

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## ACS710.1 Scope

This Specification covers the construction and materials for all underground gravity stormwater pipelines. This Specification shall be read in conjunction with Standard Specification *ACS510: Earthworks and the Particular Specifications*.

## ACS710.2 Materials

### ACS710.2.1 Concrete pipes

Concrete pipes shall comply with NZS 4058 and AS/NZS 3725. The pipe class shall be as shown in the Drawings or Particular Specifications.

### ACS710.2.2 Polyvinyl chloride (PVC) pipes

PVC pipes shall comply with AS/NZS 1254 or AS/NZS 1260. The pipe class shall be a minimum of SN16.

### ACS710.2.3 Polyethylene (PE) pipes

Polyethylene pipes shall comply with AS/NZS 5065 (*non-pressure applications*) or AS/NZS 4130 (*trenchless and pressure applications*). PE pipes shall be manufactured from PE100 resin and shall have a maximum SDR of 17.

### ACS710.2.4 Twin-walled polypropylene pipes (PP)

Twin-walled polypropylene pipes shall be manufactured to AS/NZS 5065. The pipe class shall be a minimum of SN16.

### ACS710.2.5 Fill materials

Materials used for fill shall comply with Auckland Council Standard Specification *ACS510 Earthworks*.

## ACS710.2.6 Storage of materials

Pipes shall be unloaded and handled in accordance with the manufacturer's recommendations.

Pipes shall be lifted and placed in accordance with the manufacturer's recommendations. Damaged pipes shall be replaced or repaired, as directed by the Contract Administrator. No pipe shall be laid which is cracked, spalled or damaged, and all such pipes shall be removed from the site by the Contractor.

Precast units shall be stored on level ground and shall not be stored in carriageways or footpaths without the prior consent of the Contract Administrator.

Pipes, other than concrete pipes, shall be protected from direct sunlight if stored for more than one month after delivery from the supplier.

Concrete pipes that have chips, cracks or other damage that, in the opinion of the Contract Administrator compromise their integrity, shall not be used in the works.

PVC pipes that have scoring or damage to a depth greater than 10% of the wall thickness or 1 mm (whichever is lesser) or have been distorted because of improper handling and/or storage shall not be used in the works.

PE pipes that have scoring or damage to a depth greater than 10% of the wall thickness shall not be used in the works.

## ACS710.2.7 Quality assurance

The Contractor shall ensure that the materials comply in all respects with the Drawings and Specifications.

## ACS710.3 Tolerances

The position tolerance for pipe laying at any point along the length of the installation shall be within  $\pm 30$  mm from the specified design. Notwithstanding this, no pipe shall be laid at zero or negative grade, unless otherwise indicated in the Drawings or Particular Specifications.

Pipe penetrations into any structure shall be to the tolerance required by the structure, or if not otherwise stated in the Particular Specifications or Drawings,  $\pm 5$  mm.

### ACS710.3.1 Laying tolerance

Where a pipeline is required to be straight between end points, the maximum deviation of the longitudinal axis from the design alignment of the pipe barrel shall be:

- a) Vertical position: a maximum deviation of 35 mm from the design level. There shall be no negative grades
- b) Horizontal position: within 0.3% of the drilled distance from the design position at the end of the jacked section(s) to a maximum of 100 mm.

For carrier pipes, the lateral displacement in position from that shown on the drawings shall not exceed 35 mm in any 10 m length. Any lateral displacements may be of a gradual nature only. Abrupt displacements between pipe joints shall not exceed 10 mm.

### ACS710.4 Trench excavation

Trench excavations shall be in accordance with Auckland Council Stormwater Standard Specification *ACS510 Earthworks*.

Excavations shall not commence until sufficient supplies of all relevant materials are available to ensure speedy and uninterrupted progress of the work.

The trench floor shall be excavated to form a flat, firm base to support bedding material. Over excavation at the base of the trench shall be filled with bedding material and compacted in layers as required for the bedding.

### ACS710.5 Jointing of socket and spigot pipes

Joints shall be made in accordance with the manufacturer's instructions.

Solvent welded joints shall not be used for PVC pipes.

The number of joints shall be minimised.

Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled.

All socket and spigot joints shall be made with rubber rings designed for use with the pipe being used. The spigot and socket of all pipes to be jointed shall be wiped clean immediately before jointing and rings shall only be used if they are clean. When making a joint, the rubber ring shall be stretched evenly and free from twists, around the spigot of the pipe to be laid. The pipe shall then be lined up and supported so as to be concentric with the pipes already laid.

Pressure shall be applied to the socket end to force the spigot into the socket of the preceding pipe until the end of the pipe being laid bears on the shoulder of the preceding socket.

Concentricity of the pipes shall be maintained at all times. Pressure on the sockets shall be applied through a block of wood. Crowbars shall not be applied directly to the pipes.

Pipes shall not be laid to curves, unless otherwise specified. Where pipes with flexible joints are required to be laid to curves, the deflection at any joint as-laid shall not exceed three quarters of the maximum deflection recommended by the manufacturer.

## **ACS710.6 Jointing of PE pipes**

Jointing of polyethylene pipe, except where otherwise approved, is to be achieved by butt-fusion welding of the material or, where approved, by the use of stub flanges, electrofusion couplers or mechanical PE couplers.

Only pipes from the same manufacturing batch shall be joined, unless otherwise agreed by the Contract Administrator.

Butt fusion welding shall only be used to join pipes of the same resin type, diameter and SDR from the same manufacturing batch, unless otherwise agreed by the Contract Administrator.

Electrofusion couplers must be of a type to match the pipes being installed, including resin type, diameter and SDR.

### **ACS710.6.1 Cleaning prior to welding**

Acetone shall not be used to clean PE pipe. Only Isopropyl Alcohol (IPA) having a concentration of 95% or greater shall be used. It shall be acceptable to use IPA wipes manufactured specifically for PE welding, or IPA liquid together with clean lint-free cotton cloth, to clean PE pipe prior to welding.

## ACS710.6.2 Butt welding machine

The butt welding machine shall not be a manual type.

Calibration of butt welding machines shall include:

- a) Calibration and operation checks by the machine manufacturer (or by dealers authorised by the manufacturer to carry out this work) to the manufacturer's specification, including calibration checking of any weld parameters programmed into the machine
- b) Calibration and operation checks of the heater plate by the manufacturer or authorised dealer to the manufacturer's specification
- c) Calibration of all pressure measuring devices to BS/EN 837-1 Clauses 9.1 and 10.

All butt welds shall be data-logged recording all the following:

- a) Weld number or identifier
- b) Weld location
- c) Welding machine including model & serial number
- d) Welding operator and certification number
- e) Pipeline label including material type, OD, SDR, the actual mean wall thickness specified in AS/NZS 4130, pipe annular area
- f) Date
- g) Time
- h) Ambient temperature
- i) Machine cylinder area and ram ratio
- j) Heater plate area
- k) Software version
- l) Heater plate temperature
- m) Pressure and time parameters achieved:
  - i) Drag pressure
  - ii) Bead build-up pressure & time (P1 & T1)
  - III) Heat soak pressure & time (P2 & T2)
  - iv) Maximum change over time (T3)
  - v) Maximum time to achieve weld pressure (T4)
  - vi) Welding & cooling pressure (P3)
  - vii) Maximum & minimum bead size after cooling (mm).

Alternatively, the verification can be fully automated with the welding machine automatically assessing items (i) to (m) and verifying whether the weld is acceptable with a pass or fail, if agreed in advance with the Contract Administrator.

Data-loggers shall provide pressure-time data for the whole of the weld process that can be displayed in graphical form. Data shall be sampled at a rate that would provide a resolution sufficient to clearly represent short-term critical times such as change-over time and ramp-up time.

The data-logger shall be capable of downloading to a memory device or computer. Downloaded data-log information shall be provided to the Contract Administrator daily in MS Excel format.

### ACS710.6.3 Electrofusion welding control box

Prior to any welding, details of the electrofusion control box shall be provided as well as the data logger including its age and maintenance history and evidence that the control box has a current certificate of calibration. The electrofusion welding control box shall be an automatic bar code scanner machine not a manual input type machine.

Calibration of the electrofusion control box shall include calibration and operation checks by the control box manufacturer (or by dealers authorised by the manufacturer to carry out this work) to the manufacturer's specification.

All electrofusion welds shall be data-logged recording all the following:

- a) Weld number or identifier
- b) Weld location
- c) Welding machine
- d) Welding operator and certification number
- e) Pipe and fitting details
- f) Date
- g) Time
- h) The fusion-cool cycle was completed correctly, or
- i) The error code where the fusion-cool cycle did not complete correctly.

The data-logger shall be capable of downloading to a memory device or computer. Downloaded data-log information shall be provided to the Contract Administrator daily in MS Excel format.



Any electrofusion coupler which has undergone a partial weld cycle is to be discarded and cannot be reused.

#### ACS710.6.4 Miscellaneous pipe welding equipment

No electrofusion welding shall take place without the correct alignment clamps, mechanical peeling tools, and pipe cleaning equipment.

#### ACS710.6.5 Electrofusion welding clamps

The use of alignment clamps shall be mandatory for electrofusion welding, unless otherwise agreed with the Contract Administrator. The clamp leg shall be 2.5 – 3.0 times the pipe OD in length with at least 2 clamps on each leg.

The clamp shall be arranged so that there is no stress on the actual electrofusion coupler i.e. the coupler is free to “float”.

#### ACS710.6.6 Electrofusion re-rounding clamps

Where pipe ovality results in the gap between the pipe wall and the electrofusion socket exceeding the manufacturer’s recommendation at any point around the coupler’s circumference, the pipe shall be re-rounded by a re-rounding clamp. The re-rounding clamp shall not be removed until the cool time has elapsed.

### ACS710.7 Butt welding of PE pipe

#### ACS710.7.1 Construction butt welds

All welding will be carried out in accordance with the Work Method Statement.

No construction welding shall proceed until the Contractor has proven that pre-qualification test welds, for each nominated welder, are ductile and the pre-qualifications are confirmed, in writing, as being acceptable.

All construction welding shall be undertaken using the same welding operators, welding machines, plant, and welding parameters that produced the acceptable pre-qualification welds. Should the Contractor seek to change, or substitute, any plant and/or operator, a pre-qualification weld shall be welded using the new plant and/or operator. The pre-qualification weld must be proven to be ductile by testing and be accepted before substitution of the plant occurs.

All welds will be numbered, and a specific weld record will be maintained for each weld. The welder's certification number shall also be stamped on the bead of each welded joint.

For each welded joint, the Contractor shall provide the information outlined in Clause ACS710.6.2 (*Butt welding machine*) of this specification.

Unless accepted in writing, PE butt-welding parameters shall be the Single Pressure Low Fusion Jointing Pressure procedure set out in PIPA POP003.

All welding shall be undertaken in a sound and workmanlike manner and in accordance with the approved Work Method Statement. A shelter shall be used to provide adequate protection for the pipe, fittings, and equipment against dust and adverse weather conditions and to prevent contamination of jointing surfaces.

All sections of PE pipe shall be elevated above ground when moved to prevent damage to the pipe surface. Only equipment specifically intended for the purpose of supporting and moving pipework shall be used. The use of plastic or steel drums, timber beams, sandbags, etc. is not permitted.

Welded joints between sections of pipeline shall not be stressed until sufficient time has elapsed for the pipe joints to have cooled completely and attained full strength.

Where pipeline sections are to be pressurized following welding, the weld shall be allowed to cool to ambient temperature before being pressurised. In large PE pipelines, the cool period to ambient temperature is hours and the Contractor shall allow for this in their work method.

## ACS710.7.2 Testing of butt welded joints

Welds shall be evaluated on the following criteria:

- a) Visual inspection of welds
- b) Welding within agreed welding procedures
- c) Weld records to be maintained so that checking of actual weld parameters used can be made against target weld parameters
- d) Testing shall be made of one initial test welds for each pipe size, new machine or operator or new pipe source during pre-construction
- e) Any welds that are made without the required records being made and supplied to the Contract Administrator will be rejected
- f) Until the results of the initial test welds have been received, the Contractor may, entirely at his own risk, weld pipes but may not bury any pipe.

### ACS710.7.2.1 Visual inspection

Each joint will be visually inspected to check that:

- a) Both fusion beads are of the same size and shape and project evenly above the outside diameter of the pipe
- b) The bead width is within the parameters shown in Table 1
- c) There are no cracks in the beads
- d) There are no obvious inclusions or other faults present.

A check sheet shall be kept by the welder for each weld to show that the above items have been checked.

Table 1: Bead widths

| Bead widths                 |                    |                             |                    |
|-----------------------------|--------------------|-----------------------------|--------------------|
| Minimum Wall thickness (mm) | Width of Bead (mm) | Minimum Wall thickness (mm) | Width of Bead (mm) |
| 11                          | 9-12               | 40                          | 23-33              |
| 13                          | 10-14              | 42                          | 24-35              |
| 16                          | 11-15              | 44                          | 25-36              |
| 18                          | 12-16              | 46                          | 26-38              |
| 19                          | 12-18              | 48                          | 27-39              |
| 22                          | 13-18              | 50                          | 28-41              |
| 24                          | 14-19              | 52                          | 29-42              |
| 28                          | 15-20              | 54                          | 30-44              |
| 30                          | 16-22              | 56                          | 31-45              |
| 32                          | 19-27              | 58                          | 32-47              |
| 34                          | 20-29              | 60                          | 33-48              |
| 36                          | 21-30              | 62                          | 34-50              |
| 38                          | 22-32              | 64                          | 35-51              |

### ACS710.7.3 Pre-qualifying test welds

Before any construction welding is undertaken for the pipeline, the welding operator shall prepare one sample weld for each pipe size and SDR to be used. Pre-qualifying test welds shall be prepared, in the field, using the same jointing machinery, weld parameters, welding operator and pipe and that will be used to construct the pipeline.

Butt-weld samples for destructive testing shall have a minimum of 150 mm of pipe length on one side of the weld and a minimum of 300 mm of pipe length on the other side of the weld.

Tensile testing will be carried out on the test welds to confirm the suitability of the weld procedure in accordance with ACS710.7.5 (*Tensile testing*). These tensile tests must be accepted before commencement of further series fusion welding.

### ACS710.7.4 Construction test welds

Notwithstanding the results of destructive testing carried on welds from the pre-qualifying welding phase, construction welds shall be taken from the pipeline for destructive testing as directed.

The number of welds to be removed shall be one in every 20 welds completed per pipeline, unless otherwise specified.

Construction welds shall be taken at random, and wherever possible will be taken from the pull-off side of the butt-welding machine, to reduce replacement time for the Contractor. The Contractor shall be paid the scheduled rate for each construction test weld removed that is proven to be fully ductile by destructive testing.

Tensile testing will be carried out on the test welds to confirm the suitability of the weld procedure in accordance with ACS710.7.5 (*Tensile testing*). These tensile tests must be accepted before commencement of further series fusion welding.

Additional tests will be required if any of these situations applies:

- a) The initial test results are not satisfactory
- b) At any time in the Contract when there is a change to any one of the welding operator, the welding machinery or its program or pipe batch.

### ACS710.7.5 Tensile testing

Tensile testing shall generally be carried out in accordance with *ISO/FDIS 13953 (Polyethylene (PE) pipes and fittings)*

A graph of load verses tensile extension shall be supplied with each test specimen to assist in interpretation of ductile and brittle failures. It is acceptable for the tensile extension to be measured on the machine clamps and not on the pipe itself, if desired.

The acceptance of tensile results will be based on the following:

- a) The weld record sheet shall show that the weld has been carried out within the tolerances of the weld procedure
- b) The visual inspection of the weld shall confirm that the weld is consistent with ACS710.7.2.1 (*Visual inspection*)
- c) Ultimate tensile strength of the weld shall be no less than 0.9 of the pipe strength
- d) The test specimens shall rupture in a generally ductile manner.

### ACS710.7.6 Failure of pre-qualification test weld

If a pre-construction test weld does not meet the acceptance criteria for testing of butt-welds, the Contractor shall investigate the reasons for the failure and amend their welding procedure accordingly. The Contractor shall not amend the welding parameters without written consent.

The Contractor shall then prepare three additional pre-construction test welds and have these tested. The Contractor shall provide a short report on their findings and any remedial actions required, together with the test results.

No construction welding shall commence until all pre-construction test welds meet the acceptance criteria for testing of butt-welds. ACS710.7.2.1 (*Visual inspection*)

### ACS710.7.7 Failure of a weld during construction

Where a construction test weld fails destructive testing, the Contractor shall remove and replace all joints welded after the last acceptable test weld.

## ACS710.7.8 Heater plate temperature reading

For welding machines which do not automatically control, measure and verify the full welding process, the heater plate temperature shall be manually verified daily at four locations on each face of the plate, where the plate contacts the pipe. Records of the manual check shall be submitted daily with the data log records.

The heater plate temperature shall be measured with a non-contact pyrometer. Both sides of the plate shall be measured. The readings shall be taken at even intervals, e.g. 12, 3, 6 and 9 o'clock, around the pipe circumference position and shown on the form.

Readings shall be taken four times per day and specifically each time the machine is turned back on and/or a different pipe size is welded

## ACS710.8 PE pipe joint beads

### ACS710.8.1 Internal weld beads

Internal weld beads shall not be removed, unless otherwise specified.

### ACS710.8.2 External weld beads

External weld beads shall only be removed if specified.

## ACS710.9 PE electrofusion couplers

Couplers shall be rated for the SDR, and material grade of the pipe being jointed.

### ACS710.9.1 Installation

Couplers shall be installed strictly in accordance with the Work Method Statement and PIPA POP 001. This includes procedures for end preparation, pipe scraping, pipe cleaning before and after scraping, witness marking, pipe alignment re-rounding to correct ovality, clamping and preheating and fusion heating as specified for the coupling.

All joints shall be made with computer-controlled equipment capable of producing an accurate printout of the heating current, time and any other relevant jointing parameters for the entire duration of the weld and cooling period.

Fittings should only be removed from their original packing immediately before use for jointing.

Only an approved mechanical peeling tool shall be used to uniformly scrape the pipe ends all around the pipe barrel. It shall be correctly adjusted to remove greater than 0.2 mm and less than 0.5 mm from the pipe surface over the whole of the area indicated by the witness marks. (Refer to Table 2 of POP001.) Hand scraping will not be permitted. The joint area is to be wiped clean with isopropanol using approved wipes before insertion into the coupler. The concentration of IPA shall not be less than 95%.

In every case, the Contractor shall measure the mean diameter and ovality of the PE pipe. The Contractor shall control the mean pipe OD and ovality within the tolerances set out in PIPA POP001 and the installation instructions of the manufacturer of the electrofusion fitting. As part of this, the Contractor shall measure, and control reversion as required.

Particular care is required for larger diameter pipes where a preheating period is required.

The copy of the weld log for each electrofusion fitting installed in the pipeline shall be on-supplied to the Contract Administrator on the same day the joint has been made.

## ACS710.9.2 Pre-qualifying test welds

Before any construction welding commences, the welding operator shall prepare one sample field weld per pipe size for each type of electrofusion coupler to be used. Pre-qualification test welds shall be prepared using the same jointing machinery, electrofusion fittings, welding operator and pipe and that will be used to construct the pipeline.

Testing shall be conducted by an IANZ accredited laboratory.

## ACS710.10 Expansion and contraction of PE pipes

Where polyethylene pipes could be at above ambient temperatures, e.g. when exposed to the sun, the Contractor shall ensure that thermal contraction is complete before restraining the pipe, or pipe ends. Pipes must not be secured by backfilling until this contraction has taken place.

Where pipelines are installed by HDD, the Contractor shall ensure that pipe stretch has been recovered before restraining the pipe, or pipe ends.

## ACS710.11 Cutting pipes

Pipes shall be cut by a method which provides a clean square profile, without splitting or fracturing the pipe wall, and which causes minimum damage to any protective coating. Where

necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used, and any protective coatings shall be made good as appropriate for the protective coating or lining.

Where concrete pipes are cut, any exposed reinforcement shall be sealed with an epoxy resin mortar.

### ACS710.11.1 Cutting PE pipes

Large diameter PE pipe shall be cut using an electric reciprocating saw, or specialised PE pipe cutter only. Smaller diameter PE pipe, <300 mm OD, shall be cut with a rotary pipe cutter or clean hand saw.

Petrol chain saws shall not be used to cut PE pipe.

## ACS710.12 Pipe joints adjacent to structures

Except where the construction is by tunnelling, heading or pipe jacking, a flexible joint shall be provided as close as is feasible, but not greater than 300 mm, to the outside face of any structure into which the pipe is built, compatible with the subsequent movement of the joint.

Joints adjacent to structures are not required for PE pipes, unless otherwise specified.

For PVC pipes, the length of the next pipe (rocker pipe) away from the structure shall be according to Table 2: Rocker pipe length.

Table 2: Rocker pipe length

| Nominal Diameter (mm) | Effective Length (m) |
|-----------------------|----------------------|
| 150 to 600            | 0.6                  |
| Over 600              | 1.0                  |



## ACS710.13 Embedment

### ACS710.13.1 General

The bedding material surface shall be smooth, and the pipeline offered continuous support.

Following compaction (where required), pockets for sockets, couplings flanges or other projections shall be excavated in the bedding material so as to provide full support along the pipe barrels. Pockets shall be the minimum necessary size to keep the projection clear of the bedding material.

Side support and overlay material shall be placed in layers appropriate for the compaction method and evenly around the pipe to ensure that the pipe is not distorted.

### ACS710.13.2 Flexible pipes

Embedment zone dimensions shall comply with the Auckland Code of Practice Drawing No. SW02.

Pipe embedment material for flexible pipes shall comply with AS/NZS2566: 2 Table G2 with a maximum particle size as shown in Table 3: Maximum particle size. Compaction of embedment material shall be in accordance with AS/NZS 2566:2 (*Buried flexible pipelines – Installation*) Table 5.5.

Table 3: Maximum particle size for flexible pipes

| Nominal pipe diameter DN | Maximum particle size mm |
|--------------------------|--------------------------|
| ≤200                     | 10                       |
| >200                     | 14                       |

### ACS710.13.3 Rigid pipes

Embedment (bed, haunch, side and overlay) zone dimensions shall comply with the following:

- Bed Zone** - 100 mm minimum between bottom of pipe and trench floor
- Haunch and Side Zone** - to 50% of the outside diameter of the pipe
- Overlay Zone** - to 300 mm over the crown of the pipe

Embedment and backfill materials shall be as per Table 4 below:

Table 4: Acceptable materials for embedment and backfill

| Location              | Nominal pipe diameter DN | Bedding             | Haunch | Side | Overlay | Trench Backfill |
|-----------------------|--------------------------|---------------------|--------|------|---------|-----------------|
| Within road corridor  | ≤450                     | Fine Pipe Bedding   |        |      |         | GAP 65          |
|                       | >450                     | Coarse Pipe Bedding |        |      |         | GAP 65          |
| Outside road corridor | ≤450                     | Fine Pipe Bedding   |        |      | GAP 20* | Bulk Fill       |
|                       | >450                     | Coarse Pipe Bedding |        |      | GAP 20* | Bulk Fill       |

\* Gap 20 may be replaced with either fine or coarse pipe bedding. Reference for Fine and Coarse Pipe Bedding description is in Earthworks specification-ACS510

Unless specified otherwise in the Particular Specifications or Drawings, all material within the embedment zone shall be hand-tamped with rod or shovel, or by lightweight vibratory tamper to achieve the compaction requirements stated in ACS510 Earthworks.

## ACS710.14 Connections

Connections shall be in accordance with Stormwater Auckland Code of Practice Clause 4.3.12 and Drawing SW04.

## ACS710.15 Inspections and testing

After pipe laying and manhole construction, the Contractor shall clean out all lines and ensure that they will pass any acceptance tests specified.

### ACS710.15.1 Visual inspection

All pipelines shall successfully pass a visual inspection in accordance with Auckland Council Standard Specification *ACS1510 Internal Inspection of Pipelines*.

## ACS710.15.2 Air test for non-pressure pipelines

Pipelines up to DN 400 shall be subjected to a low pressure air test. The air test shall be carried out between manholes or launch/receiving pits. Pipelines to be air tested shall have air pumped in by suitable means until a pressure of 100 mm head of water is indicated in a U-tube connected to the system. The pipeline shall be accepted if the air pressure remains above 75 mm head of water after a period of time “t”, given in the following table without further pumping, following a period for stabilisation.

Table 5: Testing period for air tests on non-pressure pipes

| Nominal diameter | Testing time (minutes) |
|------------------|------------------------|
| DN 100           | 5                      |
| DN 200           | 5                      |
| DN 300           | 7                      |
| DN 400           | 10                     |

Failure to pass the test shall not preclude acceptance of the pipeline if a successful water test can subsequently be carried out in accordance with ACS710.15.33 below.

## ACS710.15.3 Water test for non-pressure pipelines

Where a section of pipe has failed the above air pressure test, or the Contractor determines that an air pressure test is not to be undertaken, it shall be subjected to a water pressure test.

The test pressure for non-pressure pipelines, shall be not less than 1.0 m head of water above the pipe soffit or groundwater level, whichever is the higher at the highest point, and not greater than 5 m head at the lowest point of the section. Steeply-graded pipelines shall be tested in stages in cases where the maximum head, as stated above, would be exceeded if the whole section were tested in one length.

The pipeline shall be filled with water and a minimum period of 1 hour shall be allowed for absorption, following which the original water level shall be restored. Water shall then be added from a measuring vessel at intervals of 5 minutes over a 30-minute period and the quantity required to maintain the original water level noted. The length of pipeline shall be accepted if the quantity of water added in 30 minutes does not exceed 0.15 litres/m<sup>2</sup> for pipelines or 0.2 litres/m<sup>2</sup> for pipelines and manholes tested together, where m<sup>2</sup> refers to the total area of the wetted internal surface.

## ACS710.16 Backfilling

Backfilling shall generally be in accordance with Standard Specification ACS510: *Earthworks* and the Auckland Code of Practice drawing SW01.