IRRIGATION
NEW ZEALAND
TECHNICAL & TRADE

The New Zealand Piped Irrigation Systems Installation Code of Practice




Contents

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NOTE: This Code is paired with *The New Zealand Piped Irrigation Systems Design Code of Practice*.

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Introduction

Purpose

The purpose of this Code of Practice is to provide a standard practice guide for installers of piped irrigation system components. This includes the entire installation process from preparation of a contract through to commissioning of the final system. It lists the matters that must be taken into consideration throughout the installation process. It points to existing industry standards, where appropriate.

It is expected that installers will follow the general guidelines presented here, but many will have their own specific procedures. This document should be used primarily to ensure that all of the main aspects have been considered. It may also serve as a reference for locating appropriate existing standards.

Audience

This document is intended for anyone involved in the installation of piped irrigation system components. This may include the purchaser, design engineers, equipment suppliers, specialist contractors, and regulators.

Because of the diverse range of skills necessary to successfully install a modern irrigation system, it is not expected that any one person or organisation will necessarily see the process through from start to finish. It is expected that different people, with different skills, will be involved at various stages.

Background

IrrigationNZ has observed many cases of substandard installation practices leading to inadequate irrigation performance. Even well-designed and operated systems will not achieve expected performance standards unless they are installed correctly.

There are few good resources (and even fewer comprehensive resources written specifically for New Zealand) about how to install irrigation systems that allow irrigation managers to meet their goals. This document aims to pull together key information from available resources, and present a concise summary of what to do and where to go to find information.

Legal status

This document does not carry any legal status. It recognises the need for installers to interpret the guidelines according to individual requirements, provided any decisions comply with all:

- Design documents
- Manufacturers' instructions
- Legal requirements
- Other industry standards, and
- The principles of preserving natural resources

Users of this document are advised there are a number of existing standards that may be applicable for the installation of irrigation equipment. This document contains lists of standards, however, the authors cannot guarantee these are exhaustive lists or whether any specific standard is relevant to irrigation system installation. Users of this document need to be aware that some standards carry greater weight (legally) than this document, and should therefore check the contents of relevant standards if they are unsure. IrrigationNZ's intention is to produce an industry guide to all relevant standards (separate to this document) to help with this scenario.

What is not in this document

This document provides general guidelines and references to existing standards relating to the installation of piped spray irrigation systems. It does not cover:

- The design of irrigation systems
- Installation of other types of irrigation systems (e.g. flood irrigation)
- Installation of storages, water races, or other surface water structures
- Instructions for the installation of every individual component
- Detailed testing procedures
- Detailed legal requirements

This document provides sufficient detail for installers working within their current area of irrigation expertise.

Installation Code of Practice

1 Introduction

A properly installed irrigation system will:

- Allow the design to work to its full potential
- Be completed on time
- Be tested prior to handover
- Be supplied with operating and maintenance instructions
- Have a working lifespan appropriate for each component used

The installation of spray irrigation systems involves close cooperation between the purchaser, designer, and the installer(s). In many instances, the installer and designer may be the same entity.

The system must be installed in accordance with the design specifications prepared by the designer, and agreed by the purchaser. Where something is not explicitly specified by the design, the installer must:

- Use their professional judgement, but only within their area of expertise, or
- Consult the designer

If any deviation from the design specification becomes necessary, the purchaser must be notified. The system designer and the purchaser must both accept any variation to the original specification prior to installation.

Existing standards relevant to the installation of irrigation system components are listed in Tables 1–7 and are summarised in Appendix A.

2 Contracting

It is in the best interest of all parties to ensure that an appropriate contract is prepared. It is also advisable that the contract is signed by all parties prior to commencement of works.

Prior to preparing a contract, it should be determined who is going to be responsible for each aspect of the installation. This process should include the purchaser, designer, contractors, and engineers (if appointed). In some instances, one or more of these roles may be carried out by the same party.

Irrigation New Zealand has a standard contract template for irrigation installations. For further reference see the New Zealand standard, NZS 3910 – *Conditions of contract for building and civil engineering construction*, for guidance on preparing a contract.

2.1 RESPONSIBILITIES OF THE DESIGNER

The contract should explicitly state all of the items that the designer is responsible for throughout the installation process.

The irrigation system designer must provide all necessary information to the installer(s). This will include drawings, plans, or specifications that the installer(s) require to correctly install the system. This responsibility may extend beyond the initial design specification (i.e. where unforeseen problems arise during the installation process).

The installer(s) is often contracted to, or employed by the designer. In this case, the designer must:

- Ensure that the installer(s) has the necessary relevant skills prior to starting work
- Monitor the progress of the installation to ensure that the design specifications are being met
- Oversee the commissioning of the system, as outlined in section 8

2.2 RESPONSIBILITIES OF THE PURCHASER

The purchaser must supply all relevant farm information to the installer(s). Much of this information will have been previously supplied to the designer, and should therefore be readily available for the installer(s). Relevant farm information includes the following:

- A farm plan

This should show all property boundaries, existing fencing, existing structures, and other relevant infrastructure, particularly buried utilities.

- Relevant resource consent conditions

This will ensure that all parties are aware of the purchaser's legal requirements. This will allow the installer(s) to ensure that the installed system meets those requirements.

- Summary of farm operations

Describe how normal farm operation may affect the installation.

- Anything else

Any other site specific information that the installer requests or the purchaser feels is necessary to provide.

Sometimes, the purchaser may obtain a design from a designer, and decide to contract their own installer(s). In this case, the purchaser is responsible for:

- Ensuring that the installer(s) have the necessary relevant skills prior to starting work
- Monitoring the progress of the installation to ensure that the design specifications are being met. It is recommended that the purchaser employ the designer or another qualified third-party to help with this
- Overseeing the commissioning of the system, as outlined in section 8

It is recommended that the purchaser employ the designer or another qualified third-party to assist with these responsibilities.

2.3 RESPONSIBILITIES OF THE INSTALLER(S)

The contract should explicitly state the things each installer is responsible for throughout the installation process.

Installers must conduct all work in accordance with the system specifications prepared by the designer, and agreed by the purchaser. Where something is not explicitly specified by the design, the installer must:

- Use their professional judgement, but only within their area of expertise, or
- Consult the designer

Installers must adhere to all relevant industry standards.

Installers must provide all required information to assist with the commissioning process (see Section 8) and with the preparation of the:

- Commission report
- As-built plans, and
- Operation and maintenance manuals

2.4 WHAT GOES IN THE CONTRACT

All contracts for installation of piped irrigation systems should contain or refer to specific documents that contain:

- The scope of the contract
- A detailed description of the work to be completed
- Start and end dates of major milestones
- Conditions for time extensions
- A list of materials to be supplied
- A description of the methods to be used (e.g. refer to existing standards)
- Costs, including labour and materials
- Payment schedules (including any retentions or bonds)
- A clear definition of who each party is and their responsibilities
- Description of insurance cover
- Potential or common variations, and the process that will be followed
- A description of the commissioning process
- Guarantees and warranties
- Any specific exclusions
- Exclusions from liability
- Finally the contract should be signed by all parties

2.5 WARRANTIES

Warranties should include a description of:

- What the warranty is for – the workmanship, the componentary or both
- Which system components are covered
- The types of things they are covered for
- Who is responsible for repairs and or replacement, and
- When the warranty begins and ends

A good system warranty will not begin until after the system has been commissioned, and has been proven to be working correctly. Warranties on items repaired or replaced should restart from the time repairs are completed.

2.6 STANDARDS RELEVANT TO CONTRACTING

Refer to the New Zealand standards, NZS 3910 – *Conditions of contract for building and civil engineering construction*, or NZS 3915 – *Conditions of contract for building and civil engineering construction (where no person is appointed to act as Engineer to the contract)* as a starting point for preparing a contract for the installation or upgrade of a piped irrigation system.

3 Pipelines

A properly installed irrigation pipeline will:

- Carry water from its source to its intended destination
- Be free of leaks over the full range of the pipe's pressure rating
- Be free of foreign objects
- Minimise unwanted friction losses, and
- Have a working life appropriate to the site conditions and to the pipe material used

The installation process, including transportation, storage, trenching, laying, joining, and backfilling, will affect the performance of a pipeline. Because each site/design combination will be different, only general guidelines are provided here. Section 3.8 provides lists of pre-existing standards that will apply more specifically to pipe installations.

All pipeline materials must meet or exceed the specification set out by the designer. This must include specifications for pipe diameter, pressure rating, and friction loss characteristics (i.e. pipe roughness).

3.1 TRANSPORTATION & UNLOADING

Pipes and fittings must be transported and handled with care at all times. This should include transportation of pipes to the site, as well as transportation within the site. This will help maximise the working life of pipes, and minimise the likelihood of pipe failure (i.e. leaks).

A safety plan should be established for loading and unloading pipes, especially large bore. This is important as there have been a number of serious accidents in New Zealand where workers have been crushed by pipes, particularly whilst unloading.

The responsibility for transporting irrigation pipelines is often shared amongst several parties. Often, this includes the pipe manufacturer, a third-party transportation company, the Purchaser, and/or the Installer. It may be helpful to spell out these responsibilities in the installation contract, particularly when considering the timing of the handover of responsibility between parties.

When transporting pipe, support it in a secure manner to prevent damage or excessive distortion. This may be achieved by observing the following:

- Use specially built trailers to transport pipes
- Use appropriate straps or padded chains for lifting pipes that cannot be man-handled
- Use proper supports when stacking pipes for transport
  - Use horizontal supports at 1.5 m spacing
  - Use vertical supports at 3 m spacing for rectangular stacks
- Where pipes are in coils, place slings evenly around the entire coil. Transport with the coils evenly stacked on top of each other

Take special care when handling plastic pipes at temperatures near or below freezing. The impact resistance of these materials may be reduced at lower temperatures, and they may crack more easily.

Thoroughly check and inspect all pipeline components (e.g. pipes, fittings) upon delivery and immediately prior to installation (the contract should state who is responsible for this). This will ensure that the right components have been delivered and no damage has occurred. Do not install any pipes or components that are not consistent with the design or that have been damaged.

3.2 STORAGE

Proper storage will maximise the working life of the pipe, and minimise the likelihood of pipe failure (i.e. leaks). Refer to the pipe manufacture for material-specific storage instructions.

Store pipes and fittings under cover, where possible. Some materials, such as rubber, should not be stored in direct sunlight. If pipes are stored in the open, make sure one end of the pipe is slightly higher than the other so excess water can drain away.

Keep rubber rings clean and away from contaminants like petroleum products, which can degrade the rubber.

Choose an appropriate storage site to reduce double handling.

Use support blocks to stop movement or rolling of pipes due to disturbance or uneven ground.

For long-term storage (longer than 6 months), consideration must be given to distortion of some types of pipe material. Use base supports to prevent bowing. Use side supports for pipes likely to elongate or go out of round.

3.3 TRENCHING

Dig trenches to a sufficient depth to provide a minimum cover of 600 mm to the top of the pipe. In an agricultural setting, this minimum cover generally allows for normal farm operations (e.g. cultivation) to proceed without worry of disrupting the pipe. However, site specific requirements must always be taken into consideration. This may require a greater minimum cover in some cases.

Because of the relatively shallow depth of excavation (generally less than 1m), no special trench support or battering is necessary in most cases. Refer to New Zealand Department of Labour's Approved Code of Practice for Safety in Excavation and Shafts for Foundations (OSH, 1995) for more information about trench supports and batters if excavations are deeper than 1 m.

Dig trenches to an appropriate width that will allow for the pipes to be properly backfilled. This will depend on the type of pipe being used – the pipe manufacturer can provide guidance. Extra trench width may be necessary at joints and fittings (see Section 3.4, "Laying").

Dig trenches as straight as possible, and ensure an even gradient on the floor of the trench. As a guide, a pipeline trench should not have deviations exceeding 3° in any direction. This will help to minimise bending of the pipe during installation, and will reduce the likelihood of pipe failure.

Keep open trenches free of water to maintain the stability of the surrounding soil, to provide suitable working conditions, and to prevent pipes from floating until the pipeline has been installed and backfilled.

Avoid trenching when the ground is wet. Operating machinery on wet ground can damage paddocks. Avoiding wet conditions is not always possible, but reasonable measures to minimise negative impacts should be observed.

After excavation, inspect the trench floor for stones, rocky outcrops, or soft areas. The base of the trench should be as flat as possible with any hard or sharp objects (e.g. stones, sticks) removed. Over-excavate and back-fill soft areas. Compact backfill beneath the pipe prior to laying the pipe.

Special requirements may apply if more than one pipeline is to be installed in the same trench. Refer to Section 3.8 for further guidance.

3.4 LAYING

All pipe should be laid in such a way as to minimise bending, twisting, and the risk of leaks. When laying pipe, provide appropriate bedding material (either native material if suitable, or imported if not suitable) and support along the length of the pipe. This will help to maximise the operating life of the pipe and will minimise the risk of leaks.

Pipe laying instructions will be material and/or manufacturer specific. Always use the manufacturer's specific guidelines as the default standard when laying irrigation pipe. The Purchaser and the Designer must be notified if the manufacturer's instructions are not to be followed (e.g. if relaxed bedding or backfill requirements are to be used to reduce cost), and the potential consequences of this must be explained to the Purchaser.

Thoroughly check and inspect all pipeline components (e.g. pipes, fittings) upon delivery and immediately prior to installation (the contract should state who is responsible for this). This will ensure that the right components have been delivered and no damage has occurred. Do not install any pipes or components that are not consistent with the design or that have been damaged.

All pipes should be laid so that they are supported continuously along the barrel.

Avoid excessive bending. As a general guide, a pipe should not be bent more than 3° in any direction. Refer to the manufacturer's instructions for further details.

Lay all pipe manufacturing codes and class markings facing upwards.

Excavate pockets in the bedding or trench base to accommodate sockets or projections from fittings. Backfill pockets beneath fittings to ensure good support for the fitting.

Construct thrust blocks at any point on the mainline system where flow direction changes by more than 11 degrees. This is typically at each bend, valve, tee, reducer, dead end cap, and blank flange. Refer to Section 3.6 for more detailed guidance regarding thrust blocks.

Special requirements may apply if more than one pipeline is to be installed in the same trench. Refer to Section 3.8 for further guidance.

Excavated material may be used to bed the pipe provided that all of the following conditions are met:

- Imported bedding material is not specified in the design
- The pipe is within a farm boundary and not in an area of high vehicle traffic
- Excavated soil is friable and contains:
  - Less than 10% stones (≥ 20mm diameter), by volume
  - Less than 10% clay clods (≥ 75mm diameter), by volume
  - No large stones (≥ 100mm diameter), and
  - No organic material
- The base of the trench is dry
- The trench is in ground with a slope of ≤ 25°

In all other situations, it is necessary to import bedding material, or to modify the excavated material so that it meets these criteria. For example, large stones may be screened out.

If imported material is used, ensure that it meets the requirements listed above.

Photograph unusual features (e.g. complicated junctions) after pipe laying and prior to backfilling. This will provide a visual record of what was installed, and will make future maintenance, repairs, or upgrades easier.

3.5 JOINING

Pipe joining methods will be material and/or manufacturer specific. Always follow the pipe manufacturer's directions for joining pipe. This will ensure that a proper seal is achieved and that the strength and integrity of the pipeline as a whole is maintained.

Use fittings (e.g. couplings, reducers, bends, or tees) made of material that is recommended for use with the pipe.

Use solvents suitable for temperatures likely to occur at the location of the installation.

Observe any "witness marks" when joining pipe with fittings.

Observe all manufacturers' recommended curing times for pipe joints and thrust blocks prior to moving, backfilling, or pressurising the pipe.

3.6 THRUST BLOCKS

Construct thrust blocks at each bend, valve, tee, reducer, dead end cap, and blank flange greater than 90 mm in diameter. This will ensure that these joints are properly supported and protected from damage over time. Typical thrust block configurations are given in AS/NZS 2566.2 Figure 5.9.

Unless otherwise specified:

- Construct thrust blocks using concrete, and
- Size all thrust blocks to resist the pipe's rated pressure, not the design operating pressure

Always take into consideration the load bearing capability of the surrounding soil.

Most pipe suppliers provide design guidance for sizing thrust blocks. Where this is inadequate, use Table 1, Table 2 and Equation 1.

Table 1: Approximate thrust on fittings (for each 10 m or 1 bar of water pressure).

Nominal Pipe Diameter (mm)	Tee or end cap (kN)	90° bend (kN)	45° bend (kN)	22½° bend (kN)	11¼° bend (kN)
50	0.28	0.40	0.22	0.11	0.06
80	0.61	0.87	0.47	0.24	0.12
100	1.15	1.62	0.88	0.45	0.22
150	2.41	3.41	1.85	0.94	0.47
200	4.14	5.86	3.18	1.61	0.81
225	5.17	7.31	3.96	2.01	1.01
250	6.30	8.91	4.83	2.45	1.23
300	9.16	13.0	7.02	3.57	1.79
375	14.0	19.8	10.7	5.44	2.72
450	19.8	28.0	15.2	7.71	3.86

Table 2: Approximate safe bearing loads for different soil textures

Material	Safe bearing load (kPa)
Peat, running sand, much, ash, etc	0
Soft clay	50
Medium clay	
Sandy loam	100
Sand and gravel	
Hard clay	150
Sand and gravel cemented with:	
• Clay	200
• Rock	240

The following equation may be used for sizing thrust blocks:

$$A_b = T_1 \times P_r \div q_b \qquad (1)$$

Where:

A_b	is the acceptable bearing load area (m^2)
T_1	is the fitting thrust per 1 bar pressure (kN, from Table 1)
P_r	is the pressure rating of the pipe (Bar)
q_b	is the safe bearing load of the soil (kPa, from Table 2)

Example

For a 200 mm, 9 bar rated, 90° bend installed in a sandy loam soil:

T_1 = 5.86 kN (from Table 1)

P_r = 9 bar

q_b = 100 kPa (from Table 2)

Using Equation 1:

$A_b = T_1 \times P_r \div q_b$

A_b = (5.86 kN) × (9 bar) ÷ (100 kPa)

A_b = 0.5 m^2

This means that a thrust block with a bearing area of at least ½ m^2 is required. A block with two 75 cm sides (0.75 x 0.75 m) would result in an area of 0.56 m^2 in contact with the soil, and would therefore be large enough.

Do not concrete directly over pipes and fittings. At a minimum, cover the pipe or fitting with plastic sheeting or a thin membrane such as bituminised paper prior to pouring concrete. This will allow the concrete to be removed at a later date without damaging the pipe.

Ensure that bolts and flanges are freely accessible to allow fittings to be removed without interfering with thrust blocks.

Ensure that all recommended curing times for thrust blocks are observed prior to moving, backfilling, or pressurising the pipe.

3.7 BACKFILLING

Proper backfilling is important to protect the pipeline, hold it in place and in the case of some pipe materials (flexible plastic pipes) to give it strength (transfer the loads created by pressure to the surrounding ground. Properly graded backfill helps prevent puncture from stones, minimises the risk of pipe failure (i.e. leaks), and maximises the working life of the pipeline.

Photograph any unusual features (e.g. complicated junctions) after pipe laying and prior to backfilling. This will provide a visual record of what was installed, and will make future maintenance, repairs, or upgrades easier.

Backfill requirements for a particular pipe will be material and/or manufacturer specific. Use the manufacturer's specific guidelines regarding backfill, where possible.

Unless otherwise specified, ensure that all pipes achieve a minimum cover of 600 mm to the top of the pipe. In an agricultural setting, this minimum cover generally allows for normal farm operations (e.g. cultivation) to proceed without worry of disrupting the pipe. However, site specific requirements must always be taken into consideration. This may require a greater minimum cover in some cases.

Unless otherwise specified in the design or by the manufacturer, do not exceed 1.5 m of cover.

Mechanical compaction is not a requirement in all cases. If compaction is used, ensure the top of the pipeline is covered with at least 300 mm of backfill prior to using any mechanical compaction equipment.

Any backfill material that will be in contact with the pipe (i.e. within 200 mm) must be free of stones that can harm the pipe over time. This may mean that excavated material needs to be screened prior to placement on the pipe, or that imported backfill is required. Backfill material that is not in contact with the pipe (i.e. › 200 mm away from the pipe) may contain stones.

As a guide, excavated material may be used to backfill directly onto the pipeline, provided that all of the following conditions are met:

- Imported backfill material is not specified in the design
- The pipe is within a farm boundary and not in an area of high vehicle traffic
- Excavated soil is friable and contains:
    - Less than 10% stones (≥ 20mm diameter), by volume
    - Less than 10% clay clods (≥ 75mm diameter), by volume
    - No large stones (≥ 100mm diameter), and
    - No organic material
- The pipeline is being installed in ground with a slope of ≤ 25°

In all other situations, screen the material or import backfill if it will be in direct contact with the pipe (i.e. within 200 mm).

Ensure that all imported material meets the requirements listed above.

Backfilling the trench as the pipe is laid will help support the pipe in the middle of the trench. It will also help prevent unnecessary bending and/or twisting of the pipe and will reduce the safety hazard of open trenches.

However, thermal expansion/contraction of the pipe must also be considered for some materials. Where it is an issue, avoid backfilling during the day when the pipe is hot. As a hot pipe cools, it can shrink. If this pipe has already been backfilled, it has less ability to adjust its position, and some joins may be compromised.

The ground surface above a newly installed pipeline must be returned to a condition fit for its original purpose. If this will not be done, the Purchaser must be notified.

3.8 SPECIAL CONSIDERATIONS

Special consideration may be required in some situations. This may include where pipelines are being installed:

- On steep slopes (i.e. ≥ 25°)
- Under farm tracks, roads, or railroads
- Under bridges
- Through embankments, or
- Through waterways

Refer to the pipe manufacturers' literature and the Standards in Table 3 and Table 4 for guidance under these situations. Some installations may also be required to meet special resource consent conditions.

Installing more than one pipeline in a single trench

Special care is required if more than one pipeline is to be installed in a single trench. The pipelines must each meet the requirements outlined in the preceding sections, and must not interfere with each other.

Allow enough space in the trench so that each pipe may be properly and independently supported. As a guide, the minimum separation distance between any two pipes can be calculated using the following equation:

$$D_{sep} = R_1 + R_2 \tag{2}$$

Where:

D_{sep} is the separation distance (mm)

R_1 is the outside radius of the first pipe (mm) = OD ÷ 2

R_2 is the outside radius of the second pipe (mm) = OD ÷ 2

3.9 STANDARDS RELEVANT TO PIPE INSTALLATIONS

Always reference manufacturers' instructions when installing irrigation pipe.

The existing standards listed in Table 3 and Table 4 may also be referenced for further guidance. These are provided for the convenience of users of this document. The Code makes no comment on their relevance or how they are used.

Table 3: Standards relating to the installation of pipes

Standard	Description
AS 1726	Geotechnical Investigations
AS 4041	Pressure piping
AS/NZS 2032	Installation of PVC pipe systems
AS/NZS 2033	Installation of polyethylene pipe systems
AS/NZS 2566.2	Buried flexible pipelines – Installation
AS/NZS 3500	Plumbing and Drainage Code
AS/NZS 3690	Installation of ABS pipe systems
AS/NZS 3725	Design for installation of buried concrete pipes
NZS 3124	Specification for concrete construction for minor works
NZS 4404	Land development and subdivision infrastructure
NZS 7643	Code of practice for the installation of unplasticised PVC pipe systems

Table 4: Standards relating to pipe and fitting materials

Standard	Description
AS 2698.2	Plastic pipes and fittings for irrigation and rural applications – polyethylene rural pipe
AS 3571.1	Glass filament reinforced thermoplastics (GRP) systems – Pressure and non-pressure drainage and sewerage
AS 3975	Aluminium Alloys – irrigation tube
AS 4087	Metallic flanges for waterworks purposes
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 2280	Ductile Iron pressure pipes and fittings
AS/NZS 3518	Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications
AS/NZS 3879	Solvent cements and priming fluids for use with uPVC pipes and fittings
AS/NZS 4058	Precast concrete pipes (pressure and non-pressure)
AS/NZS 4129	Fittings for PE pipes for pressure applications
AS/NZS 4130	PE pipes for pressure applications
AS/NZS 4331	Metallic flanges
AS/NZS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 4442	Welded steel pipes and fittings for water, sewage and medium pressure gas
AS/NZS 4765	Modified PVC (PVC-M) pipes for pressure applications
AS/NZS 4793	Plastic or metallic tapping bands for waterworks purposes
AS/NZS 4998	Bolted unrestrained mechanical couplings for waterworks purposes
NZS/BS 1387	Specification for screwed and socketed steel tubes and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads
NZS/BS 3601	Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes

4 Pumping stations

A properly installed pumping station will:

- Deliver the required pressure and flow rate
- Be free of unwanted leaks
- Protect itself from unsafe operating conditions (e.g. high pressures)
- Be protected from the elements (e.g. rain, wind, floods)
- Maintain a safe environment for its operators

Installation of pumping stations is likely to be completed by several different contractors, all overseen by the designer and/or purchaser. This may include:

- Well drillers
- Pump specialists
- Pipe layers (for headworks)
- Electricians,
- Electricity supply companies
- Shed builders

Upon delivery to the site, inspect all pumps, motors, and associated components for damage. Check that the equipment delivered matches the design specification. Do not install damaged equipment. Do not install used components without first consulting the designer and purchaser.

4.1 WELLS

Irrigation well installation consists of:

- The drilling operation
- The installation of the well casing and screen
- The installation of any filter pack or grout material
- Production testing

This document does not specifically cover the details of well installation. This is a specialist field of work that requires its own codes of practice. Further, this work is often completed in advance of the installation of the rest of the irrigation system because the properties and performance of the well must be known in order to complete the design process.

Refer to the New Zealand Driller's Federation and the New Zealand Standard, NZS 4411 – *Environmental Standard for Drilling of Soil and Rock*, for guidance regarding drilling, installation, and production testing of wells.

4.2 SURFACE WATER INTAKES

Install all surface water intakes in accordance with the system specification provided by the designer. If actual site conditions are found to be different to those assumed in the design, notify the designer so that appropriate alterations can be made to the design.

All surface water intakes should have an appropriately sized screen or filtration system to exclude any debris present in the water source that may damage pumps. All surface water intakes should exclude fish, as necessary. Consult the designer if the size or dimensions of the screen are not specified.

To prevent air from entering the pump:

- Ensure that the suction assembly is air-tight
- Ensure the suction pipe is of sufficient diameter and is installed at a sufficient depth below the lowest expected water level so that air is not drawn into the suction assembly
- Ensure an even slope when laying the inlet pipe. This will help prevent air pockets from developing

If the intake water level is below the pump, it is normal to fit a check valve to prevent water from draining away from the pump when it is not in operation.

Place the intake screen well above the bed of any waterbody to avoid sucking in stones or other debris. If an insufficient depth of water is available, provide a sump.

To minimise friction losses in the suction pipe:

- Do not put any unnecessary valves or bends in the suction line
- Where valves are necessary, use valves that are at least the same diameter as the suction pipe
- Where bends are necessary, consider using long radius bends
- Ensure that the distance from any bends, valves, or pipe reducers to the inlet of the pump is at least five times the diameter of the inlet pipe to the pump
- The suction pipe should be at least as large as the size of the pump inlet

Consult the system designer if it becomes necessary to install an intake pipe through an existing structure (i.e. the wall of an earthen dam). The implications on the integrity of the structure must be investigated prior to installation.

4.3 PUMPS AND MOTORS

Installation procedures will depend on the type of pump and motor being used, and will be manufacturer specific. Always install pumps in accordance with the system specification and the manufacturer's instructions.

All pumps and motors must be installed by a trained and competent person, guided by existing relevant standards and the installer's training and experience.

Store pumps, motors, and associated components under cover prior to installation. Install all sensitive equipment, including surface pumps, inside a shed or other form of protection from the elements.

Groundwater pumps

Construct the rising column from material that is corrosion resistant and able to carry the weight of the pump, cables, column, and water. Ensure that pipe couplers are also able carry the full load applied to them.

As a guide, use a maximum of 60 m of threaded connections in steel rising columns. Use a flanged rising column for better strength beyond this length and for diameters exceeding 150 mm.

Attach column guides to the rising column at spacing not exceeding 6 metres. Column guides may not be necessary if rising column sections are attached using flanges.

Attach electric cables to the rising column at a spacing not exceeding 3 metres.

Install a probe tube with the pump to allow water levels to be monitored. The probe tube should extend from the wellhead plate to the top of the pump.

If a check valve is fitted into the pump column, place it at a height no greater than 7 m above the lowest expected static water level.

Surface pumps

Bolt pumps to a concrete floor or structural base inside a building. This will prevent vibration and protect the pumps from dust and weather.

When pumps and their motors are supplied separately, ensure that each unit is aligned correctly so that they can be coupled together properly.

Align the pump naturally with the surrounding pipe work – do not force pipes into place. This may upset the alignment of the pump and motor. Support pipes independently of the pump to avoid undue stress on the pump casing.

Install a method for priming the pump.

Fit a valve to the highest point on the pump casing to allow air to escape when priming the pump.

4.4 HEADWORKS

Install pump headworks in accordance with the system specification provided by the designer. If actual site conditions are found to be different to those assumed in the design, notify the designer so that appropriate alterations can be made to the design.

Consider the following when installing pump headworks:

- Use galvanised steel to construct any aboveground components of the headworks
- Support the headworks system so components or pipes do not carry heavy loads
- Ensure that there is an accessible straight pipe for the measurement of flow rate using a portable meter. The length of this straight pipe should be at least 15 times its diameter. This is necessary, even in systems with an in-line flow meter because portable meters are often used to calibrate the in-line meter

There should be no other components within this length of pipe that would impede the flow of water and cause turbulence (e.g. butterfly valves, filters, or backflow preventers).

This pipe need not be part of the headworks. It could be any length of straight pipe (e.g. the mainline leaving the pump shed) so long as there are no water off-takes between it and the water source.

- Use components with low friction losses (i.e. swept bends), wherever practical. This will help minimise the pump duty and operating cost of the final system
- The layout of the headworks should allow free access to all critical components (i.e. valves, meters, gauges). This is important for both normal operation of the irrigation system, and for maintenance
- Use unions or flanges to allow the headworks to be dismantled non-destructively
- If multiple pumps are linked together, construct the manifold so that each pump can be independently isolated
- Include a facility to drain the headworks or irrigation system to ground

If any of these items are not included in the design, contact the designer to discuss any proposed changes.

Order of pump headworks components

Install the headworks components in the order listed in the system specification. Refer to Section 7, "Accessory Components", for guidance on installing some specific components.

Unless otherwise specified, install accessory components in the headworks according to Figure 1.

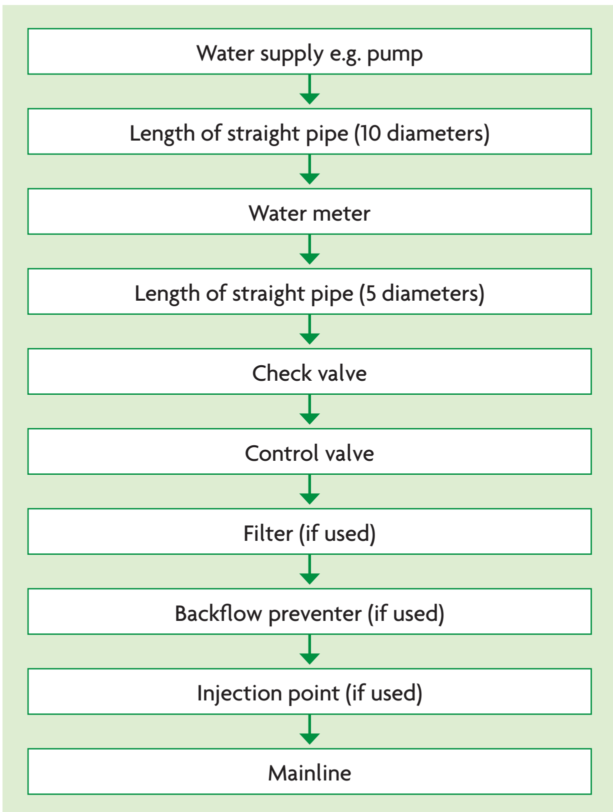

Figure 1. Recommended order of headworks components.

Install the check valve and control valve downstream from the water meter. This will help to minimise turbulence through the meter.

Ensure that any injection points (i.e. for effluent or fertiliser) are downstream of any back flow prevention devices and other sensitive instrumentation.

Protect sensitive components (e.g. backflow prevention devices) with a filter, as required by the component's manufacturer.

4.5 CONTROLS

Refer to Section 5, "Electrical Components".

4.6 PUMP SHEDS

All pumping systems should be supplied with a shelter to house equipment that is sensitive to weather (i.e. motors, control systems, and gauges).

Ensure that all pump sheds:

- Protect equipment from the elements, especially rain
- Protect equipment from animals, including nesting birds
- Protect equipment from flooding, i.e. sheds:
  - Are not located in areas prone to flooding
  - Have adequately sized drains installed in the floor
- Have proper ventilation
- Have at least one 230V outlet
- Have a light fixture to illuminate the controls for the system operator

Ensure that any building consent and New Zealand *Electrical (Safety) Regulations* requirements are met.

4.7 STANDARDS RELEVANT TO PUMPING STATIONS

Always refer to manufacturers' instructions when installing irrigation pumping equipment. The *New Zealand Building Code*, the New Zealand Drillers Federation, and the existing standards listed in Table 5 may also be referenced for further guidance. This list of standards is provided for the convenience of users of this document. The Code makes no comment on their relevance or how they are used.

Table 5: Standards relating to the installation of pumping stations

Standard	Description
AS 1396	Steel water bore casing
AS 1628	Water supply – Metallic gate, globe and non-return valves
AS 1726	Geotechnical Investigations
AS 1910	Water supply – Float control valves for use in hot and cold water
AS 2368	Test pumping of water wells
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2638	Gate valves for waterworks purposes
AS 4794	Non-return valves – Swing check and tilting disc
AS 4795	Butterfly valves for waterworks purposes
NZS 4411	Environmental standard for drilling of soil and rock
ISO 15081	Agricultural irrigation equipment – Graphical symbols for pressurised irrigation systems
ISO 21413	Manual methods for the measurement of a groundwater level in a well

5 Electrical components

Properly designed and installed electrical systems will:

- Enable the correct operation of the pump(s) and irrigator(s)
- Be safe for system operators
- Protect all connected equipment from unexpected faults
- Meet all regulatory requirements

All electrical work must be completed or overseen by a certified electrician in accordance with the New Zealand *Electrical (Safety) Regulations*. The installer will be guided by these regulations, any other relevant existing standards, and their training and experience.

Upon delivery to the site, inspect all electrical components for damage. This includes equipment supplied for the pumping station as well as for the irrigators and other components. Check that the equipment delivered matches the design specification. Do not install used or damaged electrical equipment.

Store and install all electrical equipment in a location that is protected from the elements (i.e. in the pump shed).

Install all electrical equipment in accordance with the system specification provided by the designer. If the system specification does not provide enough detail, consult the designer.

Wiring diagrams must be provided to the purchaser. Ideally, laminated copies will be supplied to remain permanently in the pump shed in case repairs are needed.

Any passwords used in setting up electronic equipment must be provided to the Purchaser.

All systems must have an electrical compliance certificate prior to commissioning of the system.

Control systems

Construct the control panel so that it is readily accessible and so that routine maintenance may be carried out from the front. Label all panels, switches, and instruments so that each component is easily identifiable by the operator.

Ensure that all systems have, at a minimum:

- A manual switch-on and switch-off for each pump
- High and low pressure or flow cut-outs
- High pressure or zero-flow cutoffs on the upstream side of pressure regulating valves, if fitted
- Low water level protection
- Fault indicators (to identify the reason for a fault)
- An external running light installed at the pump shed
- A circuit disconnect for each electricity connection
- Overload protection for every pump motor
- Phase failure and reversal protection
- Voltage and amperage display
- A running timer
- A total hour meter

Consult the designer if any of these items are not included in the design.

Take care to minimise electrical interference and noise resulting from the use of variable speed drives. Many electricity providers now require harmonic filters to be installed. Check with local regulations.

5.1 STANDARDS RELEVANT TO ELECTRICAL INSTALLATIONS

The New Zealand *Electrical (Safety) Regulations* describes general requirements related to electrical installations.

The existing standards listed in Table 6 may also be referenced for further guidance. These are provided for the convenience of users of this document. The Code makes no comment on their relevance or how they are used.

Table 6: Standards relating to the installation of electrical components

Standard	Description
AS 4777.1	Grid connection of energy systems via inverters – installation requirements
AS/NZS 2053	Conduits and fittings for electrical installations
AS/NZS 3000	Electrical installations (known as the Australia/New Zealand Wiring Rules)
AS/NZS 3010	Electrical installations – generating sets
AS/NZS 3112	Approval and test specification – Plugs and socket-outlets
AS/NZS 3820	Essential safety requirements for electrical equipment
AS/NZS 5033	Installation of photovoltaic (PV) arrays
NZECP 34	New Zealand electrical code of practice for electrical safe distances
NZECP 35	New Zealand electrical code of practice for power systems earthing
NZECP 36	New Zealand electrical code of practice for harmonic levels
NZECP 46	New Zealand electrical code of practice for high voltage live line work
ISO 12734	Agricultural irrigation – Wiring and equipment for electrically driven or controlled irrigation machines

6 Irrigation application systems

A properly designed and installed spray irrigator will:

- Apply water:
  - In the required amount (i.e. mm depth)
  - In the required place
  - At the required time
  - At the required rate (i.e. mm/hr)
- Move free of restrictions
- Have a long working life

6.1 SPRAY IRRIGATORS

All irrigation equipment should be supplied and installed by trained and competent persons. All irrigation equipment must be installed in accordance with the manufacturers' instructions.

Upon delivery to the site, inspect all equipment and associated components for damage. Also, check that:

- The irrigators are the correct model/size
- Sprinkler/nozzle/hose sizes match the specification
- The grade of the land meets the irrigator manufacturer's requirements
- Land is free of obstacles that may hinder the movement of the irrigator

Do not install damaged equipment. Do not install used components without first consulting the designer and Purchaser.

Ensure that prohibitively graded land is modified to within the specification of the irrigators prior to installing the irrigator. Also ensure that all obstacles are removed. If the land cannot be modified to meet the requirements of the irrigator, do not install the irrigator.

Double-check plans and sprinkler charts to ensure all items are installed in the correct locations.

If the irrigator requires an electrical connection (e.g. most centre pivots), a suitable plug and socket must be installed at the base of the irrigator to provide electrical isolation for field disconnection.

Any electrical work associated with irrigator installation or repair must be completed by a certified and registered electrical service technician, in accordance with the New Zealand *Electrical (Safety) Regulations*. All fixed-wiring operations should be completed by a registered electrician.

Electrical compliance certificates must be obtained prior to commissioning of the system.

6.2 DRIP OR MICRO IRRIGATION SYSTEMS

All irrigation equipment should be supplied and installed by trained and competent persons. All irrigation equipment must be installed in accordance with the manufacturers' instructions.

Site preparation

Upon delivery to the site, inspect all equipment and associated components for damage. Also, check that the sprinkler/drip tube/lateral sizes match the specification. Double-check plans and sprinkler charts to ensure all items are installed in the correct locations.

Do not install damaged equipment. Do not install used components without first consulting the designer and Purchaser.

Excavate, clean and prepare trenches as per Section 3.3. Lay and join sub-mains in the trench, as per Section 3.4.

Installing solenoid control wires

It is recommended that solenoid control wire be installed in a conduit to protect the wire and allow for easier upgrading and replacement. If a conduit is not used, then lay the cable to the side of the pipe laterals to keep the wire out of the way of future pipe repairs. Leave slack in the cable so that it is not pulled tight and broken during the backfill process.

Where possible, make sure control cable joints occur at valves. Where this is not possible, bring joints to surface and mark them on the as-built drawings. Ensure that cable joins are watertight.

Ensure that all electrical regulations are followed. In particular, ensure that the work being attempted does not require a registered electrician. Ensure that all joints are completed according to manufacturers' specifications.

Installing risers

Take care when drilling holes in the sub-main for lateral riser connections. Ensure the holes are drilled in the correct place (usually in line with the trellis system), and that they are the correct diameter for the connection method being used (e.g. tapping saddles or grommets).

Also take care to minimise foreign material entering the pipe network (e.g. dirt and pipe shavings), as this can block drippers or micro-spray nozzles.

Sub-mains that are drilled and then left exposed can move considerably due to diurnal temperature changes. This can cause the location of risers to change. Hence, when the pipe is later buried, make sure that risers are still in their correct locations.

Backfill

All bedding and backfill material should meet the requirements in Section 3.4 and 3.7.

Ensure the risers are not kinked or crushed and remain vertical while backfilling.

Ensure that backfill is carefully compacted or mounded to compensate for long term settlement.

Flushing of Lines
Install flushing valves in line with the last trellis or tree line.

Flush the sub-mains before connecting laterals to lateral risers. It is recommended that the whole system be flushed until the water runs clear, then flushed for an additional two pipe volumes (2 x Pipe Length ÷ Pipe Velocity).

Flush the system again in a similar manner prior to connecting sprinklers.

Installing driplines and under-tree micro sprinklers
There are three main installation types to consider:

1. Suspended
   This type of installation is most commonly used with fruit trellises, but may also be used with trees grown in rows. The lateral is typically suspended from a wire above ground, and allows for machinery operations to continue (e.g. mowing) without disrupting the irrigation system.

   Suspension of the lateral from the wire should allow freedom of movement caused by diurnal expansion and contraction. The use of springs or bungy cords at the end of laterals ensures expansion and contraction can occur without sagging or stretching of the lateral.

   Where individual drippers have been installed for each plant, more care is required to minimise the extent of movement.
2. On the Ground Surface
   This is done when there is no trellis or irrigation wire, or where there is a significant slope.

   The use of springs or bungy cords at the end of laterals ensures expansion and contraction can occur without "snaking" or stretching of the lateral.

   Where individual drippers have been installed for each plant, more care is required to minimise the extent of movement.
3. Buried
   Where drip emitters are below ground special care is required to ensure the drip-line will perform as it is supposed to. Strict adherence to manufacturer specifications is advised.

   Where the lateral is buried to avoid machinery damage there will be risers coming to individual or groups of micro sprinklers, drippers, or driplines. The same care needs to be taken as with installing lateral risers from sub-mains.

Installing overhead sprinklers
There are three main installation types to consider:

1. Suspended
   This type of installation is most commonly used with fruit trellises. The lateral is typically suspended from a wire above ground, and allows for machinery operations to continue (e.g. mowing) without disrupting the irrigation system. It is likely the sprinklers are relatively closely spaced and the lateral is no larger than 32 mm.

   Suspension of the lateral from the wire should allow freedom of movement caused by diurnal expansion and contraction. The size of the pipe and the need for sprinkler risers to remain fixed make the problem of minimising sagging, stretching, and a net movement of the lateral line much more difficult to achieve. Securing the pipe at a number of points is often necessary as well as securing the pipe at each end.

   Care with connecting to sprinkler risers is required to ensure the right fittings are used and are correctly fitted together.
2. On the Ground Surface
   Laying laterals on the ground exposes them to machinery damage (e.g. mowers), and is generally not viable.
3. Buried
   Buried laterals are more common for overhead sprinklers. This type of installation eliminates the contraction/expansion problem, allows for bigger sprinklers that are more widely spaced, and allows for larger lateral pipe sizes (typically 40 mm to 100 mm diameter).

   Trenching of laterals may be difficult between established trellises. Adhere to the pipe laying guidelines in Section 3.4 and 3.7 as closely as practicable given the site conditions.

   As the lateral to sprinkler riser connection is underground, strict adherence to manufacturer specifications is advised.

Update the as-build plans to identify where deviations from the original design have occurred.

6.3 STANDARDS RELEVANT TO IRRIGATOR INSTALLATIONS

Always reference manufacturers' instructions when installing irrigation equipment.

The existing standards listed in Table 7 may also be referenced for further guidance. These are provided for the convenience of users of this document. The Code makes no comment on their relevance or how they are used.

Table 7: Standards relating to the installation of irrigators

Standard	Description
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 3975	Aluminium alloys – irrigation tube
ISO 8026	Agricultural irrigation equipment – Sprayers – General requirements and test methods
ISO 9261	Agricultural irrigation equipment – emitters and emitting pipe – General requirements and test methods
ISO 12734	Agricultural irrigation – Wiring and equipment for electrically driven or controlled irrigation machines
ISO 15081	Agricultural irrigation equipment – Graphical symbols for pressurised irrigation systems
ISO 15886	Agricultural irrigation equipment – Sprinklers

7 Accessory components

Many different accessory components are likely to be specified in the design of spray irrigation systems. Each of these components should be installed according to the design and according to the manufacturers' instructions.

Upon delivery to the site, inspect all accessory components for damage. Check that the components delivered match the design specification. Do not install damaged components. Do not install used components without first consulting the designer and purchaser.

Install all devices so that they are readily accessible for ease of maintenance or testing.

If installing any of these components as part of the system headworks, also refer to Section 4.4 for guidance on the order of installation.

7.1 FLOW MEASURING DEVICES

A flow measuring device should be installed on all new irrigation systems. If no device is specified in the design, consult the designer to ensure that this was not an oversight.

Refer to Irrigation New Zealand's *Guidelines for the Measurement and Reporting of Water Takes* (2011), which provides a detailed description of installation requirements for flow measuring devices.

There are many different types of flow measuring devices, each with their own installation requirements. Always follow the manufacturer's instructions when installing flow measuring devices. Always install the devices in accordance with the design.

Flow measuring devices will require calibration by a qualified person prior to commissioning (and verification at regular intervals in the future).

Where a device is installed below ground level, it must be installed in a chamber that is readily and easily accessible. Install a cover that is able to be removed by one person. The base of the chamber must allow drainage from the chamber.

Even if an in-line flow meter is not specified, it is still recommended to install an accessible straight piece of pipe whose length is at least 15 times its diameter. This will allow for the use of a portable flow meter, or for the installation of an in-line flow meter, at a later date.

7.2 PRESSURE GAUGES

Pressure gauges or pressure sampling points are required on all spray irrigation systems. "Pressure gauges" refers to permanently installed gauges. "Pressure sampling points" refers to taps or fittings to which a portable gauge or meter may be attached.

The design should specify where pressure gauges or pressure sampling points are to be installed. At a minimum, install gauges or pressure sampling points at the following locations:

- The inlet of all surface pumps
- The outlet of all pumps, upstream of any in-line components
- Upstream and downstream of components with a large head loss (i.e. backflow preventers)
- The outlet of headworks, downstream of all in-line components
- The inlet to each irrigator, downstream of all hydrants and connecting hoses
- A second gauge should be installed near the last outlet of an irrigator if a large head loss is expected through the machine or hose (e.g. at the end of centre-pivots, or at the gun-cart of a hard hose gun system)

On the inlet (suction) side of pumps an isolation valve and a pressure gauge that can withstand negative pressure (vacuum) should be installed.

Some in-line components (i.e. valves or reducers) are likely to cause turbulence in the pipe that may interfere with pressure gauge readings. Install gauges or pressure sampling points at least 2 pipe diameters upstream and at least 4 pipe diameters downstream from these components. This will provide for more accurate pressure readings.

Mount all gauges on a firm surface (i.e. wall of the pump shed) and connect them to the irrigation pipeline with flexible tubing. Fit the flexible tubing with a stopcock (or similar) so it can be isolated from the irrigation pipeline to prevent damage when not in use. This will extend the working life of the gauges and will allow for them to be checked or replaced while the system is running.

7.3 CONTROL VALVES

Fit at least one valve to every system to allow the water supply to be manually shut off from the rest of the system. The design should specify the type of valve to be used, and the location in which it should be installed.

It is recommended that the main control valve be of a slow-opening/closing variety (i.e. not a butterfly valve). Quick opening/closing valves have the potential to cause water hammer and put pipelines and pumping equipment at risk of significant damage. Consult the designer if you think the wrong type of valve has been specified.

Unless otherwise specified, install the main control valve downstream from the pump or water supply, but upstream from all other in-line components (see Figure 1). In systems with multiple pumps, also install control valves to isolate each individual pump from the others and from the mainline.

Unless specified otherwise, install a manually controllable valve at the inlet to each irrigator. A hydrant serves this purpose.

Use valves of a diameter at least as large as the pipe in which they are being installed. This will help to minimise friction losses. If smaller valves are to be used as a cost saving measure, this must be discussed with the Designer and the Purchaser, and the consequences explained.

Do not use valves that can only be fully open or fully closed in situations where the system can be started with empty mainlines.

7.4 FILTERS

The design should specify if filtration is necessary. It should also specify the type and size of filters to be used, and the location in which they should be installed.

When installing filters it is important to ensure that provision is made for their easy servicing and safe removal. Drainage issues that may result from servicing and flushing of filters (particaulrlry if they are housed within the pump shed) should also be considered.

Filtration is recommended to protect any sensitive in-line components (e.g. backflow preventers). Consult the designer if filtration is not specified for these situations.

7.5 BACKFLOW PREVENTION

The design should specify if backflow prevention is necessary. However, it is recommended to check AS/NZS 3500.1 (Section 4) – *Connection control and backflow prevention* – and the local regulatory requirements prior to installation to ensure that the correct backflow prevention device is installed.

Refer to Irrigation New Zealand's *Backflow Prevention Guidelines* (2012), which provides a detailed description of requirements and installation guidelines for backflow prevention devices.

Each type of backflow prevention device will have its own installation requirements. Always follow the manufacturer's instructions when installing a backflow prevention device. Always install the device in accordance with the design. If the design is not specific, contact the designer for guidance.

7.6 AIR RELEASE

Install an air release valve at the highest point in the pipeline. If the highest point is inside the pump shed, route the exhaust from the air release to the outside of the shed.

For irrigation systems with longer pipelines, it is recommended to install at least one air release valve for every 1,000 metres of pipe.

For irrigation systems installed in undulating terrain, it is recommended to install air release valves at all high points where air may build up.

If air release valves are not specified, consult the designer.

7.7 PRESSURE AND VACUUM RELIEF

The design should specify if pressure or vacuum relief valves are necessary. It should also specify the type of valve to be used, and the location in which it should be installed.

A pressure relief valve is recommended for situations where the pressure rating of the system (e.g. the pressure rating of the pipe) may be occasionally exceeded.

A vacuum relief valve is recommended for situations where a negative pressure may be experienced.

Consult the designer if either of these situations are likely to occur and no relief valves are specified.

7.8 STANDARDS RELEVANT TO ACCESSORY COMPONENTS

Always reference manufacturers' instructions when installing irrigation components.

The existing standards listed in Table 8 may also be referenced for further guidance. These are provided for the convenience of users of this document. The Code makes no comment on their relevance or how they are used.

Table 8: Standards relating to the installation of accessory components

Standard	Description
AS 1349	Bourdon tube pressure and vacuum gauges
AS 1628	Water supply – Metallic gate, globe and non-return valves
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2845	Water supply – Backflow prevention devises
AS 3578	Cast iron non-return valves for general purposes
AS 3579	Cast iron wedge gate valves
AS/NZS 2845.1	Water supply – Backflow prevention devises – Materials, design and performance requirements.
AS/NZS 3500.1	Plumbing and drainage – Water services Section 4 – Connection control and backflow prevention
ISO 3635	Irrigation valves
ISO 4046	Measurement of water flow in closed conduits – Meters for cold potable water
ISO 9391	Thermoplastic valves – Pressure test methods and requirements
ISO 9952	Check valves
ISO 11419	Float-type air release valves
ISO 15081	Agricultural irrigation equipment – Graphical symbols for pressurised irrigation systems

8 Commissioning

A properly executed commissioning process will demonstrate whether or not all components of the system are installed and operating properly, and in accordance with the system specification, over the range of on-site conditions expected.

8.1 SYSTEM TESTING

The system must be tested by a qualified person, and the results of the test supplied to the installer, designer, and purchaser.

The system testing must be conducted at a suitable time so that the installer, designer, and purchaser can all be present, if desired.

System testing should include all new components, as well as all pre-existing components that are being incorporated into a system upgrade. This is particularly important for pumping stations.

Test the following during installation and/or prior to handover of the system:

- Check that construction debris is removed and then pressure-test the pipelines at 1.5 times the normal operating pressure, if possible. If this pressure is not achievable with the installed pumping equipment, then pressure-test at the maximum achievable pressure
- Check that pump performance meets the specification
- Ensure that all irrigators receive the required pressure and flow rate
- Test all controls, cut-offs, and alarms
- Calibrate all flow meters
- Test water application depth, intensity, and uniformity under each irrigator
- Test all check valves and backflow preventers, including those on the intake

A code of practice, *The New Zealand Piped Irrigation Systems Evaluation Code of Practice* (INZ, 2010), has been developed to guide the testing process. There are also several existing standards that are specific to performance testing of irrigation components (see Section 8.5, "Standards Relevant to Testing and Commissioning").

In addition, many pipe suppliers' technical documentation and pipe installation standards contain sections relating to pipe pressure testing (see Section 3.9, "Standards Relevant to Pipe Installations").

If any variations from the original design are identified during the system testing, these must be documented and recorded on the as-built plan and in the commissioning report (see Section 8.2, "Documentation").

Unless otherwise outlined in the contract, the acceptable deviation from the system specification is:

- Flow rates must not be more than ± 5% of the design value
- Pressures must not be more than ± 10% of the design value
- Current (amps) must not be more than ± 5% of the design value
- Application uniformity must not be more than 5% under that specified

Correcting poor performance

If system testing reveals that actual system performance does not meet the system specification, the fault must be:

- Corrected and the system retested, or
- Reported to the Purchaser

Any consequences of operating a system that deviates significantly from the system specification must be fully explained to the purchaser. The purchaser may decide whether or not to accept the system as installed.

If the purchaser decides that the system must be made to meet the system specification, the designer or installer (whoever is responsible) must arrange for the necessary changes to the system to be made. This must be done in accordance with the original contract.

8.2 DOCUMENTATION

Proper documentation is an essential part of the commissioning process. The documentation should show that the system was checked, and that it was installed and working properly when it was handed over. It should describe the installation and testing procedures followed and the results obtained.

When an irrigation system is handed over to the purchaser, it should be accompanied by:

- A commissioning report
- As-built plans
- Operation and maintenance manuals
- Any other relevant support information

Commissioning report

A commissioning report must be provided to the purchaser describing the system as installed. The report must be supplied within one month of carrying out the testing and commissioning of the system.

The commissioning report will include all of the following:

- The date of commissioning
- A list of all parties involved with the installation and commissioning
- A list of contact information for:
  - The designer
  - Installers
  - Those who conducted the commissioning (if different)
- An as-built plan
- A description of the procedures followed during installation and commissioning (i.e. standards, codes of practice, or manufacturers' methods)
- A description of the results of performance testing. At a minimum this will include:
  - Results of pipe pressure testing
  - Measured pressures and flow rates at key points in the system under normal operation:
- Flow rate at the pumping station(s)
- Pump pressure (total operating head)
- Pressure at the inlet(s) to the irrigator(s)
  - Water application depth (may be a range)
  - Water application rate (may be a range)
  - Water application uniformity
  - Electrical readings (voltage, amps, etc.) under load
- Copies of any compliance certificates, including:
  - Flow meter calibration
  - Electrical compliance
- Copies of any photographs taken during the installation. This is particularly important for items buried below ground

As-built plans

A final clear and concise readable plan, drawn to scale, with all key items located on the plan must be provided. Ensure that the plan provides accurate locations (minimum accuracy ± 5 metres, however ±0.5metres is desirable where possible), dimensions, and sizes of all key components in the system. This is particularly important for items buried underground.

Also provide a detailed plan of the pumping station and headworks, including below ground components.

Provide the as-built plans within one month of commissioning, or within one month of making changes to the system.

Operation manual

The installer must provide a system operation manual, specifying:

- The correct way to operate all equipment and installations
- How the system should work and its optimal operating range
- How to monitor the system's operation
- Any passwords for electronic equipment
- Protocols for operating the system safely
- Emergency procedures
- Contact information for relevant suppliers

Maintenance manual

The installer must also provide a system maintenance manual, including:

- A service manual and parts list
- A schedule of maintenance that specifies the frequency of inspection and service for all key elements of the system
- A list of monitoring points and methods, and values to be achieved
- Contact information for relevant suppliers

8.3 TRAINING

Training must be made available for the purchaser and system operator that covers all of the main items in the operation and maintenance manuals.

8.4 FINAL SIGN-OFF, FINAL PAYMENTS, AND COMMENCEMENT OF WARRANTY

Final sign-off of the irrigation system should not occur until the system testing has been completed and all of the required documentation and training has been provided to the Purchaser. This may include a certificate of completion.

The terms of the final payment should be outlined in the original installation contract. However, it is considered reasonable for a retention (typically ≤ 5%) of the project cost to be withheld until the final sign-off has been completed.

The warranty period should commence once the system testing has been completed, and the system has been shown to be performing according to the specification (see Section 8.1).

8.5 STANDARDS RELEVANT TO TESTING AND COMMISSIONING

Refer to Irrigation New Zealand's *The New Zealand Piped Irrigation Systems Evaluation Code of Practice* (INZ, 2010) for guidance on performance testing.

The existing standards listed in Table 9 may also be referenced for further guidance. These are provided for the convenience of users of this document. The Code makes no comment on their relevance or how they are used.

Table 9: Standards relating to the testing and commissioning of irrigation systems

Standard	Description
AS 2417	Rotodynamic pumps – Hydraulic performance acceptance tests
AS 2845.3	Water supply – Backflow prevention devises – Field testing and maintenance
AS 4041	Pressure piping
AS/NZS 1462	Methods of test for unplasticised PVC (uPVC) pipes and fittings
AS/NZS 2566.2	Buried flexible pipeline – Installation
AS/NZS 5902.5	Building and civil engineering drawing practices – Recommendations for drawings associated with engineering services operating manuals and maintenance manuals
ISO 9644	Agricultural irrigation equipment – Pressure losses in irrigation valves – test methods
NZS 4404	Land development and subdivision infrastructure

References

IAA (2000): *Australian Code of Practice for On-Farm Irrigation*. Developed jointly by Irrigation Association of Australia, Murray Darling Baisn Commission, and New South Wales Agriculture.

INZ (2010): *The New Zealand Piped Irrigation Systems Evaluation Code of Practice.* Irrigation New Zealand.

INZ (2012): *The New Zealand Piped Irrigation Systems Design Code of Practice.* Irrigation New Zealand.

INZ (2011): *Guidelines for the Measurement and Reporting of Water Takes*. Irrigation New Zealand.

INZ (2012): *Backflow Prevention Guidelines.* Irrigation New Zealand.

International Organization for Standardization (ISO) website: www.iso.org (last accessed on 16 June 2010)

New Zealand *Electricity (Safety) Regulations* 2010. The New Zealand Government, March 2010.

New Zealand Ministry of Economic Development. Energy Safety website: www.energysafety.govt.nz (last accessed on 16 June 2010)

OSH (1995): *Approved Code of Practice for Safety in Excavation and Shafts for Foundations*. Occupational Safety and Health Service, New Zealand Department of Labour. Wellington, New Zealand.

PPI (2001): *Material Handling Guide*. Plastic Pipe Institute. Washington DC, USA.

Standards Australia website: www.standards.org.au (last accessed on 16 June 2010).

Standards New Zealand website: www.standards.co.nz (last accessed 1 December 2011).

Definitions

For the purposes of this document, the following definitions shall apply:

Application depth: The rainfall equivalent depth of water applied to the soil surface during a single irrigation event. It is the depth of water that would be caught in a rain gauge, not the depth of soil that is wetted.

Application efficiency: The percentage of supplied water that is retained in the root zone after an application event.

Application rate: The commonly used term for the more correct term application intensity (i.e. heavy thunderstorm vs light drizzle).

Note: It does *not* mean applied depth per event (see Application depth) or applied depth per day (see System capacity).

Application uniformity: The spatial variability of application. This can be defined in a variety of ways. Common examples are:

- Distribution Uniformity (DU)
- Coefficient of Uniformity (CU)
- Coefficient of Variation (CV)

Back flow preventer: Device designed to prevent water from flowing in reverse through the system. Commonly used to prevent added nutrients, chemicals or effluent from mixing with clean water sources.

Capital cost: The overall system purchase and installation cost ($). Expressed as a cost per unit area ($/ha) as a total or annualised cost.

Design specification: A document that defines site-specific performance targets that a proposed irrigation system must be able to achieve. A designer prepares the final design to meet these requirements. A design specification includes such factors as:

- System capacity
- Application depth range
- Maximum application intensity
- Minimum distribution uniformity
- Return interval

Pumping rate: The mean flow of water per unit time (e.g. ℓ/s or m^3/hr) used in the design of the system.

Surface ponding: Water that does not immediately infiltrate into the soil, and collects on the low points of the soil surface.

System specification: A document that describes what the final system will comprise of, and what it will be capable of achieving. A system specification:

- Lists components of the system (e.g. pipes and pumps)
- Shows their locations
- Describes their key specifications (e.g. pipe diameter, pump delivery pressure)

Appendix: Summary of relevant standards

Always reference manufactures' instructions when installing irrigation components. If additional information is required, there are many existing standards that may also be referenced.

Table 1A summarises all of the existing standards referenced in the main text of the *Installation Code of Practice for Spray Irrigation Systems*. The majority of these standards are New Zealand standards (designated by "NZS") and/or Australian standards (designated by "AS"). Where there were few relevant AS/NZS standards on a particular topic, International Standards (designated by "ISO") are also listed.

These are provided for the convenience of users of this document. The Code makes no comment on their relevance or how they are used.

Table 1a: Summary of standards related to spray irrigation installations

Standard	Decription
	Contracting
NZS 3910	Conditions of contract for building and civil engineering construction
NZS 3915	Conditions of contract for building and civil engineering construction (where no person is appointed to act as Engineer to the contract)
	Pipelines and Fittings (installation)
AS 1726	Geotechnical Investigations
AS 4041	Pressure piping
AS/NZS 2032	Installation of PVC pipe systems
AS/NZS 2033	Installation of polyethylene pipe systems
AS/NZS 2566.2	Buried flexible pipelines – Installation
AS/NZS 3500	Plumbing and Drainage Code
AS/NZS 3690	Installation of ABS pipe systems
AS/NZS 3725	Design for installation of buried concrete pipes
NZS 3124	Specification for concrete construction for minor works
NZS 4404	Land development and subdivision infrastructure
NZS 7643	Code of practice for the installation of unplasticised PVC pipe systems
	Pipelines and Fittings (materials)
AS 2698.2	Plastic pipes and fittings for irrigation and rural applications – polyethylene rural pipe
AS 3571.1	Glass filament reinforced thermoplastics (GRP) systems – Pressure and non-pressure drainage and sewerage
AS 3975	Aluminium Alloys – irrigation tube
AS 4087	Metallic flanges for waterworks purposes
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 2280	Ductile Iron pressure pipes and fittings
AS/NZS 3518	Acrylonitrile butadiene styrene (ABS) pipes and fittings for pressure applications
AS/NZS 3879	Solvent cements and priming fluids for use with uPVC pipes and fittings
AS/NZS 4058	Precast concrete pipes (pressure and non-pressure)
AS/NZS 4129	Fittings for PE pipes for pressure applications
AS/NZS 4130	PE pipes for pressure applications
AS/NZS 4331	Metallic flanges
AS/NZS 4441	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 4442	Welded steel pipes and fittings for water, sewage and medium pressure gas
AS/NZS 4765	Modified PVC (PVC-M) pipes for pressure applications
AS/NZS 4793	Plastic or metallic tapping bands for waterworks purposes
AS/NZS 4998	Bolted unrestrained mechanical couplings for waterworks purposes

Standard	Decription
NZS/BS 1387	Specification for screwed and socketed steel tubes and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads
NZS/BS 3601	Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes
	Pumping Stations
AS 1396	Steel water bore casing
AS 1628	Water supply – Metallic gate, globe and non-return valves
AS 1726	Geotechnical Investigations
AS 1910	Water supply – Float control valves for use in hot and cold water
AS 2368	Test pumping of water wells
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2638	Gate valves for waterworks purposes
AS 4794	Non-return valves – Swing check and tilting disc
AS 4795	Butterfly valves for waterworks purposes
NZS 4411	Environmental standard for drilling of soil and rock
ISO 15081	Agricultural irrigation equipment – Graphical symbols for pressurised irrigation systems
ISO 21413	Manual methods for the measurement of a groundwater level in a well
	Electrical Installations
AS 4777.1	Grid connection of energy systems via inverters – installation requirements
AS/NZS 2053	Conduits and fittings for electrical installations
AS/NZS 3000	Electrical installations (known as the Australia/New Zealand Wiring Rules)
AS/NZS 3010	Electrical installations – generating sets
AS/NZS 3112	Approval and test specification – Plugs and socket-outlets
AS/NZS 3820	Essential safety requirements for electrical equipment
AS/NZS 5033	Installation of photovoltaic (PV) arrays
NZECP 34	New Zealand electrical code of practice for electrical safe distances
NZECP 35	New Zealand electrical code of practice for power systems earthing
NZECP 36	New Zealand electrical code of practice for harmonic levels
NZECP 46	New Zealand electrical code of practice for high voltage live line work
ISO 12734	Agricultural irrigation – Wiring and equipment for electrically driven or controlled irrigation machines
	Irrigators
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 3975	Aluminium Alloys – irrigation tube
ISO 8026	Agricultural irrigation equipment – Sprayers – General requirements and test methods
ISO 9261	Agricultural irrigation equipment – emitters and emitting pipe – General requirements and test methods
ISO 12734	Agricultural irrigation – Wiring and equipment for electrically driven or controlled irrigation machines
ISO 15081	Agricultural irrigation equipment – Graphical symbols for pressurised irrigation systems
ISO 15886	Agricultural irrigation equipment – Sprinklers
	Accessory Components
AS 1349	Bourdon tube pressure and vacuum gauges
AS 1628	Water supply – Metallic gate, globe and non-return valves
AS 2528	Bolts, studbolts and nuts for flanges and other high and low temperature applications
AS 2845	Water supply – Backflow prevention devises
AS 3578	Cast iron non-return valves for general purposes
AS 3579	Cast iron wedge gate valves
AS/NZS 2845.1	Water supply – Backflow prevention devises – Materials, design and performance requirements.

Standard	Decription
AS/NZS 3500.1	Plumbing and drainage – Water services Section 4 – Connection control and backflow prevention
ISO 3635	Irrigation valves
ISO 4046	Measurement of water flow in closed conduits – Meters for cold potable water
ISO 9391	Thermoplastic valves – Pressure test methods and requirements
ISO 9952	Check valves
ISO 11419	Float-type air release valves
ISO 15081	Agricultural irrigation equipment – Graphical symbols for pressurised irrigation systems
	Testing and Commissioning
AS 2417	Rotodynamic pumps – Hydraulic performance acceptance tests
AS 2845.3	Water supply – Backflow prevention devises – Field testing and maintenance
AS 4041	Pressure piping
AS/NZS 1462	Methods of test for unplasticised PVC (uPVC) pipes and fittings
AS/NZS 2566.2	Buried flexible pipeline - Installation
AS/NZS 5902.5	Building and civil engineering drawing practices – Recommendations for drawings associated with engineering services operating manuals and maintenance manuals
ISO 9644	Agricultural irrigation equipment – Pressure losses in irrigation valves – test methods
NZS 4404	Land development and subdivision infrastructure

Other relevant guidance documents

- *The New Zealand Piped Irrigation Systems Design Standards* (INZ, 2012)
- *The New Zealand Piped Irrigation Systems Evaluation Code of Practice* (INZ, 2010)
- *New Zealand Electrical (Safety) Regulations* (2010)
- *New Zealand Building Code*
- *Australian Code of Practice for On-Farm Irrigation* (IAA, 2000)
- *Guidelines for the Measurement and Reporting of Water Takes* (INZ, 2011)
- *Backflow Prevention Guidelines* (INZ, 2012)

NOTES

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REFERENCES

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