5.3 Equipment specifications

5.3.1 Collectors: Design, dimensions and orientation

5.3.1.1 Meet specifications in adopted standards

Where an audit is conducted according to specifications in any recognised standard, the collectors must meet the specification established in that standard.

5.3.1.2 Collectors for sprayer and sprinkler irrigation

These guidelines apply to collectors (catch cans) used to intercept irrigation water under sprayer or sprinkler irrigation systems where only a part of the flow from one or more sprayers or sprinklers is captured.

1. Basis of these guidelines

The guidelines for collector design and dimensions established in this Code are based specifications for collectors established in ISO 7749-2:1990, and in ISO 11545:2001(E).

Note: These two ISO Standards have different specifications for collectors, and the specifications do not correlate.

2. Minimum requirements for collectors

Ensure that all collectors used for a test are identical and shaped such that water does not splash in or out. Ensure that the lip of the collector is sharp, symmetric and without depressions or deformities. Ensure the entrance diameter (mouth) of the collector is half to one times its height, but not less than 75mm. Ensure that the height of the collector is at least twice the average depth of water collected during the test, but not less than 150mm.

Collectors that are intended for collecting water for transfer to a measuring device will have a sharp edged round opening as described above. They may be cylindrical or conical, with sidewalls inclined to at least 45^{o} from the horizontal.

Other types of collectors may be used, provided that their accuracy is not less than the accuracy of the collectors described above.

To minimise measurement error, testers are encouraged to use collectors that are as large as possible (ISO). A 10 - 20 litre bucket with a mouth opening of 250 – 300mm is generally practical (NZI, Cal).

Note that many buckets have a widened lip/rim, in which case the best estimate for diameter is to measure to the centre of the rim.

Set collectors level, and so their mouth is the same height as, and not affected by, the canopy (Cal, NZI).

3. Minimising error

To minimise measurement error, testers are encouraged to use collectors that are as large as practicable. Collectors used for measuring volumes should be cylindrical (rather than conical) to avoid interpolation errors in reading.

Measuring devices should be cylindrical and graduated with marks at no less than 10% of the volume being measured. Ideally the measuring device capacity will exceed the volume to be measured. This avoids error and time involved in splitting collected volumes into multiple readings.

5.3.1.3 Collectors for micro-sprinkler irrigation

1. Basis of these guidelines

The guidelines for collectors established in this Code apply to sprayers and sprinklers where the entire flow is collected for measurement. There is currently no international specification for this test.

Typically this will be restricted to micro-sprinkler irrigation systems where the water applied by an individual sprayer or sprinkler is directed to part of the root zone of an individual plant. This is likely to be in a mature orchard situation where the tree roots occupy all the area that is wetted by the sprayer or sprinkler.

Special consideration must be given to in-field measurements in orchards where one sprayer or sprinkler is used to apply water to two young plants with small root systems. Careful observation will identify whether plants are receiving applied water.

2. Minimum requirements for collectors

The minimum requirement for collectors is that all water emitted is collected without affecting the flow rate of the sprayer or sprinkler by blocking flow or causing pressure changes. This will involve shrouding the sprayer or sprinkler with a vented cover in such a way that normal operating pressures and flows are maintained.

3. Minimising error

To minimise measurement error, testers must ensure that normal operating pressures and flows are maintained. Either of two alternative approaches may be used: placing a shroud over the sprayer or sprinkler in situ and directing the captured flow to a second vessel for collection (Fig 5.3.1), or placing the sprayer of sprinkler in a container ensuring the sprayer or sprinkler outlet is not flooded and is at the same elevation as in the field.

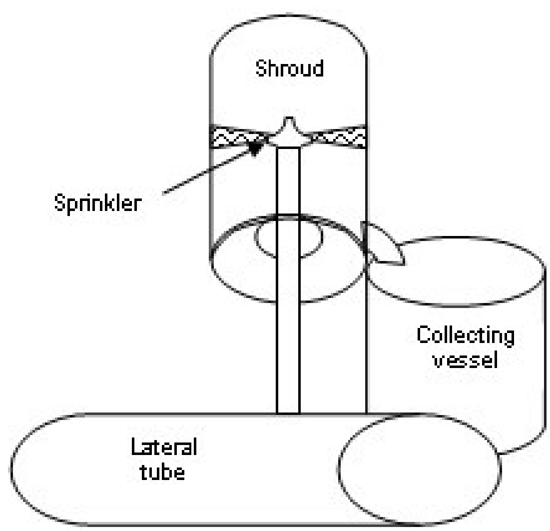

Fig 5.3.1 Shroud for sprayer flow collection

Measuring devices should be cylindrical (rather than conical) and graduated with marks at no less than 10% of the volume being measured to avoid interpolation errors in reading.

5.3.1.4 Collectors for dripline irrigation

1. Basis of these guidelines

The guidelines for collectors established in this Code recognise the specifications for collectors established in ISO 9261:1991(E) *Agricultural irrigation equipment – Emitting pipe systems – Specification and test methods* apply only to new pipe and emitting devices measured in laboratory conditions.

In-field measurements, especially of buried dripline, require special consideration.

2. Minimum requirements for collectors

ISO 9261 specifies only that the emission rates of the emitting-pipe shall be measured with an error not exceeding ± 2% of the actual values.

The system of collection used must capture all the flow from that section of pipe and/or emitters being assessed without affecting the flow rate of the sprayer or sprinkler by blocking flow or causing pressure changes.

3. Minimising error

To minimise measurement error, testers must ensure that all flow is captured and normal operating pressures and flows are maintained. Practically, this can be done by placing stopper rings around the pipe at the end of the section being measured, and a collection tray underneath the pipe or emitter in situ ensuring the outlet is not flooded and is at the same elevation as in the field (Fig 5.3.2). The captured flow should be transferred to a second vessel for measurement.

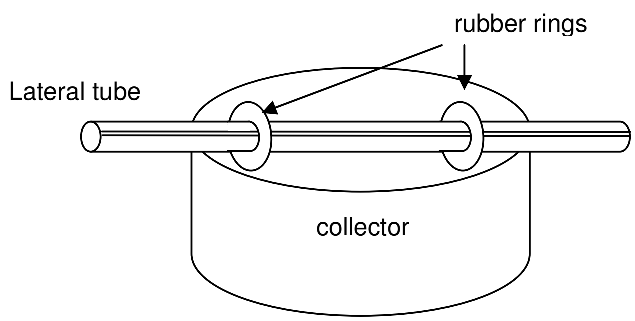

Fig. 5.3.2. Drip-line collector

5.3.1.5 Measuring Devices

Measuring devices should be cylindrical (rather than conical) and graduated with marks at no less than 10% of the volume being measured to avoid interpolation errors in reading.

Standard plastic measuring cylinders of a range of volumes (100 – 2,000 mL) are suitable for field use.

5.3.2 Pressure gauges

5.3.2.1 Meet specifications in adopted standards

Where an audit is conducted according to specifications in any recognised standard, the pressure gauges and sampling methods must meet the specification established in that standard.

5.3.2.2 Gauge specifications

1. Existing accuracy standards

ISO Standards 7749-2:1990, 11545:2001, and 9261:1991 specify that pressure gauges shall have an error not exceeding ± 2% of actual values. ISO 8224/1:1985 *Travelling irrigation machines* establishes that pressure gauges shall have an error of less than ±10 kPa.

For practical purposes, gauges with error of less than ± 2% of actual values should be used.

2. Gauge reading range

The pressure gauge used should have a reading range that is centred on the pressure value being taken.

5.3.2.3 Measurement techniques

A variety of pressure measurement techniques and positions are specified in standards and other guidelines. The critical factor is to ensure the same method is used for all similar measurements in any evaluation exercise.

1. Microirrigation laterals

Unless pressure test points are fitted to a microirrigation system, pressure measurements in the field are made using a pressure gauge with a pitot tube. The pitot is inserted into a hole punched in the lateral tubing, and the pitot directed to face into the flow (**Fig 5.3.3**).

The measurement is made with the lateral in its normal position, and the hole is sealed with a 'goof plug' once the reading is completed.

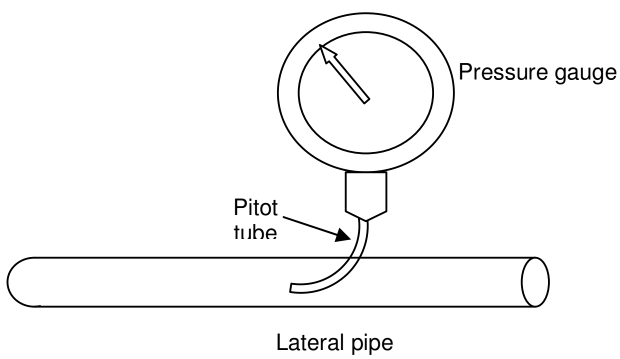

Fig 5.3.3 Pitot tube to measure soft lateral in-line pressure

2. Sprinklers, rotators or multi-outlet sprayers

ISO 7749-2:1990 establishes a procedure for measuring sprinkler pressures (see Fig 5.3.4)

The test pressure shall be measured at the height of the main nozzle of the test sprinkler. The point at which pressure is measured shall be located at least 20cm upstream of the sprinkler so that the pressure measured is not affected by any local variation. No fitting or device which may cause a drop in pressure shall be installed between the point of pressure measurement and the sprinkler.

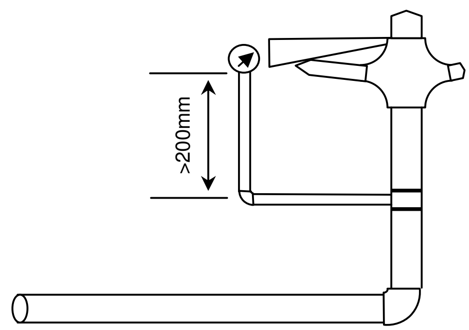

Fig 5.3.4 Measurement of sprinkler pressure from ISO 7749-2: 1990

3. Sprayer or sprinkler orifice

For in-field pressure measurement on existing systems the simplest method is usually to take pressure readings at the nozzle outlet or orifice. This technique may not be possible with some designs, or where the orifice diameter is very small.

A pressure gauge fitted with a pitot is used, with the pitot inlet positioned in the centre of the flow stream just outside the orifice (Fig 5.3.5 Measurement of sprinkler pressure).

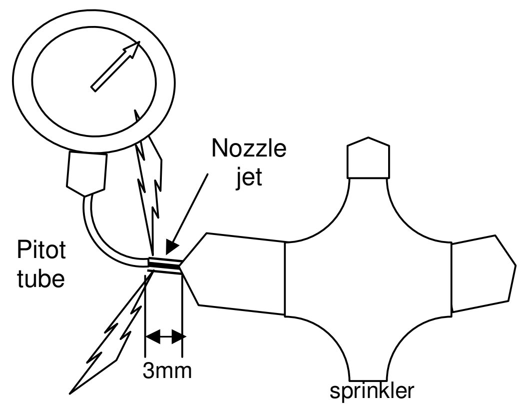

Fig 5.3.5 Measurement of sprinkler pressure

5.3.2.4 In-field sprinkler pressure measurement

It is very difficult to obtain satisfactory pressure measurements from moving irrigators, and from irrigation systems such as centre pivots where very high discharge rates are common.

It is possible to install tees fitted with pressure test points upstream of the sprinkler in many instances. The pressure can then be measured using a gauge fitted with a long flexible hose and pressure test needle.

5.3.3 Flow Meters: range and accuracy

5.3.3.1 Meet specifications in adopted standards

Where an evaluation is conducted according to specifications in any recognised standard, the pressure gauges and sampling methods must meet the specification established in that standard.

In addition, a fitted meter must comply with any regulatory requirements such as those in a Resource Consent.

5.3.3.2 Fitted water meters

The accuracy of flow meters fitted to irrigation systems is dependent on manufacture (quality) installation and maintenance history. Generally in-line flow meters fitted in New Zealand have high accuracies when supplied, generally better than $\pm$5%, so potentially give good results.

However, the accuracy can rapidly deteriorate. If water quality, especially suspended solids or included debris, is poor particular caution should be applied to meter readings. This is also the case if maintenance history is not known or unsatisfactory.

Field checks of meters regularly identify inaccuracy (often in the order of 30%) because of wear, damage or incorrect installation.

Meters should be fitted with a straight length of pipe equal to at least 10 pipe diameters upstream, and another straight length of 5 pipe diameters downstream. This should avoid influence of turbulence effects.

Deliberate sabotage or wear of internal gauge components is difficult to assess without dismantling the meter.

5.3.3.3 Mobile test water meters

A range of external flow metering technologies is available. Care must be taken to install and operate any such device correctly in accordance with manufacturers' instructions.

Many New Zealand water supplies are “too clean” to give accurate readings with externally mounted meters.

5.3.4 Weather Monitoring

Most standards require monitoring of prevailing weather conditions throughout the period of system testing.

The main purpose of weather records during the test period is to assist post-test analyses. This may include identification of possible causes of non-uniformity (wind), or confirmation of measured evaporation rates (temperature and humidity).

5.3.4.1 Wind Speed

Wind effects in particular can greatly affect system performance and should be monitored carefully.

Equipment used to measure wind speed should be accurate to better than $\pm$5%. Many small handheld meters are available with adequate performance.

Many standards specify a maximum wind speed for reliable uniformity evaluations of 3 m/s. If wind speed is greater than this, the system owner should be consulted and made aware of the potential limitations of results from testing.

Wind speed should be recorded at least once every 15 minutes throughout the test period. A logging meter simplifies this task. The average and maximum speeds should be presented in the report.

5.3.4.2 Wind direction

The direction of wind, and any significant variations, occurring during the test period should be recorded. Generally the direction relative to the irrigation system, particularly for system irrigating strips, is of significance.

5.3.4.3 Temperature

The ambient temperature, and the range of temperatures, during the test period should be recoded. Readings should be taken at no more than 15 minute intervals with equipment accurate to $\pm$1 degree Celsius.

5.3.4.4 Humidity

Equipment used to measure relative humidity should allow monitoring to $\pm$5%. A range of small handheld devices are available that meet this specification.

5.3.5 Elevation

System pressure is sensitive to changes in elevation. Systems that operate at very low pressures may be particularly affected by terrain and elevation determination can be critical in identifying factors contributing to non-uniformity.

5.3.5.1 Survey plans or topographical maps

Irrigation system design plans should provide topographical data to a satisfactory resolution. Use such plans if available, and apply some in-field checks to verify accuracy.

Standard topographical maps (eg NZMS 1 1:50,000 series) do not provide enough resolution. They may however be useful in establishing benchmark elevations.

5.3.5.2 Barometric altimeters

In most cases, an accurate barometric altimeter will provide sufficient accuracy. Equipment used should have altitude resolution of 1.0 m or better.

To ensure atmospheric change effects on barometric readings, all elevation readings should be made as quickly as possible, and the survey should be ‘closed’ by returning to the start point and retaking an elevation (altitude) reading. Variation can be accommodated using standard survey practise, adjusting intermediate readings assuming change was constant.

For ease of reading, use a pole of known length to set the barometer at a constant height above ground level when taking measurements. (Take care to record correct relative levels, if some elevations are determined at above ground locations.)

5.3.5.3 Benchmark elevation

It is not necessary to present elevations as metres altitude about mean sea level (m ASL). Reduced levels relative to a benchmark established on site are sufficient.

Suitable benchmarks will have a clearly defined point of measurement. They will be stable and enable repeated measurements, even at a later date. Examples include a defined point on a solid concrete pad (pump foundation) or similar.

5.3.6 Equipment lists for field work

Misc Equipment

Road map
Farm location / physical address
Contact details
Contact phone number

Data collection sheets
Field book
Pens, pencils
Cell phone
Camera

Magnetic compass – identify North etc
Angle finder
Wind speed meter
Thermometer / Humidity meter
Altimeter
Stop watch

Shovel
Soil probe / auger
Thread tape
Pouch – to hold tools, misc items
Nylon stockings – to sieve flushing water

Clothing

Gumboots
Parka
Overtrousers
Long rubber gloves
Towel
Change of clothes

Misc Tools

Vice grips
Spanner – 20 cm adjustable
Open end spanner set
Wrench – 35 cm adjustable
Pliers – to insert goof plugs
Secateurs
Knife snap blade – cut emitters, drippers
Wire cutters

Length Measurement
100 m fibre tape measure
50 m fibre tape
5 m steel tape
Measuring wheel
Fibre glass poles 1.5 m – to mark speed test runs

Pressure Measurements
Pressure Gauges
- 0 – 250 kPa
- 0 – 400 kPa
- 0 – 1000 kPa

Spare threaded pressure test points
Flexible hose extension – to connect to gauges
Pressure test needles – to connect to gauges
Pitot tubes – to connect to gauges

Drip-micro
Pre-made pressure test points (Tee'd to insert in thin wall drip-line)
Clamps – to close off lateral tubing
Lateral punch – to allow pitot insertion
Goof plugs – to repair holes

Pivot/linear
Threaded tee pressure test points – between dropper and pressure regulator
Bayonet pressure test point – between pressure reg & spray head (Nelson)

Flow Measurement
Measuring cylinders (depend on collector size)
- 100 mL
- 250 mL
- 1,000 mL
- 2,000 mL

Measuring jug
- 5 L

Drip-micro
Buckets x 30 10L – for sprinkler flow collection
PVC pipe 40mm x 30 pieces (20cm long) – to collect sprinkler flow to bucket
Sprinkler shroud – for sprinklers that are fixed in place
Plastic containers x 30 0.5 - 2 L – for dripper flow collection
Jiffy clips – attached to lateral to prevent dribbling past collector

Other systems
Container of known volume (~ 20L)
Shroud and pipe or hose – to divert sprinkler water to container
Flexible hose 25 – 30 mm 1 m long – to divert sprinkler flow to large container
Buckets x 100 10L – for sprinkler flow collection
Clothes pegs – to stop sprinkler movement