TENSIOMETER REFERENCE HANDBOOK

IRROMETER®
SOIL WATER MANAGEMENT SINCE 1951

Introduction

An IRROMETER tensiometer works as a filled water column sealed at the top, with a porous ceramic tip interacting with the soil. Drying soil will attempt to pull water out of the instrument through the tip, creating the tension measured on the gauge.

The basic components are shown to the right. The cap, stopper, gauge, and tip are all replaceable components. Refer to page 9 for part numbers to be used when ordering.

Proper operation requires that the IRROMETER be filled with water and that all air has been removed.
This guide will cover how to prepare for installation, perform in-field service, protect, and store the instrument when not in use, and the basics of interpreting readings.

Tools needed for installation:

Service Kit (hand pump or syringe, green fluid)
Clean Water
Installing Tool or ½" steel pipe section (7/8" or 22 mm O.D.)
Hammer

Site Selection and Placement

Proper placement of an IRROMETER is critical to providing actionable soil moisture data. Select sites that are representative of a larger block of similar conditions such as soil type, slope, and sun exposure.

Install into the active root zone of the plant and in the wetted area of the irrigation system, preferably on the side with more direct sunlight where evaporative losses are greatest.

Plants with root systems deeper than 18" (45 cm) can benefit from measuring at multiple depths to better understand the soil moisture profile. A good starting point is to install the shallow instrument at 25% of the root zone depth, and the deeper at 75%.

For trees, place at the drip line of the canopy, while in row crops place in the row itself. With drip or micro-sprinkler systems, placement is recommended at 12" (30 cm) to 18" (45 cm) from the emitter line, or 24" (60 cm) to 36" (90 cm) from the sprinkler within the wetted pattern.

In flood or furrow applications, place instruments two-thirds of the way down the run where penetration is most critical. In flood applications, selecting an instrument 6" (15 cm) longer than required can allow for keeping the gauge above the flooded water level.

Preparation

Take the plastic wrapper off the tip, remove the cap, and fill the IRROMETER with a diluted solution of the green fluid (1 capful of concentrate to 1 gallon of water) to about ¾ of the reservoir. The green fluid is optional but makes determining the water level for servicing easier.

Tap the top of the IRROMETER with the palm of your hand to force water down into the water tube, until there is no bubble between the reservoir and the water tube. Leave the instrument cap off and place the tip of the IRROMETER in clean water for at least 1 hour.

If transporting after soaking, keep the instrument ready for installation by putting the plastic wrapper back on the tip, securing with the rubber band, and installing the cap by tightening only ¼ turn past first contact with the stopper.

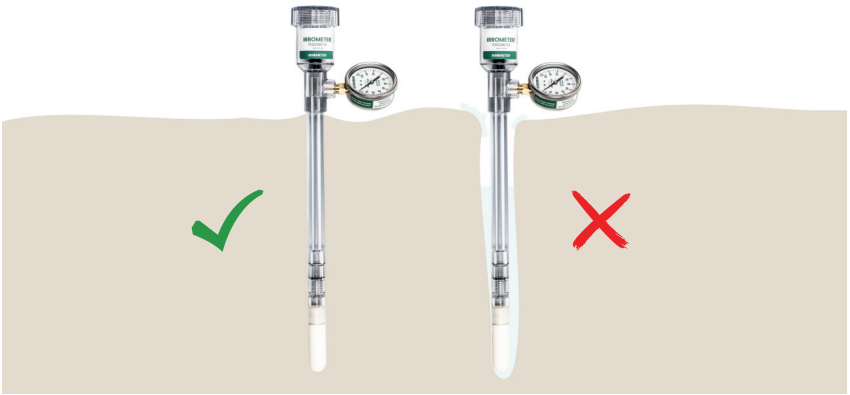
Installation

Install after irrigation when soil is wet and easy to dig.
In very loose soils, shorter length instruments can be simply pushed into the soil to the desired depth. Most heavier soils will require preparing a hole for the IRROMETER.

Drive a hole into the ground with an IRROMETER Installing Tool or a section of ½" steel pipe (7/8" or 22 mm O.D.) to the desired depth, leaving at least 1" (25 mm) of space between the bottom of the gauge and the ground to protect the gauge and allow the membrane vent to function.

It is important not to make an overly large hole, as the IRROMETER must be firmly seated to make the necessary contact between the tip and the soil. If a larger hole is necessary, make a mud slurry to fill the hole before installing the instrument to "grout" it in place.

Do not make the hole deeper than the instrument length- the tip should be against the bottom of the hole.



Push the IRROMETER into the prepared hole. Always handle by the cap or reservoir- do not push or pull on the gauge. Avoid twisting the instrument counterclockwise while installing as this can loosen the replaceable tip. Once installed, mounding a few inches of soil around the instrument will create drainage to prevent pooling.

Servicing

Proper operation requires that the IRROMETER has sufficient water, and that air is removed from the gauge and from the water column. Air is removed using the hand pump or MLT syringe. This must be done immediately after installation, and occasionally through the growing season. The service interval will depend on field conditions- when readings stay below 30 cb service is rarely required, but increasingly needed as the readings go higher.

Servicing is best performed when soil is wet to avoid drawing additional air into the IRROMETER. Add water to the instrument before pulling vacuum.

For Standard and Pro Service Kits:

Using the hand pump, extract any air by removing the cap, seating the pump cup against the top of the reservoir, and pulling on the pump a few times to get a gauge reading in the upper half of the range, typically 70 to 80 on an SR and 40 on an LT. Replace the cap and tighten only ¼ turn past first contact.

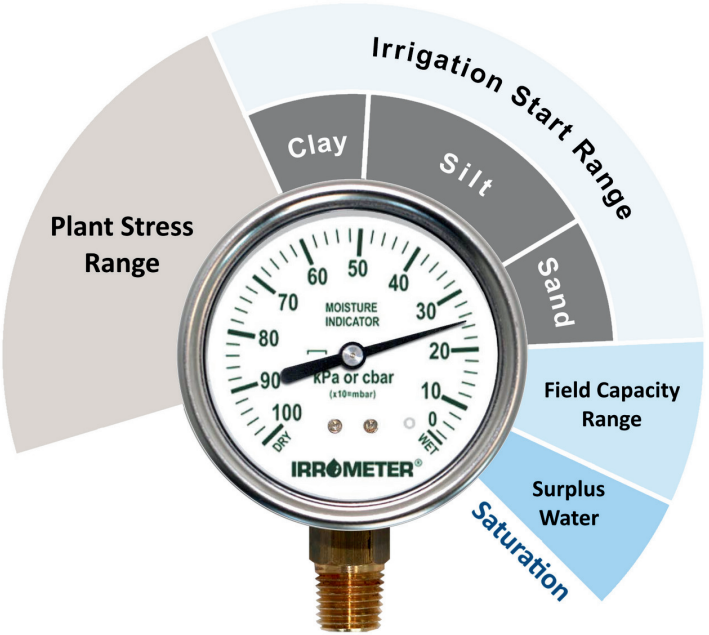
Hold the vacuum for a few seconds and then release gently using the thumb release valve on the suction cup. NOTE: for RSU (electronic output) equipped versions, it is critical that vacuum not be suddenly released to avoid damaging the RSU.

For Basic and MLT Service Kits:

Seat the tip of the syringe into the small opening at the bottom of the reservoir (against the O-ring for MLT). Apply pressure to seal the tip and pull on the syringe handle to get a gauge reading in the upper half of the range, typically 70 to 80 on an SR and 40 on an LT, then slowly release. Replace the cap and tighten only ¼ turn past first contact.

Interpreting Readings

An IRROMETER measures soil water tension, which is the force roots must overcome to extract water from the soil. A 0 reading is fully wet, or no tension. As the soil dries the tension will increase. The information below provides general guidelines for different soil types.



0-10 Centibars: Saturated soil

10-30 Centibars: Most soil is adequately wet. Coarse sands and potting media are drying and in the range for irrigation.

30-60 Centibars: Typical range of irrigation for most soils.

60-100 Centibars: Usual range for irrigation in heavy clay.

100-200 Centibars: Soil is becoming very dry. If applications require management in this range, the WATERMARK sensor can be used.

Readings can fluctuate with large daily swings in temperature, particularly in direct sunlight. This effect is exaggerated when servicing is required and there is a large air bubble in the water tube. In these conditions, readings taken in the morning are generally the most accurate.

Charts

The charts included with the Service Kits can be used to manually plot readings over time and analyze trends. The rate of change can be a key indicator of when to irrigate, and having the history of each cycle can help identify under or over irrigation.

IRROMETERs can be fitted with the RSU-V in place of or alongside the gauge, making them readable by our own and many other manufacturers devices. Our IRROcloud Monitor (IC-10-IR) can read up to six IRROMETER instruments, collect and store readings in the cloud, and make them available via an app for easy analysis.

More information can be found at: irrometer.com/basics.html

Protection and Storage

Freezing temperatures will damage the gauge on the instrument. In areas where temperatures drop slightly below freezing and only infrequently, an insulated box over the IRROMETERs can trap enough ground heat to protect them overnight.

In colder environments either the gauge or the entire instrument must be removed for winter. Gauges can retain water even if the IRROMETER is drained. If storing where freezing temperatures are expected, use the hand pump to remove all water by holding the drained instrument so that the gauge is upright and pull vacuum to remove any additional water.

Before winter storage, the tensiometer should be cleaned using clean water and a brush or cloth, and then rinsed.

To maximize tip life, flush the instrument by filling it with water (preferably distilled) and letting it drain out of the tip by gravity (cap removed). This will help to remove some of the material accumulated in the tip during the growing season.

Maintenance

Tips

The ceramic tips on the IRROMETER can mineralize over time and slow response. As a test, hang the instrument vertically, fill with water to the top of the reservoir, and allow to drain for 24 hours with the cap removed. If less than 1" (25 mm) of water drains, the tip should be replaced.

To replace the tip:

SR/LT: Unscrew the old tip and reinstall the new one, first dipping the threads and O-ring in water. Do not overtighten. Tighten until there is no gap between the tip and the tube and no more or you risk breaking the tip assembly.

MLT: Pull the entire tip and tube assembly out of the reservoir. Install the new assembly, being careful to push only on the plastic tube to avoid damaging the tip. Wetting the O-rings can ease installation.

Older "R" series IRROMETERs without the replaceable tip will have to be sent back to IRROMETER for conversion to the replaceable SR design.

Gauges

Gauges can be removed and installed with a 9/16" or 15mm open end/spanner wrench. Do not use the gauge itself to tighten by hand. Threads must be sealed with Teflon tape or an aviation style gasket sealant. Replacement gauges will come prepared with Teflon tape, ready for installation. Do not overtighten- leave at least one thread exposed.

Cap & Stopper

The stopper can become hard over years of service or be damaged by frequent over-tightening, requiring replacement.
Stoppers can be replaced individually, or an entire cap assembly can be purchased. Use water to help push the stopper into the cap stem.

Hand Pump

If you are having trouble with the hand pump pulling or holding vacuum, the standard and pro pump can be disassembled by pulling the end caps off the main tube. Clean all parts with soapy water, dry, and then spray with a silicone lubricant (particularly the ball valve) before reassembly.

The basic syringe can be pulled apart by pulling the plunger out completely, and cleaning all parts with soapy water.

IRROMETER Replacement Part Numbers:

CAP	Complete cap assembly with new stopper
STOP	One dozen (12) replacement stoppers
SRT	Threaded replaceable tip, standard SR and LT
MLT-TIP	Tip and tube section for miniature LT
SR-O	Tip O-ring for SRT and QFSRT
1008	0-100 cb/kPa gauge for standard R/SR IRROMETER
1008-LT	0-40 cb/kPa gauge for low tension LT IRROMETER
1008-MLT	0-40 cb/kPa mini gauge for MLT IRROMETER

Service Kit Part Numbers:

1000	Service Kit, Basic for R/SR/LT and MLT
1001	Service Kit, Standard for R/SR/LT
1002	Service Kit, Test Gauge version for R/SR/LT
1003	Test Gauge Adapter for converting 1001 to 1002
1004	Green Fluid concentrate, 0.7 oz
1004-L	Green Fluid concentrate, 6 oz

Troubleshooting

Leaks

A leak will cause a low or zero reading and drain the instrument quickly. They can be detected by pulling vacuum with the hand pump and watching for a steady stream of large bubbles. Small “champagne” bubbles are normal when servicing.

A leak at the gauge fitting can be addressed by removing the gauge and reapplying tape or sealant. Leaks at the tip interface can be solved by cleaning and re-installing the tip or replacing the O-ring.

Gauges

Gauges can be damaged by freezing or jarring.

With the cap removed and the IRROMETER vertical, a gauge should always read zero.

A reading higher than that indicates damage, and the gauge should be replaced. A gauge which will both zero with the cap removed and pull up to 70+ with the hand pump (40 on an LT) is likely good.

A test pump version of the Service Kit is available which incorporates a gauge of its own. This can be used to pull vacuum and compare the two gauges to fully check calibration.

Unexpected Readings

If the instrument is serviced, there are no leaks, and the gauge checks OK, the reading is likely correct. It could be that the actual conditions are different than expected, or it is possible that the site is not representative due to any combination of irrigation issues, hardpan, installation problems, or other variables in the soil. Consider reinstalling the instrument in a nearby similar location.

Reading Offset

When the cap is installed, longer instruments will never zero even when saturated as the weight of the water column creates some tension, about 1cb for every 4” (10 cm) of length. As an example, a 12” (30 cm) IRROMETER will read 3cb when fully saturated, and a 24” (60 cm) will read 6cb.

Additional Information:

irrometer.com

YouTube/@irrometer

irrometer.com/basics

Warranty

The IRROMETER Company warrants its products against defective workmanship or materials under normal use for one year from the date of purchase.

Defective parts will be replaced at no charge for either labor or parts if returned to the manufacturer during the warranty period. The seller's or manufacturer's only obligation shall be to replace the defective part and neither seller nor manufacturer shall be liable for any injury, loss, or damage, direct or consequential, arising out of the use of or inability to use the product.

This warranty does not protect against abuse, shipping damage, neglect, tampering or vandalism, freezing or other damage whether intentionally or inadvertently caused by the user.

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