

Equi-pF

Automated Soil Moisture Release Curve Apparatus

Equi-pF is a new instrument which automates the process of determining Soil Moisture Release Curves using the tension table principle.

The main advantage of Equi-pF over the traditional tension table is that once a test sample is placed on the apparatus, no further interaction is needed.

By accurately measuring the water inflow and outflow from the sample at each tension step, Equi-pF:

- S Eliminates sample disturbance throughout the test
- S Improves accuracy and reliability of the test results
- S Frees laboratory staff from repetitive and error prone sample handling and weighing

The soil moisture release curve is plotted by Equi-pF at the end of the test.

Equi-pF has the broad ability to be easily used by both the specialist and non-specialist.

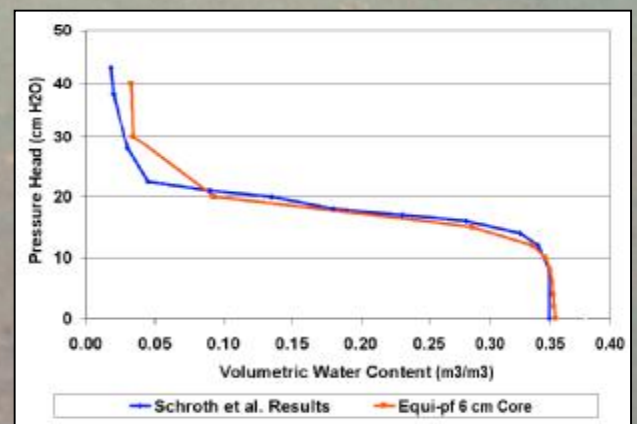


Equi-pF was developed in conjunction with scientists at Landcare Research in New Zealand, who had become frustrated with the tedious manual tension table method for determining moisture release curves. The goal was to design an apparatus that would completely automate the process. Scientists at Oregon State University have also contributed to the project.

“Equi-pF is the best instrument available to obtain the most accurate and reliable moisture retention properties of soil near saturation with the minimum effort.” Dr Tim Davie, Landcare Research, NZ

Equi-pF has undergone rigorous validation trials at Oregon State University. These included:

- S Comparisons with various grades of Accusands (which have been well characterized by Schroth et al. (1996))
- S Comparisons of cores taken from the HJ Andrews Experimental Forest and tested on both Equi-pF and traditional Tension Table apparatus



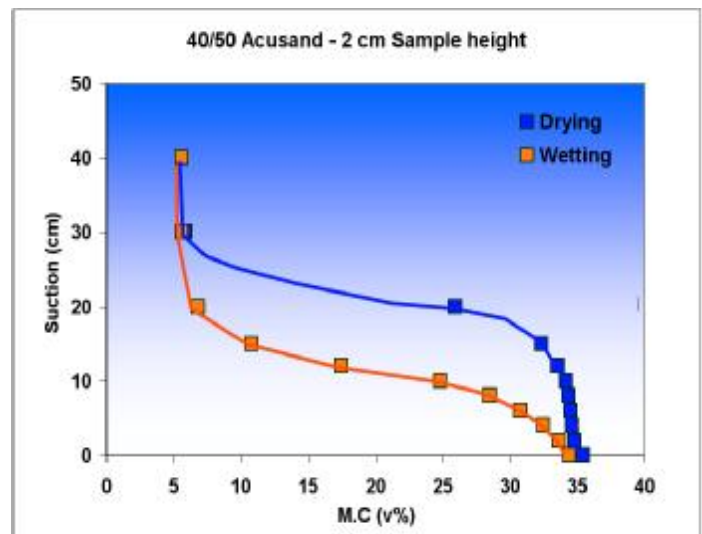
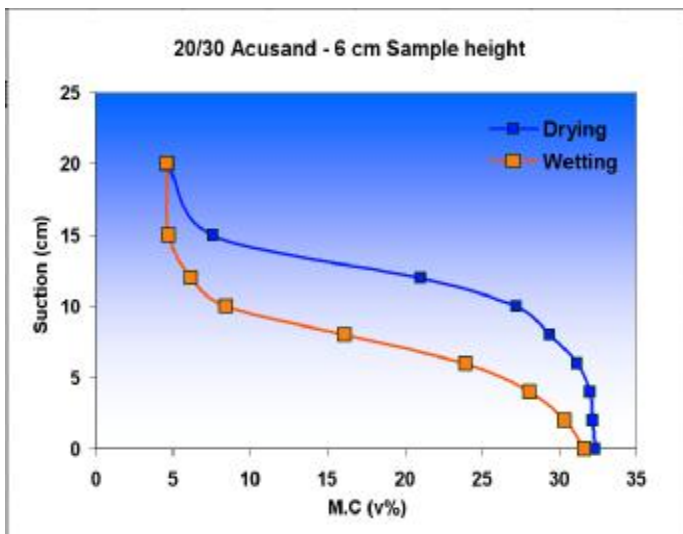
Equi-pF Benefits

- S Fully automated - the sample is put in place and no further operator intervention is required.
- S No disturbance of the sample during tests.
- S Programmable tension steps.
- S Soil reaches equilibrium at each tension step.
- S Each tension step has a user settable time limit to reach equilibrium.
- S Measures macroporosity – a key determinant of soil hydraulic conductivity and drainage status
- S Measures water properties in the macropore range – critical for preferential flow processes and contaminant transport
- S Weighing errors are eliminated - inflow and outflow water volume is measured directly, to an accuracy of 0.1 ml.
- S Outflow and inflow curves, both cumulative and for the current tension are automatically updated and displayed on a graphical LCD.
- S Each tension step can be manually bypassed.
- S Allows multiple continuous drying and wetting cycles.
- S Data on hysteresis in soils

Equi-pF Advanced Features

In addition to the measurement of the standard soil moisture release characteristic, Equi-pF can also be used to study other soil properties including:

- S Effects on water retention of soil wetting agents used in water-repellent soils
- S Effects of sand grading on water retention and movement in sports turf soils
- S The effects of temperature on the moisture characteristics of soil
- S Soil moisture characteristics of swelling soils under over-burden pressures
- S The effect of reference point on moisture release properties
- S Unsaturated hydraulic conductivity and diffusivity of soil near saturation
- S The effect of sample height on moisture release curve properties
- S Soil water storage hysteresis characteristics
- S DNAPL contaminant analysis
- S Analysis of air entrapment effects on moisture release



Drying and Wetting Curves for 20/30 and 40/50 Accusands

Equi-pF Operation

Equi-pF accurately measures the movement of water in and out of the soil sample under applied tensions.

Equi-pF is “set and forget”. To operate:

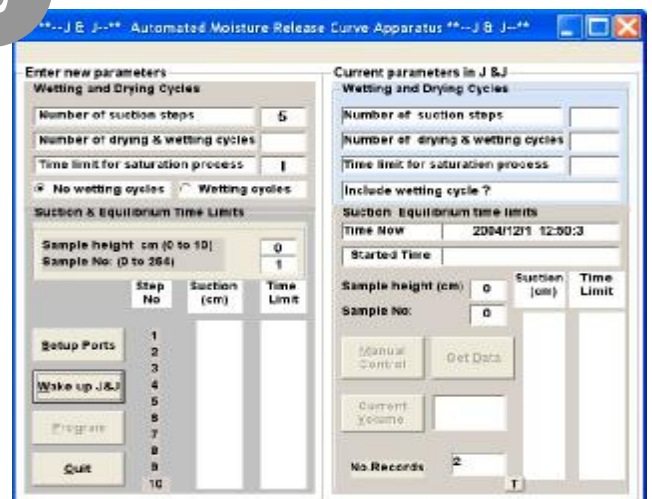
- S The soil sample is loaded onto the instrument and is not handled again until the end of the test.
- S Equi-pF automatically saturates the soil sample and measures the amount of water taken up during saturation.
- S Equi-pF then applies a series of pre-determined tension steps, measuring the amount of water released by the soil core at hydraulic equilibrium at each tension step.
- S Measurements can be taken for both drying and wetting cycles, and repeated drying and wetting cycles are possible.
- S Equi-pF automatically calculates the moisture release curves for both the drying and wetting cycles.

Using Equi-pF is as easy as 1 – 2 - 3

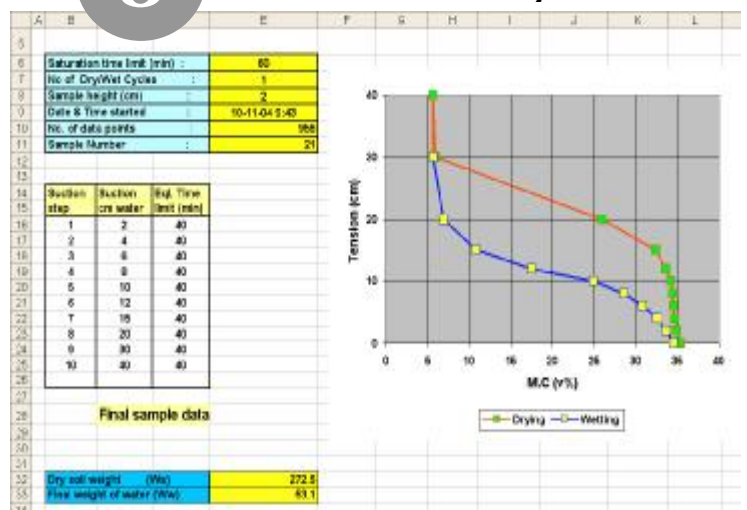
1 Load the Sample



2 Set the Parameters



3 Soil Moisture Release Curve Plotted Automatically



User Feedback

“Dr Ekanayake’s new and innovative design for “touchless” wetting-drying of intact soil cores has tremendous potential in research, teaching and professional practice. With a range of 0 to 100cm H₂O, the device covers the wet range of the “curve” and is thus applicable for many studies where soil drainable porosity, K_{sat} - water content relations etc., demand fast, easy, precise analysis of the moisture release characteristics of soils. The device also offers potential for further characterization of capillary conductivity in the 0 to 100 cm H₂O range.

The “touchless” design (no repeat handling of the sample and no need to weigh a dripping core with all the inherent measurement inaccuracies this introduces) and the ability to run wetting and drying cycles plus the added analytical feature of unsaturated hydraulic conductivity makes Equi-pf a vital tool for scientists and professionals.”

Prof. Jeffrey J McDonnell
Richardson Chair in Watershed Science
Oregon State University

“As a teaching and research tool the Equi-pF system is simple to use, rapid in its assessment of soil moisture release characteristics, and more accurate than the traditional manual methodology. It is a vital tool providing hydrologists with moisture retention data enabling them to use available hydrological models with increased accuracy and reliability.”

Dr Kellie Vache
Oregon State University

“The apparatus is readily programmable with various wetting and drying cycles, tension steps and equilibrium conditions available”

Chris Graham
Oregon State University

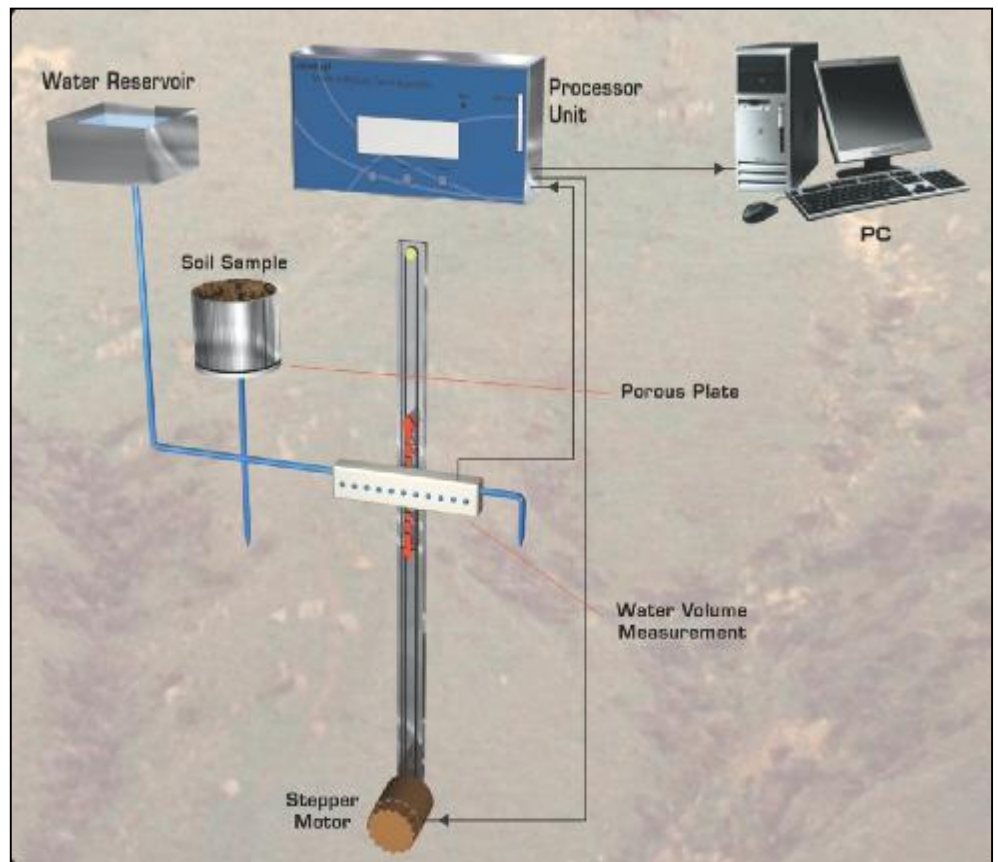
“Equi-pF is the best instrument available to obtain the most accurate and reliable moisture retention properties of soil near saturation with the minimum effort.”

Dr Tim Davie
Landcare Research, NZ

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Equi-pF Schematic

Equi-pf

Automated Soil Moisture Release Curve Apparatus

Specifications

Power Supply	Universal Power Supply for 100 to 260 volt, 0 60 Hz Operation, 0 watts
Dimensions (mm)	16 0 (height) x 3 0 x 3 0
Weight	23 kg
Operator Interface	LCD screen on instrument indicates test progress and interim results. Main operator interface is a Personal Computer.
Communications	RS232 link to PC for test setup and display archiving of test results
Measurement Range	0 to 1000mm
Tension increments	Up to 0 steps per test, each step adjustable in 1mm increments, 1 – 1000mm
Outflow measurement accuracy	0.1 ml
Number of samples per test	1
Time per test	Dependent on sample type a coarse sand may take a few days heavier soils several days.
Number of wetting and drying cycles	1 to 4
Environmental	Operating temperature: 0 to 40°C Maximum humidity: 9 RH (non-condensing)

Soil Moisture Measurement System and Method, NZ patent No. 19609 and United States patent application No. 10 18,282).

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