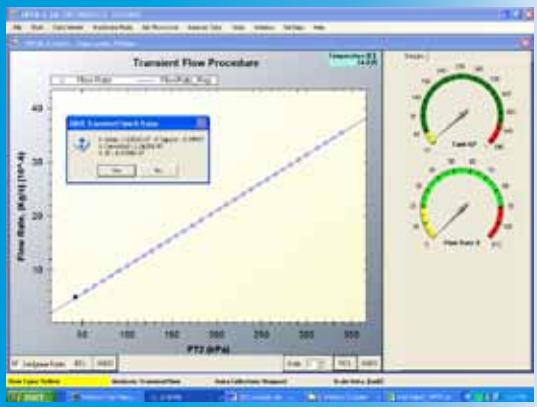
High Pressure Flow Meter - HPFM-Gen3

New Features

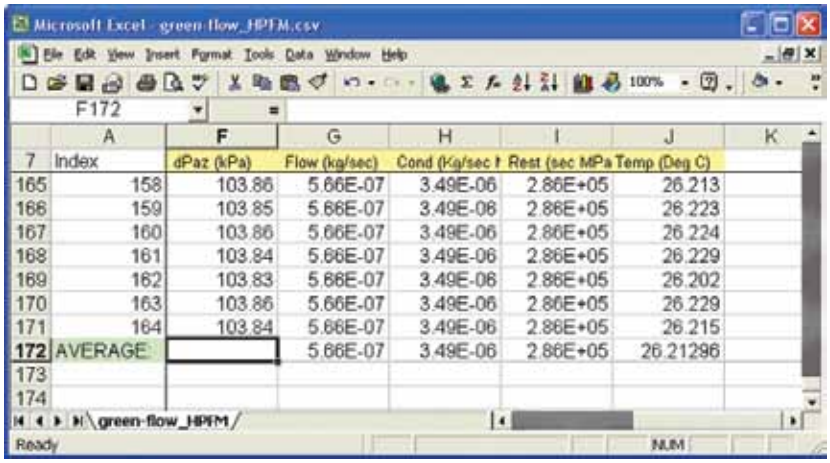
- New High Res Generation 3 HPFM
- Reading Sensors direct in parts per million
- NIST calibration standard feature
- Instant data regression, and auto-saver aged results
- USB powered data acquisition
- New High speed sensor conversion module
- Flow ranges increased by 50%
- Vista, XP, Windows 7 supported
- Upgrade packages available to previous HPFM systems, with new factory calibration



The HPFM-Gen3 measures how water movement relates to the pressure differences required to draw water from the soil or through a plant.

The hydraulic conductivity relationship is a quantitative analysis for roots and stems. The measurement is performed in the field, where in-situ root system can be measured in its natural environment.

All data sets are saved within the Project Manager framework file structure. Transient results as well as QSS flow meter data are saved for easy viewing in with Excel, including the computed conductance, temperature corrected and averaged results.



	A	F	G	H	I	J	K
7	Index	dPaz (kPa)	Flow (kg/sec)	Cond (Kg/sec t	Rest (sec MPa	Temp (Deg C)	
165	158	103.86	5.66E-07	3.49E-06	2.86E+05	26.213	
166	159	103.85	5.66E-07	3.49E-06	2.86E+05	26.223	
167	160	103.86	5.66E-07	3.49E-06	2.86E+05	26.224	
168	161	103.84	5.66E-07	3.49E-06	2.86E+05	26.229	
169	162	103.83	5.66E-07	3.49E-06	2.86E+05	26.202	
170	163	103.86	5.66E-07	3.49E-06	2.86E+05	26.229	
171	164	103.84	5.66E-07	3.49E-06	2.86E+05	26.215	
172	AVERAGE		5.66E-07	3.49E-06	2.86E+05	26.21296	
173							
174							

Advantages

In the HPFM method, the resistance of the root and shoot are measured separately by pressure perfusion and added together. The HPFM will help plant physiologists and agronomists look forward to those seasonal studies of root and shoot progression, water potential, or soil treatment effects.

Designed for Two Types of Numerical Analysis

The first analysis is an in-situ transient analysis of hydraulic conductance. HPFM measures the flow as the water pressure increases while flowing into the root or shoot. The software then intelligently calculates the slope of the increased flow and pressure. That slope is the hydraulic conductance. The second analysis is a quasi-steady state flow meter, (QSS), providing a constant pressure and flow into the sample. This derives the flow pressure and conductance in a steady state environment, and computes conductance, as well as hydraulic resistance.

The complete HPFM system is field portable with detachable wheels and backpack. The HCFM-XP is a completely portable suitcase version of the HPFM-Gen3 (5 range limit).

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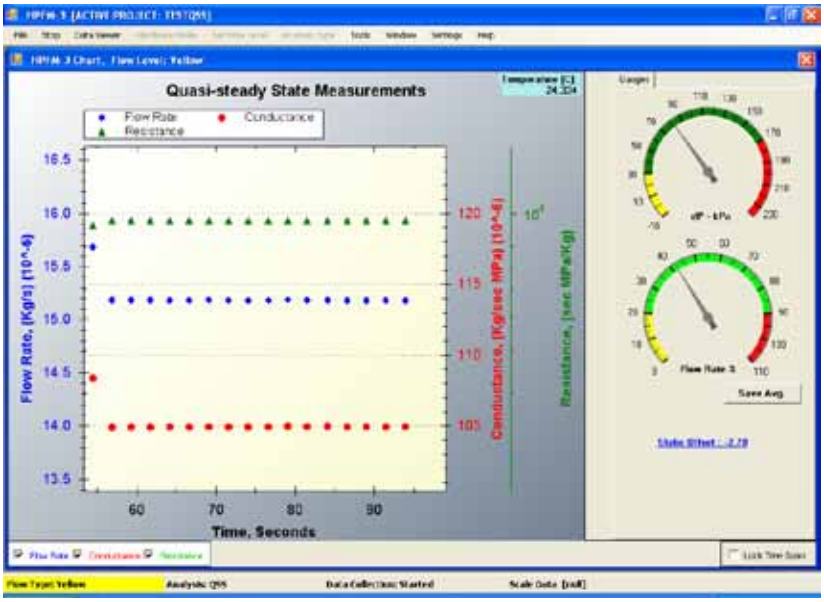
Hydraulic Conductance Meter Specifications

Software

The HPFM3 comes with menu driven software that is easy to use and straightforward in it's approach. The software also includes diagnostics and calibration modes to assure the user of correct readings. All data is saved to the PC hard drive for later analysis by HPFM or graphing packages.

What's New

- 1000 times more resolution with a highly advanced analog processing board (24 bit A/D)
- Highest analog resolution on the market provided with very little cost impact
- USB powered Analog to digital circuit – Batteries not required
- Single USB high-speed data stream – No more parallel port to add
- Powerful instant regressions, with chart saving and printing
- All regression and streaming data are saved automatically – No more hand written data
- Individually calibrated pressure ranges on two pressure sensors with traceable N.I.S.T. precision
- Accuracy calibrated on all pressure readings ±0.1%, typically r^2=.99
- Temperature Monitoring added with automatic Standard Temp adjustments to 25° C
- Completely revised Windows .NET user application package
- Installation compatibility across all Microsoft OS, Vista, Windows7, XP, NT
- Application Platform Basis on .NET, the workhorse platform for Microsoft supported developers writing in C#



Specifications

Stem Ranges
1 mm to 55 mm diameters
Flow Rates
0.7 g/h to 2500 g/h in 6 overlapping ranges
Conductance
7.7E-08 to 2.2E-03 Kg s^{-1} MPa^{-1}
Electronic A/D
24-bit resolution dual Analog / Digital converters
Analog/Digital
One reading every two seconds
Data Interface
USB
Dimensions
13.5" x 12.3" x 20.5" (33 x 31 x 52 cm)
Weight
26 lb (12 kg) with back pack and wheels
Capacity
2.1 gal. (8 liter) Degassed Water
Maximum Pressure
90 psi (630 kPa)

New Calibrations, Improved Specifications

- Sensor zero set provided with linear and 2nd order polynomial regressions removes sensor and board drift between data sets
- Improved overlap on conductance ranges by 50%
- Sensor Nonlinearity removal by unique software adjustment, 1-4th order effects removed
- Conductance and resistance results at the reading temperature are adjusted according to the calibration temperature
- Temperature adjustments are performed automatically to deliver results at 25° C
- Direct flow calibration increased to 15 points from 12.
- 50% increase in the flow range / pressure difference for all 6 flow ranges

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HPFM Gen3 Graphic Analysis

New Graphic Analysis

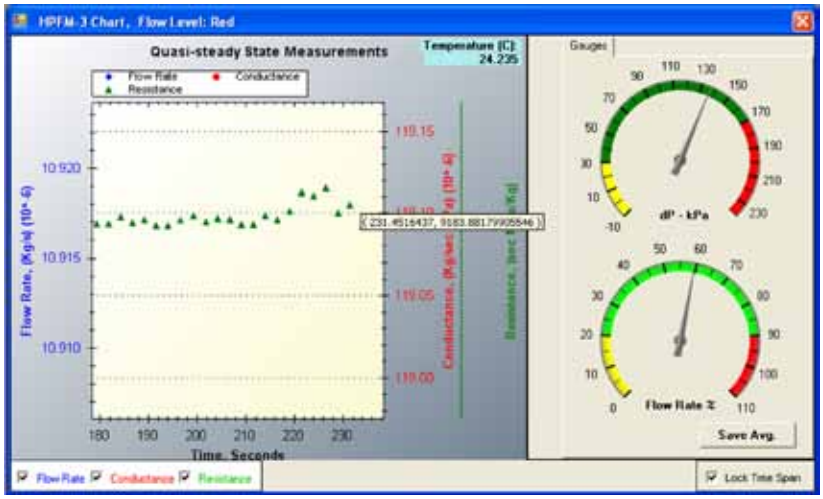
High-resolution result graphics with dynamic zoom, detail zoom, auto scale.

Steady state flow meter, results translated to

- **Resistance**
- **Conductance (new)**
- **Flow (new)**
- **Ten Point Average Option**

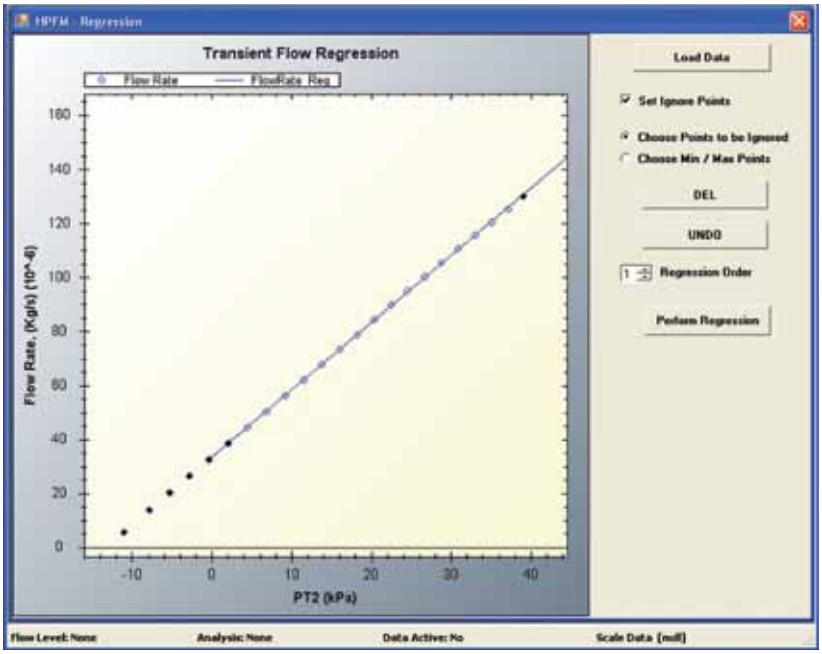
Large, easy to read pressure gauges are digitally painted on screen.

- Color coded ranges automatically defined
- Audible and graphic warnings provided to prevent over pressure or out of range readings
- Flow gauge readout in % of full scale as well as a detailed 2D chart in $kg*s^{-1}$
- Easy to read raw data display of all important parameters
- Set-up and control options in one menu
- Protected calibration mode
- All changes to initialization automatically backed up



Dynamic – Transient Conductance (K) with rapid conductance regression display.

- Instant regression, with chart view, save and printing options
- Re-analysis of saved data
- Two types of data exclusion: Min/Max, and Pick points to ignore



New Project Manager organization folders automatically organize your data by date. Data sets are saved to the designated folder, with comments. Calibration files, initialization and set-up files are saved separately from data.

Interactive Help Options, Documentation built into application are coming soon.

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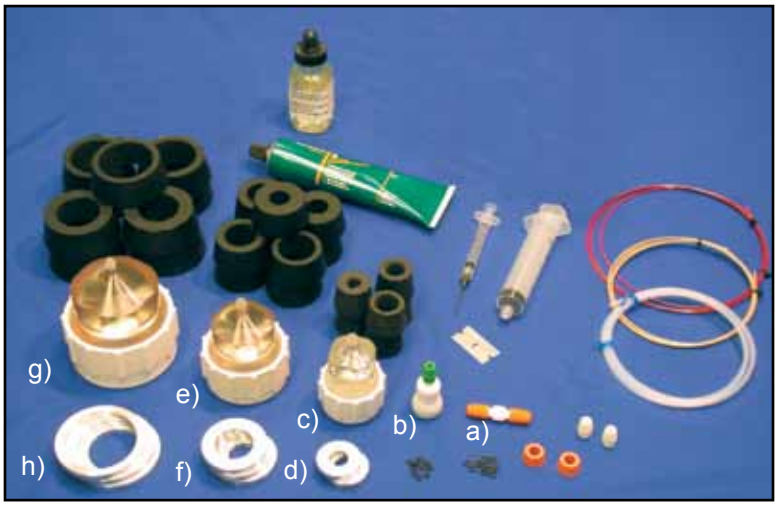
HPFM Gen3 Applications



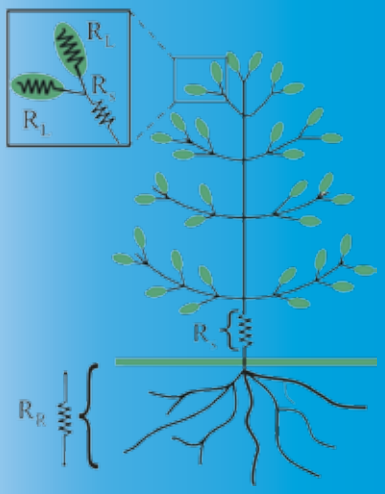
Dynamax includes all the fittings and couplings you may require for analysis. These additional parts include high quality couplings machined out of Lexan for durability and easy viewing.

Compression Couplings to Plants

a) 1 - 4 mm stem / HPLC Coupling, with O-Rings
b) 4 - 10 mm stem / HPLC Coupling, with O-Rings
c) 10 - 20 mm stem / HPLC Coupling, 6 Rubber seals with
d) compression rings
e) 19 - 36 mm stem / HPLC Coupling, 9 Rubber seals with
f) compression rings
g) 36 - 50 mm stem / HPLC Coupling, 9 Rubber seals with
h) compression rings

Components Included with the System

- Pressure bottle with 1,800 psi (12.5 MPa) pressure regulator
- Pressure safety valve
- 2 ft (0.6 m) high pressure hose
- 6 ft of FEP hose, 5 ft of HPLC hose with spare couplings
- 8-way manifolds, two each
- Micron filter
- Portable degassed water refill kit with quick disconnects
- Algicide
- Cutting tools
- Coupling lubricant
- Bleeding kit
- Manual & Software CD



In most cases, the analysis of a sample root or shoot is completed in as little as 10 minutes. HPFM-Gen3 measures the major components of the hydraulic conductance in the soil-plant-atmosphere continuum (reference #70). The hydraulic architecture of a whole shoot or of a single leaf can be represented by a resistance diagram similar to the electronic circuit shown. One can measure the values of the individual hydraulic resistances, then compute the pattern of water flow and water potentials in the resistance network. Each hydraulic resistance element (R) equals the pressure difference driving flow through the element divided by the resulting flow (F) (reference #82).

Applications

- Root conductance in the lab or field
- Conductance of shoots and petioles
- Root stress analysis on trees or crops
- Modeling root to shoot communication
- Transpiration models
- Hydraulic lift studies
- Root water status studies
- Absolute varietal statistics
- Mycorrhizae nutrient or water uptake enhancement
- Soil to root conductance statistics
- Crop conductance studies
- Root interconnection studies

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