HFD8-50 Heat Field Deformation Sap Flow Meter

For the measurement of sap flow or transpiration in plants.

The Heat Field Deformation (HFD) technique is ideally suited to sap flow research projects that require the measurement of extended radial sap flow profiles to accurately map hydraulic architecture of trees. Similar to the HRM sap flow sensor the HFD sensor can measure high sap flow rates as well as low to zero and reverse sap flow.

Heat Field Deformation – Sap Flow Meter Features

- Standalone system with integrated logger and battery

Windows & Mac Compatible

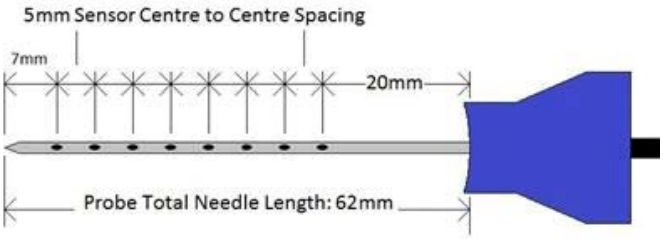
Logging:

- Stand-alone logging
- MicroSD expandable memory
- 4GB MicroSD Removable Storage Card (capacity: 10 + years data storage)
- Wireless connectivity and data transfer
- Simple conversion and scripting
- Flexible sensor calibration, look-up tables, and user scripts
- 24-Bit resolution
- IP65 rated water proof enclosure
- Free Windows and Mac utility configuration software
- Optional wireless logging

Power management:

- Field: solar power and 12V battery
- Lab: mains power supply
- Internal Lithium-Polymer battery
- Internal voltage regulation
- Optical isolation lightning protection

HFD8-50 - 8 Measurement points at 5mm intervals.



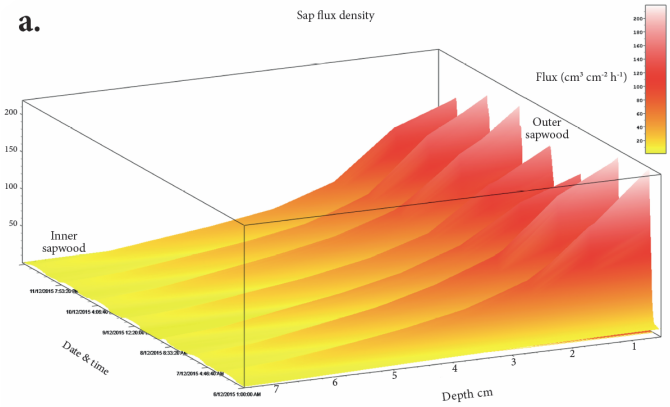
The Heat Field Deformation (HFD) technique is a radically new method for measuring sap flow. It is ideally suited to sap flow research projects that require the measurement of extended radial sap flow profiles to accurately map hydraulic architecture of trees. Similar to the HRM sap flow sensor the HFD sensor can measure high sap flow rates as well as low to zero and reverse sap flow. Hence as both sensors can measure in the same range the HFD sensor provides an extension of the HRM method making both sensors highly complimentary to each other in most sap flow measurement applications.

HFD8-50 Heat Field Deformation Sap Flow Meter

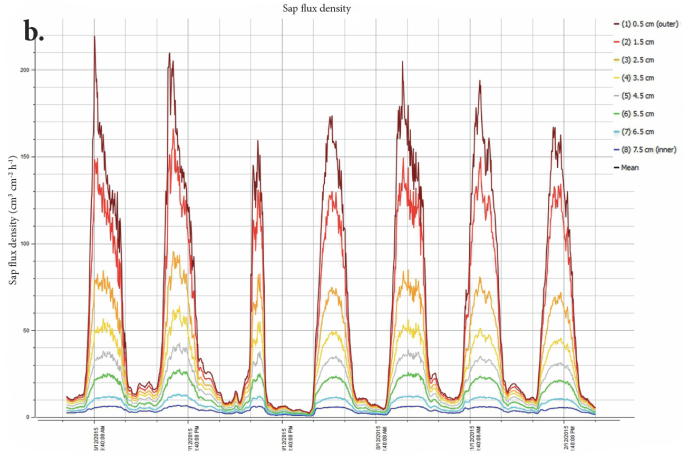
Developed by Dr. Nadezda Nadezdina Mendel University, Czech Republic the HFD technique has been used in published sap flow research since 1998 to study many previously unanswered plant physiological questions. Nadezhdina N., Ferreira M. I., Silva R., Pacheco CA. 2008 Seasonal variation of water uptake of a Quercus suber tree in Central Portugal. Plant and Soil, 305: 105-119.

One Week of Sap Flow Data, HFD – Almond Tree

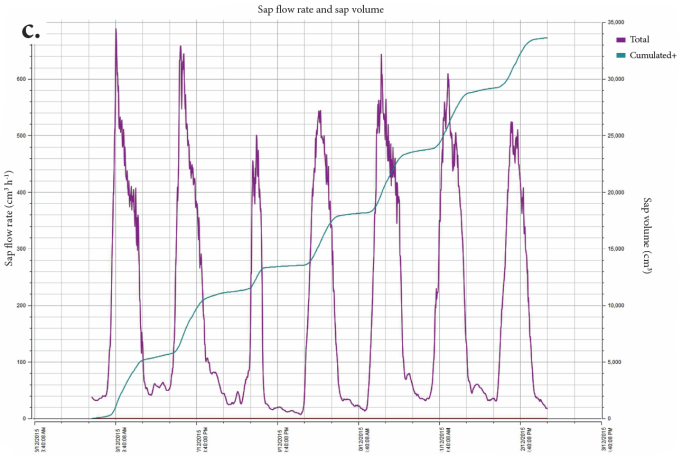
a. Sap flux rates were observed to be highest in the outer sapwood area, near the cambium, and lowest towards the heartwood.



b. Rainfall event on day three and cloud cover on day four represented by a reduction in sap flux rates, and total sapflow volumes.



c. Cumulative sap flow for one week was calculated to be 33.63L.



Principle of measurement

The HFD technique is a thermodynamic method based on measuring the dT of the sapwood both symmetrically (in the axial direction, above and below) and asymmetrically (in the tangential direction or to the side) around a line heater.

The heater is continuously heated at approx 50 mA and generates an elliptical heat field under zero flow conditions. Sap flow significantly deforms the heat field by elongating the ellipse as shown in the photo of a thermal image of a HFD measurement. The symmetrical temperature difference (dT_{sym}) allows bi-directional (acropetal and basipetal) and very low flow measurements, whereas asymmetrical temperature difference (dT_{as}) is primarily responsible for the magnitude of medium and high sap flow rates.

By using the ratio of measured temperature differences and applying correction for each measurement points local conditions using the adjustable K-values the common features of the medium (such as variable water content, natural temperature gradients and, wound effects) have negligible impact on sap flow calculations.

The value for parameter K is equal to the absolute value of dT_{s-a} or dT_{as} for a zero flow condition. Under flow conditions the parameter K can be extrapolated with accuracy using linear regression.

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Specifications

	Instrument Logging
Resolution	0.00001V—24-Bit
Accuracy	0.001V
Minimum Logging Interval	1 second
Delayed Start	Suspend Logging, Customised Intervals
Sampling Frequency	10Hz
	Data
Communications	USB, Wireless Radio Frequency 2.4 GHz
Data Storage	MicroSD Card, SD, SDHC & SDXC Compatible (FAT32 format)
Software Compatibility	Windows 7, 8, 8.1, 10 and Mac
Data Compatibility	FAT32 compatible for direct exchange of SD card with any Windows PC or Mac
Data File Format	Comma Separated Values (CSV) for compatibility with all software programs
Memory Capacity	Up to 16GB, 4GB microSD card included.
	Operating Conditions
Temperature Range	-40°C to +80°C
R/H Range	0-100%
Upgradable	User Upgradeable firmware using USB boot strap loader function
	Dimensions
Length x Width x Depth	340 x 84 x 35 mm
Weight	915g (Including mounting brackets)
	POWER
Internal Battery Specifications	4.8Ah Lithium Polymer, 4.20 Volts fully charged
External Power Requirements	
Bus Power	8-30 Volts DC, non-polarised, current draw is 340mA maximum at 17 volts per logger
USB Power	5 Volts DC
Internal Charge Rate	
Bus Power	60mA – 700mA Variable internal charge rate, maximum charge rate of 700mA active when the external voltage rises above 16 Volts DC
USB Power	100mA fixed charge rate
Internal Power Management	
Fully Charged Battery	4.20 Volts
Low Power Mode	3.60 Volts – Instrument ceases to take measurements
Discharged Battery	2.90 Volts – Instrument automatically switches off at and below this voltage when no external power connected.
Battery Life varies	• With a recommended power source connected, operation can be continuous.