Product Brochure

Pulsed Field Magnetometer (PFM) 8th generation – PFM08 revision 3

The PFM08 range of magnet characterisation magnetometer can rapidly and accurately measure the magnetic hysteresis loop and extract key values for all high-grade permanent magnetic materials such as NdFeB, SmCo, Ferrite and all coated magnets. With a maximum field of 10.5T (8356 kA/m / 105 kOe) even the most coercive materials and highest grades of NdFeB or SmCo can be measured, while traditional permeameters cannot measure these high coercivity materials due to pole piece saturation limitations. The 8th generation of PFMs from Hirst uniquely feature the eddy current correction (patented F-2F algorithm), Self-Demagnetisation Field (SDF) correction function (to allow accurate measurement of a wide range of samples from cylinders, cuboids and arbitrary sample shapes), and Hirst proprietary Self De-magnetisation Field Function SDFF™ (patented) which accurately generates an open to closed circuit mapping (O2C™). The first generation of Hirst industrial PFM was launched in 1998 and the company won an Institute of Physics business award for the SDFF™ technology in 2020. Thus generation 8 PFMs give permeameter-like measurements for the highest grades of magnets to within 1% on permeameter reference measurements. HirstLab v2 software and Hirst proprietary SDFF™ technology has been implemented in collaboration with the National Institute of Metrology (NIM), Beijing, as part of a contract for the first 8th generation PFM placed by NIM. This is the third revision of the PFM08 hardware platform which contains improvements to the Automated Sample Handling PFMs (PFM08-10 HT AH and the PFM08-40 HT/MT AH) making these fully modular and with class leading precision on sample temperature control.

PFM08-10 AT	PFM08-10 HT, 08-40 HT & 08-70 HT	PFM08-10 & 08-40 MT (-40 °C to +220°C)
MH - Manual Handling	AH-Automatic sample Handling versions	AH - Automatic sample Handling versions

Key benefits

- All high-grade permanent magnets can be fully characterised such as NdFeB (inc AH), SmCo, hard Ferrites and coated magnets
- Any shape sample can be tested
- Fast full 4 quadrant measurement of magnetic hysteresis loops
- The PFM contains an integral capacitive discharge magnetiser (and demagnetiser) producing a field of over 10T meaning the highest grades of permanent magnetic material can be tested (which is not possible on traditional permeameters) thus can test samples that are magnetised or unmagnetised
- Automatic Sample Handling - AH versions allow measurement automation so users to program standard measurement routines and step away from the PFM saving time and increasing productivity
- Class leading sample temperature control on AH machines :
  - Stabilised ambient temperature measurements from 17°C to 28 °C with sample temperature control to better than ±0.2°C
  - High temperatures up to +220°C with sample temperature control to better than ±0.3°C
  - Low temperatures down to –40°C (for the MT versions) with sample temperature control to better than ±0.3°C
- Class leading measurement repeatability better than ±0.2% at ambient temperature for H_{cJ} and B_r on standard test samples on Automated Handling versions
- User friendly HirstLab v2 software for fast precise measurements

o HirstLab v2 software automatically extracts critical parameters: Remanence: B_r, Coercivity: H_{cJ}, H_{cB}, Maximum energy product: $(BH)_{Max}$, Saturation values: H_{sat}, J_{sat}, Squareness Coefficients: H_k, H_k/H_{cJ}, H_{dx}(H_{d2}, H_{d5}, H_{d10}) and S_a are all automatically extracted from every measurement and displayed separately alongside JH and BH loops.
o Eddy Current correction for larger samples using Hirsts proprietary F-2F approach
o Any shape: cylinders, cuboid, and arbitrary shapes with built-in Self-Demagnetisation Field (SDF) shape correction function.
o Unique Self Demagnetisation Field Function SDFF™ in HirstLab v2 which accurately generates an open-to-closed circuit mapping (O2C™) for the magnet sample giving accurate closed loop magnet parameters. Generation 8 PFMs give permeameter-like measurements for the highest grades of magnets
o Initial Magnetisation curves (HirstLab version v2.1 or higher)
o English, Chinese and Korean language support (HirstLab version v2.1 or higher)
- The PFM08 revision 3 hardware platform is more modular allowing the AH MT machines (-40 °C to +220 °C) to perform low temperature measurements down to -40 °C on samples down 1x1x1mm (the SC-05 small sample kit now has an extended operating temperature range from -40 °C to +150 °C)
- Meets IEC (International Electrotechnical Commission) TR-62331 specifications for permanent magnets which is a non-destructive testing method.

Applications

- Designed for characterisation of hard magnetic materials in both production control and research applications. for all permanent magnet materials (Ferrite, NdFeB, SmCo, AlNiCo) including high grade NdFeB coated samples
- These PFMs are ideal for high-speed production testing and quality control with users being able to achieve test times of less than a minute
- The optional small sample kits available on PFM08-10 and PFM08-40 to test samples down to 1x1x1mm for grain boundary diffusion (GBD) magnets testing
- Thin sample mode for accurate measurement of 1mm thick slices on PFM08-10 and PFM8-40 often used for GBD magnet development and testing
- The large sample PFM08-40 HT support quality control applications in EV manufacture with samples sizes up to 40mm and the PFM08-70 HT for samples up to 70mm diameter
- Some high temperature versions support measurement up to 220°C for development and quality control.
- Low temperature versions support measurements down to -40°C for materials research and development.

Hirst Pulsed-Field Magnetometry systems

Designed for industrial use, the PFM offers fast, accurate, full hysteresis loop measurements of all industrial magnets, with unparalleled speed and repeatability.

Full 4 quadrant loops can be generated in less than 1s and PFMs are a non-destructive testing and characterisation technique. The process needs no pre-magnetisation of magnets prior to sample insertion (unlike permeameters) and can deliver a magnetised or demagnetised magnet at the end of the cycle.

Manual Sample Handling – MH versions for production and quality control testing

The manual sample handling versions are for lab tests and production quality control aimed at standard test sample sizes. The latest PFM08-10 AT MH revision 3 is the most cost-effective PFM so far from Hirst.

Above: PFM08-10 AT MH sample holder stick, a PFM08-10 AT MH in operation.

Automatic Sample Handling – AH versions for measurement automation

The AH versions allow measurement automation via the powerful script launcher built into HirstLab v2, once the sample is loaded into the PFM and the script is started the user can step away from the PFM whilst the PFM runs the measurement sequence selected.
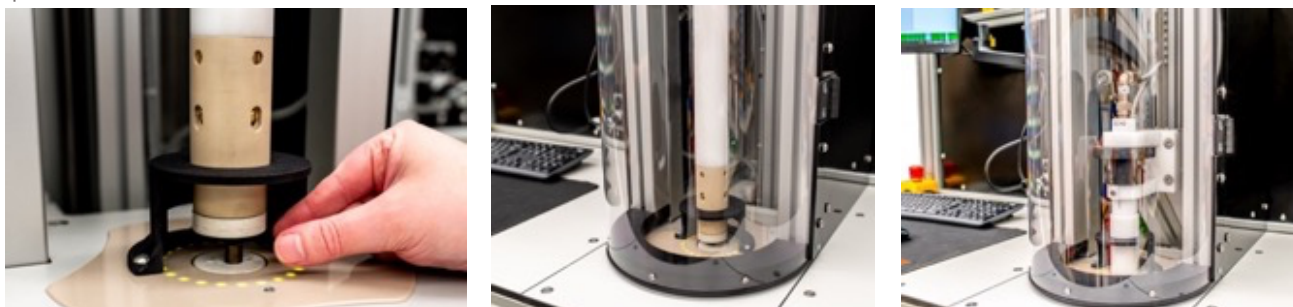

Above: PFM08-40 MT in operation showing loading the sample (left) into the automated sample management system (centre) which then manages the sample location, heating cooling and measurement automatically (right sample in measurement position).

With the AH versions of the PFM08-10 and the PFM08-40 once the sample is placed in the sample loading area and the safety door is closed the PFM automatically manages the sample, moving to the heating or cooling zones for temperature stabilisation and into the optimum location for magnetisation, measurement or demagnetisation all controlled and monitored via HirstLab v2 running on the embed industrial PC with no user intervention is required. Once the required tests are performed the sample is returned to the loading area.

The AH PFMs also further automates the measurement process via a powerful built-in scripting tool that allows full automation of repeated tests such as temperature sweeps say at 20 °C intervals over a wide range of temperatures – often used to generate datasheets. Commonly run measurements such as repeated tests and high precision temperature sweeps can be run. Some example videos can be found on the Hirst Youtube channel. Samples can also be returned demagnetised and at room temperature (following a high temperature measurement) by simply selecting this option in the script launcher. The sample loading area features an LED indicator ring, if this is green then the sample is cool enough to handle, it turns red if the sample is above 50 °C

The graph below was generated on the PFM08-40 MT and shows a temperature sweep from -40 °C to 180 °C at 20 °C intervals. This was automated using the powerful built-in scripting tool, the sample was loaded and then all measurements were automatically taken and stored in the measurement database with no further user intervention required.
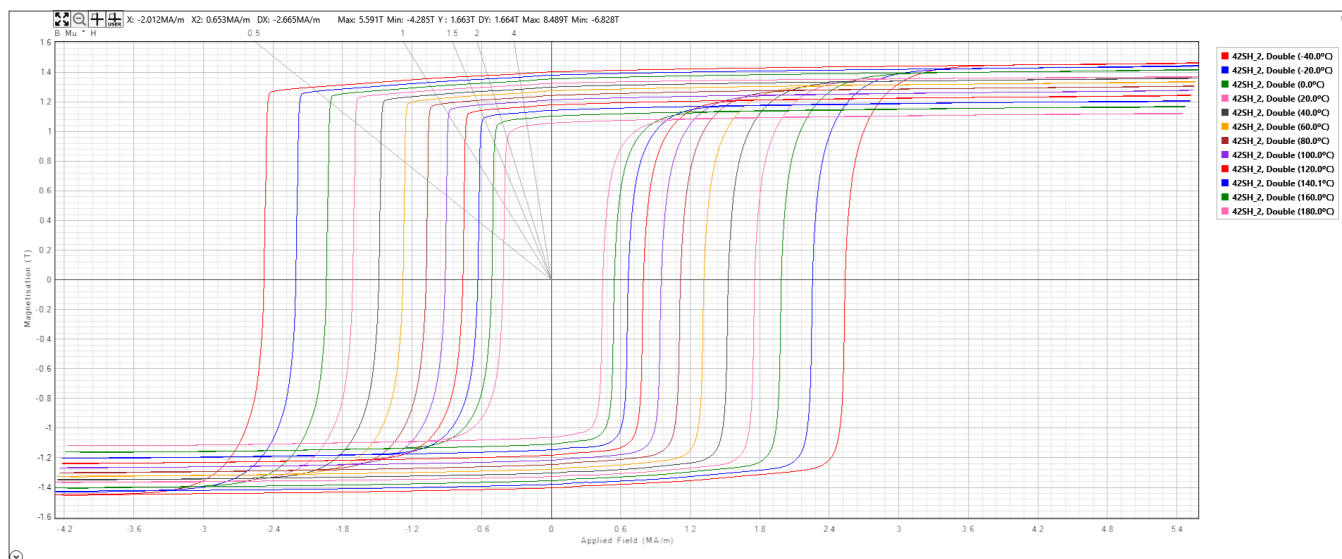
The Automatic Sample Clamping (ASC) option on rev 3 AH machines takes human error and operator variability out of the sample clamping process – the remaining factor in sample reload repeatability in the Hirst AH PFMs. A constant force is

Hirst Magnetic Instruments Ltd,
Tesla House, Tregoniggie Industrial Estate,
Falmouth, Cornwall, TR11 4SN

T: +44(0)1326 372734
sales@hirst-magnetics.com
www.hirst-magnetics.com

applied to samples prior to measurement via a software-controlled precision motor system. When complex measurement sequences are run over wide temperature ranges, such as temperature sweeps the sample clamping force is precisely set prior to each measurement ensuring the most precise measurements. This option is available for the revision 3 AH machines and works with all pick up coil sets allowing precise sample clamping from samples from 70mm diameter down to 1x1x1mm. Whilst the ASC enhances sample test repeatability and removes operator-to-operator variation in testing - it is also the final key hardware addition needed for fully automatic sample testing (from trays or conveyors

The AH PFM platform is designed to allow further automation of testing to reduce labour costs and opens the possibility of rapid 100% testing of magnetic parts as required.

High Speed Measurement

The measurement pulses on PFM08s are less than 1 second for a full 4 quadrant measurement with most of the rest of the test cycle time spent on sample loading and temperature stabilisation of the sample which is critical for accurate and repeatable measurements. The PFM system offers repeatability of measurements at speeds that are simply unattainable with other methods of measurement. The measurement process involves generating large pulsed magnetic fields. These pulsed magnetic fields drive the magnet around its major hysteresis loop. The pickup coils detect the applied field and the magnets response to the applied field. J and H signals are fed to the integrated PC where they are processed to form JH and BH loops representing the characteristics of the magnetic material. The PFM then automatically proceeds to measure the full loop characteristics and displays the results immediately with all critical parameters automatically extracted.

The PFM08 range have integral sample temperature control and monitoring and features two methods for dealing with sample temperature: stabilised temperature and temperature corrected. Even in high precision sample temperature stabilised tests of a standard 10mm diameter block test sample a fully temperature stabilised measurement will only take 5 minutes. For faster tests a temperature corrected method can be used for rapid ambient testing, this test will take less than 1 minute including sample loading on the PFM. Temperature compensated measurements are quicker as the sample is measured at its current temperature and the values obtained are corrected to the desired ambient temperature point – this is often used in quality control applications where quicker measurements are required, and data needs to be compared at a specific temperature.

In magnet block testing applications for quality control users regularly test >60 samples per hour with a temperature compensated measurements on the PFM08-10 MH. The PFM08-10 AH and 08-40 AH offer similar test speeds but with all the measurement steps fully automated once the sample is loaded. The AH MT machines are 25% slower at ambient and high temperature measurements due to the design changes needed to accommodate precision cold measurements down to -40 $^\circ$C and are ideal for National labs and R&D use whereas the AH HT variants are ideal for higher throughput production test applications.

Sample temperature control

The AH revision 3 PFMs offer class leading sample temperature control techniques to ensure the most repeatable and precise measurements. These PFMs have highly uniform top and bottom ceramic heater plates each with integral temperature sensors. Chillers and coolers ensure a base temperature below the environmental ambient can be obtained and the combination of the heaters, sensors and temperature control systems delivers class leading sample temperature control. Variable soak times and specific temperature control zones in the PFM are used to ensure minimal sample temperature gradients further increasing the accuracy.

For ambient temperature measurements from 17°C to 28 $^\circ$C, sample temperature control of the sample to better than ±0.2°C can be achieved. For high temperature sample measurements up to +220°C, sample temperature control to better than ±0.3°C is achieved and for low temperatures down to –40°C (for the MT versions), sample temperature control to better than ±0.3°C is achieved.

Sample temperature control is a key part of Hirsts' class leading measurement repeatability which is better than $\pm0.2\%$ at ambient temperature for H_{cJ} and B_r on standard test samples. Even at temperatures as high as 150 °C this is better than $\pm0.6\%$ for H_{cJ} and B_r on standard test samples.

Hirst Magnetic Instruments Ltd,
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Falmouth, Cornwall, TR11 4SN

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Small Sample kits

One of the major improvements in the revision 3 hardware platform for the generation 8 PFMs is that it allows user interchangeable pick-up coils of different diameters and sensitivities for optimum measurements of samples of differing sizes. In addition, the measurement noise levels have been dramatically reduced in revision 2 and further improved in revision 3 hardware compared to previous generations of Hirst PFMs. The combination allows the highest level of measurement repeatability over a wide range of sample sizes. For example, on the PFM08-10 HT with the optional small sample kit (SC-05) can achieve a full sample reload repeatability on coercivity (H_{cJ}) of ±0.5 % for a reference 1x1x1mm sample at ambient – which is a remarkable result considering the small sample volume. The SC-05 small sample kit is available on the PFM08-10 AH and PFM08-40 AH with automated sequence measurement capability. The PFM08 revision 3 hardware platform is more modular allowing the MT machines to perform low temperature measurements down to -40 °C on samples down 1x1x1mm (the SC-05 small sample kit now has an extended operating temperature range from -40 °C to +150 °C) on these machines.

Eddy Current Correction

A PFM08's applied field is a single period sine-wave pulse with a maximum amplitude in excess of 10 T. As such the PFM captures the full 4 quadrant hysteresis loop. It is in the nature of pulsed-field measurements that rate dependent features are present in the hysteresis loop, due to Eddy-Current effects. These rate dependent effects can be calculated out of the result by the PFM applying two pulses at different frequencies for each measurement using Hirst's patented F-2F algorithm to calculate the hysteresis loop that would be obtained from a zero-frequency measurement. F-2F has been verified to produce the same results as a static measurement obtained from a vibrating sample magnetometer and permeameter. Eddy currents are not significant on smaller samples of NdFeB below 10mm.

Any Shape

The PFM can measure any shape of magnet and as standard cylinders, cuboids are included in HirstLab v2 with a look up table with the built in Self-Demagnetisation Field (SDF) shape correction function. For more complex and arbitrary shapes this can be calculated with FEM although HirstLab v2 app by simply loading the shape into the app and copying over the SDF value.

Unique SDFF™ technology

In addition, HirstLab v2 has a unique Self Demagnetisation Field Function SDFF™ which accurately generates an open-to-closed circuit mapping (O2C™) for the magnet sample generating accurate closed loop magnet parameters as a permeameter would. Use of SDFF correction does not change the B_r or H_{cJ} measurements for the sample. The use of SDFF™ improves H_{cB}, BH_{Max} and H_k/H_{cJ} with respect to the permeameter and reduces the BH_{Max}, H_{cB} error which would naturally increase for low coercivity samples due to open circuit rounding without the SDFF™ correction. SDFF is optional and can be enabled/disabled in HirstLab v2 by user and gives the same results as the original HirstLab v1. With this technology the generation 8 PFMs give permeameter-like measurements for the highest grades of magnets to typically within 1% on permeameter reference sample measurements from NIM.

HirstLab v2 – Powerful and easy to use software

All new Hirst PFM systems are supplied with comprehensive software, HirstLab v2. The HirstLab v2 software combines all of Hirst's expertise and PFM technology into a single, easy-to-use package. The software manages the operation of the PFM and maintains a database with the history of all measurements. A flexible plotting tool provides multiple views of the measured data.
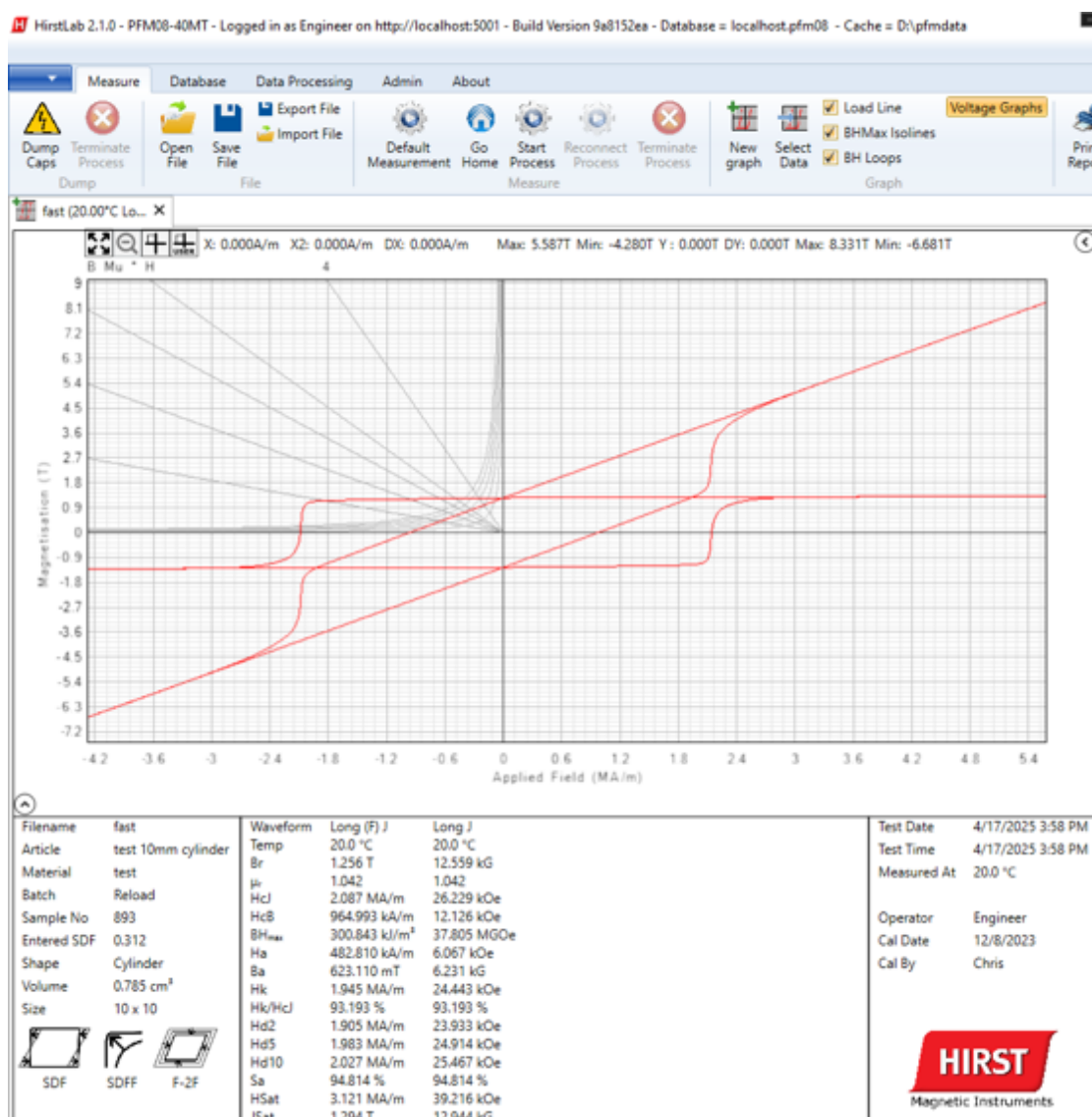
Language support options

In HirstLab v2.1 there is also support for Chinese and Korean alongside English to make the software as easy to use as possible.
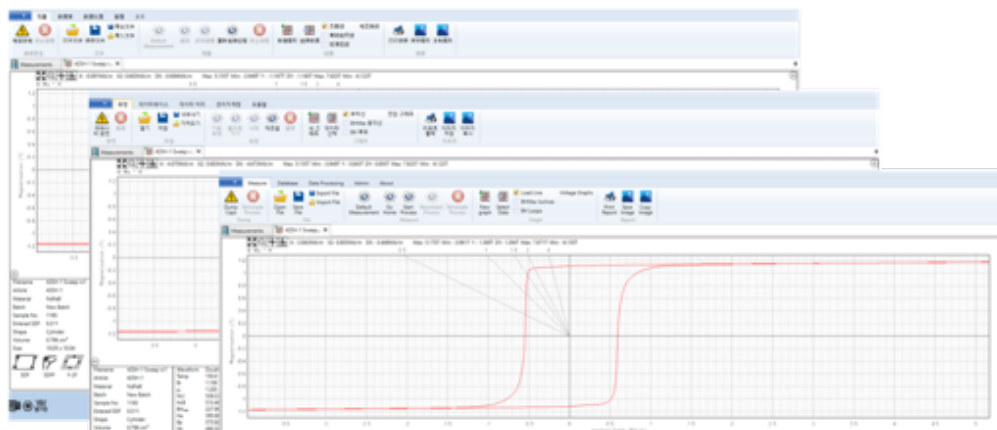
Automatically extracts critical measurement parameters

Remanence: B_r, Coercivity: H_{cJ}, H_{cB}, Maximum energy product: $(BH)_{Max}$, Saturation values: H_{sat}, J_{sat}, Squareness Coefficients: H_k, H_k/H_{cJ}, H_d (H_{d2}, H_{d5}, H_{d10}) and S_a are all automatically extracted from every measurement and displayed separately alongside JH and BH loops shown below

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Full graphical display

The software can simultaneously display multiple loops in either one or multiple windows for easy comparisons. A comparison function is available for the demagnetisation quadrant to highlight any differences between measurements. Data is also available as a hard copy via a printer and can be displayed with a choice of S.I. and/or c.g.s. Units and a fully customisable report format.

All the PFM's functions are accessible through the user interface including the extensive data processing and storage features. The software follows similar design to many other applications that run on Microsoft Windows™ creating a familiar environment and reducing the time to learn the software.

Measurement database for 100% traceability

A measurement database stores every measurement made on the system ensuring 100% traceability and making it impossible to lose a measurement. A more traditional system of entering filenames is also available but it is not a requirement to use it. Especially useful for industrial quality assurance (QA) and similar applications. The database can be stored on the built in PC or on a central server so that multiple PFM machines can be monitored from a central location. The database supports filtering through a range of parameters such as operator name, sample data etc, which allows easy recollection of any previous data.

Along with a measurement database HirstLab v2 also provides a sample database. Details of sample properties, dimensions, and required measurement parameters can be stored. When a measurement of that sample is taken the measurement settings are automatically set-up based on the parameters stored in the sample database. The sample details are also used in the processing of data to produce JH and BH loops that are calibrated to unit volume.

Report generation

HirstLab v2 can produce a detailed report describing the characteristics of the measured sample or a summary report from a set of measurements. There are several easy to use and powerful report formats built-in, here is one example showing a sample re-load test at ambient :

Batch	Filename	Article	Operator	Date	Time	Description	Temperature	Br	HcJ	HcB	BHMax	HkHcJ
reload	42SH2-Y I	42SH2-Y	Jack	2/14/2024	6:08:36 PM		20.4°C	1.320 T	1.698 MA/m	1.017 MA/m	336.292 kJ/m³	93.521 %
reload	42SH2-Y II	42SH2-Y	Jack	2/14/2024	6:12:32 PM		20.4°C	1.321 T	1.698 MA/m	1.016 MA/m	336.440 kJ/m³	93.484 %
reload	42SH2-Y III	42SH2-Y	Jack	2/14/2024	6:18:06 PM		20.4°C	1.321 T	1.699 MA/m	1.016 MA/m	336.384 kJ/m³	93.484 %
reload	42SH2-Y IV	42SH2-Y	Jack	2/14/2024	6:22:54 PM		20.4°C	1.321 T	1.698 MA/m	1.017 MA/m	336.682 kJ/m³	93.524 %
reload	42SH2-Y V	42SH2-Y	Jack	2/14/2024	6:28:59 PM		20.4°C	1.322 T	1.701 MA/m	1.017 MA/m	337.010 kJ/m³	93.525 %
reload	42SH2-Y V	42SH2-Y	Jack	2/14/2024	6:33:36 PM		20.4°C	1.321 T	1.697 MA/m	1.017 MA/m	336.542 kJ/m³	93.536 %
reload	42SH2-Y VI	42SH2-Y	Jack	2/14/2024	6:39:34 PM		20.4°C	1.322 T	1.700 MA/m	1.018 MA/m	337.159 kJ/m³	93.510 %
reload	42SH2-Y VII	42SH2-Y	Jack	2/14/2024	6:44:01 PM		20.4°C	1.322 T	1.700 MA/m	1.018 MA/m	336.908 kJ/m³	93.499 %
reload	42SH2-Y VIII	42SH2-Y	Jack	2/14/2024	6:48:32 PM		20.4°C	1.322 T	1.701 MA/m	1.017 MA/m	336.878 kJ/m³	93.490 %
reload	42SH2-Y IX	42SH2-Y	Jack	2/14/2024	6:53:52 PM		20.4°C	1.322 T	1.700 MA/m	1.018 MA/m	337.015 kJ/m³	93.500 %
Mean								1.321 T	1.699 MA/m	1.017 MA/m	336.731 kJ/m³	93.507 %
Max								1.322 T	1.701 MA/m	1.018 MA/m	337.159 kJ/m³	93.536 %
Min								1.320 T	1.697 MA/m	1.016 MA/m	336.292 kJ/m³	93.484 %
Peak error +/- %								0.063 %	0.138 %	0.098 %	0.129 %	0.028 %
Standard deviation								0.042 %	0.079 %	0.057 %	0.086 %	0.019 %

Data export facilities

Comprehensive data export facilities allow data to be easily migrated to other software applications including exporting to .csv, .JSON, .nc formats.

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T: +44(0)1326 372734
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Range overview

| Part Number	Sample size	Sample Management	Temperature Range	Typical Application
PFM08-10 AT MH	5-10.5mm diameter, 1-15mm height	Manual	Ambient	Magnet supply chain with thin sample mode for GBD with optional heater stage
PFM08-10 HT AH	5-10mm diameter, 1-20mm height	Automatic	17 to 220℃	Magnet supply chain with thin sample mode for GBD with optional small sample kit for samples down to 1x1x1mm
PFM08-10 MT AH	5-10mm diameter, 1-20mm height	Automatic	-40 to 220℃	National labs and materials research for extended temperature range with
PFM08-40 HT AH	5-40mm diameter, 1-30mm height	Automatic	17 to 220℃	Modular PFM with large sample range and automated sample handling for use in magnet supply chain with thin sample mode and optional small sample kit for samples down to 1x1x1mm - also ideal for magnet user quality control
PFM08-40 MT AH	5-40mm diameter, 1-30mm height	Automatic	-40 to 220℃	National labs and materials research for extended temperature range with thin sample mode small sample kits for 1x1x1mm samples
PFM08-70 HT AH	5-70mm diameter, 5-20mm height	Automatic	17 to 220℃	Magnet supply chain and magnet user quality control

Technical data

|	
Magnetisation pulse	Full period sine wave
Magnetiser Energy, Voltage and Peak field	PFM08-10: 9kJ, 3000V, 10T peak (7958kA/m / 100k Oe) PFM08-40 and 08-70: 45kJ, 3000V, 10.5T peak (8356 kA/m / 105k Oe)
Eddy current removal	Compensation for linear and non-linear rate dependant effects via Hirst proprietary F-2F algorithm important on larger samples
Shape correction	Built in Self-Demagnetisation Field (SDF) shape correction function
Permeameter equivalent curve	Hirst proprietary Self De-magnetisation Field Function SDFF™ which accurately generates an open to closed circuit mapping (O2C™) for the magnet sample giving accurate closed loop magnet parameters
Standard Sample sizes [+]	PFM08-10 samples 5-10mm diameter, 1-26mm height (optional small sample kit down to 1x1x1mm on 08-10 HT) PFM08-40 samples 5-40mm diameter, 1-30mm height (optional small sample kit down to 1x1x1mm) PFM08-70 samples 5-70mm diameter, 5-20mm height (upper sample volume limit of 12,000mm^3)
Sample shapes	Any shape via SDF correction – with built in standard shape look up including cylinder and cuboids. A powerful SDF calculator app is included for all other shapes Thin sample mode (TSM) on 08-10 and 08-40 for testing thin slices used in GBD magnet development and testing
Sample temperature stabilisation*	On AH machines : ±0.2℃ (sample at ambient)
Repeatability*	B_r and H_{cJ} ±0.5 % for Manual Handling machines (ambient measurement, standard 10mm samples) B_r and H_{cJ} ±0.2 % for 08-10 & 08-40 AH machines (ambient measurement, standard 10mm samples) B_r and H_{cJ} ±0.2 % for 08-70 AH (ambient measurement, standard large test samples)
Display and controls	Windows 11 computer, Intel i5 processor, 1TB storage, intuitive software with simple test initiation controls and full database system, 24" HD colour monitor, wireless keyboard and mouse (supplied)

Colours and materials	Steel and Aluminium case
Dimensions / Weight	PFM08-10 MH: 1000mm x 1400mm x 1468mm / 450kg PFM08-10 AH: 1202mm x 1490mm x 1875mm / 800kg PFM08-40 AH: 1202mm x 1490mm x 1875mm / 995kg PFM08-70 AH: 1202mm x 1490mm x 1875mm / 995kg
Connectivity	100 Mbps ethernet via RJ45, WIFI and USB
Recommended Machine Operating Range	+18 °C to +23 °C
Power Supply	PFM08-10: Single Phase 220/240VAC 50-60Hz 32A or 110VAC option Max 3m cable length PFM08-40 & PFM08-70: Single Phase 220/240VAC 50-60Hz 32A or 110VAC option Max 3m cable length (and an additional single phase 220/240VAC 50-60Hz 16A or 110VAC option for external chiller power connection is required) MT model chiller requires 3 phase connection

[+] where height is specified in relation to a sample this is along the direction of magnetisation of the sample. The sample under test must have the direction of magnetisation orientated vertically in the PFM

[*] For specific sample performance data, see detailed specifications for each machine
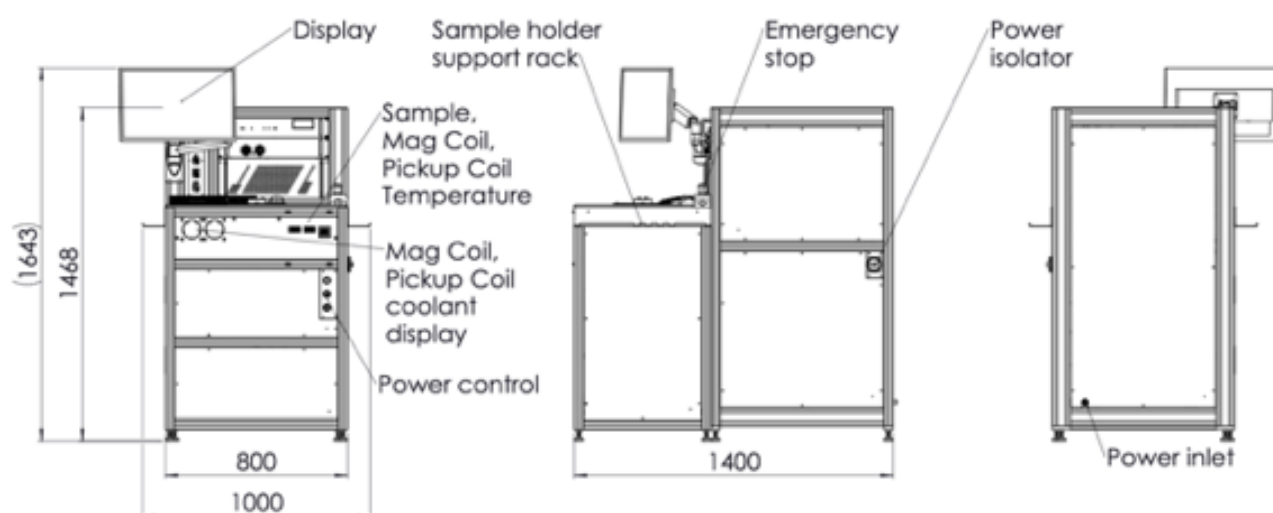
PFM08-10 AT – MH, Manual Sample Handling version (above)
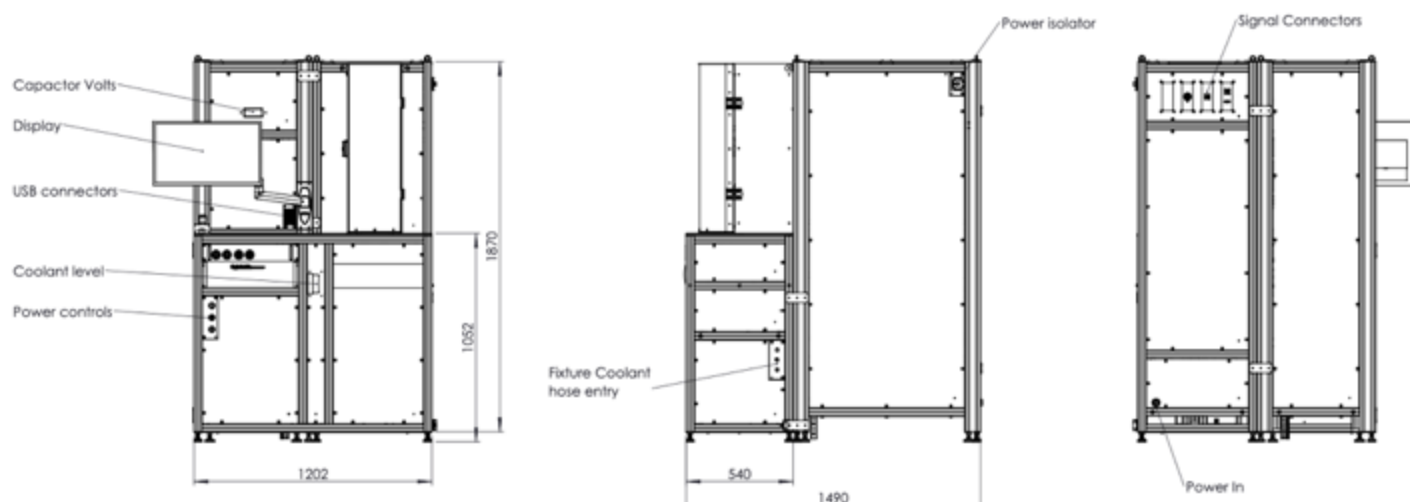
PFM08-10 HT/ MT, PFM08-40 HT/ MT and PFM08-70 HT – AH, Automatic Sample Handling version (above)

Warranty and Calibration

Supplied calibrated with 1 year warranty. A calibration is required every year to maintain the highest levels of performance – Hirst has a dedicated team of installation and service engineers, available to travel worldwide to install and support equipment, service contracts are available. Contact your local distributor for details.

Accessories

Basic reference magnet sample packs:-

- **RM-AT** - Ambient N40H, N42SH samples with NIM certification
- **RM-HT** - contains RM-AT samples plus 100°C and 150 °C samples with NIM certification
- **RM-HT+** - contains RM-HT samples plus 180 °C sample with NIM certification
- **PMP** - Precision Measurement Pack contains a range of spacers, accessories and plus transfer standard magnets to make measurements easier and more precise

Hirst Magnetic Instruments has been active in providing solutions for 60 years in magnetics and magnetic measurement. Hirst manufactures precision hand-held gaussmeters, fluxmeters, demagnetisers, bench top & workstation industrial magnetisers, industrial production-line magnetisers, pulsed field magnetometers (PFMs) for characterising magnetic materials.

Hirst Magnetic Instruments Ltd reserves the right to make changes to any specifications or performance implied in this product brochure without notice – please refer to www.hirst-magnetics.com for the latest version.

PFM08 product range brochure v4.9d Jan 2026