

## Product Brochure

### Pulse field Magnetometer (PFM) 7th generation – PFM12 and PFM14

The PFM-07 range (PFM12 and PFM14) of magnet characterisation / magnetometer can accurately measure the magnetic hysteresis curve and extract key values for all magnetic materials (Ferrite, NdFeB, SmCo, AlNiCo). With a maximum of 10.5T (8356 kA/m / 105 kOe) even the most coercive materials and highest grades of NdFeB can be measured while traditional permeameters cannot measure these high coercivity materials due to pole piece saturation limitations. The 7<sup>th</sup> generation of PFMs from Hirst uniquely feature eddy current correction (patented F-2F algorithm) and Self Demagnetisation Field (SDF) correction. The first generation of Hirst industrial PFM was launched in 1998 and this latest generation was launched in 2021 with new high-performance 2.4GHz wireless sample holders.



7<sup>th</sup> generation PFM12 and PFM14

### Key benefits

- Integral magnetiser and de-magnetiser producing field of over 10T meaning the highest grades of permanent magnetic material can be tested (not possible on traditional permeameters).
- 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:  $H_k$ ,  $H_k/H_{cJ}$ ,  $S_a$ , and more are all automatically extracted from every measurement and displayed separately alongside JH and BH loops.
- Temperature controlled measurements: PFM12 from 5°C below room ambient to 15°C above. PFM14 from 5°C below room ambient up to 200°C.
- Temperature control precision near ambient  $\pm 0.15^\circ\text{C}$ .
- Repeatability better than  $\pm 0.75\%$  at ambient temperature for  $H_{cJ}$  and  $B_r$ .
- Range of sample sizes can be accommodated 5-10mm.
- Sample shapes: cylinder, square, and arbitrary shapes via sample holders with SDF shape correction.
- User friendly easy to use hardware and software for fast measurements - ambient tests are 60 seconds per test.
- Meets IEC (International Electrotechnical Commission) TR-62331 specifications for permanent magnets as 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.
- The ambient temperature PFM12 is ideal for production testing and quality control.
- The high temperature capable PFM14 supports measurement up to 200°C for development and quality control.

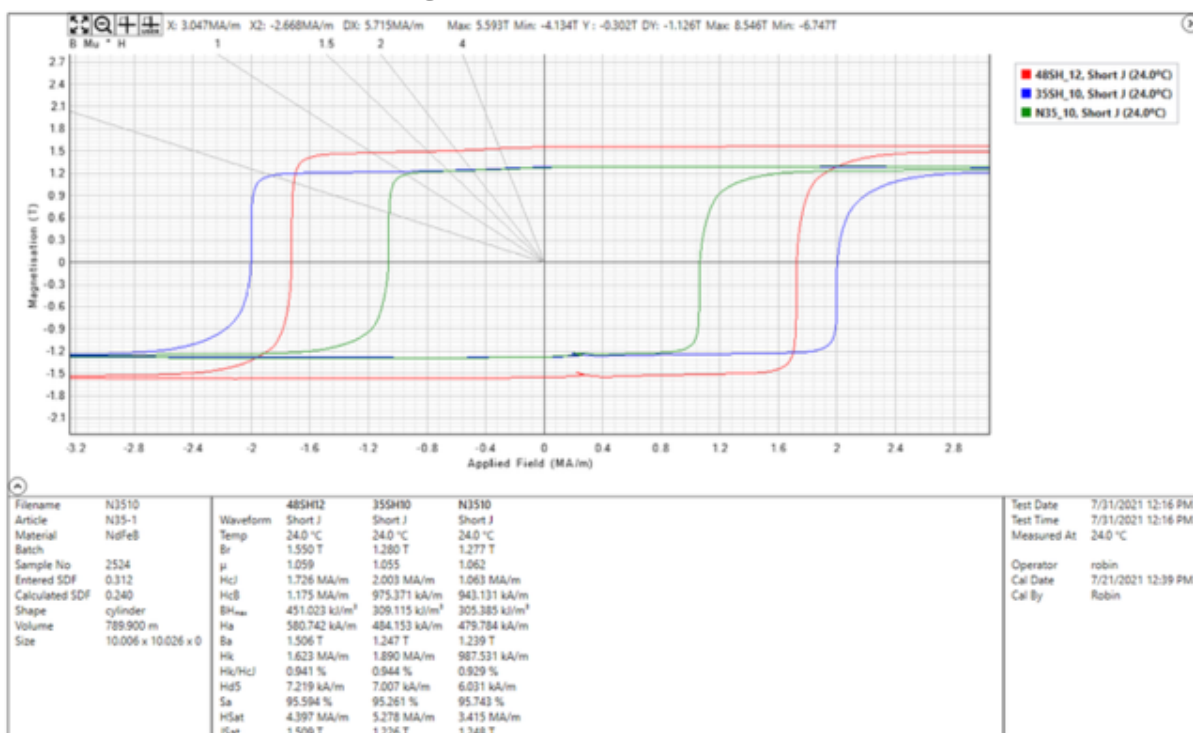
## Hirst Pulsed-Field Magnetometry systems

Designed for industrial use, the PFM offers fast, accurate, full hysteresis loop measurements of all industrial magnets, with unparalleled speed and repeatability. Capable of non-destructive testing and characterisation of industrial permanent magnet materials in a rapid, non-contact, open circuit process. The process needs no pre-magnetisation of magnets (unlike permeameters) and can deliver a magnetised or demagnetised magnet at the end of the cycle.



Sample holder sticks, sample sticks storage on the side of the PFM, cooling liquid level indicators

The 7<sup>th</sup> generation PFMs can measure manually loaded virgin or pre-magnetised permanent magnets and measure their full hysteresis loop in a fraction of the time taken by any other technique. The results are immediately available at the PC including PASS/FAIL information if limits are set.



The PFM extracts all key magnetic parameters automatically and is controlled via a comprehensive windows-based application with extensive database facilities storing full data on every single measurement. Data can also be exported in a variety of formats. The system offers repeatability of measurements at speeds that are simply unattainable with other methods of measurement.

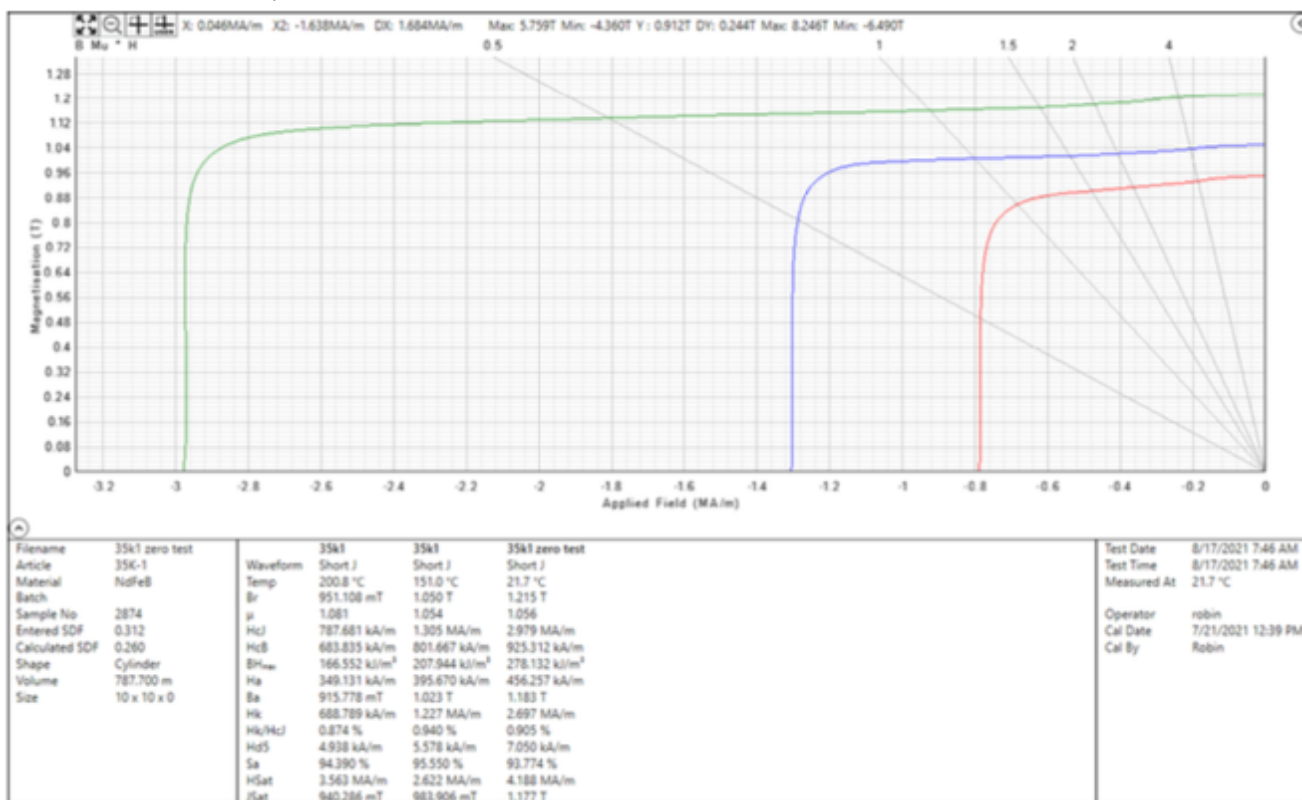
### Operation

The magnet to be tested is loaded into the sample holder and inserted into the PFM measurement chamber. The PFM then automatically proceeds to measure the full loop characteristics and displays the results immediately with all critical parameters automatically extracted.

The measurement process involves generating large pulsed magnetic fields. These pulsed magnetic fields drive the magnet around its major hysteresis loop. Suitably placed pickup coils detect the applied field and the magnets response to the applied field. J and H signals are fed to the PC where they are processed to form JH and BH loops representing the characteristics of the material.

## Temperature control and monitoring

The PFM has integral sample temperature monitoring and features two methods for dealing with sample temperature: constant temperature and corrected temperature. In constant temperature mode the sample's temperature is directly controlled and measurements are taken at the desired sample temperature. In corrected temperature mode, high speed measurements can be made and then corrected using a temperature correction coefficient. Corrected temperature mode is ideal for measuring large batches of magnets for QA analysis as fast as possible. Both methods of magnet temperature control result in excellent repeatability. The system has been specifically designed to operate at high temperatures to provide measurements up to 200°C for the HT models.



The above graphs show 2nd quadrant de-mag curves of measurements of the same magnet at various temperature, from room temp to 200°C (HT models).

## Easy to use software

All Hirst PFM systems are supplied with comprehensive software, the Hirst Lab software. The Hirst Lab software combines all of Hirst's expertise and PFM technology into a single, easy-to-use package. The software manages the operation of the machine and maintains a database with the history of all measurements.

A flexible plotting tool provides multiple views of the measured data. The Self De-magnetisation Field (SDF) correction is displayed by default. It is straight forward to select many other views of the data as required

Hirst Lab can produce a detailed report describing the characteristics of the measured sample. The software uses the familiar Windows 10 environment to give a simple and effective user interface. All the PFM's functions are accessible

through the user interface as well as extensive data processing and storage features. The user interface follows similar design principles to many other applications that run on Microsoft Windows™ creating a familiar environment and reducing the time required 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 QA and similar applications. The database can be stored on a central server so that multiple PFM machines can be monitored from a central location

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

## Automatically extracts critical measurement parameters

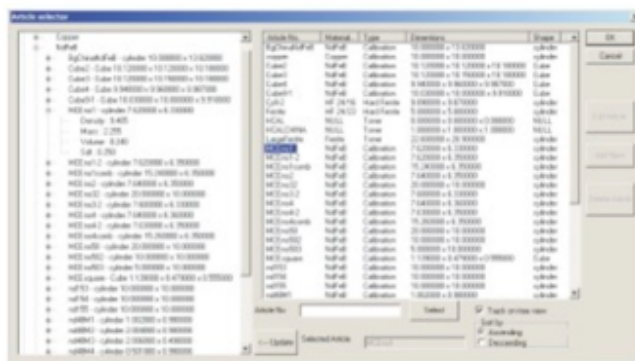
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## Data export facilities

Comprehensive data export facilities allow data to be easily migrated to other software applications.

## Full graphical display

The software can simultaneously display multiple loops in either one or multiple windows for easy comparisons of 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



Pre-programmed material definitions allow quick recall of settings to avoid human error

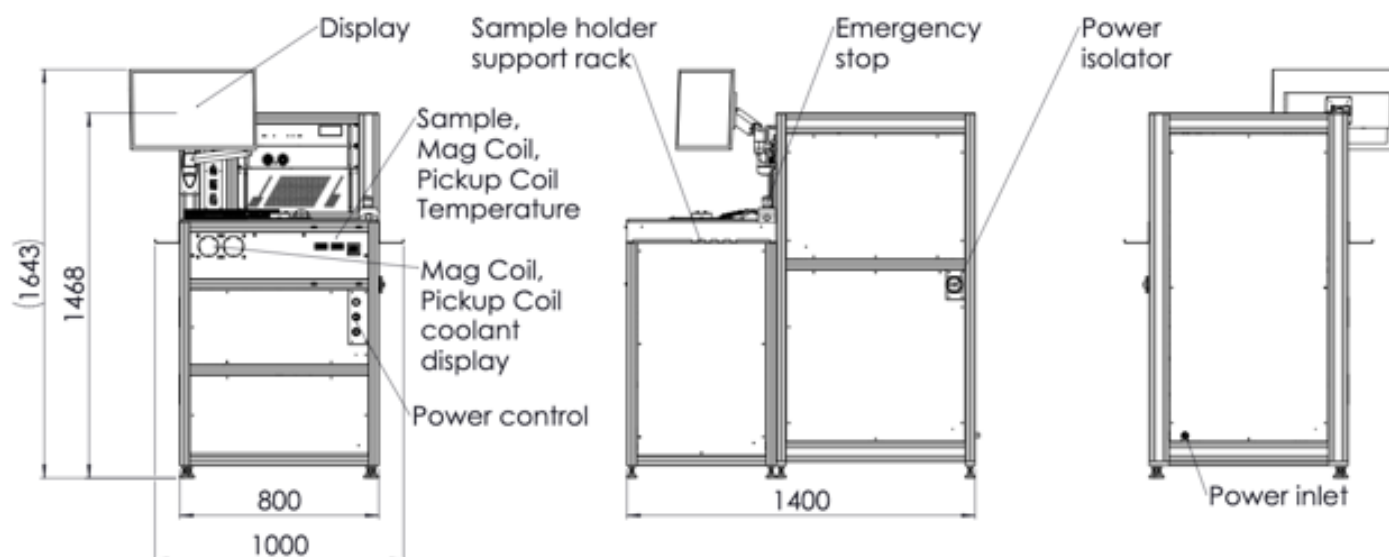
## Range overview

The standard range of products is given below

Product Number	Sample size	Temperature Range	Sample Handling	Typical Application
PFM12	5-10mm width, 5-26mm height	ambient	Manual	Quality control and development
PFM14	5-10mm width, 5-26mm height	ambient to +200DegC	Manual	Quality control and development

## Technical data

Magnetisation pulse	Full period sine wave, peak field 10.5T (8356 kA/m / 105 kOe)
Eddy current removal	Compensation for linear and non-linear rate dependant effects via Hirst proprietary F-2F algorithm
Field correction	Self-Demagnetisation Field Correction
Sample sizes	5-10mm width, 5-26mm height for both PFM12 and PFM14
Sample shapes	Cylinder, Square and arbitrary shapes via shoes
Sample holders	New high performance 2.4GHz sample holder sticks with integral temperature measurement – 2 as standard for PFM12 models with 2 additional for PFM14 models
Sample temperature accuracy	+/-0.15°C
Repeatability	$B_r$ and $H_d$ +/-0.75 % for temperature compensated samples - higher performance upon request
Display and controls	Windows 10 professional personal computer i5, 1TB storage, intuitive software, simple controls and full database system for results storage with 24" HD colour monitor
Colours and materials	Steel and Aluminium case
Dimensions / Weight	1643mm x1000mm x 1400mm / PFM12 - 700kg, PFM14 – 800kg
Connectivity	100 Mbs ethernet via RJ45, USB with wireless keyboard and mouse (supplied), RS232 and RS485.
Machine Operating Temperature Range	+15° C to +30° C
Power Supply	PFM12 and PFM14- Single Phase 220/240VAC 50-60Hz 16A or 110VAC option Max 3m cable length



PFM12 and PFM14

## 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. See website for details.

## Accessories

Basic reference magnet sample kit – RM1



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, pulse field magnetometers (PFMs) for developing and 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](http://www.hirst-magnetics.com) for the latest version.

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