7400-S Series
Vibrating Sample Magnetometers
3-year warranty and technical support

Lake Shore products are supported by a 3-year standard warranty, our confirmation of quality and commitment for the long term. Our scientists understand your applications and measurements and provide support throughout your decision making process and beyond the sale.
Contents

System Overview ..................................... 4 – 5
Materials and Measurements .......................... 6
What Our Customers are Saying .......................... 7
System Application Software .......................... 8 – 9
Post Processing and Analysis .......................... 10 – 11
FORC Utility Software .................................. 12
Magnetocaloric Effect Analysis Software .............. 13
System Pictures ......................................... 14
7400-S Series Specifications ............................ 15
7400-S Series Equipment ............................... 16
Options and Accessories ............................... 17 – 19
Option Specifications .................................. 20
Sample Rods/Tails and Holders ........................ 21
Shipping/Installation Dimensions/Weight ............. 22
Site Requirements ....................................... 22
Application Notes ....................................... 22
Ordering Information ................................... 23
Easy sample exchange — the sliding head mechanism allows easy sample exchange and positioning, ensuring reproducibility of measured results.

Multiple magnet configurations — 100 mm, 175 mm, and 250 mm (4 in, 7 in, and 10 in) variable-gap electromagnet-based configurations provide fields to 3.42 T.

Variable temperature — measure samples from -269 °C to 1000 °C (4.2 K to 1273 K) with our variable temperature options — the broadest temperature range of any electromagnet-based VSM.

Anisotropy measurements — vector coil and autorotation options enable investigations of magnetically anisotropic materials, including derived torque curves.

Magnetoresistance probe — perform fast and accurate magnetoresistance measurements with this option as a function of both magnetic field and temperature.

Sample holders — accommodate thin film, bulk, liquid, and powder samples.
**Integrated software** — set up and execute measurement routines and experiments quickly and easily from the Windows® menu-driven interface.

**Detailed post processing** — background corrections, automatic offset removal, derivative curves, parameter extraction, and more.

**Ergonomic workstation** — in addition to housing all of the integrated electronics, the workstation acts as a convenient tabletop and has a drawer to store sample holders and samples.

**Control electronics** — sensitive electromagnet-based VSM, featuring a noise floor as low as 60 nemu and moment stability of 0.05% per day.

Sensitive, low noise floor electromagnet-based VSM system for the broadest measurement range.
Materials
Magnetic thin films, multilayers, and heterostructures
- Particulate
- Continuous
- Magneto-optical
- Magnetic MEMS
- Magnetoresistors (MR)
  - Tunneling-MR (TMR)
  - Giant-MR (GMR)
  - Colossal-MR (CMR)
Nanomagnetic materials
- Diluted magnetic semiconductors (DMS)
- Paramagnets
- Diamagnets
- Superconductors
- Spin glasses
- Molecular magnetic materials
- Nanocrystalline magnetic alloys
  - Amorphous magnets
  - Melt spun ribbons
- Rare-earth permanent magnets
- Ferrites
  - Hard
  - Semi-hard
- Ferrofluids
- Biological and biomedical
  - Stents
  - MRI contrast agents
- Nanoscale and microscale particles
- Magnetic powders and inks

Direct and derived measurements as a function of field, temperature, and time
Field-dependent measurements
- Major and minor hysteresis loops
- Saturation magnetization (M_{SAT})
- Remanent magnetization (M_{REM})
- Remanent induction B_r
- Coercivity (H_C)
- Intrinsic coercivity (H_{Ci})
- Slope at H_C (S^*)
- dM/dH derivative curves
- Differential susceptibility at H_C
- Switching field distribution (SFD)
- Flatness
- Squareness ratio (SQR)
- Initial magnetization curve
- 2nd quadrant demagnetization curves
- Maximum energy
- Product (BH_{MAX})
- DC demagnetization (DCD) remanence
- Isothermal (IRM) remanence
- Permeability curves
- Pinned and free layer parameters
- Exchange field
- Magnetic anisotropy and rotational hysteresis
- Vector (anisotropy) measurements (m_x and m_y)
- Torque curves: \( \tau = \mu_0 \mathbf{M} \times \mathbf{H} = -\mu_0 M_y H_x \mathbf{k} \)
- Temperature dependent measurements M(T)
  - Curie point
  - Blocking temperature
  - Superconducting transitions and more
- Time dependent measurements M(t)
  - Magnetic relaxation
  - Magnetic viscosity
- First order reversal curves (FORCs)

Ideal for the most demanding magnet characterization applications
What our customers are saying...

“...We use a Lake Shore VSM to characterize the temperature dependence of the properties of soft magnetic amorphous and nanocrystalline alloys. Current fields of study range from the interaction of superparamagnetic nanoparticles embedded in a matrix to the magnetocaloric effect in amorphous alloys. The high resolution of the system has eliminated our dependence on external SQUID equipment for measurements up to moderate magnetic fields.

Dr. Victorino Franco,
Dpto. Física de la Materia Condensada, Sevilla University, Spain

The Lake Shore VSM purchasing experience was the best ever compared to the other pieces of metallurgical test equipment I have acquired. Lake Shore excelled in technical and sales assistance. I was invited out for training and to witness the QC testing of the equipment before it was shipped, and this was a great help to me. Once I received the equipment, Lake Shore was quick to send someone out for the installation and training. It has always been easy for me to get in touch with the technical representative whenever I had a question.

I have not had a single problem with the power supply, electromagnet, computer, and software. The software and control program seems very logical and is easy to interact with.

I have no regrets about my purchase and am very pleased with the support provided by Lake Shore during the purchasing period and thereafter. They get my highest recommendation.

Jon Stinson,
Boston Scientific Scimed

Magnequench is a premier magnetic material producer that offers products with very tight magnetic property tolerances (some as tight as ±0.6%). In order to meet these high quality standards, we use seven Lake Shore VSMs throughout our production processes as well as at our Technical (R&D) center.

Magnequench production VSMs are run continuously (24 hours a day, 7 days a week), and Lake Shore VSMs have proven themselves to be very reliable based on this very demanding environment. Magnequench will most certainly look to Lake Shore when purchasing future VSM systems based on current Lake Shore VSM performance, as well as the wonderful customer support that Lake Shore provides.

Don Kirk Senior Project Engineer,
Magnequench International Inc.

Our research focuses on the development of novel EM materials and spintronic devices, which relies heavily on the characterization of magnetic properties of various types of nanostructured materials. The Lake Shore VSM is a workhorse with high sensitivity and rapid measurements that meet our demanding needs. The Lake Shore staff has been extremely helpful in supporting the instrument. What service — I truly appreciate their support of education and research.

Dr. John Q. Xiao Professor in Physics,
University of Delaware, Newark

The sensitivity of the Lake Shore VSM is as good as specified. We were able to measure ultrathin Co films of 4 Å with the area of ~10 mm². We had two publications of Co/Pt multilayers in Physical Review B in the past two years. This instrument facilitates collaborations with my colleagues. I’m particularly satisfied with the low temperature capability. We can measure magnetization down to 8 K with high sensitivity. It replaces our need for SQUID magnetometer for many of our projects.

Dr. Fengyuan Yang,
The Ohio State University

Use us as a resource!

Our experts can advise you on the optimal system for your applications. To demonstrate the performance of our VSM and to ensure the proper configuration is selected, we can measure one of your actual samples at no charge to you. Get us involved early and benefit from our many years of experience.
System Application Software

The fully integrated IDEAS VSM software uses an intuitive Windows® interface for system operation, data acquisition, and analysis. Select a default experiment profile or customize your own profile to run a virtually unlimited number of experiments.

Set up and execute measurement routines and experiments quickly and easily. All system parameters and functions are controlled for unattended operation and any number of parameters can be automatically extracted from hysteresis loop data. Real-time field-dependent response tracks field changes for accurate curve shape definitions and parameter extraction.

Substrate corrections and backgrounds can be easily subtracted from measurement data. Calculate and display derivative curves, automatically remove offsets, and determine measurement results. Display real-time feedback of processed data in both tabular and graphical form in CGS or SI units.

**Ramp Generator**

Generate a ramp profile based on field, temperature, or angle setup that is optimized to your material and application.

**Moment vs. Field Setup**

Set up a field experiment in either continuous or point-by-point mode.

**Define Sample Parameters**

Define sample parameters before or after recording data.
Put our IDEAS™ application software in control

Temperature vs. Moment
Set up temperature-dependent measurement parameters.

Specify Adjustments and Calculations
Correct for offsets, sample holder or substrate contributions, and linear background slopes. Calculate derivative curves and determine exchange and pinning fields.

Profile Manager
Define, save, and edit individual experiments as well as versatile profiles. Profiles allow you to automate sequences of multiple experiments along with other parameters, such as start date and time, and field and temperature ramps.
Measurements

- 11 µemu CoPt hard disk film
- Magnetic tape — minor loop results
- CoPt thin film — M(H) for H parallel and perpendicular to film plane
- Vector results
- NdFeB — initial magnetization, minor and major loops

Take even the most complex measurements with ease

FORCs for a ferrite sample
NiFe thin film (3 nm) — 3.5 nAm² (3.5 µemu) and 4 A/m (0.05 Oe) steps

CMR film — low temperature results

M(T) on warming and cooling for a nanocrystalline melt-spun ribbon (NdFeBx)

Magnetic tunnel junction with Al₂O₃ barrier*

Magnetic tunnel junction with MgO barrier*

*Thanks to Professor Dr. John Q. Xiao’s group at the University of Delaware, Newark for providing the samples for these measurements
FORC Utility Software

First order reversal curve (FORC) measurements provide unprecedented insight into the magnetic properties of materials, information that is not possible to obtain from a hysteresis loop alone. FORC curves help in identifying the distribution of switching and interaction fields, and in distinguishing between multiple phases in composite or hybrid materials containing more than one phase.

A FORC is measured by saturating a sample in a field \( H_{\text{sat}} \), decreasing the field to a reversal field \( H_a \), then sweeping the field back to \( H_{\text{sat}} \) in a series of regular field steps \( H_b \). This process is repeated for many values of \( H_a \), yielding a series of FORCs. The measured magnetization at each step as a function of \( H_a \) and \( H_b \) gives \( M(H_a, H_b) \), which is then plotted as a function of \( H_a \) and \( H_b \) in field space.

A FORC measurement

Lake Shore provides a downloadable FORC Data Acquisition Utility that provides a convenient way for users of Model 7400* and 7400-S VSMs to setup and run FORC measurements. Resulting data sets can be imported into popular FORC analysis software packages like FORCinel and VARIFORC.

* A VSM controller firmware update is required for 7400 series systems

The user then runs the measurement using the IDEAS software, after which the utility converts the results into a file that can be imported into FORCinel and other similar analysis packages.

Software like FORCinel is used to view the FORC curves shown in the first diagram, and to derive FORC distribution diagrams such as the one shown above. The FORC distribution \( p(H_b, H_a) \) is the mixed second derivative, i.e., \( p(H_b, H_a) = -\partial^2 M(H_a, H_b)/\partial H_a \partial H_b \). Analysis packages will output graphical 2D or 3D FORC diagrams, contour plots of \( p(H_b, H_a) \) with the axis rotated by changing coordinates from \((H_a, H_b)\) to \((H_c, H_u)\). These diagrams represent the distributions of interaction fields \( H_u \) and of switching fields \( H_c \).

For more information on the application of FORC measurements, see the library of application notes and papers at www.lakeshore.com.
Magnetocaloric Effect (MCE) Analysis Software

User-friendly software that enables Lake Shore VSM users to easily:

- Characterize first and second order phase transition materials
- Import Lake Shore IDEAS VSM data relating to isothermal magnetization curves $M(H)$ and isofield magnetization curves $M(T)$
- Generate graphs showing the quality of data and the reliability of intermediate interpolation steps
- Calculate magnetic entropy change (peak values, full width at half maximum)
- Calculate refrigerant capacity, choosing from three widely accepted definitions

Offered in a free beta trial version, this software package allows Lake Shore 7300/7400/7400-S Series VSM users to more easily analyze candidate materials for magnetocaloric effect (MCE) behavior by calculating the magnetic entropy change and refrigerant capacity of the materials.

**MCE software application note**

Data files created by the Lake Shore IDEAS VSM software can be seamlessly imported into the MCE analysis software for experimental interpretation of magnetization curves. These include isothermal curves $M(H)$, including magnetizing ($0$ to $H_{\text{max}}$), demagnetizing curves, or hysteresis loops, as well as isofield curves $M(T)$, including increasing temperature ($T_{\text{min}}$ to $T_{\text{max}}$), decreasing temperature ($T_{\text{max}}$ to $T_{\text{min}}$), loops ($T_{\text{min}}$ to $T_{\text{max}}$ or $T_{\text{max}}$ to $T_{\text{min}}$), or both as either point-by-point measurements or continuous temperature ramping in background.

The software features a user-friendly graphic interface that automatically populates tables with imported magnetization curve data and plots them as graphs displayed in a data analysis window. It then calculates relevant magnetocaloric parameters extracted from the magnetization curves as a function of the maximum applied field. Once calculations are made by the software, the program generates ASCII files that you can then use with your preferred graphics software to create plots for publication.

For more information about the software, its value in magnetocaloric research, and background on the parameters associated with characterizing the magnetocaloric response of a material, please download the “Determining Magnetic Entropy Change from Magnetic Measurements” application note from www.lakeshore.com.

This software is a beta trial version. It is designed to operate with the Lake Shore IDEAS VSM v3.6 or newer software output data files. Lake Shore VSM owners receiving this software acknowledge that they are receiving it without warranty and their only expectation of support will be what Lake Shore Cryotronics can reasonably provide during normal business hours (9 a.m. to 5 p.m. EDT).

Questions about software usage can be directed to Dr. Cosmin Radu, Lake Shore Applications Scientist, at cosmin.radu@lakeshore.com, or by e-mailing sales@lakeshore.com.

**Developer/author**

Lake Shore Cryotronics extends a special thank you to Dr. Victorino Franco for his work in developing this software package. We also greatly appreciate his ongoing collaboration with Lake Shore as we continue to optimize our VSM systems for emerging material characterization applications.

Victorino Franco obtained his PhD in Physics from Sevilla University (Spain) in 1999, where he is now a Professor at the Condensed Matter Physics Department. His research interest is focused on magnetic materials for energy applications, including soft magnetic materials and magnetocaloric materials. He has published more than 130 articles in peer reviewed journals, has been visiting professor at numerous universities and research labs in Europe, Asia and America and has been recipient of the Young Scientist Awards from the Spanish Royal Physical Society (in 2000) and from the Royal Order of Chivalry and Royal Academy of Sciences of Sevilla (in 2005).

Victorino is the Past Chair of the Magnetic Materials Committee of the Minerals Metals and Materials Society (TMS), the Conference Coordinator of the Spain Section of IEEE, and the Secretary and Treasurer of the Spain Chapter of IEEE Magnetic Society. He is also Editor of the journal Metallurgical and Materials Transactions E: Materials for Energy Systems.

For more about Victorino Franco, his latest research, and his published work, visit his research page at http://personal.us.es/vfranco/.
Vibrating Sample Magnetometers

Model 7404-S

Model 7407-S

Model 7410-S
## 7400-S Series VSM Specifications

**Magnet pole cap face diameter**: 50 mm (2.0 in)

<table>
<thead>
<tr>
<th></th>
<th>7404-S</th>
<th>7407-S</th>
<th>7410-S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>APPLIED FIELD STRENGTH (±1%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5 mm (0.14 in) sample access</td>
<td>2.63 T</td>
<td>3.05 T</td>
<td>3.42 T</td>
</tr>
<tr>
<td>10 mm (0.4 in) sample access</td>
<td>2.27 T</td>
<td>2.72 T</td>
<td>3.16 T</td>
</tr>
<tr>
<td>16 mm (0.64 in) sample access</td>
<td>1.94 T</td>
<td>2.46 T</td>
<td>2.92 T</td>
</tr>
<tr>
<td>With oven or cryostat option</td>
<td>1.49 T</td>
<td>2.12 T</td>
<td>2.59 T</td>
</tr>
<tr>
<td>6.4 mm (0.25 in) sample access</td>
<td>1.75 T</td>
<td>2.28 T</td>
<td>2.76 T</td>
</tr>
</tbody>
</table>

### MOMENT MEASUREMENT

**Noise floor (emu RMS)**

<table>
<thead>
<tr>
<th>Room temperature</th>
<th>450 nemu</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 TC; 0.1 s/pt (no averaging)</td>
<td>175 nemu</td>
</tr>
<tr>
<td>0.1 TC; 1 s/pt</td>
<td>60 nemu</td>
</tr>
<tr>
<td>0.1 TC; 10 s/pt</td>
<td>2.5 μemu</td>
</tr>
<tr>
<td>With oven or cryostat option, 0.1 TC, 10 s/pt</td>
<td>1.25 μemu</td>
</tr>
<tr>
<td>With single-stage variable temperature option 0.1 TC, 10 s/pt</td>
<td>5 μemu</td>
</tr>
</tbody>
</table>

**Dynamic range**: 1 × 10⁻⁷ to 10³ emu

**Time constants (TC)**: 0.1, 0.3, 1.0, 3.0, or 10.0 s

**Moment stability**: Less than 0.05% RMS of full scale/day at constant field, constant temperature, and highest range after a 5 h warm-up period

**Reproducibility**: Better than ±0.5%, or ±0.1% of full scale, fixed rotation angle and range, with sample replacement

**Moment accuracy**: Better than 1% of reading ±0.2% of full scale with a geometrically identical test sample and calibrant

**Sample mass**: 0 to 10 g (higher mass can be accommodated with decreased performance)

### FIELD MEASUREMENT

**Field accuracy**: 1% of reading or ≤0.05% of full scale

**Field resolution**

<table>
<thead>
<tr>
<th>2800 kA/m (35 kOe)</th>
<th>8 A/m (0.1 Oe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>280 kA/m (3.5 kOe)</td>
<td>0.8 A/m (0.01 Oe)</td>
</tr>
<tr>
<td>28 kA/m (350 Oe)</td>
<td>0.08 A/m (0.001 Oe)</td>
</tr>
</tbody>
</table>

**Closed loop field control stability**: <0.05% RMS of full scale/h

### MANUAL ROTATION

**Setting resolution**: <1°

**Setting reproducibility**: <1°

**Rotation range**: 0 to 730°

### CERTIFICATIONS

**CE**: yes

**Application of Council directives**

- 2006/95/EC LVD
- 2004/108/EC EMC

**Standard to which conformity is declared**

- EN-61010-1:2010 - Overvoltage II, Pollution Degree 2 - LVD
- EN 61326-1:2013 - Class A, Annex B - EMC

### UTILITIES

**Total system cooling water power dissipation (50 or 60 Hz) — contact Lake Shore for the most current selection of available recirculating chillers**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.25 kW</td>
<td>13.4 kW</td>
<td>13.4 kW</td>
</tr>
</tbody>
</table>

---

1. Tested with an AlNiCo sample in a 1 in sensing coil gap after system warm-up period with the sample vibrating at field. The AlNiCo samples' moment must be >50% of full scale moment range.

Please note: Chiller power specifications listed are for 100% duty cycle. Many common magnet testing applications such as hysteresis loops will not require as much cooling power. Please consult Lake Shore for chiller recommendations for your specific applications.
# 7400-S Series VSM Equipment

<table>
<thead>
<tr>
<th>Component</th>
<th>7404-S</th>
<th>7407-S</th>
<th>7410-S</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VSM head drive</strong></td>
<td>Model 74014</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VSM frame</strong></td>
<td>Model 736-S</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Control electronics</strong></td>
<td>Model 142</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Linear amplifier</strong></td>
<td></td>
<td>Model 643</td>
<td>Model 648</td>
</tr>
<tr>
<td><strong>Bipolar magnet power supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td>DC current source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum output</td>
<td>±35 V/±70 A (2450 W)</td>
<td>±75 V/±135 A (9.1 kW nominal)</td>
<td></td>
</tr>
<tr>
<td>AC line input</td>
<td>204/8 VAC ±10%, 13 A/phase; 220/230 VAC ±10%, 12 A/phase; 380 VAC ±10%, 7 A/phase; 400/415 VAC ±10%, 6.5 A/phase at 50/60 Hz</td>
<td>200 VAC ±10%, 41 A/phase; 208 VAC ±10%, 40 A/phase; 220 VAC ±10%, 38 A/phase; 230 VAC ±10%, 37 A/phase; 380 VAC ±10%, 23 A/phase; 400 VAC ±10%, 21 A/phase; 415 VAC ±10%, 21 A/phase</td>
<td></td>
</tr>
<tr>
<td>Cooling water requirements</td>
<td>Tap water or closed cooling system (optional chiller available) +15 °C to +30 °C</td>
<td>Tap water or closed cooling system (optional chiller available) +15 °C to +30 °C</td>
<td>159 kPa (23 psi) at 7.6 L (2.0 gal)/min minimum for power supply and mandatory flow switch</td>
</tr>
<tr>
<td>Flow rate</td>
<td>5.7 L (1.5 gal)/min minimum</td>
<td>7.6 L (2.0 gal)/min minimum</td>
<td>159 kPa (23 psi) at 7.6 L (2.0 gal)/min minimum for power supply and mandatory flow switch</td>
</tr>
<tr>
<td>Pressure drop</td>
<td>10 kPa (1.5 psi) at 5.7 L (1.5 gal)/min minimum for power supply only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electromagnet</td>
<td>Model EM4-HVA</td>
<td>Model EM7-HV</td>
<td>Model EM10-HV</td>
</tr>
<tr>
<td>Pole diameter</td>
<td>100 mm (4 in)</td>
<td>180 mm (7 in)</td>
<td>250 mm (10 in)</td>
</tr>
<tr>
<td>Pole cap face diameter</td>
<td>50 mm (2 in)</td>
<td>50 mm (2 in)</td>
<td>50 mm (2 in)</td>
</tr>
<tr>
<td>Field homogeneity</td>
<td>±0.1% over 1 cm² (0.4 in²)</td>
<td>±0.1% over centered 5 cm (2 in) diameter circle</td>
<td>±0.1% over centered 5 cm (2 in) diameter circle</td>
</tr>
<tr>
<td>Cooling water requirements</td>
<td>Tap water or closed cooling system (optional chiller available)</td>
<td>Tap water or closed cooling system (optional chiller available)</td>
<td>Tap water or closed cooling system (optional chiller available)</td>
</tr>
<tr>
<td>Flow rate</td>
<td>7.6 L (2 gal)/min</td>
<td>11.4 L (3 gal)/min</td>
<td>15 L (4 gal)/min</td>
</tr>
<tr>
<td>Pressure drop</td>
<td>200 kPa (30 psi)</td>
<td>220 kPa (32 psi)</td>
<td>200 kPa (30 psi)</td>
</tr>
<tr>
<td>Hall probe</td>
<td>High sensitivity; 102 mm (4 in) aluminum stem</td>
<td>741SC and 741LC</td>
<td>High sensitivity; 203 mm (8 in) aluminum stem</td>
</tr>
<tr>
<td>Pick-up coils</td>
<td>741SC and 741LC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument console</td>
<td>483 mm (19 in) rack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer with IDEAS™ software</td>
<td></td>
<td>Model 740906</td>
<td></td>
</tr>
</tbody>
</table>

Lake Shore Cryotronics, Inc. | t. 614.891.2244 | f. 614.818.1600 | e. info@lakeshore.com | www.lakeshore.com
17

Vibrating Sample Magnetometers

74035 single-stage variable temperature option
The single stage variable temperature assembly allows you to take measurements from 100 K to 950 K using LN₂, nitrogen, and argon gas. A single point measurement can be taken at 78 K. Only one hardware device is required to go from high to low temperatures, eliminating the need to remove or resaddle your sample. This ensures accurate measurements throughout the full scale temperature range. Rapid cool down from 950 K to room temperature and from room temperature to 100 K provides efficiency and high throughput. Like our full suite of variable temperature options, the single stage variable temperature assembly is mechanically isolated from the magnetometer head and sample, minimizing noise floor. Designed to deliver superior thermal performance, the unit’s vacuum insulation prevents freeze over at low temperatures and can operate safely at high temperatures without the risk of damaging neighboring components.

Included with the 74035:
1. Single-stage variable temperature insert with mount
2. 25 liter LN₂ Dewar with condenser stand
3. Gas handling box
4. LN₂ transfer line with condenser assembly
5. Instrument cables

Supplemental 74035 equipment requirements:
1. Lake Shore 741-VTA variable temperature option kit
2. Sample rods and holders; recommended:
   a. With 7404-S and 7407-S: 740928 sample tail and holder kit
   b. With 7410-S: 740941 sample tail and holder kit
3. Argon gas cylinder with 344 kPa (50 psi) gas regulator and 3 mm hose barb (can also be a ¼ NPT female fitting)
4. Nitrogen gas cylinder with a 344 kPa (50 psi) gas regulator and 3 mm hose barb (can also be a ¼ NPT female fitting)
5. LN₂ source to fill the provided Dewar
6. Clean compressed air (276 kPa [40 psi])
7. Mechanical vacuum pump (E2M or equivalent) kit providing sample space blank off pressure of <0.67 Pa (5 × 10⁻³ Torr) for routine operation
8. Turbomolecular vacuum pump (Lake Shore TPS-FRG or equivalent) kit for cryogen transfer line maintenance — can also be used in place of the E2M rotary vacuum pump
9. A Pirani or thermocouple vacuum gauge capable of measuring pressures from 0.1 to 100 Pa (10⁻³ to 1 Torr)

74018 variable temperature cryostat
This VSM cryostat is designed for rapid sample cooling with either LHe or LN₂ as well as easy sample insertion and interchange. It allows you to take measurements from 5.5 K to 450 K using LHe and from 85 K to 450 K using LN₂. A single-point measurement can be taken at 4.2 K (LHe) and at 77.6 K (LN₂). The sample is suspended in a proprietary insulated tube constructed of nonmagnetic material.

The cryostat is mechanically isolated from the magnetometer head and sample, greatly reducing the system noise floor. It is mounted between an electromagnet base plate and a quick release mechanism located on the top of the electromagnet.

The cryostat design provides the user the capability to perform measurements economically over nearly the entire accessible temperature range with a single cryostat. The transfer line is included with the cryostat.

Included with the 74018:
1. Combination LHe/LN₂ cryostat with mount
2. LHe/LN₂ transfer line
3. Cryogen transfer kit
4. Instrument cables and related accessories
5. Sample rods and holders
   a. With 7404-S and 7407-S: 740929 sample tail and holder kit
   b. With 7410-S: 740943 sample tail and holder kit

Supplemental 74018 equipment requirements:
1. Lake Shore 741-VTA temperature option kit
2. A mechanical vacuum pump (Lake Shore E2M or similar) capable of achieving a pressure below 0.67 Pa (5 × 10⁻³ Torr) and a speed of 1 m³/h, along with a KF-16 flange pump inlet
3. Access to turbomolecular vacuum pump (Lake Shore TPS-FRG or similar) capable of doing better than 1.33 × 10⁻⁶ Pa (10⁻⁶ Torr) for annual evacuation of transfer line vacuum space
4. LHe or LN₂ storage Dewar (Lake Shore 1220-50 or similar) with top withdraw fitting to accept the 12.7 mm (0.5 in) diameter transfer line — the transfer line furnished with the Model 74018 cryostat is particularly well adapted for use with 25 to 60 L storage vessels, and can be readily adapted to other capacity storage vessels (in most cases, a LHe Dewar will be provided by your local liquid gas distributor when LHe is delivered)
5. Gas cylinder with 1 to 5 psi pressure regulator to deliver clean, dry helium or nitrogen gas (depending on liquid cryogen)
Configure your system —

74034 high temperature oven

The high temperature oven assembly enables the 7400 or 7400-S Series VSM system to be used to investigate the magnetic properties of materials at high temperature. This option consists of an electrically heated outer tube assembly with efficient thermal insulation to permit sample-zone temperature from 100 °C to 1000 °C (373 K to 1273 K). Temperatures from 30 °C to 1000 °C (303 K to 1273 K) are also possible, however, below 100 °C (373 K) measurement time increases.

The inner sample zone chamber is lined with a special heat-resistant and intrinsically non-magnetic material. A sample holder is provided which consists of a quartz tube sample rod attached to a boron-nitride sample cup. The oven secures to a special isolation mount support structure, the only special consideration being that the air gap between the coils must accommodate the 19 mm (0.75 in) outside diameter of the oven. A mechanical vacuum pump capable of maintaining inlet pressures down to 0.67 Pa (5 × 10⁻³ Torr) must be supplied by the user.

This option features efficient thermal insulation, consisting of an evacuation outer chamber with multiple reflective heat shields. Sample zone temperatures as high as 1000 °C are attained with a power consumption of approximately 70 W. Two results of the low power consumption are minimal magnetic interference and increased temperature uniformity in the sample zone. The oven is particularly well suited to measuring Curie temperatures of ferromagnetic or ferrimagnetic materials at temperatures up to 1000 °C. The sensitivity of the VSM permits Curie temperature determinations at relatively low field intensities, allowing more inherently accurate determinations.

At room temperature and above, measurements may be performed on samples contained in an argon atmosphere to protect the sample from oxidation.

Included with the 74034:
1. Oven assembly with mount
2. Gas handling box
3. Nickel Curie sample cylinder
4. Instrument cables and related accessories
5. Sample rods and holders
   a. With 7404-S and 7407-S: 740928 sample tail and holder kit
   b. With 7410-S: 740941 sample tail and holder kit

Supplemental 74034 equipment requirements:
1. Lake Shore 741-VTA temperature option kit
2. A mechanical vacuum pump (Lake Shore E2M or similar) capable of achieving a blanked-off pressure below 0.67 Pa (5 × 10⁻³ Torr) and a pumping speed of 1 m³/h, along with a KF-16 flange pump inlet
3. Argon gas cylinder with 5 to 10 psi regulator and 3 mm (1/8 in) hose barb

741-VTA temperature option kit

The autotuning cryogenic temperature controller is used to measure and control our full suite of variable temperature options. The 741-VTA includes a Lake Shore temperature controller, thermocouple input card (when purchased for use with the high temperature oven or single stage variable temperature assembly), vacuum handling kit, mounting hardware (included with the 74035 SSVT option), flanges, hoses, connectors, and accessories. Note: only one 741-VTA is required for all variable temperature options.
Vibrating Sample Magnetometers

Introduction

74046 magnetoresistance (MR) probe
The MR probe option performs fast and accurate measurements of MR, GMR spin-valve, CMR and other magnetoresistive materials as a function of both in-plane magnetic field and temperature. This measurement option includes data acquisition, control, and analysis software to automatically extract pertinent parameters for the device under test. These include free and pinned layer parameters of both simple and synthetic spin-valve sensors.

The MR probe features four in-line pins for solder-less connection to the sample and is interchangeable with the VSM sample rod for compatibility with variable temperature and autorotation options. The temperature range of use extends from 20 K to 450 K when used with the 74018 LHe/LN₂ cryostat, 325 K to 673 K with the 74034 oven, and 100 K to 673 K with the 74035 single-stage variable temperature assembly. Angular dependent MR measurements are possible when used in combination with the 74033 autorotation option. Contact pins maintain their position on the sample while the entire assembly rotates with respect to the magnetic field.

The fully automated MR software is an intuitive yet powerful user interface providing automatic control of all experimental parameters for unattended operation. Experiment recipes can be saved, retrieved, and edited, and measurement data can be displayed and exported in graphical or tabular format. Multiple step profiles can also be defined to allow for flexibility in the preparation steps and for developing annealing step process methodologies.

The MR probe option is composed of several user-replaceable parts, including contact pins, ceramic pin guides, a ceramic sample holder, a contact pressure spring, and a printed circuit board, providing the convenience of in-field maintenance.

74033 autorotation
The rotation option allows you to automatically vary the sample orientation relative to the direction of the applied magnetic field. The angle of rotation is within a single plane defined by the direction of applied magnetic field, referred to as the x-axis. Angular variation is about the z-axis. Rotation is programmable to a resolution of <1° for rotating the sample from -10 to 730° and all parameters are measured as a function of rotation angle.

74032XY vector coils
The vector option extends the VSM measurement capabilities to facilitate investigations of anisotropic magnetic materials, allowing you to determine their vector magnetization components and susceptibility tensor. When used in combination with the 74033 autorotation option, the vector coils provide information that is essentially identical to that provided by a dedicated torque magnetometer. The 74032XY 2-inch vector coils are compatible with all variable temperature options.

E2M 2-stage rotary vacuum pump
Capable of achieving a pressure below 0.67 Pa (5 × 10⁻³ Torr) at 1 m³/h, the 2-stage rotary vacuum pump is used for evacuating both the oven and cryostat vacuum spaces of our variable temperature options. This, or a similar vacuum pump, is required for daily operation of variable temperature options.

TPS-FRG turbomolecular vacuum pump station
Used to annually evacuate the cryogen transfer line of the optional cryostat and single stage variable temperature assembly (transfer line and kit are included with these options), the TPS-FRG provides vacuum to 1.33 × 10⁻⁶ Pa (10⁻⁶ Torr). In addition to annual cryogen transfer line maintenance, the turbomolecular vacuum pump can also be used in place of the E2M rotary vacuum pump for evacuating the cryostat vacuum space.

Recirculating chillers
Lake Shore offers NesLab® recirculating chillers in order to provide a complete laboratory solution. The NesLab chillers feature a CFC-free refrigeration system.

The refrigeration system uses a hermetically sealed compressor and hot gas bypass system of temperature control. This system eliminates on/off cycling and premature wear of the compressor. Strong pumps provide continuous flow even through cooling lines with small IDs.
## 7400-S Series VSM Option Specifications

Unless noted, options are compatible with both the 7400-S Series and the previous 7400 Series VSMs.

### Model 74018 variable temperature cryostat

<table>
<thead>
<tr>
<th>Option</th>
<th>Temperature range</th>
<th>Temp stability</th>
<th>Temp range</th>
<th>Temperature resolution</th>
<th>Cool-down time</th>
<th>LN₂ liquid usage</th>
<th>Argon liquid usage</th>
<th>Insulation</th>
<th>Sample zone dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>With LHe</td>
<td>4.2 K (base), 5.5 K to 450 K</td>
<td>±0.1 K</td>
<td>4.2 K (base), 5.5 K to 450 K</td>
<td>0.001 K</td>
<td>5 min (15 min initial cool-down)</td>
<td>&lt;1 L/h when operating &gt;7 K</td>
<td>&lt;1 L/h when operating &gt;85 K</td>
<td>Vacuum</td>
<td>Bore size: 7.1 mm (0.28 in), Outside diameter: 22.4 mm (0.88 in)</td>
</tr>
<tr>
<td>With LN₂</td>
<td>77.6 K (base), 85 K to 450 K</td>
<td>±0.2 K</td>
<td>77.6 K (base), 85 K to 450 K</td>
<td>±0.1 K</td>
<td>15 min from room temp to 100 K, 40 min from 1,000 K to room temp</td>
<td>&lt;0.75 L/h &gt;100 K to 350 K</td>
<td>3.2 L/min 100 K to 350 K</td>
<td>Vacuum</td>
<td>Bore size: 7.1 mm (0.28 in), Outside diameter: 17.8 mm (0.7 in)</td>
</tr>
</tbody>
</table>

### Model 74033 autorotation

<table>
<thead>
<tr>
<th>Setting resolution</th>
<th>Setting repeatability</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1°</td>
<td>&lt;1°</td>
</tr>
</tbody>
</table>

### Model 74034 high temperature oven

| Temp range          | 303 K to 1,273 K    |
| Temp stability      | ±0.1 K              |
| Temp resolution     | 0.001 K             |
| Maximum ramp rate   | 80 K/min at maximum heating rate of 80 W |
| Insulation          | Vacuum plus multiple reflective shields |
| Sample zone dimensions | Bore size: 7.1 mm (0.28 in), Outside diameter: 19 mm (0.75 in) |

### Model 74035 single stage variable temperature option

| Temperature range    | 78 K (base), 100 K to 950 K (control) |
| Temperature stability| 0.1 K RMS when operated with argon (high temperature) and 0.9 K RMS when operated with nitrogen (low temperature) |
| Temperature resolution| 0.001 K |
| Gasses               | LN₂ and nitrogen gas for T<350 K, argon for T>350 K |
| Cool-down time       | 15 min from room temp to 100 K, 40 min from 1,000 K to room temp |
| Nominal ramp rate (in the domain) | 5 K/min |
| Hold time            | Continuous flow |
| LN₂ usage            | <0.75 L/h >100 K to 350 K |
| Nitrogen gas usage   | 3.2 L/min 100 K to 350 K |
| Argon gas usage      | 3.6 L/min |
| Insulation           | Vacuum |
| Sample zone dimensions | Bore size: 7.1 mm (0.28 in), Outside diameter: 17.8 mm (0.7 in) |

### Model 74046 magnetoresistance (MR) probe

| Number of probes | 4 |
| Probe pin to pin spacing | 0.9 mm |
| Total 4-pin spacing | 2.7 mm |
| Nominal sample size | 4.5 mm × 4.5 mm cross-section, maximum height 3 mm |
| Temperature range | 20 K to 673 K |
| Current ranges    | 6 ranges; 1 µA to 100 mA |
| Resistance ranges | 9 ranges: 0.2 Ω, 2 Ω, 20 Ω, 200 Ω, 2 kΩ, 20 kΩ, 200 kΩ, 2 MΩ, up to 10 MΩ |
| Probe tip compliance voltage | 0 V to 5 V, measurement; 0 V to 100 V, contact formation |

### Model 74032XY standard vector coils

<table>
<thead>
<tr>
<th>7404-S or 7404</th>
<th>7407-S or 7407</th>
<th>7410-S or 7410</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pole caps</td>
<td>100 mm (4 in)</td>
<td>100 mm (4 in)</td>
</tr>
<tr>
<td>Air gap</td>
<td>50.8 mm (2 in)</td>
<td>50.8 mm (2 in)</td>
</tr>
<tr>
<td>Maximum applied field</td>
<td>7.7 kOe (0.77 T)</td>
<td>12.5 kOe (1.25 T)</td>
</tr>
<tr>
<td>RMS noise (Y coils)</td>
<td>5 µemu</td>
<td>5 µemu</td>
</tr>
<tr>
<td>Sample access</td>
<td>25 mm (1 in)</td>
<td>25 mm (1 in)</td>
</tr>
<tr>
<td>Torque density minimum (at maximum applied field)</td>
<td>38 × 10⁻³ dyn·cm</td>
<td>62 × 10⁻³ dyn·cm</td>
</tr>
</tbody>
</table>

2 Requires large diameter pole caps; sold separately for 7400 Series systems
Integrated Sample Tail/holders

For Model 7404-S/7404/7407-S/7407

740930 Quartz, thin film bottom

740931 Quartz, thin film side

740933 Fiberglass, 3.5 mm air gap, thin film side

740934 Fiberglass, 3.5 mm air gap, thin film bottom

For Model 7410-S/7410

740937 Quartz, 3.5 mm air gap, thin film side

740938 Quartz, 3.5 mm air gap, thin film bottom

740944 Quartz, thin film bottom

740945 Quartz, thin film side

Sample Tails

For Model 7404-S/7404/7407-S/7407

740932 Quartz to BN shown with the 730937 Disposable BN cup

740935 Fiberglass shown with the 730931 Kel-F bulk/powder upper/bottom cup

For Model 7410-S/7410

740939 Quartz to Kel-F® shown with the 730931 Kel-F bulk/powder upper/bottom cup

740942 Quartz to BN shown with the 730937 Disposable BN cup

Recommended temperature usage

<table>
<thead>
<tr>
<th>Room temp</th>
<th>Model 74034 oven</th>
<th>Model 74018 cryostat</th>
<th>Model 74035 variable tempature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fiberglass</td>
<td>✓</td>
<td>✓</td>
<td>✓ at RT and below</td>
</tr>
<tr>
<td>Kel-F®</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Boron nitride</td>
<td>✓</td>
<td>✓ above RT</td>
<td></td>
</tr>
</tbody>
</table>
Vibrating Sample Magnetometers

Site Requirements
A system-specific site prep checklist will be provided

Power
Instrumentation, computer, and optional vacuum pump require two standard single-phase electrical outlets (20 A maximum). Magnet power supply and optional recirculation chiller require 3-phase electrical outlets (21 A maximum).

Water
Electromagnet requires one supply and one return line for cooling with up to 15 L/min and 30 to 50 psi. Magnet power supply requires a minimum of 7.6 L/min with a maximum pressure of 80 psi and +15 °C to +30 °C water temperature.

Floor
The floor must support the weight of the magnet, supply, and the equipment used to move them into place. The weight of the console is negligible in comparison. Heavy concrete ground floors usually prove best, not only because they have the required strength, but such a floor also transmits minimal building vibration to the magnetometer.

The system also requires minimum spacing between each of the above three pieces and 0.75 m for access to the rear of the equipment. (See Installation Dimensions and Weight table).

Environment
The VSM requires a temperature-controlled environment that is relatively free of airborne dust and debris. There should be no equipment placed next to the VSM system that would emit or be susceptible to high levels of magnetic interference (distribution boxes, vibration equipment, x-ray machines, etc.)

Application Notes
- Determination of the Magnetic Entropy Change from Magnetic Measurements
- First-Order-Reversal-Curve Analysis of Nanoscale Magnetic Materials
- Rock Magnetism and FORC Measurements
- FORC Measurements of Magnetic Materials
- Magnetic In-line Metrology for GMR Spin-Valve Sensors
- Finite Sample Size Effects on the Calibration of Vibrating Sample Magnetometers
- Low Moment Measurements with a Vibrating Sample Magnetometer
- Magnetic Anisotropy: Measurements with a Vector Vibrating Sample Magnetometer
- Measurements with a VSM—Permanent Magnet Materials
- The Performance of the Model 7400 VSM: Sensitivity
- Magnetic Media Measurements with a VSM

Visit www.lakeshore.com for the most up-to-date information

Shipping Dimensions and Weight (w × d × h)

<table>
<thead>
<tr>
<th></th>
<th>Model 7404-S</th>
<th>Model 7407-S</th>
<th>Model 7410-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument console, electronics, head, and computer</td>
<td>122 cm × 84 cm × 165 cm (48 in × 33 in × 65 in) 392 kg (864 lb)</td>
<td>122 cm × 84 cm × 165 cm (48 in × 33 in × 65 in) 318 kg (700 lb)</td>
<td>122 cm × 84 cm × 165 cm (48 in × 33 in × 65 in) 318 kg (700 lb)</td>
</tr>
<tr>
<td>Electromagnet</td>
<td>109 cm × 94 cm × 135 cm (43 in × 37 in × 53 in) 471 kg (1038 lb)</td>
<td>122 cm × 97 cm × 128 cm (48 in × 38 in × 50 in) 860 kg (1896 lb)</td>
<td>107 cm × 107 cm × 114 cm (42 in × 42 in × 45 in) 1647 kg (3630 lb)</td>
</tr>
<tr>
<td>Electromagnet base</td>
<td>(magnet, base, and frame together)</td>
<td>(magnet, base, and frame together)</td>
<td>112 cm × 112 cm × 41 cm (44 in × 44 in × 16 in) 165 kg (363 lb)</td>
</tr>
<tr>
<td>Frame</td>
<td></td>
<td></td>
<td>122 cm × 109 cm × 147 cm (48 in × 43 in × 58 in) 341 kg (750 lb)</td>
</tr>
<tr>
<td>Power supply</td>
<td>(Included in instrument console)</td>
<td>109 cm × 79 cm × 117 cm (43 in × 31 in × 46 in) 331 kg (730 lb)</td>
<td>109 cm × 79 cm × 117 cm (43 in × 31 in × 46 in) 420 kg (926 lb)</td>
</tr>
</tbody>
</table>

Installation Dimensions and Weight (w × d × h)

<table>
<thead>
<tr>
<th></th>
<th>Model 7404-S</th>
<th>Model 7407-S</th>
<th>Model 7410-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument console, electronics, head, and computer</td>
<td>79 cm × 77 cm × 160 cm (31 in × 30 in × 63 in) 131 kg (289 lb)</td>
<td>79 cm × 77 cm × 160 cm (31 in × 30 in × 63 in) 57 kg (126 lb)</td>
<td>79 cm × 77 cm × 160 cm (31 in × 30 in × 63 in) 57 kg (126 lb)</td>
</tr>
<tr>
<td>Electromagnet, electromagnet base, and frame</td>
<td>84 cm × 82 cm × 140 cm (33 in × 32 in × 55 in) 307 kg (677 lb)</td>
<td>120 cm × 82 cm × 140 cm (47 in × 32 in × 55 in) 739 kg (1629 lb)</td>
<td>120 cm × 82 cm × 140 cm (47 in × 32 in × 55 in) 1392 kg (2459 lb)</td>
</tr>
<tr>
<td>Power supply</td>
<td>(Included in instrument console)</td>
<td>61 cm × 92 cm × 137 cm (24 in × 36 in × 54 in) 250 kg (551 lb)</td>
<td>61 cm × 92 cm × 137 cm (24 in × 36 in × 54 in) 273 kg (602 lb)</td>
</tr>
</tbody>
</table>
Ordering Information

7400-S Series Systems

7404-S High sensitivity VSM with 4 in electromagnet, 643 magnet power supply
7407-S High sensitivity VSM with 7 in electromagnet, 648 magnet power supply
7410-S High sensitivity VSM with 10 in electromagnet, 648 magnet power supply

VSM-TRAINING 2 days on-site VSM operational training/verification—price includes travel time and expenses; *1 additional operational training/verification day required for each and every temperature option
VSM-TRAINING-1 Additional VSM operational training/verification days

Options

Unless noted, options are compatible with both the 7400-S Series and the previous 7400 Series VSMs.

74019 Cryostat, variable temperature LN₂ and LHe
74032XY Vector option, X and Y coil set for 2 in gap
74033 Autorotation option for Model 736/736-S controller (not field upgradable — VSM head must be returned to Lake Shore) NOTE: for head design with serial number sequence 1740HREVXXXX
74034 Oven, high temperature
74035 Single stage variable temperature
74046 Magnetoresistance probe — can be used with high and low temperature options (740-VTA not included)
741-VTA Variable temperature option kit
741SC Small gap pick-up coils for 7400-S Series (not compatible with 7400 Series; one included with each 7400-S)
741LC Large gap pick-up coils for 7400-S Series (not compatible with 7400 Series; one included with each 7400-S)

7400 Series Options/Accessories

74032XY Vector option, X and Y coil set for 2 in gap (solled separately for 7400 Series systems)
730ESC 2 in pick-up coils for 7400 Series (not compatible with 7400-S Series)
740EMSC 1 in thin pick-up coils for EM440 Series (not compatible with 7400-S Series)
MMT-6J04-UG-06 4 in Hall probe for EM4, EM7 with 1 and 2 in coils (for 736 controller); replaces 735952 and 735954
MMT-6J06-VG-06 8 in Hall probe for EM10 (for 736 controller); replaces 735958

Additional Accessories

TPS-FRG-100/120V Compact turbo pumping system; includes V-81 turbo pump (NW 40) with oil free dry scroll backing pump, FRG-700 full range gauge, controller, and interface cable to USB port; includes Agilent 24 month warranty NOTE: requires SYS-TP-KIT
TPS-FRG-220/240V-CE Compact turbo pumping system; includes V-81 turbo pump (NW 40) with oil free dry scroll backing pump, FRG-700 full range gauge, controller, and interface cable to USB port; includes Agilent 24 month warranty NOTE: requires SYS-TP-KIT
SYS-TP-KIT Includes all components necessary to connect NW 40 turbo pumping system to the vacuum port of any Lake Shore system (except probe stations)
E2M-110/120V Two-stage rotary vacuum pump with mist filter; 110 to 120 VAC NOTE: requires SYS-RP-KIT
E2M-220/240V Two-stage rotary vacuum pump with mist filter; 220 to 240 VAC NOTE: requires SYS-RP-KIT
SYS-RP-KIT Includes all components necessary to connect E2M rotary pump to the vacuum port of any Lake Shore system (except probe stations)
1220-50 50 L LN₂ Dewar with ½ in top withdraw port and 10 psi pressure relief valve

7400 Series Upgrades

Consult Lake Shore for information on upgrading your VSM system to the latest 7400-S series

Sample Accessories

Unless noted, accessories are compatible with both the 7400-S Series and the previous 7400 Series VSMs.

7404-S/7404 and 7407-S/7407 only
740927 Sample tail kit, fiberglass to Kel-F®, RT, includes 1 each of 740933/4/5 and 730935, and 3 each of 730931/3/4
740928 Sample tail kit, quartz to BN, RT and oven, includes 1 each of 740930/1/2 and 730937
740929 Sample tail kit, fiberglass to Kel-F® and quartz, RT and cryogenic, includes 1 each of 740930/1
740930 One piece quartz sample tail/holder, RT and oven, thin film bottom
740931 One piece quartz sample tail/holder, RT and oven, thin film side
740932 Sample tail only, quartz to BN, oven, used with 730937/8/9 sample holder
740933 3.5 mm air gap, 1-piece fiberglass sample tail/holder, thin film side
740934 3.5 mm air gap, 1-piece fiberglass sample tail/holder, thin film bottom
740935 Sample tail only, fiberglass, used with 730931/3/4/5 sample holder

HMMT-6J04-VR-06 Replacement 4 in Hall probe (7400-S only)

7410-S/7410 only
740939 Sample tail only, quartz to Kel-F®, RT, used with 730931/3/4 sample holder
740940 Sample tail kit, quartz to Kel-F®, RT, includes 1 each of 740937/8/9 and 730935, and 3 each of 730931/3/4
740941 Sample tail kit, quartz tail to BN cup, oven, includes 1 each of 740942 and 730937
740942 Sample tail only, quartz to BN, oven, used with 730937 sample holder
740943 Sample tail kit, fiberglass to Kel-F® and quartz, RT and cryogenic, includes 1 each of 740944/5
740944 1-piece quartz sample tail/holder, RT and oven, thin film bottom
740945 1-piece quartz sample tail/holder, RT and oven, thin film side
740937 3.5 mm air gap, 1-piece quartz sample tail/holder, thin film side
740938 3.5 mm air gap, 1-piece quartz sample tail/holder, thin film bottom

HMMT-6J08-VR-06 Replacement 8 in Hall probe (7400-S only)

7404-S/7404, 7407-S/7407, and 7410-S/7410

730931 Sample holder cup, upper and bottom portion, Kel-F®
730933 Sample holder, thin film side, Kel-F®
730934 Sample holder, thin film bottom, Kel-F®
730935 Sample holder, liquid, upper and bottom portion, Kel-F®
730937 Sample holder, disposable, oven, BN
730938 Sample holder, thin film side, oven, BN
730939 Sample holder, thin film bottom, oven, BN
730940 Ceramic putty for oven sample mount
730907 Test sample sphere, NIST-traceable
730908 Test sample, 99% pure nickel sphere
730909 Test sample, 99% pure nickel 1 mm sphere

Go to www.lakeshore.com for the current list of available recirculating chillers
Lake Shore 7400-S Series
Vibrating Sample Magnetometers and Accessories

7404-S VSM
7407-S VSM
7410-S VSM

Sample Rods and Tails

Options and Accessories