

Model 74034 High Temperature Oven

The high temperature oven assembly enables the Model 7400 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. Temperatures from 30 °C to 1000 °C are also possible, however, below 100 °C 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 mounts to a special isolation mount support structure, the only special consideration being that the air gap between the coils must accommodate the 23 mm (0.9 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. Even at the highest operating temperature the outer case temperature does not exceed 200 °C. 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 inherent sensitivity of the Model 7400 VSM permits Curie temperature determinations at relatively low field intensities. The resulting steeper change in magnetic moment significantly increases the accuracy of the determination.

At room temperature and above, measurements may be performed on samples contained in an air or argon atmosphere. Nonmagnetic mass changes of a sample do not affect the measurement. This is particularly important at high temperatures, where moisture may be driven from a sample.



Specifications

Temperature range: 30 °C to 1000 °C (303 K to 1273 K)

Temperature stability: ± 0.1 K

Temperature resolution: 0.001 K

Ramp rate: 80 °C (353 K) per min at maximum heating rate of 80 W

Bore size: 7.1 mm (0.28 in)

Sample holders: Boron nitride

Powder 3 mm (0.13 in) diameter \times 6.35 mm (0.25 in)

Thin-film bottom 6.35 mm (0.25 in) diameter

Crated size: 82 cm (32.3 in) \times 36.3 cm (14.3 in) \times 30.5 cm (12 in)

Crated weight: 19 kg (42 lb)

Installation: Mounts to isolation support structure included in 740-VTA

Heater: Integral heater coil with a nominal resistance of 20 Ω ($\pm 20\%$)

Power requirements: 0 A to 2.0 A (max) of DC – nominally 70 W is required to maintain maximum rated temperature

Insulation: Vacuum plus multiple reflective radiation shields; outer shell temperature will not exceed 200 °C (392 °F) at highest operating temperature

Temperature sensor: Type K (chromel-alumel) thermocouple, cabled to the system for automatic temperature measurement and control

Sample environment: Open top with side port for flushing argon gas into sample zone

Sample zone dimensions: Inside diameter 7 mm (9/32 in); outside diameter 25 mm (1 in, at signal coils)

Vacuum connection: KF-16 flange

Heater connection: Hermetically sealed electrical receptacle – matching cable furnished with unit

Sample rod: Special sample rod for attachment to standard Model 7400 head by quick-attach threaded fitting – sample rod consists of fused quartz extension with high-purity boron-nitride guides and sample holder

All specifications subject to change

Ordering Information

Model	Description
74034	High temperature oven with quartz sample rod, boron nitride sample holder (bulk or thin film) assembly, and sample space gas control accessories – 740-VTA and vacuum pump ordered separately
740-VTA	Variable temperature kit with Model 340 temperature controller, thermocouple sensor input card, vacuum handling kit with KF-16 flanges, mounting hardware, and accessories
PS-E2M	Rotary vacuum pump with KF-16 inlet for evacuating oven vacuum space to 1.3 Pa (10^{-3} torr)
740936	Quartz sample tail only
730913	Sample rod guide, upper
740937	Disposable oven sample holder cup
740938	Thin film sample holder, side mount
740939	Thin film sample holder, bottom mount

Equipment required for Model 74034 operation

1. Lake Shore Model 740-VTA temperature option kit including temperature controller, thermocouple card, mounting hardware, vacuum handling kit with KF-16 flanges, and accessories
2. A mechanical vacuum pump (Lake Shore PS-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 per 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

More detailed operation requirements on page 3

Model 74018 Variable Temperature Cryostat

The 7400 Series VSM cryostat is designed for rapid sample cooling as well as easy sample insertion and interchange. The sample is suspended in a proprietary insulated tube constructed of nonmagnetic material.

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

The cryostat is designed primarily for use with liquid helium and secondarily for use with liquid nitrogen. 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.



Specifications

Temperature range (K)	
Use with LHe	4.2 K, 6 K to 450 K
Use with LN ₂	77.6 K, 85 K to 450 K
Temperature stability	
Use with LHe	0.1 K
Use with LN ₂	0.2 K
Temperature resolution:	0.001 K
Cool-down time:	5 min (15 min initial cool-down)
Hold time:	Continuous flow
Liquid usage:	<1 L per h when operating >7 K
Insulation:	Vacuum
Vacuum connection:	KF-16 flange
Sample zone dimensions	
Bore size:	7.1 mm (0.28 in)
Outside diameter:	22.4 mm (0.88 in)
Sample zone construction:	Be-Cu tubes
Temperature sensor:	TG-120-SD
Heater:	50 Ω
Power requirements:	0 A to 1.0 A (max) of DC
Crated size	96.5 cm (38 in) × 30.5 cm (12 in) × 188 cm (74 in)
Crated weight	63.5 kg (140 lb)

All specifications subject to change

Equipment required for Model 74018 operation

1. Lake Shore Model 740-VTA temperature option kit, including temperature controller, vacuum handling kit with KF-16 flanges, mounting hardware, and accessories
2. A mechanical vacuum pump (Lake Shore PS-E2M or similar) capable of achieving a pressure below 0.67 Pa (5×10^{-3} torr) and a speed of 1 m³ per h, along with a KF-16 flange pump inlet
3. Access to turbomolecular vacuum pump (Lake Shore PS-EXT70 or similar) capable of doing better than 1.33×10^{-3} 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)

More detailed operation requirements on page 3

Ordering Information

Model	Description
74018	Variable temperature cryostat with cryogen transfer line and cryogen transfer kit (includes Dewar pressure relief valves) – Lake Shore 740-VTA and vacuum pump ordered separately
740-VTA	Variable temperature kit with Model 340 temperature controller, vacuum handling kit with KF-16 flanges, mounting hardware, and accessories
PS-E2M	Rotary vacuum pump with KF-16 inlet for evacuating cryostat vacuum space to 1.3 Pa (10^{-3} torr)
PS-EXT70	Turbomolecular 1.33×10^{-3} Pa (10^{-6} torr) vacuum pump for cryogen transfer line maintenance usage – can also be used in place of the PS-E2M rotary vacuum pump
1220-50	50 L top withdraw LN ₂ storage Dewar with 10 psi pressure relief valve

Detailed Operation Requirements for Model 74034 High Temperature Oven

The Model 74034 requires a Model 340 temperature controller (included in 740-VTA) to control and ramp its sample space temperatures. The oven vacuum space requires a clean vacuum pump capable of achieving a blank off pressure of 0.67 Pa (5×10^{-3} torr). A 2-stage oil-sealed rotary vacuum pump will typically be sufficient. Better results can be obtained with high vacuum systems, such as a turbomolecular pump or a diffusion pump with a cold trap. The pump should be on and connected to the oven vacuum space whenever the sensor indicates an elevated temperature. A foreline trap is included with 740-VTA to prevent oil backstreaming from contaminating and thus destroying the heating element of the oven. In addition, a 2 m (79 in) long vacuum hose and KF-16 flanges are also provided with 740-VTA for the user to connect the oven to its vacuum source. In order to maintain a good vacuum, the length of the vacuum hose should be as short as reasonably possible. The vacuum pump should be positioned next to the magnet. If the pump must be farther away, a rigid metal tube with a diameter greater than 19 mm (0.75 in) should be provided to span the distance between the pump and the vacuum hose. KF-16 type vacuum flanges are used throughout the oven vacuum system. Unless a Lake Shore PS-E2M vacuum pump is ordered with the oven, it is the responsibility of the user to provide a suitable vacuum pump and to verify that it will reach the necessary pressure. This same vacuum pump setup can also be used with our Model 74018 cryostat.

In addition, an argon gas source capable of delivering 100 cm³ per min of gas from 34.5 to 69 kPa (5 to 10 psi; 258.5 to 517 torr) needs to be used to prevent air from getting into the oven sample space. 3 m (10 ft) of 3 mm (0.125 in) ID vinyl hose, fitting for the oven sample space, and flow meter are included with the system.

Detailed Operation Requirements for Model 74018 Variable Temperature Cryostat

1. The room should have a ceiling at least 2.9 m (9.5 ft) high to clear the transfer line and the helium vessel. The vertical inlet of the transfer line plus the elbow is approximately 1.5 m (5 ft) high and most 60 L helium vessels are approximately 1.3 m (4.3 ft) tall. If the user's vessel height varies from this value, then the overall ceiling height requirement must be adjusted accordingly.
2. The cryostat requires a vacuum pump capable of achieving a blank off pressure of 0.67 Pa (5×10^{-3} torr). A 2-stage oil-sealed rotary vacuum pump will typically be sufficient. Better results can be obtained with high vacuum systems, such as a turbomolecular pump or a diffusion pump with a cold trap. A foreline trap is included in the 740-VTA to prevent oil backstreaming from contaminating the cryostat vacuum space. In addition, a 2 m (6.6 ft) long vacuum hose and KF-16 flanges are included with the 740-VTA for the user to connect the cryostat to its vacuum source. In order to maintain a good vacuum, the length of the vacuum hose should be as short as reasonably possible. The vacuum pump should be positioned next to the magnet. If the pump must be farther away, a rigid metal tube with a diameter greater than 19 mm (0.75 in) should be provided to span the distance between the pump and the vacuum hose. KF-16 type vacuum flanges are used throughout the vacuum system. With a clean system, the vacuum space should be pumped for at least 10 min and isolated before cool-down. Unless a Lake Shore PS-E2M vacuum pump is ordered with the cryostat, it is the responsibility of the user to provide a suitable vacuum pump and to verify that it will reach the necessary pressure. This same vacuum pump setup can also be used with the Model 74034 high temperature oven.
3. The user must provide sufficient LHe in a LHe storage vessel with a 4 psi relief valve. The vessel should have a top withdraw fitting to accept the 12.7 mm (0.5 in) diameter transfer line furnished with the Model 74018 cryostat. The Dewar needs to stay with the cryostat through the operation. Local cryogenic fluid suppliers usually furnish these 30 L or 60 L vessels with liquid helium orders. It is the responsibility of the user to provide cryogens and a suitable vessel, such as the Cryofab Model CMSH-60 with 4 psi (instead of standard 10 psi) working pressure modification. To accommodate vessels with 10 psi pressure setting, a 4 psi relief valve with a 3/8 male NPT thread and adaptors to a 1/2 NPT female thread are provided for connecting the relief valve to the vent port of most helium vessels.
4. A gas cylinder and regulator capable of delivering clean, dry helium gas at controlled low pressure. The gauge regulator should be capable of measuring and delivering pressures from 1 to 5 psi to assist LHe delivery to the cryostat when needed. In addition, the necessary hose and fittings to connect between the regulator on the gas cylinder and the LHe storage vessel vent port are required.
5. In order to use the cryostat with LN₂, a similar low pressure top withdraw LN₂ storage vessel with a 10 psi relief valve should be used instead of the LHe vessel mentioned above. It is the responsibility of the user to provide cryogens and a suitable vessel, such as the Lake Shore Model 1220-50 LN₂ storage Dewar. The user can also obtain a Cryofab Model CL50 with 10 psi (instead of standard 25 psi) working pressure modification. To accommodate vessels with 25 psi pressure setting, a 10 psi relief valve with a 3/8 male NPT thread and an adaptor coupling to a 1/4 male NPT thread are provided for the change over. In these cases, the Dewar manufacturer must be consulted before any modifications are undertaken by the customer.