Spectrometer Safety Guide

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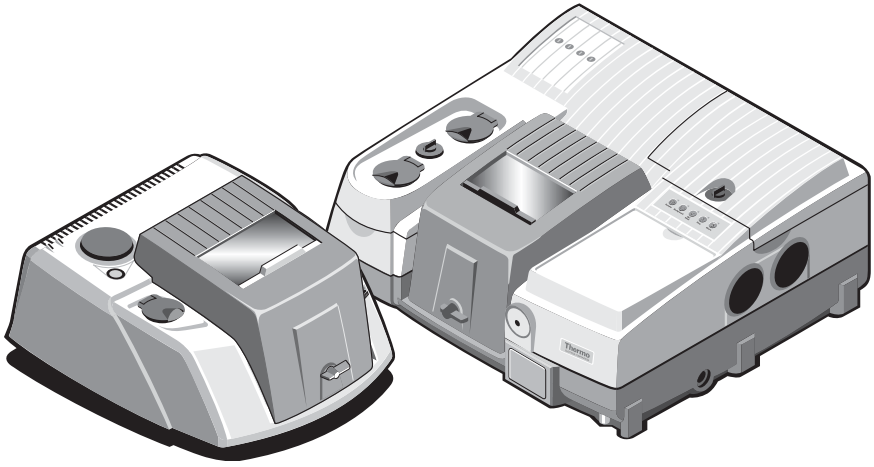
269-169600

Contents

Operating Your Spectrometer Safely

This *Spectrometer Safety Guide* contains a summary of the safety precautions that must be followed when using Nicolet™ FT-IR spectrometers.



Each person who will be using these instruments should read this manual. Safety information is also included in your spectrometer, accessory, computer, and software manuals.

In many cases, safety information is displayed on the spectrometer itself. The illustrations "Safety Labels" chapter show the locations of the safety labels. Should any of these labels become loose or unreadable, Thermo Electron will supply new ones. Spectrometer Help Topics, available through the OMNIC Help menu, contains information about obtaining replacement labels.

Conventions used in this manual

This manual includes safety precautions and other important information presented in the following format:

Note Notes contain helpful supplementary information. ▲

Important Follow instructions labeled "Important" to avoid damaging the system hardware or losing data. ▲

⚠ Caution Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. ▲

⚠ Warning Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. ▲

⚠ Danger Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. ▲

Questions or concerns

In case of emergency, follow the procedures established by your facility. If you have questions or concerns about safety or need assistance with operation, repairs or replacement parts, use the information below to contact Thermo Electron. Outside the U.S.A., contact the local Thermo Electron sales or service representative.

Phone: 1 800 642 6538 (U.S.A.) or
+1 608 273 5015 (worldwide)
Fax: +1 608 273 5045 (worldwide)
E-mail: techsupport.analyze@thermo.com
World Wide Web: http://www.thermo.com/spectroscopy

General safety information

Each Thermo Electron spectrometer and accessory is designed to comply with domestic and international safety regulations and applicable product standards. The table that follows lists each of the spectrometer models and the regulations and product standards that apply to each.

Check the *Declaration of Conformity* that came with your instrument for specific information about conformity with particular directives and standards. The regulatory organizations are described here.

CE (Conformité Européenne) — The CE mark indicates compliance with the European Union's applicable New Approach Directives. The CE mark is a self declaration and self marking process. Once a manufacturer has proven that the particular equipment meets the requirements of the CE and has collected supporting data, that equipment may be marked with the CE.

ETL (ETL SEMKO, a division of Intertek Testing Services) — ETL SEMKO is an OSHA accredited Nationally Recognized Testing Laboratory (NRTL), a Standards Council of Canada (SCC) accredited Testing Organization and Certification Organization, an IECEE accredited National Certification Body, and a Notified Body for Europe that provides testing and certification services for the products. The ETL symbol indicates that the instrument has been inspected and approved by an independent testing laboratory.

GS (Geprüfte Sicherheit) — The GS mark indicates the device is in compliance with the judicial requirements of the German Device Safety Act or the currently accepted rules of technology, as well as the work protection and accident prevention regulations. In particular, compliance with paragraph 3 of the Device Safety Act is indicated by the mark.

Model	*Regulations and product standards*
Nicolet 380 Nicolet 4700 Nicolet 5700 Nicolet 6700	• UL 61010-1 (2004) Electrical equipment for laboratory use. Part 1: general requirements. - Installation category II - Pollution degree 2 • CSA C22.2 No. 1010 (1992) Safety requirements for electrical equipment for measurement, control, and laboratory use • 73/23/EEC (1973) Low voltage directive - EN 61010-1 (2001) and A2 (1995) Safety requirements for electrical equipment for measurement, control, and laboratory use • 89/336/EEC (1989) EMC Directive • EN 61326-1 (1977) and A/(1998)Electrical equipment for measurement, control, and laboratory use – EMC requirements • EN 60825-1 (2001) Class 1; Safety of laser products • U.S. 21CFR 1040.10Class I; Safety of laser products with Laser Notice No. 50 dated July 26, 2001

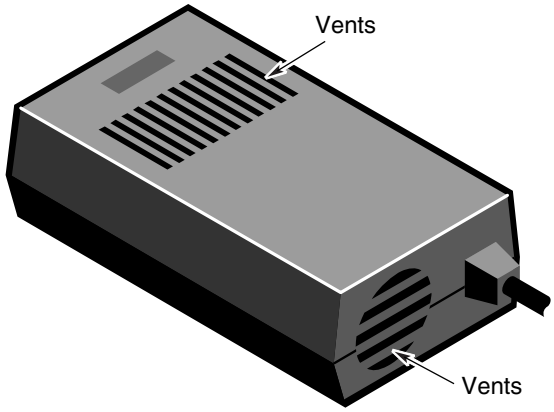
Model	*Regulations and product standards*
Nicolet 8700	• UL 3101-1 (1993) Electrical equipment for laboratory use Part 1: general requirements. Installation category II) (Pollution degree 2), • CSA C22.2 No. 1010 (1992) Safety requirements for electrical equipment for measurement, control, and laboratory use • 73/23/EEC (1973) Low voltage directive - EN 61010-1 (1993) Safety requirements for electrical equipment for measurement, control, and laboratory use • 89/336/EEC (1989) EMC Directive - EN50081-1 Generic emissions standard for residential, commercial and light industrial products - CISPR 11 (Class B) Limits and methods of electromagnetic disturbance characteristics of industrial, scientific, and medical (ISM) radio frequency equipment. - EN50082-1 Generic immunity standards for residential, commercial, and light industrial products - IEC 801-2 Electrostatic discharge requirements - IEC 801-3 Radiated electromagnetic field requirements - IEC 801-4 Electrical fast transient/burst requirements • EN 60825-1 (1994) Class 1; Safety of laser products • U.S. 21CFR 1040.10C lass I; Safety of laser products with Laser Notice No. 50 dated July 26, 2001

Fire safety and burn hazards

The following symbols appear inside the spectrometer to warn you about hot surfaces in the vicinity of the symbol.

To avoid a burn injury and the risk of fire or explosion, follow these guidelines:

- Do not test flammable or explosive samples.
- Use only nitrogen or dried air to purge your spectrometer and accessories.
- Do not touch the infrared source housing; it may be very hot.
- Do not place anything on the electronics cover of a Nicolet 380 spectrometer.
- After you turn off your spectrometer, wait 15 minutes before you replace components.
- Never block any of the vents on a spectrometer or the power supply for a spectrometer.
- Use exact replacements for bulbs, fuses and power supplies.



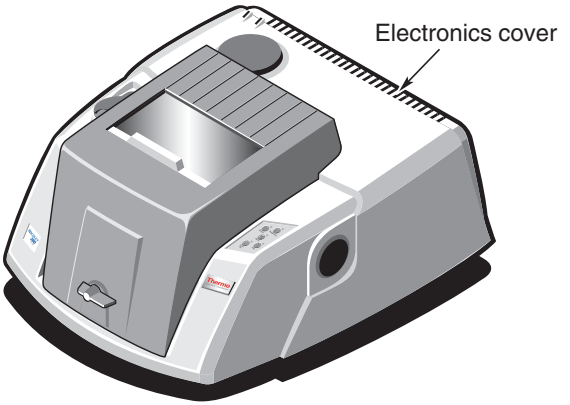
Nicolet FT-IR spectrometer power supply vent locations

The following Cautions and Warnings provide additional information about fire safety and preventing burn hazards.

⚠ Caution In FT-IR systems, the infrared source housing may be very hot. It stays hot for up to 15 minutes after you turn off your spectrometer. To avoid being burned or starting a fire, do not touch the housing with your body or any flammable object until it has cooled. Your system user's guide and on-line *Spectrometer Tour* show the location of the infrared source inside your spectrometer. ▲

⚠ Danger Never use a flammable gas to purge a spectrometer. The purge gas must be free of oil and other reactive materials. Heat from the source or from laser absorption may ignite flammable gasses or reactive materials in purge gas. ▲

⚠ Caution Do not place anything on top of the electronics cover of a Nicolet 380 spectrometer. Electronic components under the cover can become overheated if items are placed on the cover. The illustration below shows the location of the spectrometer electronics cover. ▲



Nicolet 380

Environmental conditions

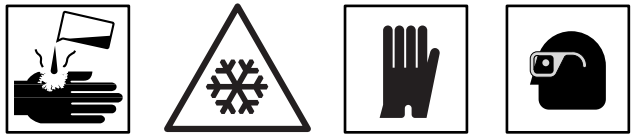
Thermo Electron spectrometers and accessories are designed for indoor use at altitudes up to 2,000 meters (6,500 feet).

They operate reliably at temperatures between 16 and 27 °C (60 and 80 °F). They may briefly be exposed to temperatures as low as -10 °C (for example, during transport) without degradation of its safety. Temperature changes may result in drift in the system response.

FT-IR and FT-NIR spectrometers must be protected from excessive humidity, since the beamsplitters, detectors, and other components may corrode with exposure to moisture. Maintain humidity in the range of 20% to 80% noncondensing. To accomplish this, some spectrometers are sealed and desiccated; other spectrometers require purging.

Using liquid nitrogen

Some detectors must be cooled with liquid nitrogen before use. The following symbols remind you to wear protective clothing when using liquid nitrogen.



⚠ Warning Liquid nitrogen is extremely cold and therefore potentially hazardous. When filling the detector dewar, be careful not to contact the liquid nitrogen with your skin. Wear protective gloves and splash-proof goggles and follow standard laboratory safety practices. ▲

⚠ Warning To avoid hazardous equipment damage or contact with liquid nitrogen, make sure any dewar or container you use to hold liquid nitrogen can do so safely without breaking. ▲

Cleaning the spectrometer

If the outside of the spectrometer needs cleaning, turn off the power and disconnect the power cord. Then use a damp (not wet), soft cloth and a mild soap to clean the outside of the spectrometer. Do not use harsh detergents, solvents, chemicals or abrasives; these can damage the finish.

⚠ Warning Avoid shock hazard. Do not allow liquid to run into the power supply. Also, do not allow liquids to run down the windows in the sample compartment walls. ▲

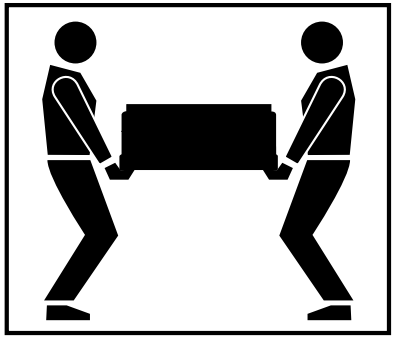
Important Do not use harsh detergents, solvents, chemicals or abrasives; these can damage the finish. Never allow a liquid to flow into the spectrometer vents, and to avoid damaging port windows, do not allow liquid to run down to these windows. ▲

Important Do not attempt to clean or even touch the mirror surfaces. The mirrors in your spectrometer are front surfaced and can be easily scratched. Dust will not harm the infrared signal, but fingerprints can degrade spectral performance or permanently damage the mirrors. If you feel it is necessary, remove dust with a gentle stream of clean air or nitrogen. Use purge air only for cleaning mirrors; commercially prepared canned air contains contaminants that can damage the mirror surface or interfere with spectral data. ▲

Lifting or moving the spectrometer

Thermo Electron spectrometers weigh between 24 kg (53 lb) and 64 kg (140 lb). To avoid risk of injury, use proper lifting techniques when lifting or moving the spectrometer or other system components.

⚠ Caution Nicolet FT-IR spectrometers cannot be lifted safely by a single person. Lifting or moving a Nicolet FT-IR spectrometer requires two people. Be sure to use the handholds on the sides of the spectrometer. ▲



Biohazard or radioactive materials and infectious agents

Instruments, accessories, components or other associated materials *may not* be returned to Thermo Electron or other accessory manufacturers if they are contaminated with biohazard or radioactive materials, infectious agents, or any other materials and/or conditions that could constitute a health or injury hazard to employees.

Contact technical support if you have questions about decontamination requirements.

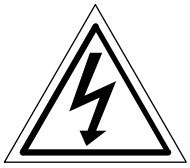
Safety labeling

In many cases, safety information is displayed on the instrument itself. The illustrations at the end of this manual show the locations of the safety labels. Should any of these labels become loose or unreadable, Thermo Electron will supply new ones. The Ordering Parts help book in Spectrometer Help Topics, or the parts list that came with your spectrometer or accessory, contains information about obtaining replacement labels.

If you see this symbol on the spectrometer or on an accessory, be sure to read the safety label and check the information in the documentation that came with the instrument or accessory. The symbol indicates that there is additional information in the documentation.

Electrical Safety

Your spectrometer, computer, and accessories were designed with protective covers to prevent exposure to dangerous voltage and other electrical hazards. If you see either of the following symbols on your spectrometer, there is a risk of electric shock in the vicinity of the symbol.



⚠ Warning Only qualified Thermo Electron service representatives should attempt to service a component that carries either of these symbols. ▲

⚠ Warning If a protective cover on the spectrometer, computer, or monitor appears damaged, turn off the system and secure it against any unintended operation. Always examine the protective cover for transport stresses after shipping. ▲

⚠ Warning Even after the spectrometer has been disconnected from all voltage sources, capacitors may remain charged for up to 30 seconds and can cause an electrical shock. ▲

You may also see one or more symbols on or near switches and connectors on your spectrometer. These symbols are often used to identify connectors or help you to locate user-replaceable fuses.

The table that follows shows the symbols and lists the meaning of each. Check the documentation that came with your spectrometer if you find a symbol that is not included in the table.

Symbol	*Description*
	Alternating current
	Earth terminal or ground
	Protective conductor terminal
	Fuse
	Power on
	Power off
	To prevent injury, refer to the accompanying documentation

Powering up

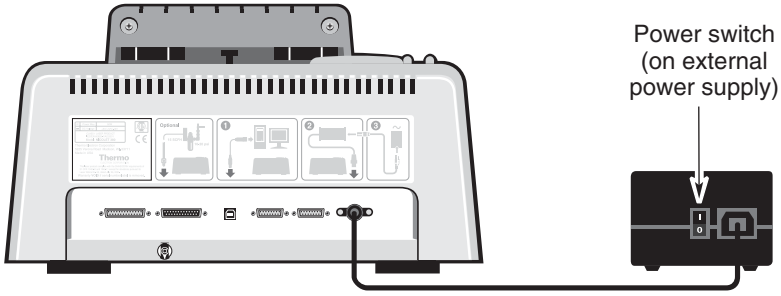
To turn on the spectrometer, press the power switch:

I = on
O = off

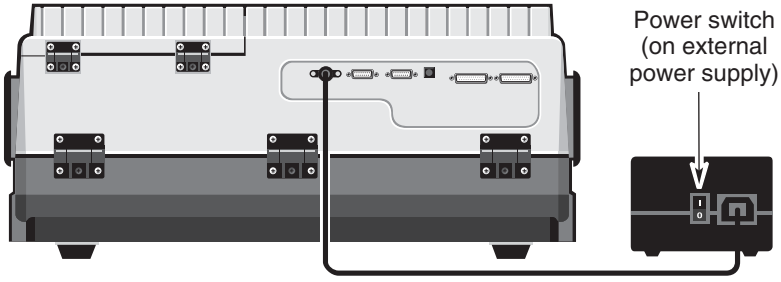
The illustrations on the next page show the location of the power switch on many Thermo Electron spectrometers.

Note For information about powering up your computer, refer to the documentation that came with the computer. ▲

⚠ Warning Do not operate a spectrometer or an accessory without following the safety precautions described in this manual and the documentation that came with your spectrometer. ▲



Nicolet 380



Nexus 4700/5700/6700/8700

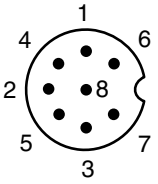
Power supplies

Many Thermo Electron instruments and accessories, including the Nicolet FT-IR spectrometers, are powered by external power supplies. Others may have power supplies built into the instrument.

⚠ Danger To avoid injury, only a qualified person using the appropriate measuring device should check the line voltage, current and frequency. ▲

Specifications and connections

The power supply used with Nicolet FT-IR spectrometers accepts a variety of AC power sources. The power supply adjusts automatically and maintains a consistent VDC output. The following illustration shows the DC power cable connector and lists the output voltage on each pin in the connector.



Pin	*Output*
1	DC common
2	-12 VDC
3	+ 5 VDC
4	- 5 VDC
5	+12 VDC
6	DC common
7	+ 5 VDC
8	Not connected

Connecting an external power supply

To connect an external power supply:

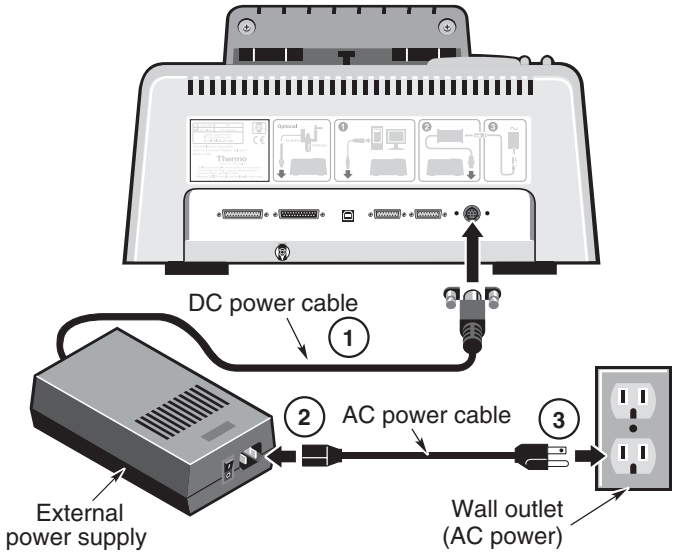
⚠ Caution Be sure the power switch is in the off (O) position before you connect the power supply to your spectrometer. ▲

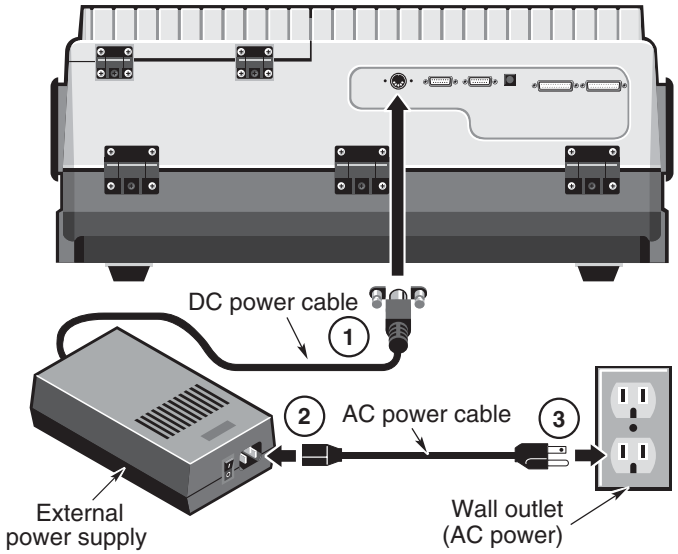
1. **Connect the DC power cable to the spectrometer.**

   Tighten the screws to secure the connection.

2. **Connect the AC power cable to the external power supply.**

3. **Connect the AC power cable to AC power source.**


DC power cable
1
2
AC power cable
3
External
power supply
Wall outlet
(AC power)


DC power cable
1
2
AC power cable
3
External
power supply
Wall outlet
(AC power)

Fuses

The Nicolet FT-IR spectrometers are protected by two 2 A, time-lag (also known as T-type or slow-blow) fuses that are built into the external power supply. The fuses for these spectrometers are not individually replaceable. If the fuses blow, you must replace the power supply.

Electrical service

Check the line voltage and frequency of the wall outlet that will be used for the spectrometer *before* you connect the instrument or turn on the power. This should be done when the system is installed and any time the system is plugged into a different wall outlet.

⚠ Danger To avoid injury, only a qualified person using the appropriate measuring device should check the line voltage, current and line frequency. ▲

Input voltages: 100 – 240 VAC

Line frequencies: 50 – 60 Hz

In addition to meeting the input voltage and line frequency requirements, your electrical service must also be stable. The following table provides the specifications for line disturbances and noise.

Characteristic	*Specification*
Line disturbances	Sags, surges, or other line disturbances must not exceed 10% of input voltage (even for a half cycle)
Noise	less than 2 volts (common mode) less than 20 volts (normal mode)

If you are not sure that your electrical service meets these requirements, contact technical support for information about a power line audit.

Grounding

Each wall outlet you use must be equipped with a 3-wire line: live, neutral, and ground. The ground must be a non-current-carrying wire connected to earth ground at the main distribution box. To assure a good ground connection and avoid shock hazard, do not use an outlet that has ground connected to a conduit ground.

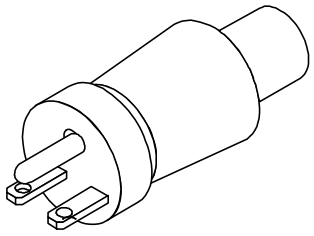
⚠ Warning Do not disconnect protective earth terminals inside the spectrometer when the power is on. Doing so would create a shock hazard.°▲

Power cords

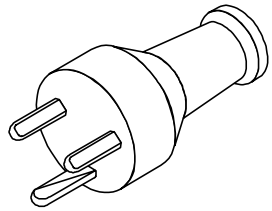
You must be sure to use an appropriate power cord for the electrical service. The power cord supplied with the spectrometer is a 3-wire, grounded power cord, appropriate for use in the country listed as the shipping destination for the spectrometer. If the power cord you received is not appropriate for the electrical system in your location, contact Thermo Electron Technical Support and order a new power cord. The illustrations on the next page show the power cord styles that are available from Thermo Electron.

If the power cord becomes damaged, replace it. Contact Technical Support or your local Thermo Electron office if you need additional information about replacement cord or extension cord specifications.

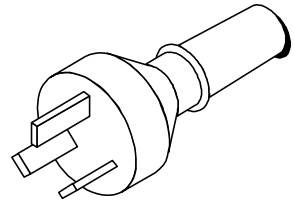
⚠ Warning To prevent electrical hazards, do not remove or defeat the ground prong on the power cord, and do not use any cords that are frayed or damaged. If you use an extension cord, it also must have a protective conductor. ◦▲



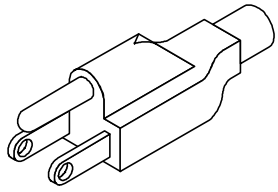
North American 220 Volt
Plug Style: NEMA 6-15



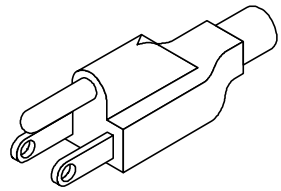
Danish style
Plug Style: Afsnit 107-2-01



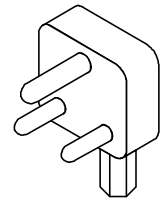
Australian style
Plug Style: AS 3112



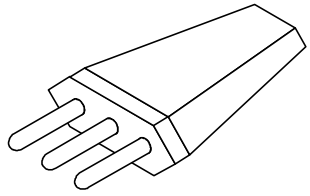
North American grounded plug
Plug Style: NEMA 5-15



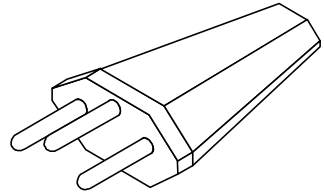
Japanese style
Plug Style: JIS 8303



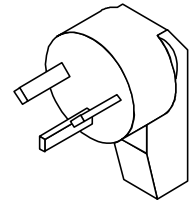
Indian, South African,
old British style
Plug Style: BS 546



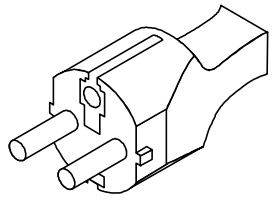
Italian style
Plug Style: CEI 23-16/VII



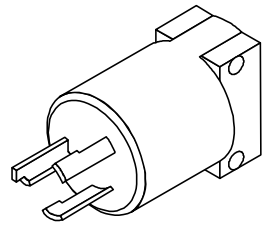
Swiss style
Plug Style: SEV 1011



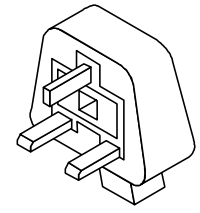
Israeli style
Plug Style: SI 32



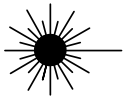
Continental Europe style
or Schuko
Plug Style: CEE7/7



North American
220 Volt locking
Plug Style: NEMA L6-15



British style or
United Kingdom style
Plug Style: BS 1363
with a 13 amp fuse



Laser Safety

The spectrometer is a laser product. The laser source in FT-IR and FT-NIR spectrometers is a helium neon (HeNe) laser head.

⚠ Warning Never stare into the laser beam or at its bright reflection. Never tamper with the laser head, even if you are replacing a defective laser. Exposure to laser light or high voltage may result. ▲

The United States Department of Health and Human Services warns against improper laser use, as follows:

⚠ Warning Use of controls or adjustments or performance of procedures other than those specified in your user's guide and on-line tutorials may result in hazardous radiation exposure. Class 3R laser light inside. ▲

Protective housing

A protective housing covers each spectrometer and accessory. More than 80 percent of the laser light is lost as it passes through Nicolet spectrometer optics. For these spectrometers, the accessible laser radiation in the sample compartment is very low, with less than 10 µW of continuous power.

For Nicolet FT-IR spectrometers, less than 0.39 mW of laser light is accessible during normal use and maintenance. Class I laser products (FDA-CDRH and IEC 60825-1:2001) are inherently safe. Virtually no laser radiation reaches the sample compartment.

The laser light inside these spectrometers' covers is in a horizontal plane. When you look through the sample compartment window, it is impossible to stare into the beam.

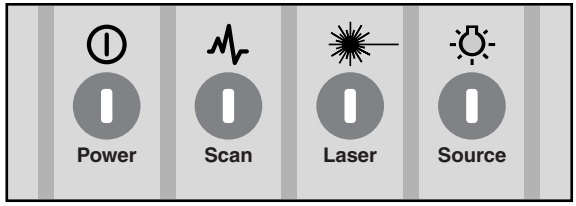
Laser emissions

The accessible radiation levels are below limits defined by the United States Department of Health and Human Services. The following table lists each spectrometer model and indicates which laser class regulations apply in the U.S.A. and internationally.

Model	*Laser class (U.S.A.)*	*Laser class (international)*
Nicolet 380	Class I	Class I
Nicolet 4700	Class I	Class I
Nicolet 5700	Class I	Class I
Nicolet 6700	Class I	Class I
Nicolet 8700	Class I	Class I

Laser emission indicator

The laser emission indicator is on the front panel of Nicolet FT-IR spectrometers. Nicolet 380 spectrometers do not have a separate laser indicator; whenever the power is on, the laser is on. The laser indicator lights whenever the laser is turned on; if laser power fails, the indicator light turns off.



Nicolet FT-IR laser indicator

Manufacturer's laser information

In some jurisdictions you may be required to register the spectrometer; check with your company's safety officer or your local government offices. The following is an excerpt from the laser manufacturer's manual regarding the information that might be needed for registration.

Laser	*Characteristic*	*Specification*
633 nm reference	manufacturer	Melles Griot
(red laser)	type of laser	helium/neon (HeNe)
	wavelength	632.8 nm
	minimum power	0.9 mW (TEM_{00})
	nominal power	1.0 mW*
	maximum power	1.6 mW*
	beam diameter	0.65 cm* ($1/e^2$)
	beam divergence	3.0 mrad
	spacing C/2L	1039 MHz
	operating voltage	1700 ± 100 VDC
	CDRH classification	Class 3R

* At output of laser head reduced with fixed neutral density filter to 150 µW.

Corrosives, Solvents, and Purge Gas

Many standard spectroscopy methods are based on the use of solvents. Sample materials dissolved in solvents can be measured using your spectrometer, but special precautions must be taken.

Purge gas

FT-IR and FT-NIR spectrometers contain precise optical components that may be damaged by corrosives, solvents, or a moist environment.

Important Optical damage caused by failure to purge the spectrometer is not covered by warranty. ▲

If your FT-IR or FT-NIR spectrometer is not sealed and desiccated, you must add a source of dry air or nitrogen to purge the system of moisture. This requirement and other purge cautions are described on labels inside the spectrometer sample compartment. For best results the purge gas should be dried to a dew point of -70 °C (-94 °F) or below.

⚠ Danger Never use a flammable gas to purge a spectrometer. Heat from the source or from laser absorption could ignite the gas. The purge gas must be free of moisture, oil and other reactive materials. Use dried air or nitrogen to purge the instrument. Other gasses, even inert gasses such as argon (AR), can damage the spectrometer. ▲

Caustic or corrosive agents

Spectrometer components may be degraded by exposure to caustic or corrosive agents or their vapors. To maintain the spectrometer in safe working condition, do not use caustic agents.

Important Damage due to pyrolysis of halogenated hydrocarbons and/or exposure to other corrosive or caustic agents is not covered by warranty. ▲

Volatile solvents

If you use volatile solvents regularly, follow these guidelines.

- Do not leave exposed solvent in the sample compartment for longer than necessary.
- Work with the sample compartment cover open. For most infrared and near-infrared applications, it is not necessary to close the sample compartment cover.
- Do not leave the solvents near the instrument.
- If possible, purge the sample compartment.
- Be sure that your work space is properly ventilated.

These measures will help prolong the life of your instrument and will eliminate the possibility of spectral interference caused by volatile solvent vapors.

Solvents containing halogenated hydrocarbons

Chlorinated solvents, perfluorochlorinated solvents, and other solvents containing halogenated hydrocarbons are often used as sample solvents. The pyrolysis of these solvents by an infrared source or by excessive heating caused by laser absorption may produce hydrochloric acid (HCl), hydrofluoric acid (HF), phosgene ($COCl_2$), or other hazardous compounds.

Materials such as hydrochloric acid and hydrofluoric acid are highly corrosive and may cause accelerated corrosion of the metallic and optical components in the spectrometer. Damage will be caused in any spectrometer, if the concentration level of corrosive gasses in the air is excessively high due to improper sampling techniques.

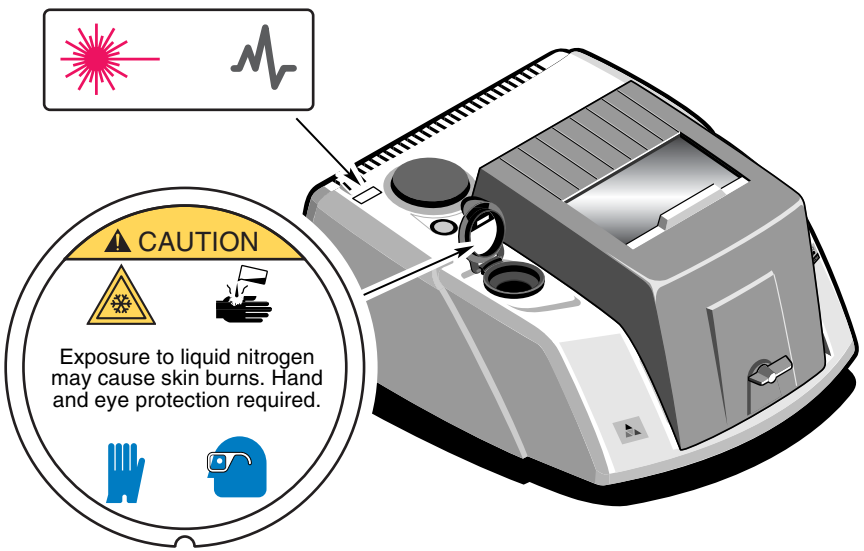
⚠ Warning Materials such as hydrochloric acid, hydrofluoric acid and phosgene are highly toxic. If you regularly use solvents containing halogenated hydrocarbons, be sure your work area is properly ventilated. ▲

Important Solvents containing halogenated hydrocarbons left in the sample compartment for an extended time will damage the spectrometer optical components. Systems used regularly to sample halogenated hydrocarbons must contain a sealed source and be purged while the solvents are in use. Damage due to pyrolysis of halogenated hydrocarbons and/or exposure to other corrosive or caustic agents is not covered by warranty. ▲

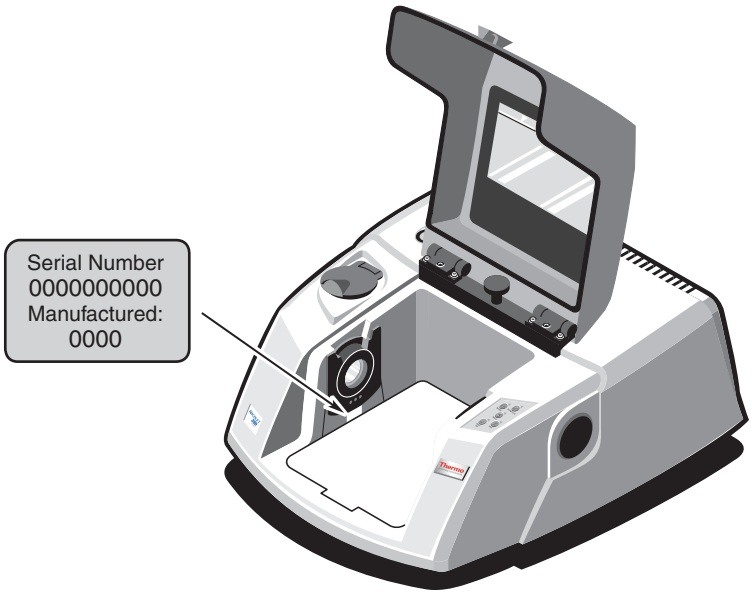
Safety Labels

The illustrations in this section show the locations of the safety labels attached to the spectrometer. In some of the illustrations, covers have been removed to show the label locations. Should any labels come loose or become unreadable, Thermo Electron will supply new ones. The Ordering Parts help book in Spectrometer Help Topics, or the parts list that came with your spectrometer, contains ordering information.

Nicolet 380

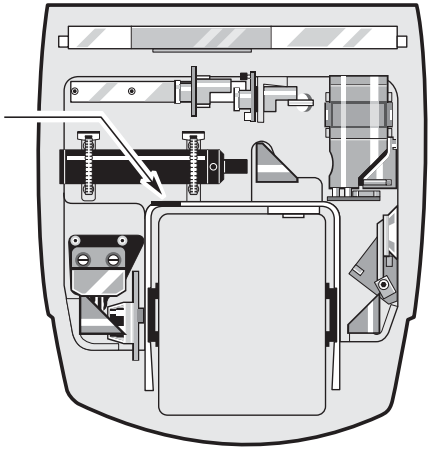


Top view Nicolet 380 with MCT detector

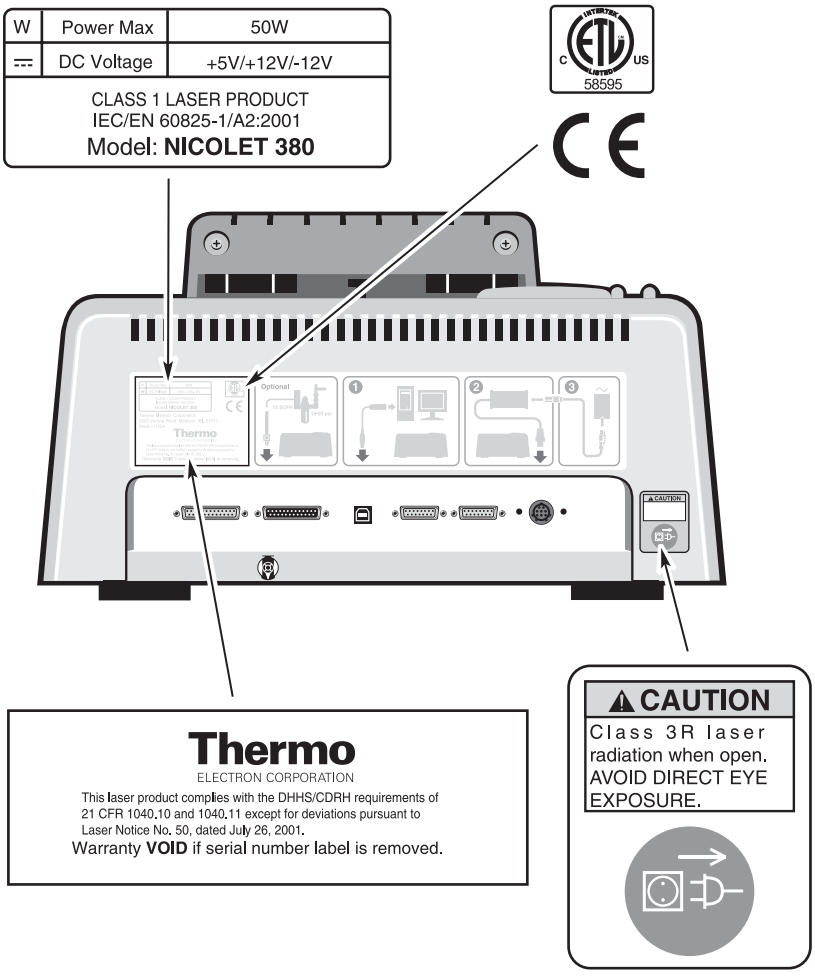


Top viewNicolet 380

W	Power Max	50W
⎓	DC Voltage	+5V/+12V/-12V
CLASS 1 LASER PRODUCT IEC/EN 60825-1/A2:2001 Model: **NICOLET 380**		



Inside view Nicolet 380

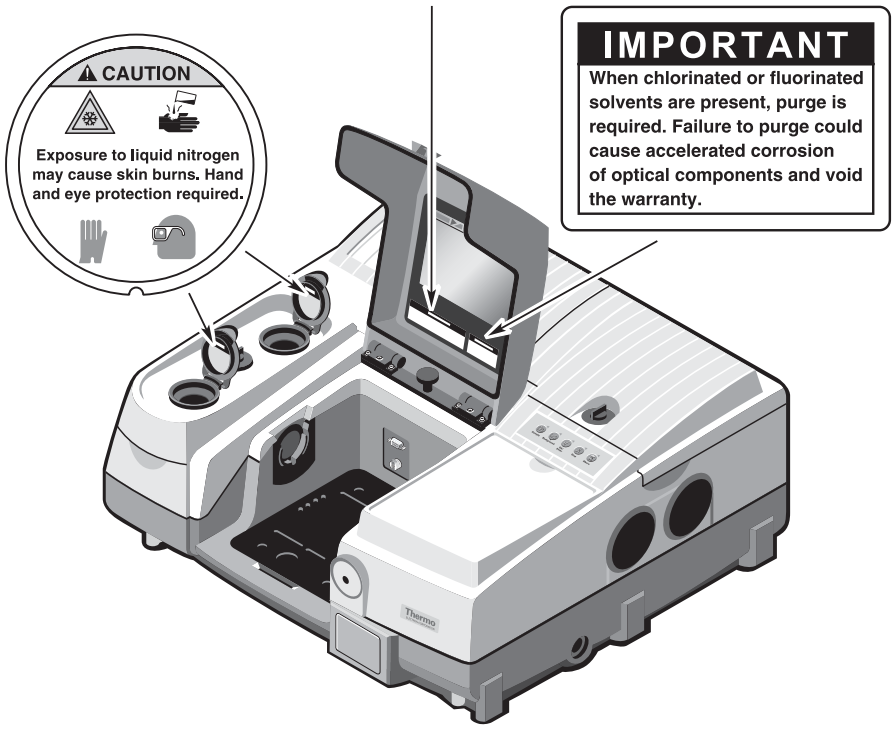


Rear view Nicolet 380

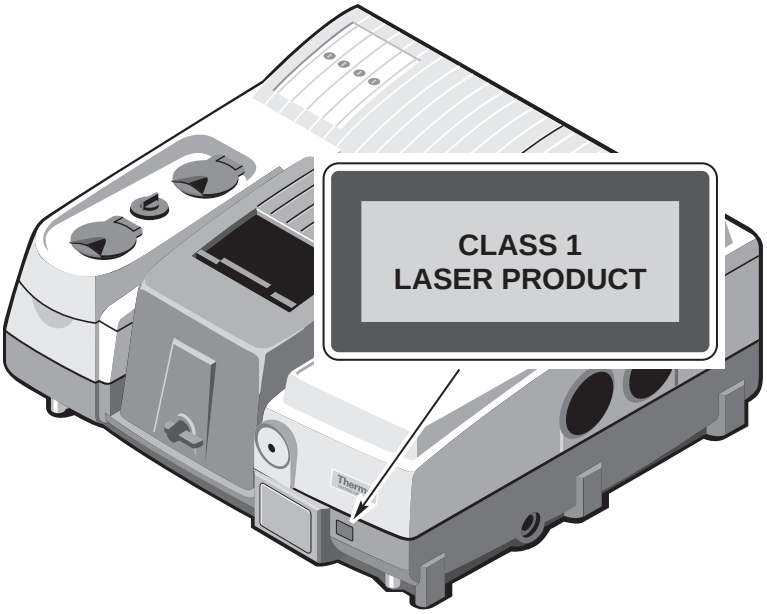
Nicolet 4700

IMPORTANT

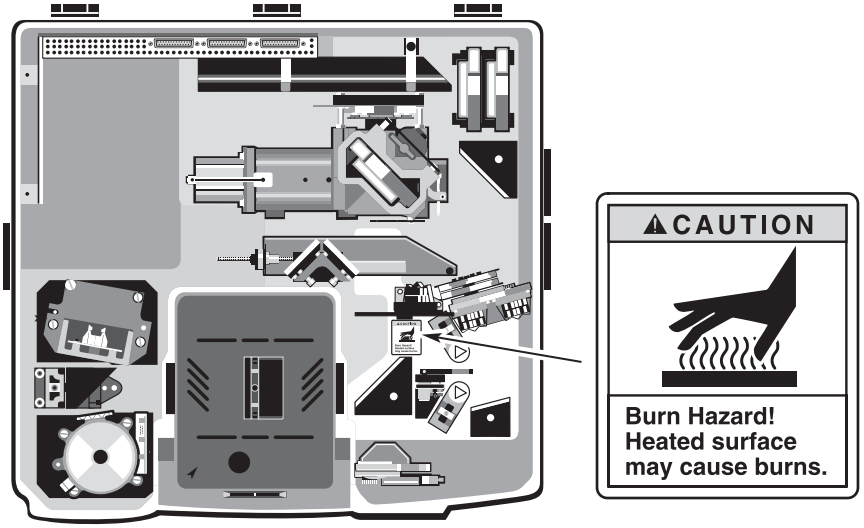
This unit contains precision optical components that may be damaged by a moist environment. Purge or sealed and desiccated option is required. Purge gas supplied to this unit should be dried to a dewpoint of -70˚C or below. Desiccant activity must be checked regularly and new desiccant added as required. Damage to internal optical or mechanical components caused by the introduction of moisture, other foreign matter, or failure to maintain desiccant may void the warranty.



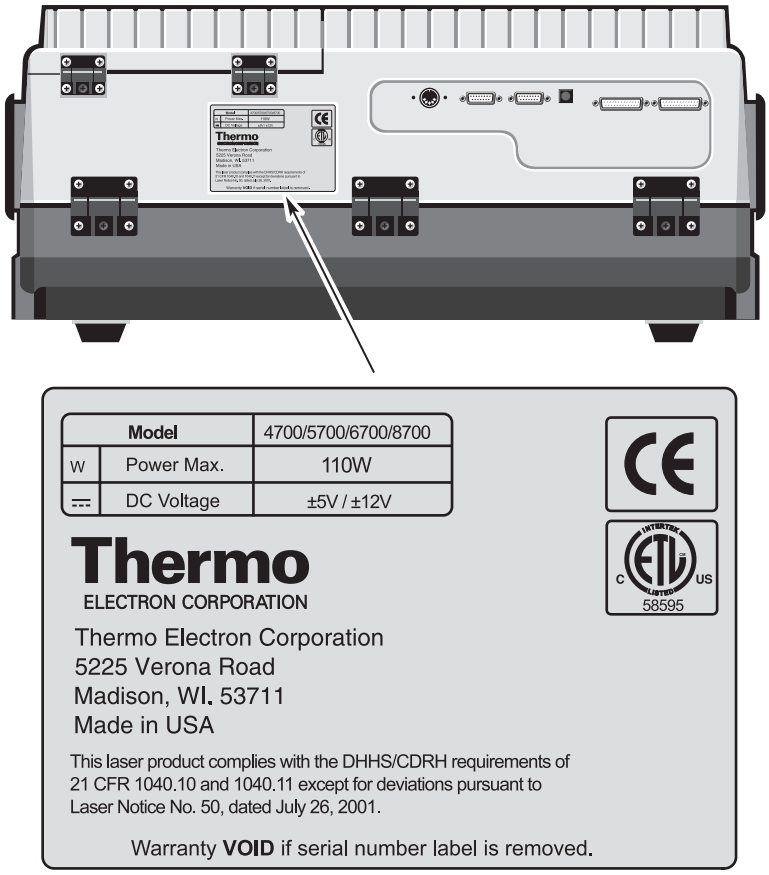
Front view Nicolet 4700



Front view Nicolet 4700



Inside view Nicolet 4700

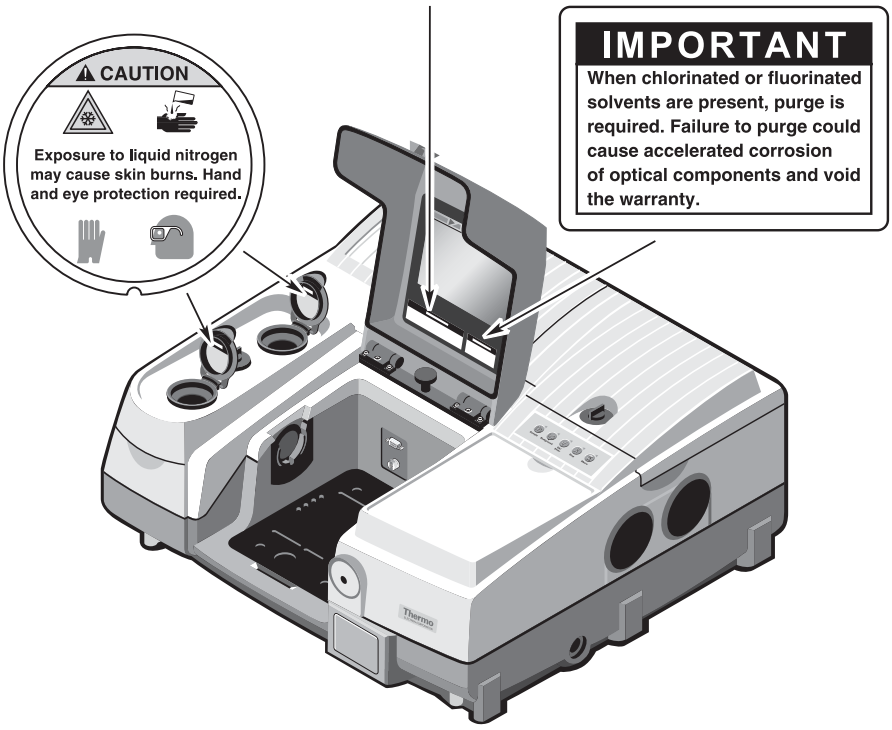


Rear view Nicolet 4700

Nicolet 5700, 6700 and 8700

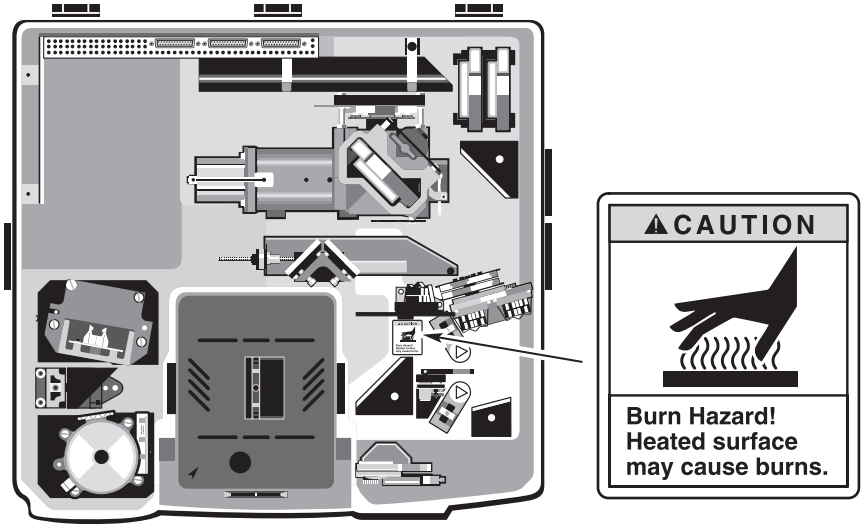
IMPORTANT

This unit contains precision optical components that may be damaged by a moist environment. Purge or sealed and desiccated option is required. Purge gas supplied to this unit should be dried to a dewpoint of -70˚C or below. Desiccant activity must be checked regularly and new desiccant added as required. Damage to internal optical or mechanical components caused by the introduction of moisture, other foreign matter, or failure to maintain desiccant may void the warranty.

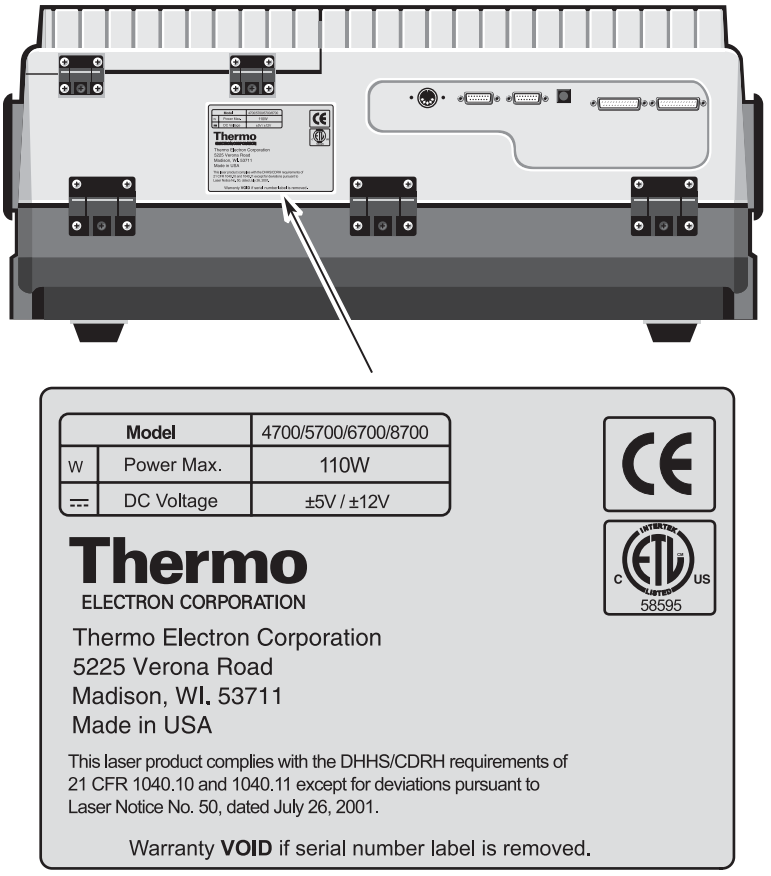


Front view Nicolet 5700, 6700 and 8700

Front view Nicolet 5700, 6700 and 8700



Inside view Nicolet 5700, 6700 and 8700



Rear view Nicolet 5700, 6700 and 8700