LABORATORY PREPARATION

Preparing Your Laboratory for PerkinElmer Atomic Absorption Spectrometers

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This document gives detailed instructions regarding the space, accessories and utilities required to operate PerkinElmer atomic absorption (AA) spectrometers, THGA and HGA graphite furnace systems, and other major AA accessories.

PerkinElmer atomic absorption instruments are complete systems with the exception of the following items which must be provided by the analyst: suitable working area; exhaust vent(s); gases and regulators and light sources. When a THGA or HGA graphite furnace system is being used, additional items may be required, which are described in Section 8. General information on each of the required items is given in the appropriate section of this brochure as indicated below.

1 Suitable Working Area

The environment in which any instrument is housed is an important consideration. The room temperature should be between 15 and 35 °C (59-95 °F) with a maximum rate of change of 3 °C (5 °F) per hour. The relative humidity should be between 20 and 80%, non-condensing.

A relatively dust-free environment is necessary. This is especially important when working with ultra-trace techniques, such as graphite furnace sampling. Other important considerations are to locate the instrument in an area free of corrosive fumes and vibration and in an area that does not receive direct sunlight.

Atomic absorption spectrometer systems are normally installed on laboratory work benches or tables. The benchtop or area in which the atomic absorption instrument is to be installed should be large enough to accommodate the instrument and all accessories. (Dimensions of those items are given in Section 10.) Make sure that there is space at the rear and sides of the system for air to circulate freely. Do not block the fan operating on the back or rear of the instrument. The back of the instrument should not be placed permanently against a wall, as the instrument must be accessible from the back for servicing purposes. An accessible space of at least 60 cm (24 in.) should be available behind the instrument. If this is not possible, the table or bench on which the instrument is mounted should be on wheels so that it can be easily moved.

A means of electrically grounding the instrument and all accessories must be available.

Atomic Absorption System Layout. In addition to the basic requirements for atomic spectroscopy systems, preparation of your laboratory for atomic absorption (AA) spectrometers equipped with graphite furnaces requires that consideration be given to the installation needs of the furnace power supply when it is not built into the spectrometer. For example, an AAnalyst™ 400 system with an HGA 900 graphite furnace typically includes the HGA 900 power supply, the HGA 900 furnace, an AS-800 autosampler, the AAnalyst 400 AA spectrometer and the system computer and printer.

WARNING: The use of atomic absorption instruments without adequate ventilation to outside air may constitute a health hazard. For example, the combustion of halogenated hydrocarbons produces toxic vapors. Extreme care should be taken that exhaust gases are vented properly.

The HGA 900 furnace power supply mounts to the left side of the AAnalyst 400 spectrometer. The system computer may be positioned on the bench next to the instrument or on a separate computer table in front of the instrument. However, it should not be positioned immediately adjacent to the furnace power supply, as the strong magnetic field generated during operation of the module might interfere with the computer's CRT display.

FIAS systems and flame autosamplers should be placed on a cart or table close to the AA spectrometer sample compartment to keep FIAS tubing to a minimum length. The FIAS can also be placed to the side of the instrument, however, maximum performance may be compromised due to the increased length of tubing required.

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2 Exhaust Vent

A venting system is required to remove the combustion fumes and vapors from the flame or graphite furnace for atomic absorption instruments. Exhaust venting is important for a number of reasons:

- It will protect laboratory personnel from toxic vapors which may be produced by some samples.
- It will tend to remove the effects of room drafts and the laboratory atmosphere on flame stability.
- It will help to protect the instrument from corrosive vapors which may originate from the samples.
- It will remove dissipated heat which is produced by the flame or furnace.

The venting system should provide a flow rate of approximately 7000-8500 liters/min (250-300 cubic feet/min). It is strongly recommended that the instrument not be placed in a chemical hood! If a chemical hood must be used, arrangements should be made to keep out corrosive vapors and backdrafts from other hoods.

Sample preparation should not be carried out in the same hood where the instrument is located.

PerkinElmer offers an accessory Blower and Vent Kit (Part No. 03030447, 110V; 03030448, 230V) which will fulfill the exhaust requirements for all atomic absorption instruments (see Figure 1). Included in the kit are a rotary blower with capacitor and hardware, a vent to be located above the instrument, and an adapter to permit connection of the blower and vent with suitable metal tubing. The adapter and vent are made of stainless steel sheets.

Notice: Local electrical codes do not permit PerkinElmer Service Engineers to install the blower and vent assembly.

The metal tubing required to connect the vent to the blower and to provide suitable exhaust from the blower is not included in the accessory Blower and Vent Kit. Flexible stainless steel tubing is recommended for this purpose and can be obtained from the companies listed in Table I and from various other firms. In some instances this type of flexible metal tubing is sold only in minimum lengths of 3 meters (10 feet).

Table I. **U.S. Suppliers of Flexible Metal Duct Tubing.**

Flexaust Co.
11 Chestnut St.
Amesbury, MA 01913
(508) 388-9700

Potomac Rubber Co.
9011 Hampton Overlook
Capital Heights, MD 20743
(301) 336-7400

Triplex Inc.
1142 Kress St.
Houston, TX 77020
(713) 672-7521

Fox Manufacturing Inc.
P.O. Box 1047
Clarkdale, AZ 86324
(602) 634-5897

Darcoid Co. of California
1742 Yosemite Ave.
San Francisco, CA 94124
(415) 861-6984

For the names of suppliers in other areas, contact your PerkinElmer representative.

The capacity of the blower depends on the duct length and the number of elbows or bends used to install the system. If an excessively long duct system or a system with many bends is used, a stronger blower may be necessary to provide sufficient exhaust volume. Alternatively, smooth stainless steel tubing may be used instead of flexible stainless steel tubing where flexibility is not required to reduce system friction loss or "drag." A length of smooth stainless steel ducting has 20-30% less friction loss than a comparable length of flexible ducting. When smooth stainless steel tubing is used, elbows must be used to turn corners. These elbows should turn at a center line radius of 45 degrees to reduce friction losses, and the number of elbows should be minimized.

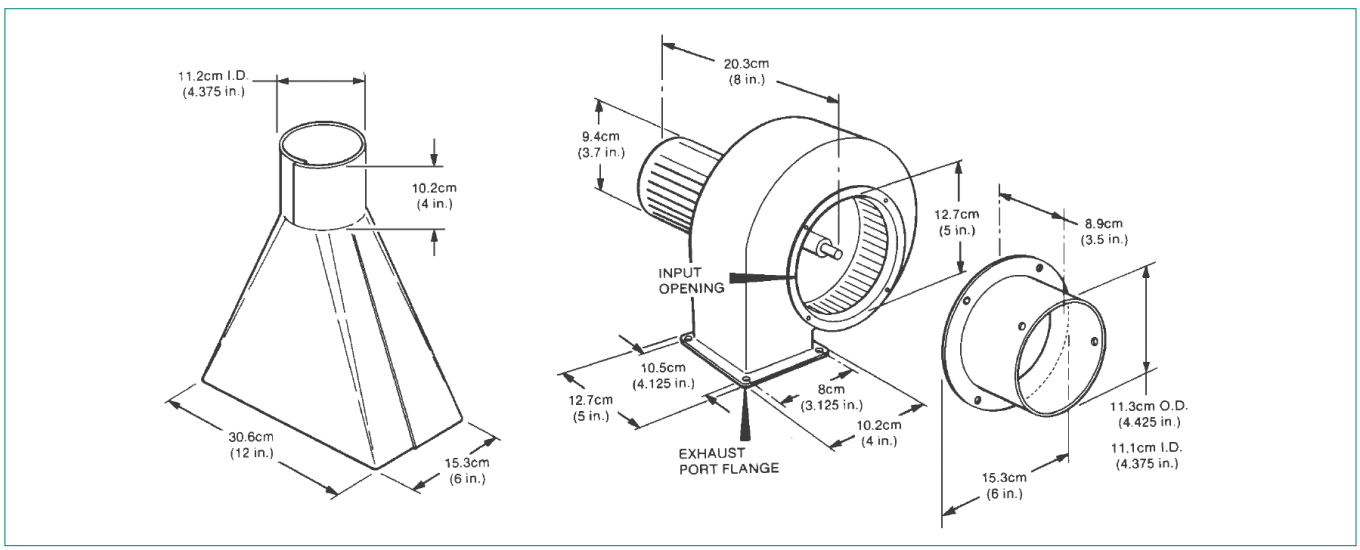


Figure 1. Blower and vent kit dimensions.

If a rigid tubing system is used, it is strongly recommended that flexible tubing be used from the vent hood to the ceiling to facilitate hood alignment and service access to the instrument.

The dimensions for the various parts of the Blower and Vent Kit are shown in Figure 1. The vent i.d. is slightly larger than the tubing o.d. to allow for tubing tolerances. A slight gap between the two units is normal.

When installing such a venting system, all connections should be made with metal screws or rivets. Solder must not be used. The blower should be located at least 4 meters (12 feet) and not more than 6.5 meters (20 feet) from the flame or the graphite furnace and should exhaust to the atmosphere or into a considerably wider exhaust duct. Under these conditions, the following temperatures have been measured during operation of a nitrous oxide-acetylene flame: 310 °C at the vent intake; 160 °C at 2.4 meters (8 feet) from the vent intake; 105 °C at the blower intake; and 50 °C at the blower motor housing near the front bearing.

Instructions for installation (Part No. 09909701) are provided with the Blower and Vent assembly. The blower provided in the PerkinElmer accessory kit requires a line voltage of 115 V or 230 V, depending on the part number ordered.

Additional recommendations on the venting system include:

- Make sure the duct casing is installed using fireproof construction. Route ducts away from sprinkler heads.
- Locate the discharge outlet as close to the blower as possible. All joints on the discharge side should be airtight, especially if toxic vapors are being carried.
- Equip the outlet end of the system with a backdraft damper and take the necessary precautions to keep the exhaust outlet away from open windows or inlet vents and to extend it above the roof of the building for proper dispersal of the exhaust.
- Equip the exhaust end of the system with an exhaust stack to improve the overall efficiency of the system.
- Make sure the length of the duct that enters into the blower is a straight length at least ten times the duct diameter. An elbow entrance into the blower inlet causes a loss in efficiency.
- Design local exhaust ventilation systems individually for each specific atomic absorption instrument. Also, the opening of the exhaust vent should be large enough to cover the graphite furnace or flame area completely.
- Provide make-up air in the same quantity as is exhausted by the system. An "airtight" lab will cause an efficiency loss in the exhaust system.
- Ensure that the system is drawing properly by releasing smoke into the mouth of the collector hood (vent). A synthetic "smoke" can be generated by placing open bottles of hydrochloric acid and ammonium hydroxide in proximity under the hood.
- Equip the blower with a pilot light located near the instrument to indicate to the operator when the blower is on.

3 Atomic Absorption Gases

NOTE: Standards for cylinder dimensions, regulator connections, gas fittings, etc. vary from country to country. The information provided here is for the U.S. Contact your PerkinElmer representative for information on the specific requirements of your area.

Compressed Air. For flame operation, the air supply should provide a minimum of 28 liters/min (1 cubic foot/min) at a minimum pressure of 350 kPa (50 psig). The pneumatics of the AAnalyst 700 and AAnalyst 800 systems require an air pressure of 500 kPa (70-75 psig).

It is desirable to have a water and oil trap or filter between the compressor and the instrument gas control system. The use of an Air Filter Accessory (Part No. 00470652) or an Air/Acetylene Filter Accessory (Part No. N9301398) is strongly recommended to remove entrained water, oil, water aerosols and solid particles from compressed air lines.

If there is any doubt regarding the usability of a central air supply (insufficient volume or pressure or excessive oil or water contamination), the quality of the supply should be checked prior to the arrival of the instrument. A small, oil-less air compressor meeting the stated requirements is available from PerkinElmer (Part No. 03030313 for 115 volts, 60 Hz or Part No. 03030314 for 230 volts, 50 Hz service).

Air compressors are generally uncomfortably noisy to have in the immediate vicinity of the instrument. Whenever possible, it is advisable to locate them at some distance from laboratory workers in an area providing suitable ventilation.

Cylinders of compressed air can also be used but are recommended only as an emergency or short-term solution for the following reasons:

- A standard #1 size air cylinder contains about 6200 liters (220 cubic feet) of air at standard temperature and pressure (STP). A premix burner-nebulizer system uses about 20 liters/min (0.7 cubic feet/min), and, therefore, a cylinder will last only about five hours. Unless an instrument is used only a few hours per day, changing cylinders becomes a nuisance as well as being expensive.
- Occasionally, cylinder air may be obtained from a liquefaction process during which the oxygen-to-nitrogen ratio can change. Therefore, it is not uncommon to find other than 20% oxygen in air cylinders. This can cause erratic burner operation and non-reproducible analytical results and, in extreme cases, may provide a potential safety hazard. In general, if cylinder air is to be used, it is important to specify *compressed* air rather than breathing air (i.e. medical grade) or an unspecified form.

WARNING: For safe operation, oxygen must NEVER be used with PerkinElmer premix burner systems.

The use of air cylinders requires the use of a suitable dual-stage regulator. A regulator for cylinders with a CGA 590 connection is available from PerkinElmer (Part No. 03030264).

Acetylene. For the overwhelming majority of analyses, acetylene is the preferred fuel gas with atomic absorption spectrometers. Air-acetylene is the preferred flame for the determination of about 35 elements by atomic absorption. The temperature of the air-acetylene flame is approximately 2300 °C. For most air-acetylene flames, the acetylene flow used is about 4 liters/min or 0.14 cubic feet/min. Using a heat combustion value of 1,450 BTU per cubic foot, the heat given off would be approximately 12,300 BTU per hour (3,600 W). An air-acetylene flame can be used with all PerkinElmer burner heads but is most commonly used with the supplied 10-cm (4-inch) burner head (Part No. N0400102 for AAnalyst series instruments).

Suitable acetylene typically has a minimum purity specification of 99.6% with the actual assay being about 99.8%. In general, ordinary welding grade acetylene is adequate for most atomic absorption analyses, though sometimes a particular tank may be contaminated. Special higher purity "atomic absorption" grade acetylene is also available from some vendors, and its use is recommended when the available welding grade acetylene is not sufficiently pure.

A size 1A acetylene cylinder contains about 8,500 liters (300 cubic feet) of acetylene and usually lasts about 30 hours of burning time with an air-acetylene flame. The cylinder requires an acetylene pressure regulator, which can be obtained from the supplier of the gas or from PerkinElmer (Part No. 03030106).

The PerkinElmer Acetylene Regulator Assembly includes an adapter so that the pressure regulator can be connected to cylinders requiring either CGA 300 or CGA 510 fittings and a connector for attaching the fuel hose assembly supplied with the instrument. The fuel hose assembly is constructed of red neoprene, reinforced with high tensile strength rayon cord, and provides a rated working pressure of about 1700 kPa (250 psig). The connectors are permanently mounted at each end of the hose assembly for connection to the pressure regulator and instrument gas controls, and use left-hand threads as per accepted practice for fuel gas connections. (See Section 5 for more details.)

It may be desirable to have an acetylene filter between the acetylene tank and the instrument gas control system to remove particulates and acetone droplets from acetylene, protecting the gas controls and AA burner system from contamination and corrosion. An Acetylene Filter (Part No. N9301399) and an Air/Acetylene Filter Accessory (Part No. N9301398) are available from PerkinElmer. Some countries also require the use of a flashback arrestor such as PerkinElmer Part No. N9300068 in the acetylene fuel line. *Please check with your local gas supplier for the appropriate flashback arrestor for the nitrous oxide line.*

Acetylene is normally supplied dissolved in acetone, and a small amount of acetone carryover with the acetylene is normal. However, as tank pressure falls, the relative amount of acetone entering the gas stream increases and can give erratic results, particularly for elements such as calcium, tin, chromium, molybdenum and others whose sensitivity is highly dependent on the fuel/oxidant ratio. For this reason, acetylene tanks should be replaced when the cylinder pressure drops to about 600 kPa (85 psig).

Since the acetylene is dissolved in acetone, the pressure drop is not linear with gas removal, and a pressure of 600 kPa (85 psig) indicates that the cylinder is nearly empty, assuming the cylinder is at room temperature.

Acetylene tanks should always be stored and operated in a vertical position, rather than horizontally, to prevent liquid acetone from reaching the cylinder valve. New tanks should be positioned vertically for at least 8 hours prior to use. The practice of "cracking the valve" of an acetylene tank (that is, opening the valve slightly for a very short period prior to attaching the regulator) is not recommended. While such an action will clear the valve opening of dust or dirt particles and may remove acetone from the cylinder valve, it is a potentially hazardous practice and one which should never be attempted in the presence of an open flame, sparks or other possible sources of ignition.

Both fuel and oxidant gas lines should be relieved of pressure at the end of the working day or if the instrument is to be unused for an extended period. Cylinder valves should be closed to avoid the possibility of pressure regulators failing and gas lines being subjected to the full cylinder pressure.

CAUTION: Acetylene may react with copper to form a potentially explosive compound. Copper tubing or fittings for acetylene gas must be strictly avoided.

IMPORTANT: Failure to change the acetylene cylinder before the cylinder pressure drops below 600 kPa (85 psig) may cause damage to valves or tubing within the burner gas control system due to high acetone carryover. Such damage from acetone is not covered by instrument warranties.

CAUTION: Acetylene line pressure from the cylinder to the instrument should never be allowed to exceed 103 kPa (15 psig). At higher pressures, acetylene can spontaneously decompose or explode. PerkinElmer recommends that a maximum acetylene line pressure of 80-95 kPa (12-14 psig) be used to provide a reasonable margin of safety.

Nitrous Oxide. The nitrous oxide-acetylene flame has a maximum temperature of approximately 2800 °C and is used for the determination of elements that form refractory oxides. It is also used to overcome chemical interferences that may occur in flames of lower temperatures. For the nitrous oxide-acetylene flame, the acetylene flow is about 14 liters/min or 0.5 cubic feet per min.

Using a heat of combustion value of 1,450 BTU per cubic foot, the heat given off would be approximately 43,000 BTU per hour (12,500 W).

The use of nitrous oxide requires a number of accessories and precautions. A size 1A cylinder of nitrous oxide contains about 14,800 liters (520 cubic feet) and will typically last for 10 to 12 hours of burning time. Cylinders of nitrous oxide (99.0% minimum purity) are available from local suppliers. A dual-stage regulator is recommended (and is mandatory in some countries).

Nitrous oxide is supplied in the liquid state, initially at a pressure of about 5000 kPa (750 psig). Since the nitrous oxide is in liquid form, the pressure gauge does not give a true indication of how much nitrous oxide remains in the cylinder until the pressure starts to fall rapidly as the residual gas is drawn off.

When nitrous oxide is rapidly removed from the cylinder, the expanding gas causes cooling of the cylinder pressure regulator and the regulator diaphragm sometimes freezes. This can create erratic flame conditions or, in the most extreme case, a flashback. It is therefore advisable to heat the regulator using either a built-in heater or an externally supplied heat source, such as an electrical resistance heating tape.

A dual-stage heated nitrous oxide pressure regulator for use with gas cylinders with a CGA 326 connection is available from PerkinElmer [Part No. 03030204 (115 volts) or 03030349 (230 volts)]. These regulators provide pressure control from 350-520 kPa (50-75 psig) and contain an integral thermostatted heater to prevent freezing of the regulator diaphragm. A color-coded hose with suitable connectors at each end is supplied with the regulators to provide connection to the instrument gas controls (see Section 5).

A nitrous oxide burner head (Part No. N0400100 for AAnalyst series instruments) must be used with nitrous oxide-based flames. The instructions provided with the nitrous oxide burner head should be strictly followed.

There is generally little advantage to using nitrous oxide-acetylene to determine elements that are best determined with air-acetylene. Air is less expensive than nitrous oxide; also, a number of elements will show poorer sensitivity and produce ionization interferences in the nitrous oxide flame.

Argon. Argon is required for external and internal gas streams through the THGA or HGA graphite furnace or as a carrier gas with mercury/hydride systems such as the FIAS or FIMS flow injections systems or the MHS-15. The quality criteria listed in Table II for argon are suitable for these applications. Normally, for graphite furnace operation, gaseous argon is used, although either liquid or gaseous argon can be used. The choice of liquid argon or gaseous argon tanks is determined primarily by the availability of each and the usage rate. Liquid argon is usually less expensive per unit volume to purchase, but cannot be stored for extended periods. If liquid argon is used, the tank should be fitted with an over-pressure regulator which will vent the tank as necessary in order to keep the liquid argon cool enough to remain in the liquid state. Gaseous argon tanks do not require venting and consequently can be stored for extended periods without loss.

A dual-stage cylinder regulator that can be used with either gaseous argon or nitrogen is available from PerkinElmer (Part No. 03030284). The regulator has a CGA 580 fitting, and includes a color-coded hose with 1/4-inch Swagelok® fittings to permit direct connection to the regulator and to the instrument gas controls (see Section 5).

Table II. **Quality Criteria for Argon.**

Criterion	Specification
Purity	≥ 99.996%
Oxygen	≤ 5 ppm
Nitrogen	≤ 20 ppm
Water	≤ 4 ppm

4 Gas Line Connections

PerkinElmer atomic absorption instruments include the hoses necessary for connection to gas lines (see Table III). It is the responsibility of the user to provide the appropriate gas lines, regulators, connectors and valves to which the hoses are connected.

5 Handling of Gas Cylinders and Other Safety Practices

- Fasten all gas cylinders securely to an immovable bulkhead or a permanent wall.
- When gas cylinders are stored in confined areas, such as a room, ventilation should be adequate to prevent toxic or explosive accumulations. Move or store gas cylinders only in a vertical position with the valve cap in place.
- Locate gas cylinders away from heat or ignition sources, including heat lamps. Cylinders have a pressure-relief device that will release the contents of the cylinder if the temperature exceeds 52 °C (125 °F).
- When storing cylinders external to a building, the cylinders should be stored so that they are protected against temperature extremes (including the direct rays of the sun) and should be stored above ground on a suitable floor.
- Mark gas cylinders clearly to identify the contents and status (full, empty, etc.).
- Do not attempt to refill gas cylinders.
- Use only approved regulators and hose connectors. Left-hand thread fittings are used for fuel gas tank connections, whereas right-hand fittings are used for oxidant and support gas connections.

CAUTION: All lines carrying nitrous oxide should be free of grease, oil or other organic material, as it is possible for spontaneous combustion to occur. Cylinders of nitrous oxide should be considered high-pressure cylinders and should be handled with care at all times.

NOTICE: The permanent installation of gas supplies is the responsibility of the user and should conform to local safety and building codes.

- Use galvanized iron tubing, steel, wrought iron or other tubing that will not react chemically with acetylene. Never use copper tubing with acetylene. Joints may be welded or made up of threaded or flanged fittings, typically stainless steel, aluminum or brass composed of less than 65% copper. Rolled, forged or cast steel or malleable iron fittings may also be used. Cast iron fittings cannot be used safely for acetylene lines.
- Arrange gas hoses where they will not be damaged or stepped on and where things will not be dropped on them.
- Never run acetylene at a pressure higher than 100 kPa (15 psig). At pressures above this level, acetylene may spontaneously explode.
- Perform periodic gas leak tests by applying a soap solution to all joints and seals.
- Periodically check for the presence of acetylene in the laboratory atmosphere, especially near the ceiling.

WARNING: Contact between acetylene gas and copper or silver (or high concentrations of silver salts), liquid mercury or gaseous chlorine can produce potentially unstable acetylides. Always clean the burner thoroughly after analyzing solutions with high silver or mercury concentrations, and aspirate solution continuously during the analysis to prevent any residues from drying.

- When the equipment is turned off (for example, at the end of the working day), close all gas cylinder valves tightly at the tank. Bleed the remainder of the line to the atmosphere before the exhaust fan (vent) is turned off.
- When using premix burners with cyanide solutions, check the pH of the liquid trap and drain vessel. The pH of the liquid should be greater than 10. If the liquid is even slightly acidic, highly toxic hydrogen cyanide gas may be released.

Table III. **Gas Line Connections (Note: Regulator, connector and fitting needs vary by country. For information on what is required in your area, consult your local PerkinElmer Service Representative.)**

Gas	Regulator Part Number	Regulator to Cylinder CGA No.	Regulator Connection to Gas Hose Assembly	Part Number	Hose Assembly Connections		
					Color	Connection to Regulator	Connection to Instrument
Air	03030264	590	1/4" Swagelok®	00570567	black	1/4" Swagelok®	1/4" Swagelok®
Argon	03030284	580	1/4" Swagelok®	00570567	black	1/4" Swagelok®	1/4" Swagelok®
Nitrogen	03030284	580	1/4" Swagelok®	00570567	black	1/4" Swagelok®	1/4" Swagelok®
N_2O	03030204	326	1/4" N.P.T.*	00470258	blue	5/16" Swagelok®	5/16" Swagelok®
Acetylene	03030106	510 or 300	9/16" L.H.T.**	00570559	red	9/16" L.H.T.	3/8" L.H.T.

N.P.T. = Normal Pipe Thread, **L.H.T.** = Left-Hand Thread

* Supplied with 5/16" x 1/4" N.P.T. Swagelok® Male connector Body (P/N 09903946).

** Supplied with Outlet Bushing (P/N 09903031), 1/4" N.P.T. to 9/16" L.H.T.

PerkinElmer Air Compressor (P/N 03030313, 03030314) provides a 1/4" Swagelok® fitting.
PerkinElmer Air Filter Assembly (P/N N0580531) provides 1/4" Swagelok® inlet and outlet fittings.
PerkinElmer Air Dryer Filter Assembly (P/N 00470652) provides 1/4" Swagelok® inlet and outlet fittings.
PerkinElmer Air/Acetylene Filter Assembly (P/N N9301398) provides 1/4" Swagelok® inlet and outlet fittings for air and 3/8" LH (A size) inlet and 9/16" LH (B size) outlet fittings for acetylene.
PerkinElmer Acetylene Filter (P/N N9301399) provides 3/8" LH (A size) inlet and 9/16" LH (B size) outlet fittings.

Also Available:

1. P/N 09903032 Connector for joining two P/N 00570559 fuel hose assemblies
2. P/N 09903898 Connector for joining two P/N 00570567 air/argon hose assemblies
3. P/N 09903196 Adapter, female 1/4" N.P.T. to male 1/4" Swagelok®.
4. P/N 09920223 Connector for joining two 00470258 nitrous oxide hose assemblies.

- Take suitable precautions when using volatile organic solvents. A potentially flammable organic vapor "cloud" can form around the opening of the sample vessel. Feeding the capillary tubing through a small hole in a covered sample container is one way of reducing the possibility for ignition.
- Never view the flame, hollow cathode lamps, electrodeless discharge lamps or deuterium background corrector lamps directly without protective eyewear. Potentially hazardous ultraviolet radiation may be emitted. Ordinary safety glasses will in general provide sufficient protection, but additional side shields will ensure a further margin of safety. Safety glasses will also provide mechanical protection for the eyes.
- Never leave the flame unattended.
- Zeeman background-corrected AA instruments generate a strong magnetic field. People with cardiac pacemakers are advised not to operate or frequent the vicinity of Zeeman-corrected instruments while they are in operation.

6 Drain Vessels

A specially-configured drain vessel is supplied with all PerkinElmer atomic spectroscopy instruments with burner systems. That vessel must be used to gather the effluent from the AA burner drain. The drain vessel should NOT be stored in an enclosed storage area. Rather, the drain vessel should be stored in plain sight of the operator, usually on the floor in front of the instrument or on an open shelf underneath the instrument table.

The drain system should be checked regularly and replaced when necessary. Follow the directions in the instrument manuals regarding the proper placement of the drain tube in the drain vessel and the proper liquid level in the drain vessel.

7 Atomic Absorption Source Lamps

Atomic absorption spectrometers require different source lamps, depending on the elements to be determined and the instrument to be used. Multielement lamps are available for some elements, but most lamps are constructed using a single element to avoid potential spectral interferences and reduced performance, especially when using a graphite furnace.

PerkinElmer manufactures all of its hollow cathode and electrodeless discharge lamps. The Lumina™ and Atomax™ series of hollow cathode lamps are especially noted for spectral purity, brightness, stability and long life.

Hollow cathode lamps are excellent for most elements; however, there are a number of "difficult" elements for which an improved light source is desirable. PerkinElmer System 2 Electrodeless Discharge Lamps (EDLs) provide improved performance in most instances. EDLs are more intense than their corresponding hollow cathode lamps. Most also provide better lamp life and stability and some also provide better sensitivity. EDLs do not require a separate power supply, except for the AAnalyst 200 without D2 background correction.

A lamp mount or turret is supplied with all PerkinElmer AA instruments and will accommodate all PerkinElmer hollow cathode or electrodeless discharge lamps. Users who may have lamps with 1.5-inch diameters rather than the standard PerkinElmer 2-inch diameter can adapt those lamps for use in PerkinElmer lamp mounts with the Small Diameter Lamp Adapter Kit, (Part No. 03030870).

8 Graphite Furnace Requirements

Location. The furnace power supply is built into the AAnalyst 600/700/800. With the AAnalyst 400, the HGA 900 must be placed on the left side of the spectrometer.

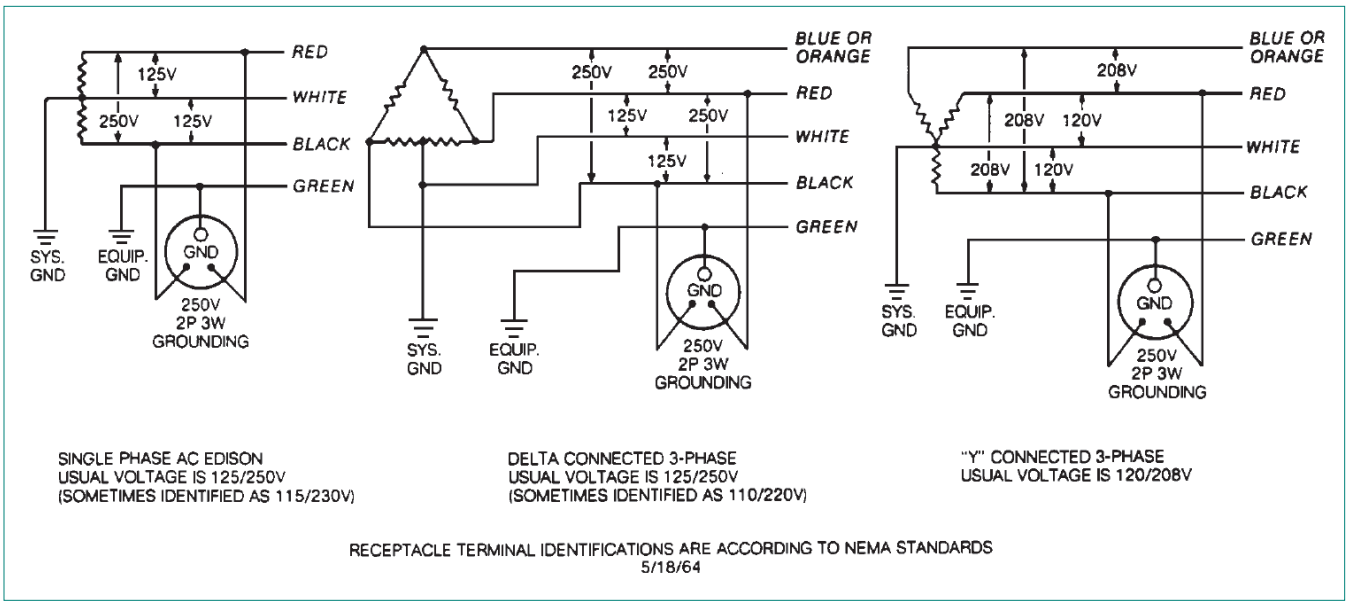


Figure 2. HGA power circuit connections.

Services. Graphite furnaces require electrical power, cooling water and a supply of inert gas, normally argon. A minimum input voltage of 208 volts is recommended (with a minimum of 195 V under load required) to enable the furnaces to reach maximum potential operating temperatures and heating rate and, for some systems with Zeeman effect background correction, proper magnetic field strength. For installations where the line voltage may drop below this level, the use of a "buck boost"-type transformer is recommended to maintain proper analytical operating conditions.

An appropriately-rated female electrical connector is required to provide power for the graphite furnace. Please contact your local Service Engineer to determine the appropriate connector for your laboratory.

Electrical supply circuitry, circuit breakers and wiring size for the graphite furnaces should be selected according to local regulations. Three types of 3-wire circuits used in North America which provide power adequate to run THGA or HGA systems are illustrated in Figure 2. The AAnalyst 700 AA requires a 230 volts (+5%, -10%), 50/60 Hz (±0.3 Hz), 20- or 30-amp line capable of delivering 3.5 kW of peak power.

The THGA furnace and Zeeman magnet of the AAnalyst 600 and AAnalyst 800 systems operate from a single, dedicated electrical supply of 230 volts (+5%, -10%), 30 amp, 50 or 60 Hz (±0.3 Hz), single phase, capable of delivering 7.7 kW of peak power.

The AAnalyst 600 and AAnalyst 800 systems are all provided with a 30-amp plug, and the HGA 900 and AAnalyst 700 AA are provided with a 20-amp plug. It is recommended that 8-gauge (6 mm^2) wire be used for the electrical supply for AAnalyst 600 and AAnalyst 800 systems, and that the length of the wiring (circuit breaker to instrument connection) not exceed 20 meters (65 feet). Although 10-gauge (4 mm^2) wire can be used for the electrical supply of the HGA 900 and AAnalyst 700 AA, 8-gauge (6 mm^2) wire is recommended.

For all furnace systems, the electrical supply should contain a "slow blow" circuit breaker capable of handling 300% of the rated current for periods of 3 seconds. Also, the AA spectrometer, graphite furnace, Zeeman magnet, computer and other accessories should all be connected to the same electrical ground, and the power supply should be free of transients in excess of 50 V over the nominal voltage.

Additional Furnace Requirements. A water supply is required to cool the furnace quickly to ambient temperature after reaching high atomization temperatures. The water supply should be free of sediment, have a pH between 6.5 and 7.5, and a hardness less than 14 °D (2.5 mMol/ liter). A maximum flow of 2.5 L/min (0.6 gal/min) is used for the THGA, 1.5 liters/min (0.4 gal/min) for the HGA at a temperature between 20 °C and 40 °C. As both the flow rate and water temperature affect the cooling rate, it is desirable to be able to vary the flow rate to compensate for variations in cooling water temperature. A suitable recirculating cooling system is included with a number of THGA systems. With an HGA system, the use of an optional Recirculating Cooling System is strongly recommended. To prevent combustion of the graphite tube at high temperatures, the furnace is purged with argon.

CAUTION: Do not use nitrogen as the furnace purge gas. Its use may lead to reduced sensitivity for some elements, and it is also possible for nitrogen to react with the graphite tube at temperatures above 2300 °C to form cyanogen, a toxic gas.

When operating the HGA Graphite Furnace systems at high temperatures, do not look directly at the tube without suitable eye protection.

Maximum gas consumption is 0.7 liters/min (0.19 cubic feet/min) for THGA furnaces and 1.2 liters/min (0.3 cubic feet/min) for the HGA furnaces, both at 300-450 kPa (44-66 psig). Purity specifications for the gases to be used with HGA Systems are given in Section 3. Ventilation is required to remove potentially toxic or corrosive gases which can be generated by the samples.

9 Training Courses

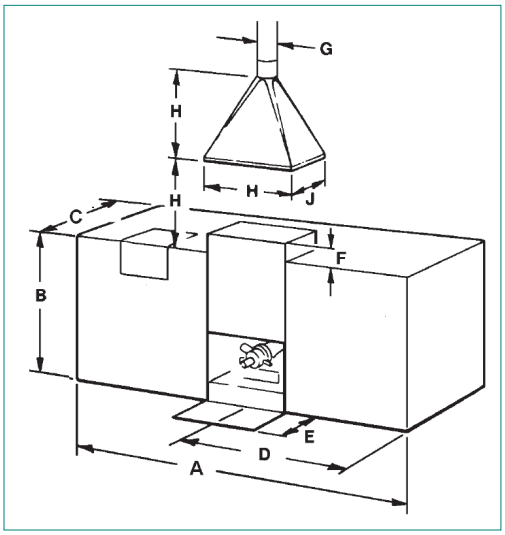
Training courses for users of PerkinElmer atomic absorption instruments are given at various locations. The courses cover basic principles and applications of atomic absorption and detailed instruction in the use of the instruments and major accessories.

To gain the most benefit from the training course, it is strongly recommended that the attendee should have operated the instrument for at least several weeks prior to the course.

For additional information on atomic spectroscopy training courses, please contact your local sales representative.

10 Facilities Required for PerkinElmer AA Instruments

The following figure and tables provide the dimensions and power requirements for PerkinElmer atomic absorption instruments and major accessories. Dimensions are defined in Figure 3. Required services are shown in Table IV, and product dimensions and approximate power consumption for AA spectrometers and major accessories are given in Table V. PerkinElmer instruments will normally operate within a ±10% range of the specified voltage and within ±1 Hz of the specified frequency, unless otherwise noted. If the power line is unstable, fluctuates in frequency or is subject to surges or sags, additional control of the incoming power may be required. A means of electrically grounding the instruments and accessories must be available.



A = length

B = height to top of cover

C = depth

D = distance from center of atomizer compartment to right hand edge of instrument

E = protuberance of sample tray in front of instrument

F = height of flame shield above top of instrument cover

G = 10 cm (4 inches) in all cases

H = 30 cm (12 inches) in all cases

J = 15 cm (6 inches) in all cases

Figure 3. Spectrometer and accessories dimensions.

Table IV. **Required Services.**

Instrument/ Accessory	Gases				Cooling Water	Computer Controlled	Req. No. of Vents	Electrical Power
	Air	N_2O	C_2H_2	Ar				
AAnalyst 50	•	•	•				1	a
AAnalyst 200	•	•	•				1	a
AAnalyst 400	•	•	•			•	1	a
AAnalyst 600				•	d	•	1	b
AAnalyst 700	•	•	•	•	d	•	1	b
AAnalyst 800	•	•	•	•		•	1	b
HGA 900				•	d	e	c	b
FIAS 100/400				•		e	c	a
FIMS 100/400				•		•	c	a
Amalgamation Attachment	•			•		e		a
MHS-15				•			c	

a = 115 V, 50/60 Hz or 230 V, 50/60 Hz, single phase

b = 230 V (+5%, -10%), 50 or 60 Hz, single phase

c = uses the same vent as the spectrometer

d = optional (included with some versions of the AAnalyst 600)

e = controlled from the spectrometer computer/controller

Table V. **Instrument and Accessory Specifications (Refer to Figure 3).**

	Width (cm) A	Height (cm) B	Depth (cm) C	(cm) D	(cm) E	(cm) F	Power VA	Weight Kg
Spectrometers:								
AAnalyst 50	82	39	55	41	12	1	220	70
AAnalyst 200	70	65	65	43	17	18	200	49
AAnalyst 400	70	65	65	43	17	18	200	49
AAnalyst 600	110	65	70	43	30	6	5000	175
AAnalyst 700	110	64	70	43	30	10	3600	147
AAnalyst 800	110	64	70	43	30	10	5000	187
Graphite Furnace Components:								
HGA 900 Controller	32	65	65				3600	43
AS-800 Autosampler	25	20	34				NA	6
HGA/THGA Cooling System	20	37.5	50				140	18
Flame Autosamplers:								
S10	42	56	34				360	4
Mercury/Hydride System:								
MHS-15	17	38	16				NA	3
Flow Injection Systems:								
FIAS 100/400	42	18	41				600	11
FIMS 100/400	42	26	41				450	12
Amalgamation Attachment	25	25	24				300	5
Lenovo ThinkCentre M58p Computers:								
CPU	18	44	40				690	11
17" LCD Monitor	37	33	18				210	15
Keyboard	46	5	18				NA	2
Accessories:								
AutoPrep™ 50 Autodilutor	34	39	20				60	7.5
Air Compressor	65	55	31				700	36
Heated N_2O Regulator							150	2
HP LaserJet® 4250 Printer	39	35	41				330	18
HP 5600 Series InkJet® Printer	44	20	37				250	6
Brother HL-5240 Laser Printer	36	24	38				610	9.5
Lexmark E260d Laser Printer	40	26	37				600	13.5

* With the AAnalyst 400, the furnace autosampler projects 30 cm from the left front of the instrument in its storage position.
** With the AAnalyst 600, 700 or 800, the furnace autosampler projects 35 cm from the right front of the instrument in its storage position.
*** Height at maximum sample arm upward travel.
NA Not applicable (powered by another device or included with another component)

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