

Agilent Microwave Plasma Atomic Emission Spectrometers

**For models 4100, 4200,
and 4210**

User's Guide



Agilent Technologies

Notices

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

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1. Safety Practices and Hazards

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General

Unless otherwise specified, statements in this manual apply to the Agilent 4100, 4200, and 4210 MP-AES instruments.

Operation of an Agilent Microwave Plasma Atomic Emission Spectrometer (MP-AES) involves the use of compressed gases, high microwave energy and hazardous materials including corrosive fluids and flammable liquids. Careless, improper or unskilled use of this instrument can cause death or serious injury to personnel, and/or severe damage to equipment and property. Only trained personnel should use this equipment.

The MP-AES instrument incorporates interlocks and covers that are designed to prevent inadvertent contact with any potential hazards. If the MP-AES instrument is used in any manner not specified by Agilent, this protection may be impaired. It is good practice to develop safe working habits that do not depend upon the correct operation of the interlocks for safe operation. It is essential that no interlock or cover is bypassed, damaged or removed.

The safety practices described below are provided to help the user operate the MP-AES instrument safely. Read each safety topic thoroughly before attempting to operate the MP-AES instrument and *always* operate the MP-AES instrument in accordance with these safety practices.

If you are unsure of the effects of any liquid, gas or chemical on the MP-AES instrument, consult your Agilent field service engineer or approved representative before use.

If the MP-AES instrument is to be used in conjunction with other non-Agilent equipment, the safety requirements of any system incorporating the MP-AES instrument is the responsibility of the assembler of the system.

Verifying Safe State

The following general safety precautions must be observed during all phases of operation, maintenance and service of this instrument.

To ensure continued safety of the instrument after maintenance or service procedures verify the instrument is returned to a safe state before use. This includes running performance checks to verify the instruments safety systems are functioning correctly. Check the general condition of the instrument during operation for wear or signs of corrosion that are likely to inhibit function or safety.

Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

Plasma

The plasma is extremely hot (about 6,000 °C, 11,000 °F) and operates using high levels of microwave energy. The plasma emits high intensity light. Always wear appropriate eye protection if viewing the plasma. Close contact with the operating plasma can result in severe heat burns to the skin, and exposure to microwave radiation can cause sub-surface skin burns.

Do *not* operate the plasma if:

- the microwave excitation assembly appears to be damaged
- foreign material is present in the viewing port (left end of the microwave excitation assembly) or the torch aperture (vertical space for the torch)
- the space above the chimney is not clear of objects
- the MP-AES instrument exhaust system is not connected or turned on

The microwave excitation assembly is designed to reduce microwave radiation to safe levels while still permitting easy installation of the torch and viewing of the plasma. The MP-AES instrument has an interlock system that is designed to extinguish the plasma if either the pre-optics window holder is opened or the torch is unloaded before the plasma has been extinguished. Do *not* attempt to bypass the interlock system.

Before opening the pre-optics window holder or unloading the torch, extinguish the plasma by:

- pressing SHIFT and F5 on the keyboard
- selecting the 'Plasma off' option from the 'Plasma' drop-down arrow on the MP Expert software toolbar
- pressing the Plasma Enable switch on the front of the MP-AES instrument

The torch remains hot for up to five minutes after the plasma is extinguished. Touching the torch before it has cooled sufficiently may result in burns. Allow the torch to cool before removing it from the loader.

The plasma system has been carefully designed to operate safely and effectively when using torches and related components that conform to Agilent's design criteria. Use of non-approved components in the MP-AES instrument may render the system inoperative and/or hazardous. It may also invalidate the warranty on the MP-AES instrument. Use only torches and related components supplied or authorized by Agilent.

Heat, Vapors and Fumes

Heat, ozone, vapors and fumes generated by the plasma can be hazardous, and must be extracted from the MP-AES instrument by means of an exhaust system. Ensure that an exhaust system of the appropriate type is fitted (as specified in the site preparation guide). The system must be vented to the outside in accordance with local regulations and never within the building. Regularly check the exhaust system by smoke test to ensure that the exhaust system is functioning correctly. The exhaust fan must always be switched on *before* igniting the plasma.

Compressed Gas Hazards

All compressed gases (other than air) can create a hazard if they leak into the atmosphere. Even small leaks in gas supply systems can be dangerous. Any leak (except that of air) can result in an oxygen-deficient atmosphere which can cause asphyxiation. The storage area must be adequately ventilated and must comply with the rules and regulations imposed by the local authorities responsible for such use in the workplace.

Gas cylinders must be stored and handled strictly in accordance with local safety codes and regulations. Cylinders must be used and stored only in a vertical position and secured to an immovable structure or a properly constructed cylinder stand. Move cylinders only by securing them to a properly constructed trolley.

If gases are to be plumbed from a remote storage area to the instrument site, ensure that the local outlets are fitted with stop valves, pressure gauges and suitable regulators that are easily accessible to the instrument operator. The gas outlets must be provided within 1.5 meters (5 feet) of the MP-AES instrument.

Use only approved regulator and hose connectors (refer to the gas supplier's instructions). Keep gas cylinders cool and properly labeled. (All cylinders are fitted with a pressure relief device that will rupture and empty the cylinder if the internal pressure is raised above the safe limit by excessive temperatures.) Ensure that you have the correct cylinder before connecting it to the MP-AES instrument.

If using cryogenic (liquid) gases (for example, liquid nitrogen or argon) prevent severe burns by wearing suitable protective clothing and gloves.

Dangerous Goods

The Onboard Argon Bottle is considered dangerous goods when shipped and must comply with the rules and regulations imposed by the local and recipient's authorities.

Electrical Hazards

The MP-AES instrument and some accessories contain electrical circuits, devices and components operating at dangerous voltages. Contact with these circuits, devices and components can cause death, serious injury or painful electric shock. Panels or covers that are retained by screws on the MP-AES instrument and accessories may be opened *only* by Agilent-trained, Agilent-qualified or Agilent-approved field service engineers (unless specifically instructed). Consult the documentation or product labels supplied with your personal computer (PC), monitor and printer to determine which parts are operator-accessible.

The power cord set shipped with the MP-AES instrument cannot be used with other products.

If necessary, replace the power cord only with a cord equivalent to the one specified in the site preparation guide.

Other Precautions

Use of the MP-AES instrument and accessories may involve materials, solvents and solutions that are flammable, corrosive, toxic or otherwise hazardous. Careless, improper or unskilled use of such materials, solvents and solutions can create explosion hazards, fire hazards, toxicity and other hazards that can result in death, serious personal injury or damage to equipment.

Always ensure that laboratory safety practices governing the use, handling and disposal of hazardous materials are strictly observed. These safety practices should include wearing appropriate safety clothing and safety glasses.

Air flow to the MP-AES instrument and accessories must be unobstructed. Do not block the ventilation grill on the instrument. Allow at least 50 mm (2 in.) of space on the sides, and 150 mm (6 in.) at the rear of the system to permit free air circulation. Consult the documentation supplied with your PC, monitor and printer for their specific ventilation requirements.

Great care should be taken when working with glass or quartz parts to prevent breakage and cuts. This is especially important when attaching plastic tubing to glass barbs, or removing and replacing pieces of broken torch.

The MP-AES instrument weighs approximately 73 kg (161 lb). To avoid injury or damage to the MP-AES instrument or property, always use a forklift or other suitable mechanical lifting device to move the MP-AES instrument.

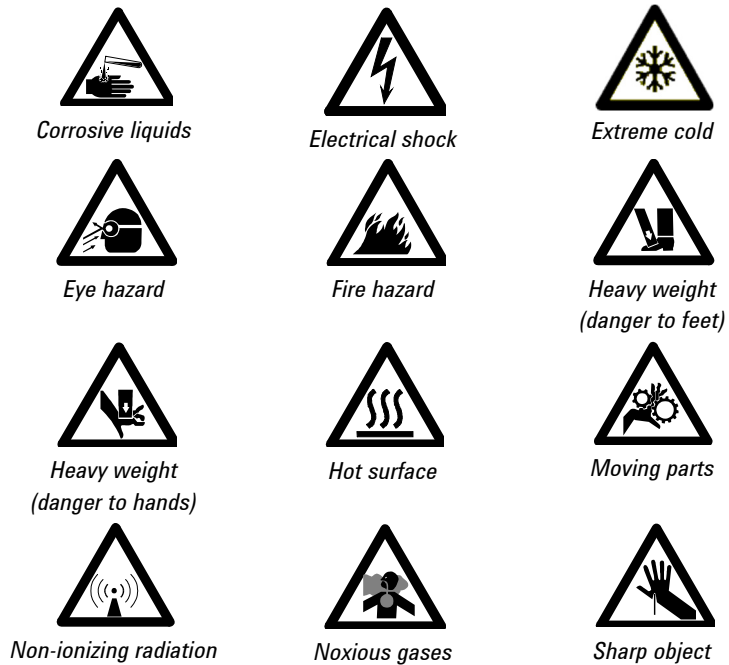
Use only Agilent-supplied spares with your MP-AES instrument.

Warning Symbols

The following is a list of symbols that appear in conjunction with warnings in this guide and on the MP-AES instrument. The hazard they describe is also shown. The beginning of the warning text is noted by a warning icon:

WARNING





A triangular symbol indicates a warning. The meanings of the symbols that may appear alongside warnings in the documentation or on the MP-AES instrument itself are as follows:



The following symbol may be used on warning labels attached to the MP-AES instrument. When you see this symbol, refer to the relevant operation or service documentation for the correct procedure referred to by that warning label.



The following symbols appear on the MP-AES instrument.

	Mains power on
	Mains power off
	Single phase alternating current
	Socket for Agilent accessory USB cable

Color Coding

The various indicator lights appearing on Agilent instruments and associated accessories represent the status of the instrument or accessory.

- A green light indicates the instrument is in normal/standby mode.
- A flashing green light indicates that firmware is being uploaded from the PC to the MP-AES instrument or that there is no USB connection from the PC to the MP-AES instrument.

CE Compliance

Your MP-AES instrument has been designed to comply with the requirements of the Electromagnetic Compatibility (EMC) Directive and the Machinery Directive of the European Union. Agilent has confirmed that each product complies with the relevant Directives by testing a prototype against the prescribed EN (European Norm) standards.

Proof that a product complies with these directives is indicated by:

- the CE Marking appearing on the rear of the product, and
- the documentation package that accompanies the product containing a copy of the Declaration of Conformity. The Declaration of Conformity is the legal declaration by Agilent that the product complies with the directives listed above, and shows the EN standards to which the product was tested to demonstrate compliance.

Electromagnetic Compatibility

EN55011/CISPR11

Group 1 ISM equipment: group 1 contains all ISM equipment in which there is intentionally generated and/or used conductively coupled radio- frequency energy which is necessary for the internal functioning of the equipment itself.

Class A equipment is equipment suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

This device complies with the requirements of CISPR11, Group 1, Class A as radiation professional equipment. Therefore, there may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

Operation is subject to the following two conditions:

- 1 This device may not cause harmful interference.
- 2 This device must accept any interference received, including interference that may cause undesired operation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try one or more of the following measures:

- 1 Relocate the radio or antenna.
- 2 Move the device away from the radio or television.
- 3 Plug the device into a different electrical outlet, so that the device and the radio or television are on separate electrical circuits.
- 4 Make sure that all peripheral devices are also certified.
- 5 Make sure that appropriate cables are used to connect the device to peripheral equipment.
- 6 Consult your equipment dealer, Agilent Technologies, or an experienced technician for assistance.

Changes or modifications not expressly approved by Agilent Technologies could void the user's authority to operate the equipment.

South Korean Class A EMC declaration

This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

A급 기기

(업무용 방송통신기자재)

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

ICES/NMB-001

This ISM device complies with Canadian ICES- 001.

Cet appareil ISM est conforme à la norme NMB-001 du Canada.



2. Introduction

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Site Preparation Requirements

Prior to receiving your Agilent MP-AES instrument, you will have been provided with an Agilent MP-AES Site Preparation Guide, which describes the environmental and operating requirements and specifications of the MP-AES instrument. You must prepare your laboratory according to these instructions and specifications before the instrument can be installed. You should keep the site preparation guide for future reference. If you have misplaced your copy, you can obtain a replacement from your local Agilent office.

User Documentation

- You have been provided with the following documentation to help you set up and operate your MP-AES instrument:
- The Agilent MP-AES Site Preparation Guide, with information on how to set up your laboratory in preparation for the MP-AES instrument.
 - This User’s Guide, with safety practices and hazards information, instructions for finding information about installing and maintaining the components of the MP-AES instrument and a brief operation overview.

- An extensive Help system containing context-sensitive Help, step-by-step instructions for frequently performed operations and instructions for using any accessories you ordered. Access the Help by pressing F1 on your keyboard with the MP Expert software open, by clicking the resources icon and then Help and Documentation on the Start page, or by double-clicking the MP Expert Help icon on the computer desktop.

Conventions

The following conventions have been used throughout the documentation:

- Menu items, menu options and field names (for example, click **Copy** on the **Edit** menu) have been typed in bold. Bold is also used to signify the pushbuttons appearing throughout the software (for example, click **OK**).
- ALL CAPITALS indicate keyboard and mouse commands (for example, press the F2 key) and text you must type using the keyboard (for example, type SETUP at the prompt).

Notes and tips

A Note is used to give advice or information.

A Tip is used to give practical hints to help you achieve the best possible performance from your MP-AES instrument.

Specifications

Installation category

The installation category is based on IEC61010:II. The installation category implies the regulation for impulse withstand voltage. It is also called the 'Over voltage category'. 'II' applies to electrical equipment.

Pollution level

The pollution level is based on IEC61010:2. Pollution level describes the degree to which a solid, liquid or gas that deteriorates dielectric strength is adhering. '2' applies to a normal indoor atmosphere.

Environmental conditions

See the Agilent MP-AES Site Preparation Guide for specifications.

Laboratory conditions

The area selected for the operation of an MP-AES instrument:

- must be free from drafts, corrosive atmospheres and vibration
- should have sample preparation areas and materials storage facilities located in a separate room
- must be a dust-free, low humidity environment
- should have air conditioning for control of the environment

Temperature control

Most of the heat generated by the MP-AES instrument into the laboratory is extracted from the laboratory by the exhaust system. When the plasma is operating, approximately 200 W of heat from the MP-AES instrument electronics flows into the laboratory.

Electrical power supplies

All power supplies should be single phase AC, 3 wire system (active, neutral, ground or two active and ground) and should be terminated at an appropriate connection receptacle that is within reach of the system power cable. Use of power boards or extension cables is *not* recommended.

Electrical requirements

The installation of electrical power supplies must comply with the rules and/or regulations imposed by the local authorities responsible for the use of electrical energy in the workplace.

Avoid using power supplies from a source that may be subject to electrical interference from other services (such as large electric motors, elevators, welders and air conditioning units).

Other electrical connections

USB

NOTE

Basic insulation is provided for single fault protection on the USB connector.

Gas supplies

The primary gas used by the MP-AES instrument is nitrogen, which is the supply gas for the plasma. A small quantity of argon is used in the plasma ignition cycle. Oil-free compressed air is used for the pre-optics protection gas. Other gases may be required for future options and accessories. Use only 'instrument-grade' nitrogen with your MP-AES instrument.

The installation of compressed or liquid gas supplies must comply with the rules and/or regulations imposed by the local authorities responsible for such use in the workplace.

See the Agilent MP-AES Site Preparation Guide for gas pressure requirements.

Liquid or gaseous argon and nitrogen may be used with the MP-AES instrument. Agilent recommends the use of liquid gases, which are more pure, more convenient and cheaper per unit volume.

The main gas supply requirements used with the MP-AES instrument are:

- Nitrogen – for the plasma and nebulizer gas supply
- Air – for the pre-optics protection gas
- Argon – only required during plasma ignition

Additional gas supply requirements used when the optional External Gas Control Module (EGCM) or Monochromator Air Purge accessories are installed are:

- Purge gas: nitrogen – for optics purging when analyzing elements below 185 nm, or air – for optics purging in corrosive environments

- Air – for supply of air to the plasma when analyzing organic samples

The MP-AES instrument is fitted with PTFE gas supply hose assemblies, 1.8 meters (6 feet) in length, and 1/4 inch Swagelok hardware.

The operator (or other authorized personnel) must carry out appropriate leak tests necessary to ensure safety on the gas connections that the operator is directed to assemble during installation, normal use or maintenance.

To avoid an unacceptable pressure drop in the tubing, the nitrogen and argon supplies from the regulator to the instrument should be not less than 3 mm internal diameter and not more than 10 m length. This will give a pressure drop of approximately 50 kPa in the tubing.

CAUTION

Use only the tubing supplied with the instrument (or equivalent quality) to deliver argon to the instrument. Inferior plastic or rubber tubing may cause ignition problems due to contamination of the argon by atmospheric gases.

Exhaust system

The plasma operates at extremely high temperatures. The MP-AES instrument exhaust fumes can be noxious or corrosive.

The MP-AES instrument exhaust must be directly connected to an exhaust system. The exhaust system must include an exhaust fan, be ducted to an external vent and provide a minimum flow of 3 m³/min (106 ft³/min).

The exhaust system installation must comply with any rules and/or regulations that may be imposed by the local authorities responsible for control of facilities and fixtures in the workplace.

The exhaust fan should be located at least 2 meters (6 ft, 6 in) away from the top of the MP-AES instrument chimney. The fan control switch and running indicator lamp should be located in a position where the instrument operator can view the indicator and access the control switch.

WARNING



Hot Surface

The external vent may become hot during MP-AES instrument operation and remain hot for some time after the MP-AES instrument has been switched off. Allow the external vent to cool for at least five minutes before attempting to remove the exhaust hose. Use heat-resistant gloves.

MP-AES instrument cooling air supply

The MP-AES instrument requires *clean, dry, non-corrosive air for cooling purposes*. This is supplied to the MP-AES instrument through an air supply vent located at the top, rear of the instrument. The vent has a dust filter, to filter out particulate matter.

The air supply is used to cool the internal mechanical and electronic components of the MP-AES instrument. Several of these assemblies contain parts prone to corrosion. The introduction of cooling air contaminated with high levels of acid vapors or other corrosive substances may cause damage to the MP-AES instrument.

Due to the corrosive nature of some analytical work, it is recommended that in applications demanding high usage of corrosive materials, an external cooling air supply system is provided. It is *required* that the cooling air be supplied from an environmentally-controlled area that is away from the MP-AES instrument exhaust and any other area where corrosive materials are stored or used. Do not duct humid, warm air into an MP-AES instrument in a cooled laboratory environment.

The cooling air system with flue, fan, ducting and supply cowl, must provide a minimum positive flow of 3 m³/min (106 ft³/min). The ducting should be corrosion-resistant and fire-proof.

Drain vessel

The MP-AES instrument needs a drain vessel for disposal of excess fluids and vapors from the spray chamber. Suitable tubing is supplied with the MP-AES instrument for use with inorganic solvents. When using organic solvents, different drain tubing that is suitable for the solvent in use will be required.

A chemically-inert container, not glass, to hold a minimum of 2 liters (4 pints) of waste must be provided by the user. It should be located underneath the sample tray (or on the right side of the MP-AES instrument), where it is protected by the bench and in full view of the operator.

Disposal of all chemical waste must comply with any rules and/or regulations that may be imposed by the local authorities.

Personal computer requirements

The recommended and minimum PC specifications can be found in the Agilent MP-AES Site Preparation Guide.

Locate the PC keyboard and mouse for ergonomically correct access.

Weights and dimensions

For the weights and dimensions of your MP-AES instrument please see the Agilent MP-AES Site Preparation Guide.

WARNING



Heavy Weight

Danger to feet and hands. The Agilent MP-AES instrument weighs approximately 73 kg (161 lb). To avoid injury to personnel or damage to equipment, always use a fork lift or other suitable lifting device when moving the MP-AES instrument.

Position the MP-AES instrument on the bench to allow easy access to the power switch located on the right side of the instrument.

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3. Installation

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The Agilent MP-AES instrument must be installed by an Agilent-trained, Agilent-qualified or Agilent-authorized field service engineer.

You should have completed and returned the form in the Agilent MP-AES Site Preparation Guide stating that you have prepared the laboratory in accordance with the requirements detailed in that guide.

Details for unpacking the MP-AES instrument and what to do in case it has been damaged in transit are also outlined in the site preparation guide.

Agilent MP-AES Instrument Overview

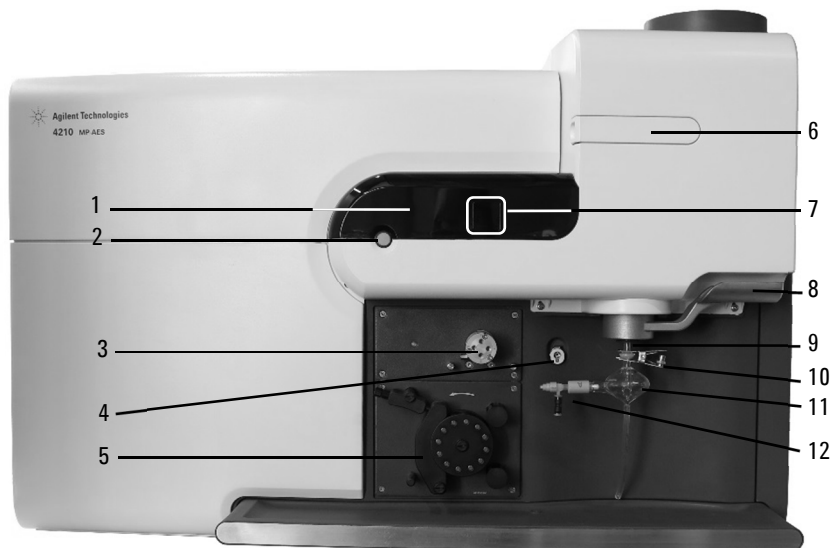


Figure 1. Front of the MP-AES instrument

Where:

1. Power status LED	5. Peristaltic pump	9. Torch
2. Plasma Enable button/ status LED	6. Pre-optics window access door	10. Torch clamp for spray chamber and torch
3. Optional AVS 4 Switching Valve accessory	7. Plasma viewing port	11. Spray chamber
4. Nebulizer gas supply	8. Torch loader handle	12. Nebulizer

NOTE

If the Plasma Enable button is used to extinguish the plasma, you will need to reset the Plasma Enable button to the 'Enable' (pushed in) position before the plasma can be re-ignited.

All connections of services to the MP-AES instrument are made on the right side of the instrument. Remove the cover by hand to gain access to the power, USB, accessory, and gas connections. The onboard argon bottle and regulator (if used) are also accessed via this side cover.



Figure 2. Input and output connections on the side of the MP-AES instrument

Item	Description
1 Accessory port	DA-15 receptacle For connection of Agilent-specified accessories only
2 Sampler port	DE-9 plug. RS-232 port for connection of the Agilent SPS 3 autosampler
3 Power switch	Combination power switch and main circuit breaker (12 A) for the MP-AES instrument
4 Power inlet	IEC-C14 mains power inlet receptacle Accepts IEC-C13 mains lead
5 USB port	USB type B receptacle. Supports USB 2.0 Full Speed Length of USB cable to PC is to be a maximum of 3 m (10 ft)
6 Gas inlets	Connect required gas supplies
7 Onboard argon bottle location	Onboard argon bottle location

Installing the MP Expert Software

Although the Agilent-trained, Agilent-qualified or Agilent-authorized field service engineer will install the MP Expert software for you during the installation process, you may need to install the software yourself at some later stage, for example if you change the PC.

NOTE

Install the MP Expert Software first, and then plug the USB cable into the computer.

To install the MP Expert software:

- 1 Log on to the instrument computer with Administrative rights.
- 2 Insert the MP Expert Software disk in your CD-ROM drive. The software will automatically start¹.
- 3 Follow the instructions on the screen.
- 4 Click **Yes** to restart the computer if prompted.
- 5 Plug the USB cable into the USB port on the MP-AES instrument and then into a USB port on the computer.
- 6 Once installation is complete, you will need to register your MP Expert Software. To start the MP Expert software, double-click the MP Expert icon on your computer desktop. Complete the Software Registration, if requested to do so, referring to the Help if required.

TIP

To familiarize yourself with the MP Expert software, after installation, double-click the MP Expert icon on your computer desktop. When the MP Expert Help appears, click the **How to** link to view step-by-step instructions on how to use the MP-AES instrument.

¹ If you have turned off the auto-start capability of your CD-ROM drive, you will need to run the MPExpertSetup.exe file on the disk.

Hardware Components Replacement

Your MP-AES instrument should be ready to operate after the Agilent field service engineer has installed it. However, during use you may need to set up items such as the pre-optics window, torch, spray chamber, nebulizer or peristaltic pump tubing.

To find instructions on how to replace these items, double-click the MP Expert Help icon on your computer desktop (or, with the MP Expert software open, press F1 on your keyboard). Expand the 'How To' section and then select the appropriate topic.

NOTE

Torches used with Agilent 4100 MP-AES instruments are different from the torches used with the Agilent 4200 and 4210 MP-AES instruments and are not interchangeable. Torches for the 4100 MP-AES have a grey base (**Figure 3**). Torches for the 4200 and 4210 MP-AES have a blue base (**Figure 4**).



Figure 3. 4100 MP-AES EasyFit torch



Figure 4. 4200 and 4210 MP-AES EasyFit torch

Accessories

The following accessories may be available for use with your MP-AES instrument:

- Organic solvents kit
- External Gas Control Module (EGCM)
- SPS 3 and SPS 4 Autosamplers
- Advanced Valve System (AVS) 4
- SVS 1/1+ Switching Valve System
- SVS 2 Switching Valve System
- Agilent 4107 Nitrogen Generator
- Multimode sample introduction system (MSIS)
- Monochromator air purge

For installation information, please see the accessory documentation provided with the accessory or the MP Expert Help.

NOTE

You must turn off the MP-AES instrument when accessories are plugged into or unplugged from the Accessory Port.

Organic solvents kit

For safety information and to install the kit on the MP-AES instrument, please see the instructions that came with the application kit.

If organic solvents are used, special organic resistant pump tubing is highly recommended.

External Gas Control Module (EGCM)

For safety information and to install the EGCM on the MP-AES instrument, please see the instructions that came with the accessory.

The EGCM is an accessory with two specific functions:

- Supply nitrogen gas to purge the optics system for analytical measurements below 185 nm
- Introduce a small amount of air into the plasma for the analysis of organics. The air facilitates the analysis of organics by MP-AES instrument techniques by reducing carbon buildup and background signal resulting in lower detection limits when analyzing organic solutions.

SPS 3 and SPS 4 Autosampler

For safety information and to prepare the SPS 3 or SPS 4 for installation, please see the instructions that came with the accessory.

The SPS 3 and SPS 4 are compatible with a wide range of commercially available low-cost autoclavable sample racks.

Sample contamination from airborne particles is eliminated and corrosive or toxic fumes are removed during sampling with the optional environmental enclosure.

Advanced Valve System (AVS) 4

For safety information and to prepare the accessory for installation, please see the instructions supplied with the accessory.

The integrated AVS 4 (4 port switching valve) rinses the sample introduction system while the next sample is being readied for analysis prior to measurement. Excess sample is diverted away from the spray chamber and rinse is introduced immediately after measurement. This will increase productivity, reduce sample carry-over and required cleaning frequency of sample introduction components.

SVS 1/1+

For safety information and to prepare the SVS 1 or SVS 1+ for installation, please see the instructions that came with the accessory.

The SVS 1/1+ is a 4-port switching valve positioned between the spray chamber and the peristaltic pump of the spectrometer. During the rinse time, when the instrument is usually idle, the autosampler cleans the probe and presents the next sample for measurement, increasing productivity. Excess sample is diverted away from the spray chamber immediately after measurement, reducing sample carry-over.

SVS 2

For safety information and to prepare the SVS 2 for installation, please see the instructions that came with the accessory.

The SVS 2 increases sample throughput and decreases turnaround time and operating costs. The SVS 2 features triple-stacked, 4-port switching valve positioned between the spray chamber and the peristaltic pump of the spectrometer. Samples are quickly loaded into the SVS 2 sample loop, ready for immediate analysis by the MP-AES, greatly reducing sample uptake delays. Pre-emptive rinsing of the sample line means analysis times are reduced. The SVS 2 also features an internal T-piece within the valve, reducing dead volume and providing online addition of internal standard and ionization buffer solutions. A bubble injector automatically injects bubbles after the sample is loaded into the loop, isolating the sample from the rinse solution. This reduces the volume of sample required for measurement as tailing (or dilution) effects are minimized.

Agilent 4107 Nitrogen Generator

For safety information and to prepare the nitrogen generator for installation, please see the User's Guide that came with this accessory.

The Agilent 4107 Nitrogen Generator can be used to provide a nitrogen supply for the MP-AES instrument and ECGM. This allows the instrument to operate without the need for a cylinder or Dewar nitrogen supply. A supply of clean, dry, oil-free compressed air is required to supply the nitrogen generator and the MP-AES instrument. This can be supplied from an in-house supply (if it meets the flow and purity requirements) or a commercial air compressor. For details on the required air flow and purity requirements for the nitrogen generator, please see the Agilent MP-AES Site Preparation Guide.

NOTE

Separate nitrogen generator units must be used to supply the nitrogen to the MP-AES instrument and the ECGM.

Multimode sample introduction system (MSIS)

For safety information and to prepare the MSIS for installation, please see the instructions that came with this accessory and the MP Expert Help.

The MSIS is used with the MP-AES instrument to provide simultaneous vapor generation of several hydride forming elements, enabling determination with low ppb detection limits.

The MSIS consists of the OneNeb nebulizer and modified glass cyclonic spray chamber that has two vertical conical tubes in the center of the chamber. This allows for reductant and sample to mix quickly and thoroughly in the chamber using thin film hydride technology to form the hydrides.

The MSIS can be operated in three modes: hydride only, simultaneous hydride and conventional nebulization or conventional nebulization only.

Monochromator air purge

For safety information and to prepare the monochromator air purge accessory for installation, please see the instructions that came with this accessory and the MP Expert Help.

The monochromator air purge accessory provides clean air to the MP-AES instrument monochromator to maintain it at a positive pressure. This should be used to prevent the ingress of dust and corrosive vapors from the laboratory environment.



4. Operation

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This chapter provides a quick guide to getting the Agilent MP-AES instrument set up and running samples.

You will find step-by-step instructions for common operations in the MP Expert Help. To access this information:

- 1 Double-click the MP Expert Help icon on the computer desktop.
- 2 When the MP Expert Help appears, click **How to** to view the available step-by-step instructions.

Analysis Checklist

You need to complete the following steps in turn to measure a solution. You will find information on each step in this chapter.

- Turn on the MP-AES instrument and open the software
- Prepare for analysis
- Perform a wavelength calibration of the MP-AES instrument
- Create/open a worksheet
- Develop a method

- Run samples
- Print a report

Turning On the MP-AES Instrument and Software

Before starting the system, carefully read the Safety Practices and Hazards section at the front of this guide and ensure that the laboratory is set up according to the details specified in the Agilent MP-AES Site Preparation Guide.

To turn on the MP-AES instrument and start the software:

- 1** Check that the exhaust and intake lines are secured to the MP-AES instrument.
- 2** Ensure the gas lines are connected to the MP-AES instrument and that the gas supplies are turned on and set to the correct pressures.
- 3** Check that the USB and power cables are plugged in.
- 4** Check that the pre-optics window is clean and correctly installed and that the interlock is engaged.
- 5** Check that the torch is clean and in good condition.
- 6** Insert the torch and completely close the torch handle. Fit the spray chamber socket to the ball joint on the base of the torch and secure using the torch clamp.
- 7** Check that all tubing on the spray chamber, nebulizer and peristaltic pump are correctly connected.
- 8** Switch on the computer, monitor and printer.
- 9** Switch on the laboratory exhaust system.
- 10** Turn on the MP-AES instrument.
- 11** Ensure that the Plasma Enable Switch is in the Enable state (pushed in).

WARNING**Hot Surfaces – Noxious Fumes – Non-Ionizing Radiation**

Burn danger, inhalation hazard. The plasma emits heat, ozone and fumes, which can be hazardous. Always switch on the exhaust system before lighting the plasma.

- 12 To start the MP Expert software, double-click the MP Expert desktop icon. The 'Main Index' window will appear.

Preparing for Analysis

To prepare for analysis:

- 1 Click the **Plasma** button in the MP Expert software. Alternatively, press F5 or choose **Plasma on** from the arrow under the **Plasma** button.
- 2 Ensure that the peristaltic pump is correctly set up (refer to the Peristaltic Pump section of the Help). If you have not already done so, adjust the pressure bars on the peristaltic pump for even sample flow.
- 3 Place the sample tubing from the peristaltic pump into the rinse solution and the drain tubing into the drainage vessel.
- 4 Click the **Pump** button in the MP Expert software and choose **Normal (15 rpm)** from the arrow under the **Pump** button. The pump will be initialized and the solution will begin aspirating.

NOTE

See the MP Expert Help for instructions on how to adjust the peristaltic pump pressure bars.

NOTE

For optimum performance and stability, for the MP-AES instrument a warm up time of 30 minutes is recommended, from standby.

NOTE

When using the nitrogen generator, a purge time of up to 20 minutes is required from power on, depending on the prior usage history, to allow the nitrogen generator to achieve required nitrogen purity.

NOTE

The plasma will take between 10–15 seconds to ignite. If it fails to ignite, refer to the Troubleshooting section in the Help for further information. In addition, the plasma can be run dry (no solution) without damaging the torch.

CAUTION

The plasma cannot be run without the spray chamber and nebulizer gas supply connected. Doing so will damage the torch.

MP-AES Instrument Wavelength Calibration

Refer to the Help for information about what a wavelength calibration is, and how to prepare the wavelength calibration solution.

To perform an MP-AES instrument wavelength calibration:

- 1 If you are using a 4100 MP-AES, ensure a standard glass concentric nebulizer, a single pass spray chamber and 4100 EasyFit plasma torch are installed. If you are using a 4200 or 4210 MP-AES, ensure the OneNeb nebulizer, double pass spray chamber and 4200 and 4210 EasyFit torch are installed. Use manual sampling for both models.

NOTE

You must install the correct peristaltic pump tubing for the wavelength calibration:

	Pump	Drain
4100 MP-AES	White/white	Blue/blue
4200 and 4210 MP-AES	Orange/green	Blue/blue

- 2 Click the **Instrument** button.
- 3 Click **Calibration**.
- 4 Place the solution inlet tubing into the wavelength calibration solution and allow the sample to reach the plasma.
- 5 Click **Calibrate Instrument**. The torch will be aligned and then a wavelength calibration and a calibration check will be performed automatically.
- 6 After a short while, an indication of the success or failure of the calibration check will appear, as well as an indication of the wavelength offsets.
- 7 If the calibration fails, check the sample introduction system. If the system seems fine, prepare a new wavelength calibration solution and try again, or consult the Troubleshooting section of the MP Expert Help.

Creating/Opening a Worksheet

Creating a new worksheet

To create a new worksheet, click **New** from the Start page or the File menu.

A list of recently used files will be presented when creating a new worksheet from a template; otherwise you may Browse for more files. The 'New From Template' dialog box will be displayed in this instance.

Opening an existing worksheet

To open an existing worksheet:

- 1 Click **Open** from the Start page or from the File menu.
- 2 A list of recently used files will be displayed. Otherwise, you may **Browse** for more files. The '**Open**' dialog box will be displayed in this instance.

NOTE

If you attempt to open a worksheet that is setup for use with a model other than the one currently connected, you will be prompted as to whether or not you would like the worksheet to be converted or that it will be opened as a Read-only file. Converting the worksheet will ensure that all settings are compatible with the connected instrument. Any changes that have been made will be visible in the Operation Log of the worksheet.

It is recommended that the conditions are re-optimized after a conversion has taken place.

Creating a new worksheet from a template


To create a new worksheet from a template click **New From** on the Start page or **New From Template** from the File menu.

A list of recently used files will be presented, otherwise you may **Browse** for more files. The '**New From Template**' dialog box will be displayed in this instance.

The Worksheet window will appear with the new worksheet loaded.

Developing a Method

To develop a method:

- 1 Open a new worksheet or one from a template.
- 2 On the 'Elements' page, select the element(s) from the 'Element' drop-down box or type the element name or symbol and then perform one of the following:
 - a Click  to add the primary wavelength for the selected element.

- b** Highlight the wavelength you wish to use from the list of available wavelengths displayed. Click **Add**.

NOTE

Alternatively, press CTRL and the element from the periodic table to add the primary wavelength for the selected element to your method.

The element will appear in the table with the selected wavelength and default settings selected.

- 3** Check that there are no interferences or other analytical lines close to the selected analytical line. Their relative intensity will govern how close the lines can be to each other. For example, if your matrix contains an element that is not of analytical interest, but is a potential interferent and has a line close to one of your analytical lines, the concentration of that element in your matrix will determine whether you need to choose another analytical line.
 - 4** Make any required adjustments to each element including selecting a different wavelength, entering additional information into the 'Label' column, selecting the type of sample (choose from analyte, internal standard or interferent) and the type of background correction is to be used.
 - 5** Enable QC and/or IEC in the Configuration tab if these features are going to be used. (Available only on the full version of the MP Expert software.)
 - 6** Click **Conditions** to modify both common settings for the run and settings for each element. Nebulizer gas settings and viewing positions can now be optimized.

NOTE

The software can automatically determine and set the optimal operating conditions for each element. For detailed information on how to select the conditions, see the MP Expert Help > Software > Worksheet Page > Conditions.

-
- 7** Click **QC** (if enabled) to enter the method detection limits, select the QC tests to be used and which error actions should be performed if an error occurs.

- 8 Click **Standards** to enter the concentration of the elements in your standards and select whether to use other options such as Standard Additions or MultiCal.
- 9 Click **IEC** (if enabled) to enter the concentration of the elements in your IEC standards.
- 10 Click **Sequence** to specify the end of run actions, number of samples, select the solution type and edit the sample labels.
- 11 If you are using an autosampler, click the 'Autosampler' tab to select the racks and probe depth (if needed). Depending on the autosampler selected, options may vary.

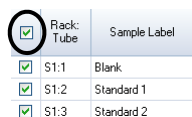
NOTE

See the MP Expert Help for a more detailed description of setting up a method.

Running Samples

To run samples:

- 1 Click the **Analysis** tab and do the following:
 - a Ensure your samples are selected. This will be indicated by a check next to the Rack:Tube column. To select all solutions, select the checkbox next to the Rack:Tube title.



<input checked="" type="checkbox"/> Rack:Tube	Sample Label
<input checked="" type="checkbox"/> S1:1	Blank
<input checked="" type="checkbox"/> S1:2	Standard 1
<input checked="" type="checkbox"/> S1:3	Standard 2

- b Click the **Run** icon in the toolbar (or press the SHIFT+F8 keys) to begin the analysis, and follow the subsequent prompts.

NOTE

For further information about running an analysis, refer to the MP Expert Help.

Printing a Report

To print a report:

- 1 Click **Report** on the toolbar or **File > Report**.
- 2 Choose whether you want to print or preview the report or save the report as a PDF file.

TIP

Previewing the report allows you to ensure that you have included all of the data you require.

-
- 3 Select the report template and then click **Open**.
 - 4 Click the **Print** button to generate a report as specified. A message will appear briefly indicating the progress status of the report being generated.
 - 5 The Print dialog box will then be opened. You can select to print all of the report, or a range of pages. Reports are printed to your default printer, unless you specify otherwise. You can specify your printer options in the Print Setup dialog box, accessible from the **File** menu.

As the Print dialog box is a standard Windows dialog box, you can obtain 'What's this' help on an item by clicking the question mark icon in the top right corner and then clicking the item of interest.

Turning Off the MP-AES instrument

To turn off the MP-AES instrument:

- 1 Rinse the spray chamber by aspirating water (or the appropriate solvent for your application) for a few minutes.

NOTE

When running organic samples it is recommended that the spray chamber be cleaned and dried thoroughly between analyses.

-
- 2 Remove solution tubing from the solution. Using the peristaltic pump, pump all solution from the sample line, nebulizer and spray chamber and then continue to run for another 30 seconds to ensure that the sample introduction system is solution free.

- 3 Extinguish the plasma by choosing **Plasma Off** from the **Plasma** button drop-down arrow or pressing SHIFT and F5 on the keyboard. The peristaltic pump stops automatically when the plasma is extinguished.

NOTE

The green Plasma enable button, located on the front of the MP-AES instrument, is intended to be used only in an emergency. It is not intended to be used every time you want to extinguish the plasma. If it is used to extinguish the plasma, you will need to reset the Plasma enable button to the 'on' position before the plasma can be re-ignited.

-
- 4 The mains power switch can be left on.
 - 5 To increase the pump tubing lifetime, loosen the pressure on the peristaltic pump tubing by releasing the pressure bars and lifting the tubing out of the grooves in the tube retainer. To do this:
 - a Push up the pressure bar tensioners. (1 in Figure 5). This releases them from the pressure bar.
 - b Allow the pressure bar to swing backwards. (2 in Figure 5)
 - c Lift the tubing out of the grooves in the tube retainer. (3 in Figure 5)

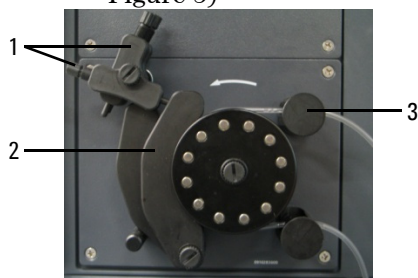


Figure 5. Peristaltic pump components

If you would like immediate operation next time the MP-AES instrument is started, leave the PC and gas on. Close the worksheet by choosing **Close** from the **File** menu but leave the MP Expert software running. You may switch off the printer, monitor and any accessories.

It is recommended that the power save option on your PC is disabled.

WARNING



Noxious Fumes

Asphyxiation danger. The exhaust system **MUST remain on if the gas supplies are on.**

NOTE

If the MP-AES instrument is not going to be in use for a period of time the torch should be cleaned of any deposits, dirt or residue. For further information about cleaning the torch see Page 49.

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5. Maintenance, Spare Parts and Troubleshooting

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This chapter includes the Agilent MP-AES instrument maintenance requirements that may be carried out by an operator. Any maintenance procedures not specifically mentioned in this chapter should be carried out only by Agilent-trained, Agilent-qualified or Agilent-authorized field service engineers.

WARNING



Shock Hazard

The MP-AES instrument contains electrical circuits, devices and components operating at dangerous voltages. Contact with these circuits, devices and components can result in death, cause serious injury, or painful electrical shock.

NOTE

This section refers to maintenance procedures for the MP-AES instrument. You should refer to your PC and printer documentation for their maintenance procedures, and to the MP Expert Help for the maintenance procedures for any accessories you ordered.

Routine Maintenance

The following parts of the MP-AES instrument require routine maintenance.

Daily

- Check and, if necessary, empty the drain vessel.
- Inspect the torch condition and cleanliness. Clean as necessary. See Page 49.
- Clean the surface of your MP-AES instrument (spills should be cleaned up immediately).
- Inspect the pump tubing and replace if it has lost its elasticity. Unclip the pump tubes when the pump is not in use.

Weekly

- Inspect the spray chamber for cleanliness. Clean as necessary. See Page 50.
- Clean the nebulizer.
- Inspect the pre-optics window for cleanliness. Clean or replace as necessary.

Monthly

- Clean the air inlet filter on top of your MP-AES instrument.
- Perform an MP-AES instrument calibration.
- Inspect the external gas supply system for leaks including the tubing connected to the MP-AES instrument. Replace any damaged, leaking or worn components.

To find instructions on how to perform maintenance procedures double-click the MP Expert Help desktop icon or, with the MP Expert software open, press F1 on your keyboard. Expand the 'Maintenance' section and then select the appropriate topic.

Cleaning the MP-AES Instrument

Any spills in the sample compartment or on the MP-AES should be wiped up immediately. The user (or other authorized personnel) must perform the appropriate decontamination procedure if hazardous material is spilled on or inside the MP-AES instrument.

The exterior surfaces of the MP-AES instrument should be kept clean. All cleaning should be done with a soft cloth. If necessary, this cloth can be dampened with water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Before using any cleaning agent, procedure or decontamination method except those specified by Agilent, the user (or other authorized personnel) should check with your local authorized Agilent field service engineer or representative to confirm that the proposed method will not damage the equipment.

Cleaning the MP-AES Easy Fit Torch

To help you achieve the maximum usable life from your MP-AES Easy Fit torch, it is recommended that the following cleaning procedures are followed as soon as any discoloration appears on the outer tube of the torch. To maximize torch lifetime and prevent contamination, you should inspect the condition and cleanliness of the torch on a daily basis.

CAUTION

The torch is fragile. To prevent damage to the torch, always take care when handling or storing it.

For detailed torch cleaning instructions, see “Agilent MP-AES Easy Fit Torch Maintenance” (part number G8000-90019) available online at www.agilent.com or the MP Expert Help. Click ‘Maintenance’ and then select ‘Cleaning the torch’.

Store the torch in the original box or a plastic bag when not in use.

Cleaning the Spray Chamber

The ‘wetting’ of a spray chamber is its ability to produce a uniform coating of aerosol on the internal surfaces of the spray chamber. This uniform coating is essential for the efficient transport of aerosol from the spray chamber to the plasma torch.

The “wetting” of a spray chamber can be judged by observing the internal surfaces of the spray chamber while an acidified aqueous solution (typically 1-5%) is nebulized. A correctly ‘wetting’ spray chamber shows a uniform internal surface without large droplet formation (Figure 6).

A poor ‘wetting’ spray chamber is usually indicated by the appearance of large droplets on the internal surfaces of the spray chamber (Figure 7) and can be caused by the analysis of water miscible organic samples, contamination of the spray chamber, or improper handling or storage.



Figure 6. Correctly ‘wetting’ spray chamber with a uniform coverage



Figure 7. Incorrectly ‘wetting’ spray chamber showing droplets

A poor ‘wetting’ spray chamber can be fixed with thorough cleaning.

For detailed spray chamber cleaning instructions, see the MP Expert Help. Click ‘Maintenance’ and then select ‘Cleaning the spray chamber’.

Checking the Gas Supply Tubing for Leaks

When any gas cylinder is changed, inspect all gas hoses. Replace any hoses showing signs of damage or deterioration.

Test all connections for leaks using a commercial leak testing solution, a mild detergent, or an electronic leak detector.

When changing gas cylinders:

- check all gas supply pipes and hoses for leaks
- test the operation of all regulators
- ensure that shutoff valves are functioning correctly

Spare Parts

For details on spare parts and consumables ordering information, refer to the Agilent Technologies website:

www.agilent.com

To replace the items listed below, you must use Agilent-manufactured parts, which can be ordered online from the Agilent website or through your local sales representative.

The following is a list of recommended spares to keep on hand to minimize downtime during maintenance and repairs:

- Torch
- Air inlet filter
- Pre-optics windows
- Spray chamber
- Nebulizer
- Peristaltic pump tubing
- Drain tubing

Technical Support

For technical support contact information, refer to the Agilent Technologies website for details:

www.agilent.com

Troubleshooting

For troubleshooting information, please see the Help provided with the MP Expert software.

To access it, double-click the MP Expert Help on the computer desktop and then click **Troubleshooting**.

In This Guide

The guide describes the following:

- Safety Practices and Hazards
- Introduction
- Installation
- Operation
- Maintenance, Spare Parts and Troubleshooting

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