2 Precautions

This chapter describes Safety Information, Environmental Conditions, and Utility Requirements.

General Precautions

WARNING

- If you have a pacemaker or similar implanted device, consult your physician before using this instrument. This instrument can potentially affect pacemaker operation.
- The power cord set that is shipped with this instrument cannot be used with other products.
- Do not use any power cord other than that supplied with this instrument.

WARNING

Do not edit or change instrument parameters with any software except MassHunter.
This may result in impairment of the safety designs equipped in the instrument.
Also take sufficient precautions if you customize MassHunter operations using script files or other means.

CAUTION

The Agilent ICP-MS is a very safe instrument with many built-in protective features:

- A safety interlock shuts off the plasma if either of the top covers is opened during operation.
- A plasma viewing window provides eye protection.
- Sensors monitor the water and argon flow rate and pressure. If the water flow is too low to sufficiently cool the ICP-MS, or if the argon supply is insufficient, the plasma is turned off automatically.
- There are fans to help ensure that the instrument's internal temperature stays within the preset limits. The plasma is turned off automatically if any of these fans, except the QP fan, fail.
- Temperature sensors on the exhaust vent, instrument inside, and intake water line stop the plasma if overheating occurs.
- A manual switch shuts down the instrument immediately, even if the MassHunter Workstation is inoperable.

CAUTION

In case of uncertainty about a specific fluid, that fluid should not be used until confirmation by the manufacturer that it will not present a Hazard.

CAUTION

The bundled power supply cable and foreline pump power supply cable are for use exclusively with the ICP-MS. Do not use them for other devices or instruments.

CAUTION

Dealing with liquid spills

Refer to and follow the safety instructions on the MSDS (Material Safety Data Sheet) when available. Keep the instrument and the area around it clean. Simple spills such as foreline pump oil may be cleaned with a dry cloth, to be disposed of according to local regulations. In the case of large spills, use of a spill kit is recommended.

CAUTION

Before using any cleaning or decontamination methods except those specified by Agilent, please confirm with Agilent that the proposed method will not damage the equipment.

NOTE

To shut down the instrument quickly, turn OFF the main switch located on the lower center of the front panel. To switch the instrument to Standby mode and/or Shutdown mode without using MassHunter Workstation, a "**Vacuum ON/OFF Switch**" is available on the front panel inside. For positioning of the Vacuum ON/OFF Switch, refer to **Figure 1** on page 13.

CAUTION

- A sensor monitors the radio frequency (RF) generator and shuts it down if it is improperly matched to the RF coil.
- A fiber-optic sensor shuts off the RF high voltage power whenever the plasma is not present or is turned off manually.
  The ICP-MS MassHunter Workstation displays warning messages when the sensors first detect a problem, enabling you to stop work before the shutdown limits are reached.
- The parameters displayed in the instrument control window change from green to yellow/red as the shutdown limits are approached/reached.

In addition to the above safety features, the following precautions should always be taken during operation or maintenance:

- Check acid concentration. Continuous aspiration of a highly concentrated acid might attack the inside of the instrument.
- Close the instrument covers and panels before operation.
- Check the exhaust system for a positive extraction at the exhaust duct.
- Handle solvents correctly.
- Check the drain vessel frequently.
- Check the condition of the pipes, replace as needed.

Pay close attention to the cautions and warnings within this manual and the MassHunter Workstation online Help.

Precautions for Use

Protective Earth

WARNING

Connecting the ICP-MS to a power source that is not equipped with a protective earth contact creates a shock hazard for the operator and can damage the ICP-MS. Likewise, interrupting the protective conductor of the ICP-MS or overriding the power cord ground creates a shock hazard for the operator and can damage the instrument.

Closing the Instrument Panels and Covers

Close the instrument top covers before starting the plasma. Because the instrument can be optimized entirely via MassHunter Workstation, there is no need to open the front and side panels or cover after the plasma is ignited. In addition, a safety interlock shuts off the plasma if the cover is lifted.

WARNING

The external covers of the instrument protect the operator from internal hazards while the instrument is in operation. Exposure to high voltage and radio frequency radiation from the RF power supply is present and can be very dangerous.

Wearing Safety Glasses

WARNING

Eye Hazard

Always wear appropriate safety glasses when handling sample solutions and other chemicals, or when the plasma is on, in order to minimize the risk of eye damage by hazardous liquids and exposure to ultraviolet rays.

Checking the Exhaust System

WARNING

Asphyxiation Hazard

Laboratory must be equipped with ventilation system to supply continuous and sufficient fresh air from outside to prevent user from asphyxiation.

WARNING

Health Hazard, Asphyxiation Hazard

Laboratory must be equipped with exhaust system to remove harmful gases via a scrubber system to outside of the laboratory, to prevent user from asphyxiation. User safety requires that the exhaust gases from the plasma and vacuum systems be vented externally to the building and not recirculated by the environmental control system. Health hazards include chemical toxicity of solvents, samples, and foreline pump fluid vapor.

WARNING

Health Hazard

If the exhaust system stops for any reason, immediately shut off all gas supplies at the source.

- **Do not turn off the exhaust system while gas supplies are on.**
- **Do not cover the holes for air intake on the ICP-MS.**
- **If the exhaust fan is inoperable or there is insufficient air flow, do not start the ICP-MS until the appropriate maintenance personnel have repaired the problem.**

NOTE

The exhaust system must remain on at all times while the ICP-MS is on: in Analysis mode, Standby mode and Shutdown mode.

WARNING

Noxious Gases

If the exhaust system stops for any reason while the vacuum pump or ICP-MS are still running, immediately turn on the exhaust system or turn off the pump and instrument. If inadequate ventilation occurs, vaporized pump fluid, ozone, and other toxic combustion products will accumulate in the laboratory. Hydrofluoric acid (HF) fumes, if inhaled, cause extensive burning of lung tissue.

WARNING

Explosion Hazard

The laboratory exhaust system must always be operational and connected to the instrument exhaust vent. Potential health hazards and the risk of explosions may occur if exhaust gases are incorrectly ventilated.

WARNING

Personal Injury Hazard

Check that the hinge for the cover is operating correctly. If the exhaust system does not operate correctly, oil mist may cause the hinge of the small flip-up cover to malfunction, which may result in personal injury.

- **If you find any problems, please contact Agilent.**
- **Do not disconnect the exhaust hose from the foreline pump.**

WARNING

Toxic Gases

Immediately turn off the gas supplies at the source in the event the exhaust system is stopped for any reason. Refer to "Appendix H. Hydrogen Safety Guide" on page 165 and "Appendix I. Ammonia Safety Guide" on page 167. These, and other gases which may be used with the ICP-MS present a variety of risks.

CAUTION

Condensation

Ensure that the exhaust system is working correctly at all times. Instrument damage from condensation may occur due to reverse flow through the exhaust system.

IMPORTANT

Exhaust venting must comply with all local environmental and safety codes. Contact your Environmental Health & Safety (EHS) specialist.

Handling Solvents Correctly

WARNING

Organic and aqueous solvents can be hazardous if handled improperly. Unskilled, improper, or careless use of flammable solvents can create explosion hazards and fire hazards. This can result in death, or severe personal injury or burns. Always follow the precautions listed below to protect both operator and instrument:

- Read the Material Safety Data Sheet (MSDS) for each solvent used.
- Prepare samples and transfer acids under a fume hood with adequate extraction.
- Wear gloves when handling acids or solvents.
- Wear safety glasses when handling any liquids.
- Cover volatile samples to minimize exposure to fumes and possible explosion hazard.
- Clean any spillage immediately using the approved laboratory procedures.
- Store and prepare samples away from the instrument to prevent corrosion.
- Use sample uptake tubing that is compatible with the sample solvent being pumped.
- Solvent spillage into instrument: please call the customer contact center.

Acid digestion at atmospheric or increased pressure require these additional precautions:

- Apply heat slowly, watching for a possible reaction after each increase in temperature.
- Drip a second acid or washing aid slowly into a hot sample while watching for signs of a vigorous reaction.
- Cool the digested sample before you transfer it, or dilute it slowly with water.
- Never use perchloric acid in a pressure digestion.

WARNING

When using Organic solvents, extra caution should be observed. If the spray chamber drain is not pumped properly, the excess flammable solvents in the spray chamber may ignite and/or become explosive. If the torch injector clogs, the increased pressure in the spray chamber may cause the end cap to blow off exposing the solvent to ignition.

Checking the Drain Vessel

WARNING

The drain vessel contains the spray chamber effluent, which can be toxic. Improper handling of the vessel can result in a serious explosion or fire if incompatible substances accumulate. Corrosion of the vessel and connecting tube can result in leaks that may damage the instrument or cause bodily harm. If the effluent collected in the drain vessel contains toxic materials or solvents, follow approved laboratory procedures to safely dispose of this hazardous waste.

Ensure that the drain bottle is adequately ventilated (by the lab ventilation system, the same as for the ICP-MS mainframe) to deal with vapors from the bottle.

Clean the drain vessel every time you empty it by thoroughly flushing it with water. If it contained organic solvents, wash the drain vessel in acetone and allow it to dry.

Follow the procedures below to avoid exposure to the contents of the drain vessel:

- **When using organic solvent, please use a suitably sized waste container of appropriately resistant material for the collection of organic solvent.**
- **Place the drain vessel on the instrument table, where it is easy to check the liquid level.**
- **Tightly connect the drainage tubing from the spray chamber around the peristaltic pump to the drain vessel. Do not crimp the tubing.**
- **Check the drain vessel frequently. Empty it before you ignite the plasma.**
- **Be aware of the nature of the vessel contents. If the contents are toxic, dispose of them as hazardous waste. Also, always empty the vessel when switching from aqueous to organic sample solutions.**
- **Check the tubing and vessel for deterioration. If the tubing becomes brittle or cracked, replace it. Organic solvents generally cause more rapid deterioration than aqueous solutions.**

Compressed Gas Tanks

WARNING Do not set the cell gas supply pressure higher than the specification of the ICP-MS instrument.

WARNING Compressed gas tanks must be handled with care. The contents of the cylinders also may be hazardous, depending on the gases you choose to use. 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 can create an explosion hazard, a fire hazard, or can result in an oxygen-deficient atmosphere. Such hazards can cause death, serious injury, asphyxiation, anesthetic effects, and serious damage to equipment and property.

WARNING Consult the cylinder, regulator and/or gas supplier for additional safety measures and ensure all staff are fully familiarized with all safety precautions.

Storing Argon Safely

WARNING

Argon, which is used to create the plasma, is a dangerous gas only if it displaces the air you are breathing or is mishandled in its storage cylinder. Take the following precautions to prevent an explosion or suffocation hazard:

- Secure the cylinder valve caps and move the cylinder with an approved handcart.
- Gas cylinders releases release gas through a pressure-relief device under excessive heat. Always follow the gas supplier's recommendations for storage and use temperatures.
- Make sure that cylinders stored outside are not in direct sunlight or subjected to extreme temperatures. Place the cylinder on a level surface above ground.
- Attach the argon hoses tightly to both the instrument and gas source. Route the hoses so they cannot be damaged or crimped. Check for leaks using an electronic leak detector or pressure test.
- Make sure that there is adequate ventilation around the gas cylinders, especially if they are placed in a small storeroom.

Cell Gas

WARNING

Health Hazard

The exhaust gas tubing from foreline pump must be always connected to the rear port of the ICP-MS instrument to ensure that the cell gas evacuated by the foreline pump is exhausted via the external duct. Health hazards include the possibility of flammable, toxic or asphyxiating gas entering the room air.

WARNING

Health Hazard

Close all gas supply valves to the ICP-MS instrument before turning off the vacuum system. Health hazards include the possibility of flammable, toxic or asphyxiating gas accumulating in the vacuum chamber or instrument enclosure.

Individual stop valves must be installed for all gas lines for each individual ICP-MS instrument.

WARNING

Flammable gas (e.g. Hydrogen) and combustion-supporting gas (e.g. Oxygen) must always be placed in separate safety cabinets.

WARNING

Fully and strictly adhere to all local and national regulations and guidelines for the proper storage, handling and transport of all gases.

Other Gas

WARNING

- All Gases must be handled with care.
- Refer to "Appendix H. Hydrogen Safety Guide" on page 165 and "Appendix I. Ammonia Safety Guide" on page 167. Pay careful attention to safety management when using these gases.
- Only 80/20 mix of Ar/O_2 should be used for the option gas. If higher concentrations of oxygen gas are used, there is an increased risk of explosion or fire.
- Refer to the MSDS (Material Safety Data Sheet) for all gases for safe handling information.
- Check for gas leaks periodically using the appropriate tools (leak detector, pressure test, etc.)

Allowing the Hot Instrument to Cool

WARNING

The torch and interface remain hot after the plasma is turned OFF. Do not touch the torch box or interface cones for 10 minutes after turning off the plasma to let them cool.

Torch Box Cover

CAUTION

Always re-attach the torch box cover after maintenance. This cover reduces the emission noise from the plasma.

Peristaltic Pump

WARNING Take care when you open and close the clamp of the peristaltic pump. Otherwise, you could get your finger caught between the stator and the rotator, or between the stator and the stopper.

Foreline Pump

WARNING Foreline Pump oil is flammable. Keep away from fire.

WARNING The pump oil may be very hot. Direct skin contact may cause burns.

If foreline pump oil is accidentally spilled on skin, in mouth, or eyes; wash immediately and thoroughly and seek expert medical attention.

WARNING The surface of the Foreline Pump may be HOT, do not touch the pump until it has cooled.

Air Intake

CAUTION Do not cover the holes for air intake on the ICP-MS.

Cautions for Toxic Materials

WARNING

There is a toxic hazard associated with disposal of components that contain beryllium or polyvinyl chloride (PVC.) Use caution to dispose of components that contain these materials.
The following components used in this instrument contain beryllium compounds (Table 4) or PVC (Table 5):

NOTE

Part numbers listed may be manufacturing part numbers (non-orderable; subject to change). As necessary, use the part description to identify components listed in tables 2 and 3 for disposal.

WARNING

Table 4. Parts list including beryllium compounds

Agilent P/N	Description
G3280-40460	Feedthrough for Quad
G3280-60025	QPHV-1 Cable Assy
G3280-60026	QPHV-2 Cable Assy
G3280-60361	Power Sensor Assy for RF
G3280-60406	Wire Assy for Quad Cable 1
G3280-60407	Wire Assy for Quad Cable 2
G3280-60408	Wire Assy for Pre-Filter Cable 1
G3280-60409	Wire Assy for Pre-Filter Cable 2
G3280-60630	Hermetic Assy
G3280-60808	Capacitor Assy
G3280-60809	Capacitor Assy
G3280-60810	Capacitor Assy
G3280-61011	RF Combiner-A PCA
G3280-65001	Detector PCA
G3280-65017	RF Power Module PCA
G3280-65031	QP Detector PCA
G3280-65237	Cell Driver PCA
G3280-65250	Entrance PCA
G3280-80101	Opt Gas Flw Ctlr (80 Ar/20 O_2) w/Inlet Valve
G3280-80102	NH3 Mass Flow Controller

WARNING

Table 5. Parts list including PVC

Agilent P/N	Description
0890-2417	Vinyl Tube 5 mm ID x 8 mm OD
5042-0917	Sample Uptake Tubing for sample intro,12 pk
5042-4709	Tubing
5043-0015	Flared Sample uptake tube, id 0.25
5064-8091	Motor Assy
5064-8099	5 Port Solenoid Valve
5182-7263	FAN 109R1224H141
G1833-80217	HVB51X0340-FL-248390
G1833-80388	VINYL CASE 280 x 110
G1833-80413	SPRING HOSE TE 25 x 33 x L 1.5 m
G1833-80414	SPRING HOSE TE 25 x 33 x L3 m
G1833-80422	HOSE NCB 12-10 m
G1833-80423	HOSE NCB 12-3 m
G3270-61020	Cable for Ar AMFC
G3280-60027	QP Detector Signal Cable
G3280-60028	QP Detector Power Cable
G3280-60029	QP RF Signal Cable
G3280-60030	QP Tank Diagnostic Cable
G3280-60031	QP DC Cable
G3280-60032	RF Power Sensor Cable Assy
G3280-60033	Unbalance Cable Assy
G3280-60034	RF Drive Power Cable Assy
G3280-60036	Cable: RF to MNB (for Phase Signal)
G3280-60037	XY Motor Cable Harness Assy
G3280-60038	Z Motor Cable Assy
G3280-60039	XY Start Pos Sensor Cable Assy
G3280-60040	Z Pos Sensor Cable Assy
G3280-60041	RF+48 V Monitor Cable Assy
G3280-60047	Cable: Main Board to ORS Board
G3280-60048	Cable: Main Board to Quad Board
G3280-60049	Cable: Power Supply to Connection Board
G3280-60050	Cable: Sample Intro Brd to S/C Connector
G3280-60051	Cable: Intro Board to 1st PeriPump
G3280-60052	Pulse Driver Cable

Table 5. Parts list including PVC (continued)

Agilent P/N	Description
G3280-60054	Pulse Cable: Detector Board to Main Board
G3280-60055	Cable: (Flat) for HV Board Connection
G3280-60059	Power Cord w/IEC60309 plug and connector
G3280-60060	Power Cord (w/IEC60309 and NEMA L6-30P)
G3280-60061	Cable: Main Board to Connection Board
G3280-60062	Cable: Main Board to Connection Board, 1
G3280-60063	Cable: Main Board to Connection Board, 2
G3280-60065	Cable: HV Board A to HV Board B
G3280-60066	QP 48 V Cable
G3280-60067	Thermo Sensor
G3280-60205	Cbl: XYZ Init Sw/Small Cvr Sens-Intro Bd
G3280-60207	Cbl: Turbo Pump On/Off Sw-Connection Bd
G3280-60310	Inlet Temperature Sensor
G3280-60319	Fan assy for MNB
G3280-60371	Cable assy for cell driver
G3280-60801	Switch and Valve Harness
G3280-60802	Harness Cbl: XYZ Bd/RF Gen/Int Bd-Main Bd
G3280-60803	Cable: Octopole Driver Board Connection
G3280-60804	Cable: Plasma RF 48V Line
G3280-60805	Cover Switch Interlock
G3280-60811	Cable for Pirani Gauge
G3280-65017	RF Power Module PCA
G3280-65245	HV Board B (PCA)
G3280-80000	Power Supply
G3280-80006	Motor for MNB
G3280-80300	Motor for XYZ
G3280-80480	Vacuum Hose (Housing to Vacuum Manifold)
G3280-80482	Vacuum Hose (Turbo Pump to Backing Valve
G3280-80501	Vacuum Hose for Interface
9499330M008	Foreline Pump (DS402)
9499225M006	Foreline Pump (MS40+)

Moving the Agilent ICP-MS

CAUTION

Observe the precautions below when relocating the ICP-MS.

- Make sure the Main Power Breaker (located on the rear) is turned OFF before moving the instrument.
- Make sure all the cables between other units are unplugged and the utility tubing are disconnected before moving equipment.
- At time of installation, and upon instrument movement, please check for leaks using an appropriate device.
- Before moving the instrument, secure the torch box using the shipping clamp.

WARNING

The ICP-MS is heavy (about 100 kg), so if you need to lift the instrument, it should be lifted by at least 4 people or with a mechanical lifter.

WARNING

If the exhaust fan is inoperable or there is insufficient air flow, do not start the plasma until the appropriate maintenance personnel have rectified the problem.

Do not cover the holes for air intake on the ICP-MS.

Environmental Conditions, Compliance and Utility Requirements

Environmental Conditions

This instrument is for indoor use only.

This equipment meets the following IEC classifications:

- Pollution Degree 2 (See Note.)
- Installation Category II (See Note.)
- Equipment Class 1

NOTE

"Pollution level" describes the degree to which a solid, liquid, or gas which deteriorates dielectric strength is adhering. "2" applies to a normal indoor atmosphere.

"Installation category" implies the regulation for impulse withstand voltage. It is also called the "Over voltage category". "II" applies to electrical equipment

This equipment requires the following space for ventilation, maintenance access, and easy access to the Main Power Breaker Switch. There must be a clear space of at least 60 cm (24 in) on all sides of the equipment. The bench in your laboratory must be able to support the entire ICP-MS system and other laboratory equipment.

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.

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

EMC Declaration for South Korea

사용자안내문

This equipment has been evaluated for its suitability for use in a commercial environment.
When used in a domestic environment, there is a risk of radio interference.

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환 경에서 사용하는 경우 전파간섭의 우려가 있습니다.

ICES/NMB-001

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Sound Emission Certification for Federal Republic of Germany

Sound pressure

Sound pressure Lp < 70 dB(A) according to DIN EN ISO 7779.

Schalldruckpegel

Schalldruckpegel LP < 70 dB(A) nach DIN EN ISO 7779.

Electrical Power (Voltage, Frequency, Amperage, Phase)

200-240 VAC, 50/60 Hz, 30 A, single phase

Supply voltage fluctuations are not exceed 10 % of the nominal supply voltage.

Argon Gas Supply

Minimum Purity:	99.99 %
Maximum Flow Rate:	20 L/min
Supply Pressure:	500 to 700 kPa

Cell Gas Supply

Gas:	Helium, Hydrogen
Minimum Purity:	99.999 %
Maximum Flow Rate:	He 12 mL/min, H_2 10 mL/min
Typical Pressure:	He 90-130 kPa, H_2 20-60 kPa

Cooling Water

Inlet Temperature:	15 to 40 °C
Inlet Pressure:	230 to 400 kPa
Minimum Flow Rate:	5.0 L/min

Exhaust Duct

Extraction Flow Rate:	5 to 7 m^3/min

Foreline Pump

Current Rating: 5 A

CAUTION **Do not use any foreline pump except those specified by Agilent for use with the Agilent ICP-MS.**

NOTE

The rated current of foreline pumps (for use other than with the Agilent ICP-MS): 6.0 A for MS40+; 6.8 A for DS402; 7.0 A for Dry pump (NeoDry36E), but the above listed rating of 5 A is applicable for use with the Agilent ICP-MS.