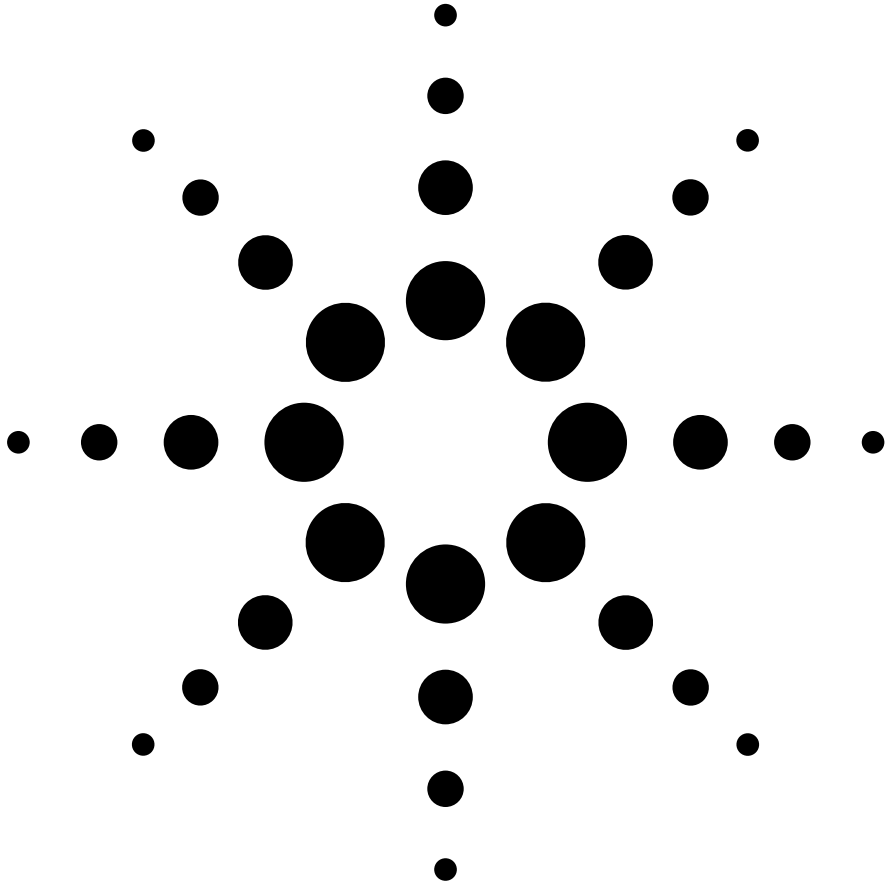

Hydrogen Carrier Gas Safety Guide

Agilent Technologies

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Safety Information

Agilent Technologies Mass Spectrometer and Gas Chromatograph instruments meet the following IEC (International Electrotechnical Commission) classifications: Safety Class 1, Transient Overvoltage Category II, and Pollution Degree 2.

These units have been designed and tested in accordance with recognized safety standards and are designed for use indoors. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired. Whenever the safety protection of the instrument has been compromised, disconnect the unit from all power sources and secure the unit against unintended operation.

Refer servicing to qualified service personnel. Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard. Disconnect the AC power cord before removing covers. The customer should not attempt to replace the battery or fuses in this instrument. The battery contained in this instrument is recyclable.

Safety Symbols

Warnings in the manual or on the instrument must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions violates safety standards of design and the intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING
A warning calls attention to a condition or possible situation that could cause injury to the user.

CAUTION
A caution calls attention to a condition or possible situation that could damage or destroy the product or the user's work.

 Indicates a hot surface

 Indicates earth (ground) terminal

Sound Emission Certification for Federal Republic of Germany

Sound pressure Lp < 68 dB(A)

During normal operation
At the operator position
According to ISO 7779 (Type Test)

Schallemission

Schalldruckpegel LP < 68 dB(A)
Am Arbeitsplatz
Normaler Betrieb
Nach DIN 45635 T. 19 (Typprüfung)

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Wilmington, DE 19808-1610
USA

Manual Conventions

Caution Cautions call attention to procedures which, if not correctly performed or adhered to, could result in ***damage to the instrument or loss of data***.

WARNING Warnings call attention to procedures which, if not correctly performed or adhered to, could result in ***personal injury***.

Hydrogen (H_2) Carrier Gas

The use of hydrogen as a GC carrier gas is potentially dangerous

Hydrogen is a commonly used GC carrier gas. Hydrogen is potentially explosive and has other dangerous characteristics.

- Hydrogen is combustible over a wide range of concentrations. At atmospheric pressure, hydrogen is combustible at concentrations from 4% to 74.2% by volume.
- Hydrogen has the highest burning velocity of any gas.
- Hydrogen has a very low ignition energy.
- Hydrogen that is allowed to expand rapidly from high pressure can self-ignite.
- Hydrogen burns with a nonluminous flame which can be invisible under bright light.

WARNING Hydrogen is potentially explosive. Take extreme care when using hydrogen as the GC carrier gas in a GC/MS system.

Some dangers are general, others are unique to GC/MS operation

Hydrogen presents a number of dangers. Some are general, others are unique to GC or GC/MS operation. Dangers include, but are not limited to:

- Combustion of leaking hydrogen.

- Combustion due to rapid expansion of hydrogen from a high-pressure cylinder.
- Accumulation of hydrogen in the GC oven and subsequent combustion (see your GC documentation and the label on the top edge of the GC oven door).
- Accumulation of hydrogen in the mass spectrometer and subsequent combustion.

In a mass spectrometer, hydrogen can accumulate several ways

All users should be aware of the mechanisms by which hydrogen can accumulate and know what precautions to take if they know or suspect that hydrogen has accumulated.

Mechanism	Results
Mass spectrometer off	A mass spectrometer can be shut down deliberately. It can also be shut down accidentally by an internal or external failure. A mass spectrometer shutdown does not shut off the flow of carrier gas. As a result, hydrogen may slowly accumulate in the mass spectrometer.
Mass spectrometer automated isolation valves closed	Some mass spectrometers are equipped with automated diffusion pump isolation valves. In these instruments, deliberate operator action or various failures can cause the isolation valves to close. Isolation valve closure does not shut off the flow of carrier gas. As a result, hydrogen may slowly accumulate in the mass spectrometer.
Mass spectrometer manual isolation valves closed	Some mass spectrometers are equipped with manual diffusion pump isolation valves. In these instruments, the operator can close the isolation valves. Closing the isolation valves does not shut off the flow of carrier gas. As a result, hydrogen may slowly accumulate in the mass spectrometer.
GC off	A GC can be shut down deliberately. It can also be shut down accidentally by an internal or external failure. Different GCs react in different ways. If a 5890 GC equipped with Electronic Pressure Control (EPC) is shut off, the EPC does not stop the flow of carrier gas. It increases the flow of carrier gas to its maximum. This flow may be more than some mass spectrometers can pump away, resulting in the accumulation of hydrogen in the mass spectrometer. If the mass spectrometer is shut off at the same time, the accumulation can be fairly rapid.
Power failure	If the power fails, both the GC and mass spectrometer shut down. The carrier gas, however, is not necessarily shut down. As described previously, in some GCs a power failure may cause the carrier gas flow to be set to maximum. As a result, hydrogen may accumulate in the mass spectrometer.

WARNING Once hydrogen has accumulated in a mass spectrometer, extreme caution must be used when removing it. Incorrect startup of a mass spectrometer filled with hydrogen can cause an explosion.

WARNING After a power failure, the mass spectrometer may start up and begin the pumpdown process by itself. This does not guarantee that all hydrogen has been removed from the system or that the explosion hazard has been removed.

Precautions to Take

Take the following precautions when operating a GC/MS system with hydrogen carrier gas. Take these precautions even if they contradict the instructions provided with your mass spectrometer.

Equipment precautions

- On **5971** or **5972 MSDs** and **G1800 GCDs**, make sure the analyzer shipping clamps are installed and all covers are properly secured. The clamps should only be finger tight. Overtightening the shipping clamps can cause air leaks. Part numbers for the shipping clamps are:

5971 MSD	05971-00210 (front)
	05971-00211 (rear)
5972 MSD	05972-00200 (set)
G1800 GCD	G1800-00008 (set)

- On **5973 MSDs**, make sure the front side-plate thumbscrew is fastened finger tight. Do not overtighten the thumbscrew; it can cause air leaks.
- On **5989A/B MS Engines**, install the safety kit (5989-20737) before operating with hydrogen carrier gas.
- Install an automatic shutoff valve (such as the 19246S Gas Saver for the 5890 GC) that will shut off hydrogen flow in the event of a power failure.

WARNING Failure to secure your mass spectrometer as described above greatly increases the chance of personal injury in the event of an explosion.

General laboratory precautions

- Avoid leaks in the carrier gas lines. Use leak-checking equipment to periodically check for hydrogen leaks.
- Eliminate from your laboratory as many ignition sources as possible (open flames, devices that can spark, sources of static electricity, etc.).
- Do not allow hydrogen from a high pressure cylinder to vent directly to atmosphere (danger of self-ignition).
- Use a hydrogen generator instead of bottled hydrogen.

Operating precautions

- Turn off the hydrogen at its source every time you shut down the GC or MS.
- Turn off the hydrogen at its source every time you vent the mass spectrometer (do not heat the capillary column without carrier gas flow).
- Turn off the hydrogen at its source every time isolation valves in a mass spectrometer are closed (do not heat the capillary column without carrier gas flow).
- Turn off the hydrogen at its source if a power failure occurs.
- If a power failure occurs while the GC/MS system is unattended, even if the system has restarted by itself:
    1. Immediately turn off the hydrogen at its source.
    2. Turn off the GC.
    3. Turn off the mass spectrometer and allow it to cool for 1 hour.
    4. Eliminate ***all*** potential sources of ignition in the room.
    5. Open the vacuum manifold of the mass spectrometer to atmosphere (remove the manifold window or analyzer or open the side-plate; do not just open the vent valve).

6. Wait at least 10 minutes to allow any hydrogen to dissipate.
7. Start up the GC and mass spectrometer as normal.

- Never turn on an ion or triode pressure gauge until the mass spectrometer has ***completed*** its pumpdown cycle.

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