

Flammable Gas Piping and Tubing

Office Fire Safety

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Campus Fire Marshal





General Compressed Gas Safety

Basic Gas Cylinder Safety Rules



- Transport cylinders with a hand truck or cylinder cart
- Replace the protective cap when not in use
- Segregate incompatible gases
- Store highly toxic gases in exhausted enclosures
- Properly restrain all gases cylinders at the top and bottom thirds with chains or fire-resistant straps.

Piped Flammable Liquids or Gases

- Use the appropriate PPE.
- Ensure work area is free from grease, oils and flammable materials.
- Watch for sparks and have a fire extinguisher available in the immediate area.
- Always check all connections before operation.
- Always turn the gas supply off at the source.
- Ensure the equipment and piping used is properly grounded.
- If you smell natural gas or discover a flammable gas leak, call 9-1-1 immediately, activate the fire alarm and evacuate the building.



Hazardous Compressed Gas Piping Safety

Ensure the piping to point of use is appropriate.

Piping, tubing, valves, fittings and related components shall be designed and fabricated from materials that are compatible with the material to be contained and shall be of adequate strength and durability to withstand the pressure, structural and seismic stress and exposure to which they are subject.

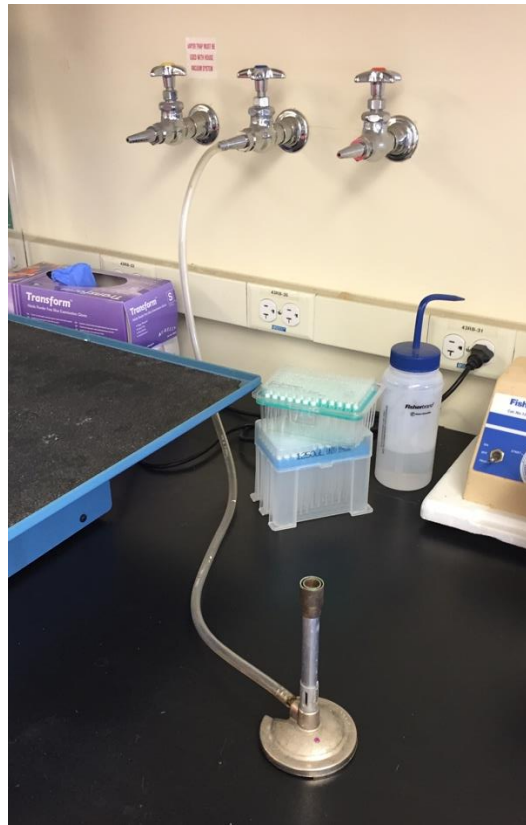
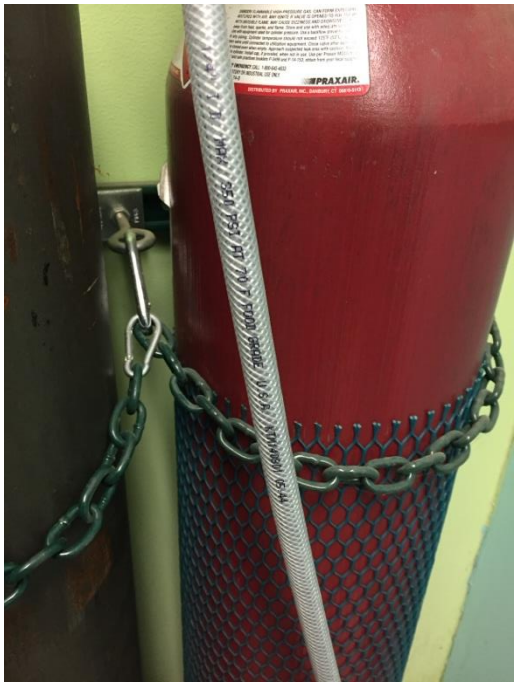
Applies to flammable liquids or gases with the following NFPA hazard categories in accordance with NFPA 704:

- Health Class 3 or 4
- Flammability Class 4
- Instability Class 3 or 4



Unsuitable Hazardous Compressed Gas Piping

Un-rated plastic combustible flexible tubing can be found in several of our laboratories. It is used to deliver natural gas, hydrogen, ethylene, carbon monoxide, or ammonia to the point of use such as Bunsen Burners and process equipment. See examples of unrated tubing use below.



Common Tubing Materials



- General use copper
- PVC/Nalgene
- Stainless steel
- Tygon – reinforced
- Tygon - general-use
- Teflon/PTFE
- Deoxidized high phosphorus copper



Copper Tubing



Standard copper tubing is suitable for use with inert gases, compressed air, lab water, house vacuum systems.

Do not use standard copper with flammable gases.

Deoxidized high phosphorus copper (DHP)

Unlike standard copper, oxygen-free copper's higher purity provides increased corrosion resistance to softening, meaning it can operate successfully at temperatures of up to 105°C for as long as 20 to 25 years. This may be acceptable for some flammable gas applications.

To differentiate between standard copper piping and high phosphorous copper piping, the key factor is the increased phosphorus content in the high phosphorous variety, which is usually indicated by a specific alloy designation like "C12200" on the pipe itself, signifying a higher phosphorus level that enhances its solderability but reduces its electrical conductivity compared to standard copper; visually, they may look similar, so checking the product label or contacting the supplier is usually necessary to confirm the type.

Stainless Steel Tubing



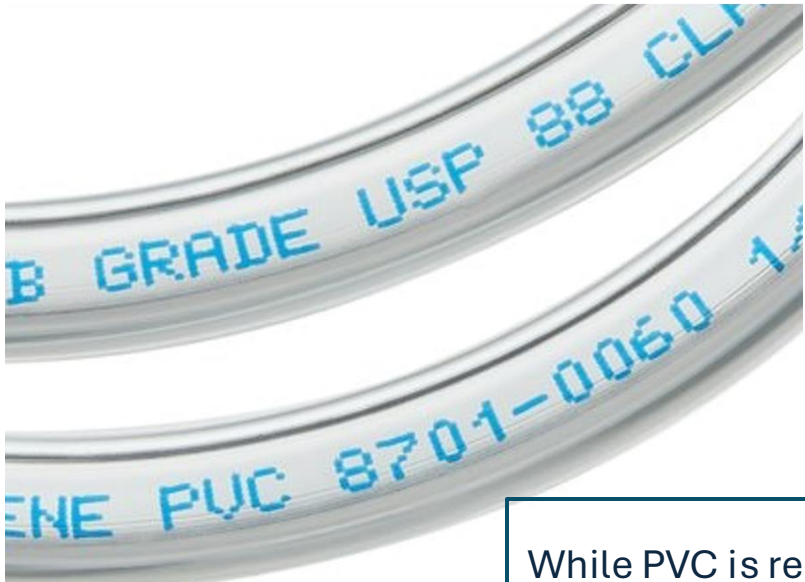
Stainless steel tubing is the go-to for most laboratory hazardous chemical or gas uses. The braided type is recommended for its flexibility when needed.

In most cases, use stainless steel tubing for flammable gases.

For hydrogen gas, always use stainless steel tubing.



PVC or Nalgene Tubing



PVC or Nalgene tubing is acceptable for use with lab water, house vacuum, and some chemical applications. Some of the lab-grade versions are autoclavable, which may be important for some applications.

PVC tubing should never be used in a closed or pressurized system regardless of the medium.

While PVC is resistant to many chemicals, including alcohols, fats, oils, and some acids, alkalis, and salts, its resistance varies significantly with factors such as the type of chemical, its concentration, and temperature.

Do not use PVC with esters, ketones, aromatic or chlorinated hydrocarbons. These substances can cause PVC to swell and reduce its tensile strength

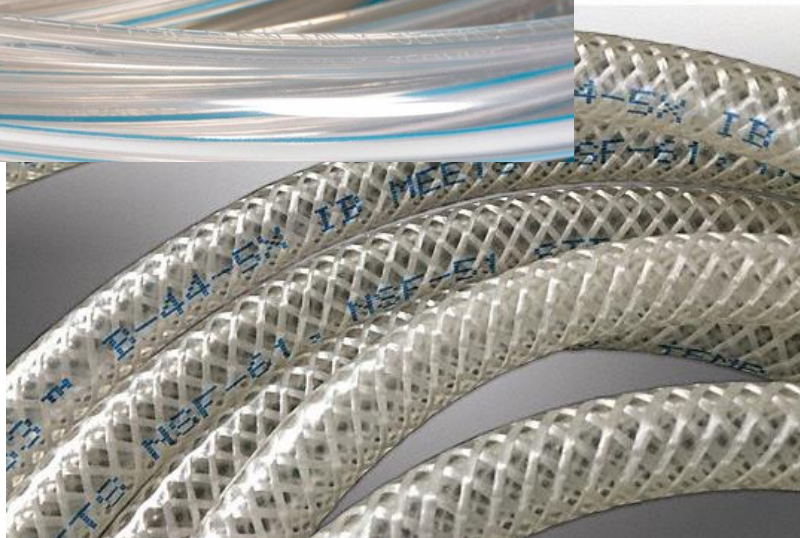
For these reasons, conduct a hazard assessment before using this type of tubing for your application.

Tygon Tubing



Both reinforced and general-use Tygon tubing are acceptable for use with lab water and house vacuum.

Tygon tubing should never be used in a closed or pressurized system regardless of the medium or with a system where a valve could be closed isolating the tubing to the pressure source.



Do not use Tygon tubing with bunsen burners or any flammable gases or liquids.

Tygon Tubing in Research

- Cheap, available, convenient.
- Origin of a number of University fires and gas leaks.
- This type of tubing can melt, slip off the connection, and become brittle and leak.
- *Not appropriate for use with flammable or hazardous gas*



Teflon or PTFE Tubing



Lab-grade Teflon (polytetrafluoroethylene or **PTFE**) tubing is acceptable for use with highly corrosive chemicals. It is typically chemical, electrical and heat resistant.

Teflon/PTFE tubing is not considered safe for use with compressed gases, as it can become brittle under high pressure and develop cracks. It is not designed to withstand the stress of a pressurized system.

Note: Some Teflon tubing may be rated by the manufacturer for flammable gases. This may be acceptable for Bunsen burners, calibration gases, and other low-pressure portable systems. Contact EH&S for an evaluation and to make sure the tubing and fittings are rated for the application.

Better Options for Bunsen Burner Tubing

Use flexible tubing that has been tested and approved for the particular gas by the manufacturer.



Compressed Gas Association (CGA)
Approved for use with natural gas



Compressed Gas Association (CGA) Approved

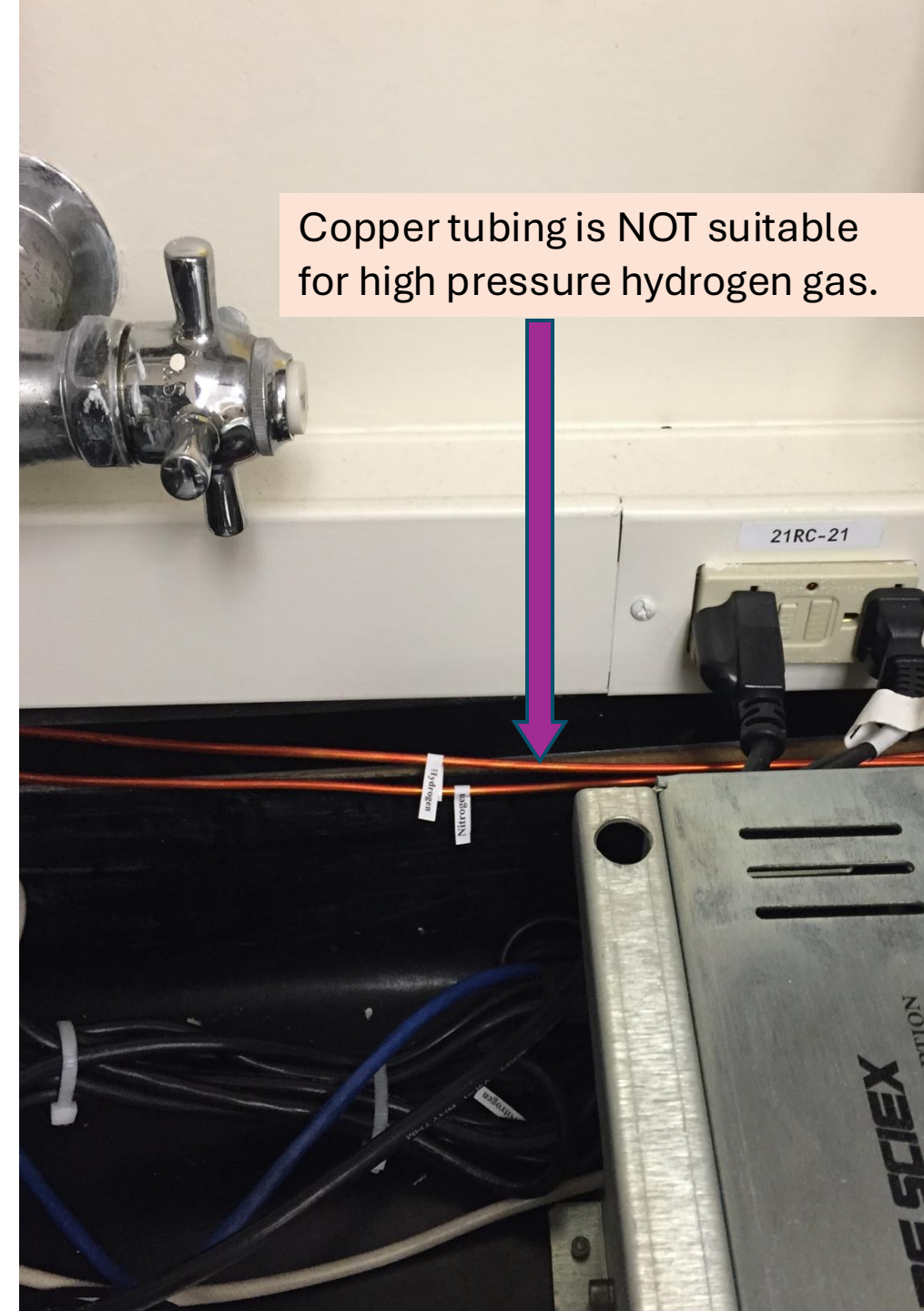
Red Series 7141 is only for fuel service and is compatible with commonly used fuel gases, including acetylene, hydrogen, natural gas, propane and propylene

Flammable/Hazardous Gas Piping

Things to consider

When making connections from a cylinder or building supply, the following characteristics should be considered when selecting appropriate tubing:

- Delivery pressure and temperature
- Chemical compatibility and durability
- Environmental conditions (i.e., UV or temperature extremes)
- Code approval
- Laboratory environment/set-up
- Label the piping



High Pressure Hydrogen Gas: Copper Embrittlement

Unique properties of Hydrogen Gas

- Wide explosive/flammability range (4%-74% in air)
- Small molecular weight and size with a low viscosity
- Can leak at a larger molecular flow rate than other gases.
 - This makes even a very small hydrogen leak a serious problem. Diffusion in small amounts is even possible through intact materials, in particular organic materials.
- When pressurized in standard copper piping, hydrogen can react with the dissolved oxygen in the metal to produce holes.
 - Use only **stainless steel**
 - **Deoxidized high phosphorus copper** may be acceptable



Review Tubing Practices

- Select the tubing material and specs that are compatible with the gas
- Avoid polymer, elastomer, Tygon and similar types of tubing for use with flammable gases.
- Do not exceed the working pressure the tubing and fittings are rated for
- Test new installations for leaks before initial use
- Consult the manufacturer's ratings and technical data for the parts being used
- Most flexible tubing deteriorates with age or exposure to chemicals or UV light. Replace old flexible tubing before it deteriorates.



Questions?

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For most questions, please contact SF State Environment, Health & Safety department by [email](#) or telephone: 415.338.2565.