Tubing, Piping, and Hoses for Compressed Gases

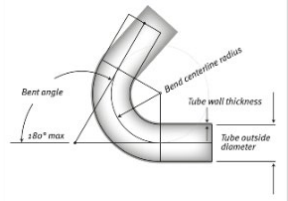
Mindfulness Minute: Contribute to a safer workplace by considering compatibility and limitations of tubing and hose materials when designing compressed gas delivery systems.
Compressed gas systems can be dangerous beyond just the cylinder. Ensure the materials are compatible with the pressure and chemicals used and always follow manufacturer's instructions to reduce the risk of leaks or explosions.

Piping, Hoses, and Tubing

The primary differences between pipes, hoses, and tubing are rigidity, dimensions, and flexibility. **Pipes** are rigid with standardized dimensions, while **tubes** have precise dimensions and can be rigid or not. **Hoses** designed for compressed gas applications are reinforced with braided steel jackets to withstand higher pressures, while unreinforced tubing is only suited for gravity flow or low-pressure applications. Hoses excel in applications that require flexibility, mobility, and the ability to withstand vibration and bending.

Physical Stress Due to Bending

Consider the flexibility and bend radius of the tubing, especially if your setup requires tight bends. Bend radius is the radius of the bent section of the hose measured to the center line. Minimum bend radii may be found in manufacturers' technical data sheets. Do not run flexible tubing through walls, doorways, or across walking paths.



Material Limitations and Compatibility

 Stainless Steel	Stainless steel tubing, grade 316L, is required for the delivery of hydrogen or toxic gases to research equipment. Use nominal size is ¼"ID with minimum pressure rating 300psig downstream from a pressure regulator. Always use Swagelok VCR fittings or equivalent connectors.  VCR fittings & connectors for high-grade stainless-steel gas delivery systems
 Copper and Copper Alloys	Standard copper tubing is used for water, plumbing and house vacuum applications. Flammable gases, inert gases, and compressed air delivery require the use of Type K and Type L copper tubing with a minimum pressure rating of 300psig. Some gases react dangerously with certain metals, e.g.: *copper or copper alloys and acetylene gas form dangerously explosive copper-acetylides; ammonia corrodes copper and copper alloys in the presence of air.*
Fluoropolymers and Elastomer	Numerous types and combinations are available, with and without internal reinforcing fibers, steel wire jackets, chemical resistant liners, etc. Fluoropolymers generally have exceptional chemical resistance, temperature tolerances ranging from 200 to 260 °C (-328 to 500 °F) and have low permeability to hazardous gases. E.g.: Teflon, which is suitable for most corrosive, toxic, and flammable gases IF used inside a fume hood/vented enclosure.
Reinforced Tygon™ or Vinyl 	Acceptable for use with inert gases (argon, nitrogen, CO_2), compressed air, and house vacuum. With the correct barb connectors and band clamps, this material can connect pressurized systems up to 150 psig. In the absence of the appropriate tubing insert, Swagelok fittings are **not** appropriate for use with non-metallic tubing.
Other flexible plastic E.g.: Nylon, PVC, low density polyethylene (LDPE), polypropylene (PP), silicone, rubber.	These tubing materials are used for drain, vent, and general laboratory applications, with max pressure ratings as low as 5psig. Do **not** use for moderate or high pressures unless manufactured and rated for such application. E.g.: Silicone is non-reactive but is porous and some compounds, such as oils, can permeate into it. *Never use rigid PVC piping for any compressed gas application to prevent over pressurization and explosion resulting in dangerous shrapnel.*

Chemical compatibility table available here: tiny.utk.edu/GasCompatibility

References:

https://www.swagelok.com/downloads/webcatalogs/EN/MS-01-180.PDF