

High Pressure Pigtail Selection Guide

Selecting the correct hose can improve your process

Selecting the correct hose for a particular application is one key element that is often overlooked. Many hose failures are attributed to a mismatch of hose and application. Armed with a little knowledge, it is not difficult to select the best hose for your customers industrial or specialty gas application.

Application Questions

To select the correct hose, make the following determinations:

- Gas or cryogenic
- Type of gas/grade (argon, helium, hydrogen, oxygen, etc.)
- Required maximum pressure (psig)
- Required maximum flow rate (CFH or CFM)
- Length of hose (give yourself extra length)
- Fitting configuration (1/4" NPT is standard; other fittings available)
- Armor casing (yes or no)
- Cleaned, capped and bagged (for oxygen service)
- Special configuration – CGA nut, hand tight, check valve, etc.

Hoses designed for specialty gas applications should not only provide pressure capacity, but also maintain the purity of gas delivered. For this reason, it is not recommended to use rubber type hoses to supply high purity gas.

Permeation is the term used to describe how gas molecules pass through the pores of a hose. When gases escape out of a hose, this is called "effusion." If permeation levels are high, ambient gases can enter into the gas stream through "diffusion," thereby adding contaminants. To varying degrees, rubber, PTFE and ETFE hoses all permeate gases. The smaller the gas molecule, the higher the rate of permeation.

"All metal" hoses utilize a corrugated inner core that features "zero permeation." One might conclude that "all metal" hoses are the final answer; however, cost, velocity issues and the application will dictate the best choice. PTFE, PTFE hybrids such as "post sintered," and ETFE thermoplastic hoses maintain pressure capacity while dramatically reducing permeation. Their flexibility and durability are much more appealing than "all metal" hoses when outfitting a high capacity fill plant. It is important to evaluate the requirements of each application and then select the hose that best fits. Selecting the correct hose can maximize gas purity, reduce the risk of contamination and improve a customer's process.

There are several choices of materials to consider when selecting a hose:

Rubber – Inexpensive, high permeation rates, not recommended for high purity applications.

Thermoplastic – Ratermann Mfg. TPL Family of Hoses

Durable, economical, flexible and features a low permeation rate. Not recommended for oxygen use.



Thermoplastic Hose Type "TPL"

PTFE Hose Type "FP" and "FPT"

PTFE – Ratermann Mfg. FP Family of Hoses

The most popular high-pressure hose in use. Commonly found in fill plants across the country. Durable, flexible, and economically priced.

PTFE "Post Sintered" – Ratermann Mfg. FPT Family of Hoses The "post sintered" process re-bakes the PTFE at a controlled time and temperature, increasing the wall thickness and tightening the molecular bond of the PTFE, which dramatically reduces effusion and diffusion. Economically priced, very flexible and works well with most gases.

Rigid Metal – Ratermann Mfg. PT Family of Rigid Hoses Economically priced, reduced flexibility, best suited for stationary applications. Rigid hoses will eventually crack as they are bent and flexed.

All Metal Corrugated Hose – Ratermann Mfg. FPS Family of Hoses

All metal hoses utilize a metal corrugated inner core (typically 316 stainless steel or Monel). Metal hoses feature "zero permeation" or "no gas loss," which is very important in static gas applications. Metal hose is more costly, and is commonly used with helium and hydrogen. Monel inner core is available for corrosive type gases. Pay close attention to dynamic stress and velocity levels (flow rate) as there are limitations with a metal hose.



All Metal Hose Type "FPS"

Call us to Help You with Your Gas Hose Needs!

High Pressure Pigtail Selection Guide		Compatibility					
Ratermann Hose Style Working Pressure (MAWP) Core or Liner		FP / FPT 3000/3600 PSIG PTFE	FPT-60P 6000 PSIG PTFE	FPS 4250 PSIG 316L S.S.	FPS-45P 4500 PSIG 316L S.S.	FPS-C 3000 PSIG Monel	TPL 2750 PSIG Polyester
Gas	Connection						
¹ Acetylene	510	4	5	3	3	3	2
Air	346	5	3	3	3	3	2
Argon	580	5	3	3	3	3	2
¹ Arsine	660	N	N	N	N	3	N
Carbon Dioxide	320	5	3	3	3	3	5
Carbon Monoxide	350	4	4	5	5	3	N
Chlorine	660	N	N	N	N	4	N
Fluorine	679	N	N	N	N	4	N
Freon 12	660	5	4	5	5	5	N
Helium	580	4	3	5	5	4	2
Hydrogen	350	3	3	4	4	3	N
Methane	350	5	4	5	5	5	N
Natural Gas	350	3	5	5	5	3	N
Nitrogen	580	5	5	3	3	3	2
Nitrous Oxide	326	5	3	3	3	3	N
Oxygen	540	5	3	3	3	4	N

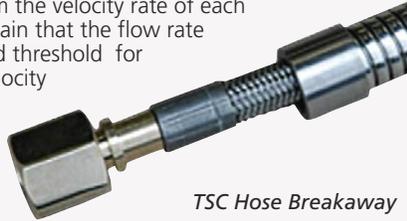
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Tube Trailer Hose Selection Guide

Dynamic Stress and Velocity

Pressure flow characteristics are important factors when using an all metal hose. Dynamic stress is an important consideration when selecting an all metal hose. The hose must not be bent on more than one plane at a time or restricted (over-bent) in any way.

All metal Corrugated hoses are not designed to handle high velocity flow rates. Confirm the velocity rate of each application, and make certain that the flow rate is below the recommended threshold for a given size hose. If the velocity exceeds this threshold, it will establish a resonant frequency that will prematurely crack the hose.



TSC Hose Breakaway

When the velocity flow rate exceeds the recommended threshold, consider using a PTFE lined hose. Tube trailer transfer is one application that often exceeds the recommended threshold rate.

Medical Gases – It is very important that you select the correct hose for medical applications. One should consult an expert prior to installing pigtails. Care should be taken with Oxygen pigtails to the heat associated with “adiabatic compression.”



We highly recommend the use of an extended brass volume piece on oxygen manifold pigtails. Oxygen charging manifolds should include flexible hoses with “heat sinks” installed near CGA connection. The heat sinks will help to absorb the potential heat from adiabatic compression. We highly recommend the use of heat sinks.

Braiding – The stainless steel braid encases the inner core and gives the hose its strength to hold pressure. A high pressure hose can have from one (3,000 psig) to four braids (5,000 psig) depending on pressure requirements.

Armor Casing – Armor casing can easily be installed over the braided hose. It will prevent hose kinking and whipping in the event of a hose burst, and also protects the exterior of the hose.

Fittings – Swivel fittings, hand tights, 90 degree elbows and brass heat sinks for adiabatic compression are a few of the more popular fittings in use.

Selecting the Best Hose

In the specialty gases industry, there are several choices when considering a hose. Here are some of the basic factors that one should take into consideration.

Pressure – Make certain that the average working pressure of the hose is well above the required maximum pressure of the application.

Molecular Weight – Hydrogen and helium have the smallest molecular weight, and therefore present a higher risk of permeation loss.

Permeation – If permeation is a concern, consider using an all metal hose. Make certain that the flow rate is below the suggested threshold level. Other options would be an ETFE or PTFE post sintered type hose. These hoses will reduce effusion by approximately 75 percent.

Purity – Hoses that effuse gases can also diffuse gases. Diffusion can introduce contaminants that could effect the high purity gas stream. If this is a concern, consider using an all metal hose.

Static State – If a gas is used in a static state, there will be times when the gas is not being used (off hours, weekend). In this case, gases trapped inside the hose could effuse out. The amount lost is minimal, but over time this loss can add up.

Fill Manifolds – Hoses used on fill manifolds are typically cycled (attached and disconnected from the cylinder) several times a day. The hose is exposed to continual flexing, and then disconnected (hanging open to the air). As a result, permeation of a fill manifold is of minimal concern. PTFE hoses work well in this application.

Laser Cutting Systems – Using the wrong hose to supply a laser can be detrimental to the operating efficiency of the laser, depending on permeability of the hose, a high permeation hose will contribute contamination, resulting in increased downtime. Ultimately this will effect the quality of cut.

Ratermann Manufacturing, Inc.

carries a tremendous range of hoses suited for all your **CRYOGENIC** needs.



Tube Trailer Hose Selection Guide

Compatibility Excellent 5 Very Good 4 Good 3 Acceptable 2 Not Acceptable N

Ratermann Hose Style Working Pressure (MAWP) Core or Liner	TT 4000 PSIG PTFE	TTS 3700 PSIG 316 SS	TTM 2500 PSIG Monel
Gas			
Air	4	3	4
Argon	4	3	4
Carbon Dioxide	4	5	2
Helium	3	5	4
Hydrogen	3	5	4
Natural Gas	4	3	3
Nitrogen	4	3	4
Nitrous Oxide	3	3	3
Oxygen	3	3	5



Transfer Hose for Nitrogen, Argon and Oxygen

Maintaining Your Hose

As a major manufacturer of hoses used in the Industrial, Medical and Specialty Gas industry, we highly recommend that you implement an ongoing inspection program for all compressed gas and cryogenic hoses.

**Remember, it is better to be
"Proactive vs. Reactive."**

**The goal is to replace the hose
before it fails."**

We care about this market, however, in the past two years we have witnessed "first hand" the negative effects of misused and abused hoses. In the interest of time, we will limit this discussion to PTFE, ETFE, and "all metal" hoses only. We have purposefully left out oxy-fuel hoses.

The following recommendations utilize some common safety practices. First of all, please understand that not all hoses are constructed in the same manner. Added to that, compressed gas and cryogenic hoses are used in many different ways. It is important that you identify and address your critical applications first. Critical applications will vary in each facility, however, a common guide would be as follows: high pressure fill manifolds, tube trailer transfill systems, and cryogenic transfer. There are a few basic "maintenance" steps that you can implement rather easily. In fact, a continual hose maintenance program will go a long ways towards increasing the life of this important tool, while preventing the chance of serious injury or damage.

How do you begin your maintenance program?

1 Conduct a Visual Inspection

Probably the most important thing that an operator can do (as part of a maintenance program) is a visual inspection. This should be conducted on a regular basis (daily, weekly, or monthly) depending on the application, and the usage/cycle rate. A continual visual inspection is the best way to identify and prevent a potential problem.

What should you look for?

• Discolorations

Freckles, spotting, or other markings are an indication of a foreign matter coming in contact with the hose. Often, freckles can occur from the use of a "leak check" solution. Typically, this is not a problem. However, it is crucial that leak check solutions be mixed to the manufacturer's recommended proportions. If the proportions are not correct, braid damage can occur.

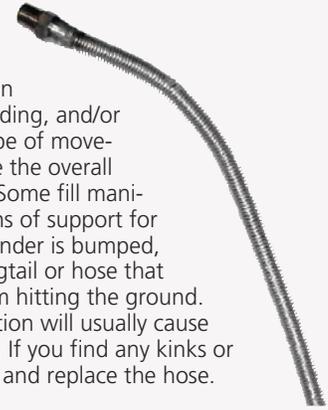
With ethylene glycol (a common substance used in oxygen free leak check), the wrong proportions can negatively affect the stainless steel braid.



The braid on this hose was chemically attacked by an improper mixture of leak check solution.

• Kinking

A kink in the hose is an indication of over bending, and/or over stressing. This type of movement can compromise the overall integrity of the hose. Some fill manifolds provide no means of support for the cylinder. If the cylinder is bumped, quite often it is the pigtail or hose that stops the cylinder from hitting the ground. Unfortunately, this action will usually cause damage to the pigtail. If you find any kinks or severe bends, remove and replace the hose.



• Braid Integrity

The stainless braid gives the inner core of the hose the ability to withstand pressure. There should not be breaks **anywhere** on the stainless steel braid. A single broken braid is the sign of a potential problem.

• Inspect the Fittings

A simple visual inspection of the threads will tell you much. Look to see that the threads are uniform, you should not see any metal shavings or cross threads. If any of these characteristics are found, remove and replace the hose. A bad thread will typically leak under pressure. Thread gauges can be purchased to ensure that fittings are within specification.



Thread checking tools are used to ensure fittings are in spec.

2 Pressure Test & Leak Check

Leak Check Hose

It is very important to leak check the hose and fittings under pressure for any signs of leakage. Leak check solutions are commonly available and work very well under pressure. It is crucial that you not only use the correct solution, but that you mix the solution to the manufacturer recommended proportions. Failure to do so can cause damage. Keep in mind, not all leak check solutions work for every gas service. Check with your supplier to make certain you are using the correct "leak check" product.

Pressure Test

It is very important to leak check hoses on a regular basis. Often, this test is conducted while the hose is attached to the fill manifold and under pressure. The best gas to use for a leak check (and most expensive) is helium. Helium works well because the helium molecule is very small. As a result, helium will find a leak better than most other gases. Keep in mind that this can get a little spendy, so other inert gases can be substituted. We do not recommend compressed air or any other gas that could contain impurities.

Maintaining Your Hose (continued)

3 Replace Old Hoses

Remove and replace old hoses. All too often, hoses are overused. **Contrary to popular belief, hoses do not last forever!** Every high pressure hose has a life expectancy. This is typically based on the amount of service the hose has provided, and the manner in which it has been used. A good "rule of thumb" is a hose that see 18 cylinder changes per day, five days a week, will operate safely for approximately 18 months. At this rate, the hose will have been connected and disconnected 12,960 times. Provided that the hose has not been abused in any other way this is a good point of reference. *Please note reference guide below that will help to determine when a hose should be changed out.*

Keep in mind, hoses attached to a fill manifold can be connected and disconnected up to 20 times a day. This equates to 9600 changes per year. At an average cost of \$20.00 per pigtail, this tool is costing pennies per change-out.



Tube trailer hoses can get "banged around" and bent in a myriad of configurations. It is important to inspect all cryogenic hoses for leaks on a regular basis.

One of the most common problems associated with cryogenic hose is exceeding the recommended velocity. If you exceed the recommended velocity, damage will occur. If this is of interest, we would be happy to supply a velocity chart for our hoses.



Circumferential cracks on the convolution are typically caused by high velocity flow rates

All of our hoses include a band that states the date of manufacture, and MAWP.

Don't assume that just because a hose is being used for a particular application, that it is the correct hose. **Call our Service Representative at 1-800-264-7793 to make certain that you are using the right hose for a particular application.**

To sum it up, a regular "hose" maintenance program is a great idea. Simply conduct regular visual inspections of the hoses that you use. Also, perform pressure test to ensure the hose is in good condition. Any hoses that fail these two test should be removed and replaced. Track the cycle rate of your current hoses and replace as required. With these three simple steps, you can maximize the life of your high pressure and cryogenic hoses, while adding a new layer of safety for your employees and customers.

Handy chart to check when Hose Replacement is Recommended

High Pressure Hose Cycle/Use Replacement Chart

Cycles per Day	4	6	8	10	16	20
Equals # of Changeouts per Month	160	240	320	480	640	800
Equals # of Changeouts per Year	1,920	2,880	3,840	5,760	7,680	9,600
Expected Life* (months)	24	22	20	18	16	12

**This is an approximate life expectation based on normal use. These numbers are not intended to be used with other hose types.*



**Ratermann's Oxygen Safe
CGA & Valve Leak Check**
**Find your Leaks Fast and Easily
with the Extending Tube to Get
in the Hard to Reach Areas.**

- Ready to Use – No Mixing

Part #	Description	Size
LC-8OZ	Leak Check Squeeze Bottle	8 oz.
LC-1GAL	Leak Check 4 to a case	1 Gallon



1 gal. size
Pt # LC-1GAL



8 oz. size
Pt # LC-8OZ