



Introduction

Poorly designed, constructed or misapplied industrial transfer hose installations are workplace hazards. Hoses can burst, disrupting production and causing costly downtime delays. Couplings can leak, incurring regulatory action and clean-up costs. Blown-off ends can maim and even kill workers. These problems don't occur very often, but when they do, someone has to pay. How can you prevent potential hose catastrophes? Abandon the common practice of mixing and matching components to fabricate a hose assembly, and start thinking *system*.

Current Practice and Problems

Mixing and matching components from different manufacturers is the traditional way of life for many industrial hose distributors and end-users. The typical assembly may contain a hose from here, a coupling from there, a clamp from somewhere else, all put together on yet another manufacturer's crimp machine. For many applications, this patchwork of components has worked just fine. But beware: times are changing. The mix and match approach to making hose assemblies leaves fabricators and users open to greater liability than ever before.

Applications today are more demanding. New hose compounds are making hose selection more complex. Working pressures and temperatures are going higher. Safety and environmental regulations are getting stricter. All these factors place greater demands on the performance of today's hose assemblies. Moreover, the intensely competitive nature of worldwide industries doesn't tolerate downtime caused by a burst hose or a leaking coupling. Lost productivity results in a direct cost to the enterprise. Also, leaks that violate safety or environmental regulations can result in stiff fines and clean-up expenses, compounding the loss of productive time. All these forces dictate the need for industrial transfer hose assemblies that bear a stronger resemblance to their hydraulic hose cousins: an engineered system resistant to leaks and accidental failure.

Comparison to Hydraulic Hose

Typically, in contrast to industrial transfer hose, a hydraulic hose assembly is considered a "hose system." Why? Because the individual components—hose, coupling and method of assembly—are designed as a unit to meet a performance standard from the get-go. Given the pressures that a hydraulic hose assembly must withstand, a systems approach is imperative.

Why hasn't industrial hose gone the way of hydraulic hose before now? One reason is that most transfer applications are relatively benign. A leaking water hose isn't much of a threat. A pinhole leak in a 6,000 psi hydraulic hose, on the other hand, can cut through flesh. Also, hydraulic applications involve a limited number of hose sizes and media. Being relatively straightforward, they lend themselves to systemization. By contrast, there are myriad industrial hose applications, conveying a variety of media through a complex array of hose types, widths and sizes.

Some of these transfer applications pose a real hazard if the hose assembly is not properly designed, built and installed, specifically those applications involving:

- Corrosive chemicals
- LP gas
- Oil field
- Petroleum products
- Steam

Let's look at how a systems approach can mitigate the risk involved in all industrial transfer hose applications.

What is an Industrial Transfer Hose System?

In simple terms, a hose system is comprised of the following elements:

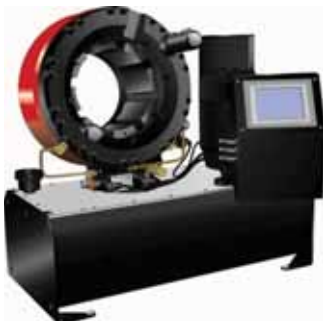
- Hose
- End fittings or couplings
- Assembly procedure or method of attachment



Hose



Coupling



Crimper

In a true hose system, all these elements are integrated *from the design stage* to match a specific application involving the transfer of liquids, solids or gases, under low or high pressure, by discharge or suction.

Typical industrial hose applications, as identified by the National Association of Hose & Assembly Distributors (NAHAD) include the following:

- Air Hose
- Asphalt
- Chemical—Plastic Lined
- Chemical—Rubber Lined
- Food Handling—Regulated
- Food Handling—Non-Regulated
- Lay Flat
- Material Handling—Bulk Transfer
- Material Handling—Cement
- Petroleum
- Push On
- Sandblast
- Steam
- Water/Multi-Purpose

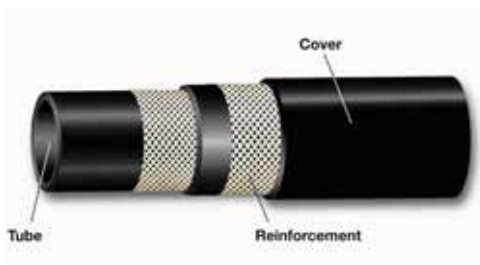
How hose and fittings come together to perform their function in any of these applications is the essence of a hose system.

Hose

An industrial hose is a flexible reinforced tube that serves three main purposes:

- To transfer gases, liquids, solids and mixtures of these materials
- As a flexible connector to absorb surges and vibrations
- As a conduit to protect other hose, pipes and wires

Every hose has three basic elements: tube, reinforcement, and cover, each contributing to the purpose for which the hose was designed.



The tube is the innermost rubber or plastic component of the hose. Tubes are made with various compounds (elastomers) for resistance to the material being conveyed.

Reinforcement is used to let the hose withstand a specific amount of working pressure (or vacuum). This pressure is measured in pounds per square inch (psi), Pascal (Pa) or vacuum (In Hg, inches of mercury). Reinforcement material also supports the inner tube, controls elongation or shrinking of the hose OD/ID and helps retain fittings. Reinforcement typically consists of layers of fabric, yarn or wire wrapped over the tube and referred to as “plies.”

There are three basic types of reinforcement used for industrial type hoses, illustrated below:



Braid reinforcement



Spiral reinforcement



Helical reinforcement

The cover is designed to protect the tube and reinforcement from external factors such as ozone, weather, abrasion and heat. A variety of compounds (rubber, thermoplastic, fiber, metal) are used for cover material, depending on the application.

Hose Selection

Selecting the right hose for the application is critical to a systems approach. The proper hose will ensure proper performance for the material being conveyed. It will also minimize the risk of property damage or bodily injury due to leaks, burst hoses or ends blowing off. Additionally, proper hose selection is important for preventive maintenance and longevity, factors that reduce downtime and maintenance costs. Proper hose selection begins with identifying the application and the material to be transferred. The key factors involved in hose selection are easily remembered with the acronym STAMPED:



Size: I.D. (Inside Diameter), O.D. (Outside Diameter) and length

Temperature: Temperature of the material conveyed (internal) and environmental (external) temperature

Application: Conditions of use

Material: Type and concentration of material being conveyed

Pressure: Working pressure that the assembly will be subject to

Ends: Style, type, orientation, attachment methods, etc.

Delivery: Volume and velocity

In a systems approach, selecting the proper hose for the application involves more than a quick glance at a hose manufacturer's chemical resistance tables. For one thing, hose compounds with identical names are more complex than they might appear. For example, a tube made from the EPDM elastomer may differ from another EPDM tube because of differing ingredients such as accelerators, age resistors, vulcanization agents, carbon black, or processing aids. The tables should also be consulted when the hose user intends to convey different solutions in the same hose. So application tables must be studied carefully to ensure proper compatibility between the tube and the material being conveyed.

Following is a list of additional considerations that may apply to proper hose selection (Ref: NAHAD):

- Abrasion
- Electrical conductivity
- Environment
- Flammability
- Flow rate
- Fluid velocity
- Movement (type, distance, frequency)
- Ozone
- Permeation (vapor conveying hose)
- Pressure drop
- Routing
- Salt water
- Static electricity
- Ultraviolet light
- Vibration (frequency rate – Hz, amplitude – “G” load)



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Fittings/Couplings

A hose becomes a hose system when fittings (couplings, ferrules, sleeves, nipples, etc.) are attached to either end, creating an assembly that can be connected to a port, pipe or another hose. Fittings vary widely in construction and materials (aluminum, brass, bronze, steel, plastics), and differ from one manufacturer to another. Because fittings are typically not made by the same manufacturer that makes the hose, the burden of creating a hose system falls largely to the assembler.

Over the years, hose and coupling manufacturers have developed highly compatible products and assembly methods. Nonetheless, due to the great variety of fittings, hoses and applications, crafting a hose system can be a tricky proposition.

Some factors to consider in selecting the proper hose coupling include:

- Hose size
- Compatibility with the material being conveyed
- Installation design and attachment options
- Corrosion resistance
- Thread type (hose end and thread end)

For crimped assemblies, additional challenges include:

- Wide array of crimp components available
- Capital investment in appropriate sized crimping machine
- Procedures needed to build reliable assemblies

Creating a hose system with a crimped ferrule, for example, depends on creating a mechanical interlock with the fitting. Fitting and ferrule must interlock during the crimping process, so the tolerances between fitting, ferrule and hose must be exact. This requires the assembler to take careful measurements of the hose OD and hose ID. The assembler must also know the hose compression factor, ferrule and fitting measurements. Precisely matching the components of this assembly is more difficult when the components all come from different vendors.

Gates Corporation has tackled this problem by making its own line of couplings designed for specific textile reinforced multi-purpose, propane-butane, and washdown industrial hoses, from ¼" to 1¼" ID, with ratings up to 1,000 psi. These Gates GLX™ couplings are a one-piece design with a smooth ID ferrule that won't cut through the reinforcement. The stem OD and the ferrule ID dimensions provide for an optimum hand insertion force, so the assembler can feel the coupling "hit bottom" and know that it is fully inserted, so it won't fall off before crimping. GLX couplings are crimpable on all Gates standard crimp machines and dies. Because the hose, couplings and crimper are designed and built from the ground up to work together as an integrated unit, this configuration constitutes a true hose system.



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Gates GLX couplings are designed for specific 1/4" to 1 1/4" ID textile-reinforced multi-purpose hoses with ratings up to 1,000 psi.

Assembly

The final element of a hose system is method of assembly. Hose and couplings can be designed to work together, but if they are not properly assembled, tested and certified, they fall short of a hose system.

Designing a hose and coupling that fit together like hand and glove goes a long way to taking the guesswork out of the assembly process. In the case of Gates GLX couplings, there is a coupling for each size of hose from 1/4" to 1 1/4" ID. The assembler can select a coupling designed for the appropriate size of hose, eliminating the need to perform the measurements outlined above. Following proper crimp procedures ensures a reliable assembly that has been tested and certified by the manufacturer to meet or exceed performance ratings.

Benefits of a systems approach

One immediate benefit of implementing a hose system whose components all come from a single manufacturer is accountability. If a hose assembly fails and it was built with components from different manufacturers, the finger of blame points in all directions. Was it the hose? The coupling? The interaction between hose, coupling and material? Improper assembly? By contrast, a single source hose system is less prone to failure in the first place; and should it fail, the manufacturer assumes responsibility.

A second related benefit is higher productivity. Productivity is the mantra of today's hotly competitive worldwide industries. Hose assemblies that fail, either prematurely or catastrophically, disrupt operations, causing unproductive downtime. In some operations that run 24/7 to meet market demand, such as large food and meat processing plants, downtime can literally represent thousands of dollars per minute. Environmentally sensitive operations pose an added risk. A chemical spill during a transfer operation, for example, may result in EPA fines and clean-up expenses, compounding the loss of productive time. Reliable hose systems minimize the risk of these occurrences.



Finally, there is the issue of personal safety. Horror stories are numerous where hose assemblies in transfer applications have gone awry. A coupling blowing off an air hose assembly under pressure causes the hose to whip around the work area, lacerating workers. A hose transferring asphalt at a temperature of 350°F bursts, severely burning two workers. A steam hose assembly ruptures, scalding a man standing nearby. Incidents like these have and will continue to occur until industrial transfer hose assemblies evolve into the highly engineered systems that they are just now becoming.

Additional Resources

To learn more about industrial transfer hose systems, visit www.gates.com/hosesystems, where you will find free engineering tools and software. Gates DesignConnect™ system is a web-based interactive catalog of Gates hose, couplings and adapters that lets you pick the parts you need and download solid model CAD drawings into your design. Also included are recommended torque charts, hose assembly templates, thread ID charts, nomographic charts and hose assembly routing tips. For specific application questions, you may call and speak with a Gates product application engineer at (303) 744-4410, or email pa0000@gates.com.