Hydraulics 201

Introduction to Hydraulic Hose and Fittings

GATES

Professional Development

SERIES

S-18a

Introduction to Hydraulic Hose and Fittings

Table of Contents

Fundamentals of Hydraulic Hose and Fittings

Why use hydraulic hose assemblies?

Hydraulic hose replaced the ridged pipes and tubes used in early hydraulic systems because a hose:

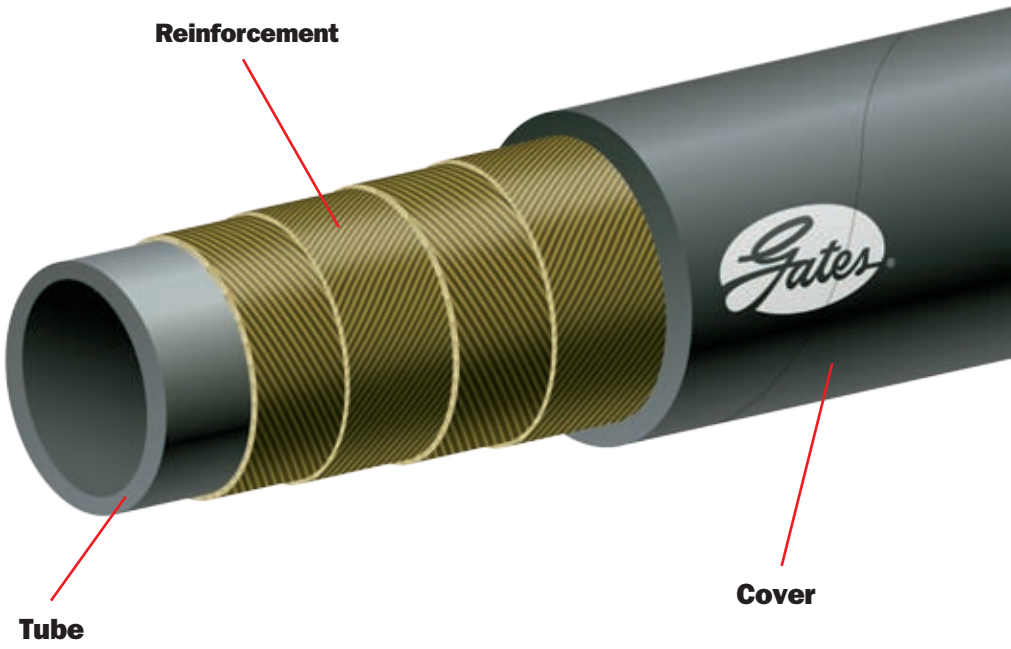
- Is less costly
- Weighs less
- Is better able to absorb shock and vibration
- Is easier to route and install
- Needs no brazing or specialized bending
- Allows for movement between components of equipment
- Is less likely to rust
- Absorbs sound better
- Dampens pressure surges

The international marketplace for hydraulic assemblies is getting larger every day.

Hose Construction

The availability and routing advantages of hose make it the preferred choice over tubing by maintenance personnel.

A hose is made up of three components:



The Tube

The Tube is the conduit. Tube construction varies to accommodate

a) the materials being conveyed, and

b) the temperature of the material.

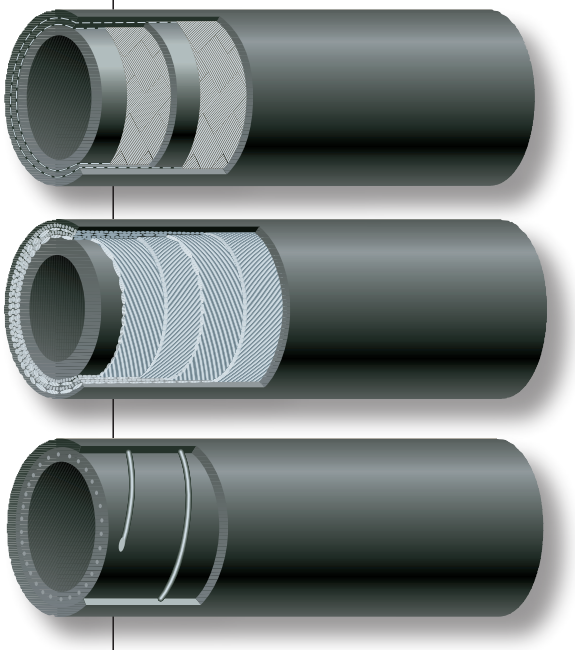
The Chemical Resistance Table in the Gates Hydraulics Catalog (Part No. 31-2080, Product No. 35093) lists the recommended tube stock for conveying a given material.

NOTE: The Inside Diameter (ID) of the tube determines the size of the hose.

The Reinforcement

The Reinforcement is the muscle of the hose. It provides the strength to resist internal pressure (or external pressure in the case of suction/vacuum).

There are three basic configurations of reinforcement:



Braided: Reinforcement can be wire or textile and may have single or multiple layers.

Spiraled: Spiral-reinforced hose is used in several demanding applications to provide a longer service life. Reinforcement is typically wire and has either four or six layers (plies) for strength.

Helical: Coil reinforcement keeps the hose from collapsing during suction (vacuum).

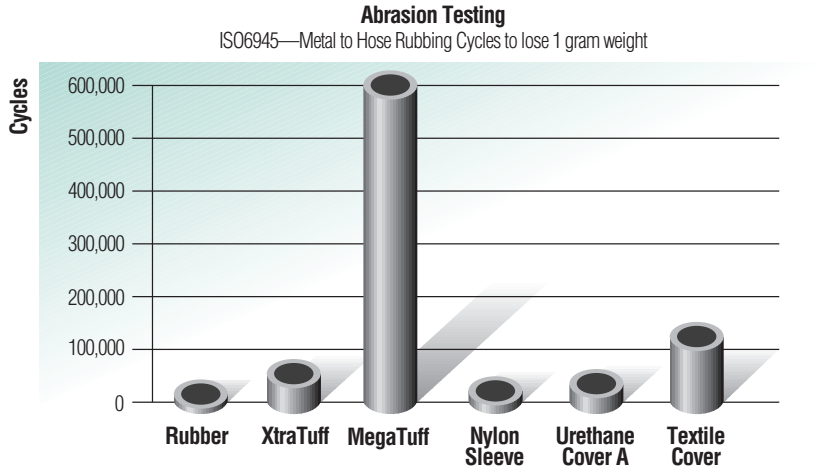
The Cover

The Cover protects the reinforcement and tube from such environmental conditions as:

- **Weather**
- **Ozone**
- **Abrasion**
- **Corrosion**
- **Temperature**
- **Chemicals**

To solve severe hose-to-hose or hose-to-metal abrasion problems, Gates offers two hose cover options:

- **MegaTuff™ Hose Cover** provides 300-times the abrasion resistance of standard hose covers.
- **XtraTuff™ Hose Cover**, for mid-range applications, offers 25-times the abrasion resistance of standard hose covers.



Hoses with multiple reinforcements have an anti-friction layer between them to prevent the steel wires from rubbing against each other.

Selecting the Right Hose

Remember the acronym, “STAMPED”. Use it as a checklist to select the right hose assembly for an application.

S = Size

T = Temperature

A = Application

M = Material

P = Pressure

E = Ends of couplings

D = Delivery (Quantity and Volume)

Do not use hose OD to identify the ID of the hose. Different hose constructions will vary with the wall thickness and OD.

S = Hose Size (Dash Numbers)

Dash Numbers, the industry standard, describe hose and coupling size. This number precedes the hose or coupling description (see table on page 6).

Dash numbers denote hose ID in sixteenths of an inch. A hose of ¼” ID is classified as -4 (4/16). A hose with ½” ID is a -8 (8/16).

The exception to this is the SAE100R5 hoses C5C, C5D, C5E and C5M, as well as C14 PTFE hose and AC134a Refrigerant hose, where dash sizes denote hose ID equal to equivalent tube OD.

Replacing a Hose

Determining the Right Size

The easiest way: Read the layline on the original hose.

If the original hose layline is unreadable, cut the original hose and measure the inside diameter.

NOTE: You also need to identify and count the number of reinforcement layers.

Dash Numbers Table

Dash No.	Hose I.D. (Inches)			
	All Except C5 Series, C14 and AC134a		C5 Series, C14 and AC134a	
	Inches	Millimeters	Inches	Millimeters
-2	1/8	3.2	--	--
-3	3/16	4.8	--	--
-4	1/4	6.4	3/16	4.8
-5	5/16	7.9	1/4	6.4
-6	3/8	9.5	5/16	7.9
-8	1/2	12.7	13/32	10.3
-10	5/8	15.9	1/2	12.7
-12	3/4	19.0	5/8	15.9
-14	7/8	22.2	--	--
-16	1	25.4	7/8	22.2
-20	1-1/4	31.8	1-1/8	28.6
-24	1-1/2	38.1	1-3/8	34.9
-32	2	50.8	1-13/16	46.0
-36	2-1/4	57.6	--	--
-40	2-1/2	63.5	2-3/8	60.3
-48	3	76.2	--	--
-56	3-1/2	88.9	--	--
-64	4	101.6	--	--
-72	4-1/2	115.2	--	--

T = Temperature

When selecting a replacement hose, you have to consider

a) the temperature of the fluid being conveyed,

b) the ambient temperature of the environment it passes through, and

c) the minimum and maximum temperature created by the system itself.

Fluid Temperature - Consult the Hose Selection Guide and the Additional Temperature Limits Chart in the Gates Hydraulics Catalog. When choosing a hose for a given application, you MUST NOT exceed the maximum operating temperature.

NOTE 1: Intermittent temperature surges of the fluid (up to 10 percent of operating time) are acceptable.

NOTE 2: DO NOT expose the hose to maximum temperature and maximum working pressure *at the same time*. That reduces the service life of the hose.

Ambient Temperature - When routing near hot manifolds, you may need to protect the hose with a heat shield.

System Temperature - The temperature generated by the hydraulic system itself is created by several factors, among them:

a) the length of the hose assembly,

b) the friction inside the hose and the size of the hose.

See “Pressure Drop” on page 9.

Avoid equipment breakdown and possible injury by not exceeding the manufacturer’s recommended maximum operating temperature.

For gaseous applications (where permeation can occur), exercise additional caution in selecting the proper hose.

A = Application

Most often, you only have to make a duplicate of the original hose. When that is not the case, you need to answer these questions:

- Did the original hose give adequate service life?
- Where will the hose be used?
- Equipment type?
- Working and surge pressures?
- Suction application?
- Fluid and/or ambient temperature?
- Fluid compatibility?
- Routing requirements?
- Are there government and/or industry standards, such as USCG, DOT/FMSS, and MSHA, to meet?
- Hose construction?
- Minimum bend radius?
- Non-conductive hose required? This consideration is critical in some applications, including aerial equipment (power and telephone mobile equipment).
- Excessive abrasion?
- Expected service life?

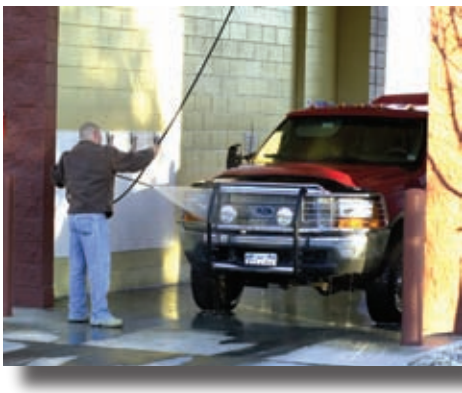
M = Material To Be Conveyed

Some applications require specialized fluids (oils or chemicals) for the system. The new hose tube, cover and couplings (including O-Rings) must be compatible with the fluid.

Permeation

Permeation, or seepage of fluid through the hose, results in fluid loss. Permeation can occur with any fluid in any hose.

In some cases, if permeation through the tube and reinforcement is likely, you can pinprick the hose cover to prevent fluid buildup and blistering under the cover. This is frequently done in pressure washer applications to release steam.



Volatile Fluids

The following fluids are of particular concern because of their volatility. Improper hose replacement for use with these volatile fluids can create a liability or have an adverse impact on the environment.

- Liquid and gas fuels
- Refrigerants (134A)
- Fuel oil
- Natural gas

NOTE: All block-type couplings contain Nitrile O-Rings, which also must be compatible with the fluids in the system. See the Chemical Resistance Table in Gates Hydraulics Catalog.

P = Pressure

You must know the system pressure, including pressure spikes. The working pressure of any hose must be equal to -- or greater than -- the system pressure.

NOTE: Gates DOES NOT recommend using hose on applications that have pressure spikes greater than the published working pressure of the hose.

Burst pressures are reference pressures and are intended for destructive testing purposes and design safety factors only. Typically the minimum burst pressure is four times that of the maximum working pressure.

Two types of Pressure Systems (or Applications)

There are two types of hydraulic pressure systems: static and dynamic.

- A static system uses static, confined liquids to perform the work. Force is multiplied proportionately from one confined container to another. A hydraulic jack is an example of a hydrostatic system.
- A dynamic system uses fluid-in-motion to perform work. A pump sets the fluid in motion to transfer energy to a driven element. A backhoe is an example of a hydrodynamic system.

More About Pressure: Impulse and Spike

Two common terms used to describe hydraulic pressures are: impulse and spike.

- An impulse is a pressure surge usually caused by the hydraulic pump.
- A pressure spike is a surge of the hydraulic pressure. Imagine a backhoe that, while digging, suddenly hits a big rock. The back

In the hose selection process it's essential to know the system pressure, including pressure spikes.

In fluid power applications, pressure drop is the difference between the pressure of a fluid as it enters one end of a hydraulic hose assembly, and the pressure of that fluid as it leaves the other end.

pressure causes the pressure within the hose to increase quickly and dramatically, but only for a short period of time.

Pressure Drop

System pressure drop occurs naturally in a hydraulic system. However, you may have to control the amount of pressure drop (by minimizing 90° bends in the routing, for example), so as not to adversely affect the performance of the equipment. Pressure drop can be caused by the following:

- **Friction.** Fluid rubbing against the inside walls of the hose and couplings creates friction.
- **Viscosity.** Different fluids behave differently under pressure. High viscosity (thicker) fluids don't move as readily as low viscosity fluids and so exhibit a greater drop in pressure.
- **Ambient** temperatures also affect viscosity. In the Arctic, for example, we'd use a low viscosity fluid because the icy ambient temperature will moderate it.

  The opposite is true in the Tropics where high ambient temperatures will moderate high viscosity fluids. In both cases, the idea is to allow the pump to move the fluid easily.
- **Fluid Temperatures.** As temperatures increase, fluid becomes thinner and allows the fluid to move more easily. Automotive oil is an example.
- **Length of Hose Assembly.** The longer it is, the more friction will decrease pressure.
- **Size (ID) of Hose:** The ID of the hose affects the fluid velocity for a given flow rate.
  - **Small IDs** increase velocity, and high velocities result in greater pressure drop.
  - **Large diameter hose** will produce less pressure drop.
- **Type of Couplings and Adapters:** Any change in bore or direction (such as with a 45° or 90° elbow) increases the amount of pressure drop.
- **Flow Rate:** Pressure drop increases with flow rate for the same size hose.

Why Pressure Drop Matters

When plumbing a system, you have to take any drop in pressure into account. Say you need 4,000 psi of output to run the equipment efficiently. The input pressure to the hose assembly must equal 4,000 psi PLUS the amount of pressure drop inherent in the system. For example, if you calculate the pressure will drop 150 psi, you will need 4,150 psi of input.

Determining the Amount of Pressure Drop

Consult the Gates Hydraulics Catalog and, using the following information, analyze pressure drop:

- **Type of application**
- **Fluid type and viscosity (at desired temperature)**
- **Fluid temperature (° F)**
- **Fluid flow rate (GPM)**
- **Hose size and length**
- **Number and types of fittings**

E = Ends of Couplings

We will discuss couplings ends in the following section. Consult the current Gates Crimp Data Chart for recommended hose and couplings combinations.

D = Delivery

If your replacement hose is the same ID as the original hose, most likely the system is properly sized to transport fluid efficiently. It pays to make sure. Check the Gates Hydraulics Catalog if you have questions about determining the optimum hose size for a specific application.

How much fluid must go through the hose? This will determine the size of hose that must be used. Under-sizing a hose leads to increased pressure loss. Over-sizing the hose adds unnecessary cost, weight and bulk.

Gates SAE Hose Nomenclature

Gates carries a complete line of replacement hoses that meet the same high-quality standards as the OEM hoses.

8 G 2

- 2 — Thin cover, no skiving required
- G — SAE 100R Spec # (SAE 100R2) 2 wire
- 8 — Dash size in 1/16" (e.g. 8/16 = ½")

Gates MegaSys® Nomenclature

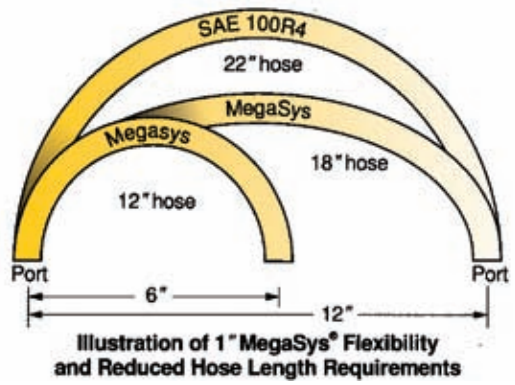


Illustration of 1" MegaSys® Flexibility and Reduced Hose Length Requirements

Gates MegaSys® hoses have half the bend radius of their SAE counterpart. This increased flexibility allows for:

- **Easier routing**
- **Faster installation**
- **Potentially shorter hose lengths**

Many OEM manufacturers use Gates MegaSys hoses as original equipment.

MegaSys® Nomenclature

8 M 3 K

- 3,000 pounds per square inch (K is the Roman numeral for 1000)
- M is the MegaSys® designation (½ SAE bend radius)
- Dash size in 1/16" (i.e., 8/16 = ½")

Examples of the MegaSys® family of hoses are:

C12M

M2T

M3K

M4K+ (exceeds 6,000 impulse cycles)

GMV (Global MegaVac®)

M5K

M6K

Gates MegaSys® Hose Benefits:

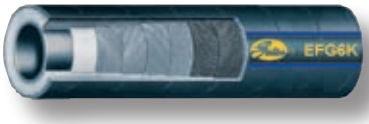
- Reduces hose length requirements up to 47 percent
- Decreases inventory requirements
- Flexibility allows routing in small spaces
- Tight bend radius means fewer bent tube couplings
- Plumbs and bends easier than conventional hoses

Hydraulic Hose Applications

Gates hydraulic hoses are designed for a world of applications.

Extremely High-Pressure (psi range)

Extremely high-pressure hoses are reinforced with either 4 or 6 spiral wires for optimum performance, meet a variety of governmental agencies requirements and are offered in the hose styles below:



- **EFG6K** meets or exceeds SAE 100R15 requirements. It has a 6,000-psi operating pressure in all sizes and is used on:
  - Hydrostatic transmissions
  - High-impulse applications, such as:
    - Snow groomers
    - Blacktop milling machines
    - Off-road construction equipment

- **EFG5K** meets or exceeds SAE 100R13 requirements and has a 5,000-psi operating pressure in all sizes. It is used on high-impulse applications, such as those found in off-road construction equipment.

- **EFG4K** and **EFG3K** meet or exceed both SAE 100R11 and SAE 100R12 requirements and have 4,000-psi and 3,000-psi operating pressures, respectively, in all sizes.

Extremely High-Pressure (psi range) hoses are used for

- Extremely high-pressure
- High-impulse
- Severe hydraulic hose applications such as hydrostatic transmissions

Very High-Pressure (psi range)

These hoses are designed and recommended for very high-pressure hydraulic applications such as:

- Construction
- Mining
- Heavy equipment applications

Very high-pressure hydraulic hoses are reinforced with 4 spiral wires and meet a variety of governmental agency requirements.

- **EFG4K** (C12M) meets or exceeds the SAE 100R12 specifications. EFG4K hose is very flexible so it can be used in applications that require the hose to be bent to ½ the bend radius of SAE 100R12.

High-Pressure (psi range)

Gates high-pressure hydraulic hoses meet a variety of governmental agency requirements and are offered in the following styles:

- **G2**—the most popular hose in the hydraulic market today found on nearly every mobile application, including:
  - Backhoes
  - Trash trucks
  - Forklifts
  - Agricultural equipment
  - Construction equipment of all types

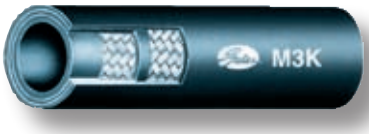
- **M2T**—the ½ bend radius version of the standard G2 hose. It meets the SAE 100R16 specification. This hose:
  - Offers superior impulse performance
  - Is lightweight
  - Has excellent flexibility, which allows for:
    - tighter bends
    - easier installations

High-Pressure (psi range) hoses are recommended for high-pressure hydraulic lines and are used on many types of machinery and other applications, such as:

- Industrial
- Farm equipment
- Construction equipment
- Trash trucks
- Porta Powers

Medium-Pressure (psi range) hoses are used on a variety of medium-pressure applications and are designed to transport many types of fluids, such as:

- Hydraulic oils
- Power steering fluid
- Transmission oils
- Antifreeze solutions
- Water
- Air



- **M3K**—has a 3,000 psi operating pressure in all sizes. M3K is an economical alternative to G2 or M2T hose in applications where the operating pressure is 3,000 psi or below (often the case on most farm equipment).

- **J2AT**—also known as "jack" hose, is a hose specially-designed for 10,000 psi applications. You will find this on Porta-Power applications in:
  - Body shops
  - Fire departments
  - Other places that use portable power units for a hydraulic jack

Medium-Pressure (psi range)

Medium-pressure hoses are used on all kinds of equipment, on trucks and buses and in industry. Each hose is designed for a specific application and each meets a variety of governmental agency requirements.

- **G1,** reinforced with one braid of high tensile wire, is designed for medium-pressure hydraulic oil lines and is used on:
  - Agricultural applications
  - Snowplows
  - Other medium-pressure applications
- **C3H** is a medium-pressure hose designed to handle:
  - Hydraulic oil
  - Antifreeze solutions
  - Water
  - Low-pressure return lines
  - Car wash wand applications
- **PowerClean™ 3000** hoses are medium-pressure hoses designed for:
  - Hot and cold pressure washer applications
- **GTH (C6H)** is a medium-pressure hose designed for:
  - Hydraulic oil
  - Automatic transmission cooler lines on automotive and heavy duty applications

Medium-Pressure Fleet Hoses

The Heavy Duty Fleet industry has many applications for medium-pressure hydraulic lines that include, but are not limited to:

- Power steering
- Fuel
- Oil
- Air lines

Originally, fleets used copper tubing for these applications. Remember, copper tubing is measured by its OD. When rubber hose replaced copper tubing, it was built with the same ID of the copper tubing. That is why -8C5 hose and -8 copper tubing have an ID of 13/32".

C5C

C5C is a medium-pressure hose that meets the SAE 100R5, SAE J1402 Type AII, and DOT FMVSS 106-74 Type AII. Fleet applications include:

- Air lines
- Lube oil line
- Petroleum-based oil lines
- Air brake lines
- Filtration lines
- Water lines
- Turbocharger oil supplies
- Tilt cab cylinders
- Transmission coolant
- Power steering (heavy-duty commercial vehicles only)

NOTE: Not recommended for gasoline or diesel fuel.

C5D

C5D is a medium-pressure hose with a synthetic rubber (CPE) tube that can handle phosphate ester fluids. C5D meets the SAE 100R5, SAE J1402 Type AII, and DOT FMVSS 106-74 Type AII, and SAE J1019. Fleet applications include:

- Air lines
- Power steering lines (heavy-duty commercial vehicles only)
- Oil lines
- Air brake lines
- Tilt cab cylinders

Hydraulic Hose Applications

Hydraulic Hose Applications

- Diesel fuel lines
- Transmission coolant lines
- Hot lube lines
- Petroleum-based or phosphate ester fluids
- Filtration lines
- Gasoline and turbocharger oil supplies

C5M

C5M is a medium-pressure hose used in the marine market for diesel fuel and gasoline applications. C5M meets SAE J1527 and SAE J1942. Applications include:

- Hot lube lines

This hose is Coast Guard approved.

C5E

C5E is a medium-pressure, higher temperature hose that meets the SAE J1402 Type AI, and DOT FMVSS 106-74 Type AI, and SAE J1019. Fleet applications include:

- Power steering (heavy-duty commercial use only)
- Hot lube lines
- Fuel filters
- Engine and transmission coolant lines
- Oil lines
- Air brake lines

LP350

LP350 is a medium-pressure hose designed for liquid or gaseous propane, butane or any combination of these two mixtures when used as fuel.

C14 (PTFE)

This medium-pressure hose is for high temperature (+400° F) applications and meets Gates SAE 100R14 specifications. Fleet applications include:

- Air brake compressor (discharge side only)
- Hot oil and fluids
- Gasoline fuel lines
- Any high-heat application

Industrial applications include:

- Plastic molded injection systems
- Other high-heat applications

PolarSeal®

PolarSeal®is designed for refrigerant applications and is approved for R134A, R12 and R22 refrigerants. It is used on:

- Automotive, truck and bus air conditioning systems
- Railroad boxcars and refrigerated systems on over-the-road trailers

Thermoplastic

Thermoplastic hose is used for medium- to high-pressure hydraulic lines found on:

- Forklifts
- Snowplows
- Farm equipment
- Aerial lifts
- Wherever lightweight, high-visibility colored hose is desirable

Thermoplastics also handle a variety of hydraulic fluids, including phosphate ester base and water glycol.

Many applications involving PTFE hose do not require a conductive tube. Be sure to review the potential for electro-static discharge for every application and be aware that static electricity can be hazardous. In those cases where electro-static discharge can occur, conductive PTFE hose with a conductive tube (Gates C14CT hose) is recommended.

GT7 and GT7NC

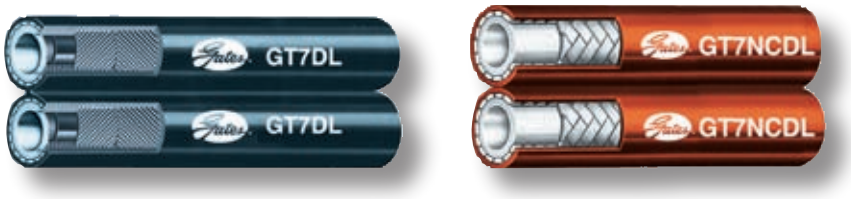
These medium-pressure hydraulic lines are used for:

- Petroleum
- Water emulsion
- Synthetic hydraulic fluids

GT7 has a perforated black cover, and is used for:

- Forklifts
- Snowplows
- Other applications

GT7NC has a non-perforated safety orange cover. The cover is electrically non-conductive, which is perfect for aerial lift applications.



GT7DL and GT7DLNC

GT7DL and GT7DLNC are dual medium-pressure hydraulic hoses (two hoses molded together) and are used for:

- Petroleum
- Water emulsion
- Synthetic hydraulic fluids

GT7DL has a black cover and is used for:

- Forklifts
- Snow plows
- Other applications

The safety orange cover of GT7DLNC is electrically non-conductive and used in aerial lift applications.

GT8 and GT8NC

GT8 and GT8NC are high-pressure hydraulic lines used for:

- Petroleum
- Water emulsion
- Synthetic hydraulic fluids

GT8 has a black cover and is used for:

- Forklifts
- Snow plows
- Other applications

GT8NC has an electrically non-conductive safety orange cover for use in aerial lift applications.

Low-Pressure/Suction/Return Lines

You'll find these low-pressure suction return hose on:

- Applications with working pressures under 300 psi
- Fluid transfer systems

Used in the industrial and transportation industries, these hoses can handle:

- Hydraulic oil
- Antifreeze
- Water
- Air
- Diesel fuels

GMV - Global MegaVac® Return Line and Suction Hose

The highly-flexible GMV hose is reinforced with a double-spiral helical wire to prevent hose collapse. It meets or exceeds requirements of 100R4 with half the bend radius.

RLA 1-Fiber Braid Return Line and Low-Pressure Hose

RLA 1 hose meets or exceeds 30R2 performance requirements of both Type 1 and Type 2, and is ideal for such applications as:

- Water
- Glycol antifreeze solutions
- Diesel fuel
- Gasoline
- Air

LOC and LOL

These hoses are used in the industrial and transportation industries and are used for:

- Petroleum-based hydraulic oils
- Glycol antifreeze solutions
- Water
- Hot lubricating oils
- Air

Hydraulic Fluids

Most hydraulic fluids are either

- Petroleum-based,
- Water glycol-based or
- Synthetic-based (i.e., phosphate ester).

Their specific properties may or may not meet the needs of a given application. In addition, leaking hydraulic fluids have contaminated the ground water supply. That is changing.

Today the industry is switching to biodegradable and environmentally friendly “green” hydraulic fluids. However, because many of these green fluids seep through ordinary hose tubes, using them to protect our environment has necessitated a change in the way hoses are made. Gates is in the forefront of this change with its line of EnviroFluid™ spiral-wire hoses. The nitrile tube stock in each EnviroFluid hose prevents permeation while conveying not only biodegradable fluids, but such aggressive oils as synthetic esters, polyglycols and vegetable oils.

The EnviroFluid hose line is one more example of the Gates commitment to developing both environmentally friendly products and the manufacturing processes that make them.

Gates EnviroFluid™ hose features a nitrile tube that makes it tough enough to handle biodegradable fluids at operating temperatures up to 250° F (120° C) without any loss of performance.

Hose Storage

Following proper storage procedures, a hose can last five-to-seven years on the shelf. However many variables in a storage environment shorten shelf life, among them:

- Temperature
- Humidity
- Ozone
- Oil
- Solvents
- Corrosive materials
- Fumes
- Insects
- Rodents
- Radioactivity
- Space allowance
- Bends in the stored hose

Apart from where the hose is stored, the material in the hose itself affects longevity. Some hose materials have a built-in resistance for long shelf life. However, others require special additives during compounding, and they are susceptible to degradation – even under seemingly ideal storage conditions.

Gates recommends hose in extended storage be visually inspected and tested before use. Hose judged marginal should be replaced to avoid potential failure, property damage or bodily injury.

Ideal Conditions

Hose should be stored on a first-in, first-out basis because unusually long storage or poor storage environments can deteriorate hose, reduce performance and may lead to premature failure.

• Store hose in a cool, dry area never exceeding +38° C (+100° F).

• Avoid direct sunlight, rain, heaters and proximity to electrical equipment.

• Don't stack heavy objects on the hose. Don't crush it.

• Store hose in original container.

NOTE: If stored below freezing, warm hose up before handling, testing and using.

Service Life Considerations

Nothing lasts forever. Depending upon the application, any hydraulic hose or hose assembly has only a limited service life. Subjecting hose or assemblies to conditions more severe than the recommended limits will further shorten service life.

Factors that Shorten Service Life

Continuous use at:

- Maximum rated working pressure
- Maximum recommended operating temperature
- Minimum bend radius

NOTE: Regularly inspect hose assemblies in service for damage. Assemblies showing signs of wear or damage should be replaced immediately.

To avoid injury to personnel and/or damage to equipment, be sure to follow these hose guidelines:

- Proper selection
- Proper installation
- Proper maintenance procedures

Couplings

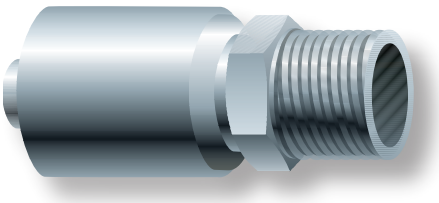
Couplings are the metal components of a hydraulic hose assembly. The stem end of the coupling (or threaded end) connects the assembly to other components in the hydraulic system. There are two types of hydraulic couplings:

1. Permanent
2. Reusable

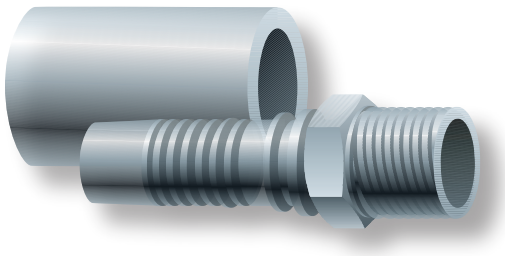
Always use NEW components when making hose assemblies. No permanent coupling component – hose, stem, or ferrule – is reusable.

Permanent Couplings

You need crimping or swaging equipment to attach permanent couplings to a hose. Gates has two types:



- MegaCrimp® one-piece couplings. The ferrule is permanently attached to the stem.



- Power Crimp® two-piece couplings, with a stem and separate ferrule. The stem is inserted into the hose. The ferrule is the outside shell that fits over the hose end.

NOTE: Stem and ferrule must be compatible.

Ferrules

There are also two types of ferrules.

1. Skive ferrules have rounded serrations (teeth). Skiving is becoming obsolete because of advanced hose technology and the additional cost in time that skiving requires.
2. Non-skive serrations are sharp so they can bite through the hose cover. Non-skive ferrules are the most popular in the replacement market.

Field-Attachable (Reusable) Couplings

As the name implies, these are the couplings-of-choice where crimping equipment is scarce – or non-existent. You can install a field-attachable coupling with a vise and a couple of crescent wrenches. There are several types:

- Skive
- No-skive
- Lock-on
- 100R5 (C5) DOT approved

Field-attachable couplings and the hose they fit on must be compatible.

Coupling Identification

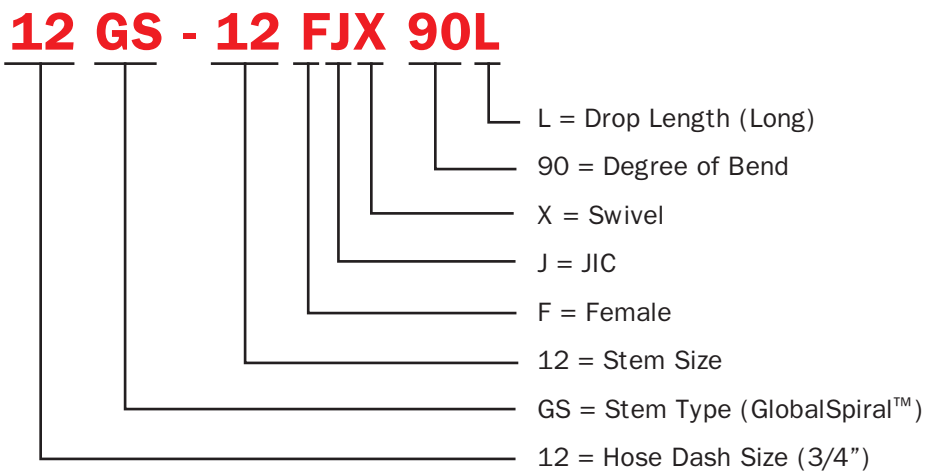
Compare the thread end of the new coupling (or adapter) with the coupling you're replacing. You can also use a thread end identification tool to measure the threads, which come in different configurations, as shown below.

GlobalSpiral™ Couplings

MegaCrimp® Couplings

Dash Sizes

Hose ends and thread ends are measured by dash sizes, the industry standard. The end of the coupling that is inserted into the hose the (dash size) refers to the inside diameter in 1/16" (except for SAE 100R5 (C5) and SAE 100R14 (C14), which are based on tube OD).

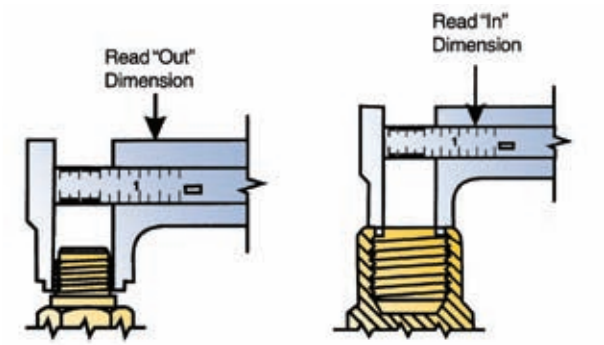


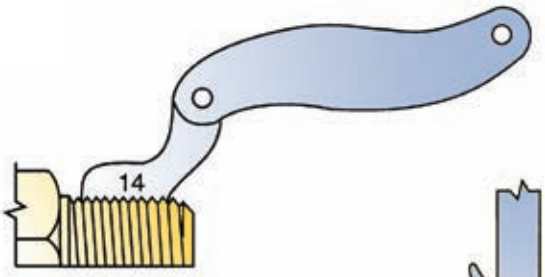
Coupling and Adapter End Style Code

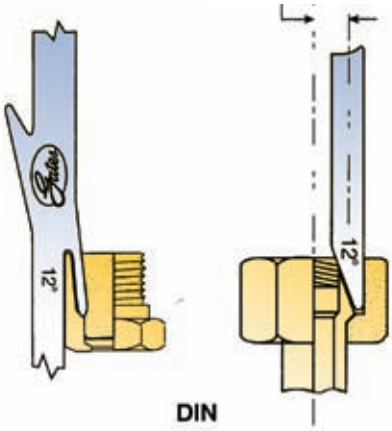
Code	Description
AB	Air Brake
B	O Ring Boss
BJ	Banjo
BKHD	Bulkhead
BS	Bite Sleeve
BSPP	British Pipe Parallel
C	Caterpillar Flange Dimension
DH	DIN Heavy
DL	DIN Light
F	Female
FBO	Female Braze-on Stem
FF	Flat Face
FFN	Female Flareless Nut
FFOR	Flat Face O-ring
FFS	Female Flareless Sleeve
FG	Female Grease Thread
FKX	Female Komatsu Style Swivel
FL	O Ring Flange (Code 61)
FLC	O Ring Flange (Caterpillar Style)
FLH	O Ring Flange (Code 62)
FT	Female Tube
HM	Hose Mender
I	Inverted Flare
J	JIC (37° Flare)
JIS	Japanese Industrial Standard
K	Komatsu Style (Japanese 30 Seat)
LH	Long Hex
LN	Lock Nut
M	Male
MFA	Male Flareless Assembly (Ermeto)
MM	Metric Male
MN	Metric Nut
MPG	Male Pipe Grease Fitting
MSP	Metric Stand Pipe
NASP	North American Stand Pipe
P	Pipe Thread (NPTF or NPSM)
PL	Press Lok
R	Reusable
S	SAE (45° Flare)
TS	Tube Sleeve
TSN	Tube Sleeve Nut
X	Swivel
Z	Parker Triple Thread
22	22 ½°
30	30°
45	45°
60	60°
67	67 ½°
90	90°
110	110°

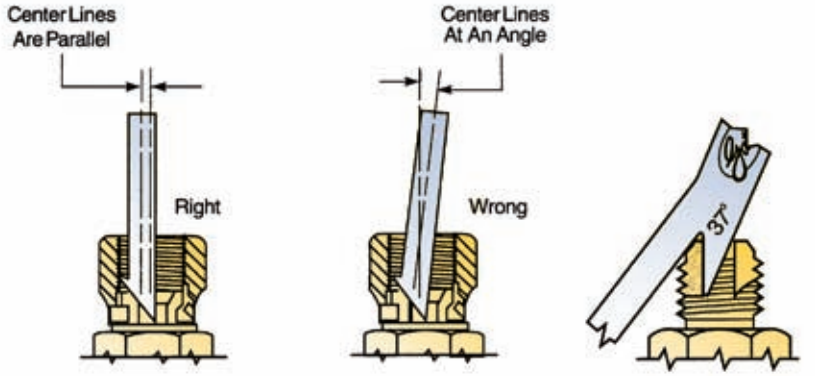
To identify a coupling:

- Measure the ID or OD
- Measure the threads per inch (USA) or per millimeter (metric)
- Measure the angle of the mating seat
- Compare all measurements to the fitting dimensions listed in the Gates Hydraulics Catalog









North American Standards

There are nine North American Standard threads, used mainly in the U.S. and Canada.

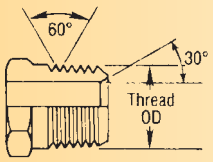
- National pipe thread
- JIC 37° flare
- SAE 45° flare
- SAE straight thread O-Ring boss
- Flat Face O-Ring
- Flareless tube
- SAE inverted flare
- Code 61
- Code 62 flange
- Caterpillar

National pipe thread are available in the following styles:

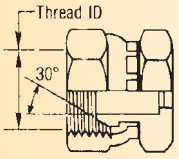
- National Pipe Tapered for Fuels (NPTF)
- National Pipe Straight for Fuels (NPSF)
- National Pipe Straight for Mechanical Joints (NPSM)

NOTE: NPTF male couplings will mate with NPTF, NPSF and NPSM female couplings.

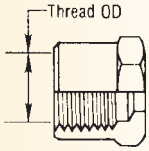
NPTF (Gates nomenclature: MP, MPX, FP and FPX)



NPTF Solid Male (MP)

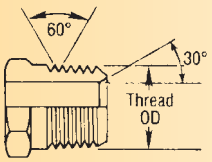


NPSM Swivel Female (FPX)

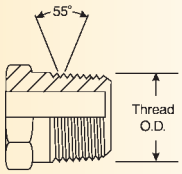


NPTF or NPSF Solid Female (FP)

- An NPTF solid male has tapered threads and a 30° inverted seat.
- The NPTF female has tapered threads and no seat.
- The male pipe swivel has only tapered threads. The seal is made on the deformed threads.
- The NPSM female has straight threads and a 30° inverted seat. The seal takes place on the 30° seat.



NPTF Solid Male (MP)



BSPT Male (MBSPT)

The NPTF coupling is similar to, but not interchangeable with, the British Standard Pipe Taper coupling. Note these differences:

- The thread pitch is different in most sizes.
- The thread angle on NPTF is 60° instead of the 55° angle of the British coupling.

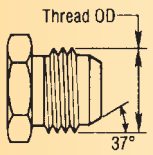
Differences Between SAE 37°and SAE 45° Flared Seats

1. Gates puts a single notch on each hex of the male and the female SAE 45° flare to differentiate them.

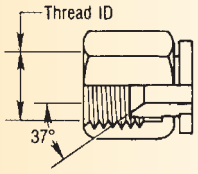
2. In contrast, the JIC 37° male and female have no markings on the hex nut.

NOTE: 100R5 (C5) field attachable couplings are dual seated, (JIC/SAE) in all sizes, except –6 and –12.

37° Flare (Gates nomenclature: MJ, FJX)



Male JIC 37° (MJ)



JIC 37° Flare Female (FJX)

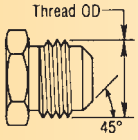
- The JIC 37° flare male coupling mates with a JIC 37° female.
- Both JIC male and female have straight threads and 37° flare seats.
- The seal is made on the 37° flared seat.

NOTE:

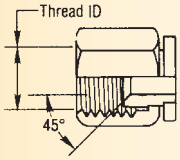
- JIC 37° sizes have the same threads as the SAE 45° flare, except for –6 and –12.
- 100R5 (C5) field attachable couplings are dual seated in all sizes, except –6 and –12.

NOTE: Measure the seat angle to determine the difference between 37° and 45° flared seats.

SAE 45° Flare



SAE 45° Flare Male (MS)



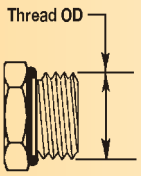
SAE 45° Flare Swivel Female (FSX)

- The SAE 45° flare male mates with a SAE 45° flare female.
- Both male and female have straight threads and a 45° flared seat where the seal is made.

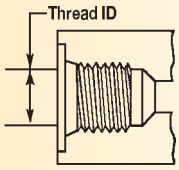
NOTE: Measure the seat angle to determine the difference between 37° and 45° flared seats.

NOTE: Some C5, C5E and Lock-on couplings may have dual machined seats (both 37° and 45° seats).

O-Ring Boss (Gates nomenclature MB, FB, MBX)



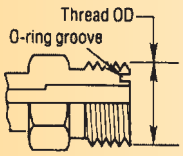
O-Ring Boss Male (MB,MBX)



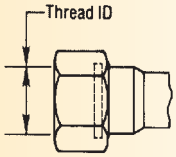
O-Ring Boss Female Port (FB)

- The O-Ring boss male mates with an O-Ring boss female port.
- The O-Ring on the male creates the seal when compressed against the face of the port.

Flat Face O-Ring (Gates nomenclature FFOR, MFFORX)



Male Flat- Face O-Ring (MFFOR)



O-Ring Face Seal Swivel Female (FFORX)

The solid male O-Ring face seal mates with a swivel female O-Ring face seal. An O-Ring rests in the O-Ring groove on the male coupling. The seal is made when the O-Ring in the male contacts the flat face on the female coupling.

24° Cone High-Pressure Applications

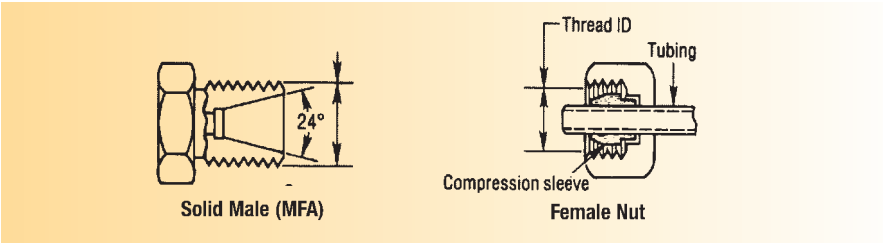
Most everyone knows that a 24° cone is used on compression tube (standpipe) couplings and on flareless assemblies to connect tubing and hose. What many don't know is that a 24° cone is also used on many high-pressure applications.

A metric standpipe, metric bite sleeve and the proper metric nut provide the same termination as German DIN (Light and Heavy), French GAZ and Kobelco. They all use the 24° compression style thread termination (see pages 40-43 for more on these couplings).

NOTE: Gates offers bite sleeves and nuts in SAE 100R2 ONLY. If you need spiral pressure ratings, you need to use a GlobalSpiral™ (GS) coupling.

Did you know? A 24° cone can also be used on many high-pressure applications.

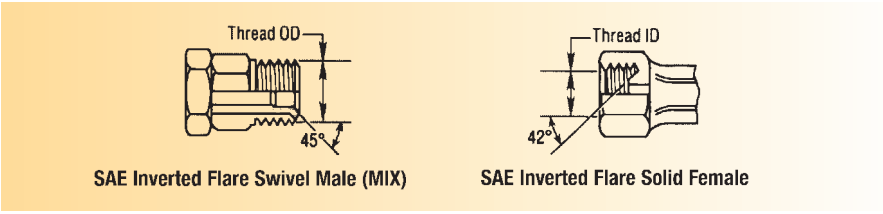
MFA Male Flareless Tube (Gates nomenclature MFA)



This fitting makes a connection between a hydraulic hose and metal tubing.

- The flareless solid male mates with a female flareless nut and a compression sleeve.
- The female has straight threads and a compression sleeve for a sealing surface.
- The seal is made between the compression sleeve on the male and the tubing of the female.

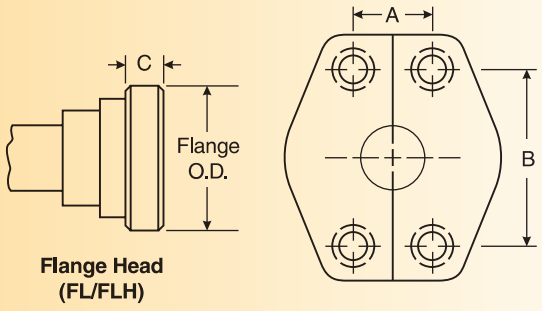
SAE inverted 45° Flare (Gates nomenclature: MIX)



The SAE 45° inverted flare male mates only with an inverted flare female.

- The male has straight threads and a 45° inverted flare.
- The female has straight threads and a 42°.
- Mating of the two flare seats makes the seal.

SAE Code 61 and Code 62 Flanges (Gates nomenclature: FL, FLH, FLK, FLC)



Flange Head (FL/FLH)

4-Bolt Split Flange Bolt Hose Dimensions

These two couplings are used worldwide on construction equipment in areas with limited space.

- Code 61 (FL) has a smaller flange diameter and thinner profile than those of Code 62 (FLH).

NOTE: The flange halves that attach to the port have different distances between the bolt holes.

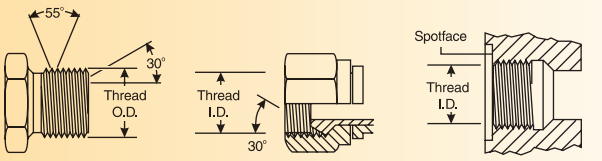
There are three specialized flanges:

1. Caterpillar flanges (FLC) are the same OD as SAE Code 62 flanges but have a thicker flange head.

NOTE: Flange halves must be compatible.

2. Size #10, called Komatsu flanges (FLK), are dimensionally the same as SAE flanges except for their O-Ring grooves.
3. Poclain flanges, discussed on page 43 (see French Standards), are completely different from SAE flanges and are not interchangeable.

British Standards



BSPP Male BSPP Female BSPP Female Port

It is not true that all foreign threads are metric. However there are two common threads styles: 1) Metric and 2) Whitworth (BSP or British Standard Pipe).

SAE Code 61 and Code 62 Flanges are used worldwide, usually as a connection on pumps and motors for extremely high-pressure lines.

There are two types of British couplings:

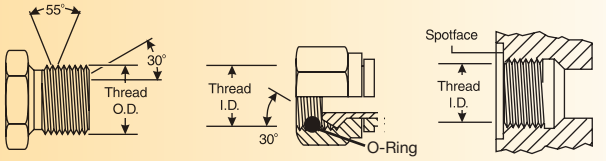
1. British Standard Pipe Parallel (BSPP).

2. British Standard Pipe Tapered (BSPT).

BSPP (Gates nomenclature MBSPP)

Both male and female have straight threads and a 30° seat. The seal on the port is made with an O-ring or a soft metal washer on the male.

NOTE: The BSPP coupling is similar to – but not interchangeable with – the North American NPSM coupling. The thread pitch is different in most sizes, and the thread angle is 55° instead of the 60° angle found on most NPSM threads.



BSPP Male (MBSPP) | **BSPOR Female (FBSPORX)** | **BSPOR Female Port**

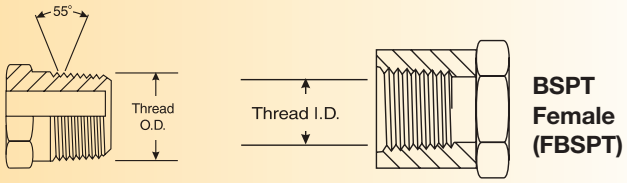
BSPT (Gates nomenclature MBSPT)

The BSPT male has tapered threads and will mate with either a female BSPT or BSPOR.

In either case, the seal is made on the threads.

NOTE 1: A BSPT coupling looks similar to a North American NPTF coupling, yet the thread pitch and thread angle can be different.

NOTE 2: Applications for BSPP and BSPT hydraulic couplings are usually found on British-built equipment. However, never assume a country-of-origin for a coupling based solely on the equipment it is on. With worldwide sourcing, you can find almost any coupling on any piece of machinery.



BSPT Male (MBSPT) | **BSPT Female (FBSPT)**

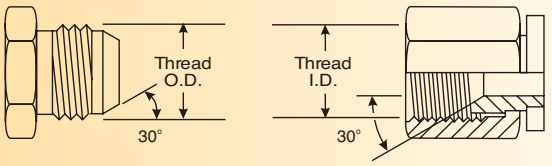
British couplings are widely used in the United Kingdom, throughout Europe, Japan and British Commonwealth countries such as India, Australia and New Zealand. They are becoming more common in North America thanks to worldwide sourcing.

Japanese Standards

There are four Japanese couplings on Japanese built or designed equipment:

- JIS 30° flare parallel thread
- JIS tapered pipe thread
- Komatsu style 30° flare
- Komatsu-style flange

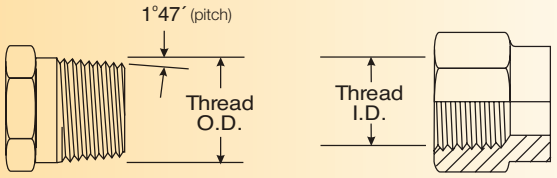
Japanese 30° Flare Parallel Thread (Gates nomenclature MJIS, FJISX)



Male (MJIS) **Female (FJISX)**

The Japanese 30° flare male coupling mates with a Japanese 30° flare female, both of which have straight threads and a 30° seat. The seal is made on the 30° flared seat.

Japanese Tapered Pipe Thread (Gates nomenclature MBSPT, FBSPT)



Male (MBSPT) **Female (FBSPT)**

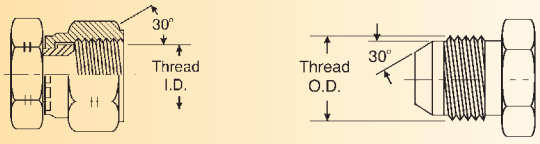
The Japanese tapered pipe thread coupling is identical to and fully interchangeable with the British BSPT (tapered) coupling. That's why we use only one description to describe this coupling, BSPT.

The seal on the Japanese pipe thread coupling is made on the threads.

While the threads on a Japanese 30° flare coupling are the same as the BSPP threads, and while both Japanese and British couplings have a 30° seat, they are not interchangeable. The British seat is inverted (shaped like a cone). The Japanese seat is not inverted and is shaped like a funnel.

Gates Komatsu-style couplings have two notches on the hex nuts to distinguish them from a JIS coupling.

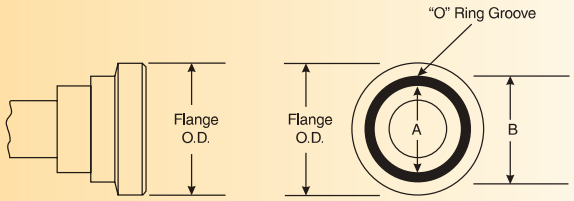
Komatsu-style 30° Flare Parallel Thread Coupling (Gates nomenclature MK, FKX)



Female (FKX) — Komatsu-Style Male (MK)

Except for the threads, the Komatsu style 30° flare parallel thread coupling is dimensionally identical to the Japanese 30° flare parallel-thread coupling. The Komatsu-style uses metric fine threads and seals on the 30° flared seat.

Komatsu-style Flange Fitting (Gates nomenclature FLK)



Flange (FL) — Flange Head

The Komatsu-style coupling is nearly identical to and fully interchangeable with the North American SAE Code 61 flange fitting. However, in all sizes, the O-ring dimensions are different. When replacing a Komatsu-style flange with an SAE flange, YOU MUST ALWAYS USE an SAE O-ring.

NOTE: Komatsu uses a -10 size flange that is not a SAE standard size.

As you would expect, all Komatsu equipment uses Komatsu couplings. However, other Japanese equipment manufacturers use these couplings:

- JIS 30°
- BSPP 30°
- North American JIC 37°

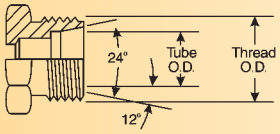
German Standards

German DIN couplings are used primarily in Germany and less frequently in Western and Eastern Europe. There are four main German Deutsche Industrial Norme (DIN) couplings:

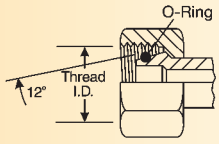
- DIN 240
- DIN 600
- DIN 3852 Types A and B
- DIN 3852 Type C

NOTE: The easiest way to identify a German DIN fitting is to use Gates Metric and BSP Female Thread Identification Kit (Part No. 86580, Product No. 7369-0319)

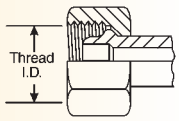
DIN 24°



Male 24° Cone, DIN 2353 (MDL/MDH)



Female 24° Cone with O-Ring (FDLORX/FDHORX)



Female Universal 24° and 60° Cone (FDLX/FDHX)

DIN 24° couplings are the most common German couplings. The male has a 24° seat, straight metric threads and a recessed counterbore that matches the tube OD of the coupling it is used with. The DIN male 24° cone (two 12° flares) will mate with three different female couplings:

- The female 24° with O-Ring
- The female metric tube (A metric stand pipe. Needs a bite sleeve and nut to mate)
- The female universal 24° or 60° cone

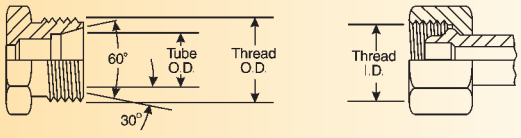
More About DIN

There is both a light and heavy series of DIN couplings. You can tell the difference by measuring both the thread size and the tube's OD.

Measure the ID of tubes of the same size to differentiate light from heavy. The heavy series has a thicker tube wall so the ID is smaller.

Use a 12° seat angle gauge to measure the flare angle (the angle from the coupling's centerline).

DIN 60°



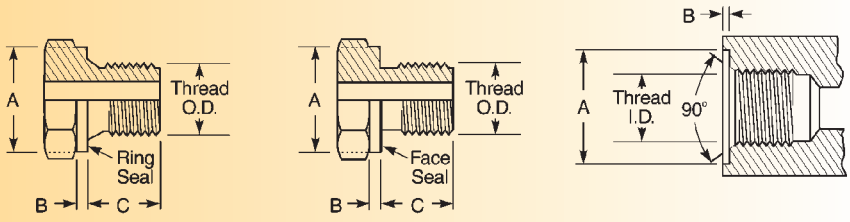
Male
60° Cone, DIN 6711

Female
Universal 24° and
60° Cone

These couplings are not commonly used. The DIN 60° cone male mates with either the female universal 24° or 60°cone couplings. The male has a 60° seat and straight metric threads.

NOTE: Use the 30° seat angle gauge to measure the flare angle.

DIN 3852 Couplings Types A and B (Parallel Threads)



Male
Type A

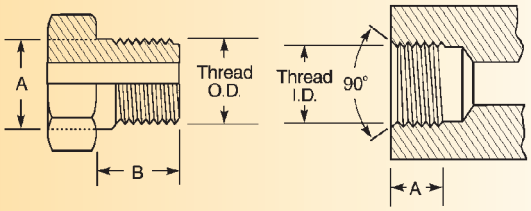
Male
Type B

Female
Types A & B

Male DIN 3852 A and B couplings mate only with a matching DIN 3852 A and B female. Both male and female A and B couplings have straight threads, but these threads can be either metric or British-designed.

The seal occurs when the O-ring seal (Type A) or the face (Type B) mates with the face of the female port.

DIN 3852 Type C Metric and Whitworth Tapered (BSPT) Thread Connectors



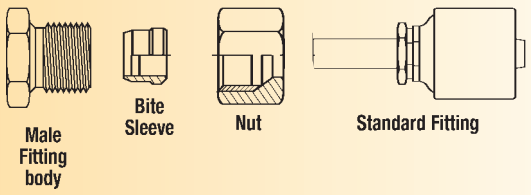
Type C couplings are available with either metric or Whitworth British threads. The seal takes place on the tapered threads.

There are three series of Type C couplings:

- Extra light (LL)
- Light (L)
- Heavy (S)

NOTE 1: Type C is also a port connection.

Metric Standpipe Assembly



A Metric Standpipe is made of three pieces

- Bite Sleeve
- Nut
- Standpipe

Tightening the nut compresses the bite sleeve onto the tube of the standpipe, which makes the seal.

Tapered threads (Type C) are less popular than straight (Types A and B) threads.

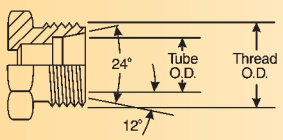
French Standards

There are two major types of French (GAZ) couplings used mainly on French equipment:

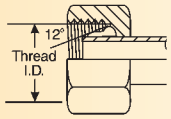
1. GAZ 24° flare, which mates with a female with either:

a) a 24° cone

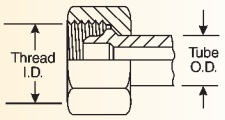
b) a female tube coupling



Male 24° Cone



Female 24° Cone

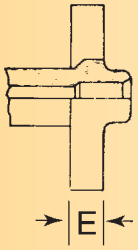


Female Tube Fitting

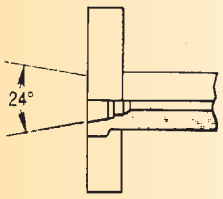
- The male has a 24° seat and straight metric fine threads.
- The female has a 24° seat or a tube sleeve and straight metric fine threads.

NOTE: Use the 12° angle seat gauge when measuring the flare angle.

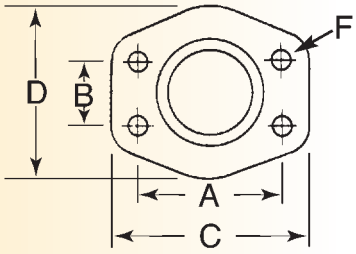
2. GAZ 24° flange (also called the Poclain 24° High-pressure Coupling).



Male Flange



Female Flange



Flange Clamp

This specialty fitting is found on equipment manufactured by Poclain.

- The male flange mates with a female flange or a port.
- The seal is made on the 24° seat.

Gates Global Part Numbering System

Gates part numbering system makes coupling identification easy. Always refer to the Gates Crimp Data Charts when selecting hose and coupling combinations.

In the following example, the Global Part Number G25100-0808 refers to a MegaCrimp® Male Pipe (MP) coupling with a –8 (½") stem size and a –8 (½") thread size.

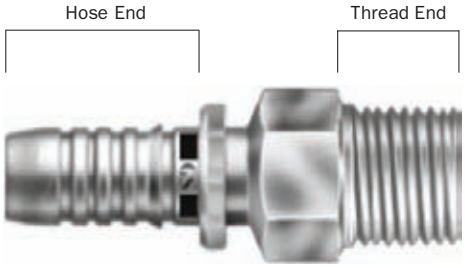
G25100-08 08

- 08 = Thread Size
- 08 = Stem Size
- 100 = Thread configuration (Male Pipe)
- G25 = Series Stem Styles (MegaCrimp®) See Stem Styles below.

Stem Styles

You'll need to know these designations for stem styles. See the Gates Hydraulics Catalog for others.

- G20 = GlobalSpiral™
- G25 = MegaCrimp®
- G40 = C14 (PTFE)
- G45 = PolarSeal®
- G9 = Quick Disconnects



Additional Coupling Selection Criteria

Be aware that a chemical reaction - galvanic action - produces an electrical current when two dissimilar metals are used together. This should be avoided.

You must take adverse chemical reactions and the factors listed below into consideration when selecting a coupling for an application:

- Corrosion resistance
- Vibration
- Temperature
- Fluid compatibility
- Pressure
- Use of adapters

Need help choosing the proper stem and ferrule? Download Gates E-crimp electronic crimp database from the Internet at www.gates.com/ecrimp.

Competitor Gates Competitor Competitor Competitor

Corrosion Resistance

For corrosion resistance, Gates uses TuffCoat™, a non-leaded carbon steel and a yellow zinc dichromate plating that provides more than 400 hours of protection from "red dust" rust formation. This is a 500 percent improvement over the standard 72-hour salt spray test in accordance with the ASTM B 117 specification. Gates also uses other materials, such as aluminum, stainless steel and brass.

Vibration

Excessive vibration can weaken or loosen a connection. Split-flange couplings or O-Ring couplings perform best under extreme vibration.

NOTE: If possible, in these applications do not use couplings that seal on the threads.

Temperature

Metal surfaces expand and contract under extreme temperature fluctuations. For these applications, use O-Ring couplings because the O-Ring will seal as the metal moves.

NOTE 1: Use only O-Rings suitable for high temperatures.

NOTE 2: Use fittings suited to the application's temperature demands. For example, if it's a high temperature application, don't use brass or aluminum.

Fluid Compatibility

Couplings, as well as hose, can be adversely affected by the fluids passing through them.

NOTE 1: Always check the chemical resistance charts for compatibility with coupling materials and O-Rings.

NOTE 2: Some male swivel couplings have internal O-rings. Always check fluid compatibility with O-Rings.

Pressure

Consider working pressure when selecting a fitting. Some fittings don't seal well at high-pressures and leak. O-Ring fittings and solid port connectors work well at high-pressures.

NOTE 1: Don't use swivel staked nut couplings at extremely high-pressures.

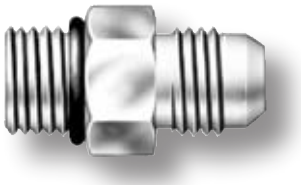
NOTE 2: Don't use aluminum ferrules on high-impulse applications.

If you have any questions about what end fittings should be used, consult your field sales representative or the Gates Hose and Connector Product Application group for assistance.

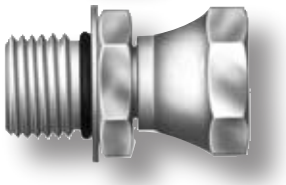
Adapters

Adapters are fittings with connection threads on two (or more) sides. They serve a variety of purposes and are found in practically all sizes, styles and thread types.

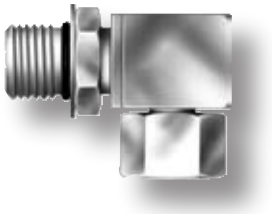
Uses of Adapters



Changing from one thread type to another. This is common in an in-line connection from a port connection.



Jump Size adapters **reduce or enlarge the size of the connection** or hose line.

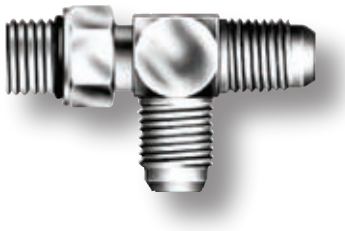


Using an adapter at a port connection where a straight hose fitting will be connected

1) eliminates stress on both port and coupling and

2) looks more streamlined.

Simplifying orientation. Instead of using two bent tubes, it's easier to use a bent tube flange adapter. It's also faster and easier to make and install hose assemblies.



A "Tee" or "Cross" adapter **accommodates several lines**, such as connecting two hose assemblies into a common port.

Conversion Adapters

Gates carries a full line of International Conversion Adapters for connecting SAE couplings to global equipment. For example, your customer wants to mount a hammer with SAE threads, but the equipment is British. A conversion adapter will solve this problem.

Locate the adapters you need through Gates International Conversion Adapters brochure and poster. Contact your sales representative for more information.

Proper Hose Assembly

Proper hose installation is essential for satisfactory performance.

Once you select the proper hose and couplings, you can then make the assembly. There are three types of assemblies you can make:

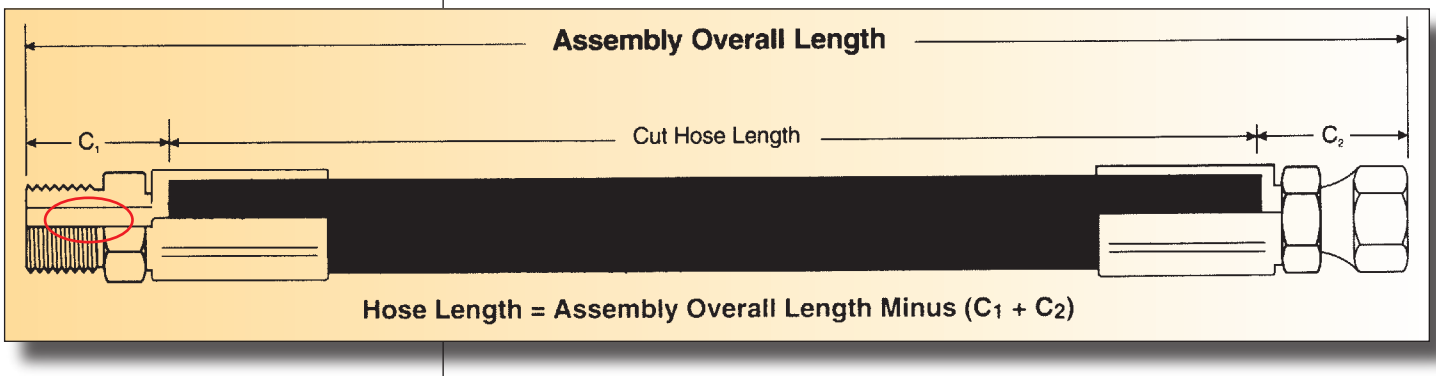
- Permanent Crimped
- Permanent Swage
- "Field Attachable"

Components, equipment and procedures vary for all types. However, measuring, cutting procedures and fitting orientation are the same.

Measuring Hose

Many assemblies require the length to be within a tight tolerance for proper installation. This is especially true for short, high-pressure hose assemblies.

It is very important to understand the difference between "hose cut length" and "overall assembly length" as shown below.

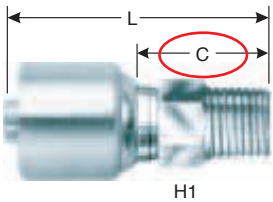


The cutoff value "C" is the length portion of the coupling that is not inside the hose. To determine how long the hose should be, subtract the total of both of the coupling "C" values from the overall length of the assembly.

NOTE: All "C" cutoff values are identified in the coupling tables in the Gates Hydraulics Catalog.

Male Pipe (NPTF – 30° Cone Seat)

Desc	#		⟷				H1 (In.)	L (In.)	C (In.)
4G-2MP	G25100-0402	7100-10025	1/4	1/8—27		1/2	1.97	0.94
4G-4MP	G25100-0404	7100-10032	1/4	1/4—18		9/16	2.07	1.04
4G-6MP	G25100-0406	7100-10045	1/4	3/8—18		11/16	2.13	1.10
4G-8MP	G25100-0408	7100-10055	1/4	1/2—14		7/8	2.40	1.38
5G-4MP	G25100-0504	7100-00065	5/16	1/4—18		5/8	2.28	1.18
6G-4MP	G25100-0604	7100-10075	3/8	1/4—18		5/8	2.28	1.19
6G-6MP	G25100-0606	7100-10085	3/8	3/8—18		11/16	2.19	1.09
6G-8MP	G25100-0608	7100-10095	3/8	1/2—14		7/8	2.46	1.36
8G-6MP	G25100-0806	7100-00105	1/2	3/8—18		13/16	2.60	1.12



Assembly Overall Length

In many cases, assemblies do not require an exact fit. In this example, you can lay the old hose on a bench, place the new fittings even with the ends of the old fittings and measure the distance between the locking grooves on the new fittings. This will give you the length of the hose you need for the new assembly.

Hose Cut Length

After you determine the length of the hose you need to cut by deducting for the fittings, cut the hose with a cutoff saw. There are two blade types you can use:

- Notched (serrated) blades cut cleanly and efficiently on non-spiral reinforced hose (one- and two-wire braid hose and textile hose). Although a notched blade will cut spiral hose, they dull quickly and are not recommended for spiral hose.
- Abrasive blades (or wheel) cut all types of hose, including spiral-reinforced hose. However, as it cuts, it creates a lot of debris. As the blade wears out, its diameter gets smaller and eventually has to be replaced.

There is a specially designed hose support plate on all Gates cutoff saws. This support plate positions the hose for a straight cut, drawing the hose away from the blade as you cut. This minimizes binding or squeezing.

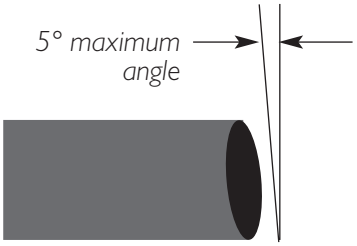
Cutting PTFE hose requires special considerations. It can be cut cleanly with a cutting shear. If you use an abrasive wheel, first wrap the hose where you plan to cut two times with heavy-duty masking tape. Once you make the cut, de-burr the PTFE tube with a sharp knife. Remove the tape prior to assembly.

SAE Length Tolerances for Hydraulic Hose Assemblies and Specified Hose Lengths

Length	Tolerance
For lengths from	
0” up to and including 12”	1/8”
12” up to and including 18”	3/16”
18” up to and including 36”	1/4”
For lengths above 36”	1”

NOTE: Length measured to the nearest 1/8”

When cutting any hose, keep the cut as straight as possible and square with the side of the hose. The maximum allowable angle of a cut is 5°, as shown below.



Hose Cleanliness

All hydraulic components add some amount of contamination to a hydraulic system. Clean hydraulic assemblies minimize contamination and therefore increase the service life of the equipment while minimizing expensive system failures.

Cleaning methods vary based on your shop capabilities and cleanliness level, and the critical nature of your equipment. Here are three cleaning methods:

1. Blow shop air through a complete assembly. Although this is the easiest cleaning method, it is also the least effective.
2. Soak a sponge in water and isopropyl alcohol. Use shop air to push the soaked sponge through the hose. Repeat until you meet the level of cleanliness you need.
3. The most effective method is to use a fluid flushing apparatus. Flush cleaning fluid at a high velocity through the hose until you meet the level of cleanliness you need.

For more information regarding hose cleanliness, contact your Gates representative.

Debris is generated when you cut any hose. Clean the hose before you assemble it. Otherwise this debris will get into the hydraulic system.

Assembly Preparation - Hose, Coupling and Crimping

Hose Preparation

Skiving

Skiving removes the hose cover down to the reinforcement for coupling assembly and/or ferrule crimping. Some tools you can use to skive are:

- Wire abrasion wheel.
- Hand Skiving Tool Kit (Gates Part No. 78030, Product No. 7480-0413).

Hoses with thick covers require skiving because the ferrule serrations cannot bite through the cover and into the wire. Hoses with a thin cover do not require skiving. If skiving is required, check Gates Hydraulics Catalog and crimp chart for specific information on skive length and diameter.

The "skive length" is the length of the cover you remove. The "skive diameter" is the diameter after skiving. For example, for 10C13, the skive length is 7/8" and the skive diameter is "to the wire."

NOTE: When skiving or buffing a hose, always wear safety glasses and avoid wearing loose-fitting clothing. If power skiving or buffing, wear hearing protection.

Skiving or buffing creates debris that could damage the hydraulic system if not properly cleaned up.

Buffing

Some non-wire reinforced hose requires buffing. Buffing is similar to skiving but doesn't require removing the hose cover down to the reinforcement.

Buffing does remove the hose cover, but only to a specific diameter dictated by the crimp data chart. Use a grinding wheel to buff a hose.

NOTE 1: Do not use a wire wheel, which could damage the reinforcement.

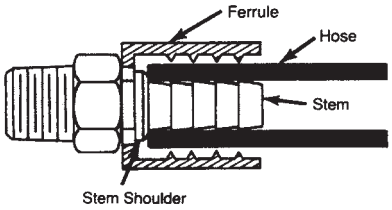
Coupling Preparation

Two-Piece Fittings (PC, PCS, PCM & GS)

1. Lubricate the first two or three serrations on the stem with lightweight lubricant.

2. Either clamp the stem in a vise on the hex portion and push the hose onto the stem, or push against a sturdy object like a work bench.

3. The cutaway illustration below shows the hose has bottomed out against the stem shoulder. To check for full insertion, pull the ferrule down. The stem should be level with the top of the ferrule.

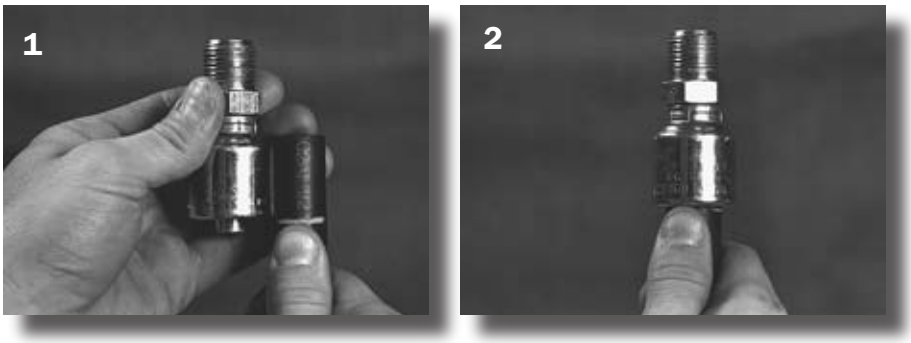


4. Push the ferrule so it rests against the hex of the stem. Now the hose and coupling are ready for crimping.

One-Piece Fittings (MegaCrimp®)

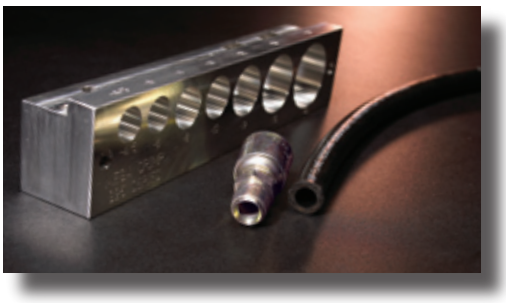
MegaCrimp® couplings are designed for easy insertion. No oil is needed for lubrication.

1. Place the hose next to the coupling. Use a marker or grease pencil to mark the depth of insertion.



2. After marking the hose, push the coupling until the shell is aligned with the mark. Twist it slightly to make sure it's fully inserted.

3. The Gates MegaCrimp® Coupling Insertion Tool ensures proper insertion depth (Part No. 78017, Product No. 7482-1342).



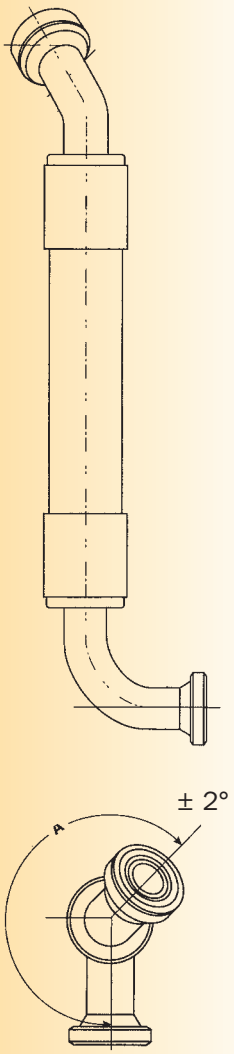
Fitting Orientation

When both fittings are bent tubes or block style (both of which are angled), they must be oriented to each other to minimize twisting and stress.

Orientation Procedure:

1. Position the far coupling vertically downward.
2. Orientation angle is measured clockwise, as shown to the left.

NOTE: Orientation angle tolerance should be plus or minus 2°.



Assembly Preparation

Basic Crimp Procedures

For specific instructions for your crimper, please refer to the appropriate operating manual.

1. Refer to the crimp data chart for the following information:

a. Ferrule selection (if necessary)

b. Die selection

c. Approximate crimp setting

d. Finished crimp diameter

e. Skive or buff data (if necessary)

2. Load the selected dies into the crimper.

When using a die set for the first time, apply a thin coat of lubricant to the contact surface and cone (not the bore of the dies). This layer of lubricant must be thinly re-applied when the contact surfaces become shiny. Position the dies in the crimp position.

3. Adjust the machine to the proper crimp setting.

4. Insert the hose assembly and properly align the coupling with the die fingers, as required by the particular model crimper that you're using.

5. Install die cone, if used.

6. Always wear safety glasses and keep hands and clothing away from the moving parts of the crimper.

7. Activate the crimping mechanism.

8. Remove crimped assembly from dies and measure final crimp diameter.

IMPORTANT SAFETY NOTE

Always measure the final crimp diameter. All settings are approximate. Machining tolerances exist for each crimper die set and support pieces of equipment that will affect your actual setting. Measure the crimp diameter to ensure it is within the published limits. If the crimp is out of tolerance, recalibration or component replacement may be necessary.

Refer to the crimper operating and maintenance manual for specific lubrication procedures.

If the actual crimp diameter is not within the recommended crimp tolerance, you may need to check the calibration of the machine and re-calibrate if necessary.

Measuring Crimp Diameters

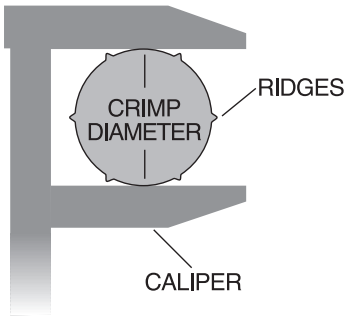
1. Measure between the ridges, halfway between the top and bottom of the coupling. See Sketch 1 below. When using calipers, be sure the caliper fingers do not touch the ridges. When measuring small crimp diameters (3/16", 3/8" and 1/4"), a set of jaw-type micrometers or Gates specially-designed Digital Caliper is required (Part No. 7369-0322, Product No. 78241).

2. Measure halfway down the crimped portion of the ferrule. See Sketch 2.

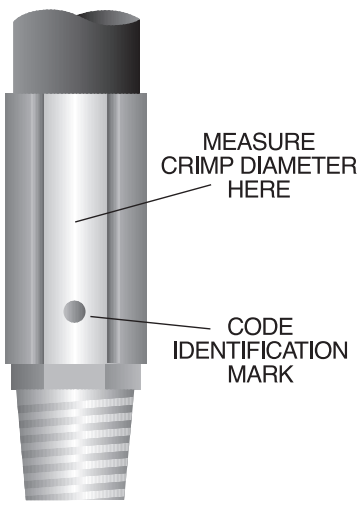
If the machine is properly calibrated, you'll need to make a slight adjustment to the setting. For example:

On the Gates PowerCrimp® 707 crimper, change the readout number to a smaller figure to reduce the crimp diameter and a larger figure to increase the crimp diameter. Changing the readout meter by .05 will change the crimp diameter .001". Note this new reading on your crimp data chart for future reference.

Sketch 1



Sketch 2



Permanent Swage Procedures for C14 (PTFE)

See the Gates Swage Data Chart for the insertion depth. Mark the proper insertion depth on the hose. Using a lightweight oil, lubricate the inside of the hose. With the coupling hex in a vise, insert the hose to the insertion depth.

The following are the basic swage procedures. For specific instructions for your crimper or swager, please refer to the appropriate operator's manual.

1. Insert the correct die and pusher into the swaging machine. Refer to Gates Swage Data Chart for the die/pusher information.

2. Lubricate inner bore surfaces of dies with a thin film of lightweight oil.

3. Feed hose assembly through the dies and hold the hose and coupling into the pusher.

4. Roll the control lever while guiding the coupling into the die until pusher bottoms against the top of the die surface.

5. Push the control lever to retract the pusher and open the die halves. Remove the swaged hose assembly.

FOR SAFETY'S SAKE, USE SWAGERS ONLY IF YOU:

1. Receive hands-on training with Gates swager and assemblies.
2. Follow current Gates Operating Manual & Swage Data for the Gates swager.
3. Use only new (UNUSED) Gates hose and fittings.
4. Wear SAFETY GLASSES.

REMEMBER: Others depend on you to make correct assemblies.

Gates swage operating manuals are listed below:

Equipment	Manual Form Number
HS-1 Hand Swager	35019-MB
Power Swager	35019-T
Thermoplastic Swage Data Charts	35068-A
C14 (PTFE)	35493-B

Training Resource: A C14 (PTFE) Assembly CD is available by contacting your Gates representative.

WARNING: An incorrect hose assembly can rupture or blow apart in use, resulting in serious injury, death or property damage.

Reusable (Field Attachable) Couplings

Reusables are field attachable. That means you don't need a crimper to attach the couplings. Below are the basic steps in the assembly of field attachable couplings.

How to Install a Gates Field Attachable "Type T" Coupling

1. Thoroughly lubricate the stem of the coupling.

2. Put the socket in the vise, as shown. Turning clockwise, thread the hose into the socket until the hose bottoms on the inside shoulder of the socket. Then turn the hose back one-half turn.

3. In a clockwise motion, thread the stem into the hose and socket until the stem hex shoulders against the ferrule.

Installing Hose Assemblies

Male-Fitting-to-Port Connections can be made using four types of configurations:

1. Solid male (MP, MB, MBSPT, etc.).

2. Male swivels (MPX, MBX, MIX).

3. Block-style adapters with lock nuts.

4. Flanges (FL, FLH, FLC, FLK).

Install male fittings by rotating the entire hose assembly as you thread the male into the port. Use Teflon* tape on the tapered threads for easy installation and a better seal. DO NOT allow the tape to get into the hydraulic system. Wrap the tape only on the upper threads, NOT over the first thread, which could contaminate the system during installation.

If using an O-ring, lubricate it with a light oil before installation. A dry O-ring will stick and pull away from the sealing area, resulting in a poor seal.

Once hand tight, use a wrench on the hex to properly torque the fitting. Since hose rotation is necessary, never use two solid males on the same hose assembly.

Male swivel installation does not require hose rotation. Simply thread the male into the port and use a wrench to torque properly. Since the hose does not rotate, you can orientate the hose curvature to assist in routing. Be aware that male swivels (except MIX) have internal O-rings that must be compatible with the fluid used.

Some block-style male port adapters use lock nuts to orient the fitting. Rotate the block and thread the fitting into the port. When nearly tight, hold the block in the position you need and tighten the lock nut against the port.

Flanges are installed using split flange clamps. Follow these steps for proper flange installation:

1. Put a small amount of oil on the O-ring and place it in the fitting groove. Oil will prevent the O-ring from falling out.

2. Install the flange fitting over the port.

3. Install the clamp halves over the flange head and thread in the bolts by hand.

4. Use a wrench to tighten. Use a crossing pattern.

5. Torque properly.

*Teflon is a Registered Trademark of DuPont.

Female Swivel Connections are made by rotating the swivel nut over the solid male threads. Never use a swivel female with a swivel male. Once hand tight, use a wrench to hold the backup hex while tightening the swivel nut to the proper torque. This will prevent stem rotation and hose twist.

Bent tube and block-style fittings must be held in position by hand while tightening.

Compression-style Fittings (MSP, MFA, STA, ABC) use a bite sleeve and nut for connections to the tubing. Follow these steps:

1. Make sure the tube is cut cleanly with no burrs or paint build-up.

2. Polish the tube with steel wool.

3. Place the nut, then the bite sleeve over the tube. The bite sleeve must be oriented with the taper facing away from the tube.

4. Locate the tubing into the male fitting and secure the nut over the threads. The bite sleeve will compress against the tube and seal with the male internal taper.

Using Adapters

Use adapters to make installation and orientation easier. Be aware, however, that adapters can also be a potential leak point. They can be used in the following situations:

1. To avoid fitting orientation. If an angle fitting is required on both ends of a hose assembly, use it on one end only; use a straight fitting and an angle adapter on the other. This makes installation easier and eliminates the need for orientation.

2. When jump-size fittings are not available, make the jump with an adapter.

3. To ease port connection and hose installation.

4. To change to a different thread configuration, including international threads.

5. To provide better flow and reduce pressure drop. As a rule of thumb, it's better to use a straight adapter and bent tube coupling then an angled adapter and straight hose end.

When using adapters, install the adapter first, and then the hose assembly.

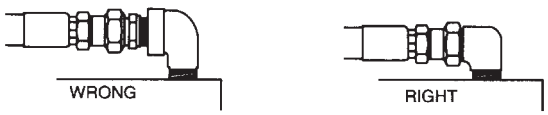
Hose Assembly Routing Tips

Proper hose installation is essential for satisfactory performance. If the hose is too long, the installation's appearance will be unsatisfactory, and unnecessary equipment costs will be incurred.

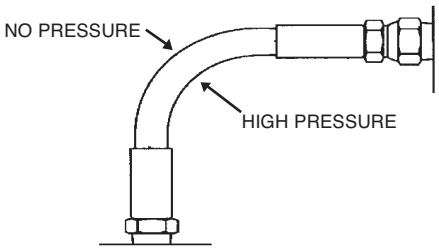
If hose assemblies are too short to permit adequate flexing and the length changes caused by expansion and contraction, the service life of the assembly will be compromised.

Hose can elongate up to two percent or contract up to four percent, depending on hose construction. You must take this into account when routing.

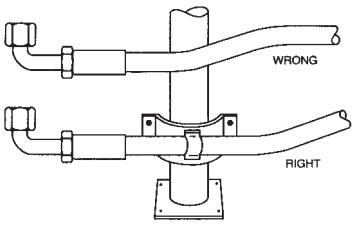
The following diagrams show proper hose routing, which provides maximum performance and cost savings. Consider these examples in determining the length of a specific assembly.



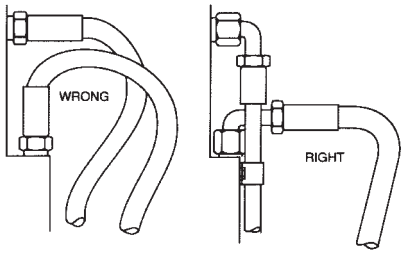
Reduce number of pipe thread joints by using hydraulic adapters instead of pipe fittings.



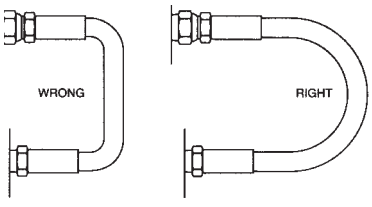
To allow for length changes when hose is pressurized, do not clamp at bends so that curves will absorb changes. Do not clamp high and low pressure lines together.



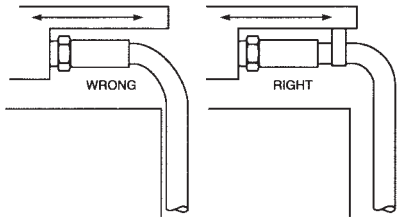
High ambient temperatures shorten hose life, so make sure hose is kept away from hot parts. If this is not possible, insulate hose.



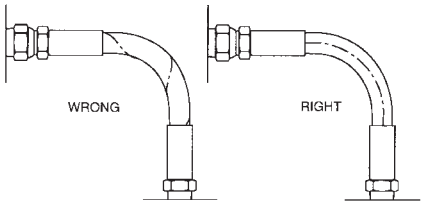
Elbows and adapters should be used to relieve strain on the assembly, and to provide neater installations, which will be more accessible for inspection and maintenance.



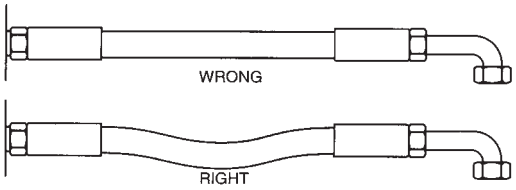
To avoid hose collapse and flow restriction, keep hose bend radii as large as possible. Refer to hose specification tables for minimum bend radii.



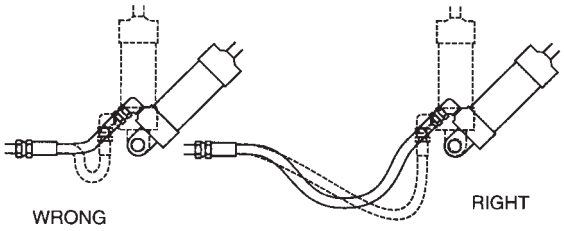
Run hose in the installation so that it avoids rubbing and abrasion. Often, clamps are required to support long hose runs or to keep hose away from moving parts. Use clamps of the correct size. A clamp too large allows hose to move inside the clamp and causes abrasion.



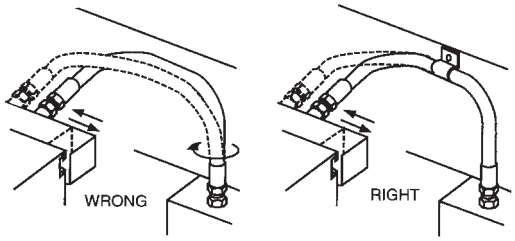
When installing hose, make sure it is not twisted. Pressure applied to a twisted hose can result in hose failure or loosening of connections.



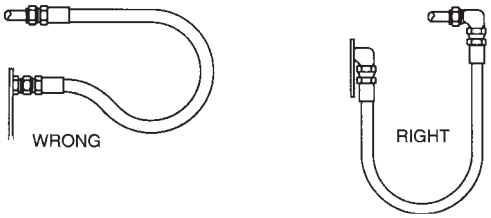
When hose installation is straight, allow enough slack in hose line to provide for length changes that will occur when pressure is applied.



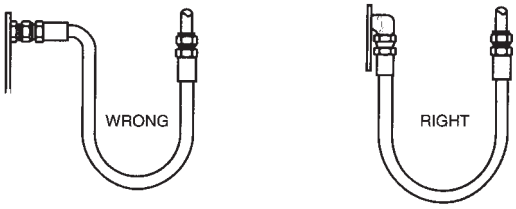
Adequate hose length is necessary to distribute movement on flexing applications and to avoid abrasion.



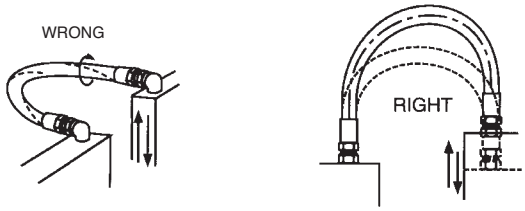
Avoid twisting of hose lines bent in two planes by clamping hose at change of plane.



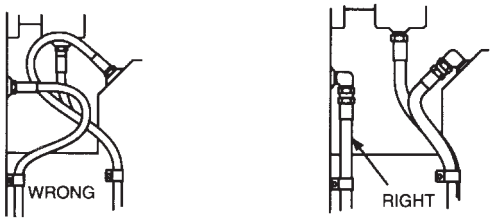
When radius is below the required minimum, use an angle adapter to avoid sharp bends.



Use proper angle adapters to avoid tight bend in hose.



Prevent twisting and distortion by bending hose in same plane as the motion of the port to which hose is connected.



Route hose directly by using 45° and/or 90° adapter and fittings. Avoid excessive hose length to improve appearance.

Troubleshooting: Hose Failure

Your goal in troubleshooting is to identify the cause or causes, and then take appropriate corrective action. The following are examples of the most common hose failures, as well as solutions on ways to correct them.

The Problem: Cover erosion. Damage to the hose exposes the hose reinforcement.

This problem may be caused by abrasion, the hose rubbing against equipment components, another hose or objects in the operating environment. Cover erosion may also be caused by non-compatible fluids, such as toxic chemicals, acids, detergents and non-compatible hydraulic fluids. Exposed hose reinforcement is susceptible to rust and accelerated damage, which leads to failure.

The Solution: Use nylon and urethane sleeving or spring guards to protect the cover from abrasion.

The Problem: The hose has burst at some length away from the hose ends.

This problem may be caused by 1) excessive pressure surges, 2) excessive flexing, kinking, crushing, or 3) exceeding the minimum bend radius.

1. Excessive pressure surges that exceed the maximum operating pressure rating for the hose can cause reinforcement failure.

The Solution: Check and inspect the operating pressure. It may be necessary to use a pressure gauge to measure the magnitude of any pressure surges. Select a hose that will accept the pressure.

2. Flexing, kinking or crushing, which causes reinforcement fatigue and eventual failure (like flexing a metal paper clip back and forth until it breaks).

The Solution: Bundle hoses together that all flex in the same direction. Clamp hose assemblies to equipment, when applicable.

3. Exceeding the minimum bend radius places excessive stress on the reinforcement and could open large gaps in it. Exceeding the minimum bend radius will severely reduce the hose's ability to withstand pressure.

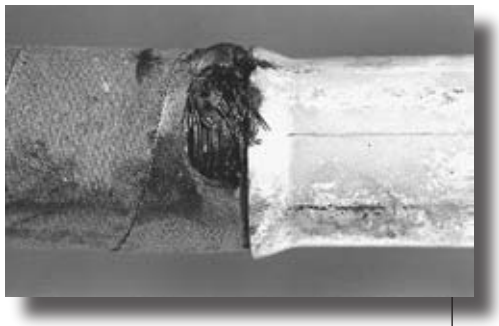
The Solution: Re-route the hose or change the fitting to eliminate the excessive stress.

The Problem: The body of the hose has burst.

The Solution: Check the working pressure rating. The hose must be ableto handle the maximum pressure, including surges, of your application. If your application has frequent pressure surges, you may want to consider a spiral wire-reinforced hose rather than a braid-reinforced hose.

PRODUCT NOTE:

Gates MegaSys® hose products are designed to improve flexibility and perform at half the industry standard (SAE) minimum bend radius. Products include very high-pressure spiral-reinforced, wire-braid and low-pressure suction hose.



The Problem: The hose has burst at a coupling end.

This may be caused by insufficient hose slack, excessive bending and flexing or an over-crimped hose end. When a hose is pressurized, it typically shortens in length, which puts excessive stress (tugging) at the coupling. Excessive bending or flexing increases stress of the reinforcement. Over-crimping or using the wrong ferrule will damage or crush the reinforcement, severely limiting the ability of the hose to withstand pressure.

The Solution: Remove the connection and inspect it. Then,

1. Increase the length of the assembly's hose to accommodate contraction under pressure.
2. Increase the actual bend radius as the hose exits the coupling.
3. Reduce bending stress at the coupling by using bend restrictors.
4. Replace the hose assembly with a properly crimped assembly. See appropriate crimp data chart for ferrule and crimp recommendations.
5. Check for damage caused by excessive heat or fluid incompatibility.

The Problem: The coupling leaks at the thread or seat.

This may be caused by any of the following:

1. Missing or damaged O-ring.
2. Damaged threads or seat angle.
3. Thread alignment problems.
4. Incompatible thread ends or seat angles.
5. Over- or under-torquing.

The Solution:

1. Install a new O-ring. Never reuse an old O-ring. The O-ring must be compatible with the fluid being conveyed.

2. Check the threads and/or seat angle that may have been damaged during installation. Any burr or ding may be a potential leak path. Replace if necessary.

3. If the coupling was misaligned during installation, threads may have been damaged. Replace and carefully install the coupling.

4. Use the Gates Thread Identification Kit (Part No. 7369-0319, Product No. 86580) to identify mating components. Some thread end configurations seal better than others.

5. Over-torquing a threaded connection can stretch and damage threads and mating seat angles. Over-torquing can also damage the staking area of the nut. Under-torquing does not create a proper seal.

The Problem: Fluid is seeping or weeping from the end of the ferrule.

This may be caused by the following factors:

1. The hose was not inserted fully during assembly.
2. The coupling may be under-crimped.
3. Excessive vibration, flexing and tugging, which may weaken the interface and reduce the assembly's ability to prevent fluid seepage.

The Solution: Whether it has been under-crimped or the stem has not been fully inserted, the hose assembly must be replaced.

The Problem: "Blow-Off". The coupling has released from the hose. The most common cause of coupling "blow-off" is improper assembly, such as:

1. Under- or over-torquing.
2. Improper die selection when crimped.
3. Improper skiving (if applicable).
4. Incorrect fitting/hose combination.
5. If using a two-piece coupling, the ferrule is not engaged into the stem locking collar.

Insufficient hose slack in routing will cause the hose to pull away from and release the coupling. Mixing various manufacturers' hose and couplings also reduces coupling retention.

The Solution: Examine and replace the hose assembly. Be sure to leave enough slack to accommodate any hose shrinkage when it's under pressure. Never mix manufacturers' hose, couplings or crimpers.

The Problem: The hose cover or tube has cracks and appears hardened.

This is caused by exposure to excessive heat and/or ozone. Excessive heat can be created by:

- Routing near a heat source, such as an exhaust manifold.
- Using an undersized hose or reservoir.

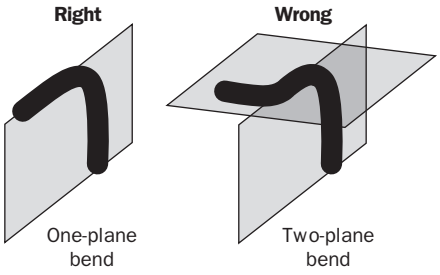
Temperatures above the maximum can decrease hose life by one half. Cracks can also be caused by flexing, especially at excessively low temperatures.

The Solution: Choose a hose that meets the temperature and flow requirements of the application. Identify the heat source and consider re-routing the hose. Examine the size of the reservoir (if necessary). Gates HeatGuard™ Protective Sheathing can be used to protect hose from heat.

The Problem: The hose assembly is twisted.

This problem is easy to see in the spiraling layline as the hose bends in two places (see image at left). Twisting misaligns the reinforcement and reduces its ability to withstand pressure. Twisting a high-pressure hose can reduce service life up to 90 percent.

The Solution: Replace and re-route the hose so that it bends only in one plane (see illustration at left). Using bent tube or block-style couplings and adapters may improve the routing. Also, when installing the assembly, hold the backup hex to prevent it from turning and applying a twist. If male and female couplings are used on the same hose assembly, install the male (non-swivel) end first.

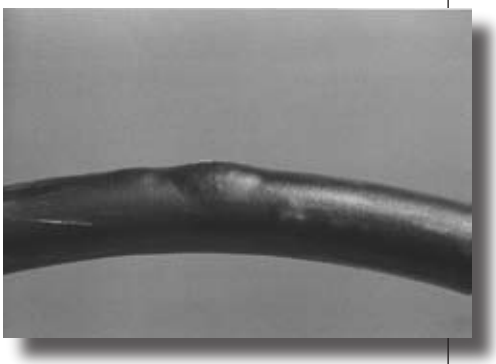


The Problem: The equipment has become sluggish and unresponsive.

This may be caused by:

- Fluid incompatibility. The hose tube swells and deteriorates and may be washed out in sections (as you can see when you cut it). Even the new environmentally friendly “green” fluids may not be compatible with the hose.
- Excessively high fluid temperatures, which can cause the tube to bulge near the end of the coupling.
- Improper hose assembly. This includes modifying the OEM design on an assembly by reducing or increasing the hose size or changing the coupling configuration.

The Solution: Replace the hose with one that has tube material recommended for that particular fluid. See the Chemical Resistance Table in the Gates Hydraulics Catalog. Or replace the assembly with the original hose size and coupling ends.



The Problem: The hose cover is blistered.

Blisters are caused by:

- Incompatible fluids permeating the hose tube and collecting under the cover.
- Compressed gases permeating the hose tube and collecting under the cover.
- Air trapped under the cover.

The Solution: Replace the hose with one that is compatible with the fluid being used. If it is compressed gas, you can perforate (pin-prick) the cover to allow the gas to escape.

NOTE: Textile hose covers eliminate blistering. Bleed the system to eliminate any trapped air.

The Problem: The hose has been crushed.

When a section of the hose has been flattened, the reinforcement is weakened and fluid flow is restricted. The hose could burst.

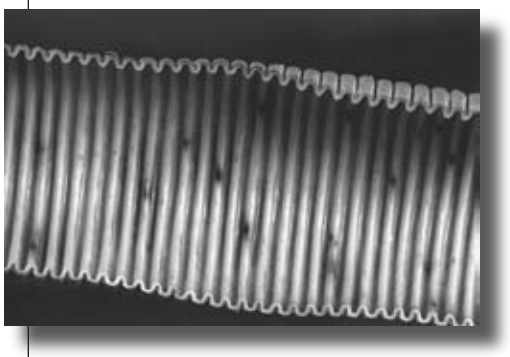
The Solution: Determine the source of the damage and re-route or guard the hose. Replace the damaged hose.

The Problem: Pinholes in the C14 (PTFE) tube allow fluid to escape through the cover.

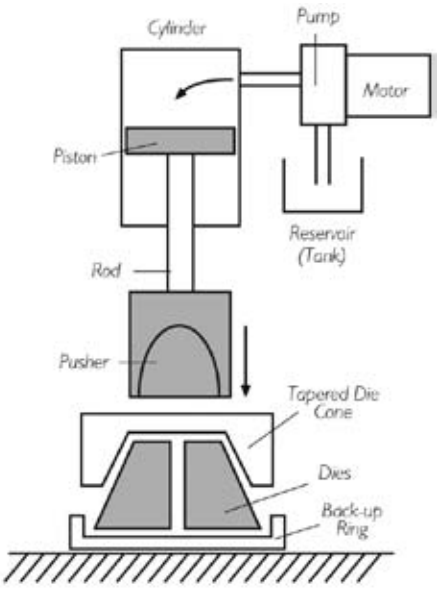
Dissecting the tube reveals black 'burn' areas and pinholes caused by an electrostatic charge through the tube to the wire cover. Some fluids have the potential for electrostatic buildup.

The Solution: Replace the damaged hose with one that has a conductive tube (Gates C14). Any electrostatic charge will then be conducted to the end fittings rather than discharging through the tube wall.

CAUTION: Some gases can displace breathable air and/or be flammable. Properly ventilate the routing area.



Crimpers



A crimper is a hydraulic ram. It uses fluid under pressure to extend the ram and crimp the fittings. Fluid under pressure flows from the pump to the cylinder, extending the piston, the rod and the pusher down onto the die cone to provide force. The taper of the die cone forces the dies together and crimps the fitting.

There are many types of crimpers: vertical (bottom- or top-loading), horizontal or angled. Whatever the configuration, the principle of operation is the same. Pumps do not have to be electronically driven. They can be manual or air driven.

Pump Types

Electric over hydraulic pumps need very little maintenance. Just check the fluid level every month.

Air over hydraulic pumps need one or two drops of oil in the air chamber every day. Check the fluid level every month.

Hand operated pumps need very little maintenance. Check the fluid level once a month.

Crimper Set-up

Follow these steps to properly set up a crimper:

1. Remove the crimper from its shipping container.

2. Position the crimper on a stable surface.

3. Connect the hydraulic hose assembly to the crimper and the pump. Refer to the pump manual for the proper port connection. Also, install the breather cap in the reservoir tank, if needed.

4. Make the proper electrical connections.

5. Bleed any air from the system. Follow the procedures in the crimper operating manual.

6. Lubricate all metal-to-metal sliding surfaces (dies, cones and die shoes) with a thin layer of the recommended lubricant.

7. Check the calibration by following the procedure in the operating manual. Re-calibrate as required.

8. Mail in your equipment registration form as soon as possible. This ensures that updated crimp data will be forwarded to you.

As with any type of equipment, crimpers also need routine maintenance.

Crimper Maintenance

If cared for properly, a crimper will last a long time. The following are routine – but very important – maintenance procedures:

Lubrication: Reapply lubricants to metal-to-metal sliding surfaces whenever the surfaces become shiny. Not doing so reduces the life of the dies and the cone. Excessive wear on these components produces poorly-performing hose assemblies that could blow apart and result in injury.

NOTE: Refer to the crimper operating and maintenance manual for specific lubrication procedures.

Calibration: Check the crimper's calibration every month. Otherwise, you could be making inaccurate hose assemblies. This is critical whenever you notice a change in crimp diameter.

Hose assembly: Check the hose assembly connecting the pump to the cylinder. Replace it if necessary with a properly-rated hose assembly.

Fluid level: Maintaining proper fluid level in the reservoir provides maximum crimp stroke and keeps air from getting into the system. Make sure the fluid is within 1/2" from the top of the tank opening.

Die wear and storage: Check the sliding and crimping surfaces of the dies for wear or damage. Replace dies if you see indentations, chips, cracks, gouges or other signs of wear. Proper storage and lubrication extend die service life. Store in stable racks or in original packaging.

Cleaning: Hydraulic fluid and lubricants attract dirt and debris. Remove any debris by using a clean shop rag. Excessive dirt and debris can damage crimper components and produce inaccurate crimped assemblies.

Oil change and bleeding: Fluid should be changed periodically, depending on the amount of usage. Fluid viscosity breaks down under high usage and temperatures. Also, component wear can contaminate the fluid. Drain and replace with the recommended fluid (see the crimper or pump operating manual).

Refer to the specific crimper or pump operating manual for proper maintenance instructions.

Crimper Troubleshooting

If your crimper isn't performing properly, you can do some troubleshooting to correct the problem.

First, determine the symptoms: what is the crimper doing or not doing? Are all the connections made properly? Is there any fluid leakage? Have any modifications been made? Below are the three most common crimper problems.

Cylinder Seal: A seal between the piston and cylinder maintains the proper operating pressure. In time, these seals may leak or roll. Leaking fluid indicates the seal needs to be replaced. Also, if the piston (ram) jams in the cylinder, the seal may need replacing.

Electrical: Electrical problems are difficult to troubleshoot. Make sure the power source is compatible with the crimper and pump. Replacement components are available, as needed. The PowerCrimp®707 must have a dedicated 30-amp circuit. Many times, electricians will recommend the pump be changed to 230-volt rather than the 115-volt rating. The pump can be changed to 230 easily, but if this is done, a new 230 cord assembly (78748) must be installed at the same time. If a new cord assembly is not used, the 230-volts will burn out the digital readout within minutes.

Pump: Pump components can be damaged from:

- debris in the fluid, which can cause a valve to stick;
- operating at low temperatures, causing fluid to thicken; or
- air in the system, damaging pump components.

The most common crimper problems fall into three categories: cylinder seal, electrical or pump.

Crimper Troubleshooting

PowerCrimp® 707 Troubleshooting

Problem: The ram is stuck and won't return.

Solution: Slowly loosen the hose assembly from the pump (be prepared to catch the fluid as it escapes). If no fluid escapes, the piston seal in the crimper might be damaged. Replace the seal using the proper seal replacement kit and follow the instructions provided.

If fluid does escape through the hose assembly, the check valve in the pump may be stuck. It might need cleaning and/or replacement. Contact your local Gates representative.

Problem: The digital display is blank.

Solution: Check all electrical wiring to make sure connections are made properly. The wrong voltage supplied to the digital display will damage it and require a replacement.

If all connections are made properly, the display may have been damaged.

A new wiring harness may be required. Identify the source of the damage and replace the digital display.

Problem: The digital display is incorrect.

Solution: A faulty digital display is not likely to be the cause. Check for proper electrical connections, including the back of the display itself. Also, check for proper calibration. If everything seems to be correct, replace the switch box.

Problem: The cylinder is leaking fluid.

Solution: Following the proper seal replacement instructions, disassemble the cylinder and check the cylinder wall for scoring or damage. If the cylinder is damaged, a replacement cylinder is suggested. If the cylinder is not damaged, replace the worn seal.

Problem: Broken die fingers or cone.

Solution: Check the crimp specifications. Are the proper die, hose, cone and settings correct? Also, check the calibration.

NOTE 1: Dropping a die can break it. The improper use of the notched die cone can also break a die.

NOTE 2: Dropping a die can damage or break the cone. Replace all broken or damaged parts.

Problem: The crimper won't plug into the power unit.

Solution: Check the voltage rating on both the power unit and the crimper for compatibility. A 115-volt connector differs from a 230-volt connector.

It is important to make sure the pump and crimper are wired the same to operate at the same voltage. For example, a 115-volt pump and 115-volt crimper. Contact your local Gates representative for assistance.

Problem: Over- or under-crimping

Solution: Check the calibration following the standard procedure as outlined in the operating manual. Adjust the actuator rod or switch box position, as necessary. Also, check the crimp specifications.

OmniCrimp® 21 Troubleshooting

Problem: The numbers won't display on the digital readout.

Solution: Turn the JOG switch to the reverse position. Once the RAM recycles, the digital readout is ready to operate properly.

Problem: The dies won't stay in the die shoes.

Solution: Usually, this affects only one or two cones at a time. Check the detente to ensure it's in place and properly adjusted. The detente should be adjusted just above the base of the die shoe. If it's too high, you cannot insert the die. If it's too low, it will not hold the die in place.

Adjusting the Detente: Use the detente wrench to adjust the detente from the inside of the die shoe. The tips of the wrench fit inside grooves cut into the detente. Engage the tips and grooves and adjust the detente by turning the wrench clockwise to lower it, counter-clockwise to raise it. If the detente is damaged, remove it from the rear of the die shoe. After removing the die shoe, remove the detente from the rear. The back of the detente has a flat screw slot cut into it.

Removing the Die Shoes: Insert half of a die set into the dies shoes (leave the other half in the die storage can). Retract the RAM to the full open position. Remove the front cover by using the special wrench and installing the two pins into the holes provided and a bar between the pins.

NOTE: Turn the face plate counter-clockwise to remove it.

Problem: The pump will not shut off.

Solution: This is caused by a faulty computer panel on the front of the crimper. Return the panel to the manufacturer for repairs. Contact Gates Hose and Connector Product Application Engineer for instructions.

Calibrating: The OmniCrimp 21 is calibrated before it is shipped and should not need to be re-calibrated. If the crimp OD is not within specification, it is appropriate to change the crimp setting on the customer's crimp charts. If this crimper must be calibrated, contact Gates Hose and Connector Product Application Engineer for the proper procedures.

MobileCrimp® 4-20 Troubleshooting

Problem: Ram will not fully extend.

Solution: Check the hydraulic oil level in pump reservoir. The oil temperature must be within +40° F and +120° F.

Problem: Ram will not retract.

Solution: Unplug the pump from the electrical outlet (WARNING: pump must be unplugged to avoid risk of injury). Slowly and carefully loosen hose at pump. Be prepared to catch oil as it escapes. If ram retracts, pump valve may be stuck or need replacing.

Problem: Pump motor will not start.

Solution: Check the electrical connections.

Problem: Setting will not change.

Solution: The locking switch may be engaged. Move the switch to the left.

Problem: Light and buzzer do not work.

Solution: Replace the controller batteries. Refer to the Maintenance section of the safety and operating manual. Replace the controller.

GC32-XD™ Troubleshooting

Problem: Pump motor will not start.

Solution: Check electrical connections.

Problem: Setting will not change.

Solution: Locking switch may be engaged. Move switch to the left.

Problem: Will not hold crimp calibration.

Solution: Flange head bolts are loose. Check torque of flange bolts to 330 Nm or 2900 in lbs ever six months of operation.

Problem: Red LED on control panel is flashing rapidly.

Solution: There may be a problem with the electronics in the control panel. Refer to the safety and operating manual for further instructions.

Crimper Troubleshooting

Glossary

Abrasion (Hose)
Wearing, grinding or rubbing away of material.

A/C Cut-Out Relay
Electrically disengages the compressor clutch during wide-open throttle.

Actuator
An electric remote-controlled mechanism for moving or controlling something indirectly instead of by hand.

Accumulator
A pressurized storage container for fluids. Used most often with a gaseous space above the fluid.

Accumulation Effect
Reduces surges and peaks in the system as 1) the hose expands or 2) fluid is stored in a container. Makes the system run smoother.

Accumulator's Function
To store energy, absorb shock, build pressure gradually and maintain constant pressure.

Actuator's Function
To do the work. Actuators extract energy from the fluid and turn it into mechanical performance. Examples: piston (linear actuator), motor (rotary actuator).

AGA
American Gas Association.

Air Breather
A device that allows air movement between the atmosphere and the components in which it is installed.

Air Conditioning (A/C)
The control of temperature, humidity, cleanliness and movement of air.

Air Delivery Assembly
Also called plenum, HVAC module or evaporator housing. Contains air ducts, doors and a blower fan to deliver air through or around the evaporator and heater cores and, finally, to the passenger compartment.

Ambient Air
Air outside the passenger compartment.

Ambient Compressor Switch
Energizes the compressor clutch when the outside air temperature is 32° F or above, and turns off the compressor when air temperature drops below 32° F.

Ambient Temperature
The temperature of the hydraulic system's environment. High ambient temperatures lower the ability of the hose and other components to dissipate fluid heat. In extreme cases, fluid temperatures need to be kept well below published hose ratings or hose service will be reduced.

Amperage
The amount of electrical current running through a circuit.

AN
Army Navy Standards.

Analog
An approximation of numerical information derived from a variable input device like the temperature sensor and signals developed by it.
NOTE: Digital data is more accurate.

Annunciator
An electrical device that emits an audible tone and/or displays some visual indicator.

Anti-Foam Foaming
Air in the lines is an undesirable characteristic created by surface tension and faulty design.

AQP (Aeroquip Quality Product)
Trade name of Aeroquip to designate a hydraulic hose tube made from chemical-resistant rubber.

ASA
American Standards Association.

ASME
American Society of Mechanical Engineers.

Aspirator
Based on passenger compartment temperature, this regulates the amount of vacuum to the vacuum motor in the HVAC programmer.

Atmospheric Pressure
Air pressure at a given altitude (14.69 pounds per square inch at sea level). Atmospheric pressure decreases as altitude increases.

Bar
A unit of pressure based on Newton's per square meter. One BAR equals 14.5 pounds per square inch.

Bend Radius
The radius of a bent hose is measured between the innermost surfaces of the curved portion. The minimum bend describes how far the hose can bend and still meet impulse test requirements.

Bend Restrictors
PVC sleeves installed near the coupling during hose assembly to reduce stress at the hose/coupling interface, and to prevent kinking or damage.

Bent Tube Fittings
Fittings that use bent tube sections to orient the desired angle. Bent tube fittings have better flow characteristics than block style fittings.

BIA
Boating Industry Association.

Bite Sleeve
The internal sleeve used in Flareless Assembly and Standpipe coupling.

Block Style Fittings
Fittings that use bar stock to orient the desired angle.
NOTE: They increase pressure drop more than tube fittings.

British Standard Pipe Parallel (BSPP)
The BSPP male has straight threads and a 30° seat. The BSPP female has straight threads and a 30° inverted seat. The female port has straight threads and a spotface. They seal on the port with an O-ring or soft metal washer on the male.

British Standard Pipe Tapered (BSPT)
The BSPT male has tapered threads. When mating with either the BSPT (tapered) female or the BSPP (parallel) female port, the seal is made by thread distortion.

Boyle's Law:
At a constant temperature, the volume of an enclosed gas varies inversely with its pressure.

Brazed Point Fitting
Fittings that use pressure containment components joined by brazing (using heat to "sweat" brazing material into a joint). Gates high-pressure couplings do not have braze joints. However, many competitors' high-pressure couplings do have braze joints.

Break-Away
Automatic disconnection of a coupling when an axial separation force is applied.

Brinelling
Dimples or grooves worn into the shoulder of a male half by the locking balls in the female half.

British Thermal Unit (BTU)
The amount of heat necessary to raise the temperature of one pound of water one degree Fahrenheit.

Buffing
The partial removal of the hose cover to permit coupling insertion. Typically, a stone wheel is used to grind or buff the cover.

Bulkhead
Usually a piece of metal that separates two sections of the equipment.

Bulkhead Fittings
Fittings attached (with a locknut) on either side of a metal bulkhead to aid the installation of the opposite hose.

Bundling
Grouping hoses together. When installing hose assemblies, bundling improves the use of space, appearance and hose life. **Caution:** use only high-impulse hoses because hose expansion and contraction causes hose-to-hose abrasion.

Burst Pressure
The pressure that ruptures a hose. It is intended only for testing purposes and designing safety factors. DO NOT USE a hose above its published working pressures.

Bu Weps
U.S. Navy Bureau of Ships and Weapons.

Caliper
A tool to measure ID and OD within a thousandth of an inch.

Capacitor
A device to store unwanted or unused voltage.

Case Hardening
Hardening the surface of low carbon steel.

Cavitation
A localized gaseous condition within a liquid stream causing the rapid implosion of a gaseous bubble.

Charlie's Law
At a constant pressure, the volume of a gas varies in direct proportion to a change in temperature.

Chemical Resistance
An index to rate how well a hose compound can endure contact with chemicals. Gates ratings are: 1 = Continuous contact, 2 = Temporary contact (transfer applications); and NR = not recommended.

Clamping Collars
Steel sleeves to crimp on to the outside of the hose. Used mainly on Case equipment to support and aid in hose routing.

Cleanliness Level
A measurement of particulate contamination in a 1) hose assembly or 2) volume of fluid.

Closed Center Hydraulic Circuits
System where the pump flow is dead-headed to the system relief or to the pressure compensator when the control valve is in the center – or neutral – position. System typically uses variable displacement pressure-compensated pumps.

Clutch
A coupling to transfer torque from a driving to a driven member. The compressor clutch transmits torque from the engine to the compressor through a drive belt, which causes the compressor shaft to rotate.

Cold
The absence of heat. An object is cold to the touch if it is less than 98.6° F (body temperature).

Comparator
An electronic device, usually a solid-state operational amplifier, used to compare two quantities whose output (signal) depends on the result of comparing its two inputs.

Compressor
The refrigeration system component that pumps refrigerant and increases the pressure and temperature of refrigerant vapor.

Compatibility (Resistance to Contacts)
Examples: The inner tube and outer cover must both be compatible with the fluid being transported, the ambient air and any abrasion. Weathering and other outside influences must be taken into consideration.

Compatibility: Selection
Does the hose meet the hydraulic system requirements? Refer to Gates Hydraulics Catalog section that explains the STAMPED method.

Component
A device in a hydraulic system that performs a given function (e.g., hose assembly, pump, valve, motor, etc.).

Compressibility
The change in unit volume of fluid when subjected to a unit change of pressure.

Condenser
Component of a refrigeration system that changes refrigerant vapor to a liquid by cooling.

Connect Under Pressure
Ability to connect coupling halves while either one side – or both sides – are still under internal line pressure.

Contaminant
Any material or substance that adversely affects the fluid power system or components. **NOTE:** You must clean a hose of contaminants after cutting it.

Convenience
Generally, pipes and hoses are easier to locate than mechanical parts.

Corrosion
Most specifically related to chemical changes in mechanical characteristics (metals) caused by the interaction of fluid or contaminants or both. The agents of change may be introduced into the system as particulate contamination.

Coupling, Quick Disconnect
A component that can quickly join or separate a fluid line without the use of tools or special devices.

Crimp
A method of permanently attaching hose couplings.

Crimp OD
The outside diameter of the ferrule after it has been crimped. Measure with a caliper in the middle of the ferrule on the flat sides (where the dies made contact with the ferrule). Make sure the points of the caliper do not rest on the crimped ridges of the ferrule.

Cut-Off-Length
Referred to as the "C" length, it is the length of assembly minus the part of the coupling that is not directly in contact with – or applied to – the hose (such as ferrules). To determine the approximate length of the hose to be replaced, subtract the sum of the "C" lengths (i.e., of both couplings) from the total length of the assembly.

Cycling Clutch System
A term referring to air conditioners in which the conditioned air temperature is controlled by the engaging and disengaging of the compressor.

Dash Size
The industry standard for measuring hose and coupling ID measured in 1/16 of an inch. For example, a -4 hose = 4/16" or 1/4" ID. Some fleet and automotive applications, such as C5, C14, and AC hoses, use a different system corresponding to the OD of the tubing used in those systems.

DIN (Deutsch Industry Norme)
The Deutsch Industry Norme are German standards that are accepted throughout much of Europe. Similar to SAE, they identify the specific requirements for size, tolerances, construction and minimum performance characteristics of major hose and fittings.

Diode
An electrical check valve that allows current to flow in one direction and blocks current flowing in the opposite direction. A diode has high resistance in one direction and low resistance in the opposite direction. Diodes can act as electrical circuit protection devices.

DNV
Del Norske Veritas for North Sea Floating Vessels. DNV certifies hose for use on floating vessels.

DOT
Department of Transportation.

DOT/FMVSS
The Department of Transportation Federal Motor Vehicle Safety Standards describe the requirements for hydraulic, air and vacuum brake hose, hose assemblies and fittings for use on passenger vehicles, trucks, buses, trailers and motorcycles.

Double-Acting Sleeve
Permits push-to-connect and pull-to-disconnect convenience on implement lines when the female half is clamp-mounted and connected with a hose.

Durometer (O-rings)
The hardness of an O-Ring.

Dynamic Pressure
Pressure that fluctuates as the hydraulic system works.

Ease and Accuracy of Control
Fluid power systems can provide constant torque at infinitely variable speeds. Large forces can be controlled by much smaller ones.

Efficiency and economy
Fluid power systems can be easily integrated with other electrical or mechanical systems. Friction loss is low and reliability is high.

Effusion
The process where chemical molecules, moving through the hose tube, escape from the hose. Certain chemicals can corrode steel and stainless steel reinforcements when they effuse through the tube.

Electronic Control Module (ECM)
A device that controls engine functions and related components by means of microprocessor circuits.

Electrostatic Discharge
Release of static electrical energy that can build up on the surface of an insulated object (such as the human body) under certain conditions. ESD can damage or destroy sensitive electronic parts or circuits.

EPA
Environmental Protection Agency.

Evaporator
An A/C component in which refrigerant liquid changes into vapor. The evaporator transfers heat from the passenger compartment air stream to the refrigerant.

Ermeto
Also known as a Flareless Assembly.

Filter's Function
To remove unwanted materials from fluid.

Field Attachable Couplings
Traditionally referred to as "reusable". These couplings allow for attachment without crimping equipment. **DO NOT re-use these components.**

Fitting
A connector or closure for fluid power lines and ports.

Fittings: Brass
Brass fittings are manufactured from extrusions to produce high quality parts with full wrenching surfaces. Brass fittings have no finish added, but are dipped to brighten their appearance.

Fittings: Steel
Steel fittings (elbows, tees, crosses) are made from forging with large wrench pads. The straight fittings (unions and connectors) are produced from bar stock. Steel fittings have either zinc plating or Weathercote (black phosphate) finish (check the catalog).

Fittings: Flange
O-ring Type (Standard). A plate attached to the end of a tube that can be clamped or bolted to a mated component interface. SAE J518 Code 61 or Code 62 defines the dimensional and performance requirements.

Fittings: Flare
May be used with any type of tubing that is capable of being flared.

Fitting: Flare Seat
The chamfered edge of the fitting – either 24°, 30°, 37° or 45° where the hydraulic seal is made.

Fittings: Flareless
Both compression type and bite type should be used only with tubing softer than the bite sleeve.

Fittings: Compression
Can be used with plastic tubing, but most frequently require the use of a tube support or insert.
NOTE: Soft plastic tubing does not have the texture to hold a compression sleeve.

Firesleeve
A fire retardant sleeve to protect hoses from heat and flame.

Fixed Delivery
A constant rate of flow that cannot be adjusted.

Flexibility
Resiliency that allows for easy installation. Where hose bends around obstacles, rigid lines require elbow fittings. When one component must move in relationship to another, hose can allow for this movement. Hose has the resiliency to return to its original shape after such movement. Rigid tubing becomes permanently flattened; hose recovers its shape.

Flexible Connections
Allows for movement and isolation of vibration.

Flow
Pascal's system was hydrostatic and did not concern itself with flowing liquids. However hydrodynamic systems do flow, creating three ramifications: friction, heat and pressure.

Flow Checking
Occurs when a nipple valve closes during flow, such as when quickly lowering a heavy implement. Also called Check Off, Back Checking or Lock-up.

Flow Rate (GPM)
The amount of fluid, measured in gallons per minute, capable of moving through a hose. The size of the hose must be sufficient to handle the flow at standard velocities. See the Nomographic chart in the Gates Hydraulics Catalog for choosing the proper hose sizes for various flow needs.

Fluid
A liquid, gas or a combination thereof.

Fluid Compatibility
The hydraulic assembly (tube, cover, reinforcement and couplings) must be compatible with the fluid flowing through them. Many hoses are compatible with most fluids. But hydraulic fluids have drastically different chemical characteristics. See the chemical resistance rating charts in the Gates Hydraulics Catalog to check compatibility.

Fluid Types
Petroleum base = Standard hydraulic oil.
Phosphate esters = Synthetics (fire resistant).

Fluids Speeds
Fluids can move rapidly in one place and slowly in another. Fluid speeds are determined by fluid flow and monitored by flow controls.

Flush Position (of the Valve)
When the coupler valve is fully open, allowing maximum oil flow.

For-Seal (Weatherhead)
Flat-Face O-ring seal.

FPS
Fluid Power Society.

Friction (Fluid)
The rubbing of fluid against the inside walls of the hose assembly, which causes heat.

Friction
Friction is caused by fluids flowing through a system. Friction produces heat. Friction is never eliminated, but it can be minimized by reducing some of its causes.

Friction: Causes
Long lines with more surface area dragging on the fluid produce more friction. Bends and fittings create liquid turbulence and prevent fluids from flowing steadily. Bends that are too tight or sharp increase liquid turbulence. Undersized lines make the fluid flow more rapidly. The more velocity, the more the liquid turbulence. Fluid that is too thick (viscous) increases friction.

Gasket Seal
Gasket seals used by OEMs have evolved over the past 30 years. Sealing depends on fairly heavy compression of the sealing material to metal surfaces.

Galvanic
Of or related to direct current electricity, especially when produced chemically.

Gates Hydraulic Hose Descriptions
The letters in a hose description are abbreviations of a more complete description. For SAE hoses the basic letter is C and it is a substitute for 100. The number following the C is the SAE specification. For example: C1A means SAE 100R1A (we dropped the R to keep the descriptions short.) Hoses also have descriptions that are abbreviations of their construction or use. See the "Hose and Coupling" section in the Gates Hydraulic Catalog.

GAZ 24°
French GAZ couplings use a 24° seat and metric threads. These are similar to German DIN couplings but the threads are different in some sizes.

GAZ Poclain 24° Flange
The Poclain 24° high-pressure flange is used on Poclain equipment. The male flange mates with a female flange or a port. The seal is made on the 24° seat.

GMC
General Motors Corporation.

GPM
Gallons Per Minute.

Ground
A conducting patch between an electrical circuit and the earth (or some conducting body serving in place of the earth). Most electrical components share a common ground through the vehicle body that starts at the negative battery terminal.

Heater Core
A water-to-air heat exchanger that provides heat to the passenger compartment air stream.

Heat Gain
The total amount of energy converted to heat energy that will raise the fluid temperature if it is not dissipated.

Heat
Heat is produced by friction. An increase in friction increases the fluid temperature.

High-Load Condition
Refers to those times of high temperature and high humidity when an air conditioning system must operate continuously at maximum capacity to provide the cool air required.

High-Pressure Cut-Off Switch
When high-side pressure reaches approximately 375 psi, this switch opens the electrical circuit to the clutch, disengaging the compressor.

High-Side Pressure
Pressure of refrigerant being discharged from the compressor.

Horsepower Loss
A measure of the conversion of mechanical energy to heat energy. Related to system heat gain.

Hose Construction
There are three basic parts to a hose: tube, reinforcement, cover.

Hose Compounds
The proper compound must be used with the proper media for best service life and performance. There are six to consider:

1. Buna-N/Nitrile: excellent oil resistance, moderate resistance to aromatics, good physical properties.

2. Butyl: low permeability to air, excellent weathering resistance, good resistance to fire resistant fluids, good physical properties.

3. EPDM: excellent resistance to heat and steam, good weathering resistance (ozone, water), good physical properties.

4. Neoprene: good oil resistance, flame retarding, excellent weathering resistance, good physical properties.

5. Nylon: excellent oil, grease resistance, resists abrasion, good physical properties.

6. PTFE: excellent high temperature properties, excellent chemical resistance, good physical properties.

Hot Wire
Connects an electrical component to the positive battery terminal.

Humidity
Water vapor or moisture in the air.

HVAC
Heating, Ventilation and Air Conditioning.

HVAC Module
Combines a number of heating, cooling and air handling components into one assembly mounted on the instrument panel and extending into both the engine compartment and the space beneath the instrument panel. Also refer to air delivery assembly.

Hydraulic Fluid's Function:
Transmit power, lubricate, dissipate heat, keep air from the system (anti-foaming).

Attributes of Hydraulic Fluids

1. Lubricity - the fluid must keep friction low and maintain an adequate film between moving parts to prevent wear of pumps, bearings, vanes, gears, pistons and rods. Increasing pressures and closer tolerances make lubricity even more important.

2. Viscosity - fluid thickness or "resistance to flow". Pump manufacturers specify viscosity according to clearances, speeds, temperatures and suction characteristics. Fluids must be thin enough to flow freely, yet heavy enough to prevent wear and leakage. Viscosity might not be so critical in selecting a hydraulic fluid except that it varies with temperature. Fluid thickens when it cools, thins as it heats up. Because some hydraulic systems must work under wide ambient temperature extremes, viscosity range is important.

3. Viscosity Index - This measures the rate of viscosity change with changes in temperature: The higher the index, the more stable the viscosity as temperature varies.

4. Rust Resistance - Moisture can get into petroleum fluids by condensation and by contamination of the reservoir. Rust inhibitors and preventives combat the effects of moisture, an important consideration in water-in-oil emulsions and water-glycol fluids.

5. Oxidation Resistance - Air, heat and contamination all promote fluid oxidation, which forms sludge and acids. Oxidation inhibitors delay the process.

6. Foaming Resistance - Although control of foaming depends largely on reservoir design, anti- foaming additives in the fluid also help.

Tube Function:
To conduct and contain the fluid. A seamless rubber tube is formed to the desired diameter and wall thickness by continuous extrusion

Tube Materials:
Buna-N is the most common. Neoprene is typically used in extremely high-pressure spiral wire hoses. Others include Neoprene, Butyl, Nylon, PTFE and EPDM.

Reinforcement Function:
To provide strength to the hose.

Reinforcement Materials:
Cotton, nylon, carbon steel wire, stainless steel wire.

Manufacturing:
Multiple braids may be applied separately or on multiple braiding machines. A layer of dough is always put between braid layers to reduce friction and braid wear.

1. Helical Coil - Resembling a spring, it does more to keep the hose round rather than adding strength. This pattern is not common.

2. Spiral - A common extremely high-pressure reinforcement, especially good in handling peaks and surges.

3. Braids - The most common reinforcement pattern, braids are made of textile, carbon steel, or stainless steel. Metal braids provide more strength, while textile braids are more flexible.

Cover Function:
To protect the reinforcement.

Hose Materials:
Modified Nitrile is a popular cover in hydraulics. Other materials include: textile, modified Nitrile/Neoprene,Polyurethane,Nylon,Hypalon.

Manufacturing
Normally, the cover is applied by extruding rubber over the carcass. Covers can also be wrapped with fabric, fiber or wire braid woven around the carcass.

There are three ways to vulcanize, or cure, rubber covers:

1. Lead Press - Lead is applied directly after extrusion and is left on until the hose has cured. The lead is cut off and reused to cure other covers. Because of environmental concerns, Gates has pioneered hose curing with a plastic sheath as a replacement for lead.

2. Wrapped - Cloth is wrapped around the hose until it has been cured, leaving spiral wrapping lines on the cover after the wrap has been removed.

3. Opening Steam Curing - No outer wrap or sheath is used. This method does not hold cover tolerances as closely as wrapped or lead, and is not used on most hose

Hose Ends
There are two groups of hose ends:

1. Permanently attached ends are swaged or crimped.

2. Field attachable ends are either: thread-together, push-on, compression, clamp type.

Hose Length
Determining correct hose length includes considering: length changes under pressure, machine vibration and motion and hose assembly routing.

Hose Size
The ID is the nominal hose size, which is often written in dash numbers (sixteenths of an inch). For example, a dash 8 = 8/16" or 1/2". **NOTE:** Exceptions include SAE 100R5, SAE 100R14, and Automotive air conditioning hoses.

Hydraulic Cylinder
The part of many hydraulic systems that performs the work. A hydraulic cylinder consists of an outer shell with an inner metal tube that extends and retracts.

Hydraulic System Pressure Drop: What Is Pressure Drop?
System pressure drop is the difference between the pressure of a fluid as it enters one end of a hydraulic hose assembly and the pressure of that fluid as it leaves the other end. This represents a loss of energy and results in increased heat in the system

Causes of Pressure Drop

1. Friction - Fluid rubbing against the inside walls of the hose assembly.

2. Type of fluid - Different fluids behave differently under pressure. Thick fluids move with difficulty and will exhibit greater pressure drop.

3. Temperature of the fluid - Heat thins fluids so they move more easily, as with automotive oil.

4. Length of the hose assembly- The longer the hose, the more surface friction there is to increase pressure drop.

5. Size of the hose - Affects the fluid velocity for a given flow rate. The smaller the ID, the higher the velocity. High velocities create more turbulence and more pressure drop. Large ID hoses produce less pressure drop. See the Nomographic graph for hose size based on flow rate in the Gates Hydraulics catalog.

6. Type of couplings and adapters - A change in bore or direction (as with a 45°or 90° elbow) increases the amount of pressure drop. Bent tube fittings create less pressure drop than block fittings.

7. Flow rate - Pressure drop increases with flow rate for the same size hose. "Heat Gain" is the total amount of energy converted to heat energy, which raises the fluid temperature if it is not dissipated.

Hydraulic Liquids
With a single source for hydraulic power, the hydraulic fluid can be divided to perform multiple tasks within the system.

Hydrodynamic
Hydro = liquid + Dynamic = activity in motion. Hydrodynamics = liquids actively in motion.

Hydrodynamics
The use of the kinetic and dynamic energy of fluid-in-motion to perform work. This principle requires a pump to transfer energy to the fluid by setting it in motion, and a driven element to which the energy is transferred.

Hydrostatic
Hydro = liquid + Static = having no motion. Hydrostatic = liquids having no motion. Hydrostatics is the multiplication of force through the use of static confined liquids.

ID
Inside Diameter.

IJS
The Industrial Jack Specification (IJS) specifies the tests and procedures for hydraulic hose and hose jacking systems. The test uses a limited impulse test life to determine a static (non-impulse) working pressure rating.

Integrated Circuit
A circuit composed of miniature resistors, transistors, diodes and capacitors on a wafer-thin piece of silicon.

I/O
Input/output. A device or signal for entering information into the computer system or reading information out of it.

I/P
Instrument panel.

Impulse
The pressure surge usually caused by the hydraulic pump.

Induction Hardening
Localized hardening of medium carbon steel.

Installation Torque
Proper installation torque ensures a proper leak-free seal. Over-torquing of a threaded connection stretches and damages threads and mating seat angles. See the Gates Hydraulics catalog for proper installation torque ranges.

Internal Skive
Removing a portion of the tube to install a fitting. Used mostly by Aeroquip on SAE 100R13 hose.

Inverted Seat
The mating seat used in the female pipe swivel and male inverted swivel.

ISO
International Organization for Standardization.

Japanese Tapered Pipe Thread
The Japanese tapered pipe thread connector is identical to and fully interchangeable with the BSPT (tapered) connector. The Japanese connector does not have a 30° flare, and will not mate with the BSPP female.

JIC
Joint Industry Conference.

JIC 37° Flare (JIC)
The Society of Automotive Engineers (SAE) specifies a 37° angle flare or seat be used with high-pressure hydraulic tubing. These are commonly called JIC couplings.

Komatsu Style 30° Flare
Flare Parallel Threads The Komatsu style 30° Flare parallel thread connector is identical to the Japanese 30° Flare parallel thread connector except for the threads. The Komatsu style connector uses metric fine threads which conform to JIS B 0207.

Leaded Steel
Lead is traditionally added to steel to aid machining. Gates pioneered the use of non-leaded steel and associated machining technologies to improve quality and performance of hydraulic couplings.

LED
Light-emitting diode. Transmits a coherent light when voltage is applied to its terminals (See Annunciator).

Lines' Function
To convey fluids and connect system components.

Locator Clamps
Used mainly on Case equipment and designed to support and aid in the routing of hoses.

Low-Pressure Cut-Off Switch
Protects the compressor from internal damage in the event of a large loss of oil-laden refrigerant. The switch opens when high-side pressure falls below approximately 40 psi.

Low-Side Pressure
Compressor intake pressure.

Microprocessor
A small integrated circuit capable of receiving data, manipulating it and supplying results – usually of an internally-stored program.

MIL/DOD
The United States Military Department of Defense has many specifications that identify dimensional and performance requirements for various hose types. Some specifications require a manufacturer to be listed as an approved source. Many specifications require a low-temperature rating to -65° F.

Minimum Bend Radius
This is the tightest a hose can be bent and still meet SAE testing without causing kinking or damage. Impulse testing is conducted at minimum bend radius in accordance with SAE.

Miscellaneous Considerations
Such things as flexing, surges and minimum bend radii must also be considered in hose selection since all these affect the performance and service life of the hose.

Mode
A specifically selected condition or setting that directs air flow to be heated or cooled, then directed to specific outlet ducts.

Motors
A motor is an actuator to produce mechanical force from the fluid's energy. Lines connect the components in the system, and fluid is needed to power it.

MS
Military Standard.

MSHA
The Mine Safety and Health Administration specifies flame-resistance properties required of hose used in underground mining applications. It's also the recognized standard for flame resistance for many other industries.

Multiplication of forces
Fluid power systems can multiply a force almost infinitely.

NASA
National Aeronautics and Space Administration.

NCB-174
The National Coal Board, now governed by British Coal Corporation, sets the dynamic and static pressures for the coal industry.

NPN Translator
Acts as a switch and/or amplifies the voltage signal. Applying negative voltage to an NPN transistor turns it off.

NPSF
The National Pipe Straight thread for Fuels. When used for female ends, NPSF mates with the NPTF male end. However, the SAE recommends female NPTF threads – not NPSF female ends – mate with NPTF males.

NPSM
National Pipe Straight thread for Mechanical joint. This is used on the female swivel nut of iron pipe swivel adapters. The leak-resistant joint is not made by the sealing fit of threads, but by a tapered seat in the coupling end.

OD
Outside Diameter.

Ohm
The amount of resistance of an electrical device or component.

Open Center Hydraulic Circuits
A system in which pump flow is diverted to a tank when the control valve is in the center or neutral position. Used typically with constant volume pumps.

Open Credit
A broken electrical circuit with no complete path for current flow. Caused by cut wires, a blown fuse, a loose connector, etc.

O-ring Boss
Usually, the O-ring boss male mates only with a port. Occasionally, the male mates with a female O-ring boss, but they are extremely rare. Made of elastomeric steel, an O-ring boss is a high-performance, leak-resistant fitting.

O-Ring Face Seal (ORFS) J1453 Flat Face O-ring
A leak-free seal is made when the O-ring in the male contracts the flat face of the female. It is less sensitive to torquing variations than the more popular JIC fitting. ORFS operates at working pressures up to 6,000 psi.

O-Ring Flange - SAE J518
The SAE Code 61 and Code 62 4-Bolt Split Flange is used worldwide, usually as a connection on pumps and motors. It is often used along with spiral wire hoses in extremely high-pressure systems.

ORS
Some competitors' version of the Flat Face O-Ring.

Operating Pressure (PSI)
The hose must be capable of continuously handling the system's pressure, including surges and spikes.

Oxidation Stability
A quality that offers better resistance to chemical deterioration to reduce harmful sludge.

OSHA
Occupational Safety and Health Administration.

Parallel Circuit
An electrical circuit in which the flow of current through the resistors has more than one path.

Pascal's Law
Pressure applied at any point in a static fluid is the same in all directions and acts with equal force on equal areas.

Pipe
Pipe ports may be NPT or NPTF.

Pipe Sealing Methods - On the Threads
Tapered pipe threads (NPTF) are the only line connections in which the threads do the sealing. As the threads tighten together, they deform to create the seal.

Plastic Tubing
Plastic tubing is produced by a continuous hot extrusion process and is seamless.

1. Polyvinyl Chloride (PVC) is used in air lines up to 65 psi, and at a temperature range of -5° F to + 105° F. It loses some flexibility below 30° F. PVXC is the most elastic plastic used in tubing and has excellent abrasion resistance.

2. Polyethylene is used for low-pressure liquid and gas lines up to 200 psi, depending on size, and at a temperature range of -40° F to +135° F.

3. Nylon is used for low-pressure hydraulic and pneumatic lines up to 300 psi, at a temperature range of -40° F +180° F. It is immune to fatigue, and has good impact resistance.

4. Nylon air brake (SAE J844 Type 3A and 3B) is used for air brake systems, air control and gauge lines up to 150 psi, at a temperature range of -40° F to +200° F. **NOTE:** Do not use in Air Brake Systems where temperature exceeds +200° F or where battery acid can drip on the tubing.

Plenum Blower Assembly
Air passes through this assembly on its way to the evaporator. It is located on the engine side of the fire wall and contains air ducts, air valves, and a blower that permits selection of air from the outside or inside of the vehicle and directs it to the evaporator core and/or the heater core.

Pneumatics
Pneumatic systems operate on compressed air.

PNP Transistor
Acts either as a switch or to amplify the voltage signal. Applying positive voltage to a PNP transistor turns it off.

Port
The inlet or outlet connection usually found on hydraulic cylinders and hydraulic pumps.

Potentiometer
A variable resistor (either a rotary or sliding type).

Power Take Off (PTO)
The hydraulic pump powered by the drive engine in the equipment where the PTO is installed.

Pour Point
The lowest temperature at which a fluid will flow under normal gravity pressure.

Pressure
Force per unit area. The English unit of pressure is pounds per square inch (psi); the metric unit of pressure is kilopascals (kPa).

Pressure Cycling Switch
Combines the functions of the thermostatic switch, low-pressure cut-off switch and ambient compressor switch.

Pressure Drop
See “Hydraulic System Pressure Drop: What is Pressure Drop?” above.

Pressure Increases
Pressure increases as volume is reduced. In a closed system, pressure increases as the temperature increases.

Pressure Spikes
A pressure spike is a surge of the hydraulic pressure, such as when a digging backhoe hits a large rock.

Printed Circuit Board (PCB)
A foil circuit that interconnects solid-state electronic devices to form a composite logical operating system.

PSI
Pounds per square inch.

PTFE
An oil additive that is used to reduce wear.

Pump (Hydraulic)
A pump to convert mechanical energy into hydraulic power, which is then distributed to actuators in the hydraulic system.

Pump Types
Most pumps used in fluid power systems are positive-displacement pumps. There are two kinds of positive displacement pumps: rotary and reciprocating pumps. Hydrostatic pumps are increasingly in use, especially in off-road equipment.

Quick Disconnect (QD)
A component that can quickly separate or join a fluid line without the use of tools or special devices.

Quick Disconnect: Ball Valve
A type of valve used on medium-pressure application, mostly on farm equipment.

Quick Disconnect: Finish
The coating used on all exposed surfaces to resist corrosion.

Quick Disconnect: Locking Ball Grooves
A groove in the male QD that mates with the locking balls in the female QD.

Quick Disconnect: Locking Balls
Ball-bearing-like pieces that fit into the female QD that lock with the male QD.

Quick Disconnect: O-Ring Seals
The synthetic rubber seal that prevents oil seepage while the QD is coupled.

Quick Disconnect: Positive Valve Stop
Allows valve to open to the Flush position, for maximum oil flow. Also prevents the female body from checking the flow.

Quick Disconnect: Retainer
In connected couplings, this retainer acts as the valving stop and ensures uniform valve opening.

Quick Disconnect: Sleeve
A spring-loaded “locking” latch. It’s hardened to resist damage from rough handling and the brinelling effects of locking balls under pressure.

Quick Disconnect: Valve Actuator
Assures that the valve in a connected male tip remains in the open position to prevent flow checking.

Quick Disconnect: Valve Seat
“Coining” – matching one seating surface to another – provides a fluid-tight metal seal between each half of the coupling.

Quick Disconnect: Valve Shield
Protects valving from high velocity flow which prevents flow checking in the connected position.

Quiescent Current
A standby or operating current flowing in a circuit or component at Azores signal, no-drain interval in operation. Often used as a Keep-alive current supplied to a computer memory.

Rated Pressure
The maximum pressure at which a product is designed to operate.

RCCC
Regular Common Carrier Conference for Fleet Truck and Bus.

Reinforcement
The primary “muscle” component of a hose giving it the ability to contain pressure. This must be taken into consideration on applications where cubical expansion (elongation and contraction) are important. Different reinforcements allow different types of hose movement.

Relay
A magnetic switch to control high amperage current using a low amperage control circuit.

Relief Valve
A safety valve that bypasses excess pressure in a hydraulic system if the system is over-pressurized.

Resistance
The opposition that a device or material offers to the electrical current flow.

Resistor
A device containing a specific amount of resistance; used in circuits to limit current flow or to provide a voltage drop.

Reservoir
A place to store the fluid.

Reservoir Function:
Store oil, keep oil clean, control oil temperature, remove air from return oil. The reservoir should hold at least three times the fluid output of the pump. For example, if pump output is equal to 15 GPM, then tank volume would be 45 gallons.

Return Line
The hydraulic hose that returns the hydraulic fluid to the reservoir after it has performed the desired work.

Reusable Fitting
A field attachable fitting.

RMA
Rubber Manufacturers of America.

Room Temperature
68° to 72° F.

Rust Prevention
Fluid should contain additives that form a corrosion-resistant film over metal surfaces. This is particularly important in water-oil-emulsion fluids.

SAE
The Society of Automotive Engineers (SAE) establishes the American standards for most hydraulic hose. SAE specifications give specific requirements concerning size tolerances and minimum performance characteristics of each major hose type.

SAE (45° Flare)
A term usually applied to fittings having a 45° angle flare or seat. Mostly used in automotive applications.

SAE Inverted Flare
The SAE 45° inverted flare male mates only with an SAE 45° inverted flare female.

Series Circuit
A one-path electrical circuit in which current flows through a resistor or resistors.

Short Circuit
A low-resistance connection across a voltage source or between both sides of a circuit. Usually accidental and usually resulting in excessive current flow that may cause damage.

Single-Acting Sleeve
Permits pull-to-connect convenience on an implement line when the female body is clamp mounted. Making connection requires manually pulling the female body forward, inserting the male tip, and allowing body and tip to return to the original position in the clamp.

Sink
A heat exchanger. Made with a heavy metal base that has a set of radiating fins to remove heat from such mounted components as power transistors and similar solid state devices.

Size Hose
See Dash Size.

Skive
Removing the rubber cover of a hose to expose the reinforcement, where the fitting attaches to the hose.

Sleeving
While a number of Sleeving types are available, the most common is nylon. Applications include: protecting the hose from abrasion, for use in bundling and protecting the equipment operator from injury due to hose failure.

Socket
The screw-on ferrule for a field attachable fitting assembly.

Solenoid
A device that converts electrical energy into mechanical energy.

Solid State
An electrical device with no moving parts (such as diodes and transistors). Solid state devices start, stop, amplify or regulate current flow.

Spillage
The fluid removed from the system during disconnection of a coupling assembly.

Spring Guards
There are many types of spring guards: flat armor, plated wire, plastic, etc. They are used to protect hoses from abrasion, to bundle hose or to provide stability. Also, tightly wound plated wire guards can be used as bend restrictors to reduce stress on the hose.

Spring Lock
Ford Motor Company uses its patented dual O-ring style OEM connection exclusively. The dual O-rings are sealed in a precision barrel and held together mechanically using a tube flare behind a garter spring.

STAMPED
Seven easy steps to selecting the proper hose: **S**–Size, **T**–Temperature, **A**–Application, **M**–Material to be conveyed, **P**–Pressure, **E**–Ends or couplings, **D**–Delivery.

Standpipe (Metric)
A coupling that uses a compression sleeve to attach to a male coupling.

Static Pressure
Pressures that 1) reach a steady pressure or 2) stay at constant pressure over time.

Straight Thread (U.S. SAE/JIC)
The seal is made when the Male and Female ends mate at a predetermined angle.

Suction Line
A hose that uses vacuum to remove a fluid from a pool of fluid.

Surge
An increase in hydraulic fluid pressure.

Surge Flows
A rapid increase in fluid flow.

Swage
Similar to crimping, but the coupling is forced into stationary dies. The coupling then takes on the profile of the dies.

Temperature
Knowing the fluid temperature and the ambient temperature is important because temperatures in excess of the temperature rating of the hose will shorten the service life.

Thermal Build-Up
Heat from an external source (like sunlight) causes the fluid – and so, the hydraulic pressure – to expand.

Thermistor
A temperature-sensitive resistor that increases its electrical resistance as temperature drops, and decreases its electrical resistance as temperature increases.

Thermostatic Switch
An adjustable component in a cycling clutch system to engage and disengage the compressor. It prevents water from freezing on the evaporator core, and controls the temperature of air that flows from the evaporator.

Transistor
Acts either as a switch or to amplify the voltage signal.

Trapped Pressure
Pressurized hydraulic fluid trapped behind closed coupling valve.

Tube Installation
When assembling tube for a system, it is important to consider the conditions involved, such as: operating pressure, temperature, type of fluid to be used, flow rate (Gallons Per Minute - GPM). These determine the type and size of tubing required.

Tube Connections
Using the proper connections control leakage. Industry standards must be recognized and followed to prevent malfunctions. Common connections include: JIC, SAE and Flareless assemblies.

Tubing Sizing and Types
To determine the nominal size for tubing, measure the outside diameter (OD) of the tube.

Metal Tubing is made from highly ductile, annealed material that is easily bent and flared.

Low Carbon steel-annealed tubing, the most common tubing for fluid power systems, may be: seamless, electric welded, double wall brazed.

Seamless Stainless Steel tubing should be used for high-pressure applications and when corrosion is a problem.

Seamless Copper tubing is suitable for low-pressure stationary systems. Copper work hardens when flared or bent and resists vibration poorly.
NOTE: Work hardening is an increase in strength that occurs with the deforming of a metal.

UL
Underwriters Laboratories.

USCG (Specifications)
The United States Coast Guard requirements are met through two SAE specifications for hose and fittings used on marine vessels. They are SAE J1475 and J1942. Also J1941/1 lists manufacturers hose that is accepted (but not approved) by the USCG.

Vacuum
A pressure less than atmospheric pressure. Measured in inches of Mercury (in Hg) or kilopascals (kPa).

Vacuum Motor
Same as vacuum actuator and vacuum power unit. It is a device that opens valves or doors using vacuum as a power source.

Variable Delivery
An adjustable rate of flow.

Vibration and Noise Absorption
Hose reduces vibration and noise compared to many mechanical power transmission methods. Consequently, the system runs quiet and cool.

Valves: Control
A valve controls the direction and amount of fluid flowing through the system. Match the control valve to the type of work the valve will do in the system.

Valves: Flow Control
Includes needle, globe, compensating and non-compensating valves.

Valves: Pressure Control
Includes relief and regular valves and pressure switches.

Viscosity
Viscosity is the measure of a fluid's ability to flow. High viscosity fluids do not flow easily. Viscosity is also affected by temperature, including ambient temperature. Fluids at high temperatures have low viscosity and so flow easily. At lower temperatures, fluids thicken and flow more slowly.

Voltage
A measurement of electricity that expresses the amount of electromotive force or electrical pressure.

Water Hydraulics
Use of treated or untreated tap water as a hydraulic fluid. These systems require special considerations, such as the use of all stainless steel components. Water hydraulics is increasingly used in limited applications. Industries such as Food Processing (contamination concerns) and Steel Mills (fire resistance) are using water as a hydraulic fluid.

Wet Line
The hoses used under the hood of a diesel vehicle. These hoses are usually C5 type and convey oil, fuel and air. Wet lines are also found on dump trailers that connect the cab to the trailer.

Wet Line Kit
A group of wet line hoses made for a specific application on a vehicle or engine.

Level 201 Review Quiz

1. Identify these stem styles:

- G20
- G25
- G40
- G45
- G9

2. Physically, what is the obvious difference between SAE 45° Flare and JIC 37° Flare?

3. NPTF and British Standard Pipe Tapered couplings look similar. Give two reasons why they are not interchangeable.

4. What does "STAMPED" stand for and why is it important to remember?

5. What is pressure drop?

6. Identify this hose from its layline: 8M3K. What is the bend radius?

7. Identify the following hoses by pressure rating:

a. G2

b. EFG6K

c. G2H

d. EFG4K

e. C3H

8. What is a dash size? How big is a –8 hose?

9. Identify this coupling: G25100-0808.

10. A 24° cone is used on a compression tube (standpipe) coupling and also on flareless assemblies to connect tubing and hose. Where would you find a 24° cone on a high-pressure application?

11. A Japanese tapered pipe thread coupling looks like a British tapered pipe thread (BSPT) coupling. Can you safely interchange them?

12. A Komatsu 30° flare parallel thread coupling is identical in dimensions to a Japanese 30° flare parallel thread coupling. Why aren't they interchangeable?

13. A metric standpipe has three components. What are they?

14. Name five uses of adapters.

15. What does a male O-ring Boss mate with?

16. Code 61 and Code 62 flanges are dimensionally different? Name three ways they differ.

17. What application would you use LP350 hose on?

18. If you cannot read the layline on the hose you're replacing, how do you decide which replacement hose to recommend?

19. We know that not all foreign couplings have metric threads. However, there are two foreign thread forms. One is metric. What's the other?

20. If you measure the ID of an SAE 100R5 hose and specify a -8 coupling for it, why won't the coupling fit?

Level 201 Review Quiz

ANSWERS

1. • G20 = GlobalSpiral™
   • G25 = MegaCrimp®
   • G40 = C14
   • G45 = PolarSeal®
   • G9 = Quick Disconnects

2. Both male and female SAE 45° Flares have a single notch cut into the nut.

3. The thread pitch is different. The thread angle is 50° in NPTF, 60° in BSPT.

4. It's an acronym standing for Size, Temperature, Application, Material, Pressure, Ends (of couplings) and Delivery. These are critical considerations when specifying a hose for application.

5. Pressure drop is the difference in the pressure of a fluid as it enters a hydraulic assembly and the pressure as it leaves the other end.

6. 8M3K = ½" MegaSys® (½" bend radius) 3000 pounds per square inch.

7. a. G2 = High-Pressure
   b. EFG6K = Extremely High-Pressure
   c. G2H = Medium-Pressure
   d. EFG4K = Very High-Pressure
   e. C3H = Medium-Pressure

8. Dash size is the industry standard for measuring hose and couplings and denotes ID in sixteenths of an inch. And -8 hose has in ID of 1/1 inch.

9. G25100-0808 = MegaCrimp Male Pipe (NPTF - 30° cone seat) with ½" stem and ½" thread.

10. A 24° cone is also used in German DIN (Light and Heavy), French GAZ and Kobelco fittings.

11. Yes, they're interchangeable.

12. A Komatsu 30° flare parallel thread coupling has metric fine threads and the Japanese does not.

13. Bite sleeve, nut and standpipe fitting.

14. a. To change thread types in an in-line connection.
    b. To reduce or enlarge the size of the connection or hose line.
    c. To make tight bends at a port connection.
    d. To make orientation easier.
    e. To accommodate several lines at once.

15. An O-Ring Boss mates with an O-Ring boss female port and only rarely on an O-Ring female fitting.

16. Code 61 has a smaller flange diameter and a thinner profile. Also, the flange halves have different distances between the bolt holes.

17. LP350 is a medium-pressure hose for liquid or gaseous propane, butane, or any combination of the two when used as fuel.

18. Cut the original hose and measure the ID.

19. Whitworth (BSP or British Standard Pipe).

20. Dash sizes for SAE 100R5 hose (SAE 100R14 and refrigerant hoses) denote OD, not ID.

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