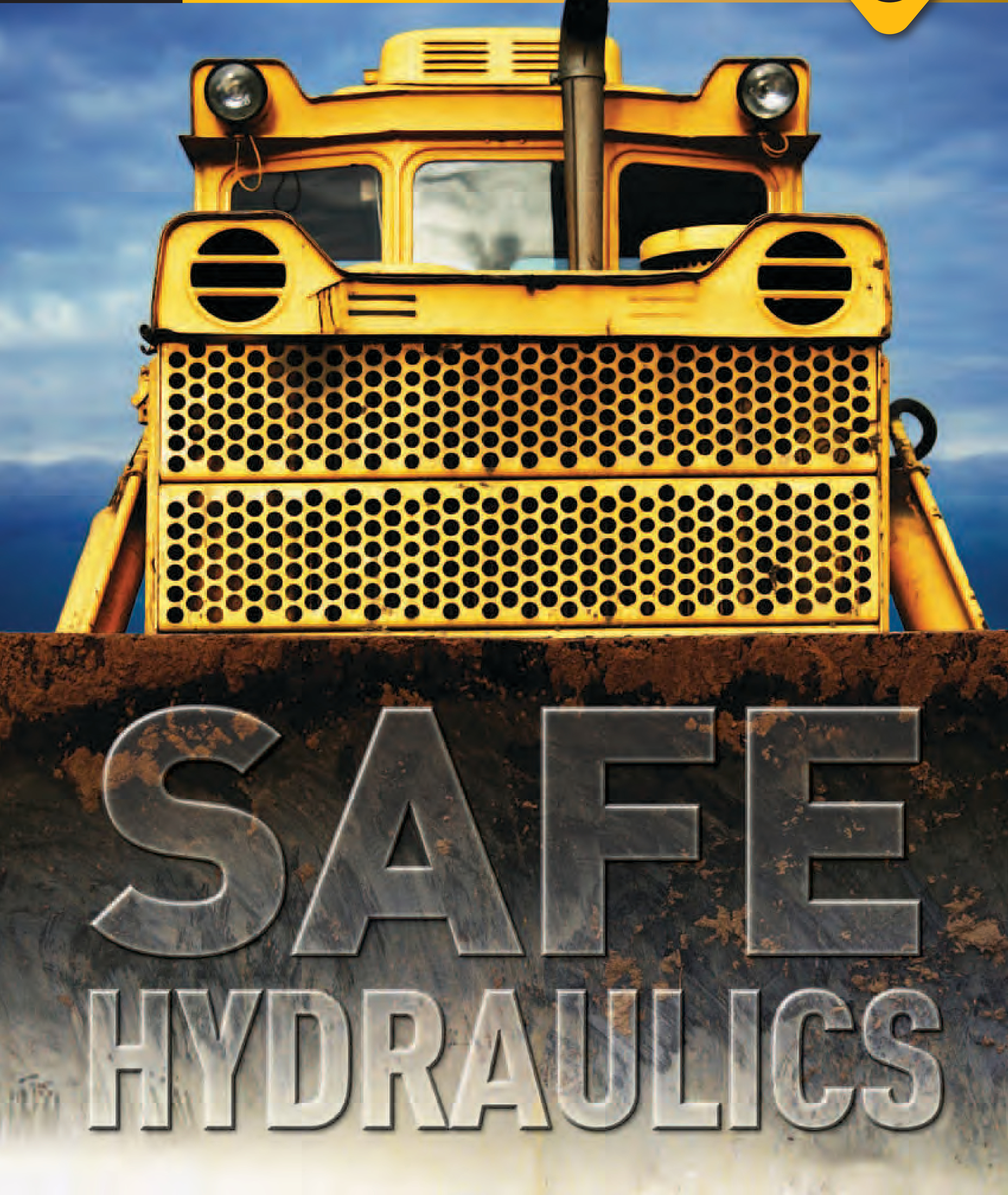
A Guide to Preventive Maintenance & Safety for Hydraulic Hose & Couplings

Safe Hydraulics



Gates also offers safety and preventive maintenance programs for industrial hose.
Contact your Gates representative for more information.

Printed in the U.S.A.

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INTRODUCTION

Think Safety!

This symbol indicates important safety information throughout this manual.

Why Preventive Maintenance?

There are several good reasons to begin a preventive maintenance program. Costly emergency repairs, production downtime and worker safety to name a few.

The main objective of a preventive maintenance program is to identify component weaknesses before failure and loss of production. Some people believe that PM actually should mean "predictive maintenance" rather than "preventive maintenance."

Preventive maintenance is especially important with hydraulic products. The high pressures and temperatures associated with hydraulics make hose and fitting maintenance as well as selection critical. If done correctly, the risk of injury and/or excessive, costly downtime decreases significantly.

In addition, there is a growing awareness regarding costs associated with cleaning up a hydraulic spill (EPA).

Combining top-quality Gates products with a regular preventive maintenance program will keep your equipment at maximum efficiency.

Benefits

1. **Efficient production** because equipment is in good operating condition at all times.
2. **Better use of in-shop maintenance personnel** since there's less emergency work and more scheduled work.
3. **Improved control** of spare parts inventory, and reduced parts usage.
4. **Reduction of equipment downtime** through scheduled inspections.
5. **Safety hazards** are minimized.
6. **Increased life expectancy** of equipment.
7. **Fewer capital outlays** for purchasing new equipment prematurely.
8. **Reduced repair costs** due to fewer breakdowns.
9. **Prevention of equipment deterioration** from causes other than obsolescence.

Components of a Preventive Maintenance Program

An effective preventive maintenance program consists of the following key elements:

- Maintaining a safe work environment.
- Maintenance records.
- Regularly scheduled inspections conducted when equipment is shut down and hoses are not pressurized.
- Troubleshooting (identifying problems and solutions).
- Proper hose and fitting selection.
- Proper assembly, routing and installation.
- Receiving updated maintenance and product training periodically.

Think Safety!

Important Note:

Though this manual contains helpful suggestions, it is not an all-inclusive reference for implementing a preventive maintenance program.

The most effective program will also take into account your equipment manufacturer's recommendations, as well as your experience in using and maintaining the equipment. You should, however, contact Gates before doing anything contrary to recommendations in this manual or in other Gates literature.

You must also consult the equipment manufacturer for information regarding injury risks related to its equipment that may not be identified or fully discussed in this manual. In addition, Society of Automotive Engineers (SAE) recommended practice J1273* contains many useful recommendations about design, installation, maintenance and other activities involving hose assemblies in hydraulic systems.

* SAE documents are available through SAE Customer Service at:
(phone) 724-776-4970
(fax) 724-776-0790

Fluid Power Technology

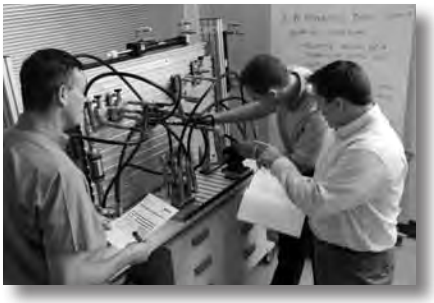
Questions Answered, Problems Solved

The Gates Customer Solutions Center (CSC) is staffed with top engineers, scientists and technicians whose sole mission is to meet the needs of the Gates fluid power customer.

Problems with equipment? Need training? Application problems? The CSC is at your disposal.

Research and Development

There is nothing static about the fluid power industry. By anticipating industry changes through research and development, Gates specialists work to improve fluid power productivity. Some search for a better hose assembly. Others address specific customer application problems. All are dedicated to advancing technologies that lead to value in the marketplace.



Testing

At the CSC, the testing of existing assemblies or prototypes is remorseless. The testing simulates real-world conditions. We freeze, heat, abrade and age. We expose materials to ozone. We evaluate metals and compounds. We examine designs for effectiveness and durability. The Impulse Test Lab is the most advanced of its kind in the industry. In short, we find out what works and what doesn't. If it passes the tests at the CSC, you can be sure of its reliability.

Customer Training

When you or your company's personnel need technical training, there is no better place to get it than in the CSC's classrooms. At individual computer workstations and in mobile equipment bays, students work side-by-side with Gates professionals to learn about hose selection, crimping, routing and system design. Our training courses instruct customers in equipment maintenance, troubleshooting and safety. In our secure mobile equipment bay, we work with customers in designing and developing new products. This high-quality, hands-on training is but one more value-added commitment to our customers.

SAFETY

Maintaining a Safe Work Environment

Establishing a safe working environment in and around your hydraulic equipment is just common sense. The easiest and most effective way to avoid problems is to make sure your associates understand their equipment, know how to operate it safely and recognize the danger it represents if handled carelessly.

A few things you must be aware of include:

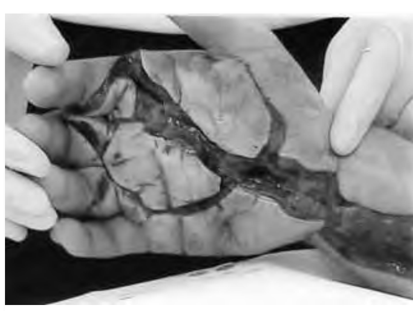
1. **Pressure.** Hydraulic fluid under pressure is dangerous and can cause serious injury.
2. **Temperature.** High fluid temperatures can cause severe burns.
3. **Flammability.** When ignited, some hydraulic fluids can explode and/or cause fires.
4. **Mechanical.** Hydraulic fluid creates movement, which causes parts of your equipment to move or rotate at high speeds and with great force. Moving components should be in a safe or neutral position.
5. **Electricity.** Electricity can create the spark that causes a fire, explosion or electrocution. Shut it down!

Pressure

Operating pressures of hydraulic systems can be up to 10,000 psi.

A few of the dangers that could be encountered with hydraulic fluid under pressure include:

Pinhole. Fluid under pressure can cause serious injury. It can be almost invisible escaping from a pinhole, and it can pierce the skin into the body. Do not touch or get near a pressurized hydraulic hose assembly with any part of your body. If fluid punctures the skin, even if no pain is felt, a serious emergency exists. Obtain medical assistance immediately.



Failure to do so can result in loss of the injured part or death.

Leak. Leaking hydraulic fluid is not only unsightly, it's hazardous. In addition to making workplace floors slippery and dangerous, leaks also contaminate the environment. As little as one quart of oil can pollute up to 250,000 gallons of water. Estimates are that 100 million gallons of oil leak from hydraulic equipment annually. Before cleaning an oil spill, always check EPA, state and local regulations.

Burst. Whether due to improper selection or damage, a ruptured hose can cause injury. If it bursts, a worker can be burned, cut, injected or may slip and fall.

Coupling Blowoff. If the assembly isn't properly made or installed, the coupling could come off and hit or spray a worker, possibly resulting in serious injury.

Whipping Hose. If the hose end or end fitting comes apart under pressure, the loose hose can whip around with great force. This has the potential to cause serious injury. If this hazard exists, restrain or shield the hose using clamps or protective shielding.

Stored Energy. Hydraulic systems sometimes use accumulators to store potential energy or absorb shock. This energy can create pressure that keeps the system's components moving.

REMEMBER: charged accumulators can be lethal. Always open the accumulator's valve to release pressure. Hoses under pressure act as accumulators.

Temperature

Most hydraulic systems typically operate at 150° to 180°F. Others may go as high as 300°F. Liquid at these temperatures may burn skin. Metal parts (such as fittings and adapters) are also hot and may cause burns. Hoses can also become hot.

Flammability

With the exception of those comprised primarily of water, all hydraulic fluids are flammable when exposed to the proper conditions (including many "fire-resistant" hydraulic fluids).

Leaking pressurized hydraulic fluids may develop a mist or fine spray that can flash or explode upon contact with a source of ignition. These explosions can be very severe and could result in serious injury or death.

Precautions should be taken to eliminate all ignition sources from contact with escaping fluids, sprays or mists resulting from hydraulic failures. Sources of ignition could include electrical discharges (sparks), open flames, extremely high temperatures, hot manifolds and engine blocks, sparks caused by metal-to-metal contact, etc.

Mechanical

Mechanical motion can be dangerous. Watch out for swinging arms, booms, rollers, presses — anything that moves can be dangerous if a hose fails. For example, when a hose bursts, objects supported by fluid pressure may fall, and vehicles or machines may lose their brakes. If the equipment is mobile, always chock the tires to prevent rolling.

Electrical

It's important to turn hydraulic equipment off before starting to work on it. If plant equipment, lock the control box, and tag it with a warning sign stating "DOWN FOR MAINTENANCE. DO NOT TURN ON POWER." If the equipment is mobile, take the key and/or disconnect the battery so it can't be started.

During normal equipment operation, you may be exposed to electrical hazards such as high-voltage power lines and underground power sources. Always identify these potential hazards before running the equipment. Most hydraulic hose is wire-reinforced, making it conductive to electricity*. Some equipment requires the use of non-conductive hose if there's a chance of contacting power sources.

OSHA standards require that all hydraulic tools used on or near energized power lines or equipment be supplied with non-conducting hose having adequate strength for normal operating pressures [29 CFR 1926.951(f)(3)].

Faulty wiring can also be an electrical hazard. A regular preventive maintenance program should always include a wiring check.

* Even non-wire reinforced hose may be conductive through the rubber compound itself or moisture that penetrates a pin-pricked hose cover.

Safe Hose Selection

Proper hose selection is critical to a safe hydraulic system. A simple rule of thumb for proper hose selection is the word "STAMPED":

S SIZE

T TEMPERATURE

A APPLICATION

M MATERIAL

P PRESSURE

E ENDS

D DELIVERY (Volume)

The first step in having a safe hydraulic system is selecting components that meet your needs. Compromises in hose selection may put you in danger, as well as affect the performance and life of your system. The decision may work for the short run, but may not be a good long-term decision. Remember, the most important thing is your safety.

Most hydraulic systems should be designed with a 4:1 safety factor (burst test pressure vs. maximum recommended working pressure). However, some applications may have different standards (examples: waterblast, jack hose).

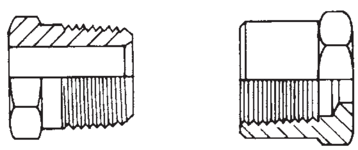
See Chapter 5 for more details.

Safe Coupling Selection

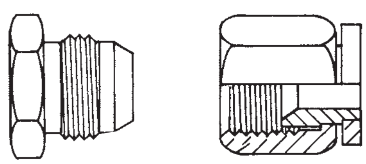
Thread ends must be compatible in order to prevent leaking or assembly blow-off.

Fittings seal three ways:

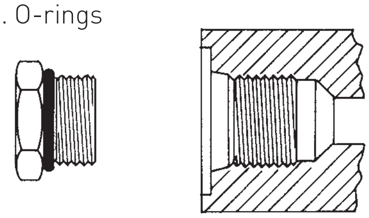
1. Thread interface



2. Mechanical joint or mated angle



3. O-rings



It's critical that both the male and female fittings are compatible to create an effective seal.

Incorrect seating can cause leaks, which can create a safety and environmental hazard.

See Chapter 6 for more details.

Safe Hose Assembly

Once the components have been selected, it's important that the assembly is made properly. If not, the ends could blow-off.

Whether you're making it yourself or buying it ready-made, **don't mix and match hose and couplings from various manufacturers.** It's critical that the hose and coupling manufacturer are the same and that they're assembled using the manufacturer's recommended equipment, components and procedures. Mixed combinations may not have been tested.

Gates has conducted extensive testing to verify the integrity of its products. For instance, an assembly with our EFG4K hose passes 1 million impulse cycles when tested at SAE100R12 conditions with GlobalSpiral® couplings.

That means not only is the product safe, but you'll receive maximum hose life as well. The key is using the recommended fitting and assembly procedures. If not followed, there's no telling how long the assembly will last.

See Chapter 7 for more details.

If making your own assemblies, refer to the operating manual for that specific equipment (crimpers, cutters, skivers, swagers, etc.) for proper use.

Think Safety!

Equipment safety precautions include:

- **Always wear safety glasses.**
- **Keep appendages clear from moving parts.**
- **Don't wear loose-fitting clothing.**
- **Make sure equipment is securely mounted and connected.**

Safe Installation

It is important to pay particular attention to hose routing (see pages 58-59):

- Hose must be properly installed to prevent hazards and ensure long life.
- Avoid twisting.
- Avoid positioning hose next to heat sources.
- Avoid positioning hose next to metal edges or too close to other hose. The hose cover and reinforcement may be damaged by abrasion, creating a safety problem.
- Sleeving, clamping and abrasion-resistant products may be problem solvers.

Proper **torquing** of fittings is also important:

- When connecting threaded or flanged ends, follow proper torque recommendations. Improperly torqued (both undertorqued or overtorqued) fittings may not only leak, but they may not withstand system pressure or vibration.

See Chapter 8 for more details.

Maintenance

A well-maintained machine is a productive machine. If not properly maintained, it could be unsafe and could breakdown. A scheduled maintenance program should ensure a long system life and a safe work environment. Refer to your equipment maintenance manual for recommendations.

PERIODIC INSPECTIONS

Think Safety!

Review Safety Precautions First

Prior to conducting any inspection of your hydraulic system, it's important to understand the precautions outlined in Chapter 2, as well as specific precautions outlined by your equipment's manufacturer.

A good place to begin is with a periodic inspection of hydraulic components. During normal operation, be aware of how the equipment sounds, looks and feels. Any noticeable difference in its daily operation may indicate a problem. Take time to check it out thoroughly.

When to Inspect and How Often

Because inspections vary by type of equipment, refer to your equipment operating manual for recommendations. Always use the manufacturer's inspection recommendations. If they are not available, a good rule of thumb is:

- For mobile equipment: every 400-600 of operation hours or three months, whichever occurs first.
- For stationary equipment: every three months.

The following factors influence how often you need to inspect your hose:

- Critical nature of equipment.
- Operating temperatures.
- Operating pressures.
- Environmental factors.
- Type of usage (rugged, abusive, shock, vibration, operating time, etc.).
- Accessibility of equipment.

Of course, personal experience with your equipment is often the best manual for knowing when to conduct inspections. If you're having a specific problem or problem area, it is important to keep a close eye on the situation.

Also, if you have a rugged, high-pressure hose application operating 24 hours a day, seven days a week, it will require more frequent inspections than a hose used in a mild environment at ambient temperature that's only pressurized a few times daily.

Potential problem areas include:

- High heat sources.
- Rough abrasion areas.
- Tight bends or twisting.

These possible trouble spots may need to be inspected and hoses replaced more often. Always look for opportunities to correct these potentially damaging situations.

Inspection Procedure

Preventive Maintenance Checklist

By following this preventive maintenance checklist, you can maintain your equipment's hoses efficiently, safely and with very little effort. Each step is covered in detail in the following section.

- ☐ 1. First, always turn off the equipment's power and release pressure in hoses.
- ☐ 2. Place equipment and components in a safe or neutral position (use lockout tag).
- ☐ 3. Remove access panels and inspect hose and fittings for damage or leaks.
- ☐ 4. Repair or replace as needed.
- ☐ 5. Inspect other hydraulic components.
- ☐ 6. Reinstall the access panels.
- ☐ 7. Turn power back on.
- ☐ 8. Be aware of your equipment, always looking and listening for anything unusual.

1. Turn off equipment power and release pressure.

Remember to release pressure from the accumulators along with the system pressure. Lock the control box and tag it with a warning sign that reads "DOWN FOR MAINTENANCE. DO NOT TURN ON POWER." If it's mobile equipment, turn the key off, put it in a safe place and disconnect battery. Chock tires if necessary.

2. Place equipment and components in a safe or neutral position.

Make sure components are not in mid-stroke, mid-cycle or holding a load. This could cause the equipment to be unstable or to move. Before working around the equipment, drop the load, retract cylinders, relieve pressure and allow cool-down time.

3. Remove access panels and inspect hose and fittings for damage or leaks.

Hose assemblies — what to look for:

A. Cover

The hose's cover protects the reinforcement. If damaged, the reinforcement could be damaged as well. Visually inspect the cover for signs of:

- Abrasion
- Blisters
- Nicks, cracks or cuts
- Hardness
- Color changes

Look around to find what caused the damage. For instance, what's causing the abrasion? Is it rubbing against metal or another hose?

Check for hardness by pressing a ballpoint pen into rubber. Pen should not permanently indent or penetrate hose cover. Be careful – it could be hot! If the hose is hard, check to see if it's near a heat source such as an exhaust manifold.

B. Leakage

Leaking can occur in the hose, at the coupling and/or the thread end. Signs of leakage include:

- Puddles of fluid in or around the equipment.
- Low fluid in reservoir.
- Greasy/dirty hose.

Release pressure and allow cool-down time. Then look around to locate the leak, but be very careful.

C. Routing

Proper routing is critical in preventing early hose failure. Make sure hoses do not rub against each other or against metal parts. Also, make sure they are not located next to a high heat source. Check for twisting or kinking, and make sure there's enough slack to allow for length changes under pressure.

See Chapter 8 for more details.

Think Safety!

CAUTION: Never check for leaks by running your hand over hose or hydraulic connections. Instead, use a piece of cardboard to locate a pressurized leak. For drips (low pressure leaks), use a rag to clean the area and determine where the leak originates.

4. Repair or replace as needed.

See Chapter 8 for hose assembly replacement.

5. Inspect other hydraulic components.

Look beyond the hose and fittings to other components like valves, pumps, cylinders, etc., for leaks and damage.

6. Reinstall the access panels.

7. Turn on the power.

8. Be aware of your equipment.

Your eyes, ears and nose are your best inspection tools. Rely on your senses. If they tell you something isn't quite right, check it out to avoid the unwanted result of a hose assembly failure.

- Smell burning oil? It's a sign of excessive heat. Measure temperature; carefully inspect and test the hose assemblies.
- Is the hose's wire reinforcement showing? This is a sign of hose damage. Replace the hose assembly.
- Hose hot to the touch? If you can't hold it for five seconds, the operating temperature may be too high. Measure the temperature against Gates specifications. Also, carefully inspect and test the hose. For hose temperature recommendations, refer to Chapter 5 in this manual.

Think Safety!

CAUTION: Never touch a pressurized hose assembly. Shut down the hydraulic system and relieve pressure before checking hose temperature.

If any step in the inspection indicates a problem (or even a potential problem), have it checked out and repaired before operating.

Keep a detailed log of inspection and service information. This can be used to identify problem areas and trends.

For specific troubleshooting information, refer to Chapter 4.

TROUBLESHOOTING

Abrasion

Problem: Part of the hose cover has been removed, exposing the hose reinforcement.

This may be caused by continuous rubbing against equipment components, other 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 leading to failure.

Solutions:

1. Reroute hose.

Bundle hoses together that flex in the same direction. Clamps, bent tube couplings, nylon ties, spring guards and sleeving can be used to keep hoses away from abrasion sources and exposure to non-compatible fluids.

2. Protect hose.

Nylon and urethane sleeving and spring guards can be used to protect the cover from abrasion. See page 62 for more information.

3. Change to a hose with a cover that is compatible with any chemicals it may contact.

Gates offers abrasion-resistant hose covers with far greater abrasion resistance than any standard rubber hose in the industry. Gates MegaTuff® and XtraTuff® hoses were developed to solve your abrasion problems.

Hose Burst at Body

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

This may be caused by excessive pressure surges, flexing, kinking, crushing or exceeding minimum bend radius.

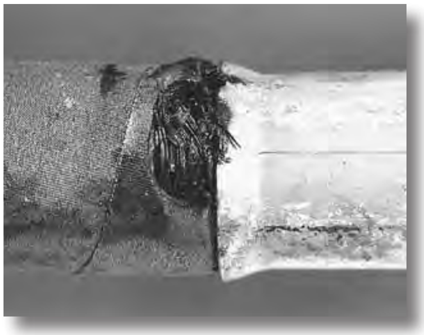
- Pressure surges that exceed the hose's maximum operating pressure rating may result in reinforcement failure.
- Excessive flexing, kinking, and crushing causes reinforcement fatigue and eventual failure, i.e., flexing a metal paper clip back and forth until it breaks.
- Bending the hose tighter than recommended will place excessive stress on the rein-forcement, could open large gaps between strands of reinforcement, and will severely reduce the hose's ability to withstand pressure.

Solution:

Review/inspect your operating pressure. It may be necessary to use a pressure transducer to measure the magnitude of any pressure surges. Select a hose that has the proper working pressure rating to 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 wire braid-reinforced hose (see Chapter 5 for proper hose selection).

Reroute hose to eliminate excessive flexing and/or exceeding the minimum recommended bend radius for the hose in use. Use a hose that has a smaller bend radius.

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



Hose Burst at Coupling

Problem: Hose has burst at coupling end.

This may be caused by insufficient hose slack, excessive bending/ flexing or an overcrimped hose end. When a hose is pressurized, it typically shortens in length putting excessive stress (tug) at the coupling. Excessive bending or flexing increases stress of the reinforcement. Overcrimping or use of the wrong ferrule will damage or crush the reinforce-ment, severely limiting its ability to withstand pressure.

Solution:

Increase hose length to accommodate contraction under pressure. Increase actual bend radius as the hose exits the coupling (see Chapter 8 for proper installation and routing). Bend restrictors can also be used to reduce bending stress at the coupling. Replace hose assembly with properly crimped assembly. See appropriate crimp data chart (form no. 35019) for ferrule, coupling and crimp recommendations.

Leak at Thread End/Seat

Problem: Coupling leaks at 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 misalignment.
4. Incompatible thread ends or seat angles.
5. Over or undertorquing.

Solutions:

Remove the connection and inspect.

1. Certain couplings require the use of an O-ring. If it is missing, replace it. If an O-ring is used, check for damage caused by installation or possible material breakdown from heat or fluid incompatibility. Alternative O-ring materials may be required. Replace if necessary.
2. Check the threads and/or seat angle for damage that may have occurred prior to or during installation. Any ding or burr 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 reinstall.

4. It is possible to thread together some components that are not compatible. Use Gates thread I.D. kit to assist in identifying mating components. Some thread end configurations have better sealability than others. Also, see Chapter 6 for proper coupling selection.
5. Overtorquing of a threaded connection can stretch and damage threads and mating seat angles. Overtorquing can also damage the staking area of the nut. Overtorquing can cause cracking of either the nut or seat. Undertorquing does not allow proper sealing. See Chapter 8 for recommended installation torque. Use of a torque wrench can alleviate such problems.

Weep at Hose Coupling Interface

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

This may be caused by insufficient hose insertion during assembly and/or undercrimping/over-crimping. Also, excessive vibration, flexing and tugging may weaken the interface and reduce the assembly's ability to prevent fluid seepage.

Solution:

Whether it has been undercrimped or the stem has been improperly inserted, the hose assembly must be replaced with one that has been properly assembled.

megasys®

Gates revolutionary MegaCrimp® coupling has been designed to provide "weep-free" performance as well as easy/simple insertion.

Coupling Blow-Off

Problem: The crimped coupling comes off the end of the hose.

This may caused by any of the following:

1. Under or overcrimping.
2. Incorrect crimping dies.
3. Improper skive (if applicable).
4. Incorrect fitting/hose combination.
5. Ferrule not engaged into the stem locking collar (if using two-piece coupling).

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

Solution: Examine and replace the hose assembly to ensure proper assembly procedures are followed (see Chapter 7 for details). Modify hose length and/or routing to accommodate potential hose length reduction under pressure (see Chapter 8). Never mix different manufacturers' hose, couplings or crimpers.

Coupling Corrosion

Problem: Coupling has been exposed to corrosive conditions that have begun to cause rust and deterioration. Chemicals, fertilizers, humidity or a marine environment could be the cause of the corrosion.

Many hydraulic fittings are manufactured from carbon steel and have zinc dichromate plating that provides minimal corrosion resistance. SAE J516 requires manufacturers to pass a 96-hour continuous salt spray test.

Solution:

Provide adequate protection for the coupling or minimize exposure to corrosive elements. Other coupling materials, such as stainless steel and brass are available and can provide better resistance to some corrosive elements.

megasys®

Gates TuffCoat® plating provides over 400 hours of protection against corrosion. This is a 400 percent improvement over the 96-hour SAE standard.

Hose Cracks

Problem: Hose cover or tube has cracks and appears hardened.

This is typically 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.

An increase of 18°F above the maximum temperature may decrease hose life by half. Cracks can also be caused by flexing, especially at excessively low temperatures. Never exceed the temperature rating of the hose.

Solution:

Select a hose that meets the temperature and flow requirements of the application. Also, identify the heat source and consider re-routing it away from the source to minimize the heat's effects. Examine reservoir size (if necessary).

See Chapter 8 for more details.

Hose Twist

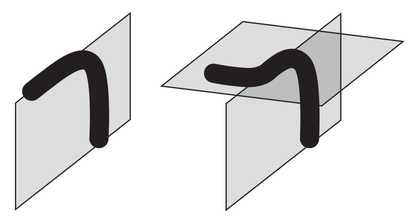
Problem: Hose assembly is twisted.

This is evident by a spiraling hose label and bends in two planes, as demonstrated in the photograph above. Twisting misaligns the reinforcement and reduces its ability to withstand pressure. Twisting a high-pressure hose seven degrees may reduce service life by as much as 90 percent.

Solution:

Replace and re-route the hose to ensure that bending occurs only in one plane (see below). The use of bent tube or block style couplings and adapters may improve 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.

Right **Wrong**



One-plane bend Two-plane bend

* Twist can also cause the coupling to twist in service causing leaks or coupling blow-off.

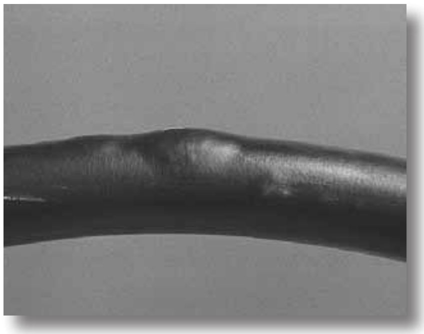
Crushed Hose

Problem: Hose has been crushed.

Flattened area has been caused by external forces (movement). Reinforcement is weakened and could burst. Also, the tube has collapsed restricting fluid flow.

Solution:

Determine source of damage. Re-routing or guarding may be necessary. Replace hose.



Cover Blisters

Problem: Blisters have formed on the hose cover.

This can be caused by incompatible fluids that have permeated the hose tube and collected under the cover. Compressed gases can also permeate or effuse through the tube and become trapped under the cover. Trapped air in the hydraulic system can also cause blisters.

Solution:

Replace the hose with one that is compatible with the fluid being used. If it is compressed gas, the cover can also be perforated (pin-pricked) to allow the gas to pass through the cover. Textile hose covers also eliminate blistering. Bleed the system to eliminate any trapped air.

Think Safety!

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

Tube Swell

Problem: The equipment has become sluggish and unresponsive.

Cutting and evaluating the hose shows the hose tube is swollen and deteriorated and possibly washed out in sections. Fluid incompatibility is the likely cause. Many new fluids are now promoted as "environmentally friendly" but may not necessarily be compatible with the hose.

See chemical resistance tables in Gates hydraulic catalog 35093.

Excess fluid temperatures can also cause the tube to bulge near the end of the coupling.

Solution:

Replace the hose using a tube material recommended for that particular fluid (see Chapter 5 for proper hose selection).

megasys®

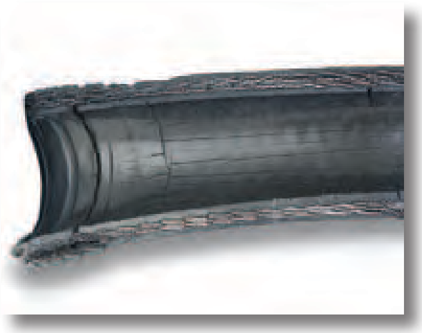
Gates EnviroFluid® hoses are compatible with biodegradable hydraulic fluids like polyolester, polyglycol and vegetable oil as well as standard petroleum-based fluids.

JIC/SAE Seat Cracks

Problem: Fitting sealing cone seat is cracked.

Solution:

If crack is due to overtorquing, use torque wrench and follow recommended torque specifications. If crack is due to excessive vibration or shock loading, change hose routing to reduce side load on fitting.

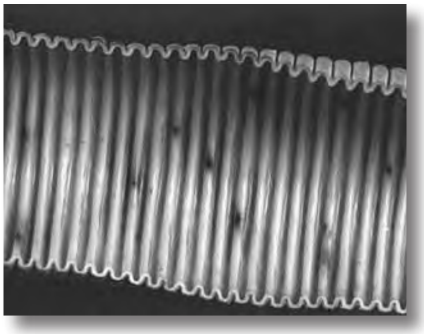


Hose Tube Failure

Problem: Hose tube failure – tube material is cracked and brittle. High temperature caused by excessive fluid velocity.

Solution:

Compare pump output to the hose size using flow rate chart (page 23). Select a hose type with a higher temperature rating. If not possible, add cooling devices and increase reservoir size.



Static Discharge On Teflon® Hose

Problem: Pinholes in Teflon® tube that allow fluid to escape through the cover.

Dissection of tube shows black "burn" areas and pinholes. This is caused by a release of an electrostatic charge through the tube to the wire cover. Some fluids have the potential for electrostatic buildup.

Solution:

Replace damaged hose with one that has a conductive tube (Gates C14 conductive tube). This allows any charge to be conducted to the end fittings rather than discharging through the tube wall.

Overcrimp

Problem: The ferrule appears to be overcrimped which could lead to leaking or premature failure.

Solution:

Refer to the crimp manuals or charts for proper die selection and crimp settings. Receive hands-on training for fabricating hydraulic assemblies. Use Gates calipers to measure the finished crimp diameter for accuracy. Crimp O.D. tolerance is +/- .010 (in.). (See Chapter 7, page 50, to properly measure crimp diameter.)

Undercrimp

Problem: The ferrule appears to be undercrimped which can lead to coupling leaks or blow-offs.

Solution:

Refer to the crimp manuals or charts for proper die selection and crimp settings. Receive hands-on training for fabricating hydraulic assemblies. Use Gates calipers to measure the finished crimp diameter for accuracy. Crimp O.D. tolerance is +/- .010 (in.) (See Chapter 7, page 50, to properly measure crimp diameter.)

Mushroom Flare Crimp

Problem: The crimp of the ferrule is not full length, leaving a mushroom flare at the top of the ferrule. This could lead to coupling blow-off or early failure.

Solution:

With the Gates crimping system, be sure that the ferrule or shell is fully engaged with the dies to ensure a full-length crimp. Refer to Gates crimp manuals and charts for proper crimping instructions. Receive proper training on crimping procedures with the Gates hose and coupling system.

Tail-Flare Crimp

Problem: The crimp of the ferrule is not full length, leaving a tail flare at the end of the ferrule.

Solution:

With the Gates crimping system, be sure that the ferrule or shell is fully engaged with the dies to ensure a full-length crimp. Refer to the Gates crimp manuals and charts for proper crimping instructions. Receive proper training on the crimping procedures with the Gates hose and coupling system.

Good Crimp
MegaCrimp® Coupling

Good Crimp
GlobalSpiral® Coupling

Unresponsive Equipment

Problem: Equipment has become sluggish or unresponsive. There are a number of potential causes that should be reviewed:

If you encounter a problem that hasn't been covered in this manual or which still exists after your troubleshooting efforts have been exhausted, contact your Gates distributor or sales representative.

Cause	Solution
Air in the hydraulic system	Check fluid level. Purge (bleed) air out of system. Check connections on suction line (pump intake).
Pressure drop	Review hose sizes and lengths to minimize pressure drop. Smaller hose diameters and longer lengths increase the pressure drop in a line. Replace block style couplings and adapters with bent tube style to improve laminar flow and reduce pressure drop.
Hose tube collapse or swell	Check fluid compatibility with tube material. Vacuum may have exceeded hose vacuum rating. Select a hose that meets the requirements.
Non-functioning hydraulic components (pumps, valves, etc.)	Check each hydraulic component for full function, i.e., seal may have rolled in a cylinder causing it to bind and limit stroke.
Blockage in fluid flow	Check flow in each line and component for blockage. It may be necessary to remove and replace each component to determine where blockage exists. Eliminate source of contamination. Check and replace filter if necessary.

H O S E   S E L E C T I O N

Why Use Hose?

There are two commons types of fluid connection — rigid tubing and hose assemblies.

Rigid tubing offers the following advantages:

- Better heat dissipation.
- Tighter bend radius.
- Lighter weight.
- Ability to handle pressures exceeding 6,000 psi.

Hose assemblies, however, have the following advantages:

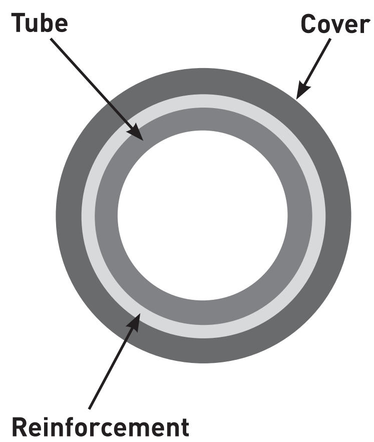
- Less susceptible to damage from vibration or movement.
- No brazing or specialized bending required.
- Easier to obtain in the aftermarket.
- Easier to route around obstacles.
- Sound absorption.
- Dampens pressure surges.

Today's hydraulic hose is much lighter and provides improved bend radius compared to earlier products. With the introduction of these hoses (such as Gates MegaSys® products), the weight advantage of bent tubing has been minimized, while the bend advantage has been reduced by half.

Given the availability and routing advantages of hose, maintenance personnel often prefer it over metal tubing. It is not uncommon to replace a hard-to-reach failed bent tube with a hose assembly.

Hose Construction

A hose is generally made up of three components:



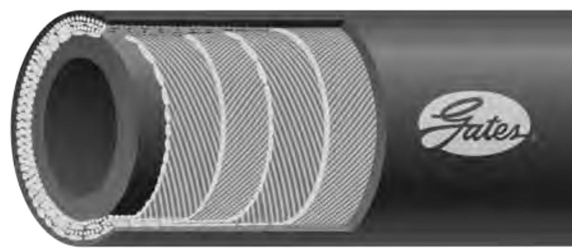
1. Tube: The tube's function is to contain the material conveyed. Refer to the chemical resistance charts and characteristics of hose stock types in Gates hydraulic catalog to identify material for a specific fluid.

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

The three basic types of reinforcement are:

- Braided
- Spiraled
- Helical

Braided reinforcement can be wire or textile and can have single or multiple layers.



Spiraled reinforcement on hydraulic hose is typically wire or textile and has four or six layers (plies). Spiral-reinforced hose can typically handle more severe applications with longer impulse service life.

Helical coil reinforcement keeps the hose from collapsing during suction (vacuum) and tight bending.

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

- Weather
- Ozone
- Abrasion
- Temperature
- Chemicals

Refer to the chemical resistance charts and characteristics of hose stock types in Gates hydraulic catalog to help identify cover material.

For the toughest abrasion applications, Gates MegaTuff® or XtraTuff® products should be specified.

Think Safety!

WARNING:

- Hoses are not designed to pull external loads or to replace ropes, cables, etc.
- Do not re-couple used hose with either field attachable or permanent fittings.
- Heed these warning messages to avoid serious injury from premature hose failures or hose being blown out of fittings.

Hose Performance Characteristics

Hydraulic hose (and hose assemblies) have a limited life dependent on service conditions to which it is applied. Subjecting hose (and hose assemblies) to conditions more severe than the recommended limits significantly reduces service life. Exposure to combinations of recommended limits (i.e., continuous use at maximum rated working pressure, maximum recommended operating temperature and minimum bend radius) will also reduce service life. Failure to follow proper selection, installation and maintenance procedures may result in injury to personnel and/or damage to equipment.

Hose assemblies in service should be regularly inspected for leaks, abrasion, kinks, cover blisters or other such damage. Assemblies showing signs of wear or damage should be replaced immediately. Maximum service life can be attained by complying with the following recommendations:

Working Pressure–The hydraulic system pressure should not exceed the rated working pressure of the hose. Pressure surges or peaks exceeding the rated working pressure are destructive and must be taken into account when selecting a hose. It is not safe to use hose assemblies above their rated working pressure.

Minimum Burst Pressure–Burst pressures are reference pressures intended for destructive testing purposes and design safety factors only.

Temperature Range–Do not expose hose to internal or external temperatures exceeding the recommended limits. Consult additional technical data when hydraulic fluids contain emulsions or solutions. The fluid manufacturer's recommended maximum operating temperature for any given fluid must not be exceeded, regardless of hose temperature range (see page 25). Some fluids reduce the safe operating temperature of a hose (i.e. water in a hydraulic hose).

Fluid Compatibility–The hydraulic assembly (tube, cover, reinforcement and couplings) must be fluid compatible. The correct hose must be used because phosphate ester and petroleum-based hydraulic fluids have drastically different chemical characteristics. Many hoses are compatible with one or the other, but not all fluids. Gates G2XH and C5D hoses are capable of handling both phosphate ester and petroleum-based hydraulic fluids.

Minimum Bend Radius–Do not bend or flex hose to a radius smaller than the minimum recommended and do not subject hose to tension or torque. This can place excessive stress on the reinforcement and severely reduce the ability of the hose to withstand pressure.

Hose Size–The hose size (inside diameter) must be capable of handling the required flow volume. Too small an I.D. for a given volume of flow results in excessive fluid turbulence, pressure drop, heat generation and tube damage. It is generally a best practice not to exceed 30 feet per second fluid velocity in a hydraulic system. Using a larger I.D. hose will lower fluid velocity.

Hose Routing–Restrain, protect or guide hose (clamps can be used) to minimize risk of damage due to excessive flexing, whipping or contacting other moving parts or corrosives. Determine hose lengths and configurations that will result in proper routing and protection from abrasion, snagging or kinking and provide leak-resistant connections.

Hose Length–Correct hose length determinations include considerations for length changes under pressure, machine vibration and motion, and hose assembly routing.

Hose Applications–Select the proper hose for the application. Vacuum service (Gates Global MegaVac®) and special fluid or high temperature capabilities are among the applications requiring particular consideration and a specific hose. Do not use Gates hydraulic hose in place of permanent piping. When additional information is required, contact your local Gates representative.

Hose Selection

To take into account the hose performance characteristics and service application, a simple and easy method is used to properly select a hydraulic hose. An effective way to remember this hose selection criteria is to remember the word STAMPED.

S T A M P E D

S = Size

T = Temperature

A = Application

M = Material to be conveyed

P = Pressure

E = Ends or couplings

D = Delivery (volume)

Nomographic Chart

Flow Capacity of Hose Assemblies at Recommended Flow Velocities

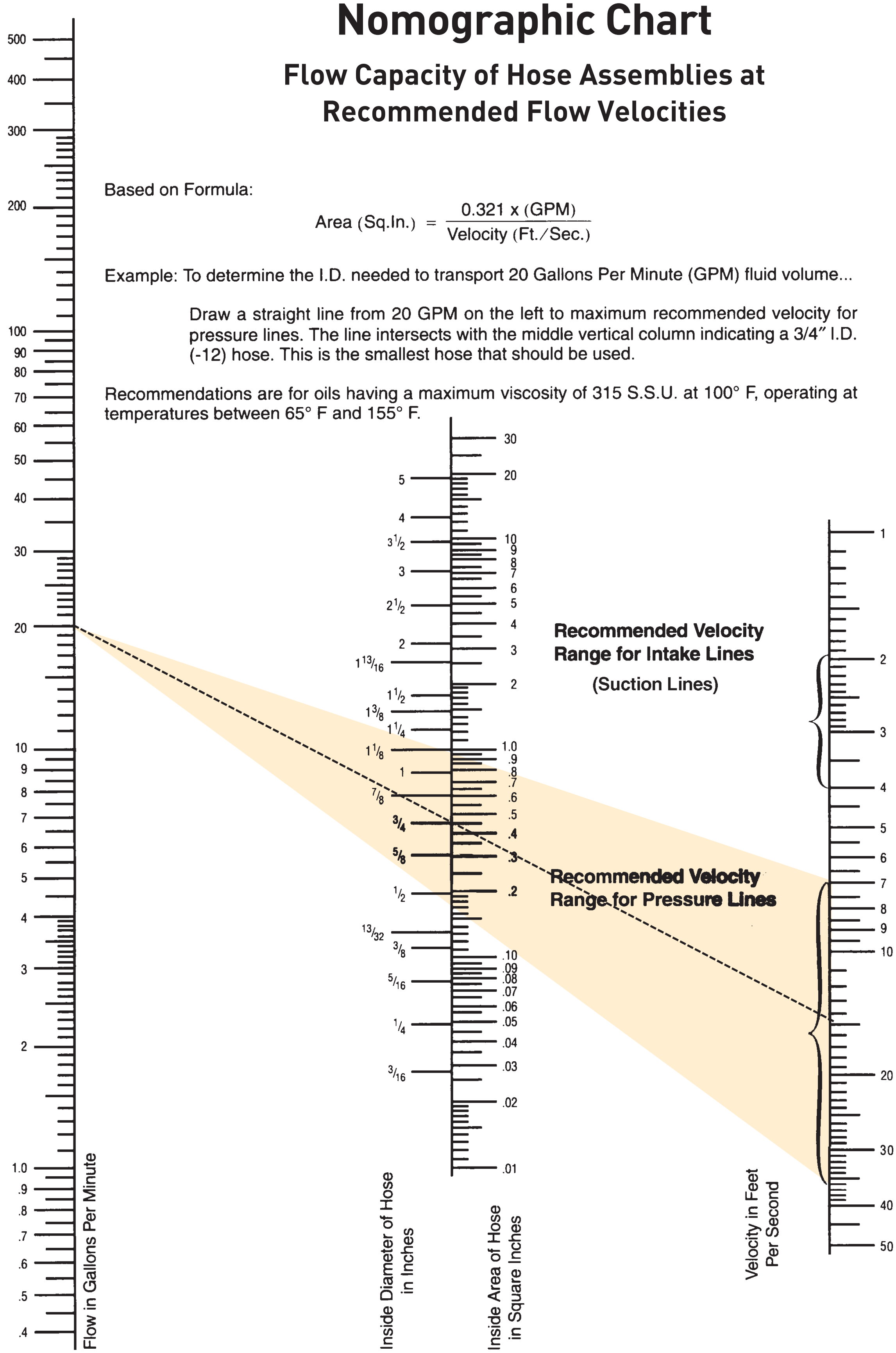
Based on Formula:

$$\text{Area (Sq.In.)} = \frac{0.321 \times (\text{GPM})}{\text{Velocity (Ft./Sec.)}}$$

Example: To determine the I.D. needed to transport 20 Gallons Per Minute (GPM) fluid volume...

Draw a straight line from 20 GPM on the left to maximum recommended velocity for pressure lines. The line intersects with the middle vertical column indicating a 3/4″ I.D. (-12) hose. This is the smallest hose that should be used.

Recommendations are for oils having a maximum viscosity of 315 S.S.U. at 100° F, operating at temperatures between 65° F and 155° F.



S

Hose Size (Dash Numbers)

The inside diameter of the hose must be adequate to keep pressure loss to a minimum and avoid damage to the hose due to heat generation by excessive turbulence. See hose sizing nomographic chart on previous page.

The nomographic chart will help you select the correct hose size for a given hydraulic system. The velocity of the hydraulic fluid should not exceed the range shown in the right-hand column. When fluid velocities are higher than recommended in the chart, the results are turbulent conditions with loss of pressure and excessive heating. Higher velocities may be used if the flow of hydraulic fluid is intermittent or for only short periods of time.

Velocity of hydraulic fluid in suction lines should always fall within the range recommended to ensure efficient pump operation.

To determine the replacement hose size, read the layline printing on the side of the original hose. If the original hose layline is painted over or worn off, the original hose must be cut and inside diameter measured for size. NOTE: Before cutting an original hose assembly, measure the overall assembly length and coupling orientation. This measurement will be required to build the replacement assembly or match the hose I.D. to the port size.

Hose O.D. should not be used to identify the I.D. of the hose. Different hose constructions will vary with the wall thickness and O.D.

The hydraulics industry has adopted a measuring system called Dash Numbers to indicate hose and coupling size. The number which precedes the hose or coupling description is the dash size (see table below). This industry standard number denotes hose I.D. in sixteenths of an inch (the exceptions are the SAE100R5, SAE100R14, and refrigerant hoses, where dash sizes denote hose I.D. compared to equivalent tube O.D.).

Hose O.D. can be a critical factor when hose routing clamps are used or hose is routed through bulkheads. Check individual hose specification tables for O.D.s.

Dash Numbers

Dash No.	Hose I.D. (inches)			
	All except C5 series, C14, and Refrigerant		C5 series, C14, and Refrigerant	
	Inches	Millimeters	Inches	Millimeters
-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
-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	—	—

T

Temperature

When selecting a replacement assembly, two areas of temperature must be considered. These are fluid temperature and ambient temperature. The hose selected must be capable of withstanding the minimum and maximum temperature of the system. Care must be taken when routing hose near hot manifolds, and in extreme cases, a heat shield may be advisable.

Think Safety!

NOTE: Water, water/oil emulsions and water/glycol solutions must be kept below the temperatures listed in the table below, relative to line pressures.

Low pressure applications (i.e., in return lines) require lower maximum temperatures as shown.

Think Safety!

CAUTION: To avoid equipment breakdown and possible injury, the fluid manufacturer's recommended maximum operating temperature for any given fluid must not be exceeded. If different than the listed hose temperatures, the lower limit must take precedence.

Actual service life at temperatures approaching the recommended limit will depend on the particular application and the fluid being used in the hose. Intermittent (up to 10 percent of operating time) refers to momentary temperature surges. Detrimental effects increase with increased exposure to elevated temperatures.

Think Safety!

NOTE: Operating at maximum temperature and maximum working pressure at the same time may cause reduced service life.

Maximum Temperature Limits for Water, Water/Oil Emulsions and Water/Glycol Solutions

Hose	Pressure Lines	Return Lines
EFG6K, EFG5K, EFG4K, EFG3K, G6K, G5K, G4K, G3K, C12, G2, G2L, MCPB+, G1, M2T®, M6K, M5K, M4K+, M3K, M3KH, RFS, RLA, C5C, C5E, CPS, LOC, LOL	+200° F (+93° C)	+180° F (+82° C)
G2H, G1H, MegaTech™ 1000 (ACR), MegaTech™ 500 (ACR), MegaTech™ 250, G2AT-HMP, G2XH, C5D, G3H(C3H), GTH(C6H), G4H, GMV, RLC, TR500 PowerClean™	+225° F (+107° C)	+180° F (+82° C)

A

Application

Determine where or how the replacement hose or assembly is to be used. Most often, only a duplicate of the original hose will have to be made, provided the original hose assembly gave acceptable service life. To fulfill the requirements of the application, additional questions may need to be answered such as:

- Where will hose be used?
- Equipment type?
- Working and surge pressures?
- Suction application?
- Fluid and/or ambient temperature?
- Fluid compatibility?
- Environmental conditions?
- Routing requirements?
- Government and industry standards being met?
- Unusual mechanical loads?
- Hose construction?
- Thread end connection type?
- Permanent or field attachable couplings?
- Thread type?
- Minimum bend radius?
- Non-conductive hose required?
- Excessive abrasion?
- Expected service life?

SAFE HYDRAULICS

Material To Be Conveyed

Some applications require specialized oils or chemicals to be conveyed through the system. Hose selection must ensure compatibility of the hose tube, cover, couplings and O-rings with the fluid used. Additional caution must be exercised in hose selection for gaseous applications where permeation can occur.

Permeation, or effusion, is seepage through the hose resulting in loss of fluid. This may occur when hose is used with fluids such as (but not limited to):

- liquid and gas fuels
- refrigerants
- helium
- fuel oil
- natural gas

Consider whether there are potential hazardous effects of permeation through the hose, such as explosions, fires, and toxicity. Refer to applicable standards for specific applications such as fuels and refrigerants.

If gas permeates through the tube, consider pin-perforated covers to prevent gas build-up under the cover. Also consider the compatibility of the system fluid not only with the tube, but also with the braid, cover, fittings, and other components since permeation may expose the entire hose assembly to the system fluid. For more information on hydraulic fluids please see page 34.

NOTE: Some couplings contain nitrile O-rings, which must be compatible with the fluids being used. See the chemical resistance tables in Gates hydraulic catalog.

Pressure

It's essential in the hose selection process to know the system pressure, including pressure spikes. Published working pressures must be equal to or greater than the system pressure. Pressure spikes greater than the published working pressure will shorten hose life and must be taken into consideration. Gates DOES NOT recommend using hose on applications having pressure spikes greater than published working pressures of the hose.

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

Pressure Drop

What Is Pressure Drop?

As related to fluid power, 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. There will be a difference in pressure, and it will be less. How much less depends on what is between the beginning and end of the hose assembly. Here are some factors that can influence the amount of pressure drop:

1. **FRICTION —** This is the rubbing of fluid against the inside walls of the hose assembly.
2. **TYPE OF FLUID —** Different fluids behave differently under pressure. Thicker fluids are moved with greater difficulty and will exhibit greater pressure drop.
3. **TEMPERATURE OF FLUID —** Warming fluids thins them so they are moved more easily, as with automotive oil.
4. **LENGTH OF HOSE ASSEMBLY —** The longer it is, the more surface there is for friction to decrease pressure.
5. **SIZE (I.D.) OF HOSE —** Affects the fluid velocity for a given flow rate. Higher velocities result in greater pressure drop. Therefore, a larger I.D. hose will produce less pressure drop.
6. **TYPE OF COUPLINGS AND ADAPTERS —** Any change in bore or change in direction (such as with 45° or 90° elbows) can increase the amount of pressure drop.
7. **FLOW RATE —** Pressure drop increases with flow rate for the same size hose.

Who Cares About Pressure Drop?

Suppose you need 4,000 psi of output from a hose assembly for hydraulic equipment to run efficiently. There will be some pressure drop, and you must allow for it in helping to plumb the system with hose, couplings and adapters. This means that the input pressure to the hose assembly must be equal to the output, plus the amount of pressure drop. If the pressure drop in this example is 150 psi, then you will need 4,150 psi of input.

Output PSI = Input PSI – Pressure Drop

4,000 PSI = 4,150 PSI – 150 PSI

How Can You Determine the Amount of Pressure Drop?

That's the easy part. Contact your local Gates representative who is trained and equipped to quickly solve such problems for you.

Your representative will need the following information:

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

To do you own pressure drop analysis, please visit our website at www.gates.com/pressuredrop.

E
Ends or Couplings

Identify the end connectors using the information provided in Chapter 6. There are two functional parts of a hose coupling: 1) the hose barb end and 2) the port connecting end. Both must be identified to determine the correct coupling to use. Once the thread ends have been identified, consult the appropriate section of the catalog for specific part number selection.

D
Delivery

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

Characteristics of Hose Stock types

The characteristics shown below are for the normal or usual range of these specific stocks. Stocks can be changed somewhat through different compounding to meet the needs of specialized applications.

Tube and cover stocks may occasionally be upgraded to take advantage of improved materials and technology.

For detailed information on a specific hose tube or cover stock, check the chemical resistance table in the Gates hydraulic catalog.

Chemical Name	Neoprene (Poly-Choroprene) Type A	Nitrile (Acrylonitrile and Butadiene) Type C	Nylon Type Z	Hypalon* (Chlorosulfonated Polyethylene) Type M	EPDM (Ethylene Propylene Diene) Type P	CPE (Chlorinated Polyethylene) Type J	PTFE (Poly-tetrafluoro-ethylene) Type T
Flame Resistance	Very Good	Poor	Good	Good	Poor	Good	Good
Petroleum Base Oils	Good	Excellent	Good to Excellent	Good	Poor	Very Good	Excellent
Diesel Fuel	Fair to Good	Good to Excellent	Good to Excellent	Good	Poor	Good	Excellent
Resistance to Gas Permeation	Good	Good	Good to Excellent	Good to Excellent	Fair to Good	Good	Good to Excellent
Weather	Good to Excellent	Poor	Excellent	Very Good	Excellent	Good	Excellent
Ozone	Good to Excellent	Poor for Tube; Good for Cover	Excellent	Very Good	Outstanding	Good	Excellent
Heat	Good	Good	Good	Very Good	Excellent	Excellent	Excellent
Low Temperature	Fair to Good	Poor to Fair	Excellent	Poor	Good to Excellent	Good	Excellent
Water-Oil Emulsions	Excellent	Excellent	Good to Excellent	Good	Poor	Excellent	Excellent
Water/Glycol Emulsions	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Diesters	Poor	Poor	Excellent	Fair	Excellent	Very Good	Excellent
Phosphate Esters	Fair (for Cover)	Poor	Excellent	Fair	Very Good	Very Good	Excellent
Phosphate Ester Base Emulsions	Fair (for Cover)	Poor	Excellent	Fair	Very Good	Very Good	Excellent

*Registered trademark of DuPont.

Gates Hydraulic Hose Selection Guide

Once you've identified STAMPED, use this manual to select the proper hose.

Standard Industry Specification	Description	Construction (Reinforcement)	Use	Stock			
				Tube		Cover	
				Name	Type	Name	Type
SAE 100R15 EN 856 TYPE 4SP/4SH	EFG6K	4&6-spiral, wire	Extremely High Pressure, Petrol, Oils, Environmental Fluids	Nitrile	C	Neoprene	A
SAE 100R13 EN 856 TYPE 4SP/4SH	EFG5K	4&6-spiral, wire	Extremely High Pressure, Petrol, Oils, Environmental Fluids	Nitrile	C	Neoprene	A
SAE 100R12 EN 856 TYPE 4SP	EFG4K	4&6-spiral, wire	Extremely High Pressure, Petrol, Oils, Environmental Fluids	Nitrile	C	Neoprene	A
SAE 100R12 EN 856 TYPE 4SP	EFG3K	4-spiral, wire	Extremely High Pressure Petrol, Oils	Nitrile	C	Neoprene	A
SAE 100R15 EN 856 TYPE 4SP/4SH	G6K	4&6-spiral, wire	Extremely High Pressure	Neoprene	A	Neoprene	A
SAE 100R13 EN 856 TYPE R13/4SP/4SH	G5K	4&6-spiral, wire	Extremely High Pressure Petrol, Oils	Neoprene	A	Neoprene	A
S EN 856 TYPE 4SP	G4K	4-spiral, wire	Extremely High Pressure Petrol, Oils	Neoprene	A	Neoprene	A
SAE 100R12 EN 856 TYPE 4SP	G3K	4-spiral, wire	Extremely High Pressure Petrol, Oils	Neoprene	A	Neoprene	A
SAE 100R12 EN 856 TYPE R12	C12	4-spiral, wire	High Pressure, Petrol, Oils	Neoprene	A	Neoprene	A
SAE 100R12 EN 856 TYPE R12	C12M	4-spiral, wire	High Pressure, Tight Bends Petrol, Oils	Neoprene	A	Neoprene	A
SAE 100R2 Type AT EN 853 Type 2SN	G2	2-braid, wire	Petroleum Oils	Nitrile	C	NBR/PVC	C_2
SAE 100R2 Type AT	MegaTech™ ACP	2-braid, wire	Petroleum Oils	CPE	J	Textile	---
SAE 100R2 Type AT EN 853 Type 2SN	G2L	2-braid, wire	Petroleum Oils, Low Temperatures	Nitrile	C	Neoprene	A
SAE 100R16	M2T®	2-braid, wire	Tight Bends, High Flexibility	Nitrile	C	NBR/PVC	C_2
Gates Proprietary	M6K	2-braid, wire	Tight Bends, High Flexibility	Nitrile	C	NBR/PVC	C_2
Gates Proprietary	M5K	2-braid, wire	Tight Bends, High Flexibility	Nitrile	C	NBR/PVC	C_2
Gates Proprietary	M4K+	2-braid, wire	Tight Bends, High Flexibility	Nitrile	C	NBR/PVC	C_2
SAE 100R17	M3K	1 & 2-braid, wire	Tight Bends, High Flexibility	Nitrile	C	NBR/PVC	C_2
SAE 100R17 EN 857 1SC	M3KH	1-braid, wire	High Pressure Oil	Nitrile	C	NBR/PVC	C_2
SAE 100R2 Type AT EN 853 TYPE 2SN	G2H	2-braid, wire	High Temperature	Nitrile	C	Hypalon+	M
SAE 100R2 Type AT	G2XH	2-braid, wire	Multi-Fluid, High Temperature	CPE	J	CPE	J
SAE 100R2 Type AT	G2AT-HMP	2-braid, wire	Multi-Fluid, High Temperature	CPE	J	Neoprene	A
IJ100	J2AT	2-braid, wire	Industrial Jack Hose	Nitrile	C	NBR/PVC	C_2
SAE 100R1 Type AT EN 853 Type 1SN	G1	1-braid, wire	Petroleum Oils	Nitrile	C	NBR/PVC	C_2
SAE 100R1 Type AT EN 853 TYPE 1SN	G1H	1-braid, wire	High Temperature	Nitrile	C	Hypalon+	M
SAE 100R3 EN 854 TYPE R3	G3H(C3/C3H)	2-braid, textile	Petrol. Oils, Antifreeze, Water, High Temperature	Nitrile	C	Neoprene	A
SAE 100R6 EN 854 TYPE R6	GTH(C6H)	1-braid, textile	Petrol. Oils, Antifreeze, Water, High Temperature	Nitrile	C	Neoprene	A
SAE 100R4	G4H	2-spiral, textile, helical wire	Return & Suction High Temperature	Nitrile	C	Neoprene	A
SAE 100R4	GMV	2-spiral, textile, helical wire	Return & Suction High Temperature	Nitrile	C	Neoprene	A
SAE 30R2 Type 1 & 2	RLA	1-braid, textile	Return & Low Pressure	Nitrile	C	NBR/PVC	C_2
	RLC	3-braid, textile	Return & Low Pressure	Nitrile	C	NBR/PVC	C_2
	LOC	1-braid, textile	Petrol, Oils, Antifreeze, Water & Air	Nitrile	C	Textile	--
	LOL	1-braid, textile	Petrol, Oils, Antifreeze, Water & Air	Nitrile	C	***	A/C_2
SAE J1402, J1019	MegaTech™ (ACR)	2-braid, wire, textile	Hot Oil, Air Return Line	CPE	J	Textile	--
SAE J1019	MegaTech™ 250	2-braid, wire, textile	Transmission Oil Cooler, Hot Oil, Air Return Line	CPE	J	Textile	--
SAE J1402, DOT FMVSS106-74	TR500	2-braid, wire, textile	Petrol & Syn. Fluids, Air Brakes	Nitrile	C	Textile	—
SAE 100R5, DOT FMVSS106-74, Type All	*C5C	3-braid, T-W-T	Petr. Oil, Air Brake, Power Steering	*Nitrile	C	Textile	—
SAE J1402, DOT FMVSS106-74, Type All	C5D	3-braid, T-W-T	Petrol & Syn. Fluids, Air Brakes	CPE	J	Textile	—
SAE J1527, SAE J1942, ISO 7840	C5M	1-braid, wire	Marine Fuel & Oil	Nitrile	C	NBR/PVC	C_2
DOTFMVSS106-74, Type AI	C5E	3-braid, T-W-T	Air Brake, Power Steering, Lube	Nitrile	C	Textile	—
PTFE							
SAE 100R14	C14	1-braid, stainless steel	High Temperature, Multi Fluid, Nonconductive	PTFE	—	Stainless Steel	—
SAE 100R14	C14CT	1-braid, stainless steel	High Temperature, Multi Fluid, Conductive	PTFE		Stainless Steel	—
Thermoplastic							
SAE 100R7	TH7(C7S)	1-braid, polyester	Petroleum & Synthetic Fluids	Nylon	Z	Urethane	U
SAE 100R7	TH7NC/TH7NCDL (C7SNC/C7SNCDL)	1-braid, polyester	Non-conductive	Nylon	Z	Urethane	U
SAE 100R7	TH7DL(C7SDL)	1-braid, polyester	Petroleum & Synthetic Fluids, Dual Line	Nylon	Z	Urethane	U
SAE 100R7	TH7NCDL(C7SNCDL)	1-braid, polyester	Non-conductive, Dual Line	Nylon	Z	Urethane	U
SAE 100R8	TH8	2-braid, Polyester	Petroleum & Synthetic Fluids	Nylon	Z	Urethane	U
SAE 100R8	TH8NC	2-braid, Polyester	Non-conductive	Nylon	Z	Urethane	U
Refrigerant							
SAE J51 Type All Dimensions/ Type D PerformanceJ2064, Type C, Class II Performance	PolarSeal® AC134a	Nylon barrier, 2-spiral, Polyester	Air Conditioning (R12 and R134a)	Chloroprene	A	EPDM	P
Power Steering, SAE J2050	PS188	2-braid, Nylon	Power Steering Fluids, High Temperature	Hypalon+	M	Neoprene	A
PowerClean™	PowerClean™	1 & 2-braid, wire,	Tight Bends, High Flexibility	Nitrile	C	NBR/PVC	C_2

* -4 and -5 sizes have a Neoprene tube.
** Nitrile or Neoprene
† Registered trademark of DuPont.

Gates Hydraulic Hose Selection Guide (continued)

Description	Temp. Range (°F)	Dash Size vs. Rated Working Pressure (psi)																Hose Page
		-2	-3	-4	-5	-6	-8	-10	-12	-16	-20	-24	-32	-40	-48	-56	-64	
EFG6K	-40 +250					6,000	6,000	6,000	6,000	6,000	6,000							D1
EFG5K	-40 +250					5,000	5,000	5,000	5,000	5,000	5,000							D2
EFG4K	-40 +250					4,000	4,000	4,000	4,000	4,000	4,000							D3
EFG3K	-40 +250										3,000							D4
G6K	-40 +250					6,000	6,000	6,000	6,000	6,000	6,000	6,000						D1
G5K	-40 +250						5,000	5,000	5,000	5,000	5,000	5,000	5,000					D2
G3K	-40 +250										3,000	3,000	3,000					D4
C12	-40 +250											2,500	2,500					D5
G2	-40 +212		6,000	5,800		4,800	4,000	3,625	3,100	2,400	1,825	1,300	1,175					E1
MegaTech™ II																		E1
G2L	-70 +212			5,800		4,800	4,000	3,625	3,100	2,400	1,825	1,300						E2
M2T®	-40 +212			5,000		4,000	3,500	3,000	2,250	2,000								E2
M6K	-40 +212			6,000														E3
M5K	-40 +212			5,000		5,000	5,000											E4
M4K+	-40 +212			4,000		4,000	4,000	4,000	4,000									E4
M3K	-40 +212			3,000	3,000	3,000	3,000	3,000	3,000	3,000								E5
M3KH	-40 +250			3,000		3,000												E5
G2H	-40 +275										1,650	1,300	1,175					E6
G2XH	-40 +300									2,500								E7
G2AT-HMP	-40 +300						4,250	3,500	3,000									E6
J2AT	-40 +120			10,000		10,000												E7
G1	-40 +212		3,625	3,275	3,125	2,600	2,325	1,900	1,525	1,275	925	725	600					E8
G1H	-40 +275			2,750		2,250	2,000	1,500	1,250	1,000	625	725	600					E8
G3H(C3H)	-40 +275			1,250		1,125	1,000		750	565	375							E9
GTH(C6H)	-40 +275		500	400	400	400	400	350	300									E10
G4H	-40 +275								300	212	200							G12
GMV	-40 +275								350	300	250	162	112	68	62	56	56	G12
RLA	-40 +212		250	250	250	250	200	200	200	160								G13
RLC	-40 +275									200	200	200	200	150	150	150		G13
LOC	-40 +212			300		300	300	300	300									G1
LOL	-40 +212		300	300	300	300	300	300	300									G2
TR500	-40 +250			500		500	500	500	500	500								F40
MegaTech™	-40 +300			1000		1000	1000	1000	1000	1000	1000	500	500	500	500			F40
MegaTech™ 250	-40 +212			250		250	250	250	250	250	250							F41
C5C	-40 +212			3,000	3,000	2,250	2,000	1,750	1,500	800	625	500	350	350				F42
C5D	-40 +300•			1,500	1,500	1,500	1,250	1,250	750	400								F43
C5M	-40 +212				500	500	500	500	500	500								F43
C5E	-40 +300•			1,500	1,500	1,500	1,250	1,250	750	400	300							F56
C14	***			1,500	1,500	1,500	1,000	800	800	800								H1
C14 (Static)	-62 +72			3,000	3,000	2,500	2,000	1,500	1,200	1,000								H1
C14CT	***					1,500	1,000											H1
C14CT (Static)	+72					2,500	2,000											H1
TH7	-65 +200	2,500	3,000	2,750	2,500	2,250	2,000		1,250	1,000								K1
TH7NC	-65 +200	2,500	3,000	2,750	2,500	2,250	2,000		1,250	1,000								K1
TH7DL	-65 +200			2,750	2,500	2,250	2,000											K2
TH7NCDL	-65 +200			2,750		2,250	2,000											K2
TH8	-65 +200		5,000	5,000		4,000	3,500		2,250	2,000								K3
TH8NC	-65 +200			5,000		4,000	3,500											K3
PolarSeal® AC134a	-22 +257					500	500	500	500									I1
PS188	-40 +300					1,500												J1
PowerClean	-40 +212			3,500 6,000		3,000 4,000 5,000	2,500 4,000											E10

*** Dynamic temperatures -65 +400; Static temperatures +73 +450

• All purpose fleet application service — 40°F to +300°F (-40°C to +149°C), air to +250°F

Hose Nomenclature

8C2AT(G2)

- G2 — Global two wire
- AT — Thin cover, no skiving required
- C2 — SAE 100R spec (SAE 100R2) two wire
- 8 — Dash size in 1/16" (i.e., 8/16 = 1/2")

Dash Numbers

Dash No.	Hose I.D. (inches)			
	All except C5 series, C14, and Refrigerant		C5 series, C14, and Refrigerant	
	Inches	Millimeters	Inches	Millimeters
-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
-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	—	—

AC – Air conditioning
AT – Thin cover, no skiving required
B – Braid
CP – Coal power
G – Gates proprietary
GTH – Global textile braid high-temp
TH7 – Gates thermoplastic 100R7
TH8 – Gates thermoplastic 100R8
H – High-temp
HMP – High-temp, multi-fluid
K – Thousands
J – Jack hose

L – Low-temp
LO – Lock-on
LW – Longwall
M – MegaSys®
MT – MegaTech®
MV – MegaVac®
NC – Non-conductive
RL – Return line
S – Spiral
SHR – Slim hose rotary
XH – Xtreme heat high-temp 300°F

Agency Specifications and Hose Selection Manual

It is important to understand the agency specification requirements that may be applicable to your application. Here is a list and a brief description of agencies.

The following page is a list of hose products that meet these specifications.

Copies of the specifications can be obtained from the controlling agency.

SAE* The Society of Automotive Engineers establishes the American standards for most hydraulic hose. SAE guidelines provide general properties of size, tolerances and minimum performance characteristics of each major hose type.

SAE is made up of representatives from the major manufacturers. SAE does not test or certify hose and fitting performance. SAE rated hoses from different manufacturers are not exactly the same. They are similar.

SAE J517 identifies the 100R hose series, which range from 100R1 to 100R17. The number designation following the "R" does not identify the number of reinforcement layers, but rather the specific requirements of a type of hose. (See SAE J517 hose specification chart, page 29.)

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

DIN The Deutch Industry Norm are German standards that are accepted through much of Europe. Similar to SAE, they identify general guidelines for size, tolerances, construction and minimum performance characteristics of major hose types.

DIN 20022 covers wire-braid constructions, while DIN 20023 covers spiral constructions. The types are identified by the number of reinforcement layers and cover thickness. For example, DIN 20023 type 4SN is a four-spiral construction with a thin (no-skive) cover.

EN By 1997, all hydraulic DIN standards were superseded by European standards called EN (European Norm). The new European Norm for spiral hydraulic hoses is now called EN856 and is again divided into sub categories, 4SP and 4SH which are identical to the old DIN 4SP and 4SH. The new European standards are also included as sub divisions of SAE standards R12 and R13.

The new European Norm for hydraulic hoses with steel braid wire reinforcement that does not require cover removal (non-skiving) is EN 853. The standard EN 853 is divided into two parts: 1SN for single braid and 2SN for two braids.

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

IJS The Industrial Jack Specification 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.

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

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.

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

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.

* SAE documents are available through SAE Customer Service at: (phone) 724-776-4970 (fax) 724-776-0790

Agency Specifications and Hose Selection Guide

INDUSTRY AGENCIES

ABS — American Bureau of Shipping

DIN — Deutsch Industry Norm, German

DNV — Det Norske Veritas for North Sea Floating Vessels

EN — European Norm/Standard

GL — Germanischer Lloyds

IJS — Industrial Jack Specifications

RCCC — Regular Commom Carrier Conference for Fleet Truck and Bus

SAE — Society of Automotive Engineers

GOVERNMENT AGENCIES

DOT/FMVSS — U.S. Department of Transportation/ Federal Motor Vehicle Safety Standard

MSHA — U.S. Mine Safety and Health Administration

USCG — U.S. Coast Guard

Meets These Agency Specifications

Hose Type	ABS	DIN	DNV	EN	GL	IJS	RCCC	SAE	DOT/ FMVSS	MSHA	††USCG	
											Fuel Oil	Power
EFG6K, G6K	X	20023 4SH/4SP	X	EN 856 4SH/4SP				100R15		X		X
EFG5K, G5K	X	20023 4SH/4SP	X	EN 856 4SH/4SP				100R13		X		X
EFG4K, G4K		20023 4SP		EN 856 4SP				100R12		X		
EFG3K, G3K	X	20023 4SP		EN 856 4SP				100R12		X		
C12M	X	20023 4SP	X	EN 856 4SP				100R12		X		X**
C12	X	20023 4SP		EN 856 4SP				100R12		X		X
M5K					X							
M4K	X				X					X		
G2XH								100R2 Type AT		X		
G2AT-HMP								100R2 Type AT		X		X*
M2T®	X		X					100R16		X		X
CM2T				EN 853 2CS				100R16		X		
G2		20022 2SN	X	EN 853 2SN	X			100R2 Type AT		X		X
G2H			X	EN 853 2SN				100R2 Type AT		X	X	X
J2AT						X				X		
M3K	X		X	EN 857	X			100R17		X		X
M3K -12, -16	X		X	EN 857	X			100R17, 100R9		X	X	X
G1		20022 1SN	X	EN 853 1SN	X			100R1 Type AT		X		X
G1H			X	EN 853 1SN				100R1 Type AT		X	X	
MegaTech™ ACR								J140Z, J1527	106-74 (-4 to -10)			
TR500								J1402	106-74			
NABT								J844				
C5C							RP305(B)	100R5	106-74 Type All (-4 to –10)			
C5E								J1019	106-74 Type AI			
C5D								J1019	106-74 Type All			
C5M	X							J30R2, J1257		X	X	
G3H(C3/C3H)				EN 854 R3				100R3				
GTH(C6/G6H)				EN 854 R6				100R6				
GMV	X@							100R4†		X		X
LOL										X		
THERMOPLASTIC												
TH8, TH8NC								100R8				
TH7, TH7NC (C7S, C7SNC)								100R7				
C14								100R14				
REFRIGERANT												
PolarSeal® AC134a								J51 Type 2, J2064				
POWER STEERING												
PS188								2050				

* Except 1/4"
** Except 3/16"
*** Except 1 1/2" & 2"
**** Except 3/8" & 1/2"
***** 3/4", 1", 1 1/4"

@ Used with a fire sleeve
† Except 1"
†† USCG approves hoses for commercial application only. Use SAE 07527 hoses for fuel applications on pleasure craft.

SAE J517 Hydraulic Hose Specifications

This SAE standard provides general, dimensional and performance specifications for the most common hoses used in hydraulic systems on mobile and stationary equipment (100R Series).

SAE 100R Series	Description	Equivalent Gates Hose
100R1	Steel Wire Reinforced, Rubber Covered Hydraulic Hose (1 wire braid) Type A – Thick Cover (skive type) Type AT – Thin Cover (no-skive type)	C1A CIT/G1 C1TH/G1H
100R2	High Pressure, Steel Wire Reinforced, Rubber Covered Hyd. Hose (2 wire) Type A- Thick Cover (skive type) Type AT – Thin Cover (no-skive type)	C2A C2AT/G2 C2ATH/ G2H/G2AT
100R3	Double Fiber Braid (Nonmetallic), Rubber Covered Hydraulic Hose	C3, C3H
100R4	Wire Inserted Hydraulic Suction Hose	C4, G4H/GMV
100R5	Single Wire Braid, Textile Covered Hydraulic Hose	C5C
100R6	Single Fiber Braid (Nonmetallic), Rubber Covered Hydraulic Hose	C6, C6H/GTH
100R7	Thermoplastic Hydraulic Hose Black Orange – Non-conductive	 TH7S TH7NC
100R8	High Pressure Thermoplastic Hydraulic Hose Black Orange - Non-conductive	 TH8S TH8NC
100R9	High Pressure, Four Spiral Steel Wire Reinforced, Rubber Covered Hyd. Hose Type A – Thick Cover (skive type) Type AT – Thin Cover (no-skive type)	
100R10	Heavy-Duty, Four Spiral Steel Wire Reinforced, Rubber Covered Hydraulic Hose Type A – Thick Cover (skive type) Type AT – Thin Cover (no-skive type)	
100R11	Heavy Duty, Six Spiral Steel Wire Reinforced, Rubber Covered Hyd. Hose	G3K, G4K
100R12	Heavy-Duty , High Impulse, Four Spiral, Wire Reinforced, Rubber Covered Hydraulic Hose	C12, C12M, G3K,G4K
100R13	Heavy-Duty, High Impulse, Multiple Spiral Wire Reinforced, Rubber Covered Hydraulic Hose	C13, G5K
100R14	PTFE Lined Hydraulic Hose Type A Type B	 C14 C14CT
100R15	Heavy-Duty, High Impulse, Multiple Spiral Wire Reinforced, Rubber Covered Hydraulic Hose	G6K
100R16	Compact, 21 Mpa, Maximum Operating Pressure, 1 & 2 Steel Wire Reinforced, with Smaller Bend Radius	M2T
100R17	Compact High Pressure, 1 & 2 Steel Wire Reinforced, Rubber Covered Hydraulic Hose	M3K

Hydraulic Fluids

Types

Most hydraulic fluids are petroleum-based. Others are either water glycol- or synthetic-based (i.e., phosphate ester). All provide specific properties that may or may not meet the needs of a given application.

In the past, hydraulic fluids have caused problems by leaking into the ground and contaminating the area and water supply. Today, the industry is moving toward more "environmentally friendly" fluids where advances have led to many new generations of "green" fluids.

Green fluids are typically synthetic- or vegetable-based. Synthetic fluids are primarily ester-based. Vegetable oils are gaining popularity since they cost less than synthetic and are more biodegradable. They also have excellent lubricity and a high viscosity index. However, they have a limited temperature range with rapid oxidation at elevated temperatures. Although the fluid base may be biodegradable and non-toxic, the additives may not be.

Vocabulary of Fluids

The properties that fluid suppliers are striving to improve are:

1. **Lubricity –** the fluid must keep friction low, maintain an adequate film between moving parts to prevent wear of pumps, bearings, vanes, gears, pistons and rods. Increasing pressures and, consequently, closer tolerances, make lubricity even more important.
2. **Viscosity –** fluid "thickness" or resistance to flow. Pump manufacturers specify this according to clearances, speeds, temperatures and suction characteristics. The fluid 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 temperature extremes, viscosity range is important.

3. **Viscosity Index –** This measures the rate of viscosity change with temperature: the higher the index, the more stable the viscosity as temperature varies.
4. **Rust resistance –** moisture gets into petroleum fluids by condensation and by contamination of the reservoir. Rust inhibitors and preventives combat the effects of moisture. Obviously, they are very important in water-in-oil emulsions and water-glycol fluids.
5. **Oxidation resistance –** air, heat and contamination all promote fluid oxidation which forms sludges 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 help, too.

Compatibility

Refer to Materials in STAMPED in this chapter (page 26).

Handling and Disposal of Fluids

Please contact local agencies for proper storage and disposal regulations.

Storage and Shelf Life Considerations

Storage environment, along with rubber materials, can vary the shelf life limit. Some hose materials last longer in storage due to inherent resistance characteristics. Other materials require additives during compounding. These additives are eventually consumed by varying environments, even in seemingly ideal storage conditions.

Shelf life is difficult to predict because many variables affect the hose. Proper storage precautions can result in five to seven years' shelf life. Beyond this time, service life can decrease significantly, depending on storage environment variables. Some of these variables include temperature, humidity, ozone, oil, solvents, corrosive materials, fumes, insects, rodents, radioactivity, space allowance and bends.

Hose should be stored in a cool, dry area never exceeding 100°F. If stored below freezing, pre-warming may be required prior to handling, testing and placing into service. Store hose in original container.

Never stack hose too high, as its weight can crush hose at the bottom of the stack. Direct sunlight, rain, heaters or close proximity to electrical equipment may reduce hose life.

Gates recommends hose in extended storage be visually inspected and tested prior to use. Hose judged marginal should be replaced to avoid potential failure, property damage or bodily injury. Store hose on a first-in, first-out basis. Unusually long or poor storage environment can deteriorate hose, reduce performance and may lead to premature failure.

Service Life Considerations

Hydraulic hose has a limited life dependent on service conditions to which it is applied. Subjecting hose (and hose assemblies) to conditions more severe than the recommended limits significantly reduces service life.

Exposure to combinations of recommended limits (i.e., continuous use at maximum rated working pressure, maximum recommended operating temperature and minimum bend radius) will also reduce service life. Failure to follow proper selection, installation and maintenance procedures may result in injury to personnel and/or damage to equipment.

Hose assemblies in service should be regularly inspected for damage. Assemblies showing signs of wear or damage should be replaced immediately.

Maximum service life can be attained by complying with the recommendations outlined in this manual.

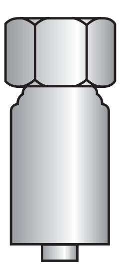
PROPER COUPLING SELECTION

There are two types of hydraulic couplings – permanent and field attachable.

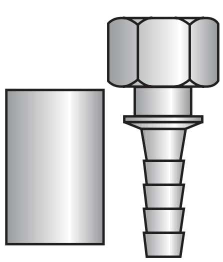
Permanent Couplings

Permanent couplings require crimping or swaging equipment to assemble to a hose. They are available in either preassembled or two-piece configurations.

Preassembled couplings are made with the ferrule permanently attached to the stem. Two-piece couplings consist of a stem and separate ferrule. When using two-piece couplings, it is important to match the ferrule with its appropriate stem and hose.

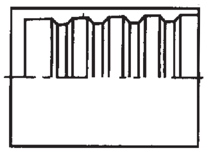


MegaCrimp® (pre-assembled)

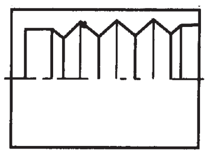


GlobalSpiral® (two-piece)

There are also two types of ferrules – skive and no-skive. Skive ferrules have blunt serrations (teeth), while serrations on no-skive are sharp to bite through the hose cover.



skive type



no-skive type

None of these components – hose, stem or ferrule – are reusable once they've been part of another assembly.

Field Attachable Couplings

There are different types of field attachable fittings: skive, no-skive, mandrel type, lock-on, C5 and those that are stamped for DOT (Dept. of Transportation) use.

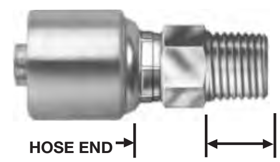
Think Safety!

CAUTION: DO NOT use couplings with any Gates hydraulic hose unless recommended by Gates in writing. Never mix couplings and hoses from different manufacturers. Never recrimp or recouple used hose with permanent or field attachable couplings. Never reuse field attachable couplings which previously have been placed in service.

Coupling Identification

A hydraulic coupling stem consists of two functional ends:

1. The hose end for hose attachment.
2. The thread end for port attachment.

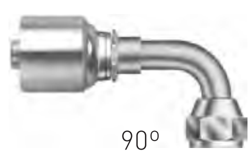


The hose end is identified by the hose size and type to which it is attached. Serration patterns are specified by the hose manufacturer to meet hose performance.

The thread end of a coupling (or adapter) can be identified by comparing it with the coupling being replaced or by measuring the port or thread end to which it will be attached. The thread end may also come in different configurations.

Straight

45º



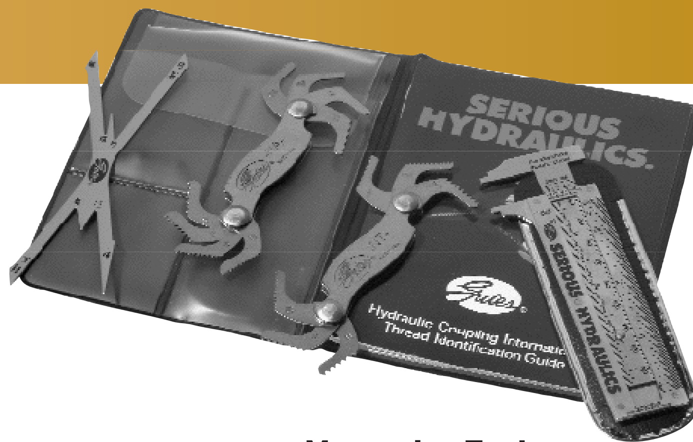
90º

Block

Hose ends and thread ends are measured by industry standard dash sizes. The hose end dash size refers to the inside diameter in 1/16" (except for SAE100R5, PolarSeal® and SAE100R14, which are based on tube O.D. and are one size smaller than the dash size implies) ie. – 8C5C hose is actually 13/32" I.D.

Identification Tools

Tools to assist you in identifying thread ends include coupling templates, thread identification kits measuring tools and calipers.

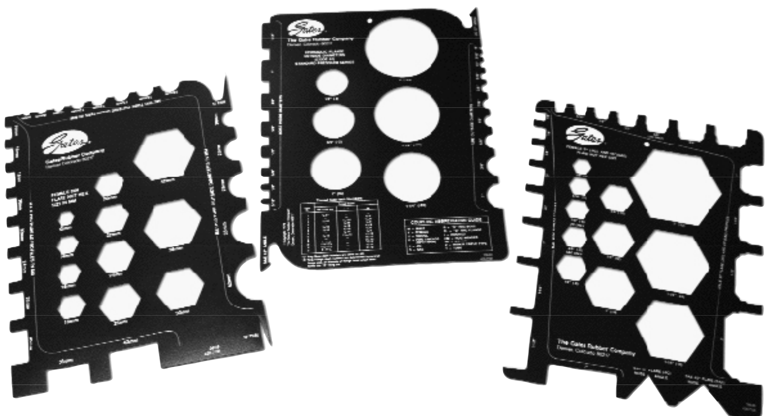


Measuring Tools

To be sure you order the correct couplings, these measuring tools should be used. They are stocked by Gates and are available on order.

Product Number: 7369-0318

Contents: Calipers
Seat Gauges (English)
Seat Gauges (Metric)
Thread Gauges
Thread I.D. Manual



Hydraulic Coupling Templates

Advertising Number: 39549

These templates provide a fast and easy way to measure North American thread and flange ends, seat angles (37° and 45°) and hose I.D.

Digital Caliper

Product Number: 7369-0322

Gates specially-designed digital caliper is perfect for making those precise measurements required for hydraulic coupling crimps. Use the color-coded buttons to switch from inches to metric, turn the caliper on and off and reset the measurements to zero - at any position. The easy-to-read LCD screen clearly displays the crimp diameter digitally, taking the guesswork out of manual readings. Constructed of hardened stainless steel, the digital caliper comes with a handy protective carrying case.

International Metric and BSP Female Thread Identification Kit

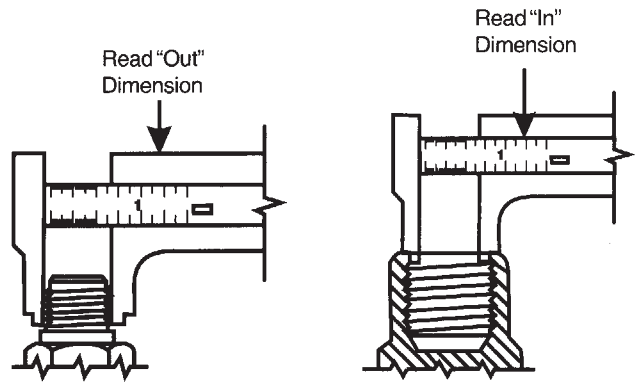
Product Number: 7369-0319

A sturdy, attractive carrying case suitable for counter display and field sales calls. Contains male metric and BSP plugs for identifying thread size, pocket I.D. kit, and flow chart with step-by-step instructions. For female thread identification, simply couple with the mating male.

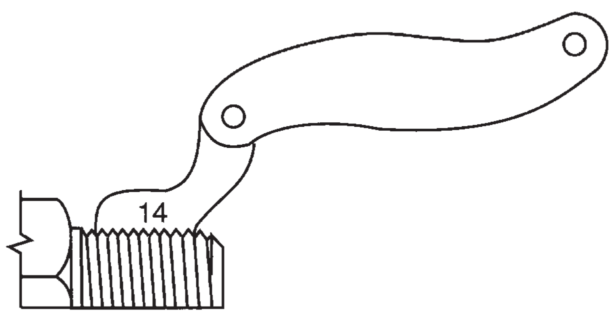
Measuring Threads and Seat Angles

Measuring Threads

With the caliper, measure the thread diameter at the largest point (O.D. of male threads — I.D. of female threads).



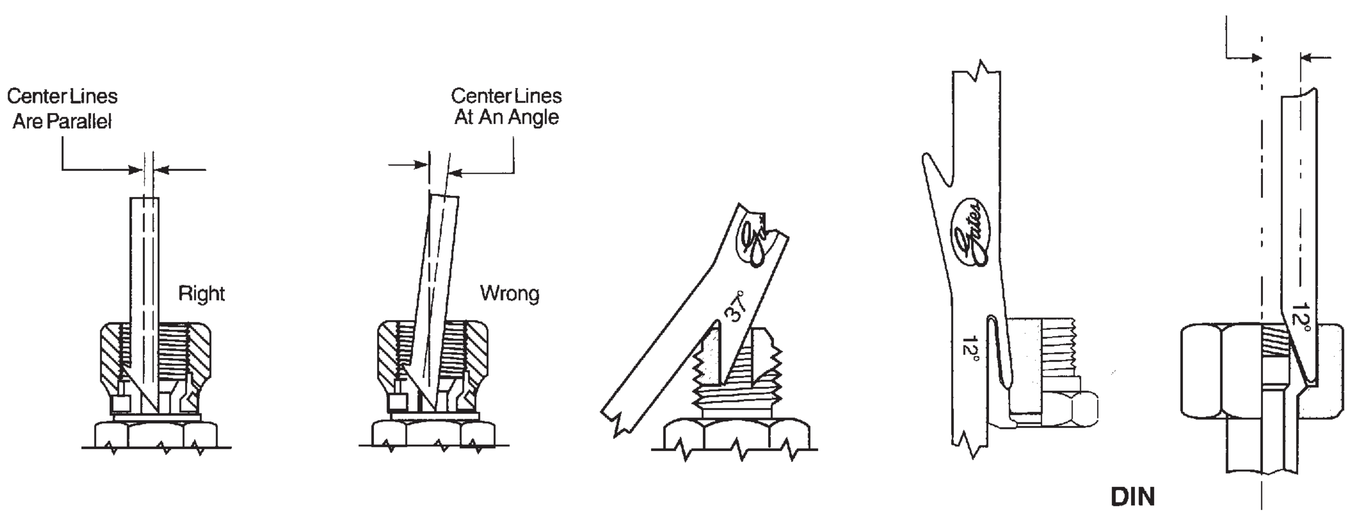
Using the pitch gauge, determine the number of threads per inch. Comparison of gauge and coupling threads against a lighted background will ensure an accurate reading.



Measuring Seat Angles

When the centerline of the seat gauge points straight out of the coupling, the angles of the gauge and seat match.

Compare the measurements taken to the coupling specification tables that appear in Gates hydraulic catalog 35093 or the specifications in the Gates Hydraulic Coupling International Thread Identification Manual 435-0998.



NOTE: Thread binding will occur when different thread configurations are used. DO NOT mix thread configurations.

North American Standards

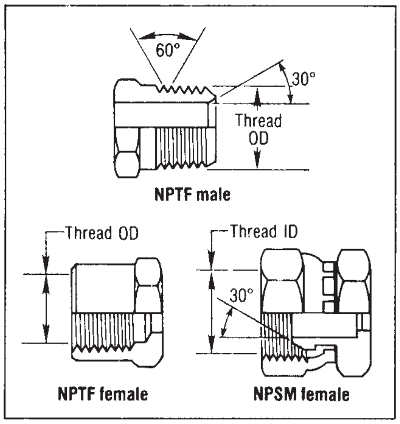
There are ten common North American hydraulic thread types — national pipe thread, SAE 45° flare, JIC 37° flare, SAE straight thread O-ring boss, O-ring face seal, flareless tube, SAE inverted flare, SAE Code 61 and Code 62 flanges and staple-type.

While all these couplings are widely used in the U.S. and Canada, they are also found on a worldwide basis in a variety of applications.

National pipe thread. These threads are available in several varieties: National Pipe Tapered for Fuels (NPTF), National Pipe Straight for Fuels (NPSF) and National Pipe Straight for Mechanical Joints (NPSM). The NPTF male coupling will mate with the NPTF, NPSF or NPSM female coupling.

The NPTF male has tapered threads and a 30° inverted seat. The NPTF female has tapered threads and no seat. The seal takes place by deformation of the threads. The NPSM female has straight threads and a 30° inverted seat. The seal takes place on the 30° seat.

National Pipe Thread

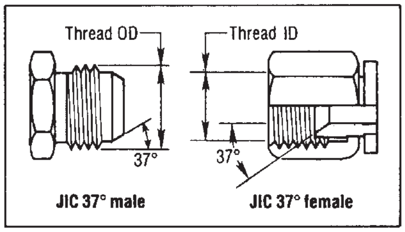


The NPTF coupling is similar to, but not interchangeable with, the BSPT coupling. The thread pitch is different in most sizes. Also, the thread angle is 60° instead of the 55° angle of the British coupling.

JIC 37° flare. The Joint Industrial Conference (JIC) is now defunct, and this standard is included as a part of SAE J516. The JIC 37° flare male coupling will mate with a JIC female only. The JIC male and female have straight threads and a 37° flare seat. The seal is made on the 37° flare seat.

Some sizes have the same threads as the SAE 45° flare. Carefully measure the seat angle to differentiate between the two.

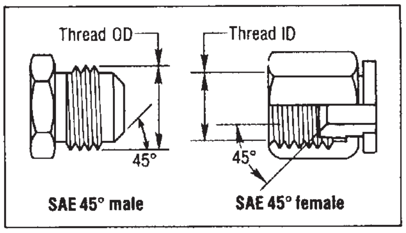
JIC 37° Flare



SAE 45° flare. The SAE 45° flare will only mate with a SAE 45° flare female. Both male and female couplings have straight threads and a 45° flare seat. The seal is made on the 45° flare seat.

Once again, because some sizes of this coupling have the same threads as the JIC 37° flare, carefully measure the seat angle to identify the correct coupling.

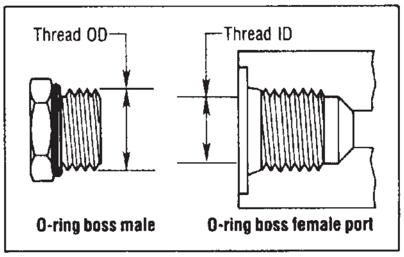
SAE 45° Flare



SAE straight thread O-ring boss. The O-ring boss male will only mate with an O-ring boss female, and the female is generally found on ports.

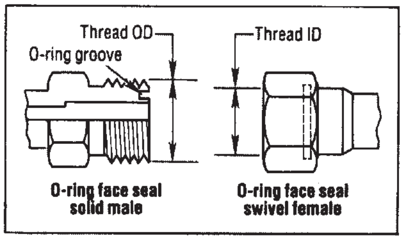
The male has straight threads and an O-ring. The female has straight threads and a sealing face. The seal is made at the O-ring on the male and the sealing face on the female.

SAE Straight Thread O-ring Boss



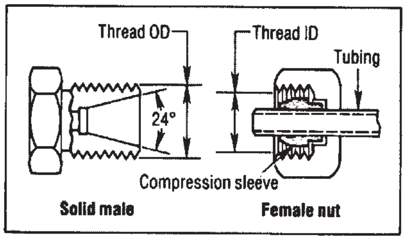
O-ring face seal. The solid male O-ring face seal fitting will mate with a swivel female O-ring face seal only. An O-ring rests in the O-ring groove in the male coupling. The seal is made when the O-ring in the male contacts the flat face on the female coupling.

O-ring Face Seal — SAE J1453



Flareless tube. The flareless solid male only mates with a female flareless nut and compression sleeve. The male has straight

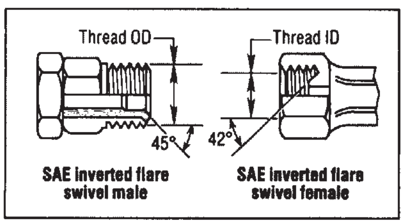
Flareless Tube



threads and a 24° seat. The female has straight threads and a compression sleeve for a sealing surface. The seal is made between the compression sleeve and the 24° seat on the male, and between the compression sleeve and the tubing on the female.

SAE inverted flare. The SAE 45° inverted flare male will only mate with an SAE 42° inverted flare female. The male has straight threads and a 45° inverted flare. The female has straight threads and a 42° inverted flare. The seal is made on the 45° flare seat on the male and the 42° flare seat on the female.

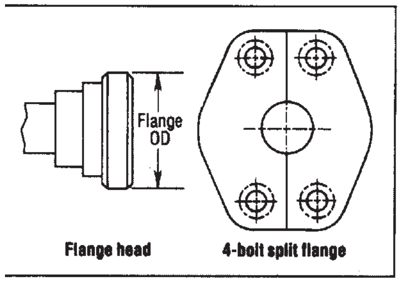
SAE Inverted Flare



SAE Code 61 and Code 62 4-bolt split flanges. These two couplings are used worldwide, usually as a connection on pumps and motors for extremely high pressure lines. There are four exceptions:

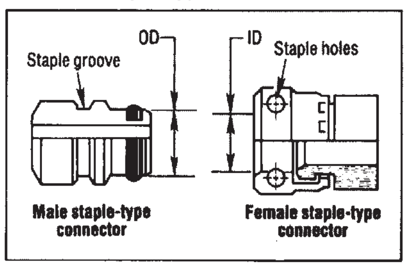
- The dash 10 size, which is common outside of North America, is not an SAE standard size.
- Caterpillar flanges, which have the same flange O.D. as SAE Code 62, have a thicker flange head, and require different flange halves, clamps and bolts.
- Poclain flanges are completely different from SAE flanges and are not interchangeable.
- Komatsu flanges are dimen-sionally the same as SAE flanges except for their O-ring grooves.

SAE Code 61 & Code 62
4-bolt split flange



Staple-type. The seal on these connectors is made when the O-ring on the male contacts the inside surface of the female. The two connectors are held together with a staple. Staple-type couplings are commonly found on mining equipment worldwide.

Staple-type Connector

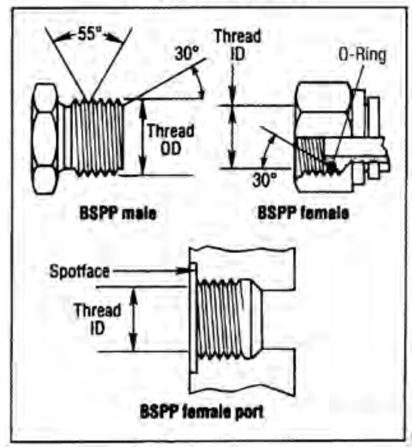


British Standards

There are two types of British couplings — British Standard Pipe Parallel (BSPP) and British Standard Pipe Tapered (BSPT). The British couplings are widely used in the United Kingdom, France, Scandinavia, Japan and British Commonwealth countries such as India, Australia and New Zealand. These components are widely available in Europe.

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

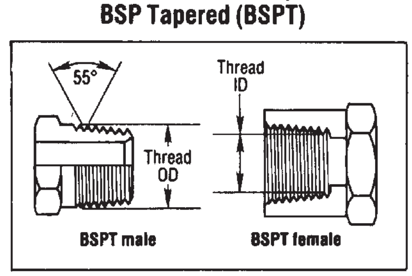
British Standard Pipe (BSP)
BSP Parallel (BSPP)



BSPT. The BSPT male has tapered threads. The BSPT male will mate with either a BSPT female or a BSPP female. When mating with either the BSPT or BSPP female port, the seal is made on the threads. The BSPT coupling is also similar to a North American coupling, the NPTF. The thread pitch is different in most cases, and the required thread angle is 55° instead of the 60° angle found on NPTF threads.

The major applications for BSPP and BSPT hydraulic couplings would include most connections on British-built hydraulic components such as valves and cylinders.

British Standard Pipe
BSP Tapered (BSPT)

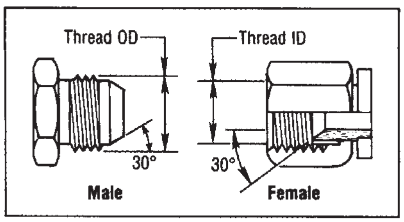


Japanese Standards

There are four major Japanese Industrial Standard (JIS) couplings — JIS 30° flare parallel thread, JIS tapered pipe thread, Komatsu-style 30° flare and Komatsu-style flange. The couplings are used primarily in Japan and the United Kingdom.

Japanese 30° flare parallel thread. The Japanese 30° flare male coupling will mate only with a Japanese 30° flare female. The male and female have straight threads and a 30° seat. The seal is made on the 30° seat.

Japanese 30° Flare Parallel threads

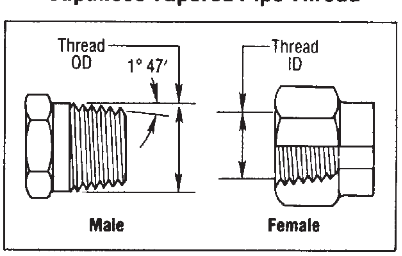


The threads on the Japanese 30° flare coupling are the same as the BSPP threads, and both the Japanese and British couplings have a 30° seat. However, these couplings are not interchangeable because the British seat is inverted.

Japanese tapered pipe thread. The Japanese tapered pipe thread coupling is identical to and fully interchangeable with the British BSPT (tapered) coupling.

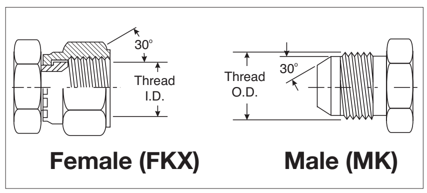
The seal on the Japanese pipe thread coupling is made on the threads.

Japanese Tapered Pipe Thread



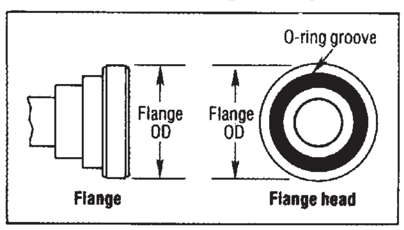
Komatsu-style 30° flare parallel thread. The Komatsu-style 30° flare parallel thread coupling is identical to the Japanese 30° flare parallel thread coupling except for the threads. The Komatsu-style uses metric fine threads. The Komatsu-style coupling seals on the 30° flare.

Komatsu Style 30• Flare



Komatsu-style flange fitting. The Komatsu-style coupling is nearly identical to and fully interchangeable with the North American SAE Code 61 flange fitting. In all sizes, the O-ring dimensions are different. When replacing a Komatsu-style flange with an SAE flange, an SAE O-ring always must be used.

Komatsu Flange Fitting



All popular equipment manufactured by Komatsu uses Komatsu couplings. Most other Japanese equipment uses JIS 30° couplings, although some use BSPP 30° couplings. Other popular couplings, such as North American SAE (JIC) 37°, are also found on Japanese equipment.

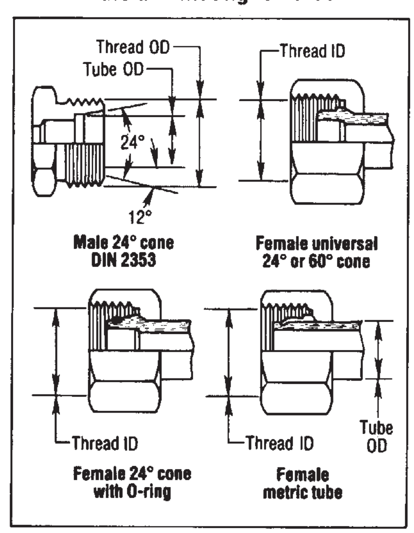
German Standards

There are four main German Deutsche Industrial Norme (DIN) couplings — DIN 24°, DIN 60°, DIN 3852 Types A and B and DIN 3852 Type C. The DIN couplings are used primarily in Germany and less frequently in Western and Eastern Europe. Availability is very good in Europe but limited elsewhere.

DIN 24°. The DIN 24° couplings are the most common German couplings. The DIN 24° cone male will mate with the female 24° cone with O-ring, female metric tube and female universal 24° or 60° cone. The male has a 24° seat, straight metric threads and a recessed counterbore which matches the tube O.D. of the coupling used with it.

There is a light and heavy series DIN coupling. Proper identification is made by measuring both the thread size and the tube O.D. (The heavy series has a smaller I.D. and thicker wall than the light series of the same O.D.). When measuring the flare angle with a seat angle gauge, use a 12° gauge. The seat angle gauge measures the angle from the coupling centerline.

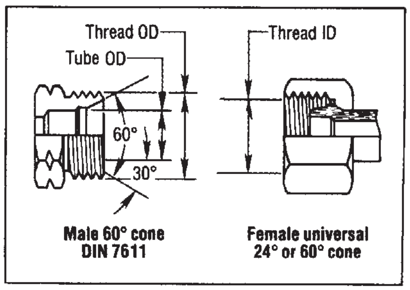
DIN 24°
Male and mating females



DIN 60°. The DIN 60° coupling is not commonly used. The DIN 60° cone male will mate with the female universal 24° or 60° cone couplings only. The male has a 60° seat and straight metric threads.

When measuring the flare angle with the seat angle gauge, use the 30° gauge.

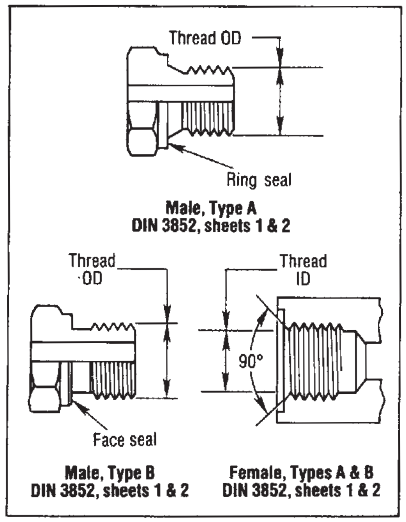
DIN 60° Male and mating female



DIN 3852 Types A and B. The male DIN 3852 A and B couplings will mate only with a matching DIN 3852 A and B female. The male and female A and B couplings have straight threads, but these threads can be either metric or British-designed Whitworth threads. (The reason for Whitworth threads on German components is that, historically, Britain built much of the world's mining equipment. Germany machined couplings to fit the equipment.) The seal occurs when the ring seal (Type A) or the face (Type B) mates with the face of the female port.

There are two series of the Types A and B couplings: the light (L) and the heavy (S) series. This is a very common German port connection.

DIN 3852 Couplings
Type A & B (parallel threads)

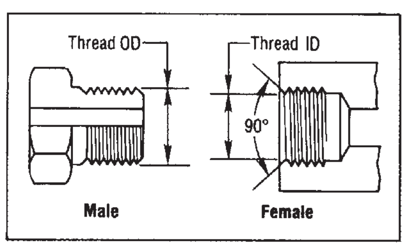


DIN 3852 Type C. Type C couplings are tapered threads. They are also available with either metric or Whitworth threads. The seal takes place on the threads.

There are three series of Type C couplings: extra light (LL), light (L) and heavy (S). Type C is also a port connection.

Tapered threads (Type C) are less popular than straight (Types A and B) threads. Again, the Whitworth threads are generally found on mining equipment.

DIN 3852 Type C
Sheets 1 & 2, metric and Whitworth tapered thread connectors



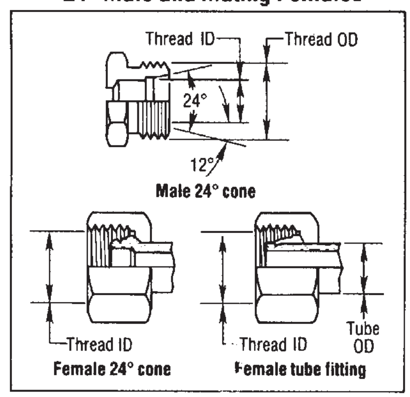
French Standards

There are two major types of French (GAZ) couplings — 24° flare and 24° flange. These couplings are used primarily on French equipment and are not broadly used in other parts of the world.

GAZ 24° flare. The French metric (GAZ) 24° flare coupling will mate with a female with either a 24° cone or the female tube coupling. 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.

When measuring the flare angle with the seat angle gauge, use the 12° gauge.

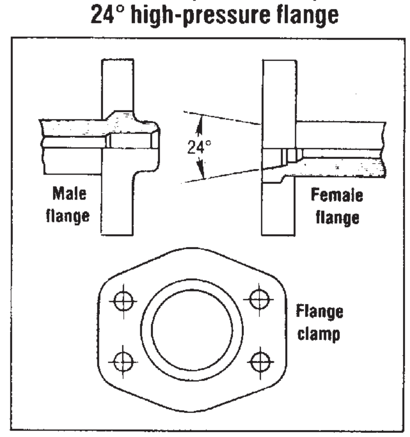
French Metric (GAZ)
24° Male and Mating Females



GAZ 24° flange. Also called the Poclain 24° high-pressure fitting, this is a specialty fitting found on equipment manufactured by Poclain. It is not commonly used.

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

Poclain (French GAZ)
24° high-pressure flange



Gates Coupling Nomenclature

Once you've identified the thread end, it is important to put it into correct nomenclature.

With a two-piece system, both stem and ferrule must be identified.

6 GS 1 F - 4

- 6 – Hose Dash Size
- GS – Stem Type
- 1 – 1=No-Skive (2=Skive)
- F – Ferrule
- 4 – 4 Spiral

Ferrule Nomenclature

Ferrule type designations (PC, PCS, PCM, C4, etc.) correspond to the stem hose end type designations (16PCS-16MP, etc.).

Some hose can use more than one ferrule. For example, C12M hose can be coupled with either PCS1F or PCS2F ferrules and PCS stems. PCS1F ferrules require no skiving. You simply crimp the coupling to the hose.

The number "2" before the "F" in ferrule designations means that two steps are needed for correct hose coupling.

1. Skiving to remove the cover from the hose end.
2. Crimping.

Always install the correct ferrule for a specific hose and stem combination. For instance, there is an important design difference between an 8PC2F-2 ferrule and an 8PC2F-2C ferrule which is vital to the compatibility and performance of the hose assembly.

Always refer to Gates crimp data charts for the right hose, stem and ferrule combination.

Coupling Nomenclature

Gates utilizes various hose ends as follows:

Couplings for Wire Braid Hose

MegaCrimp®
G Series (Global)

PC – Power Crimp®

Couplings for Spiral Hose

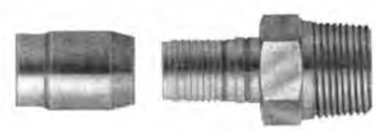
GS – GlobalSpiral®

PCS – Power Crimp® Spiral

PCM – Power Crimp® Multi-Spiral

Other Hose Ends

PCTS – Power Crimp® T/P Swage for Thermoplastic Hose



C14 – for Teflon® Hose

C4 – for Low Pressure Return and Suction Hose

ACA – Air Conditioning for Refrigerant Hose

Field Attachable Couplings

For C5, CIT, C2AT Hoses

For Lock-on Hose (LOC and LOL+)

SAFE HYDRAULICS

Thread-End Nomenclature

See the thread end identification nomenclature listed below.

Here are some examples of coupling nomenclature for stems:

Code	Description
A	Adapterless
AB	Air Brake
API	API Unions
B	O-Ring Boss
BJ	Banjo
BKHD	Bulkhead
BL	Block
BS	Bite Sleeve
BSPP	British Standard Pipe Parallel
BSPT	British Standard Pipe Tapered
C	Caterpillar Flange Dimension
CC	Clamping Collar
DH	DIN Heavy
DL	DIN Light
F	Female
FBFFOR	Female British Flat-Face O-Ring
FBO	Female Braze-on Stem
FF	Flat-Face
FFGX	Female French GAZ Swivel
FFN	Female Flareless Nut
FOR	Flat-Face O-Ring
FFS	Female Flareless Sleeve
FG	Female Grease Thread

Code	Description
FKX	Female Komatsu Style Swivel
FL	Code 61 O-Ring Flange
FLC	Caterpillar Style O-Ring Flange (Code 62)
FLH	Code 62 O-Ring Flange Heavy
FLOS	Flange O-Ring Special (Code 62)
FT	Female SAE Tube
HLE	Hose Length Extender
HLEC	Hose Length Extender (Caterpillar)
HM	Hose Mender
I	Inverted Flare
J	JIC (37° Flare)
JIS	Japanese Industrial Standard
K	Komatsu Style (Japanese 30° Seat)
LH	Long Hex
LN	Long Nose
M	Male
MBAX	Male Boss Adapterless Swivel
MFA	Male Flareless Assembly (Ermeto)
MKB	Metric Kobelco
MM	Metric Male
MN	Metric Nut
MPG	Male Special Grease Fitting

Code	Description
MLSP	Metric Light Stand Pipe
MSP	Metric Stand Pipe
NASP	North American Stand Pipe
OR	O-Ring
P	Pipe Thread (NPTF or NPSM)
PL	Press Lok®
PT	Port
PWX	Pressure Washer Swivel
R	Field Attachable
S	SAE (45° Flare)
SP	Special
TS	Tube Sleeve
TSN	Tube Sleeve Nut
X	Swivel
Z	Parker Triple Thread
22	22-1/2° Drop
30	30° Drop
45	45° Drop
60	60° Drop
67	67-1/2° Drop
90	90° Drop
110	110° Drop
135	135° Drop

Here are some examples of coupling nomenclature for stems:

4G-6FJX

- 4 — 1/4" Hose Size
- G — Global MegaCrimp® Coupling Series
- 6 — 3/8" Nom. Thread Size
- FJX — F= Female, J= JIC, X= Swivel

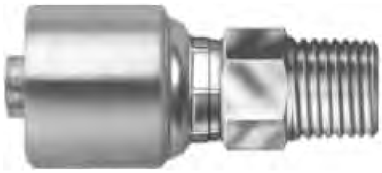
4C5-4RMIX

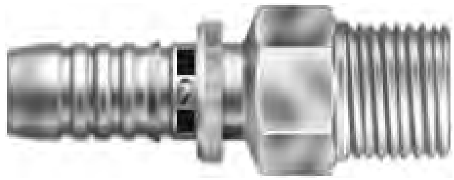
- 4 — 3/16" Hose I.D.
- C5 — C5 Hose
- 4 — 1/4" Nom. Thread Size
- R — Field Attachable
- MIX — M= Male, I= Inverted, X= Swivel

Gates Global Part Numbering System

G25100-0808

- G25 — MegaCrimp® Series Stem Style
- 100 — Thread Configuration
- 08 — Stem Size
- 08 — Thread Size





12GS-16FL 90

- 12 — 3/4" Hose Size
- GS — GlobalSpiral® Coupling Series
- 16 — 1" Nom. Thread Size
- FL — FL= Flange
- 90 — 90 = 90° Bend

Additional Selection Criteria

End Configuration Selection

It is important to keep in mind that the hose assembly, couplings and hose, is only one component of the system. In choosing the correct end terminations for the couplings attached to the hose, formal design standards and sound engineering judgement should be used.

In the absence of formal design standards, an engineer should consider the following factors in choosing the proper end termination:

- Pressure
- Impulse frequency, amplitude and wave form
- Vibration
- Corrosion
- Dissimilar metals (galvanic corrosion)
- Maintenance procedures and frequency
- Installation reliability
- The connection's risk in the system
- Exposure to the elements
- The operator's and bystander's exposure to the connection
- Installation, operation and service activities and practices that affect safety

If there are any questions as to what end fittings should be used, Gates recommends that you consult your Gates sales representative or the Product Application Group for assistance.

Corrosion Resistance

Most hydraulic fittings are manufactured from carbon steel and have zinc dichromate plating for corrosion resistance. Tested under SAE J516 and ASTMB117 salt-spray conditions, our revolutionary TuffCoat® plating provided 400 hours of protection against corrosion. That's a 400-plus percent improvement over the 96-hour SAE standard.

Vibration

Coupling selection may be influenced if the end connection has quite a bit of motion and/or vibration, which can potentially weaken or loosen a connection. Use of split flange couplings, or other couplings that use an O-ring for sealing, perform better under vibration. Avoid use of couplings that seal on the threads.

Temperature

Metal surfaces can expand and contract under extreme temperature fluctuations. Choose couplings that use O-rings for sealing. The O-ring will seal as the metal moves. It may be necessary to use O-ring materials that are suitable for high temperatures. Also, use a fitting material that is best suited for the application's temperature (i.e., if the application is high temperature, avoid using brass or aluminum).

Fluid Compatibility

While hydraulic hose is commonly selected by its compatibility with fluid, couplings usually are not. Couplings can, however, be affected by the fluid. Always check the chemical resistance charts for compatibility with coupling materials and O-rings.

Think Safety!

NOTE: Some male swivel type couplings have internal O-rings. Fluid compatibility with the O-rings must also be considered.

Pressure

Working pressure should be a consideration when selecting a fitting. Some fittings don't seal well at high pressures and can develop a leak. O-ring-type fittings as well as solid port connectors work well at high pressures. Avoid the use of swivel staked nut couplings at extremely high pressures.

Use of Adapters

You may want to select a coupling based on the need of adapters. Some couplings connect directly to a port, while others connect to adapters. Connecting directly to the port eliminates the need for an additional connection but can make installation more difficult. Adapters can make installation easier, eliminate the need for coupling orientation but introduce an additional connection or possible leak point.

PROPER HOSE ASSEMBLY

Once the proper hose and couplings have been selected, the assembly can now be made. There are three types of assemblies:

- Permanent crimped
- Permanent swage
- Field attachable

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

1. Measuring Hose

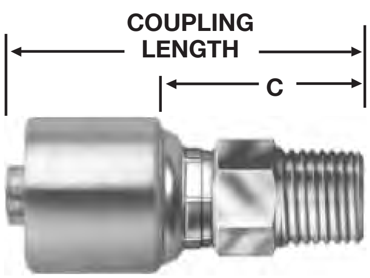
With some assemblies, the length must be within a tight tolerance for proper installation. This is especially true for short high-pressure hose assemblies.

Before cutting the hose, make sure you understand the difference between "cut hose length" and "assembly overall length" as shown below.

Cut-off value "C" is the length of that part of the coupling not directly in contact with or applied to the hose. Subtract the sum of the two "C" values from the total length of the assembly to determine the approximate hose length to be cut.

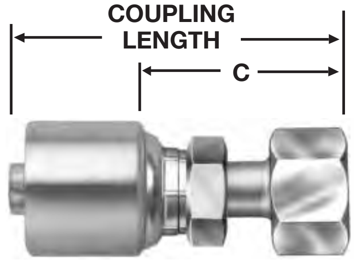
All cut-off values are identified in the coupling tables found in the Gates hydraulic catalog 35093.

For male thread couplings, the cut-off is measured from the locking collar to the end of the threads as shown.

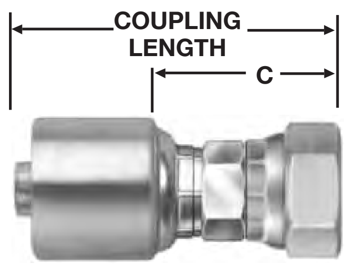


Male Pipe

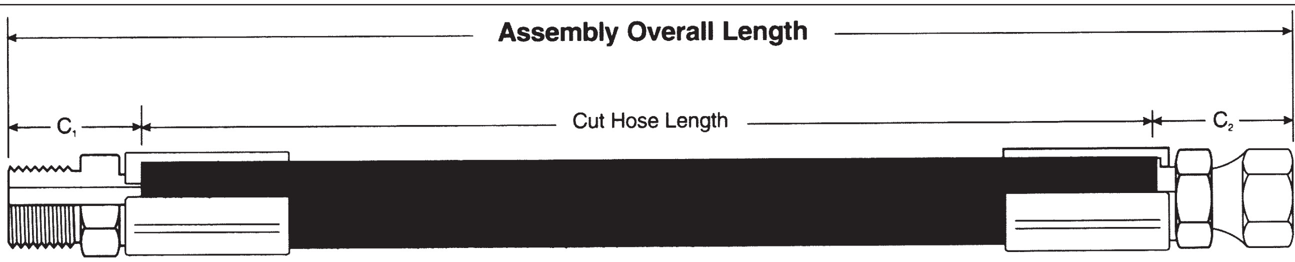
For straight female couplings, the cut-off is measured from the locking collar to either the end of the nut or seat depending on whether the nut can be pulled back exposing the seating surface as shown.



Female Flat-Face Swivel



Female JIC

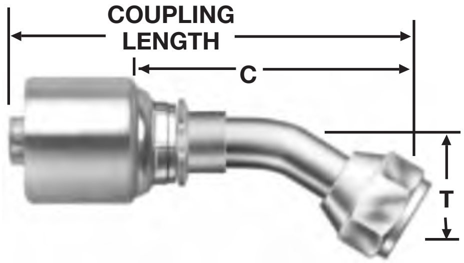


Cut Hose Length = Assembly Overall Length Minus (C_1 + C_2)

SAE Length Tolerances for Hydraulic Hose Assemblies and Specified Hose Lengths.

Length	Tolerance
For lengths from 0" up to and including 12"	±1/8"
For lengths from 12" up to and including 18"	±3/16"
For lengths from 18" up to and including 36"	±1/4"
For lengths above 36"	±1% of length measured to the nearest 1/8"

Bent tube couplings are measured to the center line of the seating surface as shown.



2. Cutting Hose

Think Safety!

CAUTION: When cutting hose, always wear safety glasses and avoid loose fitting clothing. Hearing protection is also strongly recommended.

After determining the hose cut length by deducting for fittings, cut the hose with a cut-off saw. There are two blade types that can be used: notched (serrated) or abrasive.

The notched blade gives a clean, efficient cut on non-spiral-reinforced hose (one- and two-wire braid hose and textile hose). Though notched blades will cut spiral hose, they are not recommended as they dull quickly and/or become damaged.

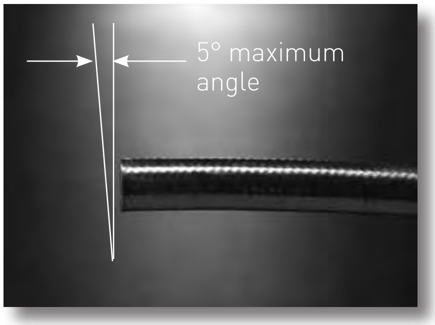
The abrasive wheel efficiently cuts all hose types, including spiral-reinforced hose. The drawback with this blade is the amount of debris it creates from cutting. As the blade wears out, its diameter becomes smaller and eventually requires replacement.

Once you've installed the appropriate blade, place the hose in the bending fixture. This draws the hose away as you cut, minimizing binding (squeezing) and making cutting easier. Hand-held cutters can be used on some textile reinforced hose.

Cutting Teflon® hose requires special consideration. It can be cut cleanly with a cutting shear. An abrasive wheel can also be used, but the hose's cutting location must be wrapped with heavy-duty masking tape (at least twice). Once the cut is made, the Teflon tube must be deburred using a sharp knife. Remove the tape prior to assembly.

NOTE: Cutting of any hose will generate some debris that if not properly removed can damage the hydraulic system. See page 51 for more information on hose cleanliness.

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



3. Fitting Orientation

Fitting orientation is necessary when neither fitting is straight (both are at an angle). Fittings must be oriented to each other to ensure proper installation with minimal stress on the hose from twisting.

Orientation procedure:

- Position far coupling vertically downward.
- Orientation angle is measured clockwise (as shown).

(Orientation angle tolerance should be ± 2°).

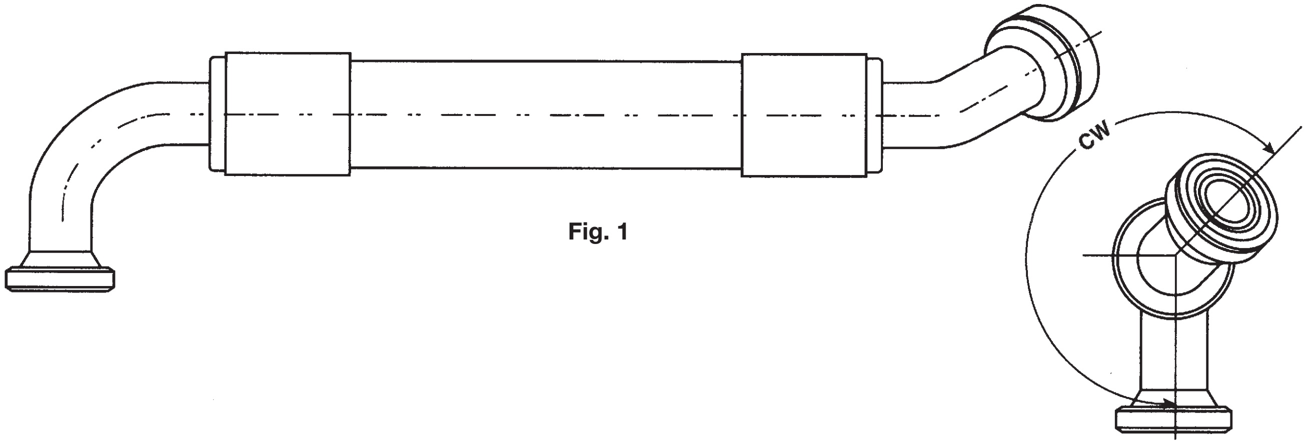


Fig. 1

Hose Preparation

Skiving

Think Safety!

CAUTION: When skiving or buffing hose, always wear safety glasses and avoid loose fitting clothing. If power skiving or buffing, hearing protection is also recommended.

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

- Wire abrasion wheel.
- Hand-skiving tool (Gates product number 7480-0413).

Thick-covered hose typically require skiving because the ferrule serrations cannot bite through the cover and into the wire. Hoses with a thin cover do not typically require skiving. Check Gates hydraulic catalog and crimp charts for specific information on skive length and diameter.

The skive length is the length of cover removed. The skive diameter is the diameter after skiving. For example, for 8C2A, the skive length is 7/8" and the skive diameter is "to the wire."

Buffing

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

When a hose is buffed, its cover is removed, but only to a specific diameter as defined by crimp data. A grinding wheel is necessary to buff a hose (not a wire wheel, which could damage the reinforcement).

NOTE: Skiving or buffing any hose will generate some debris that if not properly removed can damage the hydraulic system. See page 51 for more information on hose cleanliness.

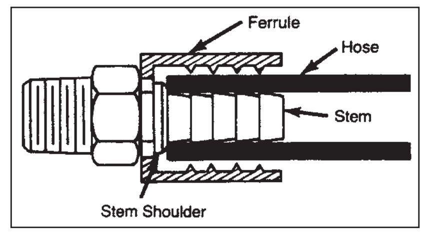
Gates MegaCrimp® and GlobalSpiral® couplings do not require skiving or buffing of the hose during assembly operation.

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

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

2. Clamp stem in vise on hex portion and push hose onto stem. Hose should be flush against the stem shoulder.

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



4. Push ferrule so it rests against hex of stem. Hose and coupling are now ready for crimping.

Preassembly Using One-Piece Fittings (MegaCrimp®)

MegaCrimp was designed for easy insertion. No oil is needed for lubrication.

1. Place the hose next to the coupling. Use your thumb or mark the depth of insertion.

2. With your thumb (or mark) in place, push the coupling until the shell touches the tip of your thumb or the mark. Twist it slightly to ensure it is fully inserted.

Correct Insertion Depth Made Easy!

Confirm the proper insertion depth for all Gates wire-braid hydraulic hose with the Gates MegaCrimp® coupling insertion tool. Made of lightweight solid aluminum, and designed to mount either on top or on the side of a work bench, it has a slot for holding a marking pen or grease pencil.

To use, just locate the slot with the correct dash size (marked on both top and side), insert the hose and push it all the way in. Check to ensure the cut is square (the maximum allowable angle of cut is 5°). Then mark the insertion depth on the hose. Now you can easily see if the coupling is properly seated on the hose before you crimp.

To order the tool, ask for product no. 7482-1342.

Crimp Procedures

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

FOR SAFETY'S SAKE, USE A CRIMPER ONLY IF YOU:

1. Receive hands-on TRAINING with Gates crimpers and assemblies.
2. Follow current GATES OPERATING MANUAL and CRIMP DATA for the Gates crimper.
3. Use only NEW (UNUSED) GATES hose and fittings.
4. Wear SAFETY GLASSES.

REMEMBER: Others depend on you to make correct assemblies.

Listed below are basic crimp procedures.

NOTE: For specific instructions for your crimper, please refer to the appropriate operator's manual.

1. Refer to crimp data chart for

   a. Skive data (if necessary)

   b. Die selection

   c. Finished crimp diameter

   d. Approximate crimp setting

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 die). This layer of lubricant must be thinly re-applied when contact surfaces become shiny. Locate dies in crimp position.

3. Adjust the machine to the proper crimp setting.

4. Adjust the depth stop (if necessary).

5. Insert the assembly and locate with the die fingers.

6. Install die cone if used.

7. Always wear safety glasses and keep hands and clothing away from moving parts.

8. Activate crimp mechanism.

9. Remove assembly from dies and measure crimp diameter.

Think Safety!

IMPORTANT SAFETY NOTE:
All settings are approximate! Machining tolerances exist for each crimper, die set and supporting piece of equipment which will affect your actual setting. Always check the crimp diameter to ensure that it is within the published limits. Record your actual crimper setting to achieve the specified crimp diameter for future use. Failure to heed this message could result in improperly made assemblies, blowing the hose out of the fittings at high pressure, and risk of fire and/or serious injury.

Think Safety!

Never reuse a stem which has been previously crimped and salvaged by cutting away the ferrule. Never reuse or recrimp hose which has been in service.

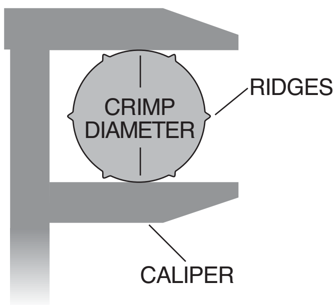
To properly measure a crimp diameter

1. Measure halfway between ridges. See "Sketch I." When using dial calipers, be sure the caliper fingers do not touch the ridges.

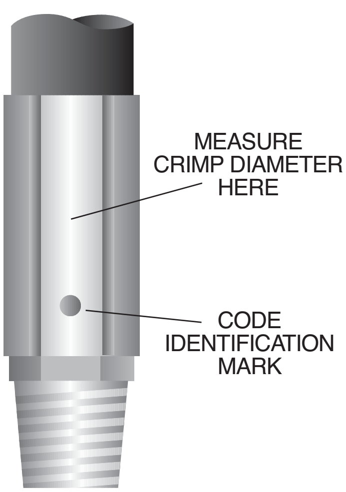
2. Measure halfway down the crimped portion of the ferrule. See "Sketch II".

3. When measuring small crimp diameters (3/16" and 1/4"), a set of jaw-type micrometers is recommended.

4. Do not measure the top of the code identification marks.



Sketch I



Sketch II

If the actual crimp diameter isn't within the recommended crimp tolerance, you may need to check the calibration of the machine and recalibrate, if necessary. If the machine is properly calibrated, you'll need to make a slight adjustment to the setting.

On the Power Crimp® 707 crimper, to obtain a smaller crimp diameter, change the meter number to a smaller figure. To get a larger crimp diameter, change the meter number to a larger figure. Changing the readout meter number by .05 will change the crimp diameter .001". Note this reading on your crimp data chart for future reference.

Gates crimp operating manuals are listed below:

Crimper	Manual
701/707/709	35019-AG
3000B	35019-ZH
OmniCrimp® 21	35052-A
MobileCrimp® 4-20	
(Digital Dial)	35032-DD
(Positive Stop)	35032-PS
GC32-XD™	34012
GC96™	35016

Permanent Swage Procedures (PCTS & C14)

Mark hose for proper insertion depth into coupling. See Gates swage data chart for insertion depth. Use a lightweight oil to lubricate the **inside** diameter of hose. Place the coupling hex into a vise and insert hose to 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 Swage Data Chart for die/pusher information.

> **WARNING:** An incorrect hose assembly can rupture or blow apart in use, resulting in serious injury, death or property damage.
>
> **FOR SAFETY'S SAKE, USE SWAGERS ONLY IF YOU:**
>
> 1. Receive hands-on TRAINING with Gates swagers 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.

2. Lubricate inner bore surfaces of dies with a thin film of lightweight oil.
3. Feed hose assembly through the dies and hold hose and coupling into the pusher.
4. Pull control lever while guiding coupling into the die, until pusher bottoms against top of die surface.
5. Push control lever to retract the pusher and open the die halves. Remove swaged hose assembly.

Gates swage operating manuals are listed below:

Equipment	Manual Form No.
HS-1 Hand Swager	35019-MB
Thermoplastic Swage Data Charts	35068-A
C14 Teflon®	35493-B

Field Attachable

"Field attachable" means no crimper is needed to attach the couplings. Below are the basic steps in the assembly of "field attachable" couplings.

Installation of Gates Field Attachable "Type T" Coupling

1. Be sure to thoroughly oil hose and nipple.

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

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

Hose Cleanliness

As your customers become more dependent on ISO standards, your overall strategy must reflect a dedication to system cleanliness.

What is Hydraulic System Cleanliness?

"Cleanliness" is a term used to describe the level of solid and liquid contamination found in hydraulic systems. "Contamination" may be defined as any substance that is not part of the hydraulic system's working fluid.

Why is cleanliness important to your customers?

Efficient production because clean systems provide for maximum productivity.

Improved control of spare parts through preventive maintenance and monitoring contamination.

Reduce equipment downtime through scheduled inspections

Safety hazards minimized through preventing contamination-related failure for increased life expectancy of components on equipment.

Reduced repair cost due to fewer breakdowns.

Several reputable sources have claimed that 70 to 80 percent of hydraulic system failures are due to contamination. By establishing a contamination control program, costly repairs and downtime may be minimized. A contamination control program can be as simple as establishing an allowable level of contamination within a hydraulic system, supplying cleaned components for the system, and monitoring levels of contamination as part of a preventive maintenance program.

How does this "contamination" get in there?

Origins of contamination may be from system components themselves, the hydraulic working fluid, the outside environment, or even generated by the system itself. These contaminants, some large and some microscopic, can have a profound impact on the performance and longevity of the hydraulic system.

There are three principal means through which contamination can occur in a typical hydraulic system. It can be:

1. Generated during system operation
2. Built into the system during assembly
3. Ingested by the system during operation

For optimum performance, the working fluid in hydraulic systems should be as homogeneous as possible and free of all visible as well as microscopic debris. Athough the complete absence of contamination in hydraulic systems is unrealistic, an acceptable and defined level of contamination is generally considered hydraulic system cleanliness. The best approach to cleanliness is to prevent contamination in the first place. Use clean hose and couplings and keep them clean (i.e. cap ends). Clean hose bore after cutting to length. Cutting hose to length is a major contributor to contamination.

How working fluid contamination affects these:

Valves: Microscopic contamination can mill away tolerances, similar to erosion. Tolerances are used for sealing purposes. For example: on spring centering valves, debris may get caught between the valve and wall surfaces, slowing down the motion of the valve or causing sluggish or adverse mechanical actuation.

When abrasive particles enter the clearances between moving parts they score and hone the surfaces to greater tolerances. As these tolerances broaden, system performance is compromised by pressure losses incurred due to fluid leakage from high to lower pressures.

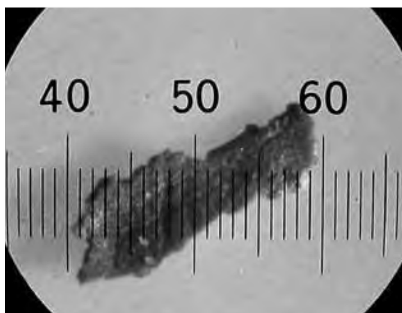
Even worse is the occurrence when particles that are greater than or equal to the orifice openings become wedged between the surfaces. This may cause wear to occur, or it may cause the system components to seize.

Pumps & drives: Just as in valves, microscopic contamination can mill away tolerances, creating leak points. These leak points rob the system of pressure and cause poor responsiveness.

System cooling: If passages do become blocked, working fluid may not flow through to remove contaminants generated from metal to metal contact. Lower flow rates mean greater heat buildup in systems and thermal breakdown of the working fluid

Methods of contamination measurement & contaminant levels

Despite efforts to totally remove all of the contaminant in a hydraulic hose assembly, some contamination remains even after the most meticulous cleaning or flushing techniques are applied. It becomes necessary to quantify varying levels of contamination to better understand the cleanliness levels in hydraulic systems.



Contamination particles are usually sized using a metric unit of measure called a micrometer, otherwise known as a micron. A micron is a very small unit of measure equivalent to 39 millionths (.000039) of an inch. Twenty-five microns are equal to one thousandth of an inch. The human eye can discern a particle no smaller than forty microns.

The International Standards Organization (ISO) has established three principal methods to measure the contamination level within a component, circuit, or system. These three methods are widely used for cleanliness quantification.

Gravimetric Measurement (ISO 4405) – Reporting method that references the total mass of contaminant found in a hydraulic component. This total mass measurement is then normalized by the total internal component surface area of a hydraulic component. A fluid is used to dislodge contamination in a hose assembly and is then poured through a membrane catch filter. An analytical balance is used to measure the total mass of contaminate which has been flushed out of a component and is referenced to the surface area or volume of the assembly or component.

Internal Hose Volume (ISO 4406 particle counting measurement)
Volume = Cross Sectional Area * Length
Cross Sectional Area = 3.1416 / 4 * Inside Diameter ^ 2
Volume = 3.1416/4 * Inside Diameter ^ 2 * Length
Volume [=] cubic inches

Internal Hose Surface Area (ISO Gravimetric analysis)
Surface Area = Internal Circumference * Length
Internal Circumference = 3.1416 * Inside Diameter
Surface Area = 3.1416 * Inside Diameter * Length
Surface Area [=] square inches

Useful Conversions
1 Cubic Inch = 16.39 mL
1 Square Inch = 0.0006452m^2

Typical Gates Hydraulic Assembly

Particle Size Distribution Analysis (ISO 4406 or NAS 1638) – Reporting method to gauge both the size and number of contaminant particles in a known quantity of fluid. A fluid sample is either taken directly out of a hydraulic system or a known quantity of fluid is used to dislodge contaminants out of a hydraulic component. This fluid is run through a particle counting instrument to size and count contaminant particles. These particle 'counts' can then be normalized by the total component volume to determine a corresponding ISO 4406 'code' level of particle contamination. Levels of five and 15 microns of contamination are reported on a logarithmic scale corresponding to and ISO 4406 'code' for the number of particles greater than or equal to these respective sizes per milliliter of fluid.

Maximum Particle Size Analysis (ISO 4407) – This is an evaluation that is done with a microscope. A microscope is used to size individual pieces of contaminant. Particle size is important in reference to maximum clearances of hydraulic components.

Whether hydraulic assembly cleanliness applies to you or not, it is worthwhile to understand the significant impact that contamination levels can have on the life of hydraulic system components. **Implementing a thorough cleanliness system may have a significant impact on warranty returns for hydraulically powered equipment.**

Gates currently offers a system of four gravimetric (ISO 4405) levels of hydraulic assembly cleanliness to meet or exceed your customer's assembly cleanliness standards.

What can Gates do for you?

Gates has actively promoted hydraulic assembly cleanliness for over a decade with the development of a system that ensures four gravimetric levels of cleanliness for customers who deal directly with our assembly facilities.

The current Gates gravimetric system:

Level One – no more than 1,000 mg of contaminant per square meter of internal assembly area

Level Two – no more than 300 mg of contaminant per square meter of internal assembly area

Level Three – no more than 100 mg of contaminant per square meter of internal assembly area

Level Four – no more than 44 mg of contaminant per square meter of internal assembly area

Gates can measure and develop cleaning/flushing methods to furnish ISO 4406 particle counts as well as report largest particle size (ISO 4407).

With our new particle counting laboratories in Chambersburg, Pennsylvania, and St. Neots, in the UK, Gates now offers certain ISO 4406 levels for supplied assemblies to customers.

Gates current system of four cleanliness levels is designed to meet a variety of system demands, both high-pressures and low. Gates continues to develop new methods of cleaning hydraulic hose assemblies to ISO 4406 levels. Contact a Gates representative in your area or call Hydraulic/Industrial Hose Product Application at (303) 744-5070 for more information.

Scrub It Clean

Contaminated hydraulic assembly components shorten service life. The easiest method of cleaning a hose is to blow air through it. But that's really only a half-measure. To do the job thoroughly, Gates recommends using the Gates MegaClean™ system. Pressurized launchers and compatible nozzles, blow foam projectiles through the inside surface of the hose, scrubbing away fine particles of loose dirt and contaminants. The projectiles are 20-30 percent larger than the hose ID, and leave nothing behind but a clean hose.

Hydraulic Crimping Equipment

Gates offers five crimpers you can use to make factory-quality assemblies in the field

MobileCrimp® 4-20

The MobileCrimp 4-20 is an easy-to-use, versatile crimper. The crimper and stand weigh only 57 pounds, making this Gates first portable crimper.

To maximize customer satisfaction, the MC 4-20 offers two different options to control the crimp:

Positive Stop: This option uses a series of rings to control the crimp diameter, as the ram will extend to a "stop" on each crimp.

Digital Dial: This option is as easy as dialing in a crimp setting and pushing a button. When the crimp is complete, a light comes on and a buzzer sounds signaling the operator to release the button.

Two options help the MC 4-20 crimp hydraulic hoses from low-pressure return lines to high-pressure, four-spiral/C12 MegaSpiral® hoses from 3/16" to 1-1/4" I.D. Six interchangeable pump options, from a hand pump to a speedy 1-1/2 HP, complete the package to meet every crimping and application need.

Power Crimp® 707

The Power Crimp 707 is a precise, yet simple crimper. It was the first crimper with an electronic digital readout to indicate gauge setting.

The toughest part about using the 707 is pushing a button. It takes just a few seconds to make factory-quality hose assemblies.

Crimps most hydraulic hoses from low-pressure return lines to extremely high-pressure spirals from 3/16" to 1 1/4" I.D. Crimps straight and bent tube stems, plus 45° and 90° block types.

Power Crimp® 3000B

You can couple permanent hose assemblies in hose sizes from 3/16" through 2" (including 6-spiral) using Gates Power Crimp 3000B.

The Power Crimp 3000B is rugged enough to absorb the punishment of continued use. The ram can exert a hydraulic force in excess of 125 tons and can crimp all Gates hydraulic hose types, 3/16" through 2".

This Gates crimper uses an automatic limit switch to give push-button convenience during the crimping operation — accurately and dependably.

Gates Global Crimpers

GC-32XD™ Crimper

The world's first global crimper capable of fabricating assemblies anywhere in the world. It automatically coverts any electrical input voltage greater than 208 volts to 258 volts (single phase).

• **The open crimper head** accommodates any hose construction or any coupling configuration. Fabricates assemblies using all standard hydraulic products, even 2-1/2" Global MegaVac® return lines.

• **Color-coded die sets** are easy to find in the crimp chart and in the rack.

• **The quick change tool** speeds the loading and unloading of dies.

• **Capability:** Crimps every hose and coupling in the Gates catalog.

• **Motor:** 5 hp

• **Pump:** Two-stage

• **Crimping force:** 470 tons

GC96™ Industrial Hose Crimper

No matter where in the world you are, this global crimper crimps up to six-inch industrial hose. All it needs is grounded 15 - 20 amp circuit and it automatically converts any electrical input (208 to 258 volts, single phase) into a compatible power source.

The large crimper head makes industrial hose assemblies in a variety of terminations using crimpable ferrules and sleeves, Additionally, by using the optional spacer dies and GC32-XD™ dies, it can also make Gates hydraulic hose assemblies.

• **Capability:**
  • 1/4" to 2" Industrial and Hydraulic Hose
  • 2-1/2" to 4" Industrial Hose
  • 5" to 6" Industrial Hose (up to 100 psi WP)

• **A two-stage crimping process** accelerates the crimp cycle, thus shortening the time it takes to make a lot of assemblies.

• **Troubleshooting is self-diagnosing.** Coded lights under the control panel diagnose problems - and provide their solutions - at a glance.

• **Wireless compter capability** allows the operator to download crimp data for Gates industrial and hydraulic hose.

• **Plug 'n' play modular components.** If the crimper head needs replacing, just unbolt it and plug in a new one. Same for the power unit or control board. Repairs are simple, in the shop or in the field.

INSTALLING HOSE ASSEMBLIES

Before installing hydraulic hose assemblies, review the safety precautions in Chapter 2 of this manual as well as your equipment's operations manual. Installation varies based on coupling configurations, use of adapters and routing.

Coupling Configurations

Male fitting to port connections can be made using four types of configurations:

- Solid male (MP, MB, MBSPT, etc.).
- Male swivels (MPX, MBX, MIX).
- Flanges (FL, FLH, FLC, FLK).
- Block-style adapters with lock nuts.

Solid male fittings are installed by rotating the entire hose assembly as you thread the male into the port. Teflon® tape can be used on the tapered threads to ease installation and improve seal.

If an O-ring is used, lubricate it with 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.

Flanges are installed using split flange clamps. The following are steps for proper flange fitting installation:

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

3. Install clamp halves over flange head and thread in bolts by hand.
4. Use torque wrench to tighten using crossing pattern.
5. Torque to manufacturer's specifications.

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

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 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 connecting to tubing. Installation steps are as follows:

1. Make sure the tube is cut cleanly with no burrs or paint buildup.
2. Place nut, then bite sleeve over tube. Bite sleeve must be oriented with taper facing away from tube.
3. Locate tubing into male fitting and secure nut over threads. The bite sleeve will compress against the tube and seal with the male internal taper.

Use of Adapters

Adapters can be used 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, use a straight fitting and an angle adapter on one end. This makes installation easier and eliminates the need for orientation. However, this requires more parts and increases the number of joints for potential leakage.
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. As a rule of thumb, it is better to use a straight adapter and bent tube coupling than an angled adapter and straight hose end. This promotes laminar flow and reduces pressure drop.

   When using adapters, the preferred method is to install the adapter first, the hose assembly next.

Hose Assembly Routing Tips

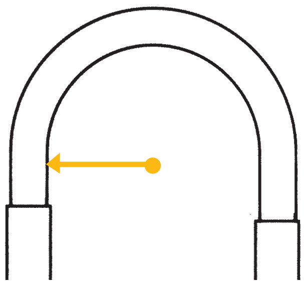
Proper hose installation is essential for satisfactory performance. If hose length is excessive, the installation's appearance will be unsatisfactory, and unnecessary equipment costs will be incurred. If hose assemblies are too short to permit adequate flexing and allow for length changes due to expansion or contraction, service life will be reduced.

Hose can elongate up to 2 percent or contract up to 4 percent depending on hose construction. Routing must take this into account.

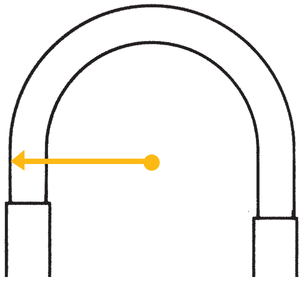
The diagrams on the following pages show proper hose routing, which provides maximum performance and cost savings. Consider these examples in determining length of a specific assembly.

Bend Radius

The minimum bend radius of a hose is 1/2 the smallest diameter the hose can be bent without internal damage or kinking. Most hydraulic hose manufacturers list the minimum bend radius for their hose, which is based on the hose construction, pressure rating, size and wall thickness. Bend radius is measured to the inside of the curvature as shown below.



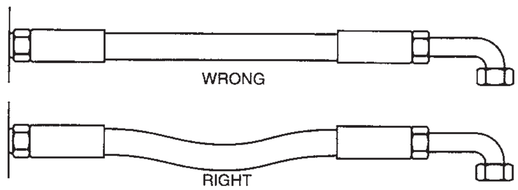
Correct



Incorrect

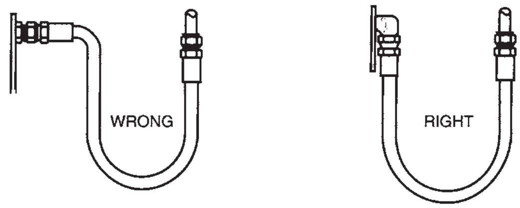
Hose Assembly Routing Tips

Length Change



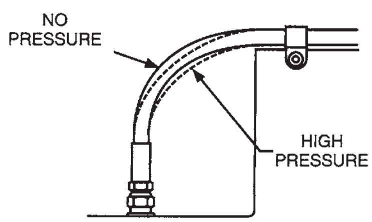
When hose installation is straight, allow enough slack in hose line to provide for length changes which will occur when pressure is applied.

Tight Bend



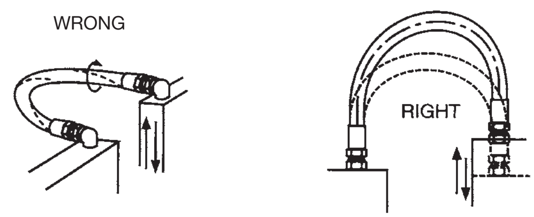
Use proper angle adapters to avoid tight bend in hose.

Length Change



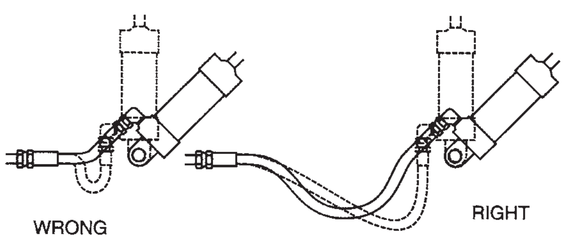
To allow for length changes when the hose is pressurized, do not clamp at bends so that curves will absorb changes. Do not clamp high and low pressure lines together.

Twist



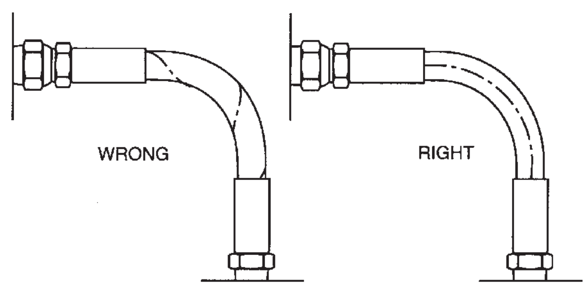
Prevent twisting and distortion by bending hose in same plane as the motion of the port to which hose is connected.

Movement/Flexing



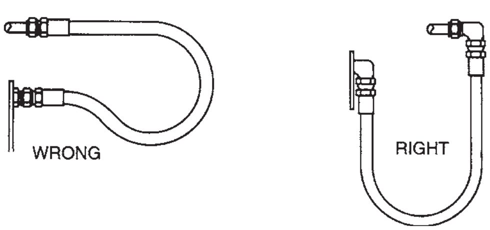
Adequate hose length is necessary to distribute movement on flexing applications and to avoid abrasion.

Twist



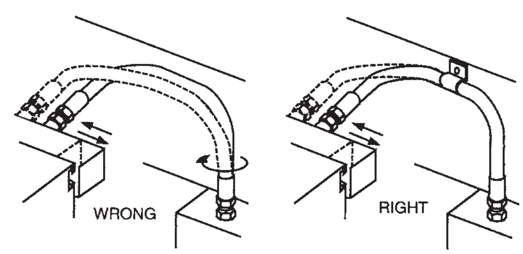
When installing hose, make sure it is not twisted. Pressure applied to a twisted hose can result in hose failure or loosening of connections.

Tight Bend



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

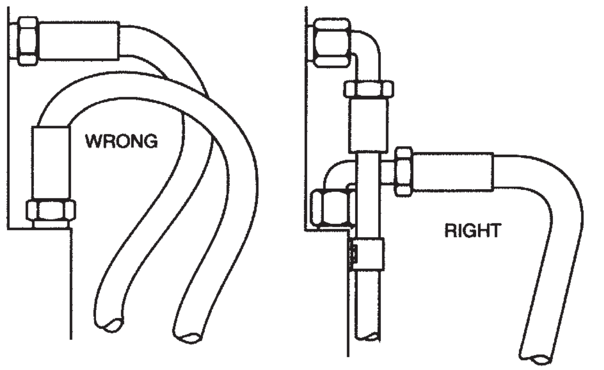
Twist



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

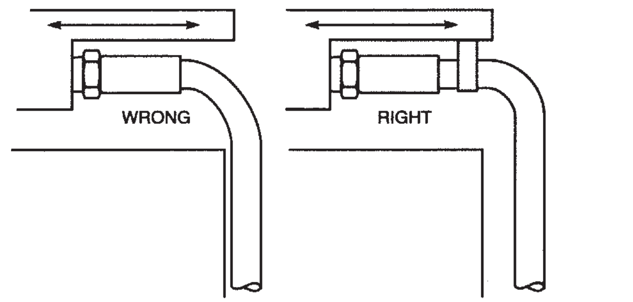
Hose Assembly Routing Tips

Strain



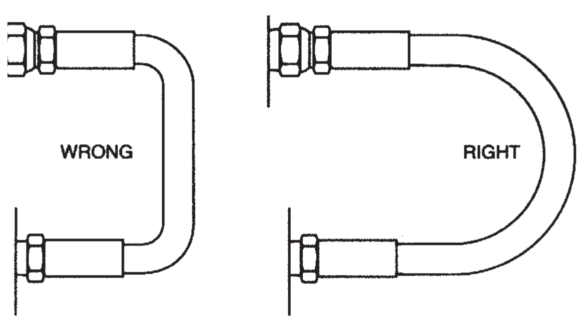
Elbows and adapters should be used to relieve strain on the assembly, and to provide neater installations which will be more accessible for inspection and maintenance.

Abrasion



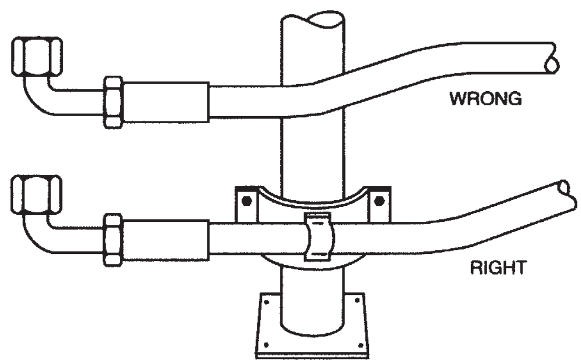
Run hose in the installation so that it avoids rubbing and abrasion. Often, clamps are required to support long hose runs or to keep hose away from moving parts. Use clamps of the correct size. A clamp too large allows hose to move inside the clamp and cause abrasion.

Collapse



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

High Heat

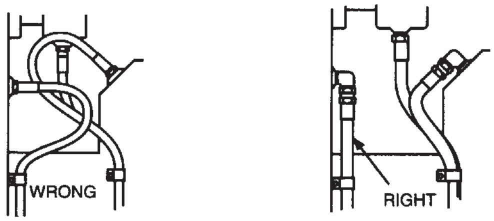


High ambient temperatures shorten hose life, so make sure hose is kept away from hot parts. If this is not possible, insulate hose with Gates HeatGuard™ sleeving.

Reduce Connections

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

Appearance



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

Seven Easy Steps to Install a Hose Assembly

1. Clean the surrounding area where connections are to be made. Make sure no dirt or contamination gets into hydraulic openings.

2. Install adapters into ports (if used). Torque to manufacturer's specifications.

3. Lay the hose assembly into routing position to verify length and correct routing.

4. Thread one end of hose assembly onto port (or adapter). If the hose assembly uses an angled fitting, always install it first to ensure proper positioning.

5. Thread other end of the assembly without twisting the hose. Use a wrench on the backup hex of the fitting while tightening.

6. Properly torque both ends (see following page for torque information).

7. Run the hydraulic system to circulate oil under low pressure and safely reinspect for leaks and potentially damaging contact. Circulating also purges air from the system that can cause sluggish performance and possible damage to pumps and other components.

(under no pressure)

Installation Torque*

Installation torque is very important to ensure a proper leak-free seal. Overtorquing of a threaded connection can stretch and damage threads and mating seat angles. It can also damage the staking area of a nut or possibly break a bolt on the port area. Undertorquing does not allow proper sealing.

*Gates recommends dry torque values. Torque values in these charts are for dry (non-lubricated) threads.

If a threaded connection leaks, maintenance personnel may be inclined to tighten the connection until the leak stops. This approach may solve the leak problem, but it also may cause more damage. Torque should first be checked before continued tightening to ensure it is within accepted limits.

The most reliable method of torquing threaded connections is to first hand-tighten the connection, then use a torque wrench to measure the torque. Torque values vary by thread configuration as follows:

Think Safety!

CAUTION: Overtorquing may damage nuts, adapters or sealing seats, which may result in leaks, breakage, and potential for injury or damage to property.

For 37° & 45° (Machined or Flared)

Size		Steel				Brass			
		Ft.-Lbs.		Newton-Meters		Ft.-Lbs.		Newton-Meters	
Dash	Fractional (In.)	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
-4	¼	10	11	13	15	5	6	6¾	9
-5	5⁄16	13	15	18	20	7	9	10	13
-6	⅜	17	19	23	26	12	15	17	20
-8	½	34	38	47	52	20	24	27⅔	33
-10	⅝	50	56	69	76	34	40	46⅓	55
-12	¾	70	78	96	106	53	60	72⅓	82
-16	1	94	104	127	141	74	82	100½	111
-20	1¼	124	138	169	188	75	83	101½	113
-24	1½	156	173	212	235	79	87	9	9
-32	2	219	243	296	329	158	175	17¾	19

For Flat-Face "O" Ring Seal (Steel)

Size		Ft.-Lbs.		Newton-Meters	
Dash	Fractional (In.)	Minimum	Maximum	Minimum	Maximum
-4	¼	10	12	14	16
-6	⅜	18	20	24	27
-8	½	32	40	43	54
-10	⅝	46	56	60	75
-12	¾	65	80	90	110
-14	⅞	65	80	90	110
-16	1	92	105	125	240
-20	1¼	125	140	170	190
-24	1½	150	180	200	245

For SAE "O" Ring Boss (Steel)

Size		Ft.-Lbs.		Newton-Meters	
Dash	Fractional (In.)	Minimum	Maximum	Minimum	Maximum
-3	3⁄16	8	10	11	13
-4	¼	14	16	20	22
-5	5⁄16	18	20	24	27
-6	⅜	24	26	33	35
-8	½	50	60	68	78
-10	⅝	72	80	98	110
-12	¾	125	135	170	183
-14	⅞	160	180	215	245
-16	1	200	220	270	300
-20	1¼	210	280	285	380
-24	1½	270	360	370	490

For BSP 30° Inverted Cone

Size		Ft.-Lbs.		Newton-Meters	
Dash	Fractional (In.)	Minimum	Maximum	Minimum	Maximum
-2	⅛	7	9	9	12
-4	¼	11	18	15	24
-6	⅜	19	28	26	38
-8	½	30	36	41	49
-10	⅝	37	44	50	60
-12	¾	50	60	68	81
-16	1	79	95	107	129
-20	1¼	127	152	172	206
-24	1½	167	190	226	258
-32	2	262	314	355	426

For DIN 2353 12°, 30° and Universal Inverted Cone

Size		Ft.-Lbs.		Newton-Meters	
Light Series Tube O.D. (mm)	Heavy Series Tube O.D. (mm)	Minimum	Maximum	Minimum	Maximum
-6	—	7	15	10	20
-8	—	15	26	20	35
-10	-8	18	30	25	40
-12	-10	22	33	30	45
-14	-12	26	37	35	50
-15	-14	30	52	40	70
—	-16	30	52	40	70
-18	—	44	74	60	100
-22	-20	59	89	80	120
-28	-25	74	111	100	150
—	-30	74	163	150	220
-35	—	133	184	180	250
-42	-38	148	221	200	300

Bundling

When installing hose assemblies, bundling techniques can improve space utilization, appearance and hose life. Here are some tips:

1. Group and bundle similarly constructed and sized hose together using clamps, nylon straps or nylon sleeving.
2. Never bundle high-pressure hose with low-pressure hose. Under pressure, they can work against each other.
3. Never bundle rubber hose with thermoplastic or Teflon® hose. Under pressure, they can also work against each other.
4. Always consider mechanical movement when bundling. Allow sufficient slack without pulling on a fitting or another hose. Bundles (like individual hose) should bend in one plane only.

Sleeving

A number of sleeving types are used today. The most common is nylon, which is typically used for one or more of the following:

1. To protect hoses from abrasion.
2. For use in bundling hoses.

LifeGuard™ Sleeving

Protect against pinhole leaks or hose bursts up to 6,000 psi with Gates LifeGuard sleeving. This sleeving system is an effective, economical alternative to costly metal shielding. Just slip on the hose and clamp at each end to contain any escaping fluids under pressure.

Think Safety!

CAUTION: It is important to remember that most sleeving provides little or no operator protection. Use sound engineering judgement in the design of equipment in order to control the hazard of direct exposure of operators to fluids under pressure.

Think Safety!

CAUTION: Do not use nylon sleeves when internal temperatures exceed 250°F, or if the ambient temperatures exceed 212°F, to avoid sleeving damage and personal injury. Use Gates HeatGuard™ sleeving.

megasys

Gates now offers an abrasion-resistant hose cover with far greater abrasion resistance than any standard rubber hose in the industry. Gates XtraTuff® and MegaTuff® hose was developed to solve your abrasion problems.

Spring Guards

There are many types of spring guards – flat armor, plated wire, plastic, etc. They can be used to bundle hose or provide stability and/or protection against abrasion. Also, tightly wound plated wire guards can be used as bend restrictors to ease stress on the hose.

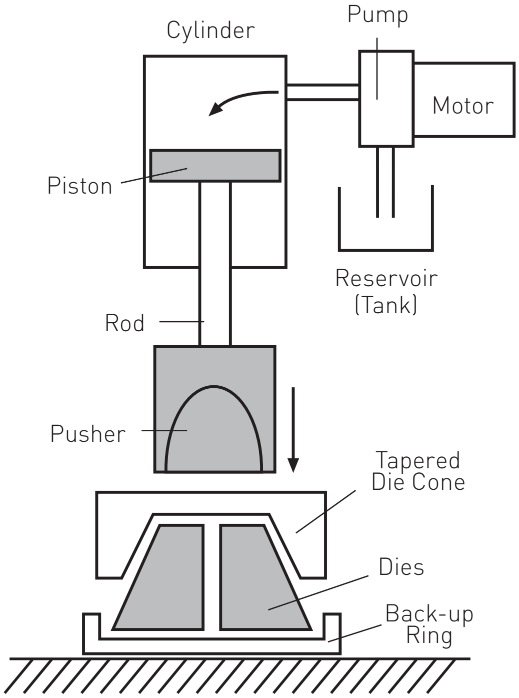
Bend Restrictors

Bend restrictors typically are PVC sleeves which are installed near the coupling during hose assembly. They reduce bending stress in the hose to prevent damage.

CRIMPER PREVENTIVE MAINTENANCE

As with other types of equipment, it is very important to properly maintain crimpers.

A typical crimper is a hydraulic ram that uses fluid under pressure to extend the ram and crimp the fittings.



Think Safety!

Read and follow operating manual. This information for general preventive maintenance.

Fluid flows from the pumps to the cylinder under pressure. This extends the piston, rod and pusher down on the die cone. The die cone is sloped to receive tapered die fingers. As the die cone is pushed by the hydraulic ram, the die fingers are forced (perpendicular) inward. The set of die fingers completely surrounds the ferrule to provide an even crimp.

Though there are many types and configurations of crimpers, i.e., vertical (bottom or top loading), horizontal or angled, the basic principle of operation is the same. Pumps do not have to be electronically driven. They can be manual or air driven.

Care should be taken to properly set up and maintain these crimpers.

Crimper Setup

Here are the steps to properly set up a crimper:

1. Remove crimper and pump from shipping container.
2. Position crimper on stable surface.

Think Safety!

NOTE: It's a good idea to place a rubber mat on the floor near the crimper to reduce the chance of damaging a die if dropped and to improve operator comfort.

3. Connect hydraulic hose assembly to the crimper and pump. Refer to pump manual for proper port connection. Also, install the breather cap in the reservoir (tank) if needed. Fill pump reservoir with oil.
4. Make the proper electrical connections.

Think Safety!

WARNING: Check to verify that the voltage and phase rating of both the crimper and power unit are compatible with the power source.

5. Bleed air from the system. Follow procedures in the crimper operations manual.
6. Lubricate all metal-to-metal sliding surfaces with a thin layer of the recommended lubricant. This includes dies, cones and die shoes.
7. Check calibration of the machine by following the procedure in the operations manual. Recalibrate as required.

Crimper Maintenance

If cared for properly, a crimper should last a long time. The following are routine but very important maintenance considerations.

Lubrication

Think Safety!

IMPORTANT NOTE: Lubricants should be reapplied to metal-to-metal sliding surfaces whenever the surfaces becomes shiny. Use only a very thin coat of Molycote lube. Failure to do so reduces the life of the dies and cone. Excessive wear on these components produces poorly performing hose assemblies that could blow apart and result in injury.

Calibration

Check the crimper's calibration at least monthly or whenever you notice a change in crimp diameter. This is critical for repeatedly producing accurate hose assemblies. Be aware that some machines calibrate automatically.

Hose Assembly

Check the hose assembly which connects the pump to the cylinder. Use Chapter 3 as a guide to inspect the hose. Replace if necessary with a properly rated hose assembly.

Think Safety!

NOTE: If hose assembly is not periodically checked for damage or replaced with properly rated assembly, personal injury may result.

Fluid Level

Proper fluid level in the reservoir (tank) is important for maximum crimp stroke as well as keeping 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 dies' sliding and crimping surfaces for wear or damage during use. Look for nicks, chips, cracks, gouges and/or other signs of wear. Replace die if any of these exist. Proper storage and lube will extend their service. Store in stable racks or in original packaging.

Cleaning

Hydraulic fluid and lubricants can pickup dirt and debris. Clean off any buildup using a clean shop rag. Buildup can damage crimper components and produce inaccurate crimped assemblies.

Oil Change and Bleeding

Depending on the amount of usage, fluid should be changed periodically. Fluid viscosity can break down under high usage and temperatures. Also, component wear can contaminate the fluid. Drain and replace with the recommended fluid (see crimper and/or pump operator's manual).

Crimper Troubleshooting

If your crimper isn't performing correctly, you may have to do some troubleshooting.

First, determine the symptoms — what is it doing or not doing? Are all connections made properly? Is there any fluid leakage? Have any modifications been made?

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

Cylinder Seal

A seal is used between the piston and cylinder that provides the proper seal under pressure. In time and with usage, these seals can wear and eventually leak or roll. Fluid leakage is a sign that seal replacement is necessary. Also, if the piston (ram) jams in the cylinder, the seal may need replacement.

Electrical

Electrical problems can be difficult to troubleshoot. Make sure the power source is compatible with the crimper and pump. Replacement components are available if necessary.

Pump

Pump components can be damaged from debris in fluid, low-temperature operation or air in the system. Debris may cause a valve to stick; low temperatures thicken the fluid and can cause component damage; and air can damage pump components.

Problem	Solution
Ram won't return (stuck).	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 must be damaged. Replace the seal using the proper seal replacement kit and instructions. If fluid escapes through the hose assembly, the check valve in the pump must be stuck. It may need cleaning and/or replacement. Contact your local Gates representative.
Digital display is blank.	Check all electrical wiring to make sure connections are made properly. The wrong voltage supplied to the digital display will damage it and require replacement. If all connections are made properly, the display may have been damaged. Identify the source of the damage and replace the digital display.
Digital display is incorrect.	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 switchbox.

Problem	Solution
Cylinder is leaking fluid.	Disassemble the cylinder using the proper seal replacement instructions and check the cylinder wall for scoring or damage. If the cylinder is damaged, it will require rework. If the cylinder is not damaged, replace the worn seal using the seal replacement kit.
Broken die fingers or die cone.	Check the crimp specifications to ensure the proper die, hose, cone and setting are being used. Also, check the calibration. A broken die finger is usually the result of damage from a fall or improper use of the notched die cone. A broken cone (usually the notched cone) may also be the result of a fall or improper use. Replace all broken or damaged parts.
Crimper won't plug into power unit.	Check the voltage rating on both the power unit and the crimper for compatibility. A 115 volt connector differs from a 230 volt connector. Return and replace the incorrect component (pump or crimper) or contact your local Gates representative.
Over- or under-crimping.	Check calibration following the standard procedure in the operator's manual or on crimper decal. Adjust the actuator rod or switchbox position as necessary. Also, check the crimp specifications.

SAFETY AND MAINTENANCE FOR GATES CRIMPERS

MobileCrimp® 4-20

SAFETY

1. Hands on TRAINING to properly and safely use this crimper is recommended.
2. Follow the procedure in GATES OPERATORS MANUAL for this crimper.
3. Use only NEW (unused) GATES HOSE AND FITTINGS.
4. Always wear SAFETY GLASSES!

S. Keep hands clear of moving parts.

6. Make sure the CYLINDER IS LOCKED IN CRIMP POSITION before operating.
7. Do not operate unless CRIMPER SAFETY COVER IS IN PLACE.
8. Do not operate crimper in a horizontal position.
9. FOLLOW GATES CRIMP SPECIFICATIONS when operating this crimper. Do not substitute coupling components or crimper dies. Use only those components and tooling that Gates specifies.

MAINTENANCE

1. A thin layer of Molycote grease should be applied to the inside surface of the die cone. Periodically use a small brush to redistribute this thin layer of Molykote grease whenever the die cone shows shiny metal areas where the sliding dies rubbed it clear.
2. A high grade of hydraulic oil such as Mobil DTE 25 should be maintained to within 1/2" of the top of the electro-hydraulic pump.
3. Periodically inspect dies, spacers, and the pressure plate looking for any scratches, gouges, chips or cracks, or any other sign of excessive wear or damage. Replace if necessary.
4. Periodically inspect the hose assembly connecting the pump to the crimper. If there is any sign of leakage, cuts, hose kinks, hose stiffness, or cover hardening or cracking, replace immediately.
5. Check the calibration of a digital dial control crimper (the relationship between the crimper setting and the finished crimp diameter) anytime a crimp diameter falls outside the specified tolerance. Follow the Operator's Manual for adjustment procedures.
6. Never operate below 40°F as cold temperatures can increase the viscosity of the oil which could result in a loss of ram force and even damage the pump. In cold environments heat the oil in the pump reservoir with a warm air blower, heat tape, or by any other safe means that does not use high heat.
7. If the ram does not retract upon completion of a crimp you can determine if the problem lies in the pump or crimper and how to correct the situation very quickly and easily by following the procedures outlined in the Operator's Manual for this crimper.
8. In the digital dial control model if the light and buzzer stop working it probably means the two AAA batteries need replacement. Refer to the Operator's Manual for instructions.

Power Crimp® 707

SAFETY

1. Hands-on TRAINING to properly use this crimper is recommended.
2. Follow the procedures in Gates OPERATOR'S MANUAL for this crimper.
3. Use only NEW (unused) GATES HOSE AND FITTINGS.
4. Always wear SAFETY GLASSES!
5. Keep hands clear of moving parts.
6. Make sure the die cone and die set together with the hose and fitting to be crimped are pushed back against the two locator pins at the back of the crimper base to center the die cone and dies under the ram pusher.
7. Do not operate this crimper in a horizontal position.
8. Follow GATES CRIMP SPECIFICATIONS when operating this crimper. Do not substitute coupling components or crimper dies. Use only those components and tooling that Gates specifies.

MAINTENANCE

1. A thin layer of Molykote grease should be applied to the inner tapered surface of the die cone. Periodically after that, use a small brush to redistribute this grease whenever the die cone shows shiny areas where the sliding dies have rubbed it clean.
2. A high grade of hydraulic oil such as Mobil DTE 25 should be maintained to within 1/2" of the top of the electro-hydraulic pump reservoir.
3. Periodically inspect dies, spacers, and the die cone looking for any scratches, gouges, chips or cracks, or any other sign of excessive wear or damage. Replace if necessary.
4. Periodically inspect the hose assembly connecting the pump to the crimper. If there is any sign of leakage, cuts, hose kinks, hose stiffness, or cover hardening or cracking, replace with a new hose assembly of the same type.
5. Any time a crimp diameter falls outside the allowable tolerance, check the calibration of the setting number to the finished crimp diameter. Procedure to do this and to make any necessary adjustments are presented in the OPERATOR'S MANUAL.
6. Never operate below 40°F as low temperatures can increase the viscosity of the pump oil which could result in slower operation, loss of ram force, and even damage the pump. If the temperature drops below 40°F, heat the oil in the pump reservoir with a warm air blower, heat tape, or by some other safe method.
7. If there is a loss of crimper ram force, first check the level of oil in the pump reservoir. If that is within 1/2" of the top, then check the crimper for oil leaks around the piston and cylinder. Worn seals can allow back-flow and pressure loss. A gauge in line can measure the pressure when the ram is bottomed. It should be 4,900 psi. If there are no leaks and the pump reservoir is full it may mean that the pump seals have worn and need replacement.
8. Failure of the ram to retract may mean that either a seal has torn and jammed between the piston and cylinder wall or the directional control valve in the pump has stuck. To determine which is the case, disconnect the hose at the pump end while the ram is down, but not under crimp load. Have a can and rags handy to catch the oil that may spurt out of the hose. If oil does come out ofthe disconnected hose end and the ram retracts, the problem is in the pump. Remove the directional control valve (unscrew the double hex on one side of the manifold plate between the pump motor and reservoir). Clean this valve in carburetor cleaner and replace in pump. If however, the ram does not move when the hose end is detached at the pump, then the problem is in the crimper. Order a replacement seal kit and follow the directions that come in the seal kit.

Power Crimp® 3000B

SAFETY

I. Hands-on TRAINING to properly and safely use this crimper is recommended.

2. Follow the procedures in Gates OPERATOR'S MANUAL for this crimper.

3. Use only NEW (unused) GATES HOSE AND FITTINGS.

4. Always wear SAFETY GLASSES!

5. Keep hands clear of moving parts.

6. Follow GATES CRIMP SPECIFICATIONS when operating this crimper. Do not substitute coupling components or crimper dies. Use only those parts and tooling as specified by Gates.

MAINTENANCE

1. A thin film of Molykote grease should be applied to the inner tapered surface in the head plate. Whenever shiny metal areas appear on this tapered cone surface from the rubbing of the dies, use a small brush to redistribute the grease.

2. Periodically inspect the dies and die cone looking for any scratches, chips or cracks, or any other sign of excessive wear or damage. Replace if necessary.

3. Periodically inspect the hose assembly connecting the pump to the crimper. If there is any sign of leakage, cuts, hose kinks, hose stiffness, or cover hardening or cracking, replace with a new hose assembly of the same type.

4. Anytime the crimp diameter falls outside the specified tolerance, check the calibration of the setting number to the finished crimp diameter. Procedure to do this and to make any necessary adjustments are presented in the OPERATOR'S MANUAL.

5. Never operate below 40°F as low temperatures can increase the viscosity of the pump oil slowing its operation or even resulting in pump damage. Use a safe method to heat the oil such as a warm air blower or heat tape.

6. If there is a loss of crimping power, check the level of the oil in the pump reservoir. If it is within 1/2" of the top, then next check for oil leaks around the base of the cylinder. This may indicate damage to the piston seals and necessitate replacement. Follow the directions that come with the replacement seal kit.

GC32-XD™

SAFETY

1. Hands-on TRAINING to properly and safely use this crimper is recommended.
2. Follow the procedures in Gates OPERATOR'S MANUAL for this crimper.
3. Use only NEW (unused) GATES HOSE AND FITTINGS.
4. Always wear SAFETY GLASSES!
5. Keep hands clear of moving parts.
6. Follow GATES CRIMP SPECIFICATIONS when operating this crimper. Do not substitute coupling components or crimper dies. Use only those parts and tooling as specified by Gates.

MAINTENANCE

1. Once every 250 crimps, expose the grease fittings by cycling the hose crimper head to its closed position. Give each fitting (eight front, 16 rear) a shot from a grease gun. Cycle the hose crimper five times to distribute the grease evenly.
2. An oil filter in the hydraulic reservoir keeps the fluid clean, extending the life of the pump. Use a wrench to loosen the spring-loaded cap on the filter. Reach in and pull out the filter to check it. Change it when you change the oil.
3. Add hydraulic oil every 10 hours or so. Keep an eye on the oil level in the reservoir sight glass. When it's low, top it off.
4. The air filter is under the breather cap that sits atop the oil reservoir. Check the filter periodically and change it when necessary.
5. Die-filler sponges prevent foreign debris and dirt from getting into the hose crimper. Every 1,000 crimps, take them out and check them. When you squeeze them, healthy sponges rebound to their original shape. If they do not, it's time to replace them.

GC96™

SAFETY

1. Hands-on TRAINING to properly and safely use this crimper is recommended.
2. Follow the procedures in Gates OPERATOR'S MANUAL for this crimper.
3. Use only NEW (unused) GATES HOSE AND FITTINGS.
4. Always wear SAFETY GLASSES!
5. Keep hands clear of moving parts.
6. Follow GATES CRIMP SPECIFICATIONS when operating this crimper. Do not substitute coupling components or crimper dies. Use only those parts and tooling as specified by Gates.

MAINTENANCE

1. Once every 250 crimps, expose the grease fittings by cycling the hose crimper head to its closed position. Give each fitting (eight front, 16 rear) a shot from a grease gun. Cycle the hose crimper five times to distribute the grease evenly.
2. An oil filter in the hydraulic reservoir keeps the fluid clean, extending the life of the pump. Use a wrench to loosen the spring-loaded cap on the filter. Reach in and pull out the filter to check it. Change it when you change the oil.
3. Add hydraulic oil every 10 hours or so. Keep an eye on the oil level in the reservoir sight glass. When it's low, top it off.
4. The air filter is under the breather cap that sits atop the oil reservoir. Check the filter periodically and change it when necessary.

GLOSSARY OF TERMS

Abrasion, Hose The wearing, grinding or rubbing away of material. The products of abrasion will be introduced into the system as generated particulate contamination.

Accumulator A container in which fluid is stored under pressure. Most commonly with a gaseous space above the fluid.

Air Breather A device permitting air movement between atmosphere and the component in which it is installed.

Bar A unit of pressure based on Newtons per square meter, approximately equal to 14.5 PSI. This unit is not preferred in SI metrics.

Bend Radius The radius of a bent section of hose is always measured to the innermost surface of curved portion.

Buffing The partial removal of the hose cover in order to put on a coupling. A stone wheel is typically used to grind or buff the cover.

Bundling Grouping numerous hoses together.

Burst Pressure The pressure that causes rupture. Reference pressure intended for destructive testing purposes and design safety factors only.

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

Cleanliness Level The measurement of contamination level.

Component A device in a system or circuit that performs a given function (i.e., pump, valve, motor, etc.).

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

Contaminant Any material or substance that is unwanted or adversely affects the fluid power system or components or both.

Corrosion The chemical change in the mechanical elements caused by the interaction of fluid or contaminants or both. More specifically related to chemical changes in metals. The products of change may be introduced into the system as generated particulate contamination.

Crimp A method of permanently attaching hose ends.

Cut-Off Length The length of that part of the coupling not directly in contact with or applied to the hose. Subtract the sum of the cut-off length of the two couplings from the total length of the assembly, and you will have the approximate hose-cut length to be replaced.

Dash Size A shorthand method of denoting the size of a particular end fitting or the inside diameter of a hose. Measured in 1/16 of an inch (i.e., -4 = 4/16 or 1/4).

EPA Environmental Protection Agency.

Effusion The process where chemical molecules move through the hose tube and escape from a hose.

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

Flange A plate attached to the end of a tube which can be clamped or bolted to a mated component interface. SAE J518 Code 61 or Code 62 defines the dimensional and performance requirements.

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

Fluid A liquid, gas or combination thereof.

Fluid Compatibility The hydraulic assembly (tube, cover, reinforcement and couplings) must be fluid compatible. The correct hose must be used because some hydraulic fluids have drastically different chemical characteristics. Many hoses are compatible with most, but not all, fluids.

Friction (Fluid) The rubbing of fluid against the inside walls of the hose assembly.

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

Hose Length Correct hose length determinations include consideration for length, length changes under pressure, machine vibration and motion, and hose assembly routing.

Hose Routing The most direct or best path a hose uses to connect one port to another. Determine hose lengths and configurations that will result in proper routing and protection from abrasion, snagging or kinking and provide leak-resistant connections.

Laminar Flow Liquid particles flowing smoothly in even layers with no cross flow.

Layline The printed line on the hose cover used as a manual to ensure that the hose lies straight with no twisting.

Locking Collar The collar behind the stem hex. When crimped, it interfaces with the ferrule lip and locks the stem and ferrule together.

Lockout/Tagout (LO/TO) The placement of a tagout device on a power switch, in accordance with an established procedure, to indicate that the power switch and the equipment being controlled may not be operated until the tagout is removed.

Minimum Bend Radius The tightest a hose can be bent prior to exerting excessive force that can cause kinking or damage.

O-Ring A ring that has a round cross-section usually used for sealing.

Orientation The alignment of couplings (bent or block) on a hose assembly.

Peaks A marked jump in pressure in a system. Also called spikes or surges.

Perforated The process of making holes in a hydraulic cover. This enables any air or gases to escape (bleed) through and not bubble or blister the cover.

Petroleum Fluid A fluid composed of petroleum oil. It may contain additives.

Pinhole A small hole in a hose that can spray fluid at a high pressure.

Port Threaded or unthreaded female connection of a fluid power component which is flush with the surface.

Pressure Force per unit area. The distributed reaction (pressure) on a confined fluid is typically measured in pounds per square inch.

Pressure Drop 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.

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

Return Line The line conducting fluid from working devices to the reservoir.

SAE Society of Automotive Engineers.

SAE Port A straight thread port used to attach tube and hose fittings. It employs an O-ring compressed in a wedge-shaped cavity.

Skiving The process of removing the outer cover of a hose before installing the coupling.

Sleeving Nylon or cordora sleeving provides excellent abrasion resistance to protect individual hoses; can be used to bundle several hose assemblies together for maximum protection.

Static Discharge Producing stationary charges of electricity.

Suction Line A supply line at sub-atmospheric pressure to a pump, compressor or other component.

Swage A method of permanently attaching couplings where the coupling is compressed to the hose by forcing it through a tapered hole in a die.

Synthetic Fluid Fluid that has been artificially compounded for use in a fluid power system.

Torque A rotational twisting force.

Turbulent Flow A flow situation in which the fluid particles move in a random manner.

Vacuum Pressure less than atmospheric pressure. It is usually expressed in inches of Mercury (in. Hg) as referred to the existing atmospheric pressure.

Velocity The time rate (speed) of linear motion in a given direction.

Viscosity A measure of the internal friction or the resistance of a fluid to flow.

Viscosity Index A measure of how viscosity changes in relation to temperature.

Water Glycol Fluid A fluid whose major constituents are water and one or more glycols or polyglycols.

Working Pressure The pressure at which the hydraulic system operates. Pressure surges or peaks exceeding the rated working pressure are destructive and must be taken into account when selecting a hose.

Gates also offers safety and preventive maintenance programs for industrial hose. Contact your Gates representative for more information.

Gates Corporation

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