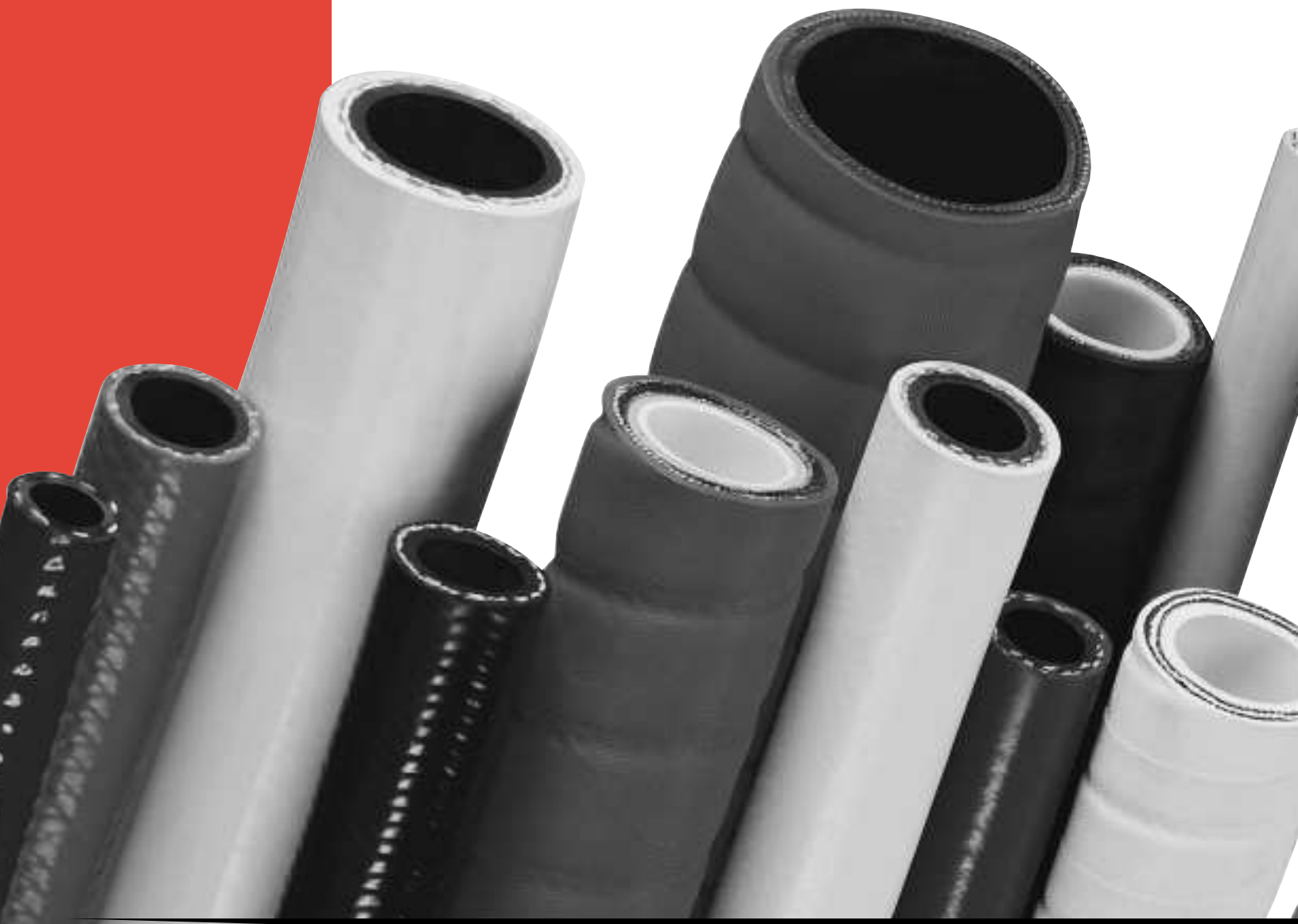
THE GATES SAFETY GUIDE

An Inspection and Preventive Maintenance Program for Industrial Hose



The New Force in Industrial Hose

TABLE OF CONTENTS

THE GATES RUBBER COMPANY

INTRODUCTION

What is Preventive Maintenance?

- Identification of potential problems before failures occur.
- Keeping equipment in operation by preventing key component failures. A ruptured hose can damage equipment, stop production, and even cause injury | or death.

Benefits of a Preventive Maintenance Program:

- Elimination of costly repairs
- Reduced production downtime due to hose failures
- Helps ensure a safe work environment
- Reduces costly EPA spill clean ups
- Increases hose life expectancy

Components of a Preventive Maintenance Program:

Preventive Knowledge

- Proper hose selection and application
- Proper coupling selection
- Proper attachment of coupling to hose
- Maintenance and storage tips
- Agency specifications

Preventive Action

- Periodic inspections
- Hydrostatic/pressure testing
- Replacement
- Proper hose storage
- Trouble-shooting

THE GATES RUBBER COMPANY

DEFINITION OF AN INDUSTRIAL HOSE

An industrial hose is a flexible reinforced tube for conveying liquids, solids, and gases. A typical industrial hose is dragged, coiled, run over, kinked and subjected to all kinds of abuse. Therefore, the application and its environment must be taken into consideration for proper hose selection. Selection of the proper hose and materials will increase hose life, improve performance, and ensure safety.

Industrial hose is used for three purposes:

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

Caution!

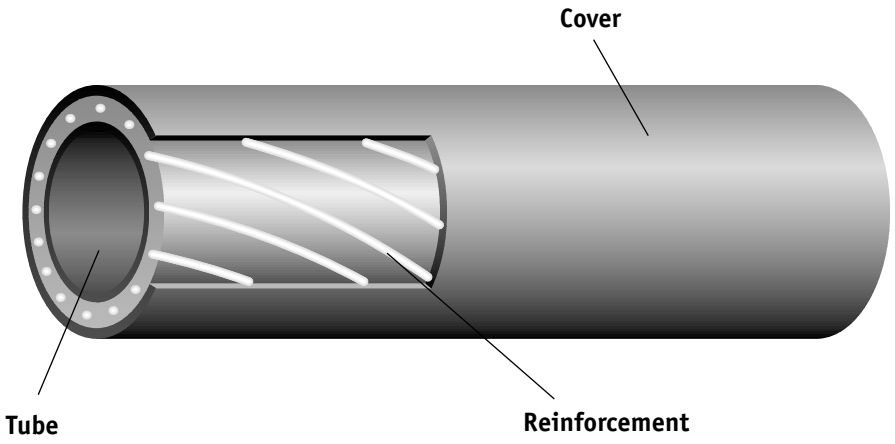
1. Hose should not be used in "out-of-sight" applications, where the hose is buried, encased, or submerged. Use rigid pipe in those applications.
2. Hose has a finite service life and is not to be used in permanent applications.

Three Basic Elements of a Hose

Tube – Its purpose is to handle specific fluids or solids. It is the innermost rubber or plastic component of the hose that must be resistant to the material that it is intended to convey because it is the part of the hose in contact with the material. A variety of compounds can be used depending on the application.

Reinforcement – Its purpose is to withstand a specific amount of working pressure measured in pounds per square inch (psi) or Pascal (Pa) or vacuum (In Hg, inches of mercury). The reinforcement may consist of many layers of fabric, yarn or wire placed on top of the tube and referred to as "plies."

Cover – Its primary purpose is to protect the tube and reinforcement from external factors such as ozone, weather, abrasion and heat. A variety of compounds can be used, depending on the application.



PROPER HOSE SELECTION

Proper hose selection is the first step in preventive maintenance. Selecting the best product for the application will allow you to obtain the maximum life expectancy from the product for the best value.

When selecting the correct hose, use the acronym STAMPED as your guide:

S - Size:

- I.D. (Inside Diameter)
- O.D. (Outside Diameter)
- Based on the machinery sizing.
- Flow rate requirements (GPM for liquids; CFM for gases).

T - Temperature:

- Consider exterior and interior temperature, as well as temperature impact on the material being conveyed.

A - Application:

- Where will the hose be used?
- How will the hose be used?
- How often will the hose be used (continuous, intermittent, seldom)?
- What are the environmental conditions?
- Special hose construction (crush resistant)?
- Conductivity requirements?
- Is the hose used in a critical application?
- Government or Industrial Standard requirements?
- Use hoses that are specifically designed for these applications:
  - Steam
  - LP Gas
  - Aircraft Ground Refueling
  - Corrosive Chemicals

M - Material being conveyed:

- Chemical name(s) and state(s) - (liquid, solid or gas)
- Food
- Dry or powder
- Liquid

P - Pressure

- What is the working pressure?
- What is the maximum surge pressure?
- Is there a vacuum?

E - End requirements

- What type of thread ends?
- See Proper Coupling Selection section on page 6

D - Delivery

- Identify how many items and when they need to be supplied.
  - Distributors - Call Customer Service.
  - End Users - Call Distributors.

THE GATES RUBBER COMPANY

When all information has been obtained, look in the most current industrial hose catalog for proper hose selection. Identify the correct tube stock from the Chemical Resistance table:

CHARACTERISTICS AND RESISTANCE INFORMATION FOR HOSE TUBE AND COVER COMPOUNDS

These ratings are for normal or usual range of the specified compounds.
Many are also modified to meet the needs of specific applications.
See notes below.

GATES TYPE	A	C	D	G	H	J	K	L	M	P	T	U	V	Z
Elastomer	Poly Chloroprene	Acrylonitrile and Butadiene	Natural Rubber or Styrene Butadiene	Polyvinyl Chloride (plasticized)	Isobutylene and Isoprene	Chlorinated Polyethylene	Cross Linked Polyethylene	Ultra High Molecular Weight Polyethylene	Chloro-sulfonated Polyethylene	Ethylene Propylene Diene	Teflon®	Polyurethane	Fluoro-carbon Fluoro-elastomer	Polyamide Resins
Common Name or Trade Name	Neoprene	Buna-N Nitrile	Gum Rubber, Buna-S	PVC	Butyl	CPE	Extron®	UHMWPE	Hypalon®	EPDM	Teflon	Urethane	FKM Viton Fluorel	Nylon
ASTM	CR	NBR	NR or SBR	—	IIR	CM	XLPE	UHPE	CSM	EPDM	FEP/PTFE	EU	FKM	PA
Physical Strength	Good	Good	Excellent	Fair to Good	Fair to Good	Good	Good	Very Good	Good to Excellent	Good	Very Good	Excellent	Good	Good
RESISTANCE TO: Abrasion	Good to Excellent	Fair to Good	Excellent	Good to Excellent	Fair to Good	Good	Good	Excellent	Good to Excellent	Good	Excellent	Excellent	Good to Excellent	Good to Excellent
Weather/Ozone	Good to Excellent	Poor	Poor to Fair	Excellent	Excellent	Good	Excellent	Good	Excellent	Excellent	Excellent	Fair to Good	Excellent	Excellent
Gas Permeation	Good	Good to Excellent	Good	Good	Excellent	Good	Good	Excellent	Good to Excellent	Fair to Good	Excellent	Fair to Good	Good	Excellent
Petroleum Oils	Excellent	Excellent	Poor	Good to Excellent	Poor	Good	Excellent	Excellent	Good to Excellent	Poor	Excellent	Good	Excellent	Excellent
Gasolines	Fair to Good	Excellent	Poor	Fair	Poor	Good	Excellent	Excellent	Fair	Poor	Excellent	Fair	Excellent	Excellent
High Temperatures	Good	Good to Excellent	Fair	Poor	Excellent	Excellent	Good	Fair	Good to Excellent	Excellent	Excellent	Fair	Excellent	Good
Low Temperatures	Fair to Good	Fair to Good	Good	Poor	Good	Good	Fair to Good	Fair	Fair	Fair to Good	Good	Excellent	Good	Excellent

A_2 White food grade Neoprene, complies with FDA (tube)
C_2 Modification of Nitrile with increased ozone resistance (tube and cover)
C_3 Modification to Nitrile tube
C_4 Modification of Nitrile with excellent abrasion, scoring and gouging resistance (cover)
D_2 White food grade Natural Rubber, complies with FDA (tube)
D_3 Natural Rubber
B_1 B_2 B_3 H Proprietary for special applications. Contact Denver Hose Product Application
P_2 Special for Steam Hose applications
T_1 FEP
T_2 PTFE

- Chemical resistance rating 1 – Continuous, intermittent or transfer use.
- Chemical resistance rating 2 – Intermittent or transfer use only.
- Chemical resistance rating X – Not recommended.
- Chemical resistance rating - – No data available.

Use hose designed for specific applications such as:

When a chemical name or hose design can not be found, contact Denver Hose Product Application for assistance by calling (303) 744-5070.

Acid/Chemical – chemicals

Air Drill – air

Air Duct – air

Food and Beverage – milk, oils, wine, beer, etc.

Material Handling – dry bulk, slurries

Multi-Purpose – water, air

Petroleum Transfer – liquid and gas

Oil Field – oil

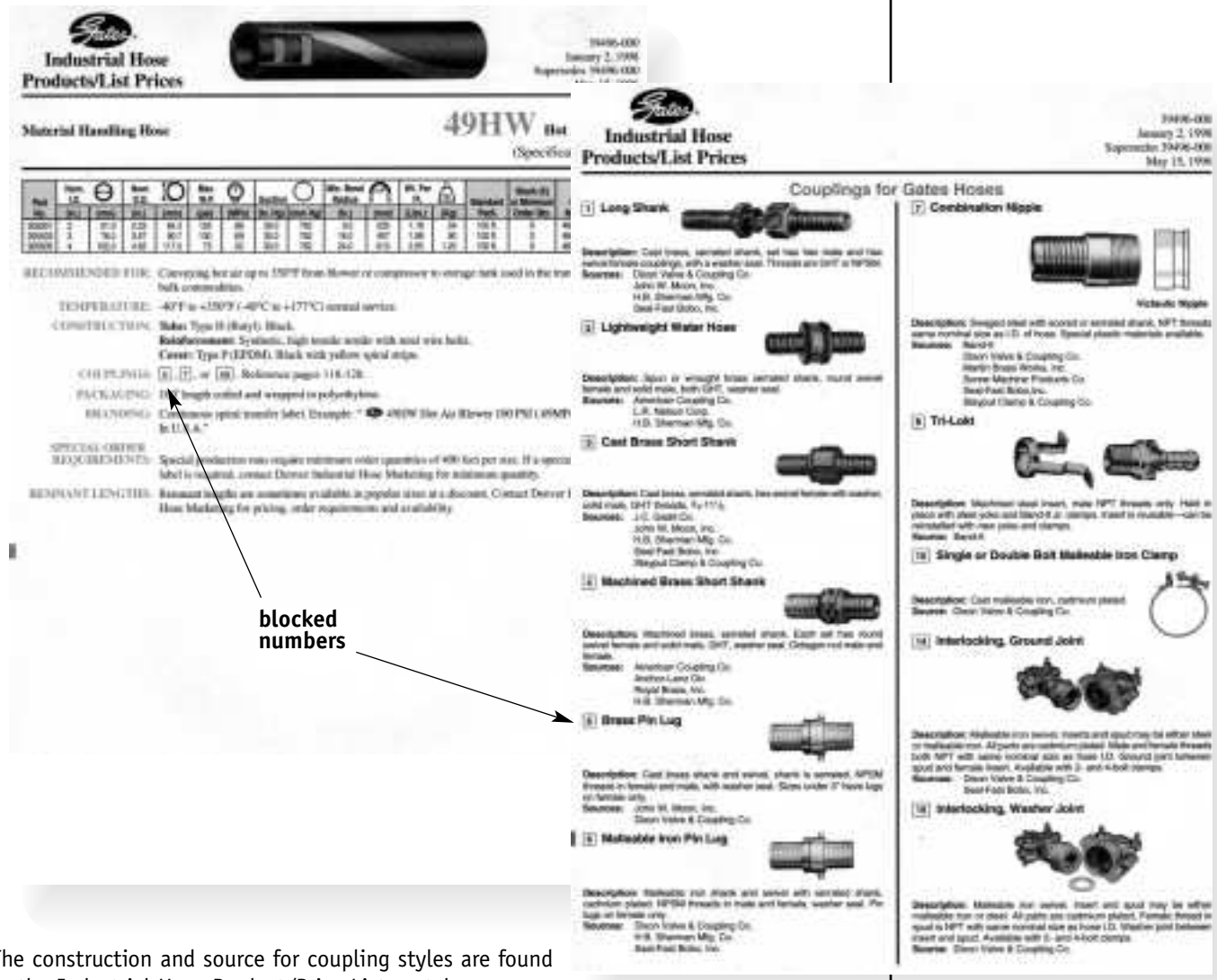
Paint Spray – paint

Steam – steam

Water – water

Industrial hose coupling recommendations are designated by the blocked numbers found on the hose product sheets in the Industrial Hose/Price Lists catalog (#39496-000).

PROPER COUPLING SELECTION



The construction and source for coupling styles are found in the Industrial Hose Product/Price Lists catalog.

Stem Selection

- **Hose end –** for hose attachment
- **Thread end –** for port attachment
- Identify thread type and purpose

THE GATES RUBBER COMPANY

Critical Application:

Specific couplings are required for critical applications. No substitutions should be made unless written authorization has been given by the hose manufacturer, coupling manufacturer and the end user for the specific application. These critical applications include:

- Corrosive chemicals
- LP gas
- Oil field
- Petroleum products
- Steam
- Couplings used in applications for conveying flammable material or gases should be of a non-sparking material such as brass or aluminum.
- Only certified, coupled assemblies should be used for ground fueling of aircraft.

If more than one coupling style is recommended, final selection of which coupling to use will be based on the cost and availability. Following are common issues that help to identify which coupling style is best for the application:

- Attachment options: ferrule, band or clamp
- Availability of size
- Availability of required thread type
- Cost
- Coupling compatibility with conveyed material
- Quality
- Ease of handling

Coupling Selection Reminders:

1. Select a coupling which will maximize safety and performance capability.
2. The coupling end type must be of the same type as the port to which the hose is being attached.
3. Never allow mixed thread types.

For identifying thread ends, Gates offers the following kits with instructions:

Hydraulic Hose & Coupling Thread Identification Kit: 7369-0318, Hydraulic Coupling templates: 35949 and International Metric & BSP Female Thread Identification Kit: 7369-0319.

STATIC BOND

What is Static Bond?

- The grounding of a static-eliminating or static-conducting component.

Why is it important?

- Electricity not conducted away from the material by the hose or hose assembly can cause the static to discharge with a spark, which could result in a dangerous explosion or injury.

Static bond can be achieved through use of:

1. Static conductive stock in the tube or cover.

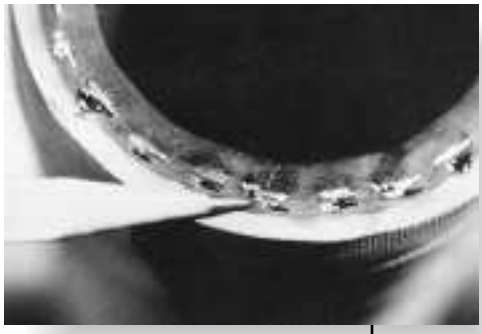
2. Bent Wire Method - Use with a hose that is wire-reinforced.

- Locate the helix wire or the static wire.
- Pull the wire out with pliers.
- Bend the wire into the inner surface of the hose tube and use caution to not puncture the tube.
- Attach the couplings so the bent wire and the coupling make contact. (The bent wire must not extend the full length of the stem, since it could create a leak at the coupling.)
- Place the assembly on a non-conductive surface and check it for electrical continuity with a voltmeter that measures voltage, current and resistance. (The maximum allowable resistance is 20-thousand ohms per foot of hose.)
- Record all test data on a hose inspection card and file it with the maintenance records.

Helix wire being bent into the inner surface of the hose tube.

Hose assembly being tested with voltmeter.

THE GATES RUBBER COMPANY



Close-up of hose end showing wire braid in hose.

Placing the staple.

Bending the staple in the tube wall.

3. Metal Staple Method - Use with a hose that has a carbon fiber static conductor or wire reinforcement where the staple can be inserted easily against a static conducting member.

- Cut the hose end square to the desired length.
- Locate the static wire, wire braid or carbon fibers.
- Place one leg of an aluminum copper or stainless steel staple into the wire reinforcement or carbon fiber. (For acid chemical hoses use only stainless steel staples.)
- Place the other leg of the staple in the tube making sure the staple straddles the tube wall and is snug against the end cut.
- Pinch the staple with pliers to force the leg against the inner surface of the tube wall.
- Clean the staple and coupling shank ends with an emery cloth or steel wool.
- Attach the coupling so the staple and the coupling make contact.
- Place the assembly on a non-conductive surface and check it for electrical continuity with a voltmeter that measures voltage, current and resistance. (The maximum allowable resistance is 20-thousand ohms per foot of hose.)
- Record all test data on a hose inspection card and file it with the maintenance records.

HOSE INSPECTIONS

Periodic Inspections – Planning for Safety and Maximum Performance

Achieving safety and performance in the use of a hose requires periodic inspections of the hose and its fittings prior to, during and after use. Hoses that have become old, worn, or damaged can present a danger to individuals and to the environment. Hoses that are not properly maintained can fail which may result in costly material spills, cleanup, downtime and injury. Planned inspections, corrective actions, and hose replacements can be less expensive than replacement or repairs made after a failure occurs.

When and how often should you inspect hose?

Inspection requirements will vary with each application type. The following factors should be considered:

- Critical nature of application
- Operating temperatures
- Operating pressures
- Environmental factors

It is helpful to think of hose inspection at two levels:

Level 1 Inspection

An inspection of hose on an on-going daily basis looking for signs such as:

1. **Hose cover damage.**
   - Cuts, cracks, abrasion, exposed reinforcement, etc.
2. **Stiffness or hardness of the hose**.
   - As a hose ages and is exposed to sunlight, ozone, extreme temperatures or chemicals it can lose some of its resiliency and become stiff and hard. When flexed, a stiffened hose can crack, leading to a failure.
3. **Changes in color**.
   - May indicate chemical attack.
   - Ozone or aging.
4. **Cover blisters.**
   - Chemical incapability.
   - Permeation in the early stages of leakage.
   - The blister can break and expose reinforcement that can degrade from contact with environmental factors.
5. **Kinked or flattened hose.**
   - Restricted material flow and hose performance.
6. **Leakage.**
   - Puddles or spilled material under the hose assembly.
   - Problem with coupling interface or attachment.
   - Weeping from the hose.
7. **Damaged hose reinforcement.**
   - Weakened hose.

THE GATES RUBBER COMPANY

Level 2 Inspection

An inspection that requires equipment shutdown in order to conduct a more thorough evaluation of the hose in a safe manner.

1. Visually inspect for leakage.

- NEVER inspect a hose for leaks by running your hand over it while it is under pressure or contains the material being transferred.
- Escaping fluid under high pressure can exert enough force to penetrate and cut flesh, causing painful and severe injury.
- Hot materials and chemicals can cause serious burns.
- ALWAYS conduct close inspection of hose when pressure is released and the hose does not contain potentially dangerous material.

2. Hydrostatic Pressure Testing (see page 15 – RMA Hydrostatic Testing Procedures).

- Test at regular intervals.
- Essential for hoses used in hazardous applications such as chemical, steam, petroleum and compressed gas transfer.
- Always use water for pressure testing.
- Never use flammable or corrosive fluids or compressed gas.

3. Inspect hose tube for hardness, color change, cracks, blisters, erosion, etc.

Level 2 inspections should be conducted, if possible, during regular equipment shutdown or at least every three months even if it means shutting the equipment down for the specific purpose of hose inspection.

HOSE MAINTENANCE TIPS

1. **Never exceed the rated working pressure of a hose.**
   - Never allow pressure spikes or surges above the maximum rated working pressure of the hose.
   - Excessive pressure can shorten the life of a hose.
2. **Never run over a hose with equipment or vehicles such as fork lifts.**
   - Running over a hose can damage the tube, reinforcement, and cover.
   - A build up of pressure can cause damage at the coupling.
3. **Never pull a hose by its coupling.**
   - Pulling a hose at the coupling can kink the hose and weaken the coupling bond to the hose.
   - When moving a hose always lift the hose and coupling together.
4. **Never lift a heavy, large-diameter hose by the middle with the ends hanging down.**
   - The internal reinforcement can be damaged at the middle point.
   - Support large hose every ten feet with rope saddles or slings.
   - Use dollies, rollers or derricks when moving large hoses.
5. **Never over-bend a hose to the point of kinking.**
   - Never bend the hose tighter than the recommended bend radius.
   - Never kink a hose to stop the flow of material.
   - Kinking a hose can seriously damage the tube and reinforcement.
   - If needed, install bend restricters at the coupling to prevent the hose from being bent past the bend radius.
6. **A hose cover exposed to excessive wear can be protected with an extra cover, such as a nylon sleeve or pad.**
   - Make the cover slightly longer than the hose to accommodate any change in the hose length when in use.
7. **Remove kinked or crushed hose from service immediately. Inspect and test the hose before putting it back in service.**
   - An outside diameter of a hose which has been permanently reduced by more than 20 percent should be removed from service.
   - An outside diameter of a hose which has been reduced by 20 percent or less, should have a hydrostatic test done before being put back into service. See RMA Hydrostatic Testing Procedures on pg. 15.
8. **Remove and test any hose assembly that is subjected to abuse.**
   - This includes hose that has been severely pulled at the coupling, flattened, crushed or kinked.

THE GATES RUBBER COMPANY

Never leave an operating transfer hose unattended or unmonitored.

9. Visually inspect and pressure test hose at regular intervals.

- This is extremely important for critical application hoses, such as acid/chemical, steam, LPG and petroleum.
- Check for kinks, bulges, soft spots, loose areas, abrasions and cuts.
- Cuts or abrasions which expose the reinforcement are signs that the hose should immediately be removed from service.

10. Always check for fluid seepage by pushing down at the base of the coupling with your thumbs. A hose softened by fluid seepage must be replaced.

- Check for coupling slippage.
- Remove any hose that does not pass your visual inspection.

Hose Cleaning

There are many different methods used to clean hose assemblies. Here are suggested cleaning methods on select products in the Industrial Hose Products/Price Lists catalog. Which method to use and how often cleaning should be performed are based upon the following:

- Type of hose product.
- Residual material in the hose.
- Cleanliness requirements for the application.
- Available cleaning facilities.
- Consideration for the used cleaning solution(s).
- Consideration for special application (food/pharmaceutical applications).

Solution Recommendations:

1. Cleaning solutions should be chosen that have the ability to dissolve or remove the residual material in the hose assembly without damaging the hose assembly.
2. The general rule of thumb is that “like dissolves like.”
3. A diluted solution of soap in water can often be sufficient.
4. Some chemicals, such as concentrated acids or bases, can react with water and release heat, byproducts and possibly splatter.
5. Consult the MSDS sheet of the material being conveyed to identify potential cleaning solutions.
6. After identifying potential cleaning solutions check the Chemical Resistance Table (Industrial Hose Products/Price Lists Catalog) for compatibility with the hose.
7. Non-compatibility of a cleaning solution with the hose can damage the hose.

Flushing or immersing in a cleaning bath

1. Do not exceed the working pressure or temperature for the product.
2. An apron, safety glasses or a face shield, rubber boots and gloves will help to protect the person cleaning the assembly from potential injury.
3. The cover should be washed or wiped to remove any material that may have splashed onto the cover.

Steam Cleaning

1. Steam cleaning is **not** a preferred method as high temperatures can accelerate the aging of a hose and shorten service life. Do not exceed the temperature rating of the hose.
2. Exceeding the recommended steam temperature/pressure combination for cleaning can cause many defects such as delamination (reducing tube to reinforcement adhesion), cracking of the tube or tube flow leaving "thin spots."
3. Steam cleaning can be used when recommended on the Industrial Hose catalog product sheet for the specific hose.
4. Caution should be taken not to damage the assembly when applying steam.
5. Never use superheated steam! This will exaggerate the possible damages listed above.
6. If the hose has a blockage, remove it before pressurizing.
7. If the steam source has a wand attached, use caution inserting the wand so that physical damage to the hose is not caused. Cuts to the tube material can be made from sharp edges of the wand and "thin spots" may result if the wand is hot and placed on the tube.

Shuttle Method:

1. This method uses a shuttle to travel the inside of the assembly to "wipe" the residual material from the hose.
2. It can be very dangerous in that the shuttle (and residual material) will come out the other end at velocities that could cause injuries.
3. There is also danger in a build up of pressure if the shuttle becomes lodged and/or damages the tube.
4. **It is not a recommended cleaning method for hose assemblies.**

Hose Maintenance Cleaning

Chemical Hose:

1. Drain after each use.
2. Flush with water or other neutralizing cleaning solutions.
3. Properly dispose of drained fluid and cleaning waste.
4. Between use store in a clean, dry environment away from sunlight.
5. Avoid cross contamination. Dedicate a hose to handle a specific chemical.

Food Hose:

1. Drain after each use.
2. Flush with steam, water and/or dilute (2-3 percent) caustics or acids such as sodium hypochlorite.

RMA HYDROSTATIC TESTING PROCEDURES

- All hose and couplings should be hydrostatic tested at regular intervals.
- Intervals for testing vary with each hose type.
- Procedure:

1. The hose should be at room temperature.
2. The testing area should be clean and dry.
3. Lay the hose out straight to its full length.
4. Place the hose on rollers. This allows the hose to be moved while under pressure.
5. Restrain the hose if there is danger of uncontrolled movement during the test.
6. Conduct a visual inspection.
   - Look for cuts, gouges, bulges, soft spots, coupling slippage or any signs of wear or failure.
7. A hose which does not pass a visual inspection should be replaced.
8. A hose which does pass a visual inspection is then connected to a test pump and the free end is fitted with a quick-opening valve.
9. Elevate the free end and fill the hose with water from the pump.
   - **Always use water. Never test with flammable or corrosive fluids, solvents or compressed gas.**
10. As the hose fills with water, bleed the air out through the open valve. Close the valve and lower it to the ground when all the air is out.
11. RMA has testing literature available for each hose type. It is imperative to pressure test the hose at the proper pressure.
12. Drain the hose and allow it to dry before returning it to service.

Safety Precaution

Hose under pressure can be dangerous so make sure to take necessary safety precautions.

HOSE STORAGE

1. Store hose in a cool, dry room with moderate humidity and temperatures between 50° F to 75° F.
2. Store hose out of direct sunlight and away from heat vents.
3. Keep hose away from ozone sources such as arc welders and other electrical equipment.
4. Store hose in original shipping container or wrapping to protect from harmful environmental exposure.
5. Hose shipped straight should be stored straight.
6. Use care when using knives or sharp tools to open packing materials.
7. Hose shipped in coils or bales should be stored on a horizontal plane.
8. Hose should be stored in a first in, first out basis.
9. Do not hang coiled hose on a hook.
10. Do not stack hose too high.

SPECIALTY HOSE

Acid/Chemical Hose

Selecting the right chemical hose is EXTREMELY critical. The incorrect hose can lead to potentially dangerous or fatal accidents/failures.

To ensure selection of the correct acid/chemical hose follow these steps:

1. Use the Chemical Resistance Table found in the Gates catalog to select the proper hose. The table lists approximately 1,400 chemicals and the Gates tube stocks most suitable for each type of chemical.
2. Use couplings that are compatible with the application and the product being conveyed.
3. Contact your Gates representative or distributor to help you select the correct hose, or contact the Gates Product Application group in Denver to answer specific application questions. Call (303) 744-5070.

Keys to Safe Chemical Hose Operations

Monitoring pressure and temperature.

1. Proper usage.

2. Wear protective clothing.

- Chemical hose operators must wear protective clothing including face or eye protection, rubber gloves and boots.
- A respirator may be required in some situations.

3. Monitor the pressure and temperature.

- Never exceed the maximum rated working pressure or temperature rating.

4. Monitor the environment.

- Never allow the hose to lay in pools of chemicals or let chemicals drip on the hose cover. A hose cover that is not resistant to the chemical it is being exposed to can deteriorate and lead to premature hose failure.
- Never leave an operating transfer hose unmonitored or unattended.

5. Always drain the chemicals from the hose.

- Always disconnect the hose when not in service.
- Completely drain and flush all corrosive residues and explosive vapors.
- Use extreme caution when flushing the hose with water. Some chemicals, such as concentrated acid, may react with water and splatter.
- Always dispose of the waste material in an environmentally safe manner.

6. Routine maintenance and testing.

- Inspect hose and couplings daily.
- Hydrostatic pressure test every 90 days.
- All hose assemblies must be inspected and tested before entering service.
- Any hose which shows signs of wear or abuse must be removed from service immediately.

7. Hydrostatic Testing.

- Lay the hose straight on rollers in a clean, dry area.
- Visually inspect the outer cover for cuts, abrasions, bulges, soft spots, coupling slippage and any other signs of wear.
- After a hose passes the visual inspection, connect it to a suitable test pump and fit the open end with a quick-opening valve.
- Fill the hose with water and bleed the air out.
- Always use water, never pressure test with compressed gases, corrosive liquids or solvents.
- Always use the recommended safety precautions listed on page 17 to protect the operator.
- Pressure test requirements for new hose:
  - Raise the pressure to twice the rated working pressure and hold for five minutes.
  - While under pressure, carefully examine the hose for leaks in the hose and at the couplings. Use a sheet of paper, not your hand, to feel for leaks. Check for coupling slippage and any indications of weakness or failure in the hose.
- Pressure test requirements for used hose:
  - First make sure it is clean!
  - Clean the used hose in a 10 percent sodium hydroxide solution at 180° F, then rinse with water.
  - After cleaning, raise the pressure to 1-1/2 times its rated working pressure.
  - Visually inspect the hose for coupling slippage, leaks or any indications of weakness or hose failure.
  - When the test and inspection are complete, thoroughly drain the water from the hose.

Hydrostatic hose testing.

8. Fitting Inspections.

- Select the proper couplings. Metals are subject to attack by the conveyed chemicals.
- Check exposed surfaces of couplings, flanges and nipples for cracks or excessive corrosion.
- Check for coupling or nipple slippage.
- Retire any hose that does not pass the inspection.

9. Electrical Conductivity Inspections.

- Test the hose assembly with an ohmmeter or a battery operated voltmeter.

10. Accurate record keeping.

- Tag each hose assembly.
- Record all test data on the hose inspection card and file it with maintenance records.

THE GATES RUBBER COMPANY

Air Hose

Increase the life of an air hose by following these preventive tips:

Oil and air do not mix.

1. Oil

- Oil and air hoses do not mix.
  - Oil can accidentally get into the hose from the air compressor or from lubricating various air tools.
  - Wipe excess oil from the hose cover.
  - If oil damage is a common problem, choose a hose that has a tube and cover that is designed to withstand oil.

2. Heat

- Keep hose away from heat sources, e.g. steam pipes.
  - A length of pipe or easily replaced hose can be attached to the heat source outlet with the air hose then attached to it. This will keep the air hose away from the excess heat. E.g. Air compressors that do not have air coolers.

3. Ferrules

- Never use a hose with a crushed ferrule.
  - Crushed ferrules can blow out causing bodily injury and property damage. Always replace a crushed ferrule before use.

4. Storage

- Always relieve excess pressure.
  - When finished using an air hose, shut the air off at the compressor and relieve excess pressure at the air tool.
- Do not run over air hoses.
  - Running over hose causes a sudden increase in air pressure which can damage the hose.

Release excess air pressure from the air tool.

5. Reversing

- Reverse the hose end for end at regular intervals.
  - Reversing the hose distributes exposure to heat, oil and points of greatest flexing.

6. RMA Oil Classifications

- Class A = High Oil Resistance
- Class B = Medium-High Oil Resistance
- Class C = Medium Oil Resistance

LPG Hose

WARNING: Liquefied petroleum gases are flammable and all precautions necessary for safe handling MUST be observed. Operating personnel must be trained in proper handling procedures. A failure in service may result in injury to personnel or damage to property.

- Use only LPG hoses that meet or exceed Underwriter Laboratories Standards.
- Use recommended and tested couplings designed for LPG hose.
- Use 20B-HB Butane-Propane hose for natural gas only under the following conditions:
  1. Use in a well ventilated environment.
  2. Use according to all state and local codes. Contact local and/or state inspectors to verify compliance.
- Hose used to transfer liquid petroleum gas should be inspected according to the procedures below:
  1. Inspect and hydrostatic test all new LPG hose assemblies.
  2. When LPG hoses are subjected to ordinary use, test every 30 days for the first six months. After initial first six months, test hoses once per week.
  3. LPG hoses subject to severe usage will deteriorate more quickly. Adjust inspection schedule to meet hose usage. Hose assemblies should be hydrostatic tested immediately after the hose is subjected to abnormal abuse. (Severe end pull, flattening or crushing by vehicles, sharp bending or kinking).
- Testing Procedures

  For testing procedures, see:

  1. LP Hose Assembly Agreement Program
     - Aerostatic Leakage Test
     - Coupling Pull Test
     - Hydrostatic Strength Test
     - Burst Test
  2. Reference UL21 Standards

Contact your local Gates representative for information on the LP Hose Assembly Agreement Program.

Petroleum Hose

Application: Make sure the hose being used is suitable for the application.

- For suction or return lines use a hose that has an internal support helix and a vacuum rating sufficient for the working conditions.

Couplings

- Use only recommended couplings and methods of attachment.
- Re-coupling of used hose:
  - This should be considered only in temporary, emergency situations.
  - This should be done only after the condition of the used hose is evaluated. Pressure test at the rated working pressure to verify continued satisfactory performance.
  - May result in reduced service life.

THE GATES RUBBER COMPANY

Inspect hose for cover cracks or cuts.

Inspect hose at the coupling for signs of leakage.

Inspection: Periodically inspect hose assemblies for the following:

- Cover abrasion.
  - A hose cover that is worn through, exposing the reinforcement, is a warning sign of potential hose failure.
- Cracks or cuts in the cover.
  - Indicates that the hose cover has been degraded or abused and should be replaced.
- Discoloration of the cover or tube.
  - This can be a sign of chemical degradation and the hose should be replaced.
  - Make sure the hose is chemically compatible with the material being transported and with the external environment.
- Discoloration of the material (such as fuels) being transported.
  - This may be a sign of chemical incompatibility resulting in leaching out of some of the hose tube material which could degrade and lower hose performance.
  - Material being leached out of the hose tube can result in contamination of the transported material and subsequent contamination of system filters, engine fuel injectors, etc.
- Ongoing performance capability.
  - Periodically test the hose assembly at the rated working pressure to verify continued performance. For fuel hoses, use water as the test fluid, then rinse with the subject fuel before returning to service.

Storage after Use

- Drain hose after use.
- Fuel hose ends should be left open in a well ventilated area to allow fumes to dissipate.
- Avoid exposure to sunlight, excessive ozone such as electrical transformers, extreme temperature and moisture, and external abuse.

Safe Hose Operations

- Do not exceed the rated working pressure, temperature, or minimum bend radius of the hose.
- Support heavy, long lengths of hose being lifted or suspended.
- Avoid any pull force to the coupling end by the hose weight or by pulling to move the hose.
- Avoid bending the hose at the coupling, even if the minimum bend radius is not exceeded. Bending at the coupling compounds stresses already applied
- If the hose is being used for continuous transfer, select a hose with a 1 rating. If the hose is being used for intermittent transfer, select a hose with a 1 or 2 rating.
- Never leave an operating transfer hose unmonitored or unattended.

Steam Hose

Steam hose failure can cause SERIOUS injury, therefore it is extremely important to properly select and maintain a steam hose.

Rules to Remember

Rule: Steam hose should be used to transfer ONLY steam! Never use it to transport other materials.

Reason: The hose is specially designed to handle steam. Materials other than steam could damage the tube.

Rule: Couple steam hose to a length of pipe to separate the hose from the steam source.

Reason: Constant high heat can shorten the life of a steam hose.

Rule: Always have an accurate pressure gauge and positive shut-off valve installed between the steam source and the hose.

Reason: A surge in the hose could cause a failure and injury.

Rule: Operators should always wear protective clothing which includes face or eye protection, heavy-duty clothing, gloves and boots.

Reason: Protection from flying particles and liquids.

Rule: Operators should NEVER open a steam valve when the hose is lying free.

Reason: The sudden surge in pressure can cause the hose to whip; which can cause injury or damage.

Rule: ALWAYS drain steam hose when not in use.

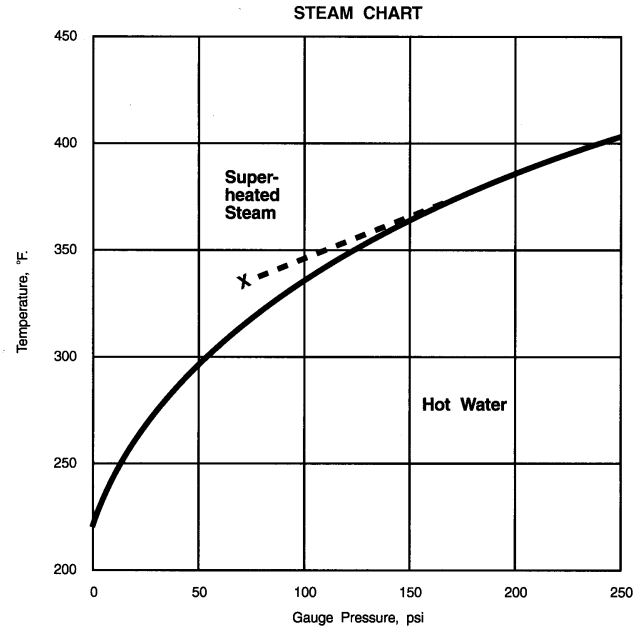
Reason: Water remaining in the hose may be absorbed by the tube. When the hose is then reheated and still under low pressure, the absorbed water may change to steam and "popcorn" or expand and explode the tube. Popcorning can weaken and destroy a hose.

Steam and Its Effect on Hose

Water can exist in three different basic states — solid, liquid or gas — and there are three different conditions of the gas (steam). Which particular condition exists is dictated by the pressure and temperature existing.

These conditions are:
Wet Saturated Steam, or "Wet Steam"
Dry Saturated Steam
Superheated Steam, or "Dry Steam"

By way of explanation, refer to the steam chart. The heavy black line is the boiling point of water at various gauge pressures. Any point on this line represents saturated steam. Saturated steam may be completely free of unvaporized water particles, or it may carry such particles. In other words, saturated steam may be "Dry" or "Wet." Any point below the line represents Hot Water — any point above the line represents Superheated Steam.



The dotted line shows the process of saturated steam being transformed into superheated steam. If a steam line is at a pressure of 150 psi, and a temperature of 366°F., it contains saturated steam. If the pressure is substantially reduced by the expansion of the steam (such as the sudden opening of a valve or the steam passing into a larger pipe or hose), the condition of the steam follows the dotted line to some point X in the superheated steam area. This condition may not last very long, but the superheated steam tends to deteriorate the tube stock in ordinary steam hose intended for use with saturated steam. This usually results in hose failure.

THE GATES RUBBER COMPANY

Couplings

1. Use two- and four-bolt interlocking clamp-type couplings.
2. The clamps must interlock over the collar of the coupling shank and the clamp halves must interlock with each other.
3. Make sure the hose clamps are tight and secure before each use. Always check them again after each shutdown.
4. A steam hose which is used for long periods, should have the clamps checked once every 24 hours and tightened as required.
5. Always tighten bolts evenly. This prevents distortion, bending and misalignment, commonly known as "cocking".
6. When clamp halves begin to touch after continuous tightening DO NOT USE THE HOSE.
   - ▶ If the hose has no other problems, it can be recoupled or fitted with the next smaller size clamp and put back into service.
7. All steam hose assemblies should be pressure tested before the hose is put into service.

How to Select The Correct Steam Hose Assembly

1. **Determine Required Hose Size**
   The hose size required is usually fixed by size of fittings or pipe to which the hose is to be connected.
   It is important that you **do not select** a hose inside diameter **larger** than the diameter of the preceding pipe.
2. **Find Actual Rated Working Pressure and Temperature**
   Take pressure and temperature readings just ahead of the hose connection.
3. **Determine Condition of Steam (Saturated or Superheated)**
   Locate the actual Rated Working Pressure and Temperature on the steam chart on previous page. Any point on the heavy line is saturated steam.
4. **Select the Correct Hose**
   From the table at right, select the hose that fulfills the requirements of both the condition of the steam and the Rated Working Pressure.
5. **Determine Length Required**
   Length required is almost always dictated by the application.
6. **Select Couplings Required**
   Gates recommends only interlocking types* of couplings for steam hose applications. These are identified as:

   [14] Interlocking, ground joint.

   [15] Interlocking, washer joint.

***Remember to retighten on a regular basis.**

NOTE: When electrical continuity is required, ground wire braid of hose to couplings with aluminum, copper or stainless steel staples.

STEAM HOSE TABLE

Hose Type	Recommended Service		
	Rated Working Pressure (psi)	Working Temperature (°F)	Type of Steam
319MB	100	338	Saturated Only
232MB Steam Queen®	250	450	Saturated or Superheated
205MB Steam King®	250	450	Saturated or Superheated

Properties of Saturated Steam
(Abridged from Handbook of Chemistry and Physics—39th Edition)

Gauge Pressure (psi)	*Temperature of Saturated Steam (°F)	Gauge Pressure (psi)	*Temperature of Saturated Steam (°F)	Gauge Pressure (psi)	*Temperature of Saturated Steam (°F)
10	239	110	344	200	388
25	267	115	347	205	390
30	274	120	350	210	392
35	281	125	353	215	394
40	287	130	356	220	395
45	292	135	358	225	397
50	298	140	361	230	399
55	303	145	363	235	401
60	307	150	366	240	403
65	312	155	368	245	404
70	316	160	371	250	406
75	320	165	373	255	408
80	324	170	375	260	409
85	328	175	377	265	411
90	331	180	380	270	413
95	335	185	382	275	414
100	338	190	384		
105	341	195	386		

*Based on an atmosphere pressure of 14.7 psi.

Do Not Alternate Use Between Steam and Water

THE GATES RUBBER COMPANY

RMA Standards for Steam Hose Testing

The Rubber Manufacturers Association (RMA) recommends pressure testing steam hose once every 90 days the first year it is in service and once a month thereafter.

1. These tests are for steam hose with a maximum rated working pressure of 250 psi, temperature ranges up to 450° F, and inside diameters of two inches or less.
   - ▶ If the hose does not meet these criteria, please contact Gates Product Application at 303-744-5070.
2. Lay the steam hose out to its full length and inspect the outer cover for cuts, abrasions, bulges, soft spots, coupling slippage or any other signs of wear.
   - ▶ If the hose has any of the above problems, discontinue use.
   - ▶ If the hose passes the visual inspection, continue to Step 3.
3. Connect the hose to a suitable pump.
4. Restrain the hose by using a cable or chain.
5. Tighten the clamp bolts evenly and securely; fit the open end of the hose with a quick-opening valve.
6. Fill the hose with water and bleed the air out through the quick-opening valve.
7. Raise the pressure to twice the maximum rated working pressure of the hose.
   - ▶ Hold this pressure for five minutes.
   - ▶ While under pressure, examine the hose for leaks, swollen areas or bulges, especially near the couplings.
   - ▶ A leak or bulge must be repaired by cutting off the affected area. If this is not possible, the hose must be replaced. Never use a steam hose that leaks!
   - ▶ If the leaks are found between the hose tube and the fitting, release the pressure, retighten the clamp, and reapply pressure.
   - ▶ If this corrects the leak, the hose can be put back into use.
   - ▶ If the leak continues, the hose must be recoupled or replaced.
8. Record all test data on an inspection card and file it with the maintenance records.

RMA®

Gates®

THE GATES RUBBER COMPANY

TROUBLESHOOTING

Avoiding Problems Caused by Misapplications

Problem	Causes	Solutions
Hose burst in one or more places along the length of the hose.	Exceeded the rated working pressure. Hose twisted during attachment to ports during application, causing gaps in the reinforcement.	Check pressure output of system. Use a hose with a higher pressure rating. Use swivel couplings.
Hose tube swells or deteriorates, blocking material flow or causing a leak.	Hose tube is not compatible with material being conveyed and/or temperature.	Identify the material and the temperature at which the system operates. Refer to the Gates Chemical Compatibility Table or contact Hose and Connector Product Application in Denver for assistance.
Hose tube becomes hard, cracks and leaks; may appear charred.	Excessive heat can leach out plasticizers in the tube. Air or aerated oil can cause oxidation of rubber that is accelerated by heat.	Select a hose with a higher temperature rating. Look at ways to reduce system temperature and aeration of oil.
Cracks in hose tube and cover result in a leakage: yet tube and cover are soft and pliable at room temperature.	Flexing of hose during a period of extreme cold when the tube and cover were too stiff.	Check lowest internal and external temperatures, especially at the time of equipment startup. If possible, use a hose that will remain flexible below the lowest operating temperature of the application.
Coupling blows off end of hose when pressurized.	Incorrect coupling used; hose was not fully inserted into the coupling; not correctly skived at coupling attachment end or coupling not crimped to specified diameter (too loose or too tight).	Check hose and coupling compatibility. Review crimp specifications and procedure. Make sure routing does not impart excessive stresses to the hose assembly.
Hose inner tube collapsed inward, folded and a portion is often torn away.	Hose not designed for high vacuum. Adhesion between tube and reinforcement may be poor. The hose may have been bent too sharply and kinked.	Use a hose designed for high vacuum. Check routing to avoid exceeding the minimum bend radius.
Hose burst on the outside of the bend and burst hole is elliptical in shape.	Hose bent too tight in routing causing the reinforcement to open up too much on outside of bend.	Check routing. Do not exceed rated minimum bend radius. Consider using bent tube couplings, adapters or bend restrictors to relieve stress on the hose.
Hose pulls out of the coupling.	Hose when pressurized shortens up, pulling out of coupling. Hose not supported with the added weight of the material, pulls out of the coupling.	Check routing for proper hose length. Allow some slack to compensate for hose movement when pressurized. Support long lengths of hose with clamps, cables, etc. Do not use hose as a rope or cable.
Hose flattened in one or more areas.	Hose twisted, kinked or run over. Extreme twisting and kinking can open up large gaps in the reinforcement allowing a blowout to occur.	Check routing. Use swivel couplings to prevent twisting the hose when making port attachments. Use bent tube couplings and longer lengths of hose to avoid excessive bending and kinking. Crush resistant hose.

Avoiding Problems Caused by Misapplications

Problem	Causes	Solutions
Wire reinforcement is rusty at site of hose burst.	Hose cover was damaged from cuts, abrasion, extreme temperatures, chemical attack, internal gases diffusing through the tube and collecting under the cover forming blisters which break or improper skiving and coupling attachment.	Protect hose against cuts and abrasion with a nylon sleeve or steel coil guard. Check temperature and chemical compatibility rating of hose tube and cover with the application. Consider pin pricking the cover of the hose to allow diffused gas to escape and not become trapped under the cover.
Hose leaks profusely without bursting.	High velocity erosion of hose inner tube. Fluid velocity in general may be too high.	Consider a larger diameter hose to handle the volume flow at a lower velocity.
Hose leaks or bursts. Cover is deteriorated, hard, has fine cracks and feels stiff.	Hose maturity causes loss of performance properties and eventually failures from the effects of environmental conditions such as heat, cold, ozone and sunlight.	Check the code date on the lay line of the hose, generally, anything beyond five to seven years of age is questionable. Suggest a maintenance replacement schedule that meets the application conditions.
Hose tube worn through on one side and leaks.	Abrasive material wore through the tube.	Select hose with a thicker and/or more abrasion resistant tube. Periodically rotate hose to even out abrasion wear. Use a larger diameter hose and reduce material velocity. Do not bend hose as severely.
Hose burst at end of coupling.	Exceeded maximum rated working pressure. Hose bent sharply over the end of the coupling. Did not follow the recommended coupling attachment procedure.	Use a higher pressure rated hose. Use hose bend restrictors and do not exceed the minimum bend radius rating. Check the coupling used and crimp diameter.
Hose cover blistered; blisters filled with material being conveyed.	Hose not compatible with material being transferred.	Select a hose with a tube having a high compatibility rating with the material being transferred.
Hose cover blistered; blisters not filled with material being conveyed.	Gas in liquid. High pressure causing high rate of gas permeation of tube.	Remove gas from line. Pin prick hose cover. Change to a hose with a tube of higher density/lower porosity.
Cover of hose soft, gummy, discolored and worn away by friction.	Hose cover not compatible with material and/or temperature.	Select a hose cover that is compatible with the material and temperature.
Discharge pressure/volume too low.	Pump output capacity too low. Hose or coupling restriction.	Increase pump output. Check for hose kinks. Increase hose and/or coupling inside diameter. Add “booster pump” if hose length is extremely long.

The Gates Rubber Company
900 South Broadway
P.O. Box 5887
Denver, Colorado 80217-5887

www.gates.com

Printed in U.S.A. 6/99 39998