



## Introduction

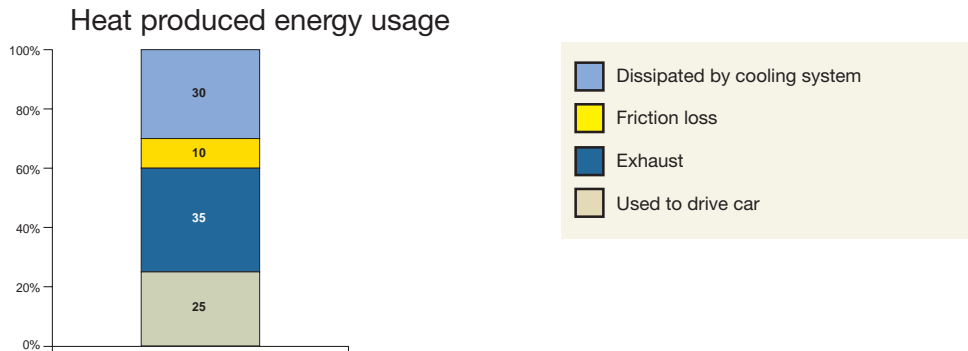


Gates customers appreciate the wide variety of choices our extensive cooling system product range offers. The hose line includes factory-moulded hoses for upper, lower, by-pass, heater and other coolant applications and offers the most comprehensive coverage in the industry. Gates also supplies several styles of hose clamps and connectors to give a wide choice for user selection. A complete range of radiator caps, as well as an extensive line of thermostats, supplied complete with gaskets and seals, conclude Gates' range of cooling system components. Gates' automotive applications overview catalogue E2/70130 describes the complete range.

Through this installation and troubleshooting guide, Gates wants to advise you how to properly install and maintain coolant hoses. The main objective of this guide is to identify component weaknesses before failure. This is especially important because cooling system failure is the major engine-related cause of roadside breakdowns. Expensive, inconvenient repairs can be avoided – if you know where and how to look. The troubleshooting chapter will help technicians identify the major causes of hose failure. It's also an excellent sales tool for showing customers how their hoses have deteriorated and why replacement is suggested.

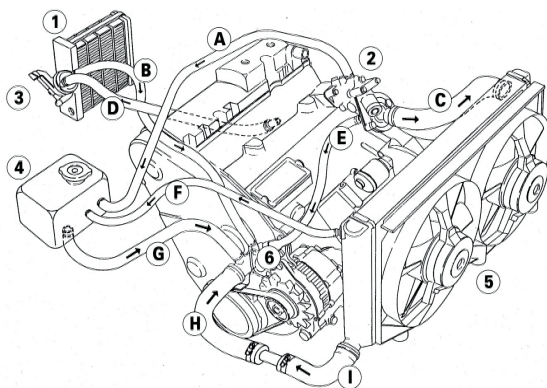
## Cooling system overview

Internal combustion engines generate tremendous heat, but they are not efficient users of that energy. Most engines use less than 25% of the heat energy produced to power the vehicle. About 35% of combustion heat exits through the exhaust system, and another 10% is lost due to internal friction. The remaining 30% of excess engine heat must be removed by the cooling system.



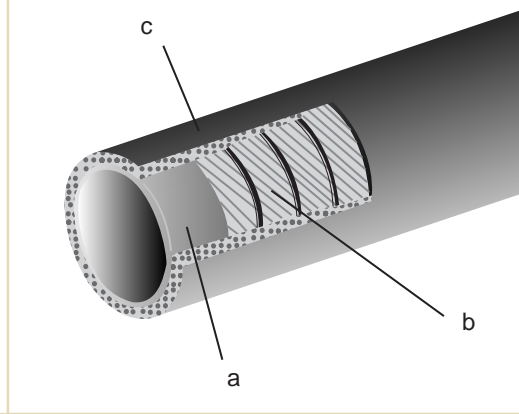
Combustion temperatures can reach 2400°F (± 1300°C) and higher, but an engine's cooling system is engineered to stabilise temperatures around 10% of this figure. Without a cooling system, motor oil would quickly break down and lose its ability to effectively lubricate moving metal components.

Today's coolant hoses carry coolant to a variety of under hood equipment and not just to the radiator, thermostat, water pump and heater. In addition to the traditional upper, lower, by-pass and heater hoses, vehicles are also equipped with small coolant hoses that carry coolant to the carburettor housing, fuel injection throttle body, turbocharger, oil cooler and other components. The coolant can act as a cooling or heat source, depending on the equipment and time of year. For example, the carburettor and throttle body use the coolant to heat the fuel in the winter to keep it from icing and cool it in the summer to prevent vapour-lock.

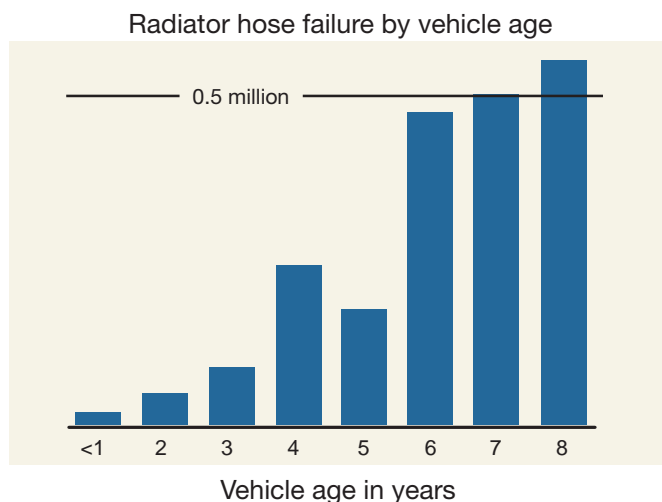


1. Heater
  2. Thermostat
  3. Heater valve
  4. Expansion tank
  5. Radiator
  6. Water pump
- A. Thermostat to expansion tank
  - B. Heater outlet
  - C. Thermostat to radiator
  - D. Heater inlet
  - E. By-pass – thermostat to water pump
  - F. Radiator to expansion tank
  - G. Expansion tank to water pump
  - H. Radiator to water pump or connecting pipe to water pump
  - I. Radiator to water pump or radiator to connecting pipe

Although hose applications have changed over the years, basic hose design has not. Hoses consist of three parts: the tube (a), reinforcement (b) and cover (c). The tube conveys the coolant, and the reinforcement prevents the tube from rupturing under pressure. The outer cover protects the entire hose assembly from harsh external environments and contaminants. These three components are bonded together by special adhesives.



While basic hose design has remained relatively unchanged over the years, hose materials have improved substantially. Thanks to these improvements coolant hoses last longer today than before. Of course, they can still fail, and when they do so, they usually fail from the inside. As there is no way to tell from a simple visual inspection if a hose has internal damage, Gates recommends that all cooling system hoses should be inspected at least once a year for damage from the major hose enemies: electrochemical degradation, heat, oil, abrasion, ozone and leakage. Pay special attention to hoses that have been in operation for



four or more years; failures increase dramatically after that period (see chart). The best advice is to suggest replacement every four years for most vehicles. Vehicles operating under severe conditions may require more frequent replacements. When replacing hoses, insist on high-quality Gates products. They deliver longer-lasting service for your customers and build a reputation of reliability for your shop.

### In short

- Inspect cooling system hoses at least once a year
- Check for:
  - electrochemical degradation
  - heat
  - oil
  - abrasion
  - ozone
  - leakage
- Suggest replacement every four years for most vehicles
- Insist on high-quality Gates products

## Troubleshooting

When inspecting a coolant hose for damage, make sure that the hose connection from the radiator to the engine is not kinked, and that it is not touching hot or moving engine parts or sharp edges. A kink can reduce the flow of coolant and cause the engine to overheat. The sharp surface may eventually cut or abrade through the hose, resulting in a loss of coolant.

By touching coolant hoses, installers can often tell if the system is functioning properly. A coolant hose should feel hot within minutes after the engine is started. If the heater is on, both the ingoing and outgoing heater hoses should be close to the same temperature. If not, it might be time for a repair. Before beginning repair work, always allow the engine to cool in order to reduce pressure in the system.

Check for kinking

Check the hose temperature

! The engine should be cool before any repair work is started !

When inspecting the hose, look for the following signs of wear:

### 1 Electrochemical degradation



No visual symptoms

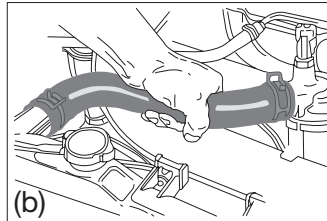
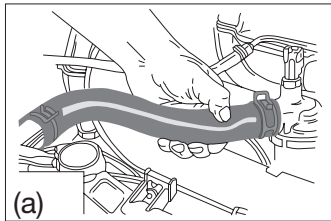
- ➔ Do the squeeze test or feel for gaps inside the hose

Replace the hose with a Gates ECR hose (electrochemical resistant)

### Appearance

Since the hose is weakened from the inside, symptoms are not obvious by visual inspection. The squeeze test is the best way to check coolant hoses for electrochemical degradation. Before checking hoses for electrochemical degradation, first make sure the engine is cool.

Next, squeeze the hose near the connectors with your thumb and two or three fingers (a). Electrochemical degradation initially attacks the hose 2 to 4 inches (5 to 10 cm) from the ends. If the hose has been weakened by electrochemical degradation, you should feel gaps or channels inside the hose. Then squeeze the middle section of hose, checking for a detectable difference between the ends and the middle (b). If you feel a difference, the hose has most likely been weakened by electrochemical degradation.



### Cause

Electrochemical degradation is a primary cause of most coolant hose failures. This phenomenon occurs when different kinds of metals in the cooling system generate an electrical charge, which is carried from one component to another by the coolant. In case of a high concentration, this electrical charge will affect the hose tube, creating tiny internal cracks, which weaken the hose.

### Solution

To avoid potential hose failure, replace suspect coolant hoses immediately. Most Gates premium radiator hoses are now resistant to electrochemical degradation.

## 2 Heat damage



Hardened glossy cover

Swelling

Hose feels soft

Protect coolant hoses  
from heat sources or route them  
away from the heat source

### Appearance

Heat-damaged hoses typically have a hardened, glossy cover that is covered with cracks. Slight swelling is one sign of internal damage. If the interior yarn has been severely damaged by heat, the hose will feel soft and may even bulge in places.

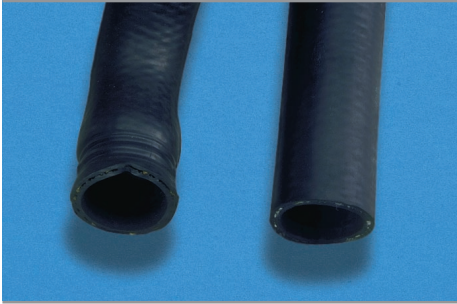
### Cause

Overheating can cause reinforcement fibres to deteriorate (note discolouration). As engine compartments become smaller and more compact, temperatures under the hood increase. Ambient temperature from nearby hot engine parts, low coolant and/or temperature spikes also contribute to deterioration.

### Solution

Replace with a Gates hose. Protect coolant hoses from radiant heat sources by wrapping new hoses in a protective hose sleeve or with a piece of the old hose. With some flexible hoses, it might be possible to route the hose away from the heat source and improve air circulation.

### 3 Oil damage



Hose feels soft or spongy

Swelling

External:

replace the hose and eliminate the source of oil

Internal:

replace the hose and coolant

#### Appearance

Soft or spongy to the touch. Bulges and swelling are readily apparent.

#### Cause

Oil reacts chemically with the hose compounds and weakens the molecular bonds. This causes the hose to soften, swell and separate, layer by layer, leading to certain failure. Oil can attack both external and internal compounds.

#### Solution

External – replace the hose and eliminate any source of oil. If this is not possible, reroute the hose.

Internal – replace the hose and coolant. Use the recommended type and quantity of coolant for the cooling system. If the vehicle has an automatic transmission, check for oil leakage from the oil cooler into the engine's cooling system.

### 4 Abrasion damage



Scuffed, gouged or abraded cover

Reroute the hose

Wrap protective sleeving around the hose

Slightly twist the hose on the spouts

#### Appearance

Scuffed, gouged or abraded cover.

#### Cause

Abrasion occurs when the hose is cut or punctured by debris that bounces up from the road. A drooping hose can be abraded by coming in contact with a moving motor part, such as a fan blade or spinning belt or pulley.

#### Solution

If the hose is resting on or will come into contact with a sharp surface, or is near a heat source, try one of the following:

1. Reroute the hose away from the point of contact;
2. Wrap protective sleeving (e.g. a slit piece of old hose) around the new hose at the point of contact;
3. Slightly twist the hose on one or both spouts to reroute the hose away from the surface.

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## Ozone damage



Tiny, parallel cracks

Install a Gates hose with EPDM cover

### Appearance

Tiny, parallel cracks in the cover, usually at hose bends.

### Cause

Increased concentrations of ozone, caused by pollution, attack the bonds in certain rubber compounds. Tiny cracks occur, primarily where the hose experiences stress: curves, bends and at clamping surface areas. These cracks allow contaminants to invade and destroy the hose.

### Solution

Install Gates hose made of EPDM rubber compounds, which are unaffected by ozone.

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## Leakage



Moisture, seepage or drips

Re-tighten clamps or use constant tension clamps

Use beaded connectors

### Appearance

Moisture, seepage or drips form on or around clamps or connectors.

### Cause

Leakage is usually caused by insufficient clamp torque or a deteriorated condition of the connector. Here's what happens: heat causes metal to expand. If a new hose is installed while the engine is still warm, the expanded diameter of the inlet or outlet tubes prevents the clamp from tightening down as much as it needs to. Heat also causes the rubber hose to expand – about 20 times more than the metal. The clamp holds the hose on the tube, but the hose “sets” in this expanded state. Then when the engine cools off, a gap appears between the “set” ID of the hose and the contracted OD of the metal tube. And the coolant leaks.

### Solution

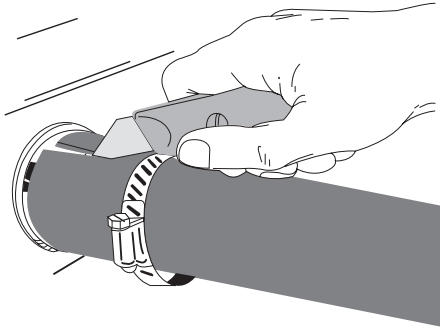
Hose suggestions – Install Gates hose: Gates uses compounds that offer better resistance to the negative effects of compression set.

Clamp torque suggestions – To avoid cold water leaks, adjustable tension clamps must be re-tightened after a brief run-in period. Another solution is to use constant tension clamps, which automatically adjust with the heating and cooling of the system.

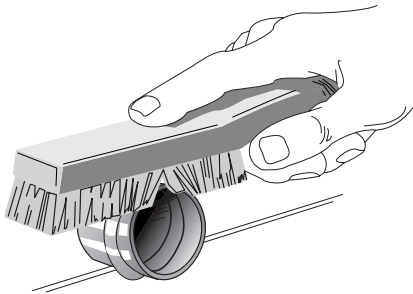
Condition of connector suggestions – A beaded connector offers better sealing and retention characteristics. The smoother the finish of the connector, the less tendency to leak under the clamp. Brass and cast iron fittings adhere to common rubber compounds after time, which reduces possibility of leaks, as does use of sealants and viscous gels.

## Installation guidelines

Hose replacement is easy as long as a few simple guidelines are followed.

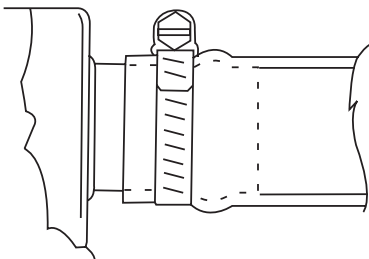


First, remove the old hose by gently twisting it off the fitting once the clamp is loosened. A rusted clamp can be carefully cut and removed with tin snips. If the hose is stuck to the fitting, do not force or pry it off – this could damage the nipple. Instead, carefully cut the hose lengthwise, then peel the hose off the fitting.



Next, check the nipple for sharp edges or burrs. It is best to clean the fitting with a wire brush before installing the new hose. Once the fitting is clean and smooth you can install the hose.

Slip a new clamp onto the hose and then push the hose onto the fitting, installing the engine end first. Lubricating the nipple with coolant will make it easier to push the hose onto the fitting. Check that the hose is shouldered well beyond the edge of the fitting.



Clamp the hose into position between the nipple and the hose end. Caution: a clamp tightened over the nipple will eventually cut the hose tube.

In some cases, if the replacement hose is not an exact original equipment duplicate, slight twisting or bending of the hose may be required for proper installation. This will not damage the hose as long as it does not kink or collapse. Also, avoid routing hoses into abrasive or high temperature environments without protective sleeving.



## Replacement choices

Gates offers a wide variety of coolant hoses. You will find detailed information on all hoses in Gates' automotive applications overview catalogue E2/70130.

### Hoses for passenger cars & light-duty commercial vehicles

#### Radiator hose



##### Curved hose

Factory moulded hose for upper, lower, by-pass, heater and other coolant applications. Thanks to consolidation — one hose size handling more than one application — inventories can be kept down. To increase the number of applications even further, cut-off marks are printed on some curved hoses.



##### Vulco-Flex® II radiator hose

This flexible radiator hose takes various shapes and is a durable alternative to curved hose that is reinforced with helical wire to prevent the hose from collapsing when bent. These hoses, unlike factory-moulded hoses, are not application specific and fit several car makes and models. Installers can bend and route the hose to fit many passenger cars and light-duty commercial vehicles. After installation, they vulcanise into shape without unnecessary strain on the connections.



##### Flexcord Plus

Lightweight straight coolant hose, designed to withstand severe conditions under the bonnet.

This hose with aramid knit reinforcement offers high temperature and burst resistance.

## Heater hose



### **Straight heater hose**

Extremely durable heater hose for straight and slightly bent connections. The resilient reinforcement allows the hose to fit a pipe that is 4 mm larger than the nominal inside diameter of the hose. Strong and flexible body allows bending to medium bend radius.

## Hoses for trucks, buses & tractors

### Radiator hose



### **Extra Service Curved hose**

This versatile hose is used for many heavy-duty applications. It is easy to cut to size and to install. Symmetrical 90° curved hoses are frequently used in trucks, buses and tractors or other industrial type applications.



### **Extra Service Vulco-Flex® radiator hose**

Vulco-Flex® is a flexible radiator hose with built-in spiral wire, which allows for medium sized curves without kinking or collapsing. It can replace a multitude of curved hose sizes and shapes, and it vulcanises into shape without unnecessary strain on connections.



### **Extra Service Flexible radiator hose**

Practical, flexible and long radiator hose replacing many different shapes of curved hose. The built-in spiral wire enables it to bend to any required shape, with minimum strain on radiator and engine connections.



### **Green Stripe® Straight coolant hose**

This resistant and flexible radiator hose is perfect for general use on straight or slightly bent connections in heavy-duty vehicles. It resists “cold water leaks” thanks to an advanced EPDM tube that stays soft and pliable, even under adverse operating conditions.



### **Extra Service Straight silicone hose**

This straight silicone hose functions perfectly as radiator, heater or other coolant transfer hose in poorly ventilated conditions. Silicone hose resists extreme temperatures and is easy to cut to size. The extra thick and resilient tube prevents cold-water leaks and hardening under effect of heat.

## **Heater hose**



### **Extra Service Straight heater hose**

Strong heater hose ensuring long, trouble-free service on straight or large bend radius connections. Rubber cover with textile imprint (wrapped appearance), textile braid reinforcement.



### **Extra Service Straight silicone heater hose**

Highly durable and flexible heater hose for heavy-duty vehicles. Outstanding resistance to the extreme temperatures occurring in poorly ventilated conditions.

Your distributor:



A Tomkins Company

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# Automotive cooling system

Installation and troubleshooting guide

