28502

GENERAL MOTORS CORVETTE

1984-96 REPAIR MANUAL

Covers all U.S. and Canadian models of Chevrolet Corvette

WIRING AND VACUUM DIAGRAMS

An American Tradition Since 1925

www.chiltonsonline.com

Stain noted 4-12-04 MD

DAMAGE OFFICIALLY NOTED

Contents

See last page for information on additional titles

SAFETY NOTICE

Proper service and repair procedures are vital to the safe, reliable operation of all motor vehicles, as well as the personal safety of those performing repairs. This manual outlines procedures for servicing and repairing vehicles using safe, effective methods. The procedures contain many NOTES, CAUTIONS and WARNINGS which should be followed, along with standard procedures to eliminate the possibility of personal injury or improper service which could damage the vehicle or compromise its safety.

It is important to note that repair procedures and techniques, tools and parts for servicing motor vehicles, as well as the skill and experience of the individual performing the work vary widely. It is not possible to anticipate all of the conceivable ways or conditions under which vehicles may be serviced, or to provide cautions as to all possible hazards that may result. Standard and accepted safety precautions and equipment should be used when handling toxic or flammable fluids, and safety goggles or other protection should be used during cutting, grinding, chiseling, prying, or any other process that can cause material removal or projectiles.

Some procedures require the use of tools specially designed for a specific purpose. Before substituting another tool or procedure, you must be completely satisfied that neither your personal safety, nor the performance of the vehicle will be endangered.

Although information in this manual is based on industry sources and is complete as possible at the time of publication, the possibility exists that some car manufacturers made later changes which could not be included here. While striving for total accuracy, NP/Chilton cannot assume responsibility for any errors, changes or omissions that may occur in the compilation of this data.

PART NUMBERS

Part numbers listed in this reference are not recommendations by Chilton for any product brand name. They are references that can be used with interchange manuals and aftermarket supplier catalogs to locate each brand supplier's discrete part number.

SPECIAL TOOLS

Special tools are recommended by the vehicle manufacturer to perform their specific job. Use has been kept to a minimum, but where absolutely necessary, they are referred to in the text by the part number of the tool manufacturer. These tools can be purchased, under the appropriate part number, from your local dealer or regional distributor, or an equivalent tool can be purchased locally from a tool supplier or parts outlet. Before substituting any tool for the one recommended, read the SAFETY NOTICE at the top of this page.

ACKNOWLEDGMENTS

Portions of the materials contained herein have been reprinted with the permission of General Motors Corporation, Service Technology Group.

A special thanks to the fine companies who supported the production of this book. Hand tools, supplied by Craftsman, were used during all phases of vehicle teardown and photography. Many of the fine specialty tools used in procedures were provided courtesy of Lisle Corporation. Lincoln Automotive Products has provided their industrial shop equipment including jacks, engine stands and shop presses. A Rotary lift, the largest automobile lift manufacturer in the world offering the biggest variety of surface and inground lifts available, was also used.

1

GENERAL INFORMATION AND MAINTENANCE

HOW TO USE THIS BOOK

Chilton's Total Car Care manual for the 1984–96 Chevrolet Corvette is intended to help you learn more about the inner workings of your vehicle while saving you money on its upkeep and operation.

The beginning of the book will likely be referred to the most, since that is where you will find information for maintenance and tune-up. The other sections deal with the more complex systems of your vehicle. Operating systems from engine through brakes are covered to the extent that the average do-it-yourselfer becomes mechanically involved. This book will not explain such things as rebuilding a differential for the simple reason that the expertise required and the investment in special tools make this task uneconomical. It will, however, give you detailed instructions to help you change your own brake pads and shoes, replace spark plugs, and perform many more jobs that can save you money, give you personal satisfaction and help you avoid expensive problems.

A secondary purpose of this book is a reference for owners who want to understand their vehicle and/or their mechanics better. In this case, no tools at all are required.

Where to Begin

Before removing any bolts, read through the entire procedure. This will give you the overall view of what tools and supplies will be required. There is nothing more frustrating than having to walk to the bus stop on Monday morning because you were short one bolt on Sunday afternoon. So read ahead and plan ahead. Each operation should be approached logically and all procedures thoroughly understood before attempting any work.

All sections contain adjustments, maintenance, removal and installation procedures, and in some cases, repair or overhaul procedures. When repair is not considered practical, we tell you how to remove the part and then how to install the new or rebuilt replacement. In this way, you at least save labor costs. "Backyard" repair of some components is just not practical.

Avoiding Trouble

Many procedures in this book require you to "label and disconnect . . ." a group of lines, hoses or wires. Don't be lulled into thinking you can remember where everything goes—you won't. If you hook up vacuum or fuel lines incorrectly, the vehicle may run poorly, if at all. If you hook up electrical wiring incorrectly, you may instantly learn a very expensive lesson.

You don't need to know the official or engineering name for each hose or line. A piece of masking tape on the hose and a piece on its fitting will allow you to assign your own label such as the letter A or a short name. As long as you remember your own code, the lines can be reconnected by matching similar letters or names. Do remember that tape will dissolve in gasoline or other fluids; if a component is to be washed or cleaned, use another method of identification. A permanent felt-tipped marker or a metal scribe can be very handy for marking metal parts. Remove any tape or paper labels after assembly.

Maintenance or Repair?

It's necessary to mention the difference between maintenance and repair. Maintenance includes routine inspections, adjustments, and replacement of parts which show signs of normal wear. Maintenance compensates for wear or deterioration. Repair implies that something has broken or is not working. A need for repair is often caused by lack of maintenance. Example: draining and refilling the automatic transmission fluid is maintenance recommended by the manufacturer at specific mileage intervals. Failure to do this can shorten the life of the transmission, requiring very expensive repairs. While no maintenance program can prevent items from breaking or wearing out, a general rule can be stated: MAINTENANCE IS CHEAPER THAN REPAIR.

Two basic mechanic's rules should be mentioned here. First, whenever the left side of the vehicle or engine is referred to, it is meant to specify the driver's side. Conversely, the right side of the vehicle means the passenger's side. Second, screws and bolts are removed by turning counterclockwise, and tightened by turning clockwise unless specifically noted.

Safety is always the most important rule. Constantly be aware of the dangers involved in working on an automobile and take the proper precautions. See the information in this section regarding SERVICING YOUR VEHICLE SAFELY and the SAFETY NOTICE on the acknowledgment page.

Avoiding the Most Common Mistakes

Pay attention to the instructions provided. There are 3 common mistakes in mechanical work:

1. Incorrect order of assembly, disassembly or adjustment. When taking something apart or putting it together, performing steps in the wrong order usually just costs you extra time; however, it CAN break something. Read the entire procedure before beginning disassembly. Perform everything in the order in which the instructions say you should, even if you can't immediately see a reason for it. When you're taking apart something that is very intricate, you might want to draw a picture of how it looks when assembled at one point in order to make sure you get everything back in its proper position. We will supply exploded views whenever possible. When making adjustments, perform them in the proper order. One adjustment possibly will affect another.
2. Overtorquing (or undertorquing). While it is more common for overtorquing to cause damage, undertorquing may allow a fastener to vibrate loose causing serious damage. Especially when dealing with aluminum parts, pay attention to torque specifications and utilize a torque wrench in assembly. If a torque figure is not available, remember that if you are using the right tool to perform the job, you will probably not have to strain yourself to get a fastener tight enough. The pitch of most threads is so slight that the tension you put on the wrench will be multiplied many times in actual force on what you are tightening. A good example of how critical torque is can be seen in the case of spark plug installation, especially where you are putting the plug into an aluminum cylinder head. Too little torque can fail to crush the gasket, causing leakage of combustion gases and consequent overheating of the plug and engine parts. Too much torque can damage the threads or distort the plug, changing the spark gap.

There are many commercial products available for ensuring that fasteners won't come loose, even if they are not torqued just right (a very common brand is Loctite®. If you're worried about getting something together tight enough to hold, but loose enough to avoid mechanical damage during assembly, one of these products might offer substantial insurance. Before choosing a threadlocking compound, read the label on the package and make sure the product is compatible with the materials, fluids, etc. involved.

3. Crossthreading. This occurs when a part such as a bolt is screwed into a nut or casting at the wrong angle and forced. Crossthreading is more likely to occur if access is difficult. It helps to clean and lubricate fasteners, then to start threading the bolt, spark plug, etc. with your fingers. If you encounter resistance, unscrew the part and start over again at a different angle until it can be inserted and turned several times without much effort. Keep in mind that many parts, especially spark plugs, have tapered threads, so that gentle turning will automatically bring the part you're threading to the proper angle. Don't put a wrench on the part until it's been tightened a couple of turns by hand. If you suddenly encounter resistance, and the part has not seated fully, don't force it. Pull it back out to make sure it's clean and threading properly.

Be sure to take your time and be patient, and always plan ahead. Allow yourself ample time to perform repairs and maintenance. You may find maintaining your car a satisfying and enjoyable experience.

TOOLS AND EQUIPMENT

▸ See Figures 1 thru 15

Naturally, without the proper tools and equipment it is impossible to properly service your vehicle. It would also be virtually impossible to catalog every tool that you would need to perform all of the operations in this book. Of course, It would be unwise for the amateur to rush out and buy an expensive set of tools on the theory that he/she may need one or more of them at some time.

The best approach is to proceed slowly, gathering a good quality set of those tools that are used most frequently. Don't be misled by the low cost of bargain tools. It is far better to spend a little more for better quality. Forged wrenches, 6 or 12-point sockets and fine tooth ratchets are by far preferable to their less expensive counterparts. As any good mechanic can tell you, there are few worse experiences than trying to work on a vehicle with bad tools. Your monetary savings will be far outweighed by frustration and mangled knuckles.

Begin accumulating those tools that are used most frequently: those associated with routine maintenance and tune-up. In addition to the normal assortment of screwdrivers and pliers, you should have the following tools:

- Wrenches/sockets and combination open end/box end wrenches in sizes 3mm–19mm 13/16 in. or 5/8 in. spark plug socket (depending on plug type).

➡If possible, buy various length socket drive extensions. Universal-joint and wobble extensions can be extremely useful, but be careful when using them, as they can change the amount of torque applied to the socket.

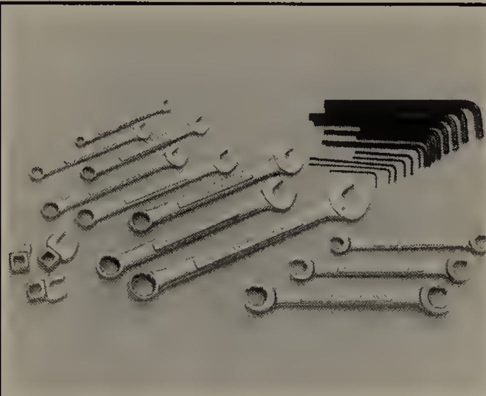
- Jackstands for support.
- Oil filter wrench.
- Spout or funnel for pouring fluids.
- Grease gun for chassis lubrication (unless your vehicle is not equipped with any grease fittings—for details, please refer to information on Fluids and Lubricants, later in this section).
- Hydrometer for checking the F (unless equipped with a sealed, maintenance-free battery).
- A container for draining oil and other fluids.
- Rags for wiping up the inevitable mess.

In addition to the above items there are several others that are not absolutely necessary, but handy to have around. These include Oil Dry((or an equivalent oil absorbent gravel—such as cat litter) and the usual supply of lubricants, antifreeze and fluids, although these can be purchased as needed. This is a basic list for routine maintenance, but only your personal needs and desire can accurately determine your list of tools.

After performing a few projects on the vehicle, you'll be amazed at the other tools and non-tools on your workbench. Some useful household items are: a large turkey baster or siphon, empty coffee cans and ice trays (to store parts),

TCCS1200

Fig. 1 All but the most basic procedures will require an assortment of ratchets and sockets

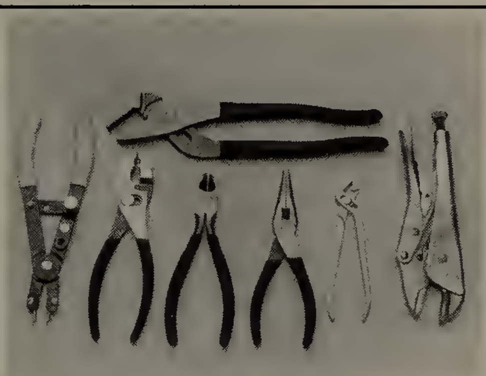


TCCS1201

Fig. 2 In addition to ratchets, a good set of wrenches and hex keys will be necessary

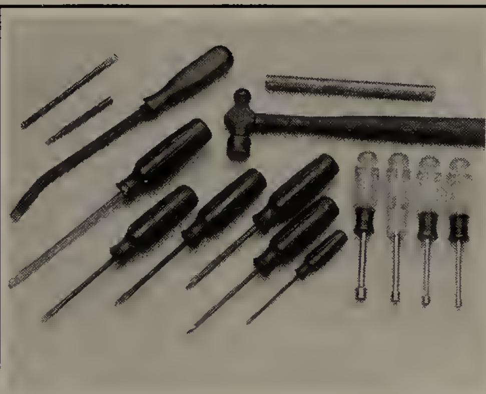
TCCS1202

Fig. 3 A hydraulic floor jack and a set of jackstands are essential for lifting and supporting the vehicle



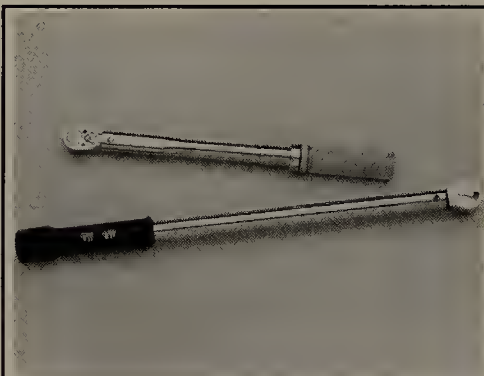
TCCS1203

Fig. 4 An assortment of pliers, grippers and cutters will be handy for old rusted parts and stripped bolt heads



TCCS1204

Fig. 5 Various drivers, chisels and prybars are great tools to have in your toolbox

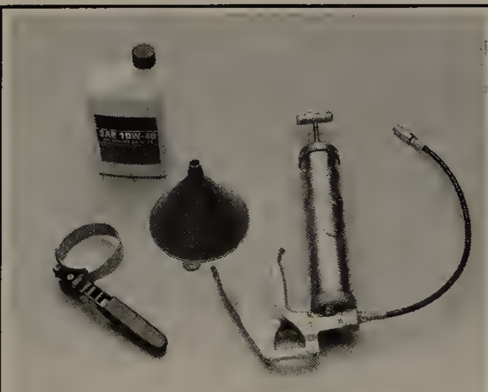


TCCS1205

Fig. 6 Many repairs will require the use of a torque wrench to assure the components are properly fastened

TCCS1209

Fig. 7 Although not always necessary, using specialized brake tools will save time



TCCS1210

Fig. 8 A few inexpensive lubrication tools will make maintenance easier

TCCS1211

Fig. 9 Various pullers, clamps and separator tools are needed for many larger, more complicated repairs

TCCS1212

Fig. 10 A variety of tools and gauges should be used for spark plug gapping and installation

TCCX1P01

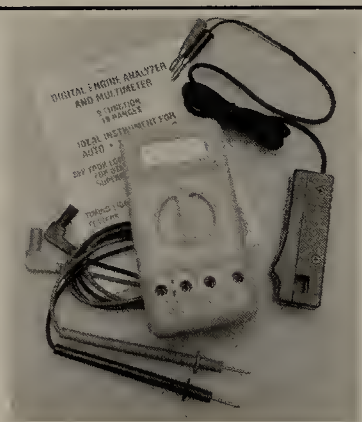
Fig. 11 Inductive type timing light

TCCX1P02

Fig. 12 A screw-in type compression gauge is recommended for compression testing

TCCX1P03

Fig. 13 A vacuum/pressure tester is necessary for many testing procedures



TCCX1P06

Fig. 14 Most modern automotive multimeters incorporate many helpful features

TCCS1213

Fig. 15 Proper information is vital, so always have a Chilton Total Car Care manual handy

ball of twine, electrical tape for wiring, small rolls of colored tape for tagging lines or hoses, markers and pens, a note pad, golf tees (for plugging vacuum lines), metal coat hangers or a roll of mechanics's wire (to hold things out of the way), dental pick or similar long, pointed probe, a strong magnet, and a small mirror (to see into recesses and under manifolds).

A more advanced set of tools, suitable for tune-up work, can be drawn up easily. While the tools are slightly more sophisticated, they need not be outrageously expensive. There are several inexpensive tach/dwell meters on the market that are every bit as good for the average mechanic as a professional model. Just be sure that it goes to a least 1200–1500 rpm on the tach scale and that it works on 4, 6 and 8-cylinder engines. The key to these purchases is to make them with an eye towards adaptability and wide range. A basic list of tune-up tools could include:

- Tach/dwell meter.
- Spark plug wrench and gapping tool.
- Feeler gauges for valve adjustment.
- Timing light.

The choice of a timing light should be made carefully. A light which works on the DC current supplied by the vehicle's battery is the best choice; it should have a xenon tube for brightness. On any vehicle with an electronic ignition system, a timing light with an inductive pickup that clamps around the No. 1 spark plug cable is preferred.

In addition to these basic tools, there are several other tools and gauges you may find useful. These include:

- Compression gauge. The screw-in type is slower to use, but eliminates the possibility of a faulty reading due to escaping pressure.
- Manifold vacuum gauge.
- 12V test light.
- A combination volt/ohmmeter
- Induction Ammeter. This is used for determining whether or not there is current in a wire. These are handy for use if a wire is broken somewhere in a wiring harness.

As a final note, you will probably find a torque wrench necessary for all but the most basic work. The beam type models are perfectly adequate, although the newer click types (breakaway) are easier to use. The click type torque wrenches tend to be more expensive. Also keep in mind that all types of torque wrenches should be periodically checked and/or recalibrated. You will have to decide for yourself which better fits your pocketbook, and purpose.

Special Tools

Normally, the use of special factory tools is avoided for repair procedures, since these are not readily available for the do-it-yourself mechanic. When it is possible to perform the job with more commonly available tools, it will be pointed out, but occasionally, a special tool was designed to perform a specific function and should be used. Before substituting another tool, you should be convinced that neither your safety nor the performance of the vehicle will be compromised.

Special tools can usually be purchased from an automotive parts store or from your dealer. In some cases special tools may be available directly from the tool manufacturer.

SERVICING YOUR VEHICLE SAFELY

See Figures 16, 17, 18 and 19

It is virtually impossible to anticipate all of the hazards involved with automotive maintenance and service, but care and common sense will prevent most accidents.

The rules of safety for mechanics range from "don't smoke around gasoline," to "use the proper tool(s) for the job." The trick to avoiding injuries is to develop safe work habits and to take every possible precaution.

Do's

- Do keep a fire extinguisher and first aid kit handy.
- Do wear safety glasses or goggles when cutting, drilling, grinding or prying, even if you have 20–20 vision. If you wear glasses for the sake of vision, wear safety goggles over your regular glasses.
- Do shield your eyes whenever you work around the battery. Batteries contain sulfuric acid. In case of contact with the eyes or skin, flush the area with water or a mixture of water and baking soda. then seek immediate medical attention.
- Do use safety stands (jackstands) for any undervehicle service. Jacks are for raising vehicles; jackstands are for making sure the vehicle stays raised until you want it to come down. Whenever the vehicle is raised, block the wheels remaining on the ground and set the parking brake.
- Do use adequate ventilation when working with any chemicals or hazardous materials. Like carbon monoxide, the asbestos dust resulting from some brake lining wear can be hazardous in sufficient quantities.
- Do disconnect the negative battery cable when working on the electrical system. The secondary ignition system contains EXTREMELY HIGH VOLTAGE. In some cases it can even exceed 50,000 volts.
- Do follow manufacturer's directions whenever working with potentially hazardous materials. Most chemicals and fluids are poisonous if taken internally.
- Do properly maintain your tools. Loose hammerheads, mushroomed punches and chisels, frayed or poorly grounded electrical cords, excessively worn screwdrivers, spread wrenches (open end), cracked sockets, slipping ratchets, or faulty droplight sockets can cause accidents.
- Likewise, keep your tools clean; a greasy wrench can slip off a bolt head, ruining the bolt and often harming your knuckles in the process.
- Do use the proper size and type of tool for the job at hand. Do select a wrench or socket that fits the nut or bolt. The wrench or socket should sit straight, not cocked.
- Do, when possible, pull on a wrench handle rather than push on it, and adjust your stance to prevent a fall.
- Do be sure that adjustable wrenches are tightly closed on the nut or bolt and pulled so that the force is on the side of the fixed jaw.
- Do strike squarely with a hammer; avoid glancing blows.
- Do set the parking brake and block the drive wheels if the work requires a running engine.

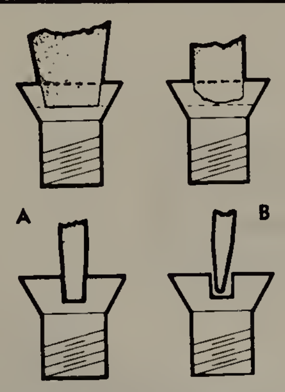


Fig. 16 Screwdrivers should be kept in good condition to prevent injury or damage which could result if the blade slips from the screw

Don'ts

- Don't run the engine in a garage or anywhere else without proper ventilation—EVER! Carbon monoxide is poisonous; it takes a long time to leave the human body and you can build up a deadly supply of it in your system by simply breathing in a little every day. You may not realize you are slowly poisoning yourself. Always use power vents, windows, fans and/or open the garage door.
- Don't work around moving parts while wearing loose clothing. Short sleeves are much safer than long, loose sleeves. Hard-toed shoes with neoprene soles protect your toes and give a better grip on slippery surfaces. Jewelry such as watches, fancy belt buckles, beads or body adornment of any kind is not safe working around a vehicle. Long hair should be tied back under a hat or cap.
- Don't use pockets for toolboxes. A fall or bump can drive a screwdriver deep into your body. Even a rag hanging from your back pocket can wrap around a spinning shaft or fan.
- Don't smoke when working around gasoline, cleaning solvent or other flammable material.
- Don't smoke when working around the battery. When the battery is being charged, it gives off explosive hydrogen gas.
- Don't use gasoline to wash your hands; there are excellent soaps available. Gasoline contains dangerous additives which can enter the body through a cut or through your pores. Gasoline also removes all the natural oils from the skin so that bone dry hands will suck up oil and grease.
- Don't service the air conditioning system unless you are equipped with the necessary tools and training. When liquid or compressed gas refrigerant is released to atmospheric pressure it will absorb heat from whatever it contacts. This will chill or freeze anything it touches.
- Don't use screwdrivers for anything other than driving screws! A screwdriver used as an prying tool can snap when you least expect it, causing injuries. At the very least, you'll ruin a good screwdriver.
- Don't use an emergency jack (that little ratchet, scissors, or pantograph jack supplied with the vehicle) for anything other than changing a flat! These jacks are only intended for emergency use out on the road; they are NOT designed as a maintenance tool. If you are serious about maintaining your vehicle yourself, invest in a hydraulic floor jack of at least a 1½ ton capacity, and at least two sturdy jackstands.

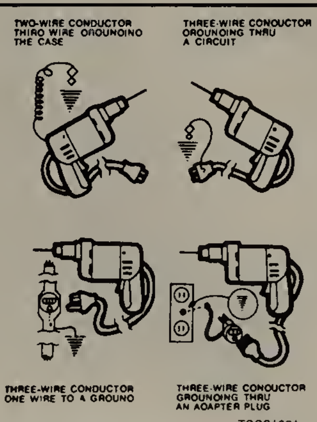


Fig. 17 Power tools should always be properly grounded

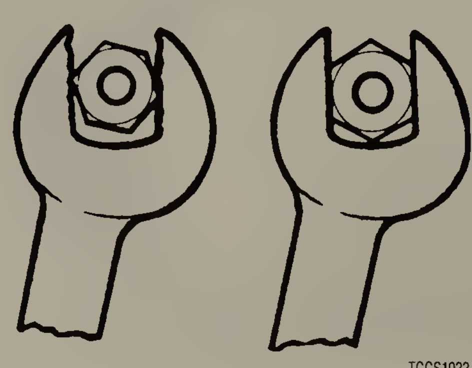


Fig. 18 Using the correct size wrench will help prevent the possibility of rounding off a nut

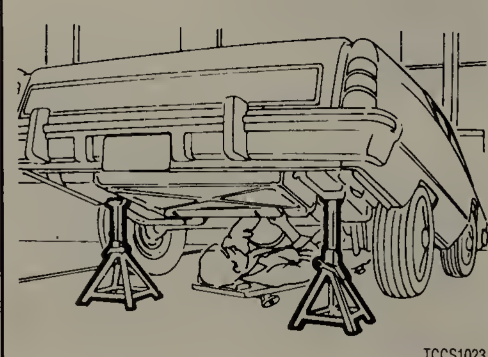


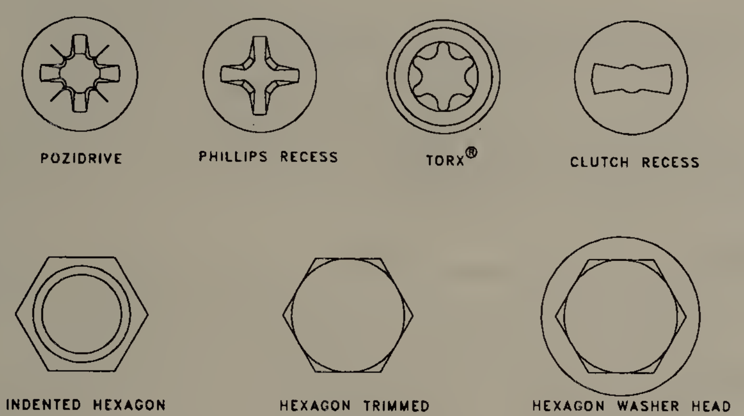
Fig. 19 NEVER work under a vehicle unless it is supported using safety stands (jackstands)

FASTENERS, MEASUREMENTS AND CONVERSIONS

Bolts, Nuts and Other Threaded Retainers

See Figures 20, 21, 22 and 23

Although there are a great variety of fasteners found in the modern car or truck, the most commonly used retainer is the threaded fastener (nuts, bolts, screws, studs, etc). Most threaded retainers may be reused, provided that they are not damaged in use or during the repair. Some retainers (such as stretch bolts or torque prevailing nuts) are designed to deform when tightened or in use and should not be reinstalled.

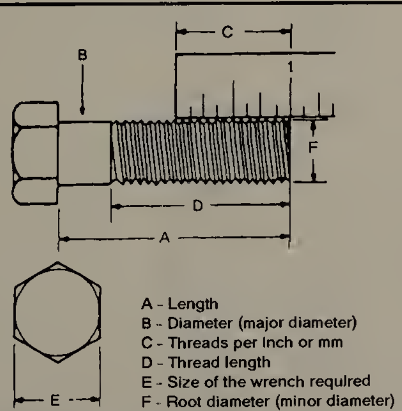


TCCS1037

Fig. 20 Here are a few of the most common screw/bolt driver styles

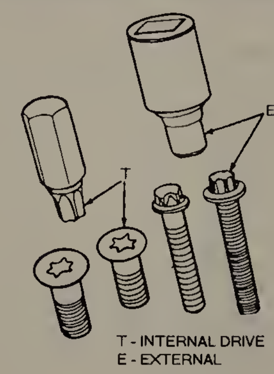
TCCS1036

Fig. 21 There are many different types of threaded retainers found on vehicles



TCCS1038

Fig. 22 Threaded retainer sizes are determined using these measurements



TCCS1016

Fig. 23 Special fasteners such as these Torx® head bolts are used by manufacturers to discourage people from working on vehicles without the proper tools

Whenever possible, we will note any special retainers which should be replaced during a procedure. But you should always inspect the condition of a retainer when it is removed and replace any that show signs of damage. Check all threads for rust or corrosion which can increase the torque necessary to achieve the desired clamp load for which that fastener was originally selected. Additionally, be sure that the driver surface of the fastener has not been compromised by rounding or other damage. In some cases a driver surface may become only partially rounded, allowing the driver to catch in only one direction. In many of these occurrences, a fastener may be installed and tightened, but the driver would not be able to grip and loosen the fastener again. (This could lead to frustration down the line should that component ever need to be disassembled again).

If you must replace a fastener, whether due to design or damage, you must ALWAYS be sure to use the proper replacement. In all cases, a retainer of the same design, material and strength should be used. Markings on the heads of most bolts will help determine the proper strength of the fastener. The same material, thread and pitch must be selected to assure proper installation and safe operation of the vehicle afterwards.

Thread gauges are available to help measure a bolt or stud's thread. Most automotive and hardware stores keep gauges available to help you select the proper size. In a pinch, you can use another nut or bolt for a thread gauge. If the bolt you are replacing is not too badly damaged, you can select a match by finding another bolt which will thread in its place. If you find a nut which threads properly onto the damaged bolt, then use that nut to help select the replacement bolt. If however, the bolt you are replacing is so badly damaged (broken or drilled out) that its threads cannot be used as a gauge, you might start by looking for another bolt (from the same assembly or a similar location on your vehicle) which will thread into the damaged bolt's mounting. If so, the other bolt can be used to select a nut; the nut can then be used to select the replacement bolt.

In all cases, be absolutely sure you have selected the proper replacement. Don't be shy, you can always ask the store clerk for help.

WARNING

Be aware that when you find a bolt with damaged threads, you may also find the nut or drilled hole it was threaded into has also been damaged. If this is the case, you may have to drill and tap the hole, replace the nut or otherwise repair the threads. NEVER try to force a replacement bolt to fit into the damaged threads.

Torque

Torque is defined as the measurement of resistance to turning or rotating. It tends to twist a body about an axis of rotation. A common example of this would be tightening a threaded retainer such as a nut, bolt or screw. Measuring torque is one of the most common ways to help assure that a threaded retainer has been properly fastened.

When tightening a threaded fastener, torque is applied in three distinct areas, the head, the bearing surface and the clamp load. About 50 percent of the measured torque is used in overcoming bearing friction. This is the friction between the bearing surface of the bolt head, screw head or nut face and the base material or washer (the surface on which the fastener is rotating). Approximately 40 percent of the applied torque is used in overcoming thread friction. This leaves only about 10 percent of the applied torque to develop a useful clamp load (the force which holds a joint together). This means that friction can account for as much as 90 percent of the applied torque on a fastener.

TORQUE WRENCHES

➧ **See Figures 24 and 25**

In most applications, a torque wrench can be used to assure proper installation of a fastener. Torque wrenches come in various designs and most automotive supply stores will carry a variety to suit your needs. A torque wrench should be used any time we supply a specific torque value for a fastener. A torque wrench can also be used if you are following the general guidelines in the accompanying charts. Keep in mind that because there is no worldwide stan-

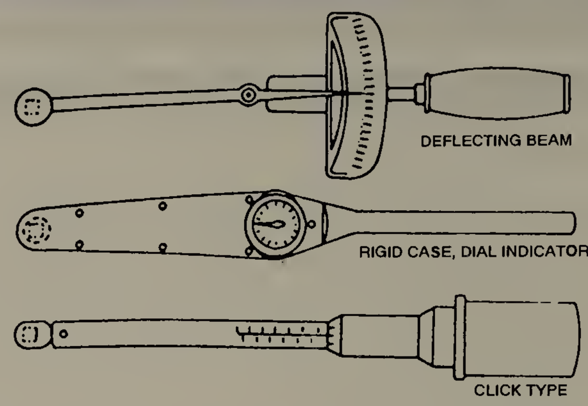


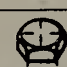
Fig. 24 Various styles of torque wrenches are usually available at your local automotive supply store

Standard Torque Specifications and Fastener Markings

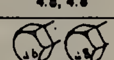
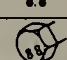
In the absence of specific torques, the following chart can be used as a guide to the maximum safe torque of a particular size/grade of fastener.

- There is no torque difference for fine or coarse threads.
- Torque values are based on clean, dry threads. Reduce the value by 10% if threads are oiled prior to assembly.
- The torque required for aluminum components or fasteners is considerably less.

U.S. Bolts

SAE Grade Number	1 or 2			5			8 or 7		
Number of lines always 2 less than the grade number.									
Bolt Size (Inches)—(Thread)	Maximum Torque			Maximum Torque			Maximum Torque		
	Ft./Lbs.	Kgm	Nm	Ft./Lbs.	Kgm	Nm	Ft./Lbs.	Kgm	Nm
¼—20	5	0.7	6.8	8	1.1	10.8	10	1.4	13.5
—28	6	0.8	8.1	10	1.4	13.6			
⁵⁄₁₆—18	11	1.5	14.9	17	2.3	23.0	19	2.6	25.8
—24	13	1.8	17.6	19	2.6	25.7			
⅜—16	18	2.5	24.4	31	4.3	42.0	34	4.7	46.0
—24	20	2.75	27.1	35	4.8	47.5			
⁷⁄₁₆—14	28	3.8	37.0	49	6.8	66.4	55	7.6	74.5
—20	30	4.2	40.7	55	7.6	74.5			
½—13	39	5.4	52.8	75	10.4	101.7	85	11.75	115.2
—20	41	5.7	55.6	85	11.7	115.2			
⁹⁄₁₆—12	51	7.0	69.2	110	15.2	149.1	120	16.6	162.7
—18	55	7.6	74.5	120	16.6	162.7			
⅝—11	83	11.5	112.5	150	20.7	203.3	167	23.0	226.5
—18	95	13.1	128.8	170	23.5	230.5			
¾—10	105	14.5	142.3	270	37.3	366.0	280	38.7	379.6
—16	115	15.9	155.9	295	40.8	400.0			
⅞— 9	160	22.1	216.9	395	54.6	535.5	440	60.9	596.5
—14	175	24.2	237.2	435	60.1	589.7			
1— 8	236	32.5	318.6	590	81.6	799.9	660	91.3	894.8
—14	250	34.6	338.9	660	91.3	849.8			

Metric Bolts

Relative Strength Marking	4.6, 4.8			8.8		
Bolt Markings						
Bolt Size Thread Size x Pitch (mm)	Maximum Torque			Maximum Torque		
	Ft./Lbs.	Kgm	Nm	Ft./Lbs.	Kgm	Nm
6 x 1.0	2–3	.2–.4	3–4	3–6	4–.8	5–8
8 x 1.25	6–8	.8–1	8–12	9–14	1.2–1.9	13–19
10 x 1.25	12–17	1.5–2.3	16–23	20–29	2.7–4.0	27–39
12 x 1.25	21–32	2.9–4.4	29–43	35–53	4.8–7.3	47–72
14 x 1.5	35–52	4.8–7.1	48–70	57–85	7.8–11.7	77–110
16 x 1.5	51–77	7.0–10.6	67–100	90–120	12.4–16.5	130–160
18 x 1.5	74–110	10.2–15.1	100–150	130–170	17.9–23.4	180–230
20 x 1.5	110–140	15.1–19.3	150–190	190–240	26.2–46.9	160–320
22 x 1.5	150–190	22.0–26.2	200–260	250–320	34.5–44.1	340–430
24 x 1.5	190–240	26.2–46.9	260–320	310–410	42.7–56.5	420–550

TCCS1098

Fig. 25 Standard and metric bolt torque specifications based on bolt strengths—WARNING: use only as a guide

dardization of fasteners, the charts are a general guideline and should be used with caution. Again, the general rule of "if you are using the right tool for the job, you should not have to strain to tighten a fastener" applies here.

Beam Type

➧ See Figure 26

The beam type torque wrench is one of the most popular types. It consists of a pointer attached to the head that runs the length of the flexible beam (shaft) to a scale located near the handle. As the wrench is pulled, the beam bends and the pointer indicates the torque using the scale.

Click (Breakaway) Type

➧ See Figure 27

Another popular design of torque wrench is the click type. To use the click type wrench you pre-adjust it to a torque setting. Once the torque is reached, the wrench has a reflex signaling feature that causes a momentary breakaway of the torque wrench body, sending an impulse to the operator's hand.

Pivot Head Type

➧ See Figures 27 and 28

Some torque wrenches (usually of the click type) may be equipped with a pivot head which can allow it to be used in areas of limited access. BUT, it must be used properly. To hold a pivot head wrench, grasp the handle lightly, and as you pull on the handle, it should be floated on the pivot point. If the handle comes in contact with the yoke extension during the process of pulling, there is a very good chance the torque readings will be inaccurate because this could alter the wrench loading point. The design of the handle is usually such as to make it inconvenient to deliberately misuse the wrench.

➡It should be mentioned that the use of any U-joint, wobble or extension will have an effect on the torque readings, no matter what type of wrench you are using. For the most accurate readings, install the socket directly on the wrench driver. If necessary, straight extensions (which hold a socket directly under the wrench driver) will have the least effect on the torque reading. Avoid any extension that alters the length of the wrench from the handle to the head/driving point (such as a crow's foot). U-joint or wobble extensions can greatly affect the readings; avoid their use at all times.

Rigid Case (Direct Reading)

➧ See Figure 29

A rigid case or direct reading torque wrench is equipped with a dial indicator to show torque values. One advantage of these wrenches is that they can be held at any position on the wrench without affecting accuracy. These wrenches are often preferred because they tend to be compact, easy to read and have a great degree of accuracy.

TORQUE ANGLE METERS

➧ See Figure 30

Because the frictional characteristics of each fastener or threaded hole will vary, clamp loads which are based strictly on torque will vary as well. In most applications, this variance is not significant enough to cause worry. But, in certain applications, a manufacturer's engineers may determine that more precise clamp loads are necessary (such is the case with many aluminum cylinder heads). In these cases, a torque angle method of installation would be specified. When installing fasteners which are torque angle tightened, a predetermined seating torque and standard torque wrench are usually used first to remove any compliance from the joint. The fastener is then tightened the specified additional portion of a turn measured in degrees. A torque angle gauge (mechanical protractor) is used for these applications.

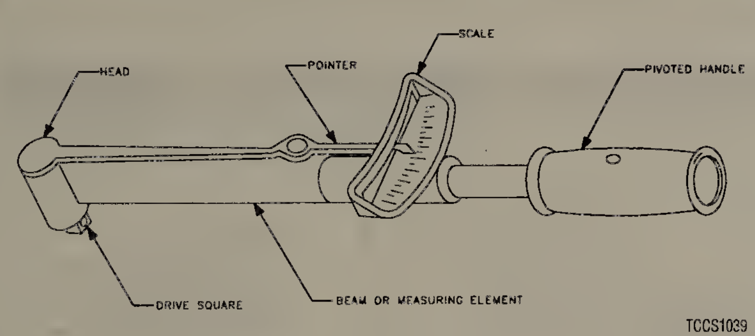


Fig. 26 Example of a beam type torque wrench

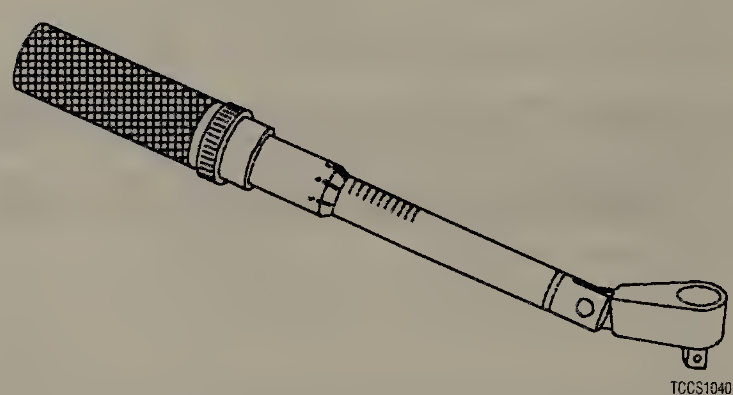


Fig. 27 A click type or breakaway torque wrench—note that this one has a pivoting head

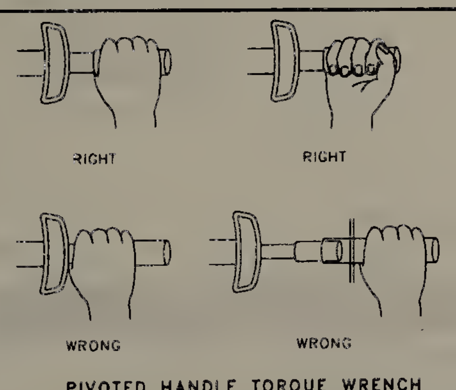


Fig. 28 Torque wrenches with pivoting heads must be grasped and used properly to prevent an incorrect reading

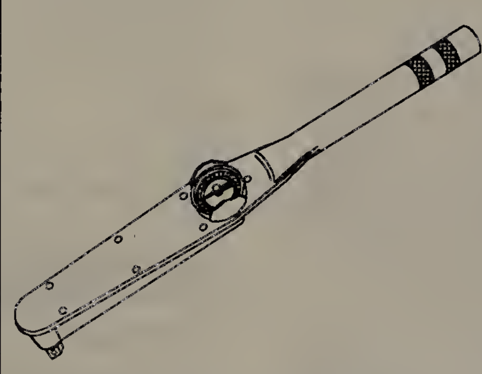


Fig. 29 The rigid case (direct reading) torque wrench uses a dial indicator to show torque

Fig. 30 Some specifications require the use of a torque angle meter (mechanical protractor)

Standard and Metric Measurements

See Figure 31

Throughout this manual, specifications are given to help you determine the condition of various components on your vehicle, or to assist you in their installation. Some of the most common measurements include length (in. or cm/mm), torque (ft. lbs., inch lbs. or Nm) and pressure (psi, in. Hg, kPa or mm Hg). In most cases, we strive to provide the proper measurement as determined by the manufacturer's engineers.

Though, in some cases, that value may not be conveniently measured with what is available in your toolbox. Luckily, many of the measuring devices which are available today will have two scales so the Standard or Metric measurements may easily be taken. If any of the various measuring tools which are available to you do not contain the same scale as listed in the specifications, use the accompanying conversion factors to determine the proper value.

The conversion factor chart is used by taking the given specification and multiplying it by the necessary conversion factor. For instance, looking at the first line, if you have a measurement in inches such as "free-play should be 2 in." but your ruler reads only in millimeters, multiply 2 in. by the conversion factor of 25.4 to get the metric equivalent of 50.8mm. Likewise, if the specification was given only in a Metric measurement, for example in Newton Meters (Nm), then look at the center column first. If the measurement is 100 Nm, multiply it by the conversion factor of 0.738 to get 73.8 ft. lbs.

CONVERSION FACTORS

LENGTH–DISTANCE				
Inches (in.)	x 25.4	= Millimeters (mm)	x .0394	= Inches
Feet (ft.)	x .305	= Meters (m)	x 3.281	= Feet
Miles	x 1.609	= Kilometers (km)	x .0621	= Miles
VOLUME				
Cubic Inches (in3)	x 16.387	= Cubic Centimeters	x .061	= in3
IMP Pints (IMP pt.)	x .568	= Liters (L)	x 1.76	= IMP pt.
IMP Quarts (IMP qt.)	x 1.137	= Liters (L)	x .88	= IMP qt.
IMP Gallons (IMP gal.)	x 4.546	= Liters (L)	x .22	= IMP gal.
IMP Quarts (IMP qt.)	x 1.201	= US Quarts (US qt.)	x .833	= IMP qt.
IMP Gallons (IMP gal.)	x 1.201	= US Gallons (US gal.)	x .833	= IMP gal.
Fl. Ounces	x 29.573	= Milliliters	x .034	= Ounces
US Pints (US pt.)	x .473	= Liters (L)	x 2.113	= Pints
US Quarts (US qt.)	x .946	= Liters (L)	x 1.057	= Quarts
US Gallons (US gal.)	x 3.785	= Liters (L)	x .264	= Gallons
MASS–WEIGHT				
Ounces (oz.)	x 28.35	= Grams (g)	x .035	= Ounces
Pounds (lb.)	x .454	= Kilograms (kg)	x 2.205	= Pounds
PRESSURE				
Pounds Per Sq. In. (psi)	x 6.895	= Kilopascals (kPa)	x .145	= psi
Inches of Mercury (Hg)	x .4912	= psi	x 2.036	= Hg
Inches of Mercury (Hg)	x 3.377	= Kilopascals (kPa)	x .2961	= Hg
Inches of Water (H_2O)	x .07355	= Inches of Mercury	x 13.783	= H_2O
Inches of Water (H_2O)	x .03613	= psi	x 27.684	= H_2O
Inches of Water (H_2O)	x .248	= Kilopascals (kPa)	x 4.026	= H_2O
TORQUE				
Pounds–Force Inches (in–lb)	x .113	= Newton Meters (N·m)	x 8.85	= in–lb
Pounds–Force Feet (ft–lb)	x 1.356	= Newton Meters (N·m)	x .738	= ft–lb
VELOCITY				
Miles Per Hour (MPH)	x 1.609	= Kilometers Per Hour (KPH)	x .621	= MPH
POWER				
Horsepower (Hp)	x .745	= Kilowatts	x 1.34	= Horsepower
FUEL CONSUMPTION*				
Miles Per Gallon IMP (MPG)	x .354	= Kilometers Per Liter (Km/L)		
Kilometers Per Liter (Km/L)	x 2.352	= IMP MPG		
Miles Per Gallon US (MPG)	x .425	= Kilometers Per Liter (Km/L)		
Kilometers Per Liter (Km/L)	x 2.352	= US MPG		

*It is common to covert from miles per gallon (mpg) to liters/100 kilometers (1/100 km), where mpg (IMP) x 1/100 km = 282 and mpg (US) x 1/100 km = 235.

TEMPERATURE

Degree Fahrenheit (°F) = (°C x 1.8) + 32

Degree Celsius (°C) = (°F – 32) x .56

TCCS1044

Fig. 31 Standard and metric conversion factors chart

SERIAL NUMBER IDENTIFICATION

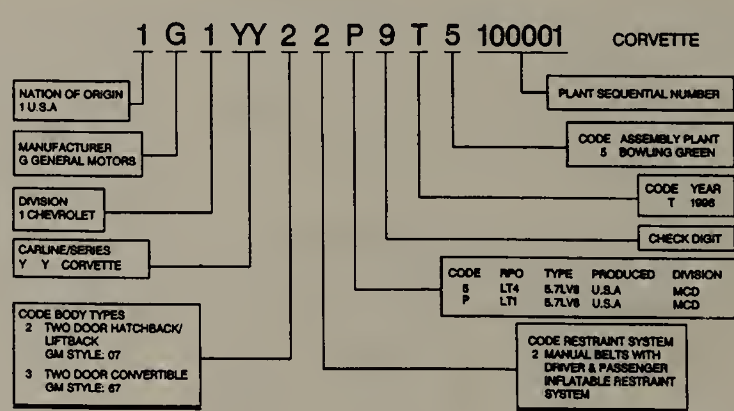
Vehicle

See Figures 32 and 33

The Vehicle Identification Number (VIN) plate, which contains the Vehicle Identification Number (VIN), is located at the top rear of the instrument panel on the left side. It is visible from outside the vehicle on the lower left (driver's) side of the windshield. The VIN consists of 17 characters which represent codes supplying important information about your vehicle. Refer to the illustration for an example of VIN interpretation.

91031P11

Fig. 32 The VIN is stamped into a plate which is visible through the windshield



91031G01

Fig. 33 Example of VIN interpretation

Engine

See Figures 34, 35 and 36

The engine code is represented by the eighth character in the VIN and identifies the engine type, displacement, fuel system and manufacturing division.

The engine identification code is either stamped onto the engine block or found on a label affixed to the engine. This code supplies information about the manufacturing plant location and time of manufacture. The location of the engine code is shown in the accompanying illustrations.

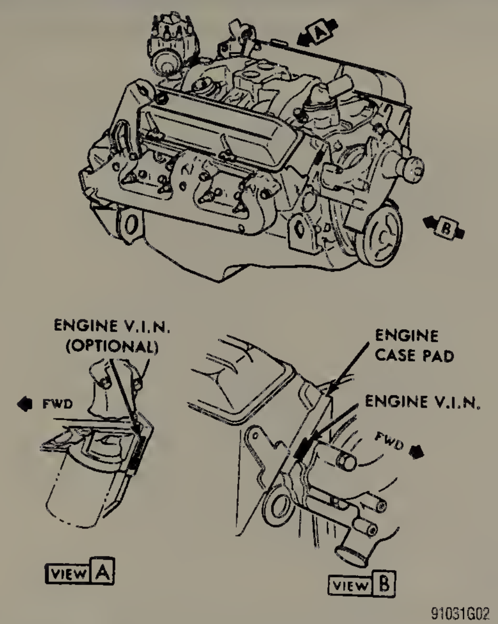


Fig. 34 Engine VIN location—5.7L (VIN 8) engines

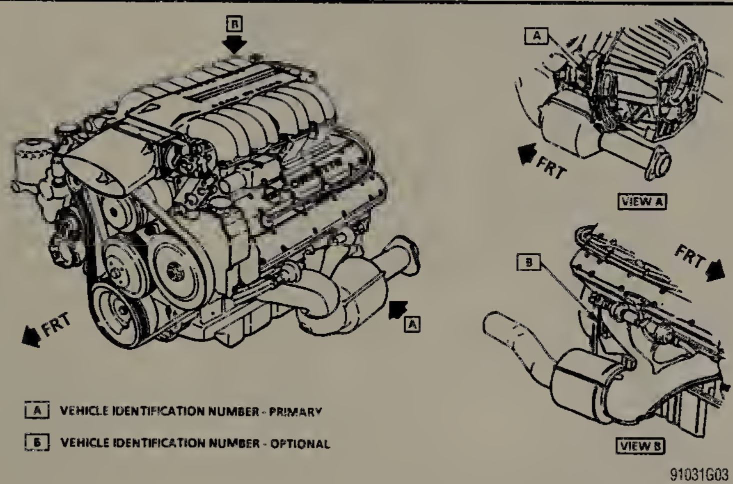


Fig. 35 Engine identification tag locations—5.7L (VIN J) engines

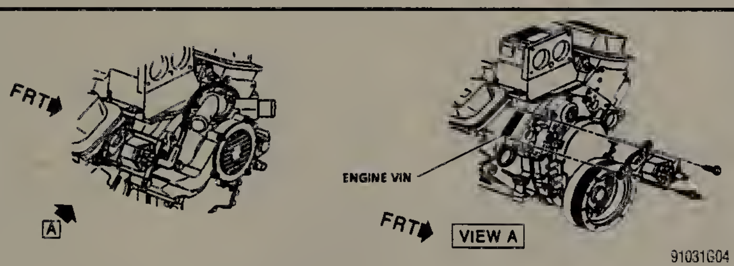


Fig. 36 Engine VIN plate locations—5.7L (VIN P and 5) engines

Transmission

➧ See Figures 37 and 38

Similar to the engine identification code, the transaxle identification code supplies information about the transaxle such as the manufacturing plant, Julian date of manufacture, shift number and model. The location for the transaxle code is shown in the accompanying illustrations.

Rear Axle

These vehicles have an identification number stamped into the bottom surface of the carrier at the cover mounting flange.

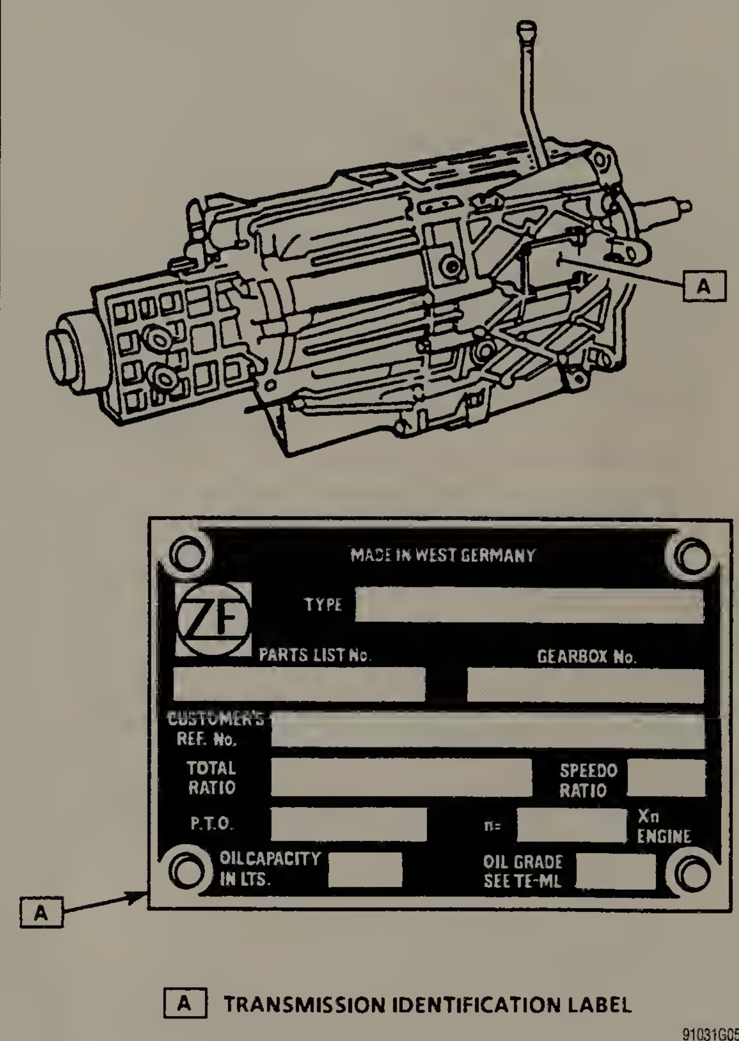


Fig. 38 Typical manual transmission identification label location

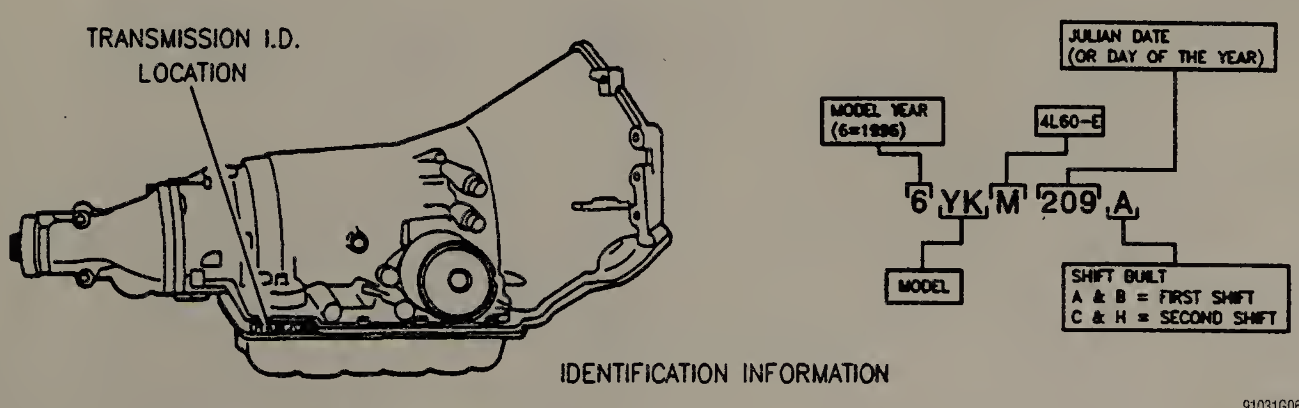


Fig. 37 Location of the automatic transmission identification tag

VEHICLE IDENTIFICATION CHART

Engine Code

Code	Liters	Cu. In. (cc)	Cyl.	Fuel Sys.	Eng. Mfg.
8	5.7	350 (5700)	8	TBI	Chevrolet
8	5.7	350 (5700)	8	TPI	Chevrolet
J	5.7	350 (5700)	8	MFI	①
P	5.7	350 (5700)	8	MFI/SFI	Chevolet
5	5.7	350 (5700)	8	SFI	Chevrolet

TBI - Throttle Body Injection (Cross-Fire Injection)

TPI - Tuned Port Injection

MPI - Multi-Port electronic fuel Injection

SFI - Sequential Multi-port Fuel Injection

① Manufactured by Mecury Marine

Model Year

Code	Year
E	1984
F	1985
G	1986
H	1987
J	1988
K	1989
L	1990
M	1991
N	1992
P	1993
R	1994
S	1995
T	1996

91031C01

ENGINE IDENTIFICATION

Year	Model	Engine Displacement Liters (cc)	Engine Series (ID/VIN)	Fuel System	No. of Cylinders	Engine Type
1984	Corvette	5.7L (5700)	8	TBI	8	OHV
1985	Corvette	5.7L (5700)	8	TPI	8	OHV
1986	Corvette	5.7L (5700)	8	TPI	8	OHV
1987	Corvette	5.7L (5700)	8	TPI	8	OHV
1988	Corvette	5.7L (5700)	8	TPI	8	OHV
1989	Corvette	5.7L (5700)	8	TPI	8	OHV
1990	Corvette	5.7L (5700)	8	TPI	8	OHV
	Corvette	5.7L (5700)	J	MFI	8	DOHC
1991	Corvette	5.7L (5700)	8	TPI	8	OHV
	Corvette	5.7L (5700)	J	MFI	8	DOHC
1992	Corvette	5.7L (5700)	P	MFI	8	OHV
	Corvette	5.7L (5700)	J	MFI	8	DOHC
1993	Corvette	5.7L (5700)	P	MFI	8	OHV
	Corvette	5.7L (5700)	J	MFI	8	DOHC
1994	Corvette	5.7L (5700)	P	SFI	8	OHV
	Corvette	5.7L (5700)	J	MFI	8	DOHC
1995	Corvette	5.7L (5700)	P	SFI	8	OHV
	Corvette	5.7L (5700)	J	MFI	8	DOHC
1996	Corvette	5.7L (5700)	P	SFI	8	OHV
	Corvette	5.7L (5700)	5	SFI	8	OHV

TBI - Throttle Body Injection (Cross-Fire Injection)

TPI - Tuned Port Injection

MPI - Multi-Port electronic fuel Injection

SFI - Sequential Multi-port Fuel Injection

OHV - OverHead Valve

DOHC - Dual OverHead Cam

91031C02

GENERAL ENGINE SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Fuel System Type	Net Horsepower @ rpm	Net Torque @ rpm (ft. lbs.)	Bore x Stroke (in.)	Com-pression Ratio	Oil Pressure @ rpm
1984	8	5.7L (5700)	TBI	165 @ 5200	210 @ 2000	4.00 x 3.48	9.0:1	37 @ 2400
1985	8	5.7L (5700)	TPI	165 @ 5200	210 @ 2000	4.00 x 3.48	9.0:1	37 @ 2400
1986	8	5.7L (5700)	TPI	165 @ 5200	210 @ 2100	4.00 x 3.48	9.0:1	37 @ 2400
1987	8	5.7L (5700)	TPI	230 @ 4000	330 @ 3200	4.00 x 3.48	9.0:1	50-65 @ 2000
1988	8	5.7L (5700)	TPI	245 @ 4300	340 @ 3200	4.00 x 3.48	9.0:1	50-65 @ 2000
1989	8	5.7L (5700)	TPI	240 @ 4300	335 @ 3200	4.00 x 3.48	9.0:1	50-65 @ 2000
1990	8	5.7L (5700)	TPI	245 @ 4000	345 @ 3200	4.00 x 3.48	10.25:1	50-65 @ 2000
	J	5.7L (5700)	MFI	375 @ 5800	370 @ 5600	3.90 x 3.66	11.0:1	60 @ 1850
1991	8	5.7L (5700)	TPI	245 @ 4000	345 @ 3200	4.00 x 3.48	10.25:1	50-65 @ 2000
	J	5.7L (5700)	MFI	375 @ 5800	370 @ 5600	3.90 x 3.66	11.0:1	60 @ 1850
1992	P	5.7L (5700)	MFI	300 @ 5000	330 @ 4000	4.00 x 3.48	10.2:1	18 @ 2000
	J	5.7L (5700)	MFI	375 @ 3800	370 @ 4800	3.90 x 3.66	11.0:1	40 @ 2000
1993	P	5.7L (5700)	MFI	300 @ 5000	330 @ 4000	4.00 x 3.48	10.5:1	18 @ 2000
	J	5.7L (5700)	MFI	375 @ 3800	370 @ 4800	3.90 x 3.66	11.0:1	40 @ 2000
1994	P	5.7L (5700)	SFI	300 @ 5000	330 @ 4000	4.00 x 3.48	10.5:1	18 @ 2000
	J	5.7L (5700)	MFI	375 @ 3800	370 @ 4800	3.90 x 3.66	11.0:1	40 @ 2000
1995	P	5.7L (5700)	SFI	300 @ 5000	330 @ 4000	4.00 x 3.48	10.5:1	18 @ 2000
	J	5.7L (5700)	MFI	375 @ 3800	370 @ 4800	3.90 x 3.66	11.0:1	40 @ 2000
1996	P	5.7L (5700)	SFI	300 @ 5000	335 @ 3600	4.00 x 3.48	10.5:1	18 @ 2000
	5	5.7L (5700)	SFI	330 @ 5800	340 @ 4500	4.00 x 3.48	10.8:1	18 @ 2000

TBI - Throttle Body Injection (Cross-Fire Injection)

TPI - Tuned Port Injection

MPI - Multi-Port electronic fuel Injection

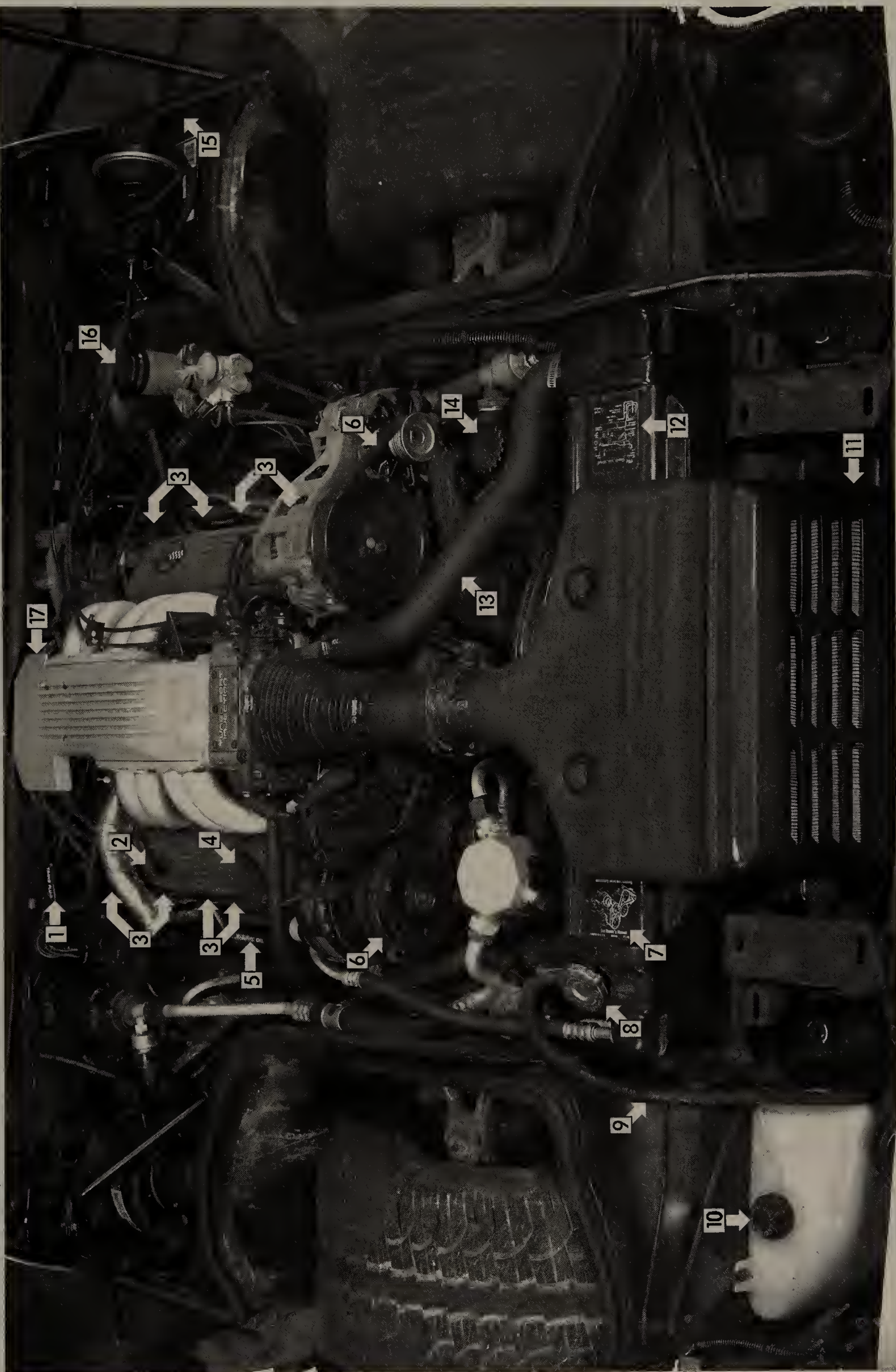
SFI - Sequential Multi-port Fuel Injection

91031C03

ROUTINE MAINTENANCE AND TUNE-UP

UNDERHOOD MAINTENANCE COMPONENT LOCATIONS

1. Automatic transmission fluid dipstick
2. PCV valve
3. Spark plugs and wires
4. Engine oil fill cap
5. Engine oil dipstick
6. Accessory drive belt
7. Accessory drive belt routing label
8. Radiator fill cap
9. Radiator overflow hose
10. Coolant recovery reservoir
11. Air cleaner assembly
12. Vehicle Emission Control Information (VECI) label
13. Upper radiator hose
14. Power steering fluid reservoir
15. Battery
16. Brake master cylinder fluid reservoir
17. Distributor cap and rotor (located under plate)



91031PC1

Proper maintenance and tune-up is the key to long and trouble-free vehicle life, and the work can yield its own rewards. Studies have shown that a properly tuned and maintained vehicle can achieve better gas mileage than an out-of-tune vehicle. As a conscientious owner and driver, set aside a Saturday morning, say once a month, to check or replace items which could cause major problems later. Keep your own personal log to jot down which services you performed, how much the parts cost you, the date, and the exact odometer reading at the time. Keep all receipts for such items as engine oil and filters, so that they may be referred to in case of related problems or to determine operating expenses. As a do-it-yourselfer, these receipts are the only proof you have that the required maintenance was performed. In the event of a warranty problem, these receipts will be invaluable.

The literature provided with your vehicle when it was originally delivered includes the factory recommended maintenance schedule. If you no longer have this literature, replacement copies are usually available from the dealer. A maintenance schedule is provided later in this section, in case you do not have the factory literature.

Air Cleaner

Regular air cleaner element replacement is a must, since a partially clogged element will cause a performance loss, decreased fuel mileage, and engine damage if enough dirt gets into the cylinders and contaminates the engine oil.

REMOVAL & INSTALLATION

See Figures 39 thru 46

The removal of air filter assembly will vary slightly for different year and different engine. The following procedure can be altered as you see fit for your specific vehicle.

1. Disconnect the negative battery cable.
2. If necessary to remove the air cleaner assembly cover, disconnect the air duct tube clamp to the throttle body and slip the duct off.
3. Unfasten the bolts/screws, or retaining clips, then remove the air cleaner cover. The cover should be easy to remove, if not look to see if you missed a hidden clip or screw.
4. Remove the air cleaner cover, then lift the air cleaner element from the housing.
5. Clean the air cleaner housing to remove any remaining dirt. Inspect the element for dirt, dust and/or water and replace if necessary.

To install:

➡When installing the new filter make certain not to bend or tear the paper element.

6. Place the new element in the air cleaner housing.
7. Position the cover over the air cleaner assembly and secure with the retaining clips or screws, as applicable. Do not overtighten the cover retaining screws/bolts. Only tighten them finger-tight or to about 8 inch lbs. (1.1 Nm).
8. If removed, install the air cleaner assembly duct and secure the retaining clamps, as necessary.
9. Connect the negative battery cable.

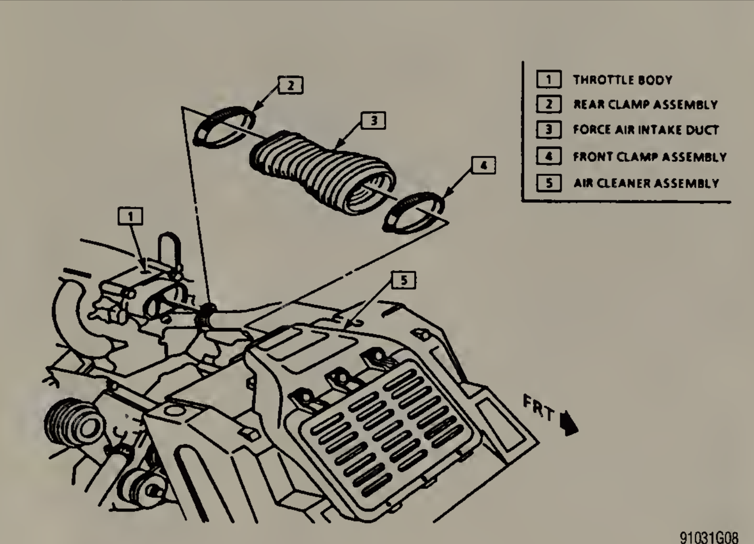


Fig. 39 If necessary, loosen the clamps, then remove the air intake duct from the air cleaner assembly

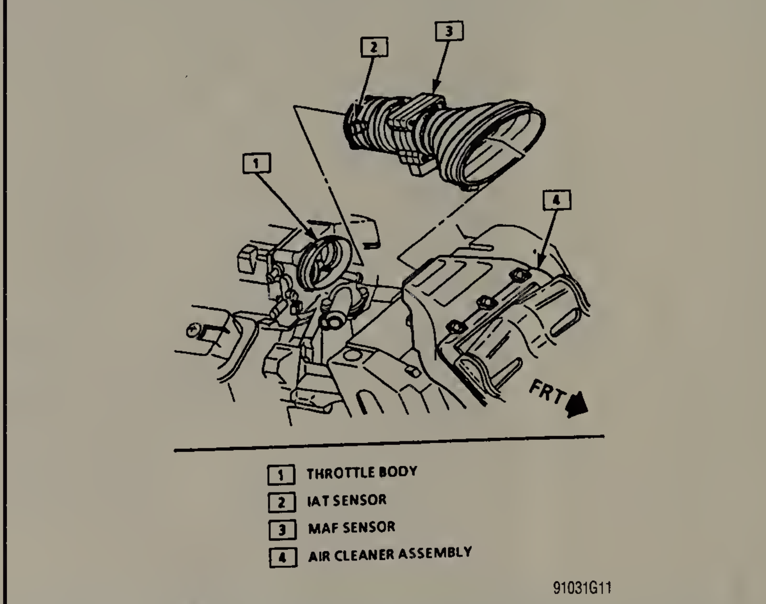


Fig. 40 On many later model vehicles, the air intake duct must be removed in order to access the air cleaner assembly

Fig. 41 On this 1986 Corvette, you must unscrew the 2 air cleaner cover retainers

Fig. 42 Then, lift the cover off and pull the air cleaner element from the housing

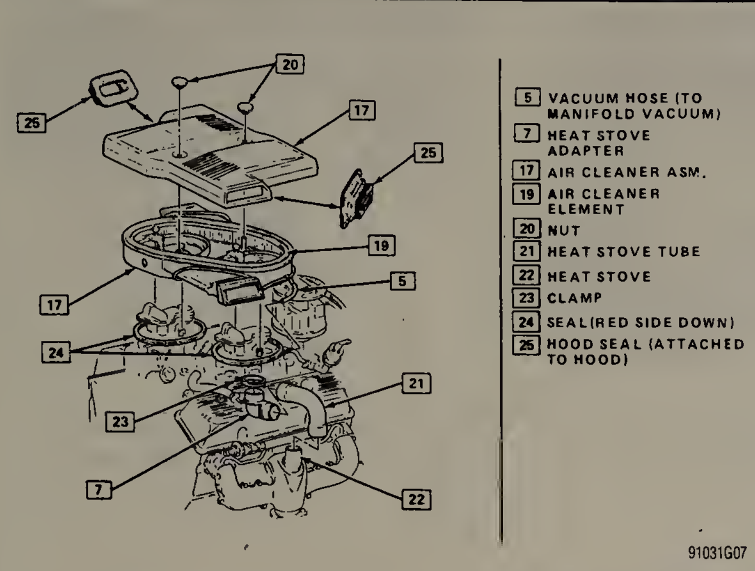


Fig. 43 Exploded view of the air cleaner assembly—1984 vehicle shown

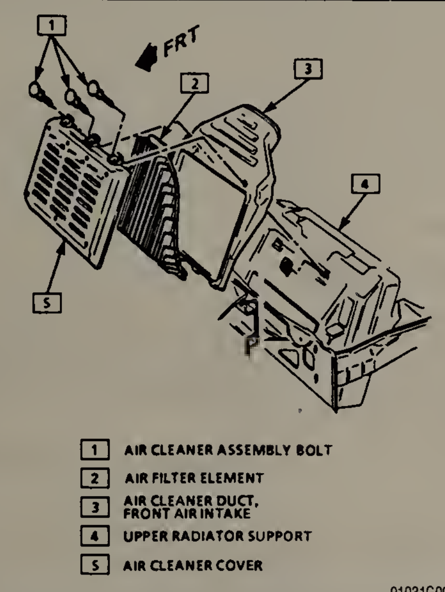


Fig. 44 On 1990–94 5.7L (VIN 8 & J) engines, the air cleaner cover is secured with 3 mounting bolts

Fuel Filter

REMOVAL & INSTALLATION

The fuel filter is located in the fuel feed line attached to the frame rail, at the rear of the vehicle. The fuel filter is a threaded fitting type.

CAUTION

Observe all applicable safety precautions when working around fuel. Whenever servicing the fuel system, always work in a well ventilated area. Do not allow fuel spray or vapors to come in contact with a spark or open flame. Keep a dry chemical fire extinguisher near the work area. Always keep fuel in a container specifically designed for fuel storage; also, always properly seal fuel containers to avoid the possibility of fire or explosion. To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing any fuel system component. If this procedure is not performed, fuel may be sprayed out of the connection under pressure. Cover fuel hose connections with a shop towel before disconnecting to catch any residual fuel that may still be in the line. Always keep a dry chemical (Class B) fire extinguisher near the work area.

1984–92 Vehicles

See Figures 47, 48, 49 and 50

1. Properly relieve the fuel system pressure, as outlined in Section 5 of this manual.

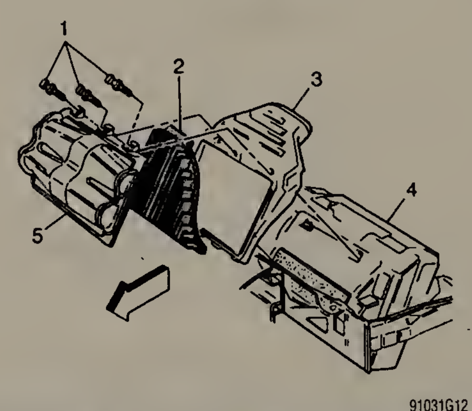


Fig. 45 Exploded view of the air cleaner and related components—1992–96 5.7L (VIN P & 5) engines

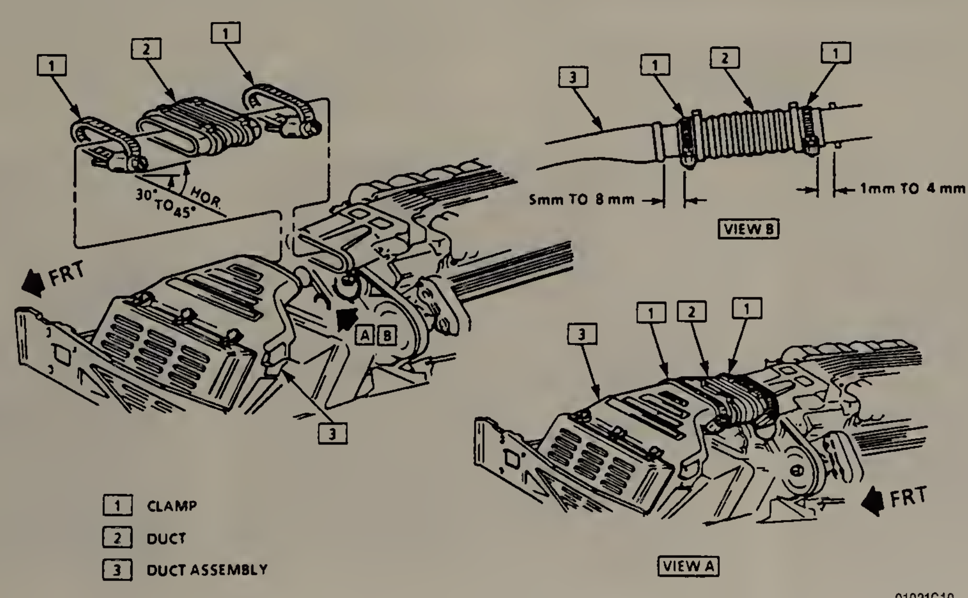
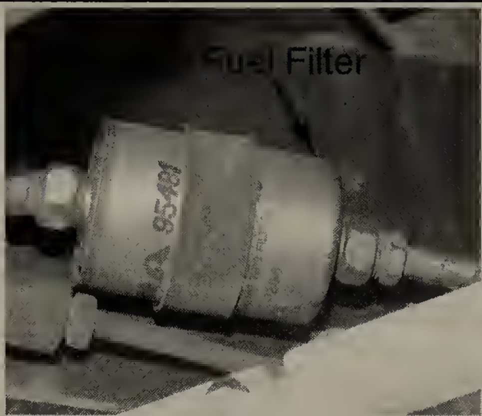
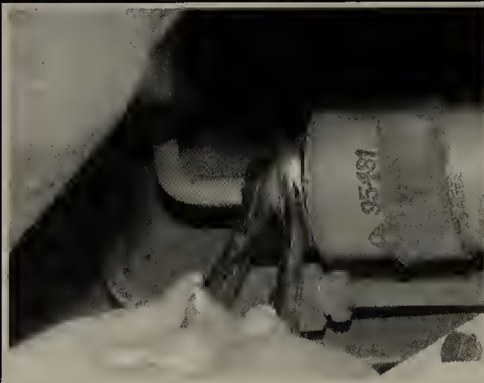


Fig. 46 Air cleaner duct installation—1990 5.7L (VIN J) engine shown



91031P43

Fig. 47 Fuel filter location and mounting—1986 vehicle shown, other years similar

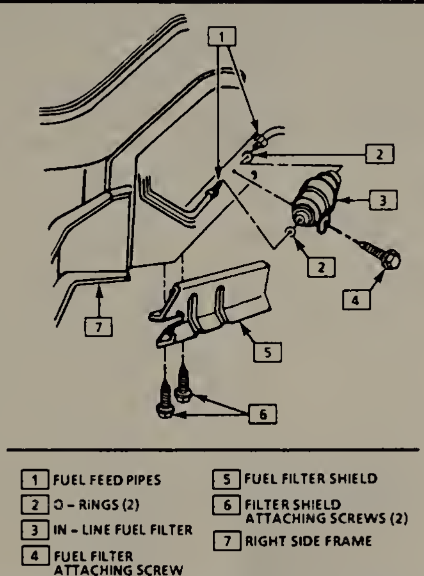


91031P44

Fig. 48 ALWAYS use a back-up wrench when loosening the fuel feed pipes from the filter

91031P45

Fig. 49 Remove the fuel filter attaching bolt, then remove the fuel filter from the vehicle



91031G13

Fig. 50 Exploded view of the in-line fuel filter assembly—1984–92 vehicles

2. If not already done, disconnect the negative battery cable.
3. Raise and safely support the vehicle.
4. Unfasten the fuel filter attaching screws, then remove the fuel filter shield.
5. Thoroughly clean the area around all in-line fuel filter connections and surrounding areas before disconnecting to avoid possible contamination of the fuel system.
6. Using a back-up wrench to avoid warping the lines, disconnect the fuel feed pipes from the filter.
7. Unfasten the fuel filter attaching screw and remove the fuel filter from the vehicle. Check the fuel pipe O-rings for cuts, nicks swelling or distortion. Replace, if necessary.

To install:

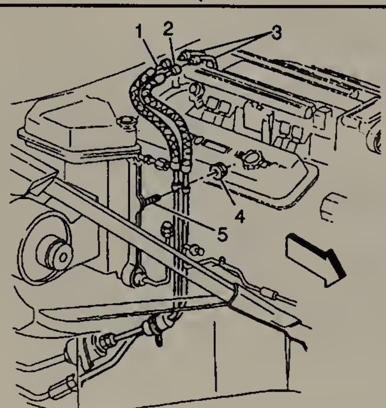
8. Loosely install the new fuel filter and secure with the attaching screw.
9. Attach the fuel feed pipes to the fuel filter. Using back-up wrench, tighten the fitting to 20–22 ft. lbs. (27–30 Nm).
10. Tighten the fuel filter attaching screw to 53 inch lbs. (6 Nm).
11. Install the fuel filter shield and secure with the attaching screw.
12. Carefully lower the vehicle.
13. Add fuel, if necessary, and tighten the fuel filler cap.
14. Connect the negative battery cable. Turn the ignition switch **ON** for 2 seconds, then turn **OFF** for 5 seconds. Turn the ignition switch to the **ON** position again, and check for fuel leaks.

1993–96 Vehicles

See Figures 51, 52 and 53

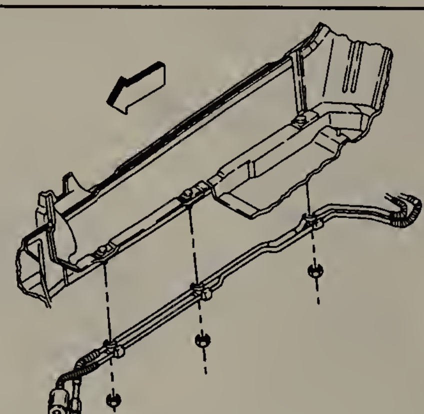
➡There is no service interval for replacing the fuel filter. Only replace a filter that is restricted. Check the fuel tank internally and clean it a restricted fuel filter is found. Fuel tank removal and installation is outlined in Section 5 of this manual.

1. Properly relieve the fuel system pressure, as outlined in Section 5 of this manual.
2. If not already done, disconnect the negative battery cable.
3. Remove the fuel pipe retaining nut from the A/C evaporator and blower module stud.
4. Raise and safely support the vehicle.
5. On convertibles, remove the lower underbody brace bolts and nuts, then remove the underbody brace.
6. Unfasten the chassis fuel pipe retaining nuts.
7. Thoroughly clean the area around all in-line fuel filter connections and surrounding areas before disconnecting to avoid possible contamination of the fuel system.
8. Using a back-up wrench to avoid warping the lines, disconnect the fuel inlet pipe from the filter.



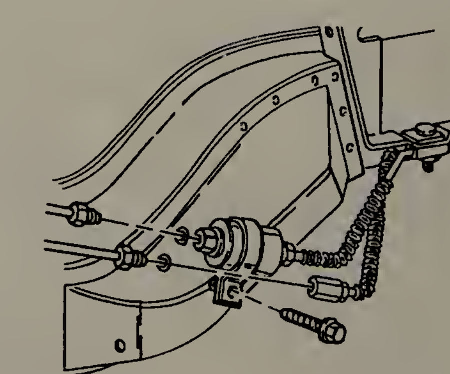
91031G14

Fig. 51 Unfasten the fuel line nut (4) from the evaporator and blower module stud (5)



91031G15

Fig. 52 On convertibles, you must remove the retainers and the underbody brace



91031G16

Fig. 53 Exploded view of the fuel filter attachment

9. Reposition the inlet pipe for access to the fuel filter. Drain any remaining fuel into an approved container.
10. Unfasten the filter attaching screw and the fuel filter bracket.
11. Hold the pipe outlet nut stationary, then turn the fuel filter to remove it.
12. Check the fuel pipe O-rings for cuts, nicks, swelling or distortion and replace the O-rings as necessary.

To install:

13. Loosely install the new fuel filter on the outlet side fuel pipe.
14. Install the inlet nut to the filter and tighten to 20 ft. lbs. (27 Nm).
15. Install the fuel filter bracket and secure with the retaining screw. Tighten the screw to 53 inch lbs. (6 Nm).
16. Install the chassis fuel pipe retaining nuts and tighten to 40 inch lbs. (4.5 Nm).
17. For convertibles, install the lower underbody brace and secure with the retaining bolts and nuts, then tighten the nuts to 20 ft. lbs. (27 Nm). and the underbody brace bolt to 46 ft. lbs. (53 Nm).
18. Carefully lower the vehicle.
19. Install the fuel feed retaining nut to the A/C evaporator and blower motor. Tighten the fuel pump retaining nut to 40 inch lbs. (4.5 Nm).
20. Add fuel, if necessary, and tighten the fuel filler cap.
21. Connect the negative battery cable. Turn the ignition switch **ON** for 2 seconds, then turn **OFF** for 5 seconds. Turn the ignition switch to the **ON** position again, and check for fuel leaks.

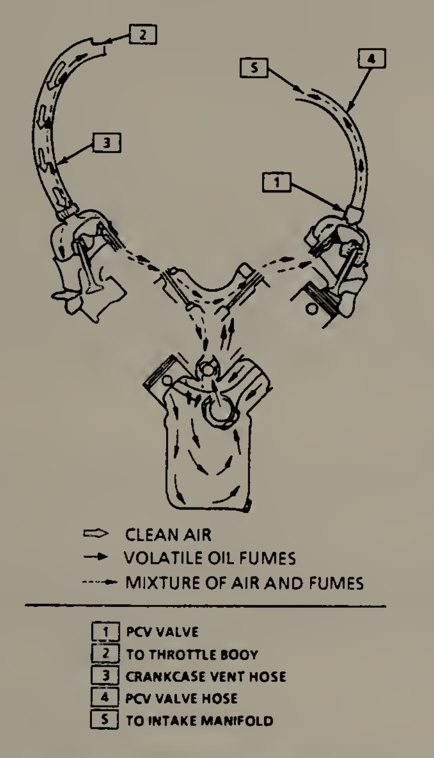


Fig. 54 Typical Positive Crankcase Ventilation (PCV) system flow—except 5.7L (VIN J) engine

PCV Valve

REMOVAL & INSTALLATION

Except 5.7L (VIN J) Engines

See Figures 54, 55, 56, 57 and 58

1. Disconnect the negative battery cable.
2. Unfasten the hose clamps, if necessary, then disconnect the hoses from the PCV valve.
3. Remove the PCV valve from the grommet in the valve cover.

To install:

4. Insert the PCV valve into the grommet in the valve cover.
5. Connect the hoses to the PCV valve, then install the hose clamps, if equipped.
6. Connect the negative battery cable.

5.7L (VIN J) Engine

See Figures 55 and 59

This engine is equipped with dual PCV valves.

1. Disconnect the negative battery cable.
2. Unplug the PCV molded vacuum hose.

Make sure to note the position of the PCV valves, because they are not interchangeable.

3. Remove the PCV valve(s).

To install:

4. Place the PCV valve(s) into the proper location.
5. Attach the molded vacuum hose to the valve(s).
6. Connect the negative battery cable.

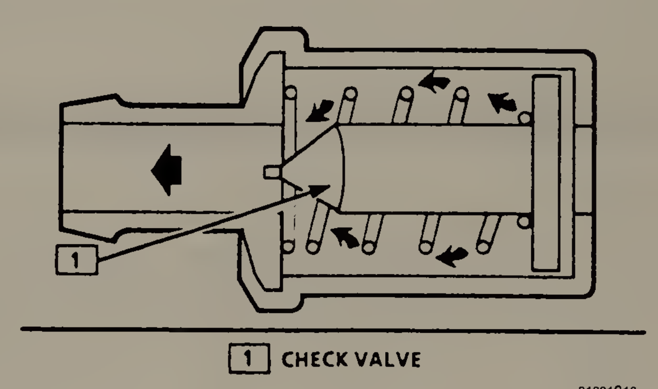


Fig. 55 Cross-sectional view of a PCV valve

Fig. 56 Pull the PCV valve out of the grommet in the rocker arm cover first

Fig. 57 . . . then pull the valve from the hose . . .

Fig. 58 . . . and remove it from the vehicle

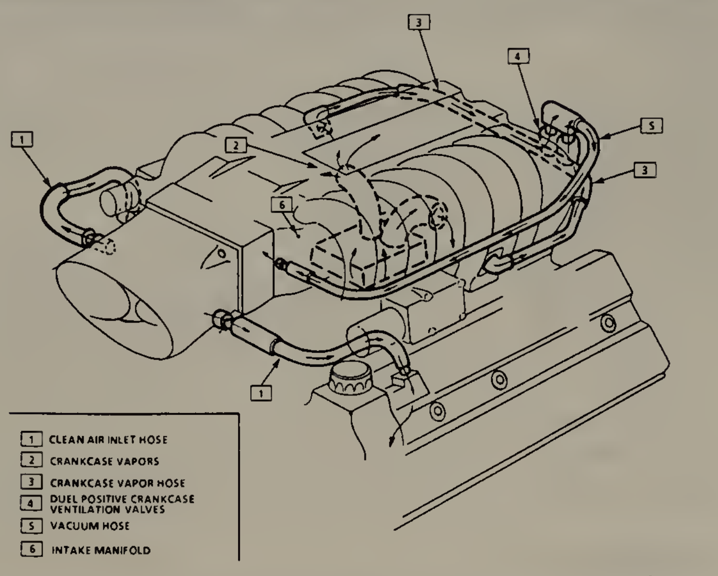


Fig. 59 Schematic of the PCV air flow and valve location—5.7L (VIN J) engine

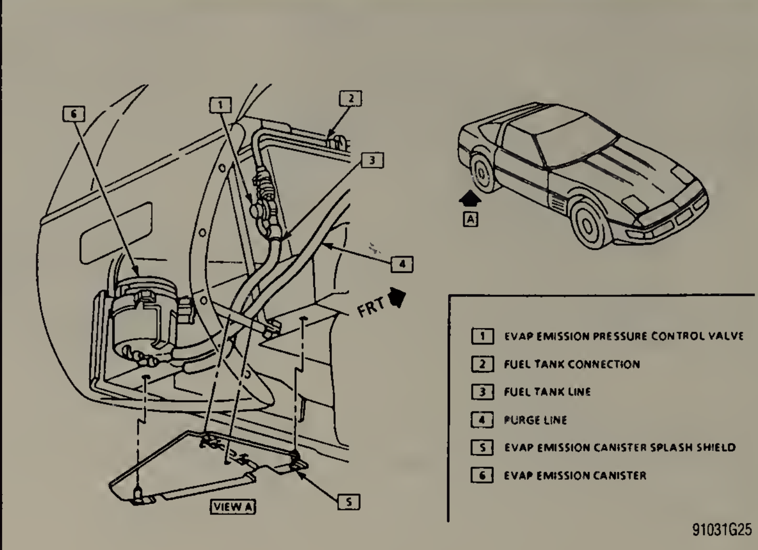


Fig. 61 On 1991–96 vehicles, the canister is located underneath the vehicle, behind the passenger's rear wheel

Evaporative Canister

This system is designed to limit gasoline vapor, which normally escapes from the fuel tank and intake manifold, from discharging into the atmosphere. Vapor absorption is accomplished through the use of the charcoal canister, which stores the vapors until they can be removed and burned in the combustion process.

SERVICING

➧ See Figures 60 and 61

The evaporative canister does not require periodic service. Check the hoses and canister for cracks and/or other damage. For canister removal and installation procedures, please refer to Section 4 of this manual.

Battery

PRECAUTIONS

Always use caution when working on or near the battery. Never allow a tool to bridge the gap between the negative and positive battery terminals. Also, be careful not to allow a tool to provide a ground between the positive cable/terminal and any metal component on the vehicle. Either of these conditions will cause a short circuit, leading to sparks and possible personal injury.

Do not smoke, have an open flame or create sparks near a battery; the gases contained in the battery are very explosive and, if ignited, could cause severe injury or death.

All batteries, regardless of type, should be carefully secured by a battery hold-down device. If this is not done, the battery terminals or casing may crack from stress applied to the battery during vehicle operation. A battery which is not secured may allow acid to leak out, making it discharge faster; such leaking corrosive acid can also eat away at components under the hood.

Always visually inspect the battery case for cracks, leakage and corrosion. A white corrosive substance on the battery case or on nearby components would indicate a leaking or cracked battery. If the battery is cracked, it should be replaced immediately.

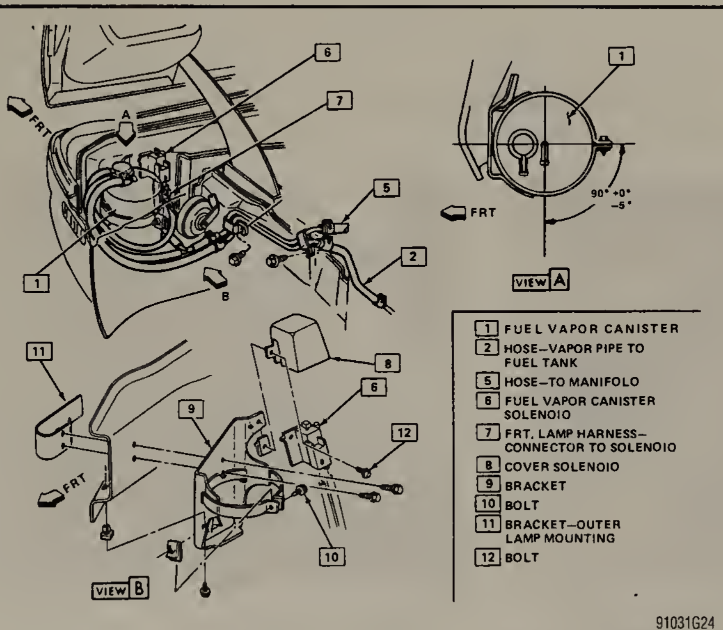


Fig. 60 Location of the evaporative canister—1984–90 vehicles

GENERAL MAINTENANCE

➧ See Figure 62

A battery that is not sealed must be checked periodically for electrolyte level. You cannot add water to a sealed maintenance-free battery (though not all maintenance-free batteries are sealed); however, a sealed battery must also be checked for proper electrolyte level, as indicated by the color of the built-in hydrometer "eye."

Always keep the battery cables and terminals free of corrosion. Check these components about once a year. Refer to the removal, installation and cleaning procedures outlined in this section.

Keep the top of the battery clean, as a film of dirt can help completely discharge a battery that is not used for long periods. A solution of baking soda and

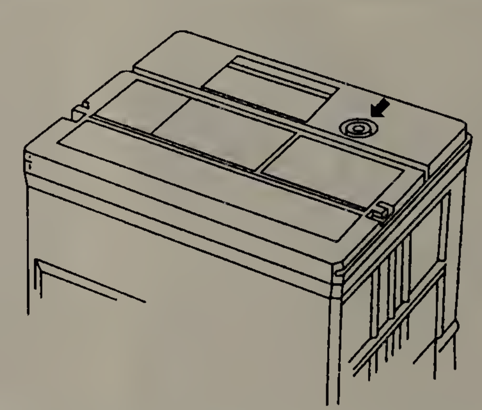


Fig. 62 A typical location for the built-in hydrometer on maintenance-free batteries

water may be used for cleaning, but be careful to flush this off with clear water. DO NOT let any of the solution into the filler holes. Baking soda neutralizes battery acid and will de-activate a battery cell.

Batteries in vehicles which are not operated on a regular basis can fall victim to parasitic loads (small current drains which are constantly drawing current from the battery). Normal parasitic loads may drain a battery on a vehicle that is in storage and not used for 6–8 weeks. Vehicles that have additional accessories such as a cellular phone, an alarm system or other devices that increase parasitic load may discharge a battery sooner. If the vehicle is to be stored for 6–8 weeks in a secure area and the alarm system, if present, is not necessary, the negative battery cable should be disconnected at the onset of storage to protect the battery charge.

Remember that constantly discharging and recharging will shorten battery life. Take care not to allow a battery to be needlessly discharged.

BATTERY FLUID

Check the battery electrolyte level at least once a month, or more often in hot weather or during periods of extended vehicle operation. On non-sealed batteries, the level can be checked either through the case on translucent batteries or by removing the cell caps on opaque-cased types. The electrolyte level in each cell should be kept filled to the split ring inside each cell, or the line marked on the outside of the case.

If the level is low, add only distilled water through the opening until the level is correct. Each cell is separate from the others, so each must be checked and filled individually. Distilled water should be used, because the chemicals and minerals found in most drinking water are harmful to the battery and could significantly shorten its life.

If water is added in freezing weather, the vehicle should be driven several miles to allow the water to mix with the electrolyte. Otherwise, the battery could freeze.

Although some maintenance-free batteries have removable cell caps for access to the electrolyte, the electrolyte condition and level on all sealed maintenance-free batteries must be checked using the built-in hydrometer "eye." The exact type of eye varies between battery manufacturers, but most apply a sticker to the battery itself explaining the possible readings. When in doubt, refer to the battery manufacturer's instructions to interpret battery condition using the built-in hydrometer.

➡Although the readings from built-in hydrometers found in sealed batteries may vary, a green eye usually indicates a properly charged battery with sufficient fluid level. A dark eye is normally an indicator of a battery with sufficient fluid, but one which may be low in charge. And a light or yellow eye is usually an indication that electrolyte supply has dropped below the necessary level for battery (and hydrometer) operation. In this last case, sealed batteries with an insufficient electrolyte level must usually be discarded.

Checking the Specific Gravity

See Figures 63, 64 and 65

A hydrometer is required to check the specific gravity on all batteries that are not maintenance-free. On batteries that are maintenance-free, the specific gravity is checked by observing the built-in hydrometer "eye" on the top of the battery case. Check with your battery's manufacturer for proper interpretation of its built-in hydrometer readings.

CAUTION

Battery electrolyte contains sulfuric acid. If you should splash any on your skin or in your eyes, flush the affected area with plenty of clear water. If it lands in your eyes, get medical help immediately.

The fluid (sulfuric acid solution) contained in the battery cells will tell you many things about the condition of the battery. Because the cell plates must be kept submerged below the fluid level in order to operate, maintaining the fluid level is extremely important. And, because the specific gravity of the acid is an indication of electrical charge, testing the fluid can be an aid in determining if the battery must be replaced. A battery in a vehicle with a properly operating charging system should require little maintenance, but careful, periodic inspection should reveal problems before they leave you stranded.

As stated earlier, the specific gravity of a battery's electrolyte level can be used as an indication of battery charge. At least once a year, check the specific gravity of the battery. It should be between 1.20 and 1.26 on the gravity scale. Most auto supply stores carry a variety of inexpensive battery testing hydrometers. These can be used on any non-sealed battery to test the specific gravity in each cell.

The battery testing hydrometer has a squeeze bulb at one end and a nozzle at the other. Battery electrolyte is sucked into the hydrometer until the float is lifted from its seat. The specific gravity is then read by noting the position of the float. If gravity is low in one or more cells, the battery should be slowly charged and checked again to see if the gravity has come up. Generally, if after charging, the specific gravity between any two cells varies more than 50 points (0.50), the battery should be replaced, as it can no longer produce sufficient voltage to guarantee proper operation.

CABLES

See Figures 66 thru 71

Once a year (or as necessary), the battery terminals and the cable clamps should be cleaned. Loosen the clamps and remove the cables, negative cable first. On batteries with posts on top, the use of a puller specially made for this purpose is recommended. These are inexpensive and available in most auto parts stores. Side terminal battery cables are secured with a small bolt.

Clean the cable clamps and the battery terminal with a wire brush, until all corrosion, grease, etc., is removed and the metal is shiny. It is especially important to clean the inside of the clamp thoroughly (an old knife is useful here), since a small deposit of foreign material or oxidation there will prevent a sound electrical connection and inhibit either starting or charging. Special tools are available for cleaning these parts, one type for conventional top post batteries and another type for side terminal batteries. It is also a good idea to apply some dielectric grease to the terminal, as this will aid in the prevention of corrosion.

After the clamps and terminals are clean, reinstall the cables, negative cable last; DO NOT hammer the clamps onto battery posts. Tighten the clamps securely, but do not distort them. Give the clamps and terminals a thin external coating of grease after installation, to retard corrosion.

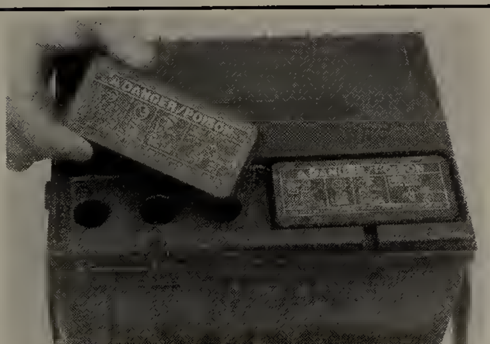

TCCA1P07

Fig. 63 On non-maintenance-free batteries, the fluid level can be checked through the case on translucent models; the cell caps must be removed on other models

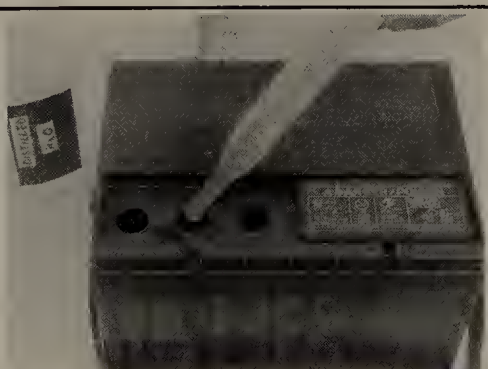

TCCA1P08

Fig. 64 If the fluid level is low, add only distilled water through the opening until the level is correct

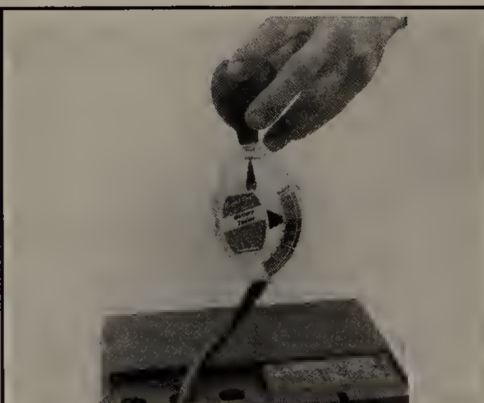
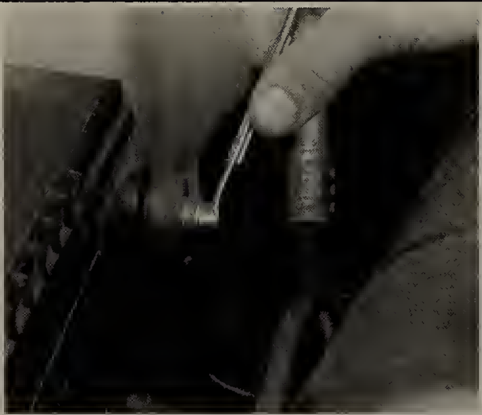

TCCA1P09

Fig. 65 Check the specific gravity of the battery's electrolyte with a hydrometer



TCCA1P01

Fig. 66 Loosen the battery cable retaining nut . . .

TCCA1P02

Fig. 67 . . . then disconnect the cable from the battery

TCCA1P03

Fig. 68 A wire brush may be used to clean any corrosion or foreign material from the cable

TCCA1P04

Fig. 69 The wire brush can also be used to remove any corrosion or dirt from the battery terminal

TCCA1P05

Fig. 70 The battery terminal can also be cleaned using a solution of baking soda and water

TCCA1P06

Fig. 71 Before connecting the cables, it's a good idea to coat the terminals with a small amount of dielectric grease

Check the cables at the same time that the terminals are cleaned. If the cable insulation is cracked or broken, or if the ends are frayed, the cable should be replaced with a new cable of the same length and gauge.

CHARGING

CAUTION

The chemical reaction which takes place in all batteries generates explosive hydrogen gas. A spark can cause the battery to explode and splash acid. To avoid serious personal injury, be sure there is proper ventilation and take appropriate fire safety precautions when connecting, disconnecting, or charging a battery and when using jumper cables.

A battery should be charged at a slow rate to keep the plates inside from getting too hot. However, if some maintenance-free batteries are allowed to discharge until they are almost "dead," they may have to be charged at a high rate to bring them back to "life." Always follow the charger manufacturer's instructions on charging the battery.

REPLACEMENT

See Figures 72 thru 77

When it becomes necessary to replace the battery, select one with an amperage rating equal to or greater than the battery originally installed. Deterioration and just plain aging of the battery cables, starter motor, and associated wires makes the battery's job harder in successive years. The slow increase in electrical resistance over time makes it prudent to install a new battery with a greater capacity than the old.

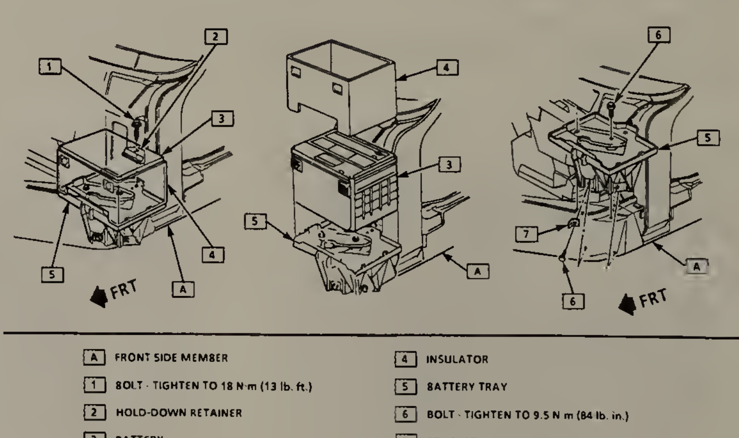
On these vehicles, in order to replace the battery, you must remove the left front fender. To remove the battery, perform the following:

1. Remove the left front fender, as outlined in Section 10 of this manual.
2. Disconnect the negative, then the positive battery cables.
3. Unfasten the battery hold-down retainer, then remove the battery and insulator from the vehicle.

The battery hold-down retainer should be clean and free from corrosion before installing the battery. The retainer should be in the proper condition to securely hold the battery. Make sure there are no parts in the battery tray before installing the battery. To keep the battery from shaking and vibrating in its tray, the retainer bolt should be tight, but not overtightened.

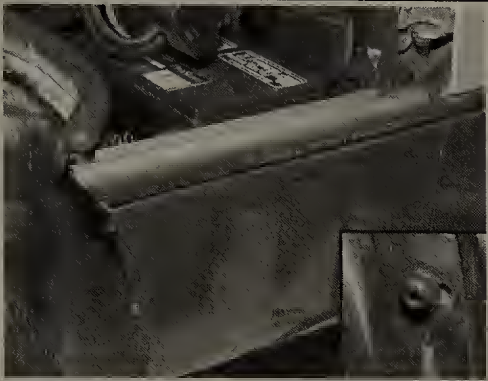
To install:

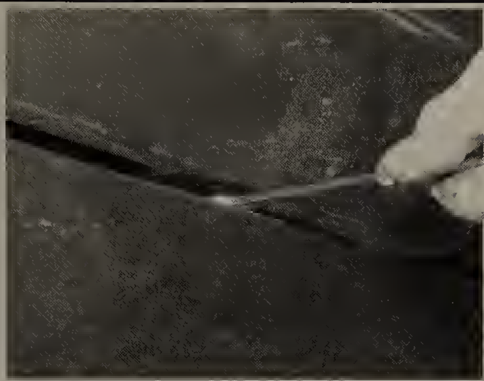
4. Position the battery and insulator on the battery tray.

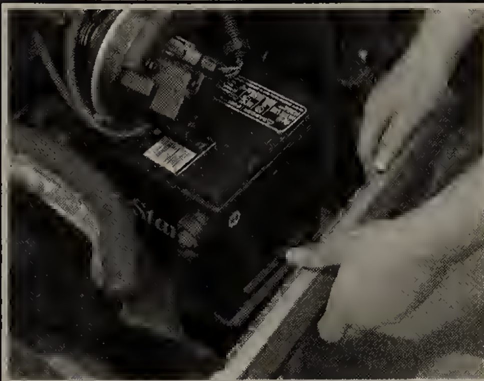


91031G26

Fig. 72 On Corvettes, the battery is located under the left front fender


91031P13
Fig. 73 To remove the left front fender, your must remove the Torx® bolts along the fender


91031P56
Fig. 74 There is a hidden retainer, located under the fender which must be removed or loosened to remove the fender


91031P14
Fig. 75 After all of the retainers are removed, you can pull the fender away for access to the battery

91031P15
Fig. 76 ALWAYS disconnect the negative battery cable first!


91031P16
Fig. 77 Make sure to place the cable out of the way so it doesn't accidentally contact the terminal

5. Install the battery hold-down retainer and tighten the bolt to 13 ft. lbs. (18 Nm).
6. Attach the positive, then the negative battery cables to the battery. Tighten the cable bolts to 11 ft. lbs. (15 Nm).
7. Install the left front fender, as outlined in Section 10 of this manual.

Belts

INSPECTION

➧ **See Figures 78 thru 83**

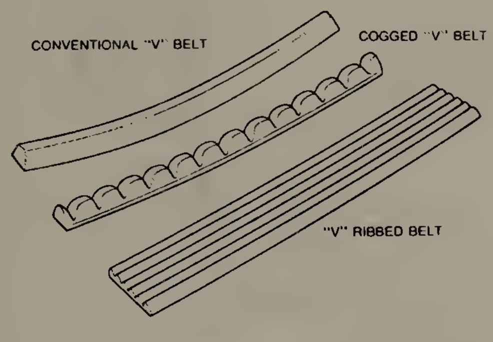
Inspect the belts for signs of glazing or cracking. A glazed belt will be perfectly smooth from slippage, while a good belt will have a slight texture of fabric visible. Cracks will usually start at the inner edge of the belt and run outward. All worn or damaged drive belts should be replaced immediately. It is best to replace all drive belts at one time, as a preventive maintenance measure, during this service operation.

REMOVAL & INSTALLATION

1984–89 Vehicles

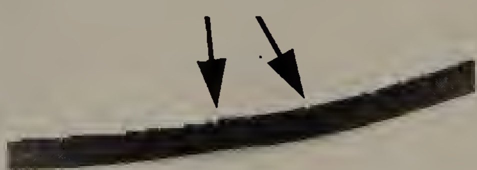
➧ **See Figures 84, 85, 86, 87 and 88**

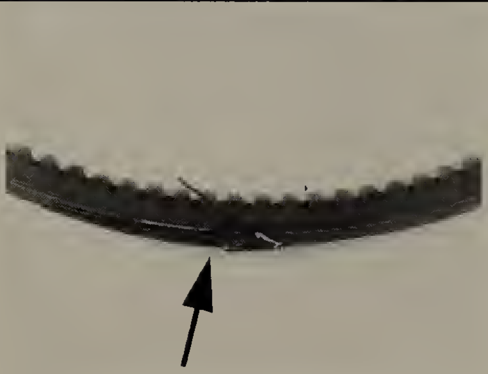
1. To remove or install the belt, lift or rotate the tensioner using a ½ inch breaker bar. The proper belt routing is shown in the accompanying figures.
2. To check belt tension, install a suitable belt tension gauge, BT-7825, J-23600 or equivalent between the alternator and A.I.R. pump. The measured tension should be between 120–140 lbs. (534–623 Nm).



TCCS1218
Fig. 78 There are typically 3 types of accessory drive belts found on vehicles today


TCCS1214
Fig. 79 An example of a healthy drive belt


TCCS1215
Fig. 80 Deep cracks in this belt will cause flex, building up heat that will eventually lead to belt failure



TCCS1216

Fig. 81 The cover of this belt is worn, exposing the critical reinforcing cords to excessive wear

TCCS1217

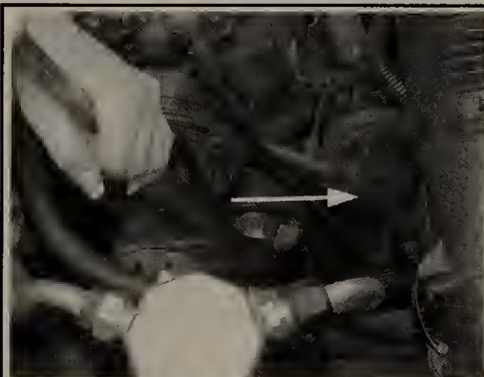
Fig. 82 Installing too wide a belt can result in serious belt wear and/or breakage

91031P17

Fig. 83 There is usually a accessory drive belt routing label located in the engine compartment

91031P61

Fig. 84 To remove the belt, insert a ½ in. breaker bar in the square opening in the tensioner

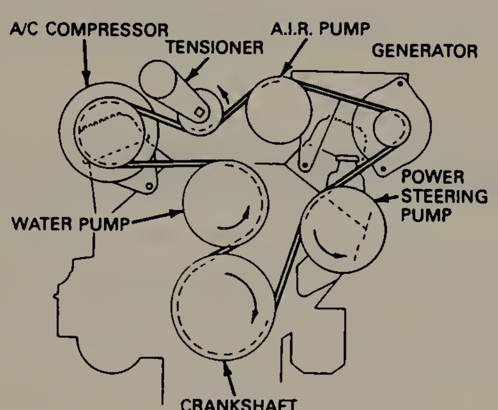


91031P62

Fig. 85 Rotate the breaker bar in the tensioner toward the driver's side of the vehicle

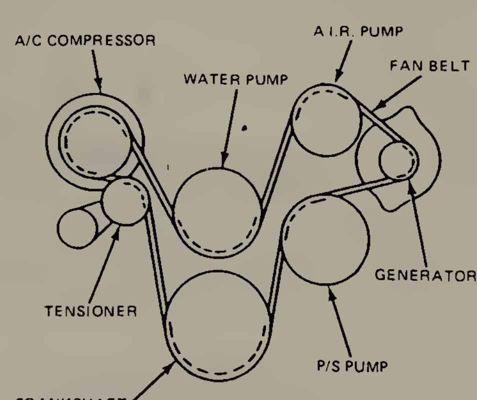
91031P63

Fig. 86 Once the tension is relieved, you can remove the unroute the drive belt from the pulleys



91031G27

Fig. 87 Drive belt routing—1984 vehicles



91031G28

Fig. 88 Serpentine drive belt routing—1986–89 vehicles

1990–96 Vehicles

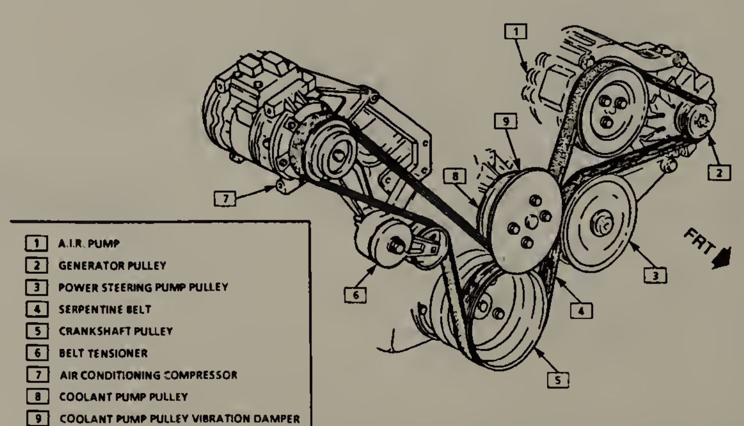
1989–91 5.7L (VIN 8 ENGINE)

See Figure 89

1. Disconnect the negative battery cable.
2. Remove the air intake duct.
3. Rotate the belt tensioner using a ½ in. breaker bar.
4. Remove the belt from the vehicle.

To install:

5. Install the belts on the pulleys.
6. Rotate the tensioner, using a ½ in. breaker bar.
7. Install the air intake duct.
8. Connect the negative battery cable.



91031G29

Fig. 89 View of the serpentine drive belt routing and tensioner—1989–91 VIN 8 engine

5.7L (VIN J) ENGINE

See Figure 90

1. Disconnect the negative battery cable.
2. Detach the air intake duct from the throttle body extension.
3. Retract the belt tensioner using a ½ in. drive ratchet.
4. Slip the belt rearward off the water pump pulley.
5. Remove the belt from the vehicle.

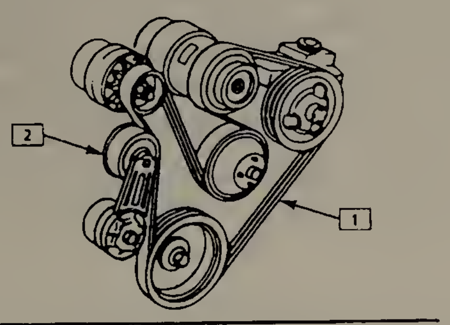
To install:

6. Slip the drive belt on the A/C compressor pulley.
7. Retract the tensioner using a ½ in. drive ratchet.
8. Route the belt over the alternator, crankshaft, power steering pulleys, and behind the water pump pulley.
9. Check to see if the belt is in all grooves. Pull the belt forward to the water pump pulley.
10. Release the drive belt tensioner.
11. Install the air cleaner intake duct assembly.
12. Connect the negative battery cable.

5.7L (VIN P AND 5) ENGINES

See Figures 91 and 92

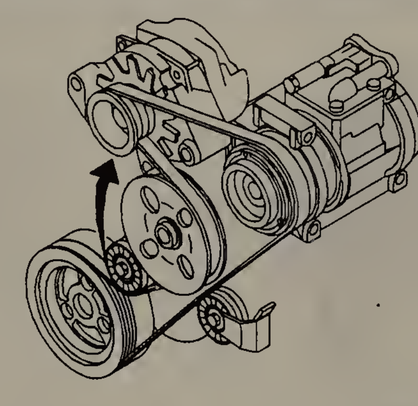
1. Examine the belt length scale on the drive belt tensioner for proper installed length. If the length is not correct, install a new drive belt.
2. Disconnect the negative battery cable.
3. Lift the drive belt tensioner pulley upward (clockwise) using a socket and a handle on the tensioner pulley bolt.



1 SERPENTINE DRIVE BELT
2 BELT TENSIONER

91031G30

Fig. 90 Drive belt routing—1990–95 5.7L (VIN J) engine



91031G32

Fig. 92 Drive belt routing and tensioner rotation direction—1996 5.7L (VIN P & 5) engines

4. Remove the drive belt.
5. Clean the drive belt surfaces.

To install:

6. Lift the drive belt tensioner pulley upward.
7. Install the drive belt under the tensioner pulley. Use a socket and a handle on the tensioner pulley bolt. Make sure you align the drive belt into the proper grooves on the drive belt pulleys.
8. Connect the negative battery cable.

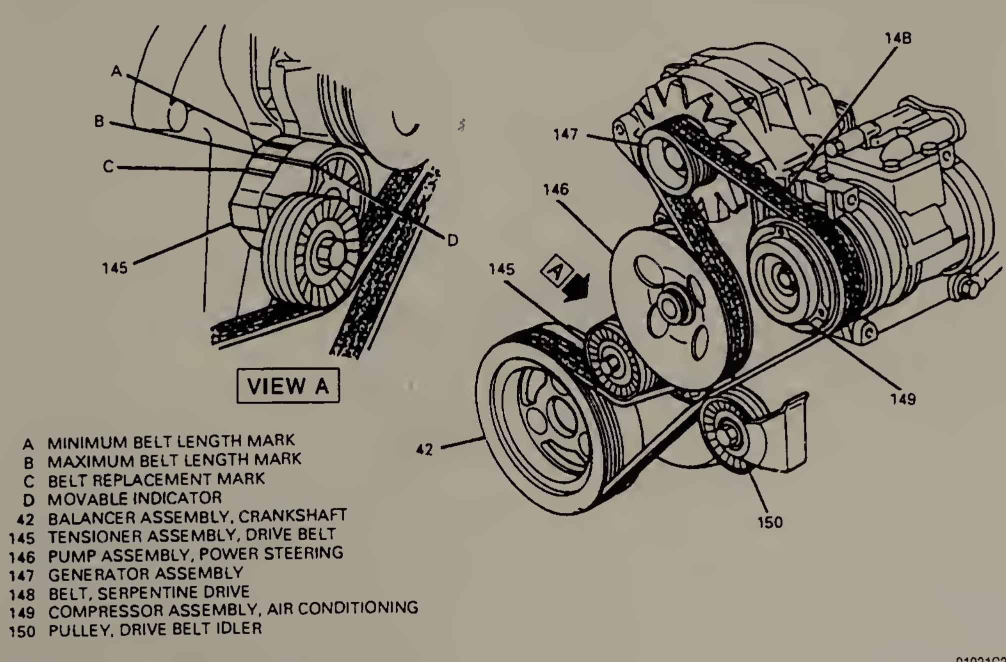
Hoses

INSPECTION

See Figures 93, 94, 95 and 96

Upper and lower radiator hoses along with the heater hoses should be checked for deterioration, leaks and loose hose clamps at least every 30,000 miles (50,000 km). It is also wise to check the hoses periodically in early spring and at the beginning of the fall or winter when you are performing other maintenance. A quick visual inspection could discover a weakened hose which might have left you stranded if it had remained unrepaired.

Whenever you are checking the hoses, make sure the engine and cooling system are cold. Visually inspect for cracking, rotting or collapsed hoses, and replace as necessary. Run your hand along the length of the hose. If a weak or swollen spot is noted when squeezing the hose wall, the hose should be replaced.



91031G31

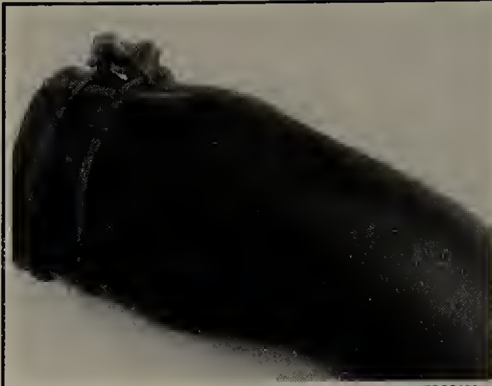
Fig. 91 Serpentine drive belt routing—1992–95 5.7L (VIN P) engines

TCCS1219

Fig. 93 The cracks developing along this hose are a result of age-related hardening

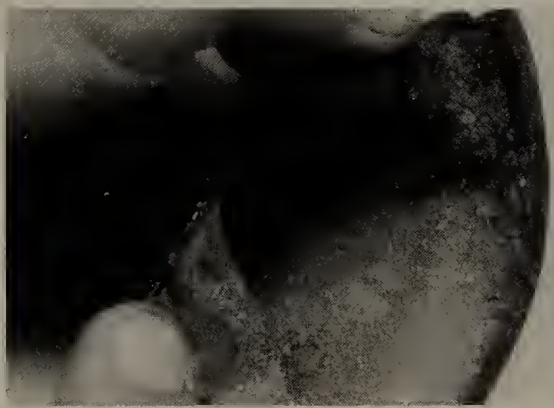
TCCS1220

Fig. 94 A hose clamp that is too tight can cause older hoses to separate and tear on either side of the clamp



TCCS1221

Fig. 95 A soft spongy hose (identifiable by the swollen section) will eventually burst and should be replaced



TCCS1222

Fig. 96 Hoses are likely to deteriorate from the inside if the cooling system is not periodically flushed

REMOVAL & INSTALLATION

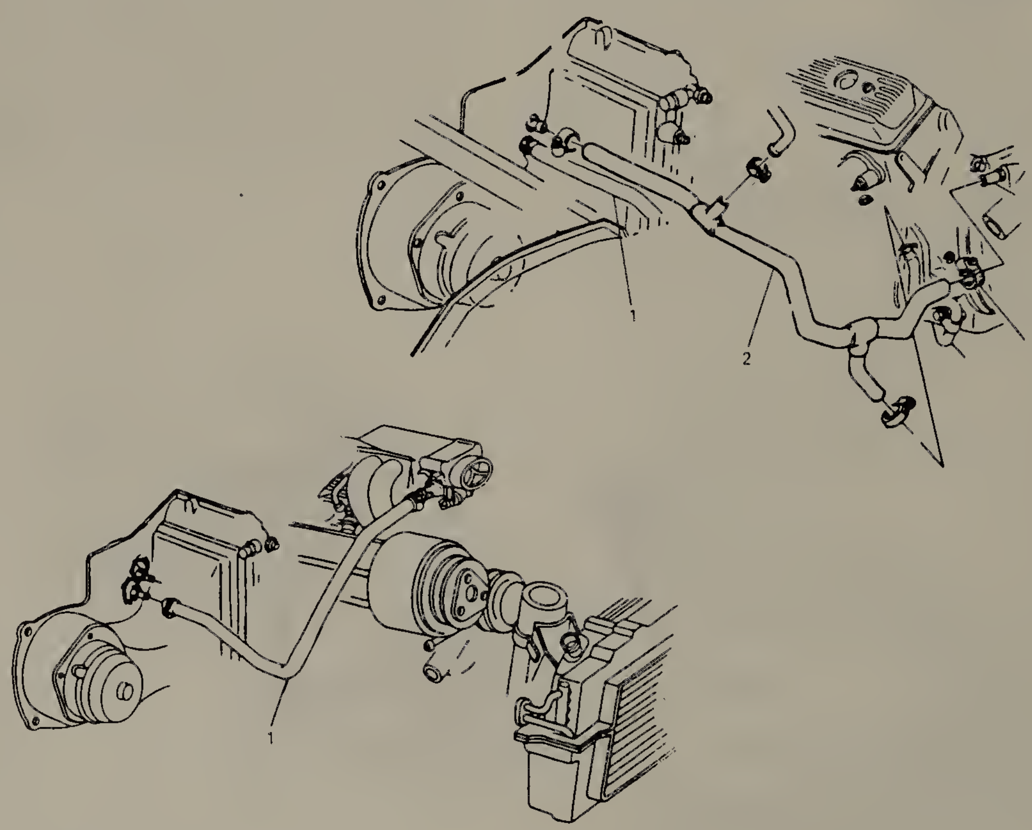
See Figures 97, 98 and 99

1. Remove the radiator pressure cap.

CAUTION

Never remove the pressure cap while the engine is running, or personal injury from scalding hot coolant or steam may result. If possible, wait until the engine has cooled to remove the pressure cap. If this is not possible, wrap a thick cloth around the pressure cap and turn it slowly to the stop. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, use the cloth to turn and remove the cap.

2. Position a clean container under the radiator and/or engine draincock or plug, then open the drain and allow the cooling system to drain to an appropri-



1 HOSE, HEATER INLET
2 HOSE, HEATER OUTLET

91031G34

Fig. 97 Heater hose routing—5.7L (VIN 8) engine

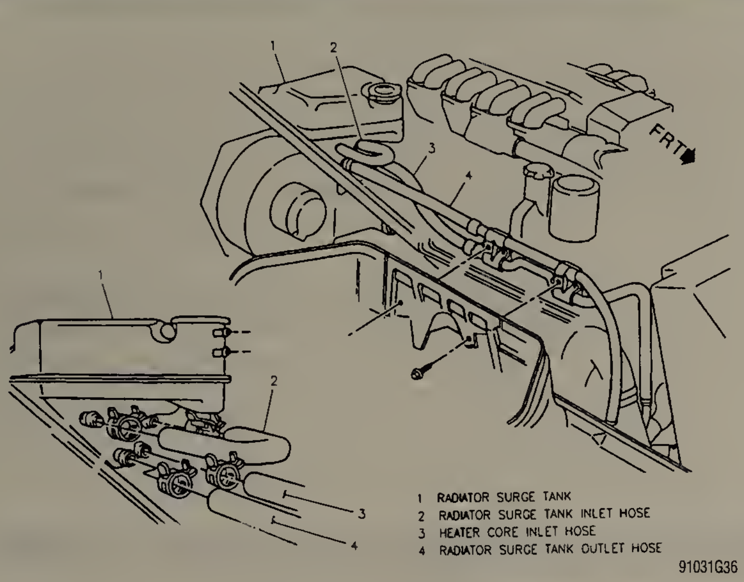


Fig. 98 Heater hose locations and routing—5.7L (VIN J) engine

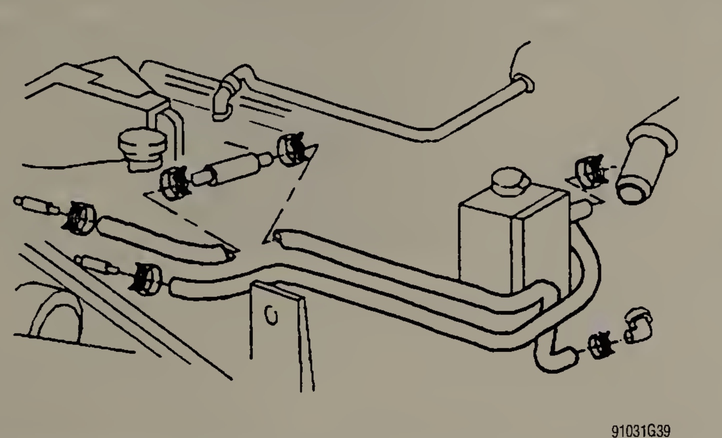


Fig. 99 Heater hose attachments—1996 5.7L (VIN P & 5) engines

ate level. For some upper hoses, only a little coolant must be drained. To remove hoses positioned lower on the engine, such as a lower radiator hose, the entire cooling system must be emptied.

⁂ CAUTION

When draining coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain coolant into a sealable container. Coolant may be reused unless it is contaminated or several years old.

3. Loosen the hose clamps at each end of the hose requiring replacement. Clamps are usually either of the spring tension type (which require pliers to squeeze the tabs and loosen) or of the screw tension type (which require screw or hex drivers to loosen). Pull the clamps back on the hose away from the connection.
4. Twist, pull and slide the hose off the fitting, taking care not to damage the neck of the component from which the hose is being removed.

➡If the hose is stuck at the connection, do not try to insert a screwdriver or other sharp tool under the hose end in an effort to free it, as the connection and/or hose may become damaged. Heater connections especially may be easily damaged by such a procedure. If the hose is to be replaced, use a single-edged razor blade to make a slice along the portion of the hose which is stuck on the connection, perpendicular to the end of the hose. Do not cut deep so as to prevent damaging the connection. The hose can then be peeled from the connection and discarded.

5. Clean both hose mounting connections. Inspect the condition of the hose clamps and replace them, if necessary.

To install:

6. Dip the ends of the new hose into clean engine coolant to ease installation.
7. Slide the clamps over the replacement hose, then slide the hose ends over the connections into position.
8. Position and secure the clamps at least ¼ in. (6.35mm) from the ends of the hose. Make sure they are located beyond the raised bead of the connector.
9. Close the radiator or engine drains and properly refill the cooling system with the clean drained engine coolant or a suitable mixture of ethylene glycol coolant and water.
10. If available, install a pressure tester and check for leaks. If a pressure tester is not available, run the engine until normal operating temperature is reached (allowing the system to naturally pressurize), then check for leaks.

⁂ CAUTION

If you are checking for leaks with the system at normal operating temperature, BE EXTREMELY CAREFUL not to touch any moving or hot engine parts. Once temperature has been reached, shut the engine OFF, and check for leaks around the hose fittings and connections which were removed earlier.

Spark Plugs

➧ See Figure 100

A typical spark plug consists of a metal shell surrounding a ceramic insulator. A metal electrode extends downward through the center of the insulator and protrudes a small distance. Located at the end of the plug and attached to the side of the outer metal shell is the side electrode. The side electrode bends in at a 90(angle so that its tip is just past and parallel to the tip of the center electrode. The distance between these two electrodes (measured in thousandths of an inch or hundredths of a millimeter) is called the spark plug gap.

The spark plug does not produce a spark but instead provides a gap across which the current can arc. The coil produces anywhere from 20,000 to 50,000 volts (depending on the type and application) which travels through the wires to the spark plugs. The current passes along the center electrode and jumps the gap to the side electrode, and in doing so, ignites the air/fuel mixture in the combustion chamber.

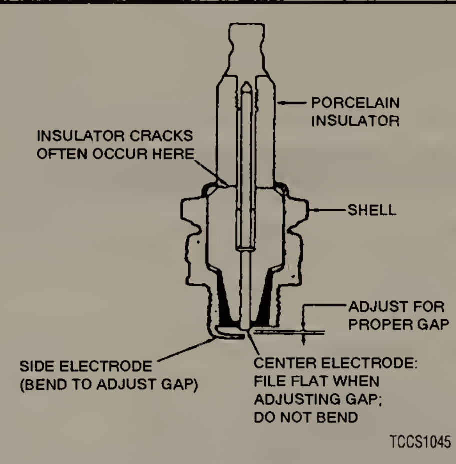


Fig. 100 Cross-section of a spark plug

SPARK PLUG HEAT RANGE

➧ See Figure 101

Spark plug heat range is the ability of the plug to dissipate heat. The longer the insulator (or the farther it extends into the engine), the hotter the plug will operate; the shorter the insulator (the closer the electrode is to the block's cooling passages) the cooler it will operate. A plug that absorbs little heat and remains too cool will quickly accumulate deposits of oil and carbon since it is not hot enough to burn them off. This leads to plug fouling and consequently to misfiring. A plug that absorbs too much heat will have no deposits but, due to

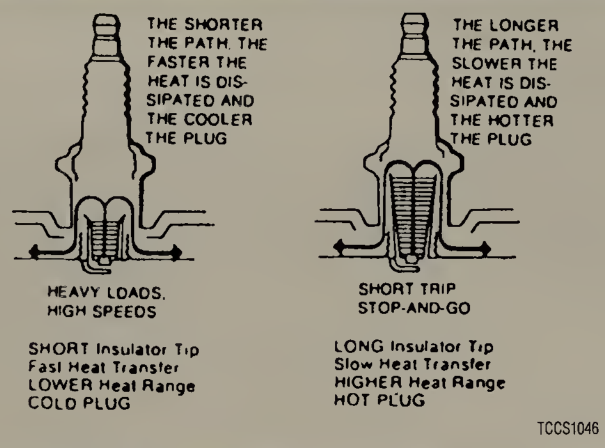


Fig. 101 Spark plug heat range

the excessive heat, the electrodes will burn away quickly and might possibly lead to pre-ignition or other ignition problems. Pre-ignition takes place when plug tips get so hot that they glow sufficiently to ignite the air/fuel mixture before the actual spark occurs. This early ignition will usually cause a pinging during low speeds and heavy loads.

The general rule of thumb for choosing the correct heat range when picking a spark plug is: if most of your driving is long distance, high speed travel, use a colder plug; if most of your driving is stop and go, use a hotter plug. Original equipment plugs are generally a good compromise between the 2 styles and most people never have the need to change their plugs from the factory-recommended heat range.

REMOVAL & INSTALLATION

See Figures 102, 103 and 104

A set of spark plugs usually requires replacement after about 20,000–30,000 miles (32,000–48,000 km), depending on your style of driving. In normal operation plug gap increases about 0.001 in. (0.025mm) for every 2500 miles (4000 km). As the gap increases, the plug's voltage requirement also increases. It requires a greater voltage to jump the wider gap and about two to three times as much voltage to fire the plug at high speeds than at idle. The improved air/fuel ratio control of modern fuel injection combined with the higher voltage output of modern ignition systems will often allow an engine to run significantly longer on a set of standard spark plugs, but keep in mind that efficiency will drop as the gap widens (along with fuel economy and power).

When you're removing spark plugs, work on one at a time. Don't start by removing the plug wires all at once, because, unless you number them, they may become mixed up. Take a minute before you begin and number the wires with tape.

WARNING

The engines covered by this manual are equipped with aluminum cylinder heads. Always allow the engine to thoroughly cool before removing the spark plugs, or the threads in the cylinder head may be damaged.

1. Disconnect the negative battery cable, and if the vehicle has been run recently, allow the engine to thoroughly cool.
2. Carefully twist the spark plug wire boot to loosen it, then pull upward and remove the boot from the plug. Be sure to pull on the boot and not on the wire, otherwise the connector located inside the boot may become separated.
3. Using compressed air, blow any water or debris from the spark plug well to assure that no harmful contaminants are allowed to enter the combustion chamber when the spark plug is removed. If compressed air is not available, use a rag or a brush to clean the area.

➡Remove the spark plugs when the engine is cold, to prevent damage to the threads. If removal of the plugs is difficult, apply a few drops of penetrating oil or silicone spray to the area around the base of the plug, and allow it a few minutes to work.

4. Using a spark plug socket that is equipped with a rubber insert to properly hold the plug, turn the spark plug counterclockwise to loosen and remove the spark plug from the bore.

WARNING

Be sure not to use a flexible extension on the socket. Use of a flexible extension may allow a shear force to be applied to the plug. A shear force could break the plug off in the cylinder head, leading to costly and frustrating repairs.

5. Place the spark plugs in a tray labeled by cylinder number to help identify the spark plug and relate any unusual condition with the cylinder involved.

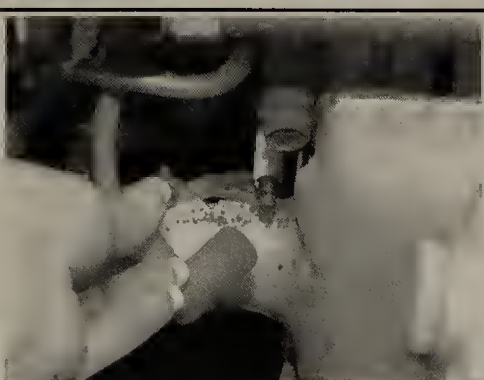
To install:

6. Inspect the spark plug boot for tears or damage. If a damaged boot is found, the spark plug wire must be replaced.
7. Using a wire feeler gauge, check and adjust the spark plug gap. When using a gauge, the proper size should pass between the electrodes with a slight drag. The next larger size should not be able to pass while the next smaller size should pass freely.
8. Carefully thread the plug into the bore by hand. If resistance is felt before the plug is almost completely threaded, back the plug out and begin threading again. In small, hard to reach areas, an old spark plug wire and boot could be used as a threading tool. The boot will hold the plug while you twist the end of the wire and the wire is supple enough to twist before it would allow the plug to crossthread.

WARNING

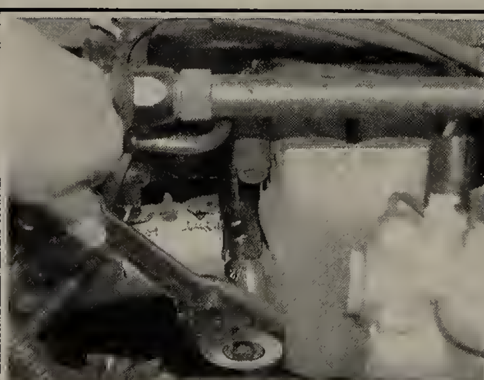
Do not use the spark plug socket to thread the plugs. Always carefully thread the plug by hand or using an old plug wire to prevent the possibility of crossthreading and damaging the cylinder head bore.

9. Carefully tighten the spark plug. If the plug you are installing is equipped with a crush washer, seat the plug, then tighten about ¼ turn to crush the washer. If you are installing a tapered seat plug, tighten the plug to specifications provided by the vehicle or plug manufacturer. Tighten the spark plugs to the following specifications:
    a. 1984–91 VIN 8 engine: 20 ft. lbs. (27 Nm).



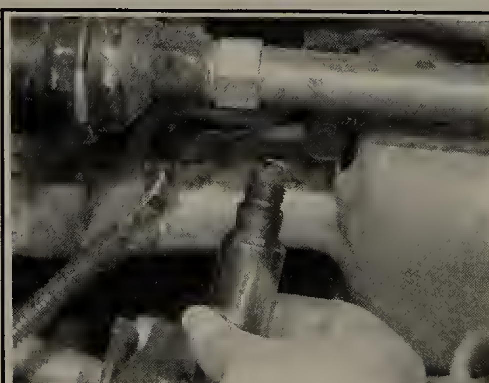
91031P71

Fig. 102 Twist the spark plug boot to unseat it, then unplug the wire from the spark plug, pulling on the boot only



91031P72

Fig. 103 Use a ratchet and extension with a ⅜ spark plug socket to loosen the spark plug



91033P73

Fig. 104 When the spark plug is completely loosened, pull it out carefully and inspect its condition

b. 1990–95 VIN J engine: 15 ft. lbs. (20 Nm).
c. 1992–95 VIN P engine: 11 ft. lbs. (15 Nm).
d. 1996 VIN P and 5 engines: 15 ft. lbs. (20 Nm).

10. Apply a small amount of silicone dielectric compound to the end of the spark plug lead or inside the spark plug boot to prevent sticking, then install the boot to the spark plug and push until it clicks into place. The click may be felt or heard, then gently pull back on the boot to assure proper contact.

INSPECTION & GAPPING

➧ See Figures 105, 106, 107, 108 and 109

Check the plugs for deposits and wear. If they are not going to be replaced, clean the plugs thoroughly. Remember that any kind of deposit will decrease the efficiency of the plug. Plugs can be cleaned on a spark plug cleaning machine, which can sometimes be found in service stations, or you can do an acceptable job of cleaning with a stiff brush. If the plugs are cleaned, the electrodes must be filed flat. Use an ignition points file, not an emery board or the like, which will leave deposits. The electrodes must be filed perfectly flat with sharp edges; rounded edges reduce the spark plug voltage by as much as 50%.

Check spark plug gap before installation. The ground electrode (the L-shaped one connected to the body of the plug) must be parallel to the center electrode and the specified size wire gauge (please refer to the Tune-Up Specifications chart for details) must pass between the electrodes with a slight drag.

➡NEVER adjust the gap on a used platinum type spark plug.

Always check the gap on new plugs as they are not always set correctly at the factory. Do not use a flat feeler gauge when measuring the gap on a used plug, because the reading may be inaccurate. A round-wire type gapping tool is the best way to check the gap. The correct gauge should pass through the electrode gap with a slight drag. If you're in doubt, try one size smaller and one larger. The smaller gauge should go through easily, while the larger one shouldn't go through at all. Wire gapping tools usually have a bending tool attached. Use that to adjust the side electrode until the proper distance is obtained. Absolutely

A normally worn spark plug should have light tan or gray deposits on the firing tip.

A carbon fouled plug, identified by soft, sooty, black deposits, may indicate an improperly tuned vehicle. Check the air cleaner, ignition components and engine control system.

This spark plug has been **left in the engine too long**, as evidenced by the extreme gap- Plugs with such an extreme gap can cause misfiring and stumbling accompanied by a noticeable lack of power.

An oil fouled spark plug indicates an engine with worn poston rings and/or bad valve seals allowing excessive oil to enter the chamber.

A physically damaged spark plug may be evidence of severe detonation in that cylinder. Watch that cylinder carefully between services, as a continued detonation will not only damage the plug, but could also damage the engine.

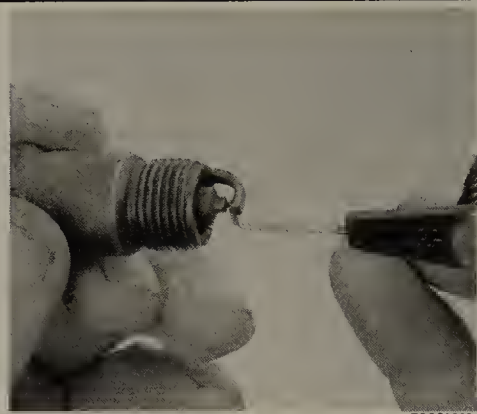
A bridged or almost bridged spark plug, identified by a build-up between the electrodes caused by excessive carbon or oil build-up on the plug.

TCCA1P40

Fig. 105 Inspect the spark plug to determine engine running conditions

TCCS1212

Fig. 106 A variety of tools and gauges are needed for spark plug service

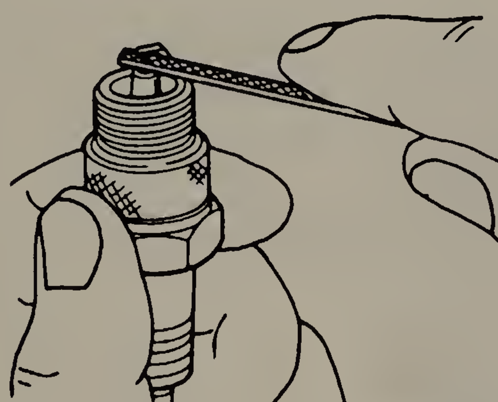


TCCS2903

Fig. 107 Checking the spark plug gap with a feeler gauge

TCCS2904

Fig. 108 Adjusting the spark plug gap



TCCS1141

Fig. 109 If the standard plug is in good condition, the electrode may be filed flat—WARNING: do not file platinum plugs

never attempt to bend the center electrode. Also, be careful not to bend the side electrode too far or too often as it may weaken and break off within the engine, requiring removal of the cylinder head to retrieve it.

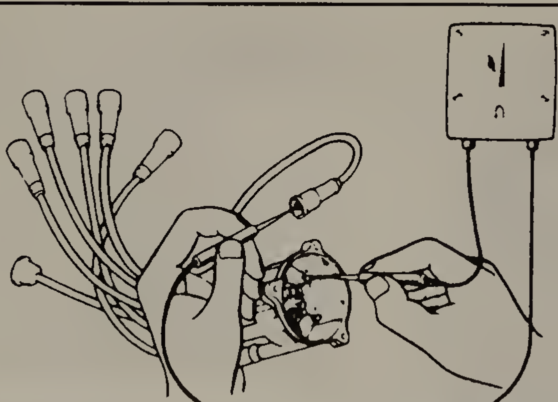
Spark Plug Wires

TESTING

➧ See Figure 110

At every tune-up/inspection, visually check the spark plug cables for burns cuts, or breaks in the insulation. Check the boots and the nipples on the distributor cap and/or coil. Replace any damaged wiring.

Every 50,000 miles (80,000 Km) or 60 months, the resistance of the wires should be checked with an ohmmeter. Wires with excessive resistance will cause misfiring, and may make the engine difficult to start in damp weather.



TCCS1008

Fig. 110 Checking individual plug wire resistance with a digital ohmmeter

To check resistance, connect one lead of an ohmmeter to each end of the wire. Replace any wire which shows a resistance over 30,000 ohms. Generally speaking, it is preferable that resistance be below 25,000 ohms, but 30,000 ohms must be considered the outer limit of acceptability. It should be remembered that resistance is also a function of length; the longer the wire, the greater the resistance. Thus, if the wires on your car are longer than the factory originals, resistance will be higher, quite possible outside these limits.

Wire length can therefore be used to determine appropriate resistance values:

- 0–15 in. (0–38cm)—3,000–10,000 ohms
- 15–25 in. (38–64cm)—4,000–15,000 ohms
- 25–35 in. (64–89cm)—6,000–20,000 ohms
- Wire over 35 in. (89cm)—25,000 ohms

REMOVAL & INSTALLATION

➧ See Figures 111, 112, 113 and 114

When installing new wires, replace them one at a time to avoid mix-ups. If it becomes necessary to remove all of the wires from the distributor cap or coil packs at one time, take the time to label the distributor cap/coil pack towers to denote the cylinder number of the wire for that position. When this is done, incorrect positioning of wires can more easily be avoided. Start by replacing the longest one first. Route the wire over the same path as the original and secure in place.

1. Disconnect the negative battery cable.
2. Note the locations of the spark plug wires, retainers, spark plug and distributor or ignition coil pack.
3. If removing all of the spark plug wires, make sure to label the wires and their corresponding positions on the coil or distributor with the proper cylinder number. This will greatly ease installation, preventing much confusion.
4. Twist the spark plug boot ½ turn in each direction before removing, then pull on the boot to remove the wire from the spark plug. Always pull on the boot, never the wire itself.
5. Twist the spark plug boot ½ turn in each direction, then pull the boot to disconnect the spark plug from the distributor or ignition coil, as applicable. Never pull on the spark plug wire, only the plug boot.
6. Remove the spark plug wire from any retainers, then remove it from the vehicle.

To install:

7. Route the wires in the proper location as noted during removal. The wires must be properly routed; you can refer to the accompanying illustrations for spark plug wire routing and retaining clip location.
8. Apply a small amount of silicone dielectric compound to the spark plug wire boots and ignition coil or distributor towers.
9. Attach the spark plug wire to the to the ignition coil pack or distributor, and spark plug, pushing it on firmly. A click should be felt or heard when the boot is on properly.
10. Check that the boot is properly installed by pushing sideways on the installed boots; they should be stiff with only slight looseness. If the boot feels like it's not on properly, reseat the boot by twisting it ½ turn, pulling the boot off, then reinstalling the boot.
11. Connect the negative battery cable.

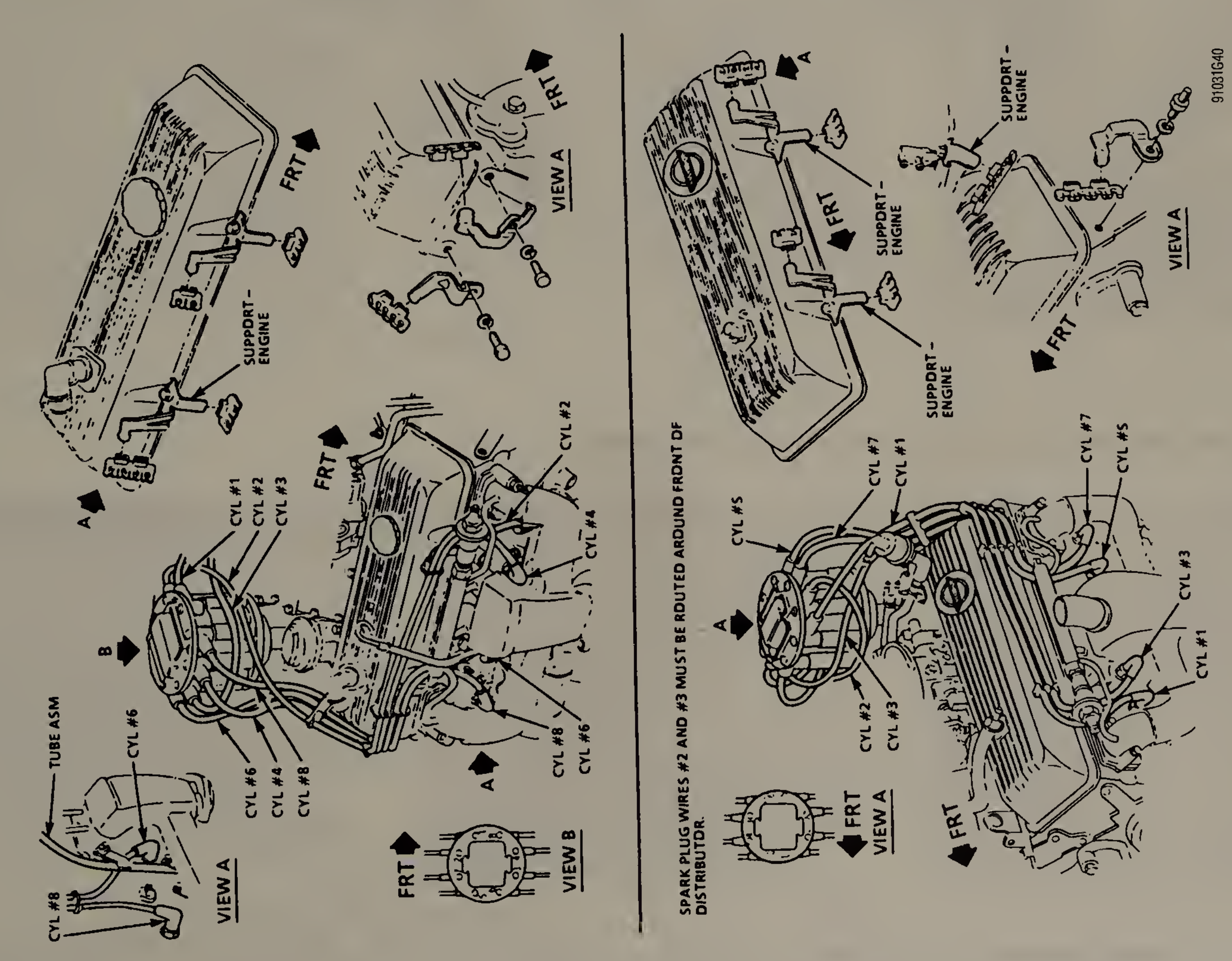


Fig. 111 Spark plug wire routing and cylinder identification—5.7L (VIN 8) engine

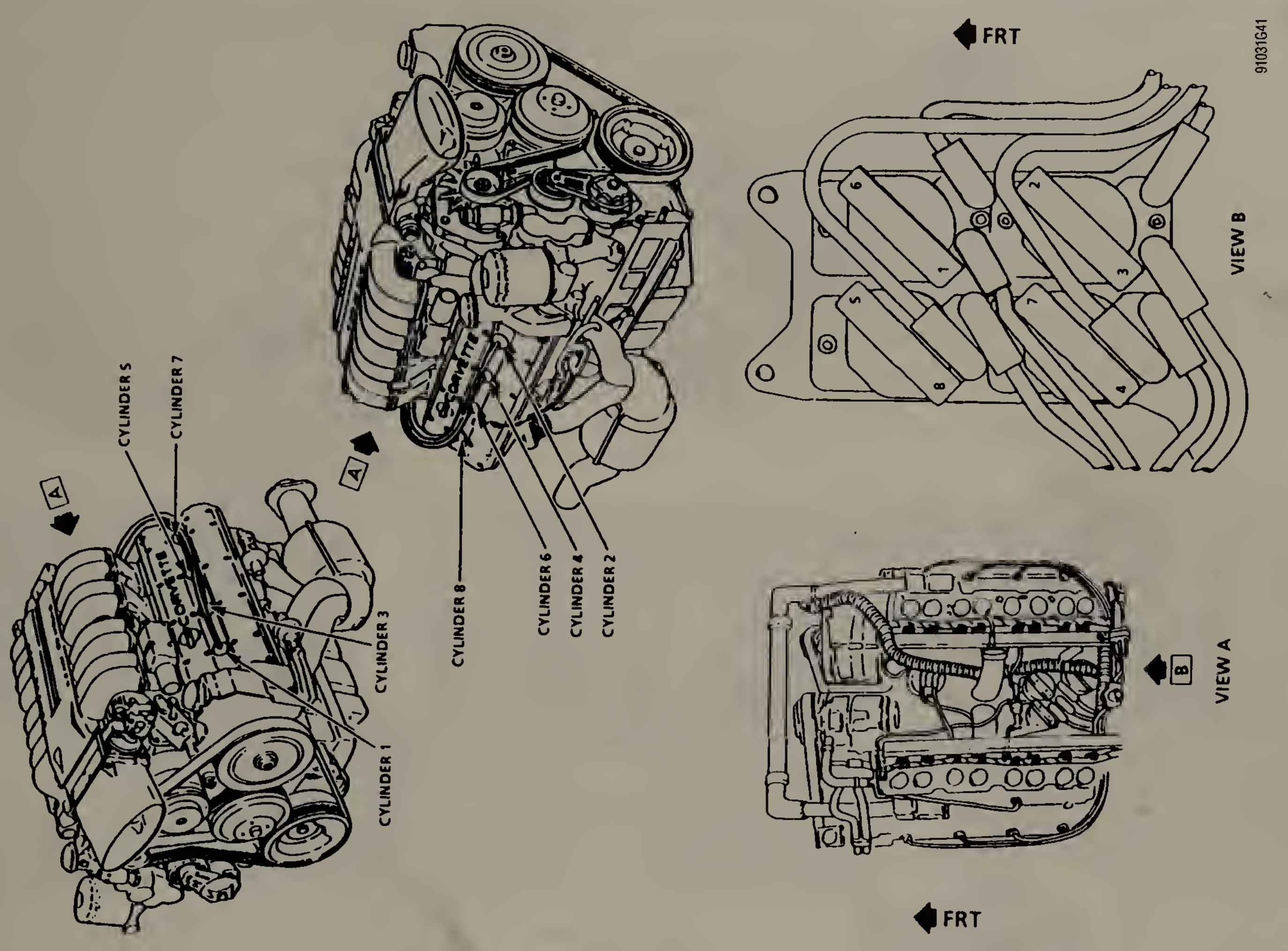


Fig. 112 Spark plug wire routing and cylinder and coil identification—1990–95 5.7L (VIN J) engine

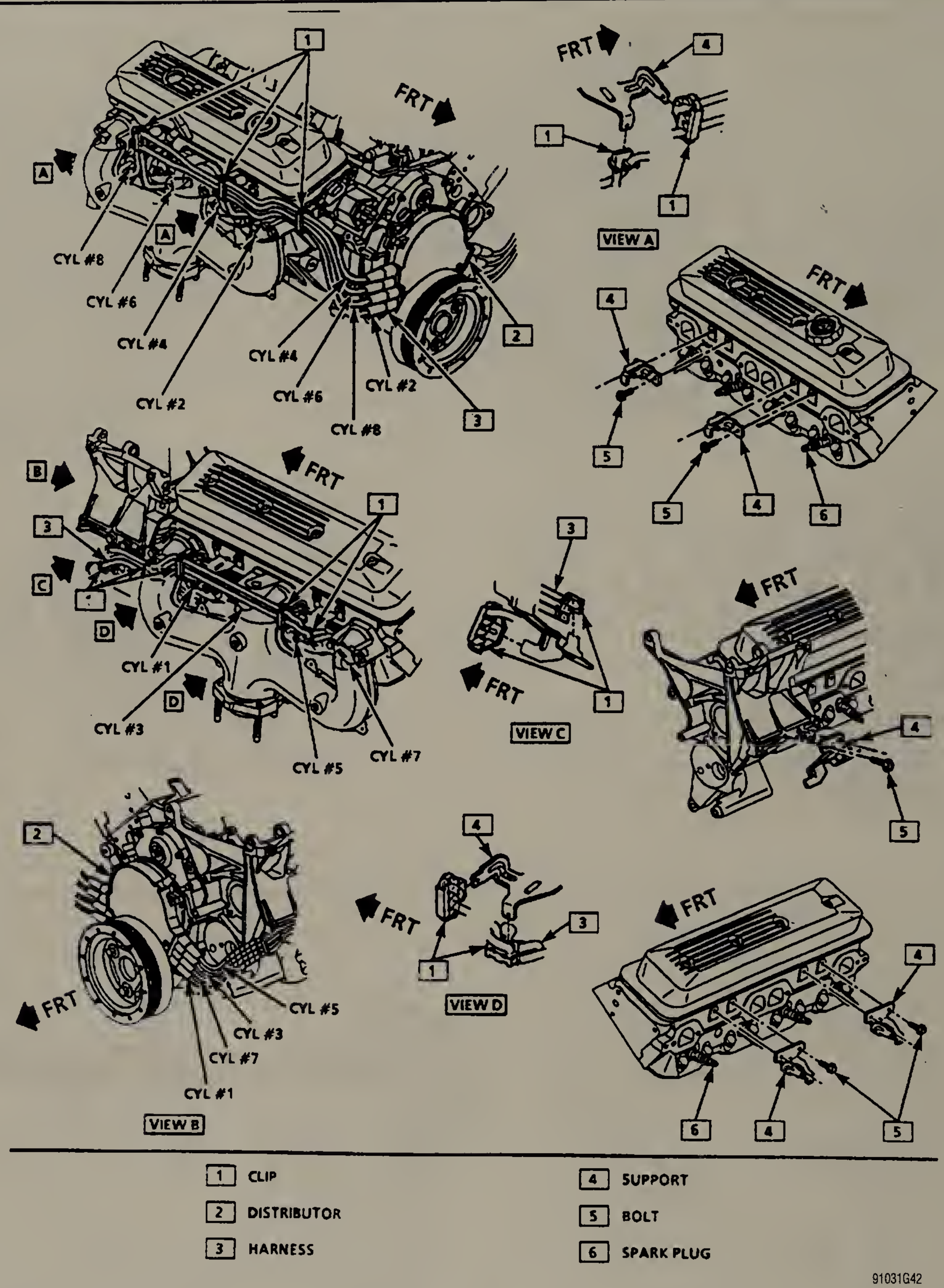


Fig. 113 Spark plug wire routing and cylinder identification—5.7L (VIN P) engine

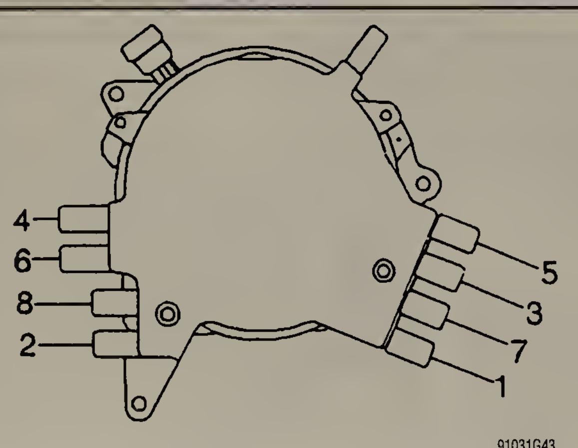


Fig. 114 Distributor cylinder identification—1996 vehicles

Distributor Cap and Rotor

REMOVAL & INSTALLATION

➡The 5.7L (VIN J) engines uses a Direct Ignition system which uses an ignition coil in place of a distributor. The 5.7L (VIN 8) engine uses a conventional High Energy Ignition (HEI) distributor. The 5.7L (VIN P & 5) engines are equipped with a distributor that is mounted on the front of the camshaft.

5.7L (VIN 8) Engines

➧ See Figures 115 thru 125

1. Disconnect the negative battery cable.
2. Remove the air cleaner cover and/or intake manifold plenum extension, as necessary.

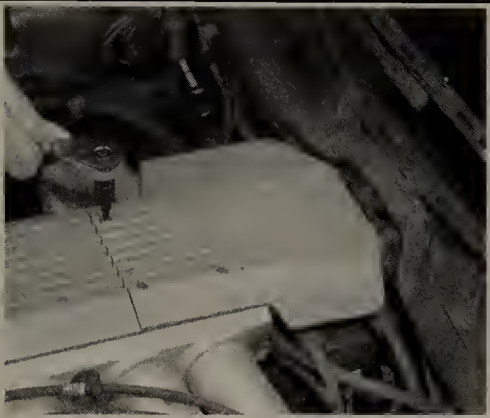
3. Remove the distributor shield.
4. Disconnect the ignition switch battery feed wire and tachometer lead (if equipped) from the distributor cap.
5. Tag and unplug the coil connectors from the cap. Do NOT use a screwdriver, or equivalent tool to release the locking tabs.
6. If necessary for access, tag and disconnect the spark plug wires, then release the spark plug wire harness latches, then remove the wiring harness retainer. The spark plug wire numbers are indicated on the retainer.
7. Remove the distributor cap by using a screwdriver to turn the 4 retaining latches counterclockwise, or unfastening the 4 retaining screws, depending upon the vehicle. Move the distributor cap out of the way.

➡The rotor is secured with 2 screws and has a slot which fits over a square lug on the advance weight base, so that the rotor can be installed in only one position.

8. Remove the 2 retaining screws, then lift the rotor from the distributor.

To install:

9. Place the rotor on the distributor; it can only be installed in one position. Install the 2 rotor retaining screws.
10. Position the distributor cap over the distributor and secure the 4 latches by turning them clockwise with a screwdriver, or installing the 4 retaining screws, as applicable.
11. If removed, attach the spark plug wires, as tagged during removal, then install and secure the wire retainers.
12. Attach the coil connectors to the cap, as tagged during removal. Make sure the locking tabs are fastened securely.
13. Connect the tachometer lead (if equipped) and the ignition switch battery feed wire to the distributor cap.
14. Install the distributor shield.
15. Install the air cleaner cover and/or intake manifold plenum extension, as necessary.
16. Connect the negative battery cable.



91031P74

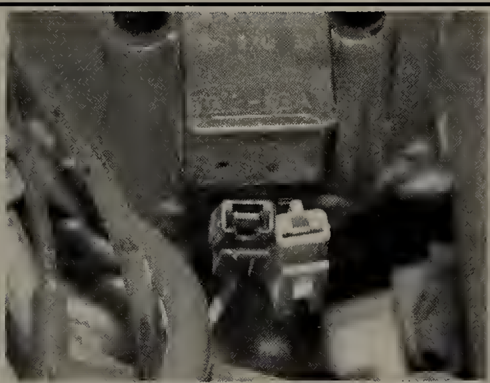
Fig. 115 Unfasten the plenum extension Torx® retaining screws

91031P75

Fig. 116 Remove the plenum extension for access to the distributor cap

91033P76

Fig. 117 Remove the distributor shield by pulling it up, off the spark plug wires



91031P78

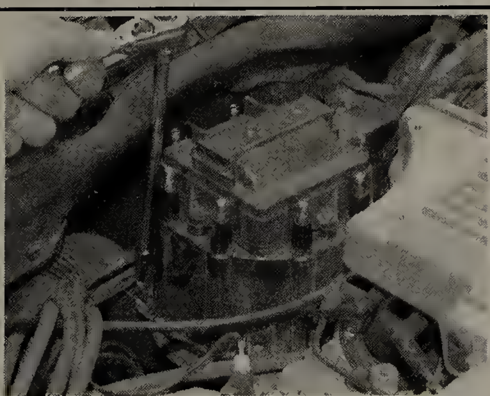
Fig. 118 Unplug the ignition switch battery feed wire and tachometer lead from the cap

91031P81

Fig. 119 Tag and unplug the coil connectors from the cap, but do NOT use any type of prytool to release the locking tabs

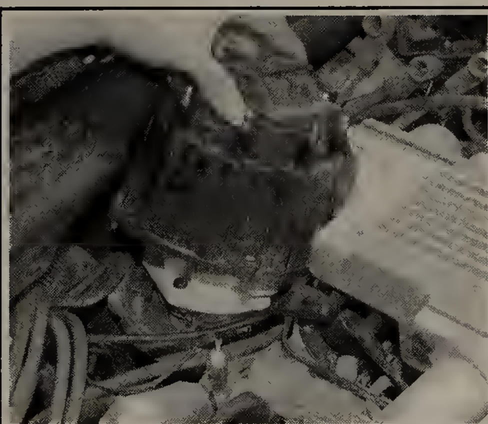
91031P77

Fig. 120 If you are replacing the cap with a new one, label and disconnect the spark plug wires from the distributor cap



91031P79

Fig. 121 On this 1986 vehicle, use a ratchet with a long extension to loosen the distributor cap bolts



91031P80

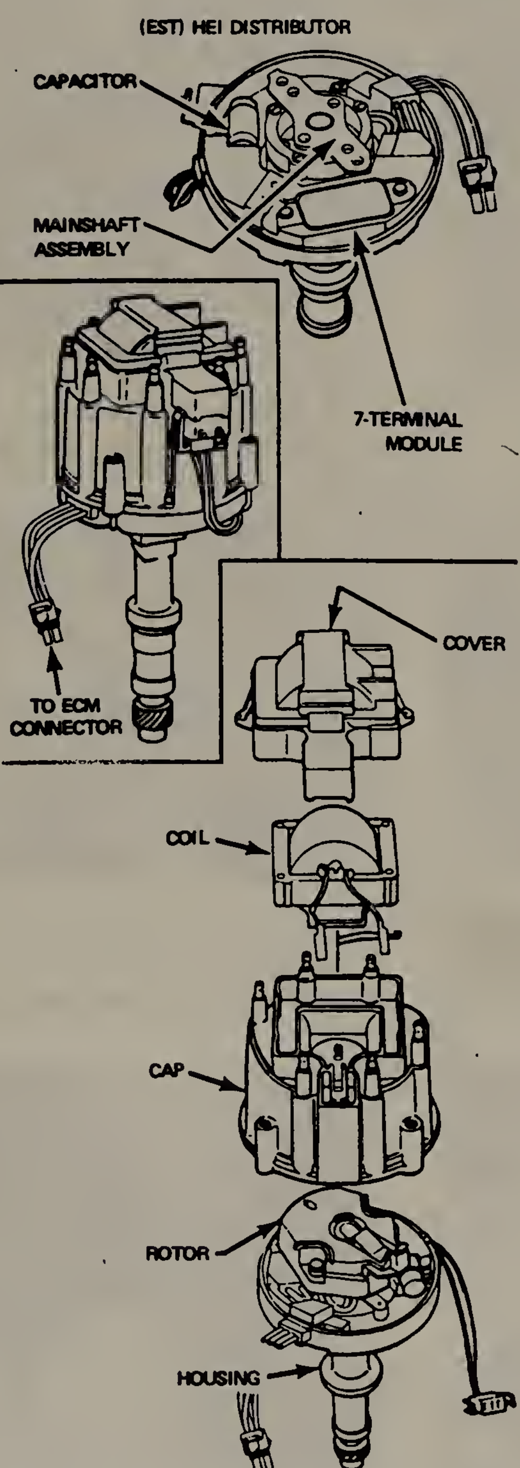
Fig. 122 Carefully lift the distributor cap up, and remove it from the vehicle

91031P82

Fig. 123 Unfasten the 2 rotor retaining screws . . .

91031P83

Fig. 124 . . . then pull the rotor straight up to remove it from the distributor



91031G44

Fig. 125 Exploded view of the HEI distributor cap and rotor, and related components—5.7L (VIN 8) engines

5.7L (VIN P & 5) Engines

See Figure 126

➡Removal of the distributor cap and rotor on these vehicles requires the use of two special tools; an ignition distributor cap socket (tool J 39997 or equivalent), and ignition distributor rotor socket (tool J 39998 or equivalent).

✲✲ WARNING

The distributor and timing disc assembly must be kept clean and free of oil, dirt and engine coolant. Any contamination may cause engine misfire and/or distributor damage. Do not disassemble the distributor until all debris has been cleaned from the distributor and surrounding area.

1. Disconnect the negative battery cable.
2. Remove the water pump and crankshaft balancer assembly, as outlined in Section 3 of this manual.
3. Tag and disconnect the spark plug wires from the distributor assembly.
4. Unplug the 4-terminal PCM connector and vacuum harness from the distributor. Plug or cap the vacuum line to prevent any debris from entering.
5. Use a suitable distributor cap socket, tool J 39997 or equivalent, to remove the distributor cap bolts/screws. Remove the distributor cap.
6. Use a suitable distributor rotor socket, tool J 39998 or equivalent bit, to unfasten the retaining bolts/screws, then remove the rotor.
7. If necessary, remove the distributor cover and shield at this time.

✲✲ WARNING

Do NOT touch the timing disk sensor or distributor base.

8. Inspect the distributor base and timing disk for damage, corrosion, or plastic particles. If you find any, the entire distributor assembly must be replaced.
9. The distributor is driven by a camshaft pin that mates to one slot in the distributor driveshaft. Align the distributor driveshaft with the distributor base timing mark.
10. Rotate the engine crankshaft until number one piston is at Top Dead Center (TDC) with the intake and exhaust valves closed. The camshaft pin will be in the 9 o'clock position.

To install:

11. If removed, install the distributor shield and cover.
12. Position the rotor, then secure with the retaining screws/bolts. Tighten the screws to 6 inch lbs. (0.7 Nm).
13. Place the distributor cap on the distributor assembly and install the retaining bolts/screws. Tighten the cap bolts/screws to 25 inch lbs. (2.8 Nm).
14. Unplug and connect the vacuum harness to the distributor.
15. Attach the 4-terminal PCM connector to the distributor. Connect the spark plugs to the distributor, as tagged during removal.
16. Install the crankshaft balancer and water pump, as outlined in Section 3 of this manual.
17. Connect the negative battery cable.

Ignition Timing

GENERAL INFORMATION

Ignition timing is the measurement, in degrees of crankshaft rotation, of the point at which the spark plugs fire in each of the cylinders. It is measured in degrees before or after Top Dead Center (TDC) of the compression stroke.

Because it takes a fraction of a second for the spark plug to ignite the mixture in the cylinder, the spark plug must fire a little before the piston reaches TDC. Otherwise, the mixture will not be completely ignited as the piston passes TDC and the full power of the explosion will not be used by the engine.

The timing measurement is given in degrees of crankshaft rotation before the piston reaches TDC (BTDC). If the setting for the ignition timing is 5° BTDC, the spark plug must fire 5° before each piston reaches TDC. This only holds true, however, when the engine is at idle speed.

As the engine speed increases, the pistons go faster. The spark plugs have to ignite the fuel even sooner if it is to be completely ignited when the piston reaches TDC.

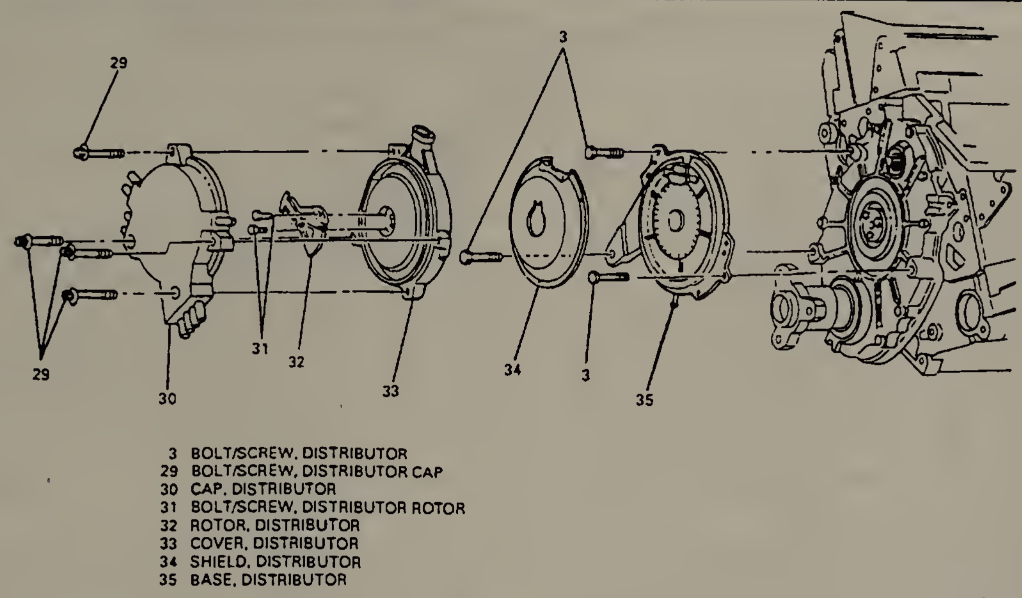


Fig. 126 Exploded view of the distributor cap, cover, rotor and base assembly—5.7L (VIN P & 5) engines

If the ignition is set too far advanced (BTDC), the ignition and expansion of the fuel in the cylinder will occur too soon and try to force the piston down while it is still traveling up. This causes engine ping. If the ignition spark is set too far retarded, after TDC (ATDC), the piston will have already passed TDC and started on its way down when the fuel is ignited. This will cause the piston to be forced down for only a portion of its travel, resulting in poor engine performance and lack of power.

There are two basic types of timing lights available. The first type of light operates from the car's battery. Two alligator clips connect to the battery terminals, while a third wire connects to the spark plug with an adapter or to the spark plug wire with an inductive pickup. This type of light is more expensive, but the xenon bulb provides a nice bright flash which can even be seen in sunlight. The second type replaces the battery source with 110-volt house current. Some timing lights have other functions built into them, such as dwell meters, tachometers, or remote starting switches. These are convenient, in that they reduce the tangle of wires under the hood, but may duplicate the functions of tools you already have.

On vehicles with electronic ignition, you should use a timing light with an inductive pickup. This pickup simply clamps around the spark plug wire, eliminating the adapter. It is not susceptible to crossfiring or false triggering, which may occur with a conventional light due to the greater voltages produced by these systems.

INSPECTION & ADJUSTMENT

5.7L (VIN 8) Engine

See Figure 127

On vehicles with Electronic Spark Timing (EST), it will be necessary to detach the EST connector at the distributor to cause the engine to operate in the bypass timing mode.

1. Refer to the Vehicle Emission Control Information (VECI) label located on the radiator support panel. Follow all directions given on the label.
2. With the ignition **OFF**, connect the pick-up lead of a suitable timing light to the No. 1 spark plug. Use jumper lead between the wire and plug, or an inductive type pick-up. Do NOT pierce the wire or attempt to insert a wire between the boot and the wire. Connect the timing light power leads according to the manufacturer's directions.
3. Start the engine, then aim the timing light at the timing mark (shown in the accompanying illustration). The line on the balancer or pulley will line up at the timing mark. If a change is necessary, loosen the distributor hold-down clamp bolt at the base of the distributor. While observing the mark with the timing light, slightly rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt and re-check the timing.

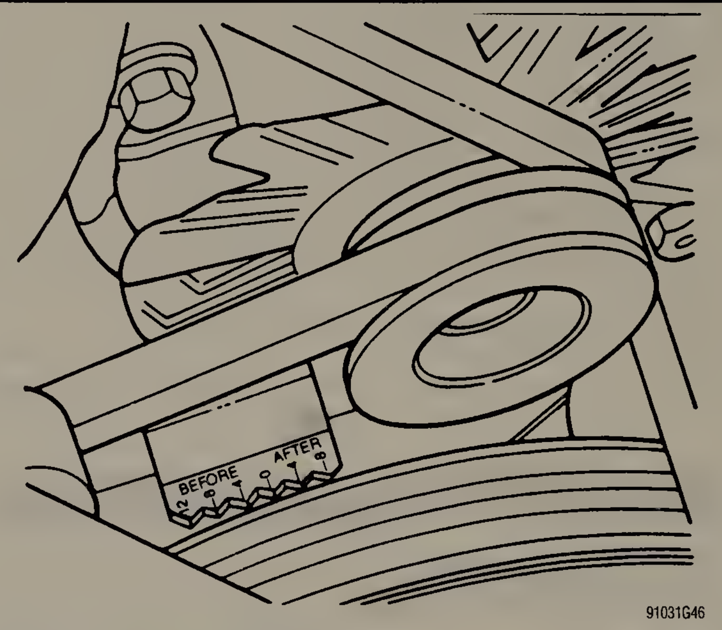


Fig. 127 Typical timing marks

4. Turn the engine **OFF**, and remove the timing light. If removed, reconnect the No. 1 spark plug wire.

5.7L (VIN J, P, and 5) Engines

The base ignition timing on these vehicles is preset when the engine is manufactured. No adjustment is possible. Timing advance and retard are accomplished through the ECM/PCM with ignition control and knock sensor systems.

Valve Lash

All models utilize a hydraulic valve lifter system to obtain zero lash. No periodic adjustment is necessary. An initial adjustment is required anytime that the lifters are removed or the valve train is disturbed. This procedure is covered in Section 3.

Idle Speed and Mixture Adjustments

Idle speed and mixture adjustments are factory set. No adjustment is possible. If a problem exists with the vehicle's idle speed or mixture, refer to Section 4 for testing the electronic engine controls and system.

GASOLINE ENGINE TUNE-UP SPECIFICATIONS

Year	Engine ID/VIN	Engine Displacement Liters (cc)	Spark Plugs Gap (in.)	Ignition Timing (deg.) MT	Ignition Timing (deg.) AT	Fuel Pump (psi)	Idle Speed (rpm) MT	Idle Speed (rpm) AT	Valve Clearance In.	Valve Clearance Ex.
1984	8	5.7L (5700)	0.035	①	①	9-13	450	400 ②	HYD	HYD
1985	8	5.7L (5700)	0.035	①	①	41-47	450 ③	400 ③	HYD	HYD
1986	8	5.7L (5700)	0.035	①	①	41-47	450 ③	400 ③	HYD	HYD
1987	8	5.7L (5700)	0.035	①	①	41-47	450 ③	400 ③	HYD	HYD
1988	8	5.7L (5700)	0.035	①	①	41-47	450 ③	450 ③	HYD	HYD
1989	8	5.7L (5700)	0.035	①	①	41-47	450 ③	450 ③	HYD	HYD
1990	8	5.7L (5700)	0.035	①	①	41-47	450 ③	450 ③	HYD	HYD
	J	5.7L (5700)	0.035	①	①	48-55	450 ③	450 ③	HYD	HYD
1991	8	5.7L (5700)	0.035	①	①	41-47	—	①	HYD	HYD
	J	5.7L (5700)	0.035	①	①	48-55	—	①	HYD	HYD
1992	P	5.7L (5700)	0.035	—	①	41-47	—	①	HYD	HYD
	J	5.7L (5700)	0.035	①	①	48-55	①	①	HYD	HYD
1993	P	5.7L (5700)	0.035	—	①	41-47	—	①	HYD	HYD
	J	5.7L (5700)	0.035	①	①	48-55	①	①	HYD	HYD
1994	P	5.7L (5700)	0.035	—	①	41-47	—	①	HYD	HYD
	J	5.7L (5700)	0.035	①	①	48-55	①	①	HYD	HYD
1995	P	5.7L (5700)	0.035	—	①	41-47	—	①	HYD	HYD
	J	5.7L (5700)	0.035	①	①	48-55	①	①	HYD	HYD
1996	P	5.7L (5700)	0.035	—	①	41-47	①	①	HYD	HYD
	5	5.7L (5700)	0.035	①	①	41-47	①	①	HYD	HYD

NOTE: The Vehicle Emission Control Information Label often reflects specification changes made during production. The label figures must be used if they differ from those in this chart.

HYD - Hydraulic

① Refer to the Vehicle Emission Control Information label

② In Drive

③ Minimum idle speed specification shown. Idle speed is usually a non-adjustable specification controlled by the ECM.

91031C04

Air Conditioning Systems

SYSTEM SERVICE & REPAIR

See Figure 128

It is recommended that the A/C system be serviced by an EPA Section 609 certified automotive technician utilizing a refrigerant recovery/recycling machine.

The do-it-yourselfer should not service his/her own vehicle's A/C system for many reasons, including legal concerns, personal injury, environmental damage and cost. The following are some of the reasons why you may decide not to service your own vehicle's A/C system.

According to the U.S. Clean Air Act, it is a federal crime to service or repair (involving the refrigerant) a Motor Vehicle Air Conditioning (MVAC) system for money without being EPA certified. It is also illegal to vent R-12 and R-134a refrigerants into the atmosphere. Selling or distributing A/C system refrigerant (in a container which contains less than 20 pounds of refrigerant) to any person who is not EPA 609 certified is also not allowed by law.

State and/or local laws may be more strict than the federal regulations, so be sure to check with your state and/or local authorities for further information. For further federal information on the legality of SERVICING your A/C system, call the EPA Stratospheric Ozone Hotline.

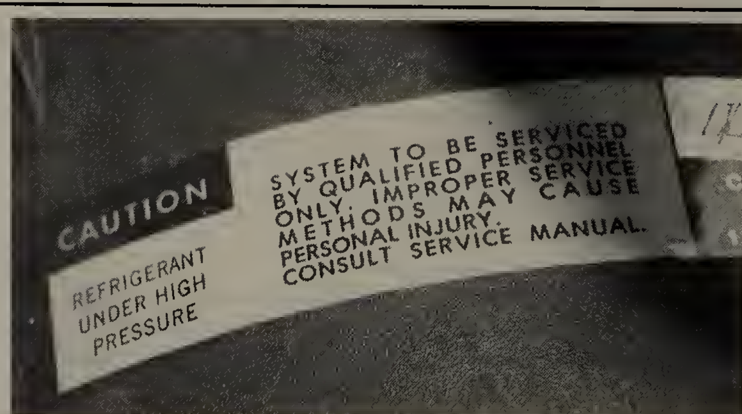
Federal law dictates that a fine of up to $25,000 may be levied on people convicted of venting refrigerant into the atmosphere. Additionally, the EPA may pay up to $10,000 for information or services leading to a criminal conviction of the violation of these laws.

When SERVICING an A/C system you run the risk of handling or coming in contact with refrigerant, which may result in skin or eye irritation or frostbite. Although low in toxicity (due to chemical stability), inhalation of concentrated refrigerant fumes is dangerous and can result in death; cases of fatal cardiac arrhythmia have been reported in people accidentally subjected to high levels of refrigerant. Some early symptoms include loss of concentration and drowsiness.

Generally, the limit for exposure is lower for R-134a than it is for R-12. Exceptional care must be practiced when handling R-134a.

Also, refrigerants can decompose at high temperatures (near gas heaters or open flame), which may result in hydrofluoric acid, hydrochloric acid and phosgene (a fatal nerve gas).

R-12 refrigerant can damage the environment because it is a Chlorofluorocarbon (CFC), which has been proven to add to ozone layer depletion, leading to increasing levels of UV radiation. UV radiation has been linked with an increase in skin cancer, suppression of the human immune system, an increase



91031P18

Fig. 128 Labels like this, found in the engine compartment, should be warning enough not to service your own A/C system

in cataracts, damage to crops, damage to aquatic organisms, an increase in ground-level ozone, and increased global warming.

R-134a refrigerant is a greenhouse gas which, if allowed to vent into the atmosphere, will contribute to global warming (the Greenhouse Effect).

It is usually more economically feasible to have a certified MVAC automotive technician perform A/C system service on your vehicle. Some possible reasons for this are as follows:

• While it is illegal to service an A/C system without the proper equipment, the home mechanic would have to purchase an expensive refrigerant recovery/recycling machine to service his/her own vehicle.

• Since only a certified person may purchase refrigerant—according to the Clean Air Act, there are specific restrictions on selling or distributing A/C system refrigerant—it is legally impossible (unless certified) for the home mechanic to service his/her own vehicle. Procuring refrigerant in an illegal fashion exposes one to the risk of paying a $25,000 fine to the EPA.

R-12 Refrigerant Conversion

If your vehicle still uses R-12 refrigerant, one way to save A/C system costs down the road is to investigate the possibility of having your system converted to R-134a. The older R-12 systems can be easily converted to R-134a refrigerant by a certified automotive technician by installing a few new components and changing the system oil.

The cost of R-12 is steadily rising and will continue to increase, because it is no longer imported or manufactured in the United States. Therefore, it is often possible to have an R-12 system converted to R-134a and recharged for less than it would cost to just charge the system with R-12.

If you are interested in having your system converted, contact local automotive service stations for more details and information.

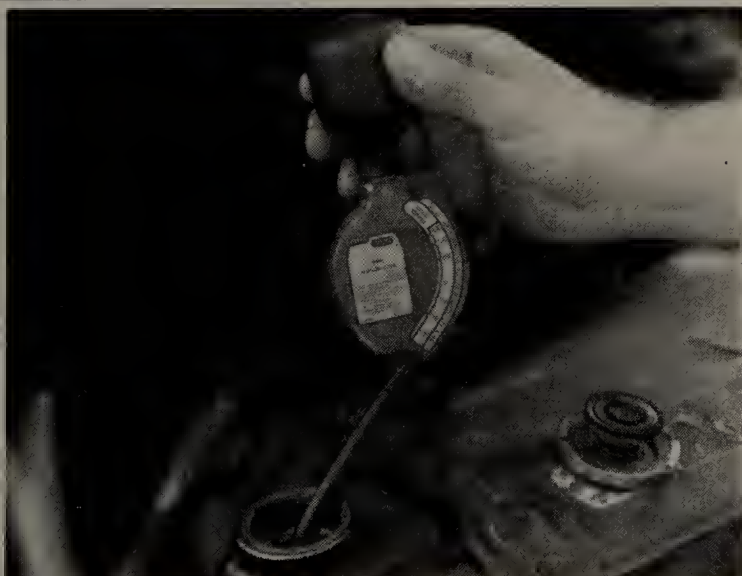
PREVENTIVE MAINTENANCE

➧ See Figures 129 thru 130

Although the A/C system should not be serviced by the do-it-yourselfer, preventive maintenance can be practiced and A/C system inspections can be performed to help maintain the efficiency of the vehicle's A/C system. For preventive maintenance, perform the following:

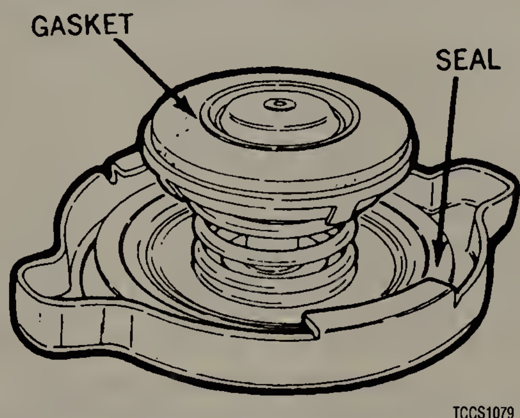
• The easiest and most important preventive maintenance for your A/C system is to be sure that it is used on a regular basis. Running the system for five minutes each month (no matter what the season) will help ensure that the seals and all internal components remain lubricated.

➡Some newer vehicles automatically operate the A/C system compressor whenever the windshield defroster is activated. When running, the compressor lubricates the A/C system components; therefore, the A/C system would not need to be operated each month.



TCCS1233

Fig. 129 A coolant tester can be used to determine the freezing and boiling levels of the coolant in your vehicle



TCCS1079

Fig. 130 To ensure efficient cooling system operation, inspect the radiator cap gasket and seal

• In order to prevent heater core freeze-up during A/C operation, it is necessary to maintain proper antifreeze protection. Use a hand-held coolant tester (hydrometer) to periodically check the condition of the antifreeze in your engine's cooling system.

➡Antifreeze should not be used longer than the manufacturer specifies.

• For efficient operation of an air conditioned vehicle's cooling system, the radiator cap should have a holding pressure which meets manufacturer's specifications. A cap which fails to hold these pressures should be replaced.

• Any obstruction of or damage to the condenser configuration will restrict air flow which is essential to its efficient operation. It is, therefore, a good rule to keep this unit clean and in proper physical shape.

➡Bug screens which are mounted in front of the condenser (unless they are original equipment) are regarded as obstructions.

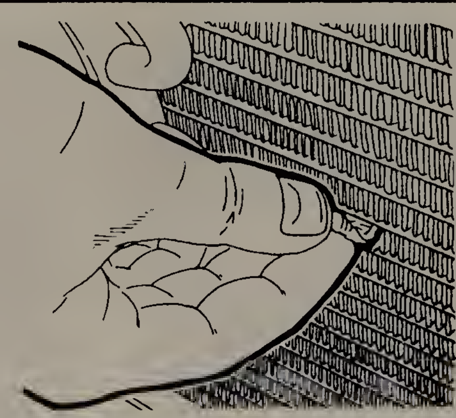
• The condensation drain tube expels any water which accumulates on the bottom of the evaporator housing into the engine compartment. If this tube is obstructed, the air conditioning performance can be restricted and condensation buildup can spill over onto the vehicle's floor.

SYSTEM INSPECTION

➧ See Figure 131

Although the A/C system should not be serviced by the do-it-yourselfer, preventive maintenance can be practiced and A/C system inspections can be performed to help maintain the efficiency of the vehicle's A/C system. For A/C system inspection, perform the following:

The easiest and often most important check for the air conditioning system consists of a visual inspection of the system components. Visually inspect the air conditioning system for refrigerant leaks, damaged compressor clutch, abnormal compressor drive belt tension and/or condition, plugged evaporator drain tube, blocked condenser fins, disconnected or broken wires, blown fuses, corroded connections and poor insulation.



TCCS1081

Fig. 131 Periodically remove any debris from the condenser and radiator fins

A refrigerant leak will usually appear as an oily residue at the leakage point in the system. The oily residue soon picks up dust or dirt particles from the surrounding air and appears greasy. Through time, this will build up and appear to be a heavy dirt impregnated grease.

For a thorough visual and operational inspection, check the following:

- Check the surface of the radiator and condenser for dirt, leaves or other material which might block air flow.
- Check for kinks in hoses and lines. Check the system for leaks.
- Make sure the drive belt is properly tensioned. When the air conditioning is operating, make sure the drive belt is free of noise or slippage.
- Make sure the blower motor operates at all appropriate positions, then check for distribution of the air from all outlets with the blower on **HIGH** or **MAX**.

➡Keep in mind that under conditions of high humidity, air discharged from the A/C vents may not feel as cold as expected, even if the system is working properly. This is because vaporized moisture in humid air retains heat more effectively than dry air, thereby making humid air more difficult to cool.

- Make sure the air passage selection lever is operating correctly. Start the engine and warm it to normal operating temperature, then make sure the temperature selection lever is operating correctly.

Windshield Wipers

ELEMENT (REFILL) CARE & REPLACEMENT

➧ See Figures 132 thru 141

For maximum effectiveness and longest element life, the windshield and wiper blades should be kept clean. Dirt, tree sap, road tar and so on will cause streaking, smearing and blade deterioration if left on the glass. It is advisable to wash the windshield carefully with a commercial glass cleaner at least once a month. Wipe off the rubber blades with the wet rag afterwards. Do not attempt to move wipers across the windshield by hand; damage to the motor and drive mechanism will result.

To inspect and/or replace the wiper blade elements, place the wiper switch in the **LOW** speed position and the ignition switch in the **ACC** position. When the wiper blades are approximately vertical on the windshield, turn the ignition switch to **OFF**.

Examine the wiper blade elements. If they are found to be cracked, broken or torn, they should be replaced immediately. Replacement intervals will vary with usage, although ozone deterioration usually limits element life to about one year. If the wiper pattern is smeared or streaked, or if the blade chatters across the glass, the elements should be replaced. It is easiest and most sensible to replace the elements in pairs.

If your vehicle is equipped with aftermarket blades, there are several different types of refills and your vehicle might have any kind. Aftermarket blades and arms rarely use the exact same type blade or refill as the original equipment. Here are some typical aftermarket blades; not all may be available for your vehicle:

The Anco® type uses a release button that is pushed down to allow the refill to slide out of the yoke jaws. The new refill slides back into the frame and locks in place.

Some Trico® refills are removed by locating where the metal backing strip or the refill is wider. Insert a small screwdriver blade between the frame and metal backing strip. Press down to release the refill from the retaining tab.

Other types of Trico® refills have two metal tabs which are unlocked by squeezing them together. The rubber filler can then be withdrawn from the frame jaws. A new refill is installed by inserting the refill into the front frame jaws and sliding it rearward to engage the remaining frame jaws. There are usually four jaws; be certain when installing that the refill is engaged in all of them. At the end of its travel, the tabs will lock into place on the front jaws of the wiper blade frame.

Another type of refill is made from polycarbonate. The refill has a simple locking device at one end which flexes downward out of the groove into which the jaws of the holder fit, allowing easy release. By sliding the new refill through all the jaws and pushing through the slight resistance when it reaches the end of its travel, the refill will lock into position.

To replace the Tridon® refill, it is necessary to remove the wiper blade. This refill has a plastic backing strip with a notch about 1 in. (25mm) from the end. Hold the blade (frame) on a hard surface so that the frame is tightly bowed. Grip

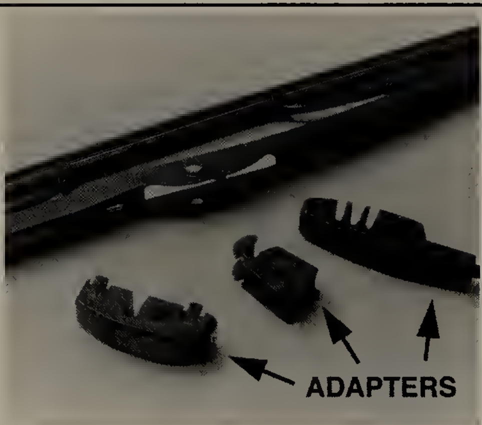


Fig. 132 Bosch® wiper blade and fit kit

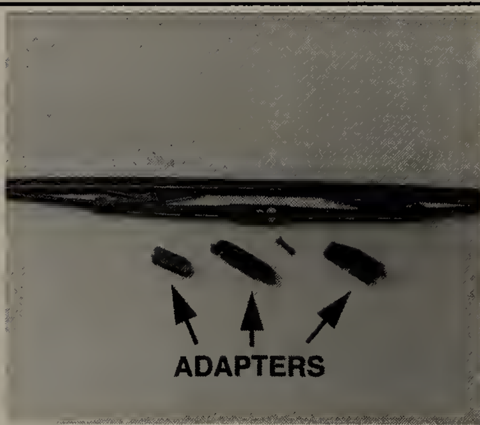


Fig. 133 Lexor® wiper blade and fit kit

Fig. 134 Pylon® wiper blade and adapter

Fig. 135 Trico® wiper blade and fit kit

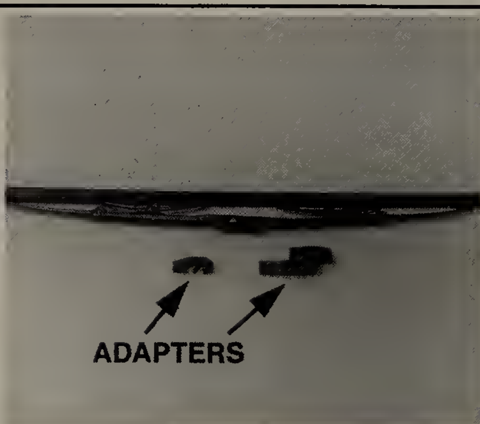


Fig. 136 Tripledge® wiper blade and fit kit

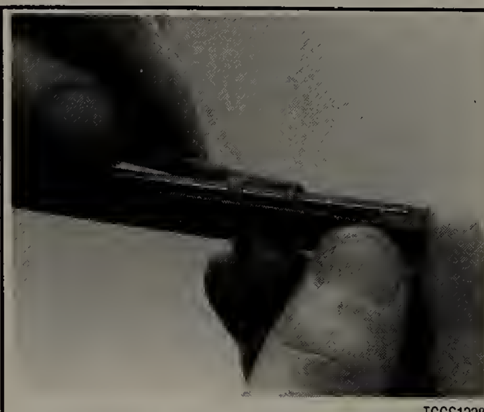
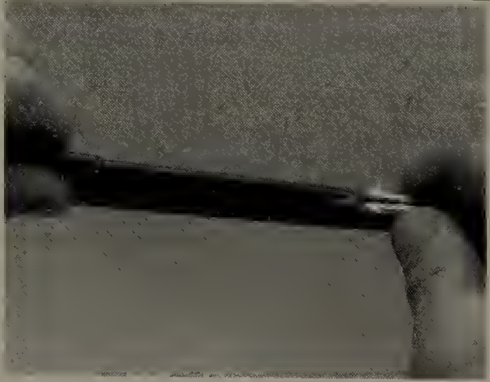


Fig. 137 To remove and install a Lexor® wiper blade refill, slip out the old insert and slide in a new one



TCCS1229

Fig. 138 On Pylon® inserts, the clip at the end has to be removed prior to sliding the insert off

TCCS1230

Fig. 139 On Trico® wiper blades, the tab at the end of the blade must be turned up . . .

TCCS1231

Fig. 140 . . . then the insert can be removed. After installing the replacement insert, bend the tab back

TCCS1232

Fig. 141 The Tripledge® wiper blade insert is removed and installed using a securing clip

the tip of the backing strip and pull up while twisting counterclockwise. The backing strip will snap out of the retaining tab. Do this for the remaining tabs until the refill is free of the blade. The length of these refills is molded into the end and they should be replaced with identical types.

Regardless of the type of refill used, be sure to follow the part manufacturer's instructions closely. Make sure that all of the frame jaws are engaged as the refill is pushed into place and locked. If the metal blade holder and frame are allowed to touch the glass during wiper operation, the glass will be scratched.

Tires and Wheels

Common sense and good driving habits will afford maximum tire life. Fast starts, sudden stops and hard cornering are hard on tires and will shorten their useful life span. Make sure that you don't overload the vehicle or run with incorrect pressure in the tires. Both of these practices will increase tread wear.

➡**For optimum tire life, keep the tires properly inflated, rotate them often and have the wheel alignment checked periodically.**

Inspect your tires frequently. Be especially careful to watch for bubbles in the tread or sidewall, deep cuts or underinflation. Replace any tires with bubbles in the sidewall. If cuts are so deep that they penetrate to the cords, discard the tire. Any cut in the sidewall of a radial tire renders it unsafe. Also look for uneven tread wear patterns that may indicate the front end is out of alignment or that the tires are out of balance.

TIRE ROTATION

◆ See Figures 142 and 143

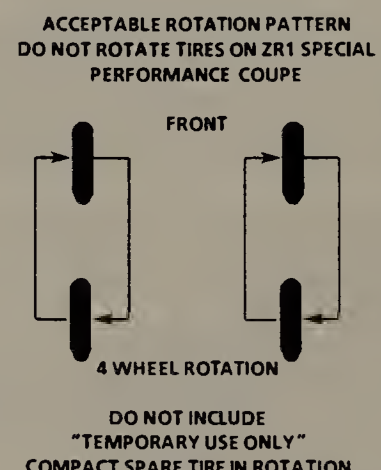
⁂ WARNING

Since the front and rear tires on the Corvette ZR-1 are different sizes, they must NOT be rotated.

Tires must be rotated periodically to equalize wear patterns that vary with a tire's position on the vehicle. Tires will also wear in an uneven way as the front steering/suspension system wears to the point where the alignment should be reset.

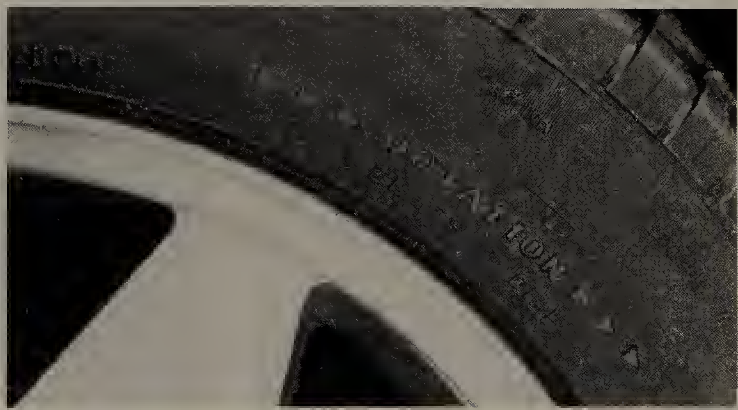
Rotating the tires will ensure maximum life for the tires as a set, so you will not have to discard a tire early due to wear on only part of the tread. Regular rotation is required to equalize wear.

When rotating "unidirectional tires," make sure that they always roll in the same direction. This means that a tire used on the left side of the vehicle must not be switched to the right side and vice-versa. Such tires should only be rotated front-to-rear or rear-to-front, while always remaining on the same side of the vehicle. These tires are marked on the sidewall as to the direction of rotation; observe the marks when reinstalling the tire(s).



91031G47

Fig. 142 Compact spare tires must NEVER be used in the rotation pattern



TCCS1234

Fig. 143 Unidirectional tires are identifiable by sidewall arrows and/or the word "rotation"

Some styled or "mag" wheels may have different offsets front to rear. In these cases, the rear wheels must not be used up front and vice-versa. Furthermore, if these wheels are equipped with unidirectional tires, they cannot be rotated unless the tire is remounted for the proper direction of rotation.

➡The compact or space-saver spare is strictly for emergency use. It must never be included in the tire rotation or placed on the vehicle for everyday use.

TIRE DESIGN

See Figure 144

For maximum satisfaction, tires should be used in sets of four. Mixing of different types (radial, bias-belted, fiberglass belted) must be avoided. In most cases, the vehicle manufacturer has designated a type of tire on which the vehicle will perform best. Your first choice when replacing tires should be to use the same type of tire that the manufacturer recommends.

When radial tires are used, tire sizes and wheel diameters should be selected to maintain ground clearance and tire load capacity equivalent to the original specified tire. Radial tires should always be used in sets of four.

CAUTION

Radial tires should never be used on only the front axle.

When selecting tires, pay attention to the original size as marked on the tire. Most tires are described using an industry size code sometimes referred to as P-Metric. This allows the exact identification of the tire specifications, regardless of the manufacturer. If selecting a different tire size or brand, remember to check the installed tire for any sign of interference with the body or suspension while the vehicle is stopping, turning sharply or heavily loaded.

Snow Tires

Good radial tires can produce a big advantage in slippery weather, but in snow, a street radial tire does not have sufficient tread to provide traction and control. The small grooves of a street tire quickly pack with snow and the tire behaves like a billiard ball on a marble floor. The more open, chunky tread of a snow tire will self-clean as the tire turns, providing much better grip on snowy surfaces.

To satisfy municipalities requiring snow tires during weather emergencies, most snow tires carry either an M + S designation after the tire size stamped on the sidewall, or the designation "all-season." In general, no change in tire size is necessary when buying snow tires.

Most manufacturers strongly recommend the use of 4 snow tires on their vehicles for reasons of stability. If snow tires are fitted only to the drive wheels, the opposite end of the vehicle may become very unstable when braking or turning on slippery surfaces. This instability can lead to unpleasant endings if the driver can't counteract the slide in time.

Note that snow tires, whether 2 or 4, will affect vehicle handling in all non-snow situations. The stiffer, heavier snow tires will noticeably change the turning and braking characteristics of the vehicle. Once the snow tires are installed, you must re-learn the behavior of the vehicle and drive accordingly.

➡Consider buying extra wheels on which to mount the snow tires. Once done, the "snow wheels" can be installed and removed as needed. This eliminates the potential damage to tires or wheels from seasonal removal and installation. Even if your vehicle has styled wheels, see if inexpensive steel wheels are available. Although the look of the vehicle will change, the expensive wheels will be protected from salt, curb hits and pothole damage.

TIRE STORAGE

If they are mounted on wheels, store the tires at proper inflation pressure. All tires should be kept in a cool, dry place. If they are stored in the garage or basement, do not let them stand on a concrete floor; set them on strips of wood, a mat or a large stack of newspaper. Keeping them away from direct moisture is of paramount importance. Tires should not be stored upright, but in a flat position.

INFLATION & INSPECTION

See Figures 145 thru 152

The importance of proper tire inflation cannot be overemphasized. A tire employs air as part of its structure. It is designed around the supporting strength of the air at a specified pressure. For this reason, improper inflation drastically reduces the tire's ability to perform as intended. A tire will lose some air in day-to-day use; having to add a few pounds of air periodically is not necessarily a sign of a leaking tire.

Two items should be a permanent fixture in every glove compartment: an accurate tire pressure gauge and a tread depth gauge. Check the tire pressure (including the spare) regularly with a pocket type gauge. Too often, the gauge on the end of the air hose at your corner garage is not accurate because it suffers too much abuse. Always check tire pressure when the tires are cold, as pressure increases with temperature. If you must move the vehicle to check the tire inflation, do not drive more than a mile before checking. A cold tire is generally one that has not been driven for more than three hours.

A plate or sticker is normally provided somewhere in the vehicle (door post, hood, tailgate or trunk lid)

which shows the proper pressure for the tires. Never counteract excessive pressure build-up by bleeding off air pressure (letting some air out). This will cause the tire to run hotter and wear quicker.

CAUTION

Never exceed the maximum tire pressure embossed on the tire! This is the pressure to be used when the tire is at maximum loading, but it is rarely the correct pressure for everyday driving. Consult the owner's manual or the tire pressure sticker for the correct tire pressure.

Once you've maintained the correct tire pressures for several weeks, you'll be familiar with the vehicle's braking and handling personality. Slight adjustments in tire pressures can fine-tune these characteristics, but never change the cold pressure specification by more than 2 psi. A slightly softer tire pres-

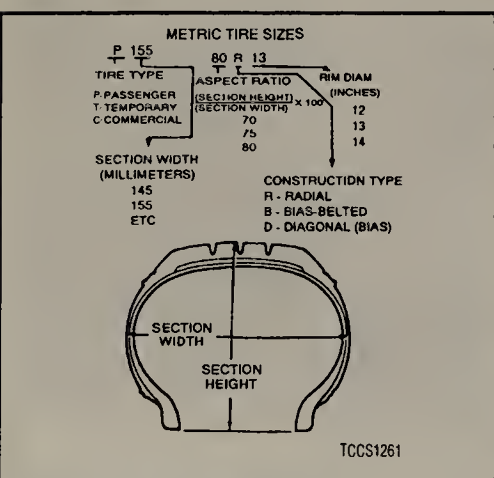


Fig. 144 P-Metric tire coding

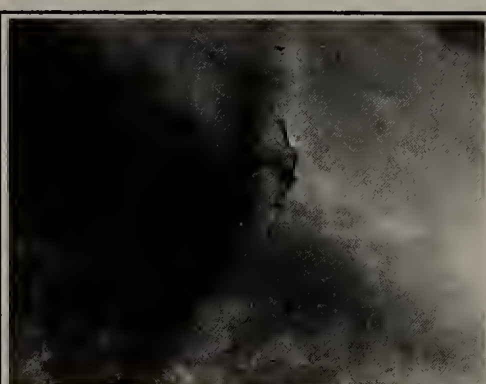

TCCS1097

Fig. 145 Tires should be checked frequently for any sign of puncture or damage

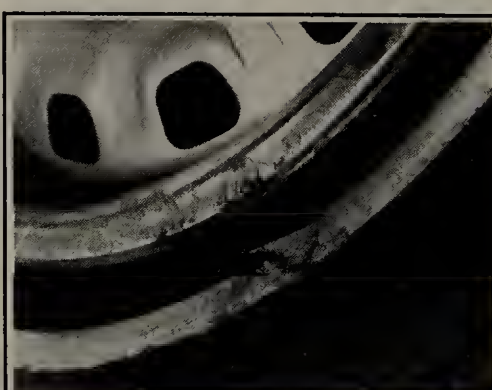

TCCS1095

Fig. 146 Tires with deep cuts, or cuts which bulge, should be replaced immediately

Fig. 147 Examples of inflation-related tire wear patterns

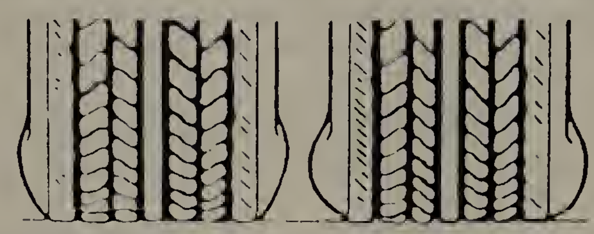


Fig. 148 Radial tires have a characteristic sidewall bulge; don't try to measure pressure by looking at the tire. Use a quality air pressure gauge

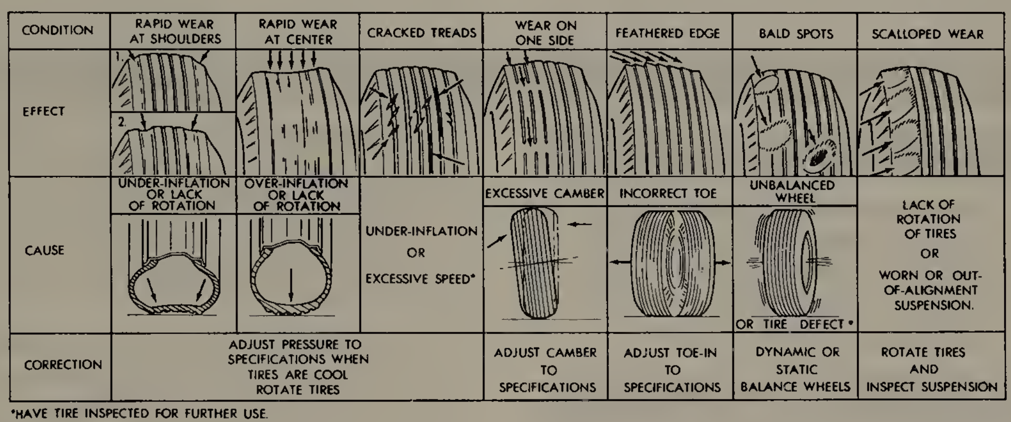


Fig. 149 Common tire wear patterns and causes

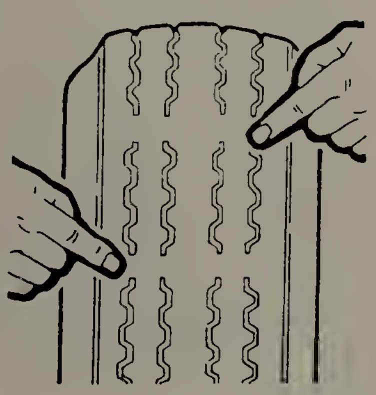


Fig. 150 Tread wear indicators will appear when the tire is worn

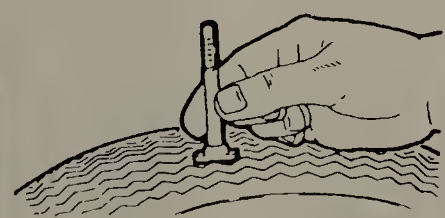


Fig. 151 Accurate tread depth indicators are inexpensive and handy

Fig. 152 A penny works well for a quick check of tread depth

sure will give a softer ride but also yield lower fuel mileage. A slightly harder tire will give crisper dry road handling but can cause skidding on wet surfaces. Unless you're fully attuned to the vehicle, stick to the recommended inflation pressures.

All tires made since 1968 have built-in tread wear indicator bars that show up as ½ in. (13mm) wide smooth bands across the tire when $\frac{1}{16}$ in. (1.5mm) of tread remains. The appearance of tread wear indicators means that the tires should be replaced. In fact, many states have laws prohibiting the use of tires with less than this amount of tread.

You can check your own tread depth with an inexpensive gauge or by using a Lincoln head penny. Slip the Lincoln penny (with Lincoln's head upside-down) into several tread grooves. If you can see the top of Lincoln's head in 2 adjacent grooves, the tire has less than $\frac{1}{16}$ in. (1.5mm) tread left and should be replaced. You can measure snow tires in the same manner by using the "tails" side of the Lincoln penny. If you can see the top of the Lincoln memorial, it's time to replace the snow tire(s).

CARE OF SPECIAL WHEELS

If you have invested money in magnesium, aluminum alloy or sport wheels, special precautions should be taken to make sure your investment is not wasted and that your special wheels look good for the life of the vehicle.

Special wheels are easily damaged and/or scratched. Occasionally check the rims for cracking, impact damage or air leaks. If any of these are found, replace the wheel. But in order to prevent this type of damage and the costly replacement of a special wheel, observe the following precautions:

- Use extra care not to damage the wheels during removal, installation, balancing, etc. After removal of the wheels from the vehicle, place them on a mat or other protective surface. If they are to be stored for any length of time, support them on strips of wood. Never store tires and wheels upright; the tread may develop flat spots.
- When driving, watch for hazards; it doesn't take much to crack a wheel.

• When washing, use a mild soap or non-abrasive dish detergent (keeping in mind that detergent tends to remove wax). Avoid cleansers with abrasives or the use of hard brushes. There are many cleaners and polishes for special wheels.

• If possible, remove the wheels during the winter. Salt and sand used for snow removal can severely damage the finish of a wheel.

• Make certain the recommended lug nut torque is never exceeded or the wheel may crack. Never use snow chains on special wheels; severe scratching will occur.

Maintenance Lights

RESETTING

1990–91 Vehicles

The CHANGE OIL monitor light is on the left side of the instrument cluster. When changing the oil, reset the engine oil lift monitor whether the CHANGE OIL light came on or not. Reset the monitor as follows:

1. Turn the ignition key to the **ON** position, but do not start the engine.
2. Press the ENG MET button on the trip monitor and release. Press the button again within 5 seconds.
3. Within 5 seconds of pressing the button the second time, press and hold the RANGE button on the trip monitor. The CHANGE OIL light will flash.
4. Hold the RANGE button until the CHANGE OIL light stops flashing and extinguishes. The monitor is reset at this point. Repeat this procedure if the light does not go out.

1992–96 Vehicles

1. Turn the ignition key to the **ON** position, but do not start the engine.
2. Press the ENG MET button on the trip monitor and release. Press the button again within 5 seconds.
3. Within 5 seconds of pressing the button the second time, press and hold the GAUGES button on the trip monitor. The CHANGE OIL light will flash.
4. Hold the GAUGES button until the CHANGE OIL light stops flashing and extinguishes. The monitor is reset at this point. Repeat this procedure if the light does not go out.

FLUIDS AND LUBRICANTS

Fluid Disposal

Used fluids such as engine oil, transmission fluid, antifreeze and brake fluid are hazardous wastes and must be disposed of properly. Before draining any fluids, consult with your local authorities; in many areas, waste oil, antifreeze, etc. is being accepted as a part of recycling programs. A number of service stations and auto parts stores are also accepting waste fluids for recycling.

Fuel and Engine Oil Recommendations

FUEL

➡Some fuel additives contain chemicals that can damage the catalytic converter and/or oxygen sensor. Read all of the labels carefully before using any additive in the engine or fuel system.

All of the vehicles covered by this manual are designed to run on unleaded fuel. The use of a leaded fuel in a car requiring unleaded fuel will plug the catalytic converter and render it inoperative. It will also increase exhaust backpressure to the point where engine output will be severely reduced. The minimum octane rating of the unleaded fuel being used must be at least 87, which usually means regular unleaded, but some high performance engines may require higher ratings. Fuel should be selected for the brand and octane which performs best with your engine. Judge a gasoline by its ability to prevent pinging, its engine starting capabilities (cold and hot) and general all weather performance.

As far as the octane rating is concerned, if your engine's compression ratio is 9.0:1 or lower, in most cases a regular unleaded grade of gasoline can be used. If the compression ratio is higher than 9.0:1, use a premium grade of unleaded fuel.

The use of a fuel too low in octane (a measure of anti-knock quality) will result in spark knock. Since many factors such as altitude, terrain, air temperature and humidity affect operating efficiency, knocking may result even though the recommended fuel is being used. If persistent knocking occurs, it may be necessary to switch to a higher grade of fuel. Continuous or heavy knocking may result in engine damage.

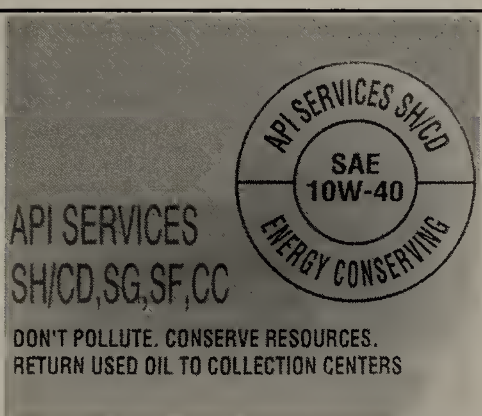
➡Your engine's fuel requirement can change with time, mainly due to carbon build-up, which will in turn change the compression ratio. If you engine pings, knocks or diesels (runs with the ignition OFF) switch to a higher grade of fuel. Sometimes, just changing brands will cure the problem. If it becomes necessary to retard the timing from the specifications, don't change it more than a few degrees. Retarded timing will reduce power output and fuel mileage, in addition to making the engine run hotter.

ENGINE OIL

➧ See Figures 153, 154 and 155

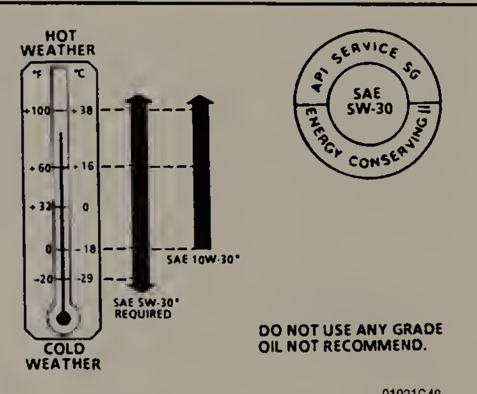
The Society Of Automotive Engineers (SAE) grade number indicates the viscosity of the engine oil and thus its ability to lubricate at a given temperature. The lower the SAE grade number, the lighter the oil; the lower the viscosity, the easier it is to crank the engine in cold weather. Oil viscosities should be chosen from those oils recommended for the lowest anticipated temperatures during the oil change interval. With the proper viscosity, you will be assured of easy cold starting and sufficient engine protection.

Multi-viscosity oils (5W-30, 10W-30 etc.) offer the important advantage of being adaptable to temperature extremes. They allow easy starting at low temperatures, yet they give good protection at high speeds and engine tempera-



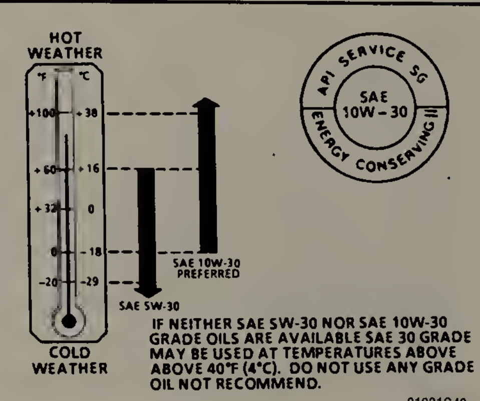
TCCS1235

Fig. 153 Look for the API oil identification label when choosing your engine oil



91031G48

Fig. 154 Recommended SAE engine oil viscosity grades for 5.7L (VIN 8, P and 5) engines



91031G49

Fig. 155 Recommended SAE engine oil viscosity grades for 5.7L (VIN J) engines tures. This is a decided advantage in changeable climates or in long distance driving.

The American Petroleum Institute (API) designation indicates the classification of engine oil used under certain given operating conditions. Only oil designated for Service SJ, or latest superseding oil grade, should be used. Oils of the SH type perform a variety of functions inside the engine in addition to their basic function as a lubricant. Through a balanced system of metallic detergents and polymeric dispersants, the oil prevents the formation of high and low temperature deposits and also keeps sludge and particles of dirt in suspension. Acids, particularly sulfuric acid, as well as other byproducts of combustion, are neutralized. Both the SAE grade number and the API designation can be found on the side of the oil bottle.

Synthetic Oils

There are excellent synthetic and fuel-efficient oils available that, under the right circumstances, can help provide better fuel mileage and better engine protection. However, these advantages come at a price, which can be significantly more than the price per quart of conventional motor oils.

Before pouring any synthetic oils into your car's engine, you should consider the condition of the engine and the type of driving you do. It is also wise to check the vehicle manufacturer's position on synthetic oils.

Generally, it is best to avoid the use of synthetic oil in both brand new and older, high mileage engines. New engines require a proper break-in, and the synthetics are so slippery that they can impede this; most manufacturers recommend that you wait at least 5,000 miles (8,000 km) before switching to a synthetic oil. Conversely, older engines are looser and tend to lose more oil; synthetics will slip past worn parts more readily than regular oil. If your car already leaks oil, (due to worn parts or bad seals/gaskets), it may leak more with a synthetic inside.

Consider your type of driving. If most of your accumulated mileage is on the highway at higher, steadier speed, a synthetic oil will reduce friction and probably help deliver better fuel mileage. Under such ideal highway conditions, the oil change interval can be extended, as long as the oil filter can operated effectively for the extended life of the oil. If the filter can't do its job for this extended period, dirt and sludge will build up in your engine's crankcase, sump, oil pump and lines, no matter what type of oil is used. If using synthetic oil in this manner, you should continue to change the oil filter at the recommended intervals.

Cars used under harder, stop-and-go, short hop circumstances should always be serviced more frequently, and for these cars synthetic oil may not be a wise investment. Because of the necessary shorter change interval needed for this type of driving, you cannot take advantage of the long recommended change interval of most synthetic oils.

Engine

OIL LEVEL CHECK

See Figures 156, 157, 158 and 159

Every time you stop for fuel, check the engine oil, making sure the engine has fully warmed and the vehicle is parked on a level surface. Because it takes some time for the oil to drain back to the oil pan, you should wait a few minutes before checking your oil. If you are doing this at a fuel stop, first fill the fuel tank, then open the hood and check the oil. Don't get so carried away as to forget to pay for the fuel; most station attendants won't believe that you forgot!

1. Make sure the car is parked on level ground.

For the Corvette ZR-1, equipped with the 5.7L (VIN J) engine, the engine oil should be checked with the engine cold for the most accurate reading. If the engine is warm, allow ample time for it to cool before checking the oil level.

2. For most engines, when checking the oil level, it is best for the engine to be at normal operating temperature, although checking the oil immediately after stopping will lead to a false reading. Wait a few minutes after turning off the engine to allow the oil to drain back into the crankcase.
3. Open the hood and locate the dipstick which will be in a guide tube mounted in the engine block. Pull the dipstick from its tube, wipe it clean (using a clean, lint free rag) and then reinsert it.
4. Pull the dipstick out again and, holding it horizontally, read the oil level. The oil should be between the FULL and ADD marks on the dipstick. The oil is below the ADD mark, add oil of the proper viscosity through the capped opening in the top of the valve cover. See the oil and fuel recommendations listed earlier in this section for the proper viscosity and rating of oil to use.
5. Insert the dipstick and check the oil level again after adding any oil. Approximately one quart of oil will raise the level from the ADD mark to the FULL mark. Be sure not to overfill the crankcase and waste the oil. Excess oil will generally be consumed at an accelerated rate.

WARNING

DO NOT overfill the crankcase. It may result in oil-fouled spark plugs, oil leaks caused by oil seal failure or engine damage due to oil foaming.

Fig. 156 Pull the dipstick out of the tube

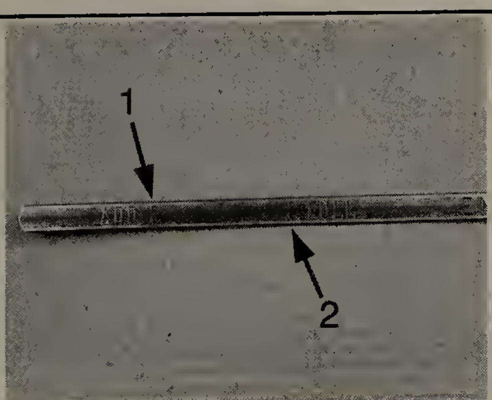


Fig. 157 The engine oil level should be between the ADD (1) and FULL (2) marks on the dipstick

Fig. 158 If the level is low, remove the engine oil fill cap, located on the valve cover

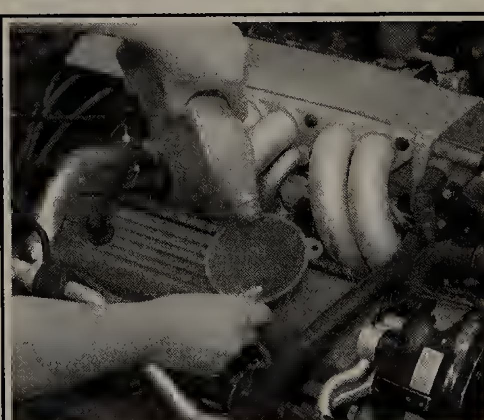


Fig. 159 Then, using a funnel, add the proper type and amount of oil

OIL & FILTER CHANGE

See Figures 160 thru 168

➡Although the manufacturer recommends changing the filter at the first oil change and then at every other oil change, (unless 12 months pass between changes), we recommend changing the filter with each service. It is a small price to pay for extra protection.

Under normal operating conditions, the oil is to be changed every 7500 miles (12,000 km) or 12 months, whichever occurs first. When driving conditions frequently include dusty or polluted areas, trailer towing, idling for long periods of time, low speed operation, when operating at temperatures below freezing or driving short distances (under 4 miles or 6.4km), change the oil and filter more frequently. Under these circumstances, oil has a greater chance of building up sludge and contaminants which could damage your engine. If your vehicle use fits into one or more of these categories (as it does for most vehicles), it is suggested that the oil and filter be changed every 3000 miles (5000 km) or 3 months, whichever comes first.

The oil should be disposed of properly after it is drained from the vehicle. Store the oil in a suitable container and take the container to an official oil recycling station. Most gas stations or oil and lube facilities will take the used oil at little or no expense to you.

Oil should always be changed after the engine has been running long enough to bring it up to normal operating temperature. Hot oil will flow more easily and will carry more contaminants than will cold oil. The oil drain plug is located on the bottom of the oil pan (bottom of the engine, underneath the car). The oil filter is located on the left side of most engines covered by this manual. To change the oil and filter:

1. Run the engine until it reaches normal operating temperature.
2. Raise the front of the vehicle and support it safely using a suitable pair of jackstands.
3. Slide a drain pan of a least 6 quarts capacity under the oil pan. Wipe the drain plug and surrounding area clean using an old rag.

CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

4. Loosen the drain plug using a ratchet, short extension and socket or a box-wrench. Turn the plug out by hand, using a rag to shield your fingers from the hot oil. By keeping an inward pressure on the plug as you unscrew it, oil won't escape past the threads and you can remove it without being burned by hot oil.

➡If the drain plug is equipped with a removable washer or gasket, check its condition and replace, if necessary, to provide a leakproof seal.

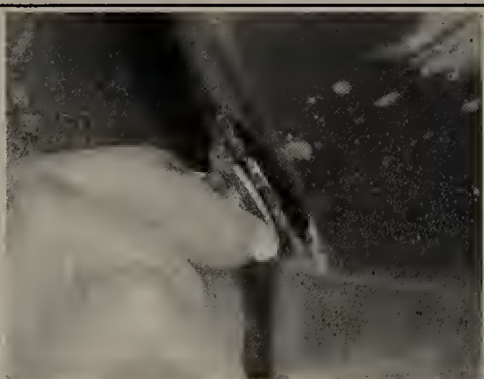
5. Quickly withdraw the plug and move your hands out of the way. Allow the oil to drain completely into the pan, then install and carefully tighten the drain plug. Be careful not to overtighten the drain plug, otherwise you'll be buying a new pan or a replacement plug for stripped threads.

➡Although some manufacturers recommend changing the oil filter every other oil change, we recommend the filter be changed each time you change your oil. The old filter will contain up to a quart of dirty oil, which will contaminate the clean oil. Also, the benefit of clean oil is quickly lost if the old filter is clogged. The added protection for your engine far outweighs the few dollars saved by using an old filter.

6. Move the drain pan under the oil filter. Use a strap-type or cap-type filter wrench to loosen and remove the oil filter from the engine block. Keep in mind that it's holding about one quart of hot, dirty oil.

91031P47

Fig. 160 Use a 13mm box-end wrench or ratchet to loosen the oil pan drain plug



91031P48

Fig. 161 Keep an inward pressure on the drain plug while loosening it, so hot oil does not drip onto your hands

91031P49

Fig. 162 Quickly withdraw the plug and allow the oil to drain completely

91031P50

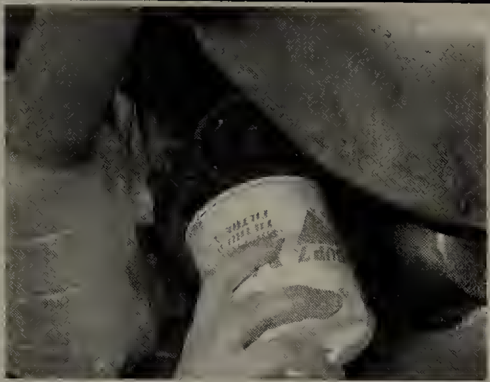
Fig. 163 Make sure you thoroughly clean the oil pan drain plug threads to avoid stripping the pan threads

91031P51

Fig. 164 Also, make sure to clean the oil pan drain plug mating surface

91031P52

Fig. 165 You can use a cap-type oil filter wrench with a socket to loosen the oil filter



91031P53

Fig. 166 Carefully lower the oil filter. Remember, it's holding about a quart of hot, dirty oil

91031P54

Fig. 167 Use a clean, lint-free rag to wiper off the engine block filter adapter

TCCS1901

Fig. 168 Before installing a new oil filter, lightly coat the rubber gasket with clean oil

7. Empty the old filter into the drain pan and properly dispose of the filter.
8. Using a clean rag, wipe off the filter adapter on the engine block. Be sure that the rag doesn't leave any lint which could clog an oil passage.
9. Coat the rubber gasket on the filter with fresh oil, then spin it onto the engine by hand. When the gasket touches the adapter surface, give it another ⅓–½ turn (but no more, or you'll squash the gasket and it will leak).
10. Refill the engine with the correct amount of fresh oil. Please refer to the Capacities chart in this section.
11. Check the oil level on the dipstick. It is normal for the level to be a bit above the full mark. Start the engine and allow it to idle for a few minutes.

WARNING

Do not run the engine above idle speed until it has built up oil pressure, as indicated when the oil light goes out.

12. Shut off the engine and allow the oil to flow back to the crankcase for a minute, then recheck the oil level. Check around the filter and drain plug for any leaks, and correct as necessary.

Manual Transmission

FLUID RECOMMENDATIONS

According to General Motors, the manual transmission fluid on 1984–88 Corvettes, equipped with the 4-speed manual transmission (with automatic overdrive), does not require changing. However the fluid in the overdrive unit must be changed every 30,000 miles (50,000km). Dexron® II, or its latest superseding grade of automatic transmission fluid is the only type of fluid that can be used on these vehicles. The use of any other fluids or additives may damage the transmission.

On 1989–96 vehicles, equipped with the 6-speed manual transmission, General Motors does not give an interval for changing the fluid. The only service required is to check the fluid level and add if necessary. The required fluid on this vehicle is manual transmission fluid SAE 5W-30, GM part no. 1052931, or equivalent gear lubricant.

LEVEL CHECK

To check or add fluid to the manual transmission on these vehicles, perform the following:

1. Carefully raise the car and support on jackstands as close to level as possible.
2. Clean the dirt and/or foreign material from around the filler plug, then remove the filler plug.
3. If lubricant begins to trickle out of the hole, there is enough and you need not go any further. Otherwise, carefully insert your finger (watch out for sharp threads) and check to see if the oil is up to the edge of the hole.
4. If not, add the proper type of oil through the hole until the level is up to the edge of the hole.
5. Install and tighten the filler plug to 26 ft. lbs. (35 Nm).

DRAIN & REFILL

1984–88 Vehicles

➧ See Figure 169

To drain the overdrive unit and replace the oil filter, perform the following procedure.

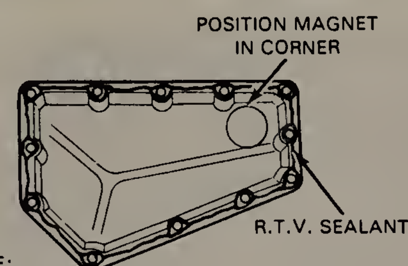
1. Raise and safely support the vehicle.
2. For convertibles, remove the upper and lower underbody braces.
3. Place a suitable drain pan under the overdrive oil pan, then remove the pan attaching bolts from the front and sides of the pan.
4. Loosen the rear pan bolts about 4 turns each.
5. Carefully pry the pan loose, allowing the fluid to drain into the pan.
6. Unfasten the remaining bolts, then remove the fluid pan.
7. Drain any fluid remaining in the pan into the drain pan. Remove and clean the pan magnet. Clean the fluid pan with a suitable solvent, then allow to dry thoroughly .
8. Unfasten any necessary retainers, then remove the filter from the transmission.

To install:

9. Install a new filter and secure with any necessary retainers.

➡The case and pan flange surfaces must be free of oil before applying the RTV sealant.

10. Install the magnet in the oil pan as shown in the accompanying figure. Apply a bead of RTV sealant to the oil pan flange, then place the pan in position while the RTV is stills wet. The bead of RTV should be applied as shown in the accompanying figure.
11. Install the oil pan-to-case bolts and tighten to 6–8 ft. lbs. (8–10 Nm).
12. Fill the overdrive unit with Dexron® III, or equivalent automatic transmission fluid.
13. For convertibles, install the upper and lower underbody braces.
14. Carefully lower the vehicle.



NOTE:
1. INSTALL THE OIL PAN ON HOUSING WHILE R.T.V. SEALANT IS WET.
PAN AND HOUSING FLANGE SURFACE MUST BE DRY AND FREE OF OIL FILM.

91031G50

Fig. 169 Positioning of the magnet, and RTV sealant application locations

1989–96 Vehicles

See Figures 170, 171 and 172

On these vehicles, the fluid in the manual transmission does not require changing. If you do choose to change the transmission fluid, perform the following procedure. The transmission fluid should be drained after a short period of operation when the oil is warm. This allows any existing moisture absorbed by the oil to be expelled when the oil is drained.

1. Raise and safely support the vehicle with safety stands.
2. Clean the dirt and oil from around the fill plug and the oil drain plug.
3. Remove the oil fill plug.
4. Position a suitable drain pan under the oil drain plug and allow the oil to drain into a suitable container.

To install:

5. Install the oil drain plug and tighten to 26 ft. lbs. (35 Nm).
6. Fill the transmission with the proper type and amount of fluid to the level of the fill plug, then install the plug.
7. Carefully lower the vehicle.

Automatic Transmission

FLUID RECOMMENDATIONS

When adding fluid or refilling the transmission, use only Dexron® II or its latest superseding grade of automatic transmission fluid for 1984–91 vehicles. For 1992–96 vehicles, use Dexron® IIE or III automatic transmission fluid.

LEVEL CHECK

See Figures 173, 174 and 175

Check the automatic transmission fluid level at each oil change. Driving with too much or too little transmission fluid can damage the transmission. The fluid level should be checked only when the transmission is at normal operating temperature. If your vehicle has been driven at highway speeds for a long time, in city traffic in hot weather, or pulling a trailer, wait for about 30 minutes for the fluid to cool down so a correct reading can be read.

1. Park the car on a level surface, with the parking brake on. Start the engine and let it idle for about 15 minutes for 1984–90 vehicles or about 5 minutes for 1991–96 vehicles. With the brake firmly applied, move the transmission through all the gears and then back to **P**, pausing for about 3 seconds in each gear.
2. For 1992–96 vehicles, allow the engine to idle for about 3 more minutes.
3. Remove the dipstick and carefully touch the wet end of the dipstick to see if the fluid is cool, warm, or hot. Wipe it clean and then reinsert it firmly for about 3 seconds. Be sure that it has been pushed all the way in. Remove the dipstick again and check the fluid level while holding it horizontally. Read both sides of the dipstick, using the lowest level.
   a. If fluid is cool (room temperature), the level should be about 1/8–3/8 in. (3–10mm) below the ADD/COLD mark.
   b. If fluid is warm, the level should be close to the **ADD** mark, either above or below.
   c. If fluid is too hot to touch, the level should be at the **FULL/HOT** mark.
4. If the fluid level is low, add Dexron® II, IIE or III Automatic Transmission Fluid (ATF), as applicable, through the dipstick tube. This is easily done with the aid of a funnel. Check the level often as you are filling the transmission. Be extremely careful not to overfill it. Overfilling will cause slippage, seal damage and overheating. Approximately 1 pint (0.473L) of ATF will raise the fluid level from one notch/line to the other.

➡Transmission fluid should be red in color when the fluid is new. If the fluid on the dipstick appears discolored (brown or black), or smells burnt, serious transmission troubles (probably due to overheating) should be suspected. The transmission should be inspected by a qualified technician to locate the cause of the burnt fluid.

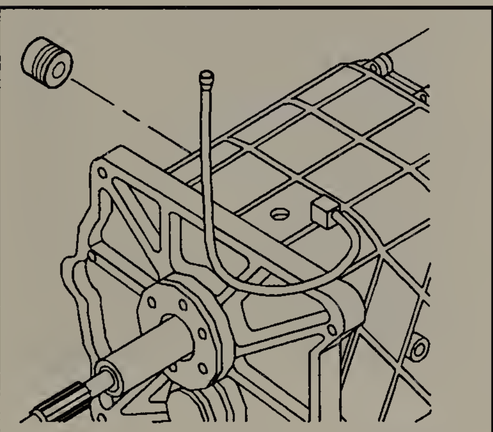


Fig. 170 Clean the remove the oil fill plug

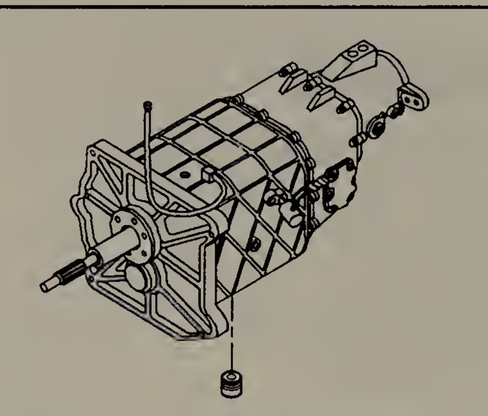


Fig. 171 Location of the manual transmission drain plug

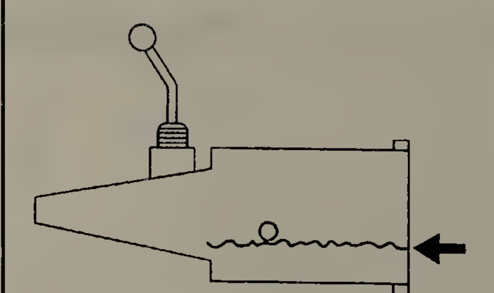


Fig. 172 Fill the transmission case the level of the fill plug

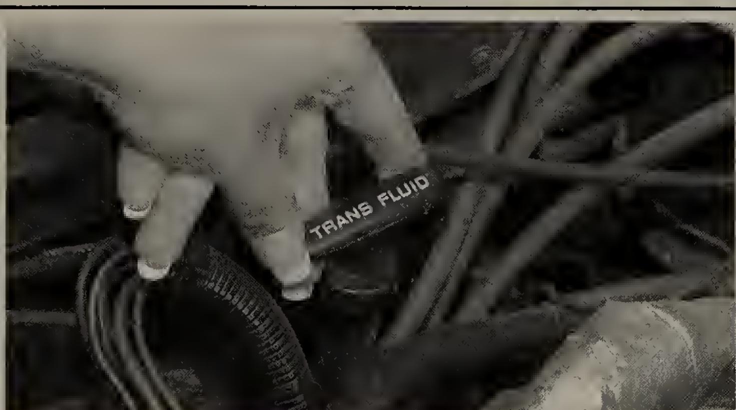


Fig. 173 Pull the automatic transmission fluid dipstick from the tube, located at the rear of the engine

PAN & FILTER SERVICE

See Figures 176 thru 185

The automatic transmission fluid and filter should be changed every 15,000 miles (24,000km) if your vehicle is driven in heavy city traffic in hot weather, in hilly or mountainous terrain, frequent trailer pulling, or uses such as found in taxi, police car or delivery service. If your vehicle is driven under other than listed above conditions, change the fluid and filter every 100,000 miles (160,000 km).

1. Raise and support the car on jackstands.
2. If equipped, remove the upper and lower underbody braces.
3. Place an suitable drain pan under the transmission.

➡When removing the oil pan bolts, be careful not to damage the oil pan sealing surfaces.

4. Remove the oil pan bolts from the sides and front of the pan only.

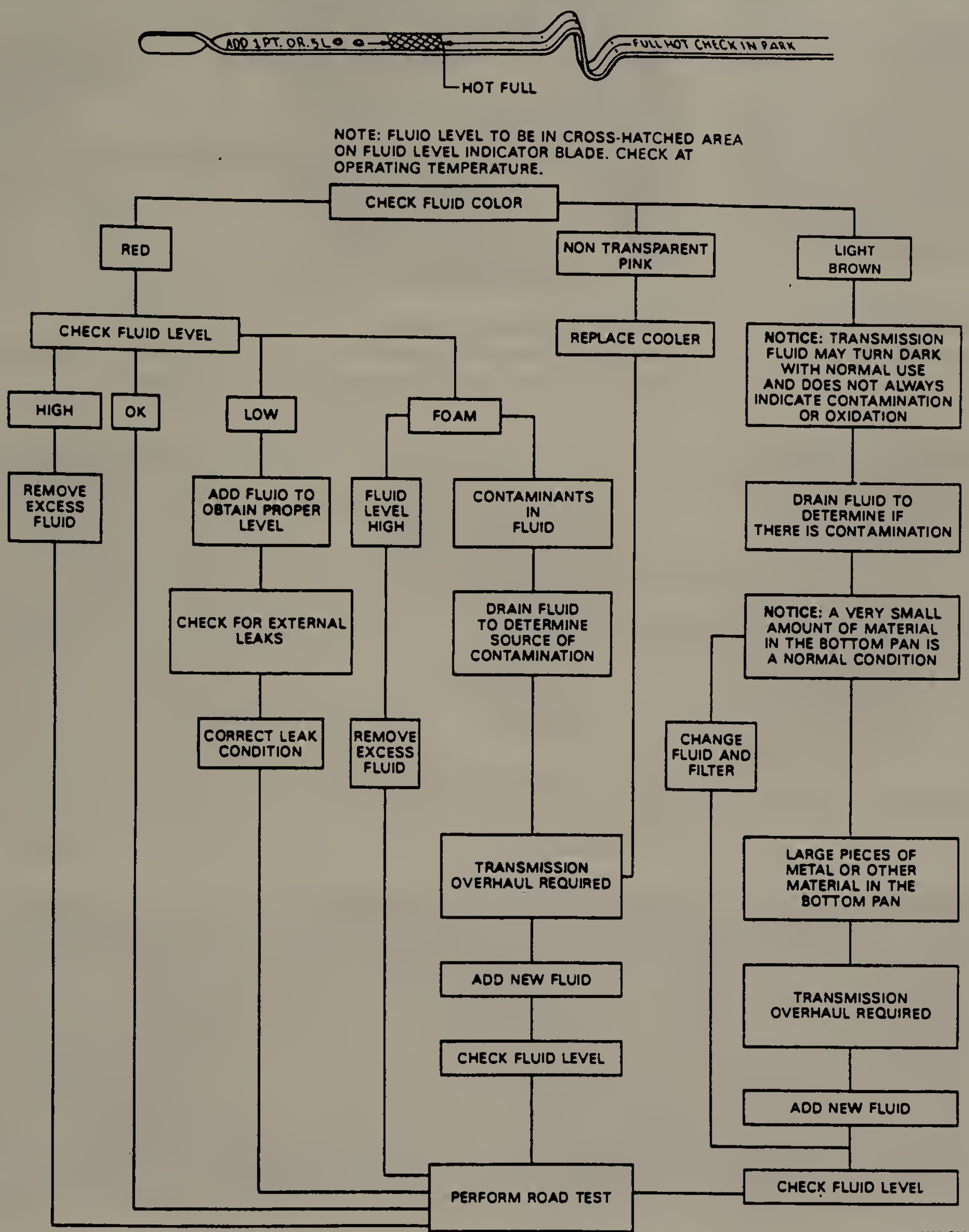


Fig. 174 Automatic transmission fluid color, level and condition check

Fig. 175 Using a funnel, SLOWLY add a small amount of fluid through the dipstick tube, stopping often to check the level

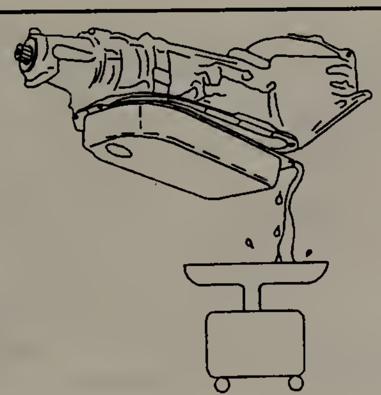


Fig. 176 Place a drain pan of sufficient capacity under the transmission pan

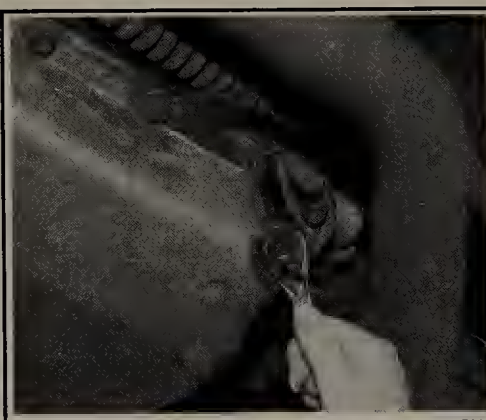


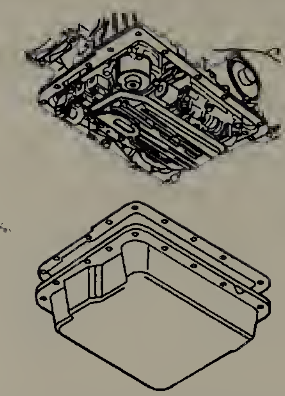
Fig. 177 Loosen and remove the oil pan bolts from the front and sides of the pan

91031P37

Fig. 178 Loosen the rear oil pan bolts about 4 turns, then carefully pry the front of the pan down, and allow the fluid to drain

981031P38

Fig. 179 Remove the remaining bolts, then carefully lower the pan and dump any remaining fluid in a suitable container

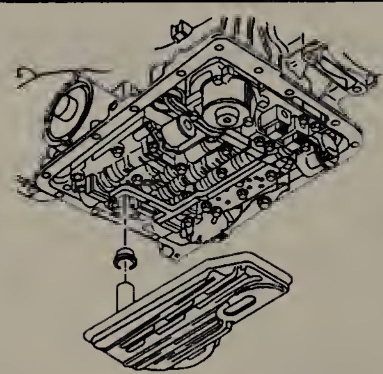


91031G56

Fig. 180 Remove the transmission oil pan and gasket

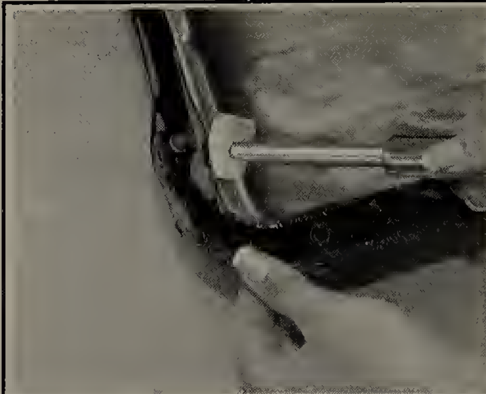
91031P39

Fig. 181 Remove the transmission filter and seal



91031G57

Fig. 182 If the filter seal does not come out of the filter, it is stuck in the transmission case and must be removed

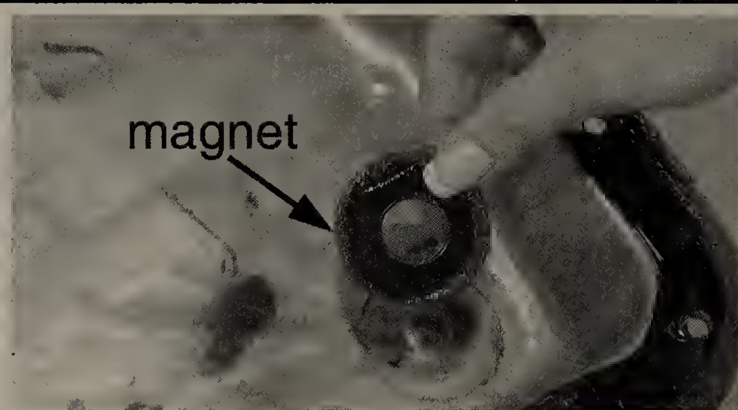


91031P41

Fig. 183 Remove and discard the pan gasket, then use a suitable scraper to carefully clean the mating surfaces

91031P42

Fig. 184 Make sure to thoroughly clean the pan before reinstalling it



91031P40

Fig. 185 Remove the transmission pan magnet, and clean it off before reinstalling it

5. Loosen the rear oil pan bolts about 4 turns each.
6. Lightly tap the oil pan with a rubber mallet or gently pry it downward to allow fluid to drain.

WARNING

Do not damage the transmission case or oil pan sealing surfaces.

7. Remove the remaining oil pan bolts, then remove the oil pan and pan gasket.
8. Remove the filter and seal. The seal may stick in the transmission case.
9. Inspect the fluid color and the filter. Pry the metal crimping away from the top of the filter, then pull it apart. The filter may contain the following evidence that may require further investigation:
   a. Clutch material
   b. Bronze slivers indicating bushing wear
   c. Steel particles
10. Clean the transmission case and oil pan gasket surfaces with suitable solvent and air dry. Make sure to remove all traces of the old gasket. If equipped, remove the magnet and clean it off before reinstalling it.

To install:

11. Coat the seal with a small amount of Transjel®.
12. Install the new seal onto the filter neck.
13. Position the new filter into the case.
14. Install the oil pan and new gasket.

➡Inspect the oil pan screws and washer assemblies. The screws must not be used if the conical washer is reversed. Failure to replace the screw and washer assembly may result in improper fastening of system components.

15. Install the oil pan bolts and tighten them to 15 ft. lbs. (20 Nm) for 1984–88 vehicles or to 97 inch lbs. (11 Nm) for 1989–96 vehicles.
16. Carefully lower the car.

17. Fill the transmission to proper level with Dexron® II, IIE or III fluid.
18. Check cold fluid level reading for initial fill. Do NOT overfill the transmission.
19. Follow the fluid level check procedure described earlier.
20. Check the oil pan gasket for leaks.

Rear Axle

FLUID RECOMMENDATIONS

On limited slip differential rear axle assemblies, use 4 fl. oz. of limited slip differential additive lubricant and SAE 80W-90 GL-5 gear lubricant.

LEVEL CHECK

See Figures 186, 187, 188 and 189

The gear lubricant in the rear axle should be checked every 12 months or 15,000 miles (24,000km).

1. Raise the car and safely support on jackstands as close to level as possible.
2. Remove the filler plug from the right side of the differential carrier housing.
3. If lubricant begins to trickle out of the hole, there is enough and you need not go any further. Otherwise, carefully insert your finger (watch out for sharp threads) and check to see if the lubricant is up to the edge of the hole. The fluid level should be maintained from flush with the bottom of the opening, to no lower than 1/4 in. (6mm) below the opening.
4. If not, add oil through the hole until the level is at the edge of the hole. Most gear lubricants come in a plastic squeeze bottle with a nozzle or a pump-type device, making additions simple.
5. Install the filler plug and tighten to 8–11 ft. lbs. (10–15 Nm) for 1984–88 vehicles, to 30 ft. lbs. (41 Nm) for 1989–95 or to 11 ft. lbs. (15 Nm) for 1996 vehicles.
6. Carefully lower the vehicle.

DRAIN & REFILL

See Figures 187, 190, 191 and 192

The rear axle should have the gear lubricant changed every 7,500 miles (12,000km). Be sure to add 4 oz. (118mL) of GM limited slip additive part No. 1052358.

1. Raise the car and safely support on jackstands. Place a suitable container under the differential to catch the fluid.
2. If necessary, Remove the bolts retaining the parking brake cable guides and position aside.
3. Clean all dirt from the area around the drain plug.
4. Unfasten the drain plug using a13mm socket, then allow the fluid to drain into the drain pan.

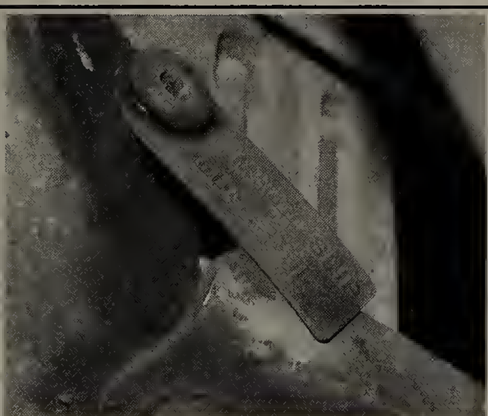
To install:

5. Install the drain plug and tighten securely.
6. Fill the differential with fluid through the fill plug and add limited slip additive, as required.
7. Install the parking brake cable guides, if removed.
8. The fluid level should reached a level within 3/8 in. (10mm) of the filler plug hole. Replace the filler plug.
9. Carefully lower the car and inspect for leaks.

Cooling System

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old (in which case it should be taken to a recycling facility such as a service station).



91031P64

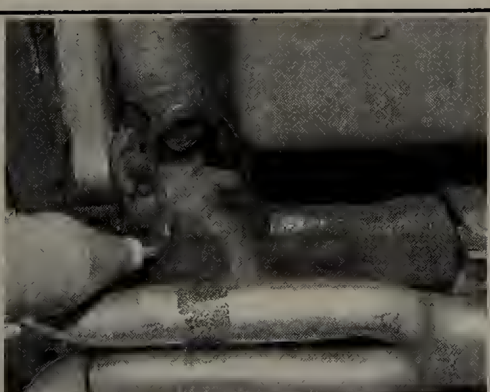
Fig. 186 The rear axle fill plug has tag on it listing the type of fluid required

91031P65

Fig. 187 Use a ratchet with a hex socket to loosen the filler plug

91031P66

Fig. 188 Finish unscrewing the plug by hand, then remove it

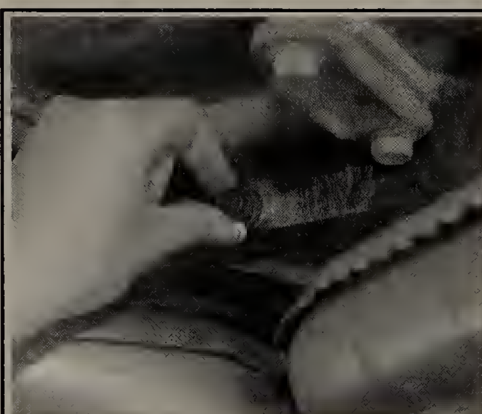


91031P67

Fig. 189 If necessary, add fluid through the fill plug, using a plastic squeeze bottle with a tube attached to it

91031P68

Fig. 190 Use ratchet and extension combination with a 13mm socket to loosen the rear axle drain plug



91031P69

Fig. 191 After the drain plug has been loosened, you can unthread it by hand

91031P70

Fig. 192 Withdraw the drain plug, and allow the fluid to drain

FLUID RECOMMENDATIONS

When adding or changing the fluid in the system, create a 50/50 mixture of high quality ethylene glycol antifreeze and water for 1984–95 vehicles. For 1996 vehicles, use a 50/50 mixture of ethylene based DEX-COOL® and water.

LEVEL CHECK

See Figures 193 thru 198

The fluid level may be checked by observing the fluid level marks of the coolant recovery reservoir or by unscrewing and reading the recovery reservoir dipstick. The level should be between the **HOT** and **COLD** mark when the system is at normal operating temperature. When the engine is cold, the fluid level should be above the **HOT** mark on the reservoir or dipstick, as applicable. Only add coolant to bring the level to the full **HOT** mark.

CAUTION

Should it be necessary to remove the radiator cap or radiator surge tank cap, make sure that the system has had time to cool, reducing the internal pressure. If the system is opened while the engine is still hot, scalding fluid and steam may be blown out under pressure.

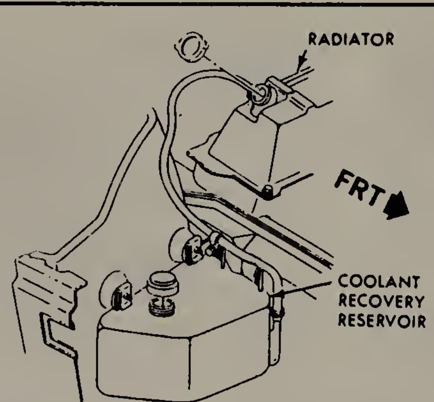
COOLING SYSTEM INSPECTION

Checking the Radiator Cap Seal

See Figure 199

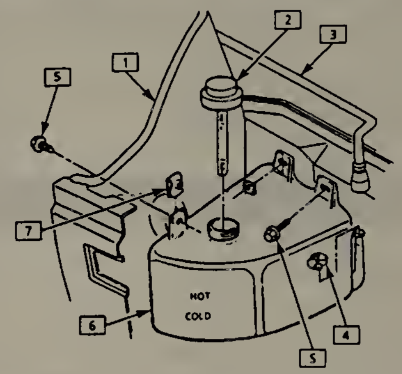
While you are checking the coolant level, check the radiator cap for a worn or cracked gasket. If the cap doesn't seal properly, fluid will be lost and the engine will overheat.

Worn caps should be replaced with a new one.



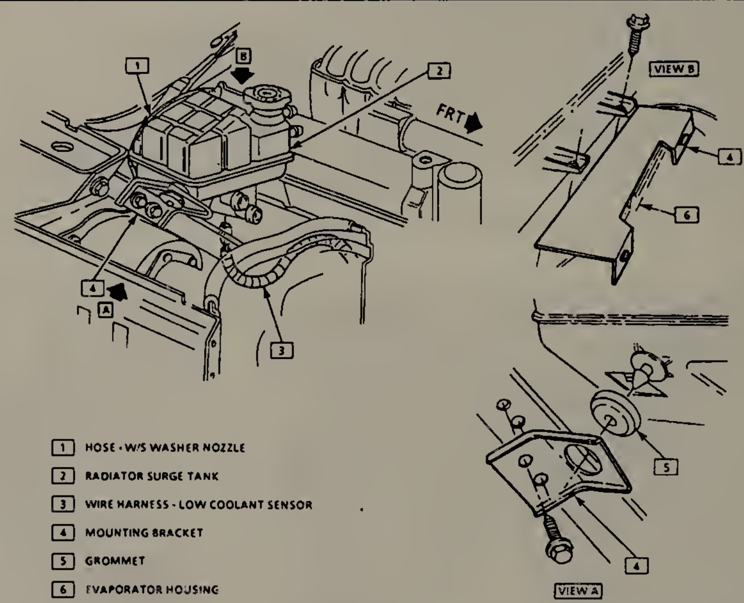
91031G58

Fig. 193 Relation of the coolant recovery reservoir and radiator—1984–88 vehicles



91031G59

Fig. 194 Most vehicles have a dipstick that is screwed into the top of the coolant recovery reservoir



91031G60

Fig. 195 Some later model vehicles have a radiator surge tank in place of a radiator cap

Checking the Radiator for Debris

See Figure 200

Periodically clean any debris; leaves, paper, insects, etc. from the radiator fins. Pick the large pieces off by hand. The smaller pieces can be washed away with water pressure from a hose.

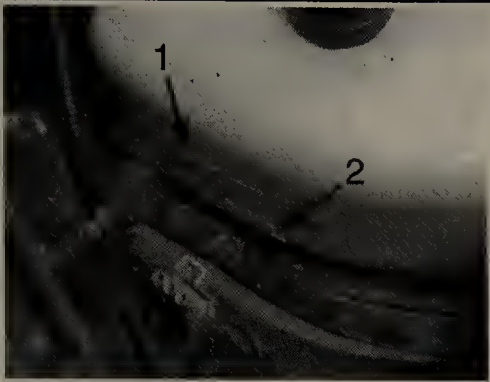
Carefully straighten any bent radiator fins with a pair of needle nose pliers. Be careful, the fins are very soft. Don't wiggle the fins back and forth too much. Straighten them once and try not move them again.

DRAIN & REFILL

See Figures 201 thru 206

CAUTION

Do not remove a radiator cap or radiator surge tank cap, as applicable, while the engine and radiator are still hot. Danger of burns by scalding fluid and steam under pressure may result!



91031P27

Fig. 196 The coolant recovery reservoir has HOT (1) and COLD (2) marks stamped into the side of it


91031P28

Fig. 197 If equipped, unscrew the reservoir cap/dipstick in order to get a fluid level reading

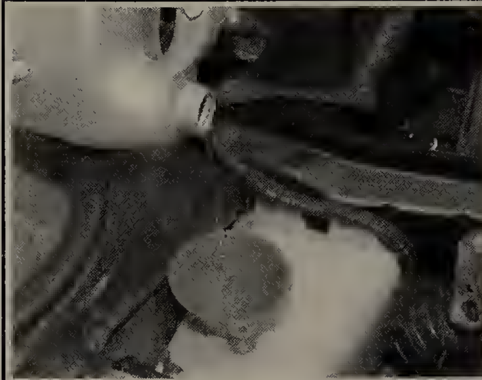
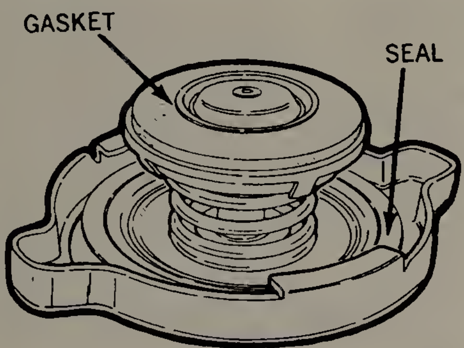

91031P29

Fig. 198 If the fluid level is low, add coolant to the recovery reservoir until it reaches the proper level



TCCS1079

Fig. 199 Be sure the rubber gasket on the radiator cap has a tight seal

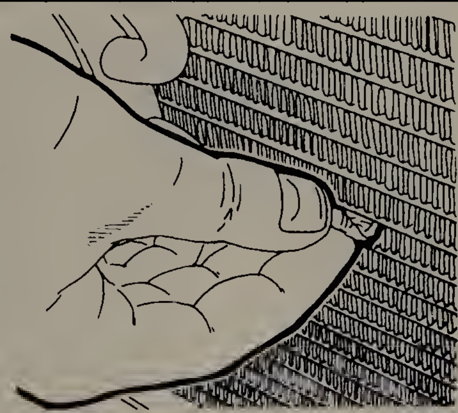

TCCS1081

Fig. 200 Periodically remove all debris from the radiator fins

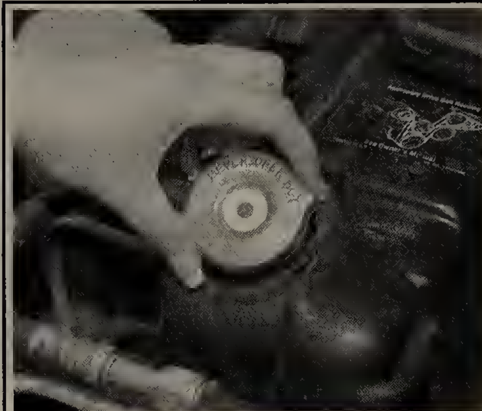

91031P24

Fig. 201 NEVER take the radiator cap off when the engine is hot!

1. Park the vehicle on a level surface, and allow the engine to thoroughly cool.
2. With a cool engine, slowly rotate the radiator cap or radiator surge tank cap, as applicable, counterclockwise to the detent without pressing down on the cap.
3. Wait until any remaining pressure is relieved by listening for a hissing sound.
4. After all the pressure is relieved, press down on the cap and continue to rotate the cap counterclockwise.
5. With a suitable container to catch the fluid under the radiator, open the radiator draincock.
6. If equipped, position a drain pan, then remove all engine block plugs, as applicable.

➡On VIN P, J and 5 engines, a large amount of coolant will be left in the system after the radiator draincock has been opened and the coolant drained. A lot of coolant will come pouring out when the knock sensors is removed or thermostat housing separated, as applicable. Avoid contacting the coolant, as much as possible.

7. For 1992–96 5.7L (VIN P and 5) engines, perform the following:
   a. If equipped, open the air bleed valves on the thermostat housing and the throttle body unit.
   b. Position a suitable drain pan under the knock sensors.
   c. Remove the engine knock sensors from the lower right and left hand side of the engine block.
   d. If equipped, remove the engine block coolant drain hole plug.
8. For 1990–95 5.7L (VIN J) engines, perform the following:
   a. Place a suitable drain pan under the thermostat housing.
   b. Remove the thermostat from the thermostat housing, being careful not to scratch housing mating surfaces or damage the seal on the thermostat during removal.
9. Allow the system to drain completely.
10. Close the radiator draincock and install the engine block drain plug, knock sensors and/or thermostat and housing, as applicable.


91031P25

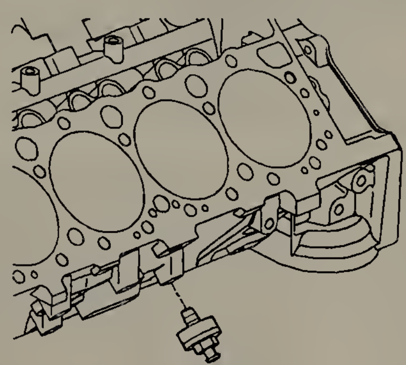
Fig. 202 When you remove the radiator cap, check the gaskets and make sure they are OK


91031P55

Fig. 203 You must turn the radiator draincock counterclockwise to open it

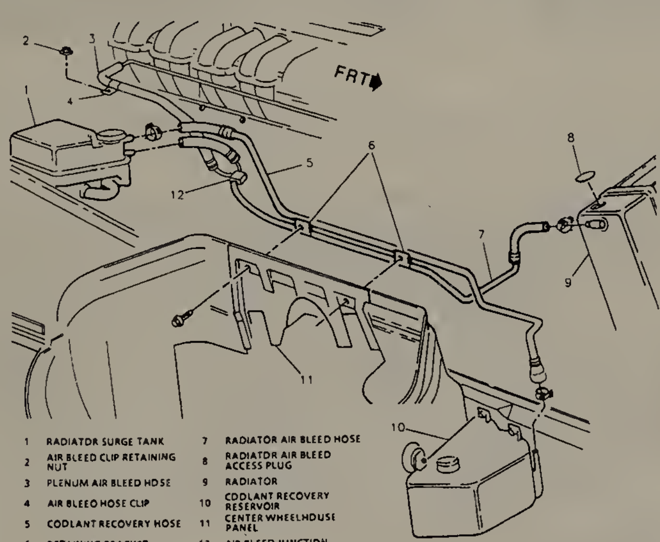
➡Use a 50/50 mixture of water and Ethylene Glycol antifreeze (1984–95 vehicles) or DEX-COOL® (1996 vehicles). Freezing protection should be appropriate for temperatures of -34°F (-37°C).

11. Fill the cooling system through the radiator/surge tank neck. If equipped, close the air bleed vent when bubbles disappear and only engine coolant is visible.
12. Fill the reservoir assembly to the "COLD" mark. Install the coolant reservoir cap/dipstick.
13. Firmly set the parking brake. Run the engine with the radiator cap off, until normal operating temperature is reached.



91031G62

Fig. 204 On some vehicles, it is necessary to remove the knock sensors to fully drain the cooling system



91031G63

Fig. 205 Exploded view of the radiator surge tank, air bleed and overflow hoses—1995 vehicle shown, others similar

91031P26

Fig. 206 Add coolant to the radiator until the level reaches the bottom of the fill neck

⁂ CAUTION

Under some conditions, ethylene glycol is flammable. To avoid being burned when adding engine coolant, do not spill it on the exhaust system or on hot engine parts.

14. With the engine idling, add engine coolant to the radiator until the level reaches the bottom of the radiator fill neck.

➡On 1988–90 5.7L (VIN 8) engines, when filling the engine coolant system, add 6 engine coolant supplement sealant pellets (GM part no. 3634621 or equivalent) to the system. On 1992–96 5.7L (VIN P) engines, add 6 engine coolant sealant pellets when filling the engine coolant system.

15. Install the radiator cap or surge tank cap, as applicable. After running the engine until normal operating temperature is reached, inspect the system for leaks.

➡The "LOW COOLANT" warning indicator lamp may come on after this procedure. After operating the vehicle so that the engine heats up and cools down three times, this indicator should go out. If the "LOW COOLANT" warning indicator lamp does not go out, or fails to come on at ignition check and the coolant is above "COLD" mark in reservoir, electrical diagnosis performed by a certified technician is required. If at any time the "TEMP" warning indicator lamp comes on, immediate action is required. Turn off the engine and allow the vehicle to cool down. Do not remove the coolant recovery reservoir cap at this time.

FLUSHING & CLEANING THE SYSTEM

The cooling system should be drained, thoroughly flushed and refilled at least every 30,000 miles or 24 months. This operation should be done with the engine cold.

1. Drain the cooling system as described earlier in this section.

⁂ WARNING

Do NOT use a chemical flush in these engines!

2. Fill the cooling system with warm water and start the engine. Run the engine until normal operating temperature is reached.
3. At this point, turn the engine off and again drain the cooling system.
4. Repeat this procedure until the fluid draining from the system is nearly colorless.
5. Remove, empty and reinstall the coolant recovery reservoir assembly.
6. Fill the cooling system with a 50/50 mixture of ethylene glycol antifreeze, as outlined in the previous procedure.

Brake Master Cylinder

FLUID RECOMMENDATIONS

When adding or replacing the brake fluid, always use a top quality fluid, such as Delco Supreme II or equivalent DOT-3 fluid. DO NOT allow the master cylinder reservoir to remain open for long periods of time; brake fluid absorbs moisture from the air, reducing its effectiveness and causing corrosion in the lines.

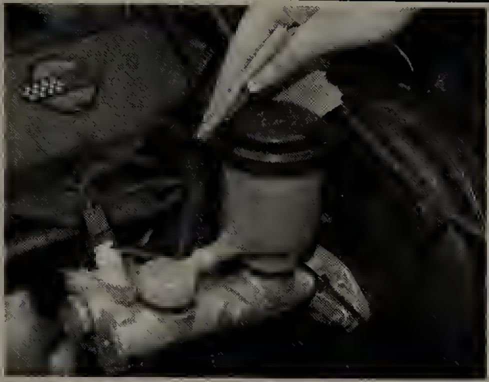
➡Avoid spilling brake fluid on any of the vehicle's painted surfaces, wiring cables or electrical connections. Brake fluid will damage paint and electrical connections. If any fluid is spilled on the vehicle, flush with water to lessen damage.

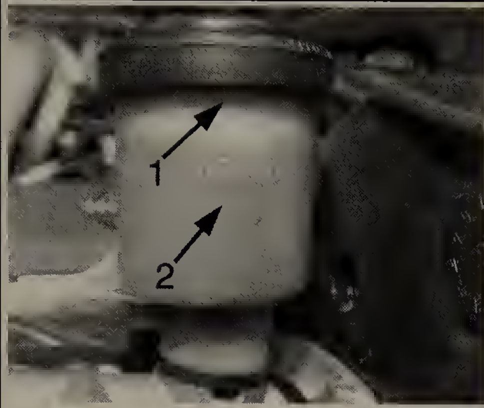
LEVEL CHECK

▶ See Figures 207 thru 212

The master cylinder is located in the left rear section of the engine compartment. The brake master cylinder consists of an aluminum body and a translucent nylon reservoir with minimum fill indicators.

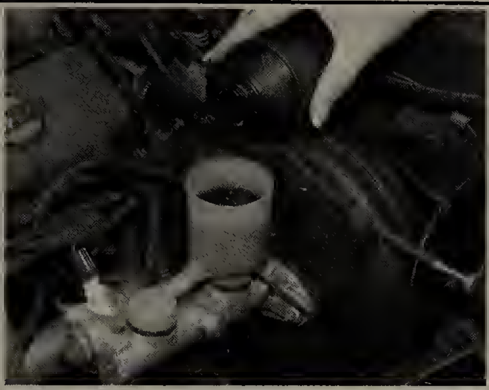
1. Check the master cylinder body for cracks. Inspect the area around the master cylinder for brake fluid. Leaks are indicated if there is at least a drop of fluid. A damp condition is not normal.

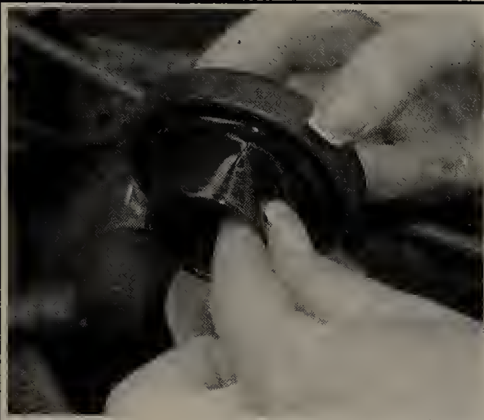

91031P01
Fig. 207 Clean all of the dirt from the master cylinder cap, to avoid contaminating the system when you remove the cap



91031P02
Fig. 208 The master cylinder reservoir has MAX (1) and MIN (2) fill lines


91031P03
Fig. 209 Remove the master cylinder reservoir cap by pulling it off the top of the reservoir. Note the cap diaphragm


91031P04
Fig. 210 Add fluid, from a fresh, sealed container, until it reaches the MAX mark on the reservoir


91031P57
Fig. 211 If the cap diaphragm is extended due to low fluid levels . . .


91031P58
Fig. 212 . . . make sure to push it back into place before reinstalling it

2. Inspect the level of the brake fluid to assure it is at the correct height. Clean the top of the reservoir cap so that all dirt is removed. Remove the cap(s) or reservoir cover and the reservoir diaphragm.
3. Inspect the brake fluid level. Add clean DOT-3 brake fluid as required to bring the fluid level to the line located inside the neck of the reservoir fill opening.
4. Install the reservoir cap.

WARNING

Any sudden decrease in the fluid level indicates a possible leak in the system and should be checked out immediately. Do not allow brake fluid to spill on the vehicle's finish; it will remove the paint. In case of a spill, flush the area with water and mild soap.

Clutch Master Cylinder

FLUID RECOMMENDATIONS

WARNING

Do not use silicon, mineral or paraffin based oil in the clutch hydraulic system. These oil based fluids will damage the clutch system seals and rubber parts in the cylinders.

When adding fluid to the hydraulic clutch system, use only hydraulic clutch fluid, GM part number 12345347, or equivalent.

LEVEL CHECK

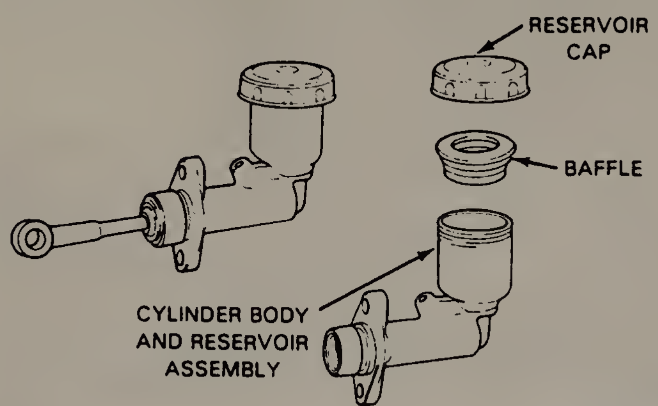
See Figures 213 and 214

The clutch master cylinder is normally located below the brake master cylinder. The reservoir for it is located right beside the brake master cylinder and is made of translucent nylon. The fluid level of the reservoir should be kept near the top of the observation window. Before removing the cap to the reservoir, clean all dirt from the area. This will prevent system contamination due to particles falling into the reservoir when the caps are removed.

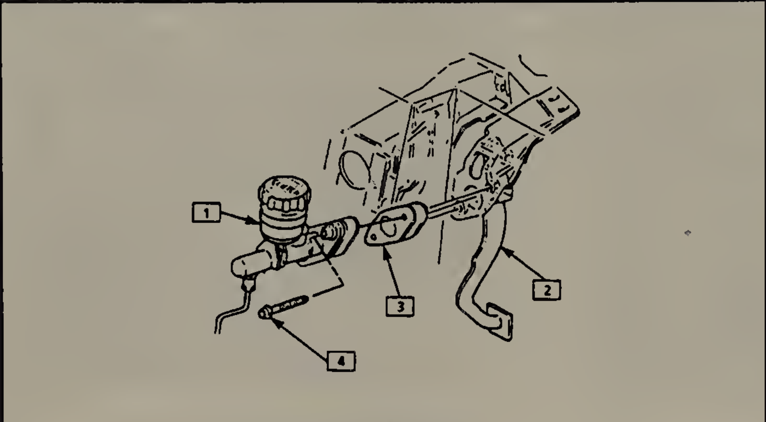
Power Steering Pump

FLUID RECOMMENDATIONS

On 1984–91 vehicles, use GM power steering fluid, part nos. 1050017 or 1052884, or equivalent, meeting requirements 9985010. For 1992–96 vehicles, use GM power steering fluid, part no. 12345867 or 12345866, or equivalent.



91031G66
Fig. 213 Some clutch master cylinder reservoirs have a baffle under the reservoir cap to help keep contaminants out



91031G67

Fig. 214 The clutch master cylinder and reservoir are mounted next to the brake master cylinder

LEVEL CHECK

➧ **See Figures 215, 216, 217 and 218**

The power steering pump used on these models has a remote reservoir assembly. The fluid reservoir cap has a fluid level indicator attached, which shows the fluid level.

Power steering fluid level should be checked at least twice a year. To prevent possible overfilling, check the fluid level only when the fluid has warmed to operating temperatures and the wheels are turned straight ahead. If the level is low, fill the pump reservoir until the fluid level measures between the COLD and HOT marks on the reservoir dipstick. Low fluid level usually produces a moaning sound as the wheels are turned (especially when standing still or parking) and increases steering wheel effort.

Steering Gear

FLUID RECOMMENDATIONS

The power rack and pinion assembly used on these vehicles is a sealed unit, no level checks or fluid additions are ever necessary.

Chassis Greasing

➧ **See Figures 219 thru 226**

Chassis lubrication can be performed with a pressurized grease gun or by using a hand-operated grease gun. Wipe the grease fittings clean before greasing in order to prevent the possibility of forcing any dirt into the component.

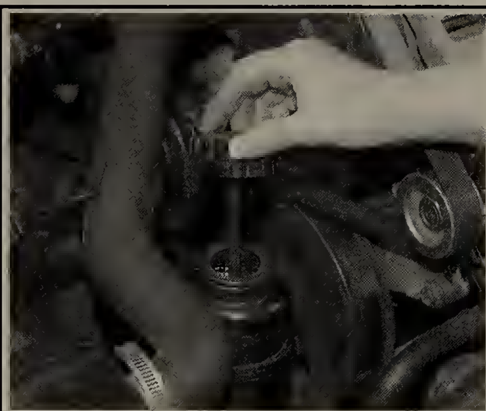
Body Lubrication

HOOD LATCH & HINGES

Clean the latch surfaces and apply clean engine oil to the latch pilot bolts and the spring anchor. Use the engine oil to lubricate the hood hinges as well. Use a chassis grease to lubricate all the pivot points in the latch release mechanism.

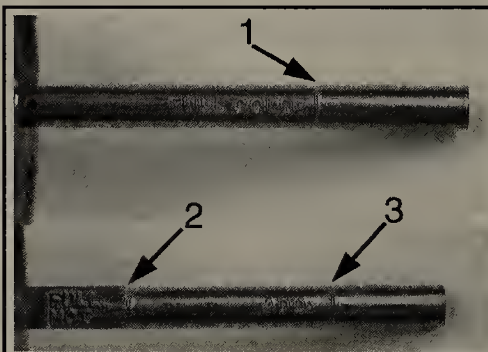
91031P08

Fig. 215 The power steering fluid reservoir is marked with FULL HOT (1) and FULL COLD (2) lines



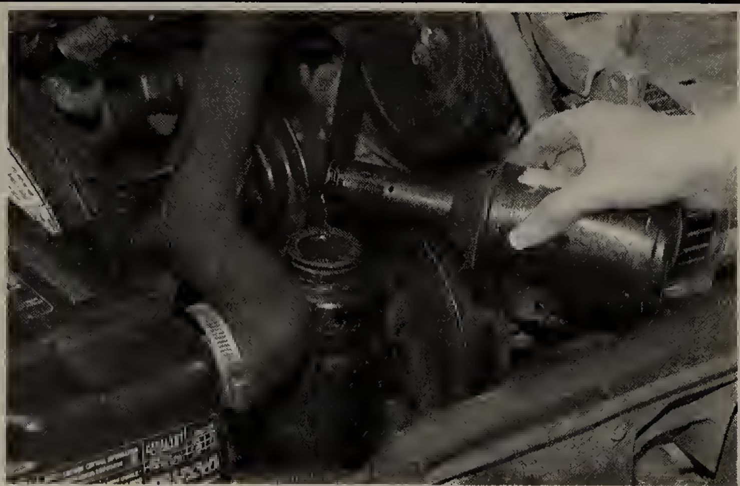
91031P09

Fig. 216 Unscrew the power steering reservoir cap/dipstick



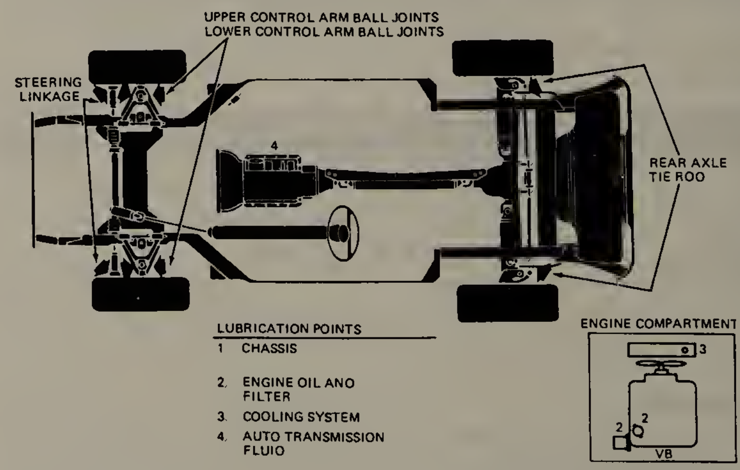
91031P30

Fig. 217 The dipstick is marked on both sides. On one side it has markings for FULL COLD (1), and the other side has markings for FULL HOT (2) and ADD (3)



91031P10

Fig. 218 Add the proper type of power steering fluid, until the level reaches the proper mark



91031G71

Fig. 219 Maintenance locations and chassis lubrication points—1984–89 5.7L (VIN 8) engine

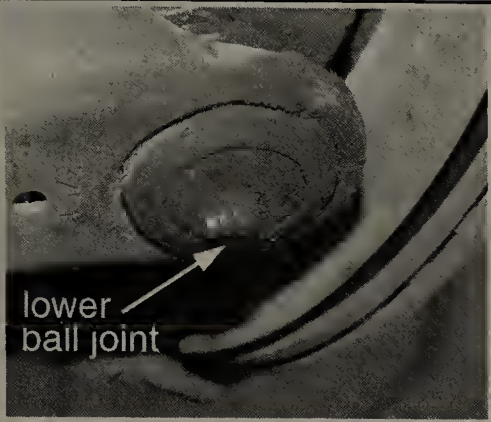


Fig. 220 Lower ball joint grease fitting location

Fig. 221 Steering linkage (outer tie rod end) grease fitting location

Fig. 222 Rear axle tie rod end grease fitting location

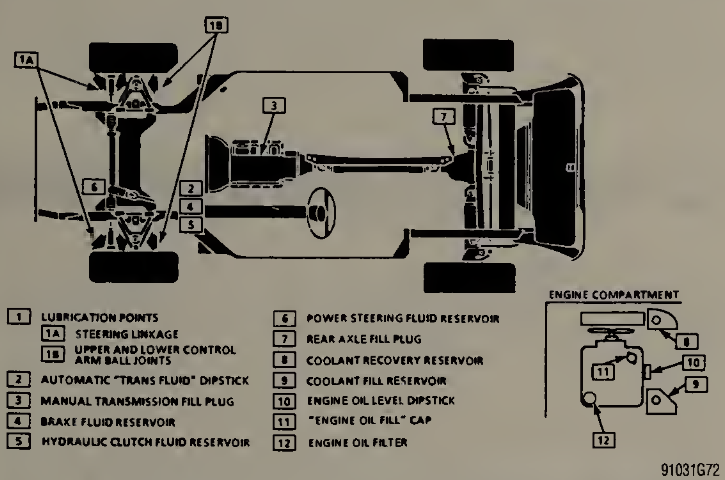


Fig. 223 Maintenance and chassis lubrication points—1990–91 5.7L (VIN 8) engine

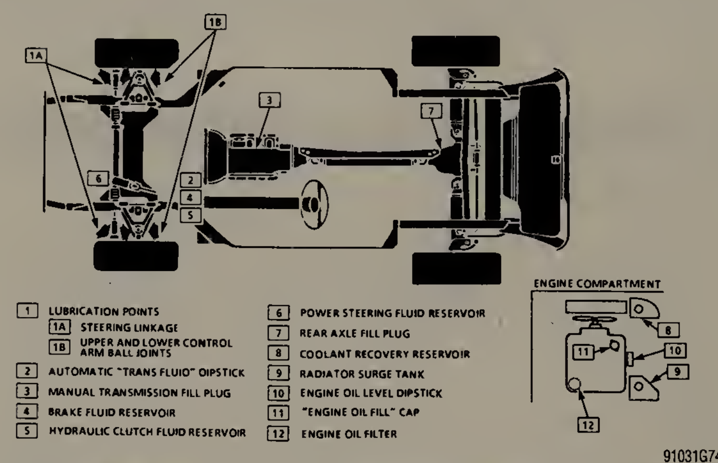


Fig. 225 Maintenance and lubrication fitting locations—5.7L (VIN P) engine

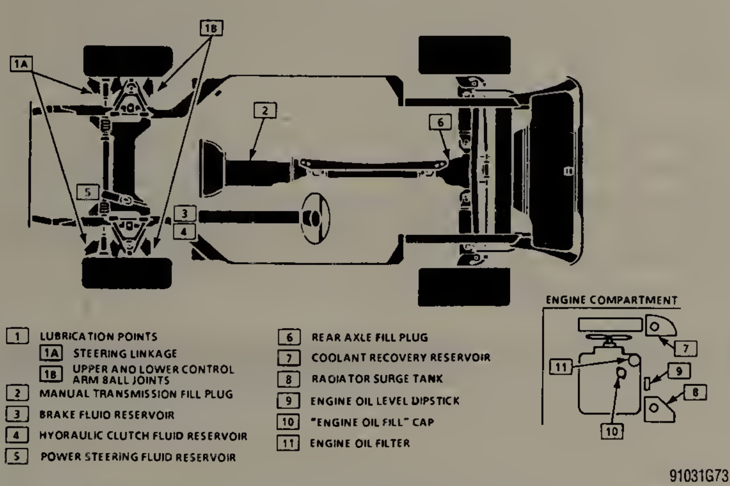


Fig. 224 Maintenance and lubrication fitting locations—5.7L (VIN J) engine

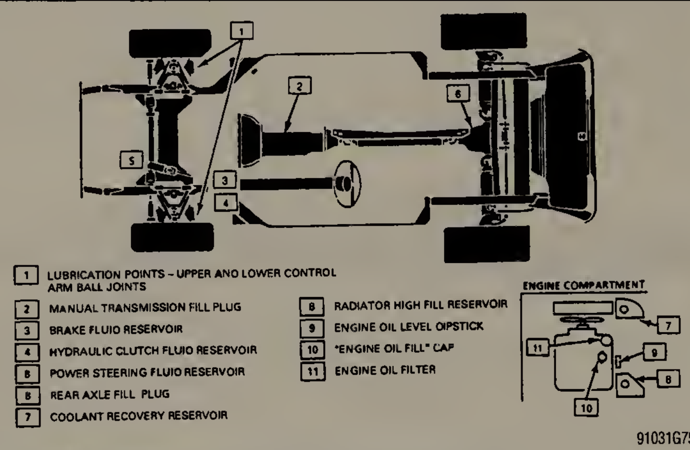


Fig. 226 Maintenance and lubrication fitting locations—5.7L (VIN 5) engine

DOOR HINGES

The gas tank filler door, car door, and rear hatch or trunk lid hinges should be wiped clean and lubricated with clean engine oil. Silicone spray also works well on seals, but must be applied more often. Use engine oil to lubricate the trunk or hatch lock mechanism and the lock bolt and striker. The door lock cylinders can be lubricated easily with a shot of silicone spray or one of the many dry penetrating lubricants commercially available.

PARKING BRAKE LINKAGE

Use chassis grease on the parking brake cable where it contacts the guides, links, levers, and pulleys. The grease should be water resistant for durability.

ACCELERATOR LINKAGE

Lubricate the throttle lever, and the accelerator pedal lever at the support inside the car with clean engine oil.

TRANSMISSION SHIFT LINKAGE

Lubricate the shift linkage with water resistant chassis grease which meets GM Specification 6031M or its equal.

Wheel Bearings

The front wheel bearing assembly used on these vehicles is a sealed, non-serviceable unit. No wheel bearing adjustments are necessary or possible. For bearing removal and installation procedures, please refer to Section 8 of this manual.

TRAILER TOWING

General Recommendations

Your vehicle was primarily designed to carry passengers and cargo. It is important to remember that towing a trailer will place additional loads on your vehicles engine, drivetrain, steering, braking and other systems. However, if you decide to tow a trailer, using the prior equipment is a must.

Local laws may require specific equipment such as trailer brakes or fender mounted mirrors. Check your local laws.

Trailer Weight

The weight of the trailer is the most important factor. A good weight-to-horsepower ratio is about 35:1, 35 lbs. of Gross Combined Weight (GCW) for every horsepower your engine develops. Multiply the engine's rated horsepower by 35 and subtract the weight of the vehicle passengers and luggage. The number remaining is the approximate ideal maximum weight you should tow, although a numerically higher axle ratio can help compensate for heavier weight.

Hitch (Tongue) Weight

See Figure 227

Calculate the hitch weight in order to select a proper hitch. The weight of the hitch is usually 9–11% of the trailer gross weight and should be measured with the trailer loaded. Hitches fall into various categories: those that mount on the frame and rear bumper, the bolt-on type, or the weld-on distribution type used for larger trailers. Axle mounted or clamp-on bumper hitches should never be used.

Check the gross weight rating of your trailer. Tongue weight is usually figured as 10% of gross trailer weight. Therefore, a trailer with a maximum gross weight of 2000 lbs. will have a maximum tongue weight of 200 lbs. Class I trailers fall into this category. Class II trailers are those with a gross weight rating of 2000–3000 lbs., while Class III trailers fall into the 3500–6000 lbs. category. Class IV trailers are those over 6000 lbs. and are for use with fifth wheel trucks, only.

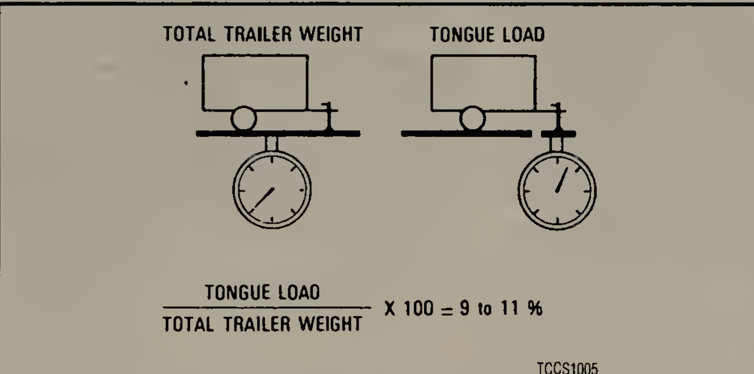


Fig. 227 Calculating proper tongue weight for your trailer

When you've determined the hitch that you'll need, follow the manufacturer's installation instructions, exactly, especially when it comes to fastener torques. The hitch will subjected to a lot of stress and good hitches come with hardened bolts. Never substitute an inferior bolt for a hardened bolt.

Engine

One of the most common, if not THE most common, problems associated with trailer towing is engine overheating. If you have a cooling system without an expansion tank, you'll definitely need to get an aftermarket expansion tank kit, preferably one with at least a 2 quart capacity. These kits are easily installed on the radiator's overflow hose, and come with a pressure cap designed for expansion tanks.

Aftermarket engine oil coolers are helpful for prolonging engine oil life and reducing overall engine temperatures. Both of these factors increase engine life. While not absolutely necessary in towing Class I and some Class II trailers, they are recommended for heavier Class II and all Class III towing. Engine oil cooler systems usually consist of an adapter, screwed on in place of the oil filter, a remote filter mounting and a multi-tube, finned heat exchanger, which is mounted in front of the radiator or air conditioning condenser.

Transmission

An automatic transmission is usually recommended for trailer towing. Modern automatics have proven reliable and, of course, easy to operate, in trailer towing. The increased load of a trailer, however, causes an increase in the temperature of the automatic transmission fluid. Heat is the worst enemy of an automatic transmission. As the temperature of the fluid increases, the life of the fluid decreases.

It is essential, therefore, that you install an automatic transmission cooler. The cooler, which consists of a multi-tube, finned heat exchanger, is usually installed in front of the radiator or air conditioning compressor, and hooked inline with the transmission cooler tank inlet line. Follow the cooler manufacturer's installation instructions.

Select a cooler of at least adequate capacity, based upon the combined gross weights of the vehicle and trailer.

Cooler manufacturers recommend that you use an aftermarket cooler in addition to, and not instead of, the present cooling tank in your radiator. If you do want to use it in place of the radiator cooling tank, get a cooler at least two sizes larger than normally necessary.

➡A transmission cooler can, sometimes, cause slow or harsh shifting in the transmission during cold weather, until the fluid has a chance to come up to normal operating temperature. Some coolers can be purchased with or retrofitted with a temperature bypass valve which will allow fluid flow through the cooler only when the fluid has reached above a certain operating temperature.

Handling A Trailer

Towing a trailer with ease and safety requires a certain amount of experience. It's a good idea to learn the feel of a trailer by practicing turning, stopping and backing in an open area such as an empty parking lot.

JUMP STARTING A DEAD BATTERY

See Figure 228

Whenever a vehicle is jump started, precautions must be followed in order to prevent the possibility of personal injury. Remember that batteries contain a small amount of explosive hydrogen gas which is a by-product of battery charging. Sparks should always be avoided when working around batteries, especially when attaching jumper cables. To minimize the possibility of accidental sparks, follow the procedure carefully.

CAUTION

NEVER hook the batteries up in a series circuit or the entire electrical system will go up in smoke, including the starter!

Vehicles equipped with a diesel engine may utilize two 12 volt batteries. If so, the batteries are connected in a parallel circuit (positive terminal to positive terminal, negative terminal to negative terminal). Hooking the batteries up in parallel circuit increases battery cranking power without increasing total battery voltage output. Output remains at 12 volts. On the other hand, hooking two 12 volt batteries up in a series circuit (positive terminal to negative terminal, positive terminal to negative terminal) increases total battery output to 24 volts (12 volts plus 12 volts).

Jump Starting Precautions

- Be sure that both batteries are of the same voltage. Vehicles covered by this manual and most vehicles on the road today utilize a 12 volt charging system.

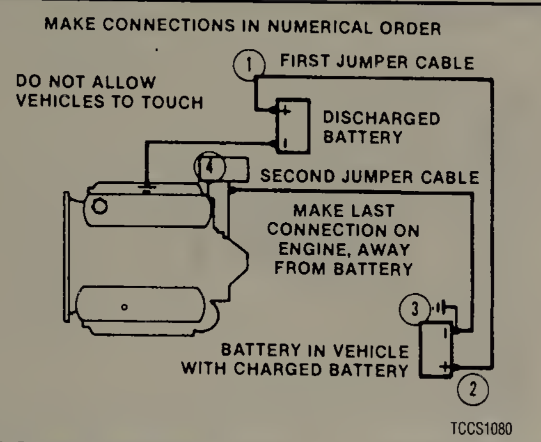


Fig. 228 Connect the jumper cables to the batteries and engine in the order shown

- Be sure that both batteries are of the same polarity (have the same terminal, in most cases NEGATIVE grounded).
- Be sure that the vehicles are not touching or a short could occur.
- On serviceable batteries, be sure the vent cap holes are not obstructed.
- Do not smoke or allow sparks anywhere near the batteries.
- In cold weather, make sure the battery electrolyte is not frozen. This can occur more readily in a battery that has been in a state of discharge.
- Do not allow electrolyte to contact your skin or clothing.

Jump Starting Procedure

1. Make sure that the voltages of the 2 batteries are the same. Most batteries and charging systems are of the 12 volt variety.
2. Pull the jumping vehicle (with the good battery) into a position so the jumper cables can reach the dead battery and that vehicle's engine. Make sure that the vehicles do NOT touch.
3. Place the transmissions/transaxles of both vehicles in **Neutral** (MT) or **P** (AT), as applicable, then firmly set their parking brakes.

➡If necessary for safety reasons, the hazard lights on both vehicles may be operated throughout the entire procedure without significantly increasing the difficulty of jumping the dead battery.

4. Turn all lights and accessories OFF on both vehicles. Make sure the ignition switches on both vehicles are turned to the **OFF** position.
5. Cover the battery cell caps with a rag, but do not cover the terminals.
6. Make sure the terminals on both batteries are clean and free of corrosion or proper electrical connection will be impeded. If necessary, clean the battery terminals before proceeding.
7. Identify the positive (+) and negative (–) terminals on both batteries.
8. Connect the first jumper cable to the positive (+) terminal of the dead battery, then connect the other end of that cable to the positive (+) terminal of the booster (good) battery.
9. Connect one end of the other jumper cable to the negative (–) terminal on the booster battery and the final cable clamp to an engine bolt head, alternator bracket or other solid, metallic point on the engine with the dead battery. Try to pick a ground on the engine that is positioned away from the battery in order to minimize the possibility of the 2 clamps touching should one loosen during the procedure. DO NOT connect this clamp to the negative (–) terminal of the bad battery.

⁂ CAUTION

Be very careful to keep the jumper cables away from moving parts (cooling fan, belts, etc.) on both engines.

10. Check to make sure that the cables are routed away from any moving parts, then start the donor vehicle's engine. Run the engine at moderate speed for several minutes to allow the dead battery a chance to receive some initial charge.
11. With the donor vehicle's engine still running slightly above idle, try to start the vehicle with the dead battery. Crank the engine for no more than 10 seconds at a time and let the starter cool for at least 20 seconds between tries. If the vehicle does not start in 3 tries, it is likely that something else is also wrong or that the battery needs additional time to charge.
12. Once the vehicle is started, allow it to run at idle for a few seconds to make sure that it is operating properly.
13. Turn ON the headlights, heater blower and, if equipped, the rear defroster of both vehicles in order to reduce the severity of voltage spikes and subsequent risk of damage to the vehicles' electrical systems when the cables are disconnected. This step is especially important to any vehicle equipped with computer control modules.
14. Carefully disconnect the cables in the reverse order of connection. Start with the negative cable that is attached to the engine ground, then the negative cable on the donor battery. Disconnect the positive cable from the donor battery and finally, disconnect the positive cable from the formerly dead battery. Be careful when disconnecting the cables from the positive terminals not to allow the alligator clips to touch any metal on either vehicle or a short and sparks will occur.

JACKING

➧ See Figure 229

Your vehicle was supplied with a jack for emergency road repairs. This jack is fine for changing a flat tire or other short term procedures not requiring you to go beneath the vehicle. If it is used in an emergency situation, carefully follow the instructions provided either with the jack or in your owner's manual. Do not attempt to use the jack on any portions of the vehicle other than specified by the vehicle manufacturer. Always block the diagonally opposite wheel when using a jack.

A more convenient way of jacking is the use of a garage or floor jack. You may use the floor jack to lift the front of the vehicle by positioning the jack in the center of the front crossmember. When raising the rear of the vehicle, position the jack on the rear axle housing.

Never place the jack under the radiator, engine or transmission components. Severe and expensive damage will result when the jack is raised. Additionally, never jack under the floorpan or bodywork; the metal will deform.

Whenever you plan to work under the vehicle, you must support it on jackstands or ramps. Never use cinder blocks or stacks of wood to support the vehicle, even if you're only going to be under it for a few minutes. Never crawl under the vehicle when it is supported only by the tire-changing jack or other floor jack.

➡Always position a block of wood or small rubber pad on top of the jack or jackstand to protect the lifting point's finish when lifting or supporting the vehicle.

Small hydraulic, screw, or scissors jacks are satisfactory for raising the vehicle. Drive-on trestles or ramps are also a handy and safe way to both raise and support the vehicle. Be careful though, some ramps may be too steep to drive your vehicle onto without scraping the front bottom panels. Never support the vehicle on any suspension member (unless specifically instructed to do so by a repair manual) or by an underbody panel.

Jacking Precautions

The following safety points cannot be overemphasized:

- Always block the opposite wheel or wheels to keep the vehicle from rolling off the jack.
- When raising the front of the vehicle, firmly apply the parking brake.
- When the drive wheels are to remain on the ground, leave the vehicle in gear to help prevent it from rolling.
- Always use jackstands to support the vehicle when you are working underneath. Place the stands beneath the vehicle's jacking brackets. Before climbing underneath, rock the vehicle a bit to make sure it is firmly supported.

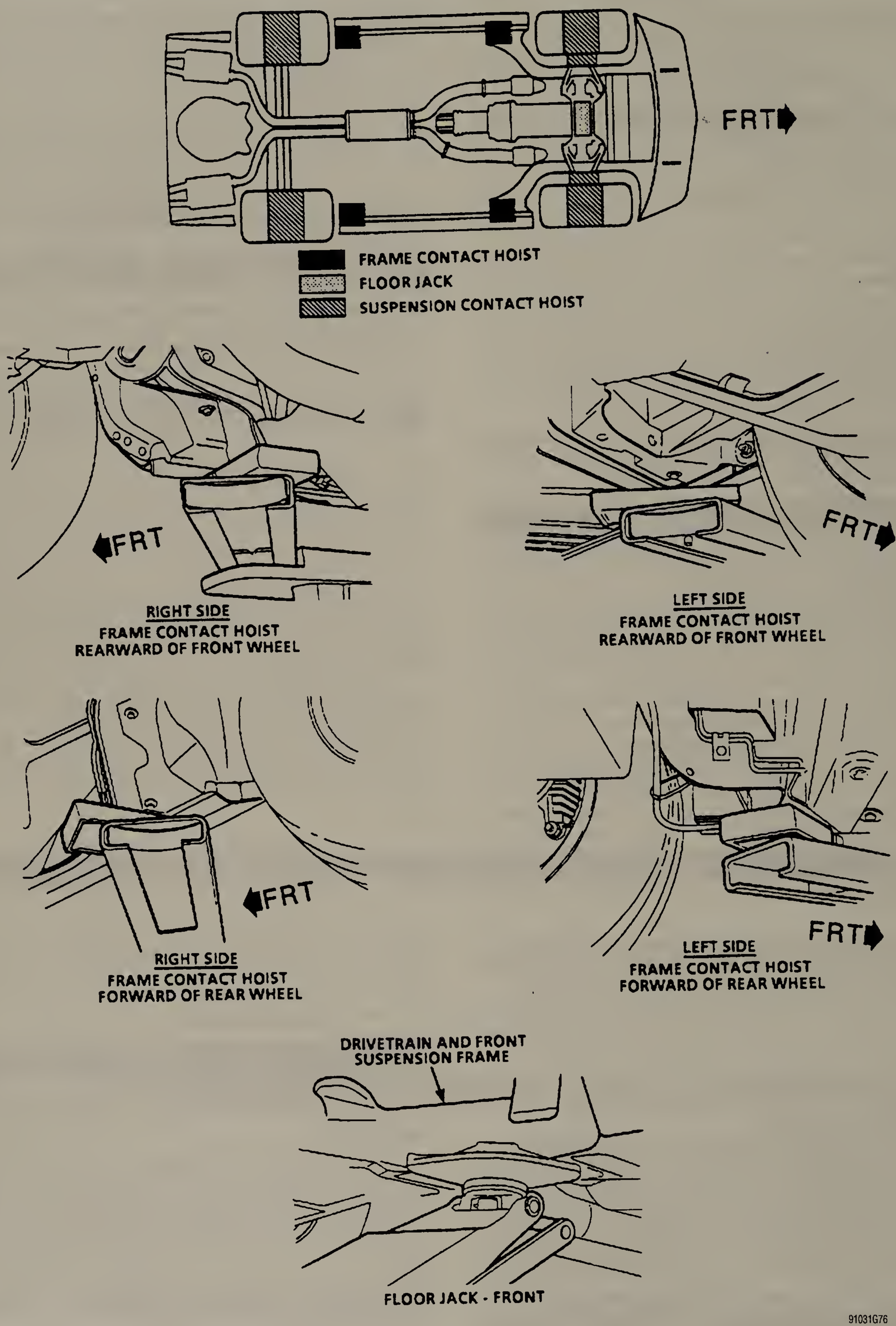


Fig. 229 Vehicle lifting points

SEVERE MAINTENANCE INTERVALS

TO BE SERVICED	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)																			
		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
Change engine oil	R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace engine oil filter	R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Check manual transmission fluid and add if necessary	S/I																				
Chassis lubrication	L		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Rotate and inspect the tires and wheels	S/I		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Inspect the brake system components	S/I		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Throttle body mount bolt torque (1984-91 vehicles only)	S/I		✓																		
Check and adjust idle speed (if possible)	S/I		✓																		
Inspect the caliper and steering knuckle	S/I				✓				✓				✓				✓				✓
Inspect the air cleaner element ①	S/I					✓					✓					✓					✓
Replace the air cleaner element	R										✓										✓
Inspect the accessory drive belts	S/I																				✓
Inspect the PCV valve (1984-88 vehicles)	S/I										✓										✓
Inspect the EGR system (1984-88 vehicles)											✓										✓
Change the automatic transaxle fluid and filter	R	Every 50,000 miles, if operated in conditions listed below ②																			
Inspect the spark plug wires	S/I	See note below ③																			
Replace the spark plugs	R	See note below ④																			
Cooling system service ⑤	R	See note below ⑥																			

R - Replace S/I - Inspect and service, if needed L - Lubricate A - Adjust C - Clean

NOTE: The services shown in this schedule up to 120,000 miles, should be performed at the same intervals after 120,000 miles.

① Inspect air cleaner element if vehicle is driven under dusty conditions

② Change the automatic transaxle fluid and filter ONLY if the vehicle is mainly driven under one or more of the conditions listed under severe service.

③ For 1984-95 vehicles, inspect the spark plug wires every 30,000 miles. For 1996 vehicles, inspect them every 100,000 miles

④ For 1984-91 vehicles, & 1992 VIN J engines, replace the spark plugs every 30,000 miles. On 1992 VIN P and 1993-96 vehicles, replace every 100,000 miles

⑤ Drain, flush and refill the cooling system. Inspect the hoses, clean the radiator, condenser, pressure cap and neck. Pressure test the cooling system and pressure cap.

⑥ For 1984-93 vehicles, perform the cooling system service every 30,000 miles. For 1994-96 vehicles perform the service every 100,000 miles.

FREQUENT OPERATION MAINTENANCE (SEVERE SERVICE)

If a vehicle is operated under any of the following conditions it is considered severe service:

- **Towing a trailer or using a camper or car-top carrier.**
- **Repeated short trips of less than 5 miles in temperatures below freezing, or trips of less than 10 miles in any temperature.**
- **Extensive idling or low-speed driving for long distances as in heavy commercial use, such as delivery, taxi or police cars.**
- **Operating on rough, muddy or salt-covered roads.**
- **Operating on unpaved or dusty roads.**
- **Driving in extremely hot (over 90°) conditions.**

91031C05

NORMAL MAINTENANCE INTERVALS

Use this chart only if none of the conditions listed under Severe Maintenance apply

TO BE SERVICED	TYPE OF SERVICE	VEHICLE MILEAGE INTERVAL (x1000)															
		7.5	15	22.5	30	37.5	45	52.5	60	67.5	75	82.5	90	97.5	105	112.5	120
Change engine oil	R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace engine oil filter		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Check manual transmission fluid and add if necessary	S/I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lube the suspension grease fittings and linkages	L	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rotate and inspect the tires and wheels	S/I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Inspect the brake system components	S/I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Inspect throttle body mount torque (1984-91 vehicles)	S/I	✓															
Check and adjust idle speed (if possible)	S/I	✓															
Inspect the caliper and steering knuckle	S/I		✓		✓		✓		✓		✓		✓		✓		✓
Replace the air cleaner element	R				✓				✓				✓				✓
Inspect the fuel tank cap and fuel lines	S/I				✓				✓				✓				✓
Inspect the accessory drive belts	S/I								✓								✓
Inspect the PCV valve (1984-88) vehicles	S/I								✓								✓
Inspect the EGR system (1984-88) vehicles									✓								✓
Change the automatic transaxle fluid and filter	R	Every 50,000 miles, if operated in conditions listed below ①															
Inspect the spark plug wires	S/I	See note below ②															
Replace the spark plugs	R	See note below ③															
Cooling system	R	See note below ④															

R - Replace S/I - Inspect and service, if needed L - Lubricate A - Adjust C - Clean

NOTE: The services shown in this schedule up to 120,000 miles, should be performed at the same intervals after 150,000 miles.

① Change the automatic transaxle fluid and filter ONLY if the vehicle is mainly driven under on or more of the following conditions:

a: In heavy city traffic where the outside temperatures reach 90°F (32°C) or higher.

b: In hilly or mountainous terrain.

c: When performing frequent trailer towing.

d: When used as a taxi, police car or for delivery service.

② For 1984-95 vehicles, inspect the spark plug wires every 30,000 miles. For 1996 vehicles, inspect them every 100,000 miles

③ For 1984-91 vehicles and 1992 VIN J engines, replace the spark plugs every 30,000 miles. For 1992 VIN P and all 1993-96 vehicles, replace the spark plugs every 100,000 miles.

④ Drain, flush and refill the cooling system. Inspect the hoses, clean the radiator, condenser, pressure cap and neck. Pressure test the cooling system and pressure cap. For 1984-93 vehicles, perform the cooling system service every 30,000 miles. For 1994-96 vehicles perform the service every 100,000 mil

91031C06

CAPACITIES

Year	Model	Engine ID/VIN	Engine Displacement Liters (cc)	Engine Oil with Filter	Transmission (pts.)			Drive Axle		Fuel Tank (gal.)	Cooling System (qts.)
					5-Spd	6-Spd	Auto.	Front (pts.)	Rear (pts.)		
1984	Corvette	8	5.7L (5700)	5.0 ①	6.0		20.0	—	4.0	20.0	14.5
1985	Corvette	8	5.7L (5700)	5.0	7.0	—	20.0 ②	—	3.75	20.0	14.0
1986	Corvette	8	5.7L (5700)	5.0	7.0	—	20.0 ②	—	3.75	20.0	14.0
1987	Corvette	8	5.7L (5700)	5.0	7.0	—	20.0 ②	—	3.75	20.0	14.0
1988	Corvette	8	5.7L (5700)	5.0	7.0	—	20.0 ②	—	3.75	20.0	14.0
1989	Corvette	8	5.7L (5700)	5.0	—	4.4	20.0 ②	—	3.75	20.0	14.0
1990	Corvette	8	5.7L (5700)	5.0	—	4.4	20.0 ②	—	3.75	20.0	17.8
	Corvette	J	5.7L (5700)	8.6	—	4.4	20.0 ②	—	3.75	20.0	14.7
1991	Corvette	8	5.7L (5700)	5.0	—	4.4	20.0 ③	—	3.75	20.0	17.8
	Corvette	J	5.7L (5700)	8.6	—	4.4	20.0 ③	—	3.75	20.0	14.7
1992	Corvette	P	5.7L (5700)	5.0	—	4.4	20.0 ③	—	3.75	20.0	17.8
	Corvette	J	5.7L (5700)	8.6	—	4.4	20.0 ③	—	3.75	20.0	14.7
1993	Corvette	P	5.7L (5700)	4.5	—	4.4	20.0 ③	—	3.75	20.0	17.8
	Corvette	J	5.7L (5700)	8.6	—	4.4	20.0 ③	—	3.75	20.0	14.7
1994	Corvette	P	5.7L (5700)	4.5	—	4.4	20.0 ③	—	3.75	20.0	17.8
	Corvette	J	5.7L (5700)	8.6	—	4.4	20.0 ③	—	3.75	20.0	14.7
1995	Corvette	P	5.7L (5700)	4.5	—	4.4	20.0 ③	—	④	20.0	17.8
	Corvette	J	5.7L (5700)	8.6	—	4.4	20.0 ③	—	④	20.0	14.7
1996	Corvette	P	5.7L (5700)	4.5	—	4.4	20.0 ③	—	④	20.0	14.5
	Corvette	5	5.7L (5700)	4.5	—	4.4	20.0 ③	—	④	20.0	14.5

NOTE: All capacities are approximate. Add fluid gradually and check to be sure a proper fluid level is obtained

① Add 1 quart if equipped with an engine oil cooler.

② Specification given is for fluid drain and refill. For transmission overhaul, use approximately 23 pts.

③ Specification given is for fluid drain and refill. For transmission overhaul, use approximately 22.4 pts.

④ Specification for rear axle is 3.0 pts., plus 4 oz. of limited-slip additive

91031C07

ENGLISH TO METRIC CONVERSION: MASS (WEIGHT)

Current mass measurement is expressed in pounds and ounces (lbs. & ozs.). The metric unit of mass (or weight) is the kilogram (kg). Even although this table does not show conversion of masses (weights) larger than 15 lbs, it is easy to calculate larger units by following the data immediately below.

To convert ounces (oz.) to grams (g): multiply th number of ozs. by 28
To convert grams (g) to ounces (oz.): multiply the number of grams by .035

To convert pounds (lbs.) to kilograms (kg): multiply the number of lbs. by .45
To convert kilograms (kg) to pounds (lbs.): multiply the number of kilograms by 2.2

lbs	kg	lbs	kg	oz	kg	oz	kg
0.1	0.04	0.9	0.41	0.1	0.003	0.9	0.024
0.2	0.09	1	0.4	0.2	0.005	1	0.03
0.3	0.14	2	0.9	0.3	0.008	2	0.06
0.4	0.18	3	1.4	0.4	0.011	3	0.08
0.5	0.23	4	1.8	0.5	0.014	4	0.11
0.6	0.27	5	2.3	0.6	0.017	5	0.14
0.7	0.32	10	4.5	0.7	0.020	10	0.28
0.8	0.36	15	6.8	0.8	0.023	15	0.42

ENGLISH TO METRIC CONVERSION: TEMPERATURE

To convert Fahrenheit (°F) to Celsius (°C): take number of °F and subtract 32; multiply result by 5; divide result by 9

To convert Celsius (°C) to Fahrenheit (°F): take number of °C and multiply by 9; divide result by 5; add 32 to total

Fahrenheit (F)	Celsius (C)			Fahrenheit (F)	Celsius (C)			Fahrenheit (F)	Celsius (C)		
°F	°C	°C	°F	°F	°C	°C	°F	°F	°C	°C	°F
−40	−40	−38	−36.4	80	26.7	18	64.4	215	101.7	80	176
−35	−37.2	−36	−32.8	85	29.4	20	68	220	104.4	85	185
−30	−34.4	−34	−29.2	90	32.2	22	71.6	225	107.2	90	194
−25	−31.7	−32	−25.6	95	35.0	24	75.2	230	110.0	95	202
−20	−28.9	−30	−22	100	37.8	26	78.8	235	112.8	100	212
−15	−26.1	−28	−18.4	105	40.6	28	82.4	240	115.6	105	221
−10	−23.3	−26	−14.8	110	43.3	30	86	245	118.3	110	230
−5	−20.6	−24	−11.2	115	46.1	32	89.6	250	121.1	115	239
0	−17.8	−22	−7.6	120	48.9	34	93.2	255	123.9	120	248
1	−17.2	−20	−4	125	51.7	36	96.8	260	126.6	125	257
2	−16.7	−18	−0.4	130	54.4	38	100.4	265	129.4	130	266
3	−16.1	−16	3.2	135	57.2	40	104	270	132.2	135	275
4	−15.6	−14	6.8	140	60.0	42	107.6	275	135.0	140	284
5	−15.0	−12	10.4	145	62.8	44	112.2	280	137.8	145	293
10	−12.2	−10	14	150	65.6	46	114.8	285	140.6	150	302
15	−9.4	−8	17.6	155	68.3	48	118.4	290	143.3	155	311
20	−6.7	−6	21.2	160	71.1	50	122	295	146.1	160	320
25	−3.9	−4	24.8	165	73.9	52	125.6	300	148.9	165	329
30	−1.1	−2	28.4	170	76.7	54	129.2	305	151.7	170	338
35	1.7	0	32	175	79.4	56	132.8	310	154.4	175	347
40	4.4	2	35.6	180	82.2	58	136.4	315	157.2	180	356
45	7.2	4	39.2	185	85.0	60	140	320	160.0	185	365
50	10.0	6	42.8	190	87.8	62	143.6	325	162.8	190	374
55	12.8	8	46.4	195	90.6	64	147.2	330	165.6	195	383
60	15.6	10	50	200	93.3	66	150.8	335	168.3	200	392
65	18.3	12	53.6	205	96.1	68	154.4	340	171.1	205	401
70	21.1	14	57.2	210	98.9	70	158	345	173.9	210	410
75	23.9	16	60.8	212	100.0	75	167	350	176.7	215	414

TCCS1C01

ENGLISH TO METRIC CONVERSION: LENGTH

To convert inches (ins.) to millimeters (mm): multiply number of inches by 25.4

To convert millimeters (mm) to inches (ins.): multiply number of millimeters by .04

Inches	Decimals	Milli-meters	Inches to millimeters inches	mm	Inches	Decimals	Milli-meters	Inches to millimeters inches	mm
1/64	0.051625	0.3969	0.0001	0.00254	33/64	0.515625	13.0969	0.6	15.24
1/32	0.03125	0.7937	0.0002	0.00508	17/32	0.53125	13.4937	0.7	17.78
3/64	0.046875	1.1906	0.0003	0.00762	35/64	0.546875	13.8906	0.8	20.32
1/16	0.0625	1.5875	0.0004	0.01016	9/16	0.5625	14.2875	0.9	22.86
5/64	0.078125	1.9844	0.0005	0.01270	37/64	0.578125	14.6844	1	25.4
3/32	0.09375	2.3812	0.0006	0.01524	19/32	0.59375	15.0812	2	50.8
7/64	0.109375	2.7781	0.0007	0.01778	39/64	0.609375	15.4781	3	76.2
1/8	0.125	3.1750	0.0008	0.02032	5/8	0.625	15.8750	4	101.6
9/64	0.140625	3.5719	0.0009	0.02286	41/64	0.640625	16.2719	5	127.0
5/32	0.15625	3.9687	0.001	0.0254	21/32	0.65625	16.6687	6	152.4
11/64	0.171875	4.3656	0.002	0.0508	43/64	0.671875	17.0656	7	177.8
3/16	0.1875	4.7625	0.003	0.0762	11/16	0.6875	17.4625	8	203.2
13/64	0.203125	5.1594	0.004	0.1016	45/64	0.703125	17.8594	9	228.6
7/32	0.21875	5.5562	0.005	0.1270	23/32	0.71875	18.2562	10	254.0
15/64	0.234375	5.9531	0.006	0.1524	47/64	0.734375	18.6531	11	279.4
1/4	0.25	6.3500	0.007	0.1778	3/4	0.75	19.0500	12	304.8
17/64	0.265625	6.7469	0.008	0.2032	49/64	0.765625	19.4469	13	330.2
9/32	0.28125	7.1437	0.009	0.2286	25/32	0.78125	19.8437	14	355.6
19/64	0.296875	7.5406	0.01	0.254	51/64	0.796875	20.2406	15	381.0
5/16	0.3125	7.9375	0.02	0.508	13/16	0.8125	20.6375	16	406.4
21/64	0.328125	8.3344	0.03	0.762	53/64	0.828125	21.0344	17	431.8
11/32	0.34375	8.7312	0.04	1.016	27/32	0.84375	21.4312	18	457.2
23/64	0.359375	9.1281	0.05	1.270	55/64	0.859375	21.8281	19	482.6
3/8	0.375	9.5250	0.06	1.524	7/8	0.875	22.2250	20	508.0
25/64	0.390625	9.9219	0.07	1.778	57/64	0.890625	22.6219	21	533.4
13/32	0.40625	10.3187	0.08	2.032	29/32	0.90625	23.0187	22	558.8
27/64	0.421875	10.7156	0.09	2.286	59/64	0.921875	23.4156	23	584.2
7/16	0.4375	11.1125	0.1	2.54	15/16	0.9375	23.8125	24	609.6
29/64	0.453125	11.5094	0.2	5.08	61/64	0.953125	24.2094	25	635.0
15/32	0.46875	11.9062	0.3	7.62	31/32	0.96875	24.6062	26	660.4
31/64	0.484375	12.3031	0.4	10.16	63/64	0.984375	25.0031	27	690.6
1/2	0.5	12.7000	0.5	12.70					

ENGLISH TO METRIC CONVERSION: TORQUE

To convert foot-pounds (ft. lbs.) to Newton-meters: multiply the number of ft. lbs. by 1.3

To convert inch-pounds (in. lbs.) to Newton-meters: multiply the number of in. lbs. by .11

in lbs	N·m	in lbs	N·m	in lbs	N·m	in lbs	N·m	in lbs	N·m
0.1	0.01	1	0.11	10	1.13	19	2.15	28	3.16
0.2	0.02	2	0.23	11	1.24	20	2.26	29	3.28
0.3	0.03	3	0.34	12	1.36	21	2.37	30	3.39
0.4	0.04	4	0.45	13	1.47	22	2.49	31	3.50
0.5	0.06	5	0.56	14	1.58	23	2.60	32	3.62
0.6	0.07	6	0.68	15	1.70	24	2.71	33	3.73
0.7	0.08	7	0.78	16	1.81	25	2.82	34	3.84
0.8	0.09	8	0.90	17	1.92	26	2.94	35	3.95
0.9	0.10	9	1.02	18	2.03	27	3.05	36	4.0

TCCS1C02

ENGLISH TO METRIC CONVERSION: TORQUE

Torque is now expressed as either foot-pounds (ft./lbs.) or inch-pounds (in./lbs.). The metric measurement unit for torque is the Newton-meter (Nm). This unit—the Nm—will be used for all SI metric torque references, both the present ft./lbs. and in./lbs.

ft lbs	N-m	ft lbs	N-m	ft lbs	N-m	ft lbs	N-m
0.1	0.1	33	44.7	74	100.3	115	155.9
0.2	0.3	34	46.1	75	101.7	116	157.3
0.3	0.4	35	47.4	76	103.0	117	158.6
0.4	0.5	36	48.8	77	104.4	118	160.0
0.5	0.7	37	50.7	78	105.8	119	161.3
0.6	0.8	38	51.5	79	107.1	120	162.7
0.7	1.0	39	52.9	80	108.5	121	164.0
0.8	1.1	40	54.2	81	109.8	122	165.4
0.9	1.2	41	55.6	82	111.2	123	166.8
1	1.3	42	56.9	83	112.5	124	168.1
2	2.7	43	58.3	84	113.9	125	169.5
3	4.1	44	59.7	85	115.2	126	170.8
4	5.4	45	61.0	86	116.6	127	172.2
5	6.8	46	62.4	87	118.0	128	173.5
6	8.1	47	63.7	88	119.3	129	174.9
7	9.5	48	65.1	89	120.7	130	176.2
8	10.8	49	66.4	90	122.0	131	177.6
9	12.2	50	67.8	91	123.4	132	179.0
10	13.6	51	69.2	92	124.7	133	180.3
11	14.9	52	70.5	93	126.1	134	181.7
12	16.3	53	71.9	94	127.4	135	183.0
13	17.6	54	73.2	95	128.8	136	184.4
14	18.9	55	74.6	96	130.2	137	185.7
15	20.3	56	75.9	97	131.5	138	187.1
16	21.7	57	77.3	98	132.9	139	188.5
17	23.0	58	78.6	99	134.2	140	189.8
18	24.4	59	80.0	100	135.6	141	191.2
19	25.8	60	81.4	101	136.9	142	192.5
20	27.1	61	82.7	102	138.3	143	193.9
21	28.5	62	84.1	103	139.6	144	195.2
22	29.8	63	85.4	104	141.0	145	196.6
23	31.2	64	86.8	105	142.4	146	198.0
24	32.5	65	88.1	106	143.7	147	199.3
25	33.9	66	89.5	107	145.1	148	200.7
26	35.2	67	90.8	108	146.4	149	202.0
27	36.6	68	92.2	109	147.8	150	203.4
28	38.0	69	93.6	110	149.1	151	204.7
29	39.3	70	94.9	111	150.5	152	206.1
30	40.7	71	96.3	112	151.8	153	207.4
31	42.0	72	97.6	113	153.2	154	208.8
32	43.4	73	99.0	114	154.6	155	210.2

TCCS1C03

2

ENGINE ELECTRICAL

HEI DISTRIBUTOR IGNITION SYSTEM

➡For information on understanding electricity and troubleshooting electrical circuits, please refer to Section 6 of this manual.

General Information

See Figure 1

The General Motors/Delco-Remy High Energy Ignition (HEI) system is a breakerless, pulse-triggered, transistor controlled, inductive discharge ignition system. It is used on 1984–91 vehicles equipped with the 5.7L (VIN 8) engine. The entire HEI system (except for the ignition coil) is contained within the distributor cap.

The distributor contains the electronic ignition module, and the magnetic pick-up assembly which contains a permanent magnet, a pole piece with internal teeth, and a pick-up coil (not to be confused with the ignition coil). The ignition coil is mounted to the top of the distributor cap.

The HEI distributor is equipped to aid in spark timing changes which is necessary to maintain emissions, economy and performance. This is achieved by the Electronic Spark Timing (EST) control system. On these vehicles, timing changes are electronically regulated through the computer control module, which monitors information from the various engine sensors, computes the desired spark timing and signals the distributor to change the timing accordingly. With this distributor, no vacuum or centrifugal advances are used.

In the HEI system, as in other electronic ignition systems, the breaker points have been replaced with an electronic switch, a transistor, which is located within the ignition module. This switching transistor performs the same function the points did in a conventional ignition system; it simply turns coil primary current on and off at the correct time. Essentially, the electronic and conventional ignition systems operate on the same principal.

The module which houses the switching transistor is controlled (turned on and off) by a magnetically generated impulse induced in the pick-up coil. When the teeth of the rotating timer align with the teeth of the pole piece, the induced voltage in the pick-up coil signals the electronic module to open the coil primary circuit. The primary current then decreases and a high voltage is induced in the ignition coil secondary windings which is then directed through the rotor and high voltage leads (spark plug wires) to fire the spark plugs.

In essence then, the pick-up coil module system simply replaces the conventional breaker points and condenser. The condenser found within the distributor is for radio suppression purposes only and has nothing to do with the ignition process. The module automatically controls the dwell period, increasing it with increasing engine speed. The HEI system features a longer spark duration which is instrumental in firing lean and Exhaust Gas Recirculation (EGR) diluted fuel/air mixtures. Since dwell is automatically controlled, it cannot be adjusted. The module itself is non-adjustable and non-repairable and must be replaced if found defective.

These engines are also with Electronic Spark Control (ESC). A knock sensor is mounted in the engine block. It is connected to the ESC module which is mounted to the cowl in the engine compartment. In response to engine knock, the sensor sends a signal to the ESC module. The module will then signal the ECM which will retard the spark timing in the distributor.

HEI SYSTEM PRECAUTIONS

Before proceeding with troubleshooting or HEI system service, please note the following precautions:

Timing Light Use

Inductive pick-up timing lights are the best kind to use with the HEI system. Timing lights which connect between the spark plug and the spark plug wire occasionally (not always) give false readings due to the high voltage of the HEI system which more easily leads to arcing.

Spark Plug Wires

The plug wires used with HEI systems are of a different construction than conventional wires. When replacing them, make sure you get the correct wires, since conventional point system wires won't carry the voltage. Also, handle them carefully to avoid cracking or splitting them and never pierce them.

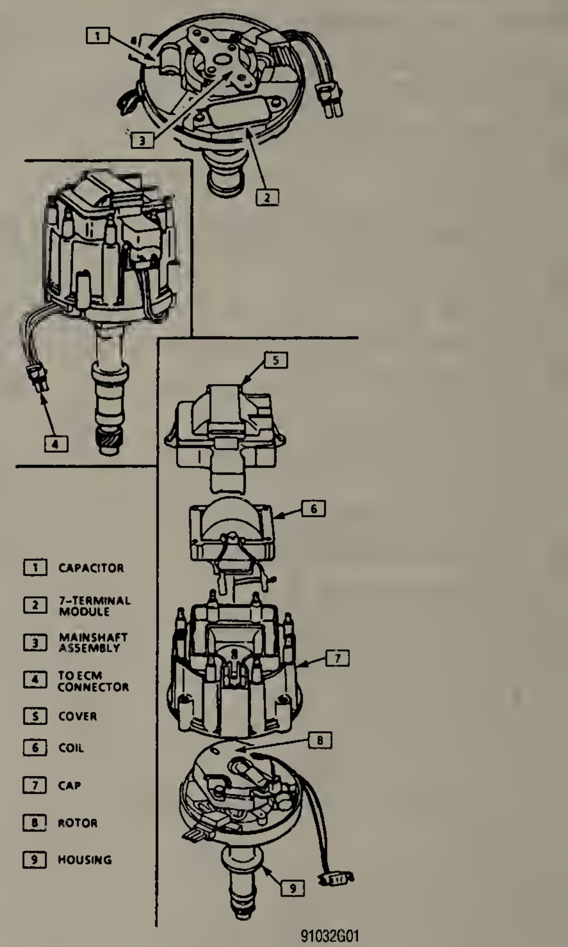


Fig. 1 Exploded view of the HEI distributor, which is used on 1984–91 vehicles

Tachometer Use

Not all tachometers will operate or indicate correctly when used on a HEI system. While some tachometers may give a reading, this does not necessarily mean the reading is correct. In addition, some tachometers hook up differently from others. If you can't figure out whether or not your tachometer will work on your car, check with the tachometer manufacturer.

HEI System Testers

Instruments designed specifically for testing HEI systems are available from several tool manufacturers. Some of these will even test the module itself. However, most of the tests given in the following require only an ohmmeter and a voltmeter.

Diagnosis and Testing

Diagnosis and testing procedures in this section should be used in conjunction with those in Section 4 (Emission Controls) and Section 5 (Fuel System) o this manual. This will enable you to diagnose problems involving all components controlled by the computer control module.

➡An accurate diagnosis is the first step to problem solution and repair. For several of the following steps, a HEI spark tester, tool ST 125, to ground. Use of this tool is recommended, as there is more control of th high energy spark and less chance of being shocked. If a tachometer is connected to the TACH terminal on the distributor, disconnect it before proceeding with this test.

The symptoms of a defective components within the HEI system are exactly the same as those you would encounter in a conventional system. Some of these symptoms could be:

- Hard or no starting
- Rough idle

- Poor fuel economy
- Engine misses under load or while accelerating

If you suspect a problem in your ignition system, there are certain preliminary checks which you should carry out before you begin to check the electronic portions of the system. First, it is extremely important to make sure the vehicle battery is in a good state of charge. A defective or poorly charged battery will cause the various components of the ignition system to read incorrectly when they are being tested. Second, make sure all wiring connections are clean and tight, not only at the battery, but also at the distributor cap, ignition coil and at the computer control module.

The quickest and easiest test of the ignition system is to check the secondary ignition circuit first (check for spark). If the secondary circuit checks out properly, then the engine condition is probably not the fault of the ignition system. To check the secondary ignition circuit, perform a simple spark test. Remove one of the plug wires and insert a spark tester. If a normal spark occurs, then the problem is most likely not in the ignition system. Check for fuel system problems, or fouled spark plugs.

➡For further diagnosis, please refer to component testing found later in this section.

SECONDARY SPARK TEST

1. Check for spark at the spark plugs by attaching the HEI spark tester, tool ST 125, to one of the plug wires, grounding the HEI spark tester on the engine and cranking the starter.
2. Check fuel system, plug wires, and spark plugs. If spark is present, the HEI system is good.
3. If no spark occurs from EST distributor, disconnect the 4 terminal EST connector and recheck for spark. If spark is present, EST system service check should be performed.

Ignition Coil

TESTING

➧ See Figure 2

1. Tag and detach the spark plug wires, and unplug the electrical connectors from the distributor cap and coil.
2. Use a screwdriver to turn the 4 latches, then remove the cap and coil assembly from the lower distributor housing.
3. Connect an ohmmeter, as shown in test 1, in the accompanying figure. The reading should be zero, or nearly zero. If not, replace the ignition coil.
4. Using the high scale, connect the ohmmeter both ways, as shown in test 2 in the accompanying figure. The readings should NOT be infinite. Replace the coil ONLY if both readings are infinite.
5. If the coil is good, test the pick up coil, as outlined later in this section.

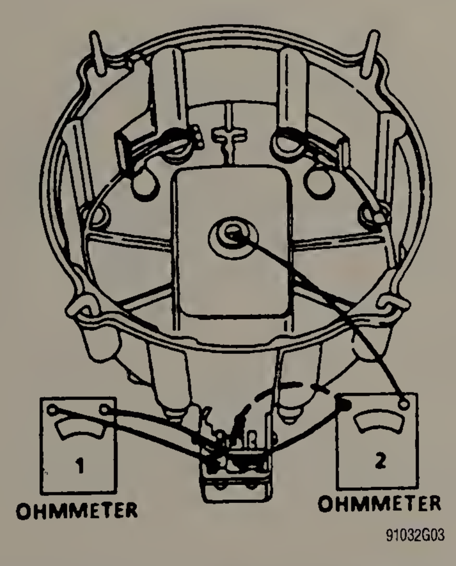


Fig. 2 Connect the ohmmeter as shown to test the ignition coil

REMOVAL & INSTALLATION

➧ See Figures 3 and 4

1. Disconnect the negative battery cable.
2. Remove the intake manifold plenum extension.
3. Tag and disconnect the secondary wires, then remove the retainer(s) from the distributor cap, and position aside.
4. Unfasten the 2 coil cover attaching screws, then lift the cover off.
5. Remove the 4 coil-to-cap attaching screws and lift the ignition coil and leads from the cap.
6. Remove the ignition coil arc seal.
7. Clean the cap with a soft cloth and inspect for defects. Replace if necessary.

To install:

8. Place a new seal on the distributor cap.
9. Position the ignition coil to the distributor cap and secure with the retaining screws. Tighten the screws to 13 inch lbs. (1.5 Nm).
10. Attach the coil electrical leads.
11. Install the distributor cap cover.
12. Attach the secondary wires, as tagged during removal and install the retainer(s).
13. Install the intake manifold plenum extension.
14. Connect the negative battery cable.

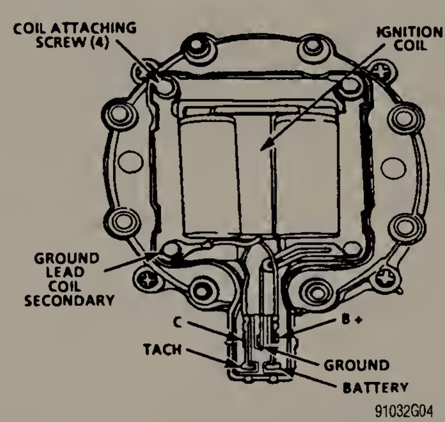


Fig. 3 The ignition coil is secured to the distributor cap with 4 screws

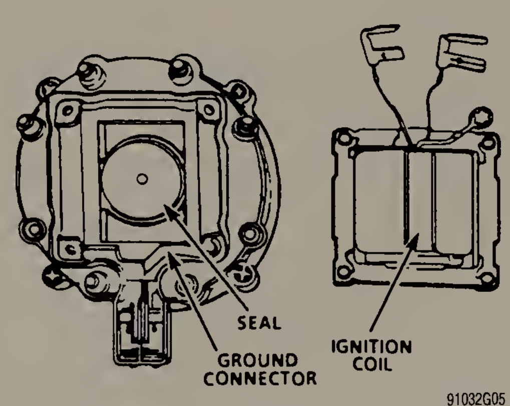


Fig. 4 View of the ignition coil removed from the distributor cap

Pick-up Coil

TESTING

➧ See Figure 5

1. Remove the rotor and pick-up coil leads from the module.
2. Using an ohmmeter, attach one lead to the distributor base and the sec-

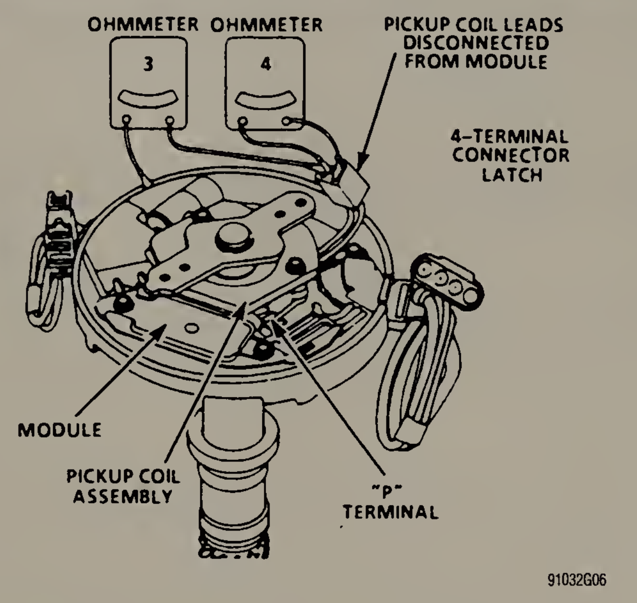


Fig. 5 Ohmmeter connections for testing the pick-up coil

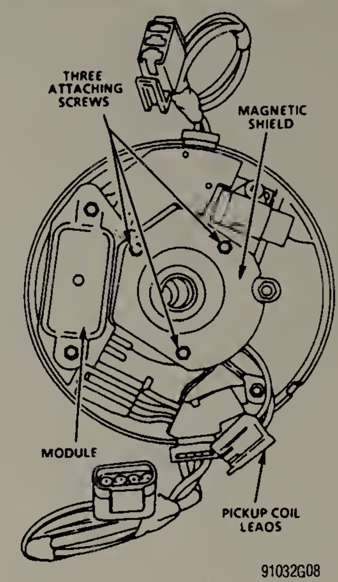


Fig. 7 The magnetic shield is held in place with 3 screws

ond lead to one of the pick-up coil terminals of the connector, as shown in test 3 in the accompanying figure.

3. The reading should be infinite. If not, the pick-up coil is defective.
4. Attach both leads of the ohmmeter to the pick-up terminal ends of the connector, as shown in test 4 in the accompanying figure.
5. The reading should be a steady value between 500–1500 ohms.
6. If the reading is not within the specifications, the pick-up coil is defective.

➡While testing, flex the leads to determine if wire breaks are present under the wiring insulation.

REMOVAL & INSTALLATION

See Figures 6, 7, 8 and 9

1. Disconnect the negative battery cable.
2. Remove the distributor from the vehicle. For details, please refer to the procedure later in this section. Remove the cap and rotor.
3. Matchmark the gear and shaft for installation purposes, then drive the roll pin from the gear and pull the shaft assembly from the distributor.
4. Unfasten the 3 retaining screws, then remove the magnetic shield from the distributor.
5. Remove the thin "C" washer (waved retaining ring), then lift the pick-up coil straight up to remove from the distributor.
6. Remove the magnet and pole piece.

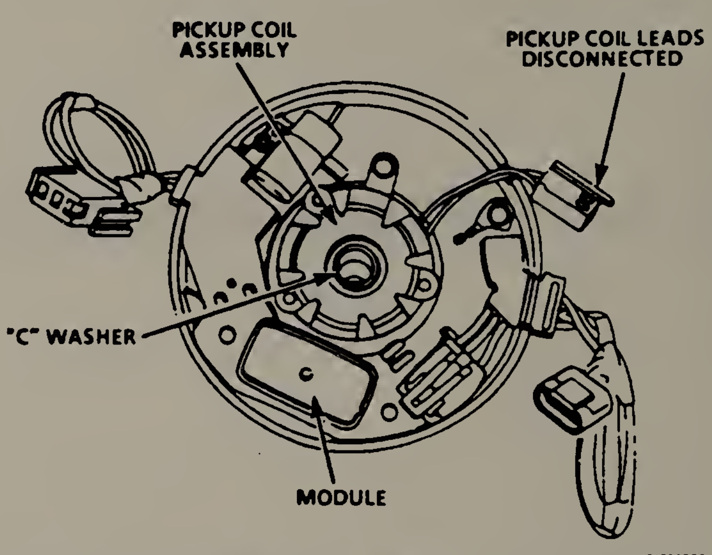


Fig. 8 You must remove the thin "C" washer in order to remove the pickup coil

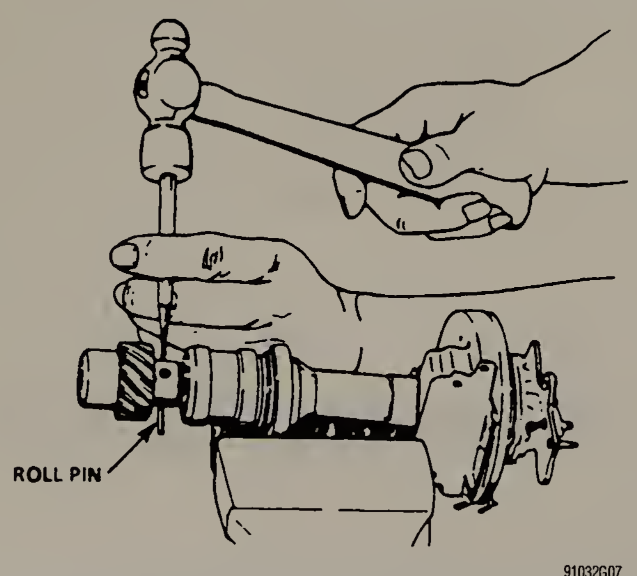


Fig. 6 Once the distributor is removed from the vehicle, use a hammer and punch to carefully drive the roll pin from the shaft

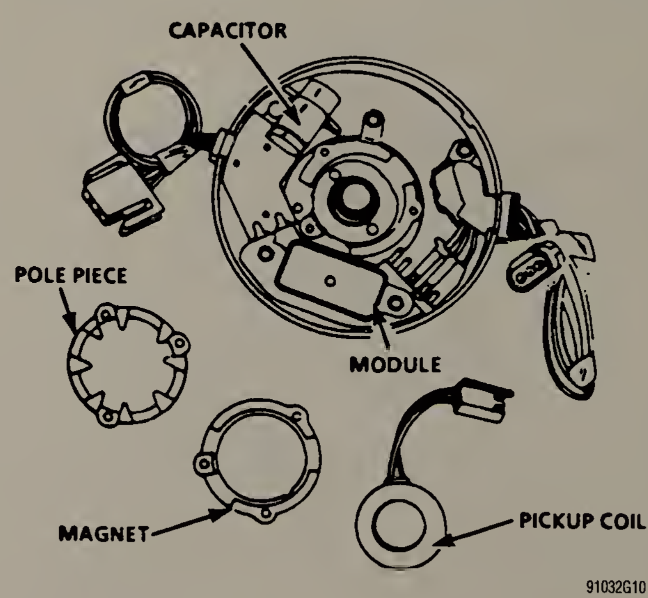
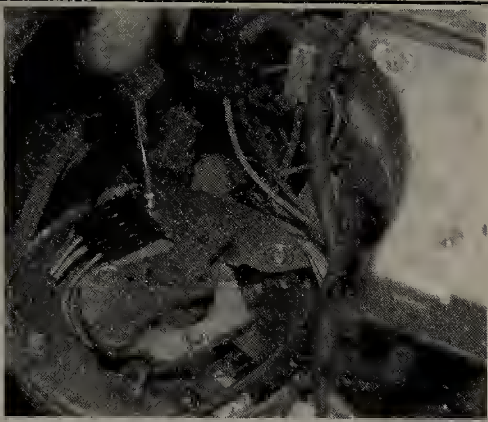
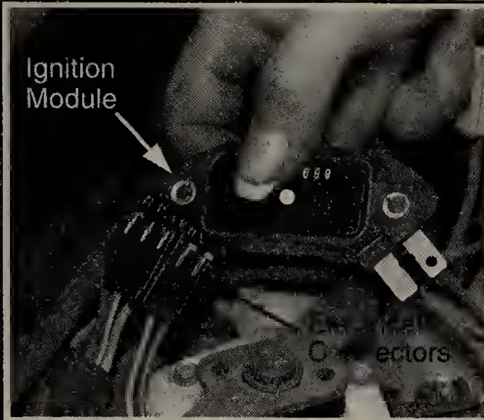


Fig. 9 Exploded view of the pick-up coil, magnet and pole piece



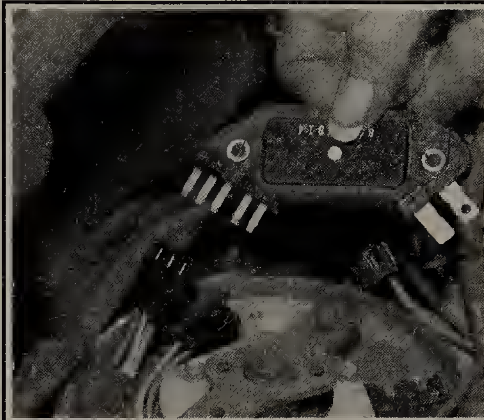
91032P26

Fig. 10 Remove the 2 ignition module retaining bolts



91032P27

Fig. 11 Lift the module from the distributor, note the connector colors . . .



91032P28

Fig. 12 . . . then detach the connectors and remove the module from the vehicle

To install:

7. Install the pole piece and magnet.
8. Install the pickup coil and the thin "C" washer.
9. Assemble the shaft, gears parts and roll pin. Use the marks made during removal for alignment purposes.
10. Spin the distributor shaft to be sure the teeth do not touch. If the teeth make contact, loosen, then re-tighten the pickup coil teeth and Hall Effect Switch teeth (if used) to eliminate contact.
11. Install the rotor and cap, then install the distributor assembly. For details, please refer to the procedure located later in this section.
12. Connect the negative battery cable.

Ignition Module

TESTING

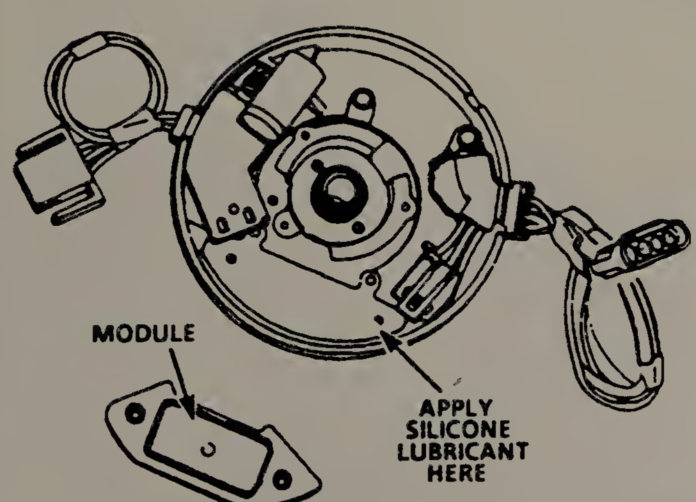
Because of the complexity of the internal circuitry of the HEI/EST module, it is recommended the module be tested with an accurate module tester.

REMOVAL & INSTALLATION

See Figures 10, 11, 12 and 13

➡It is imperative that silicone lubricant be used under the module when it is installed, to prevent module failure due to overheating.

1. Disconnect the negative battery cable.
2. Remove the intake manifold plenum extension.
3. If necessary for access, tag and disconnect the spark plug wires from the distributor cap.



91032G11

Fig. 13 Before installing the ignition module, apply silicone grease to the module to aid in heat dissipation

4. Remove the distributor cap and rotor, as outlined in
5. Unfasten the 2 module attaching screws, then lift the module up. Note the colors of the module leads, then disconnect them from the module.
6. If installing a new module, wipe the old silicone grease from the module and distributor base. If reinstalling the removed module, do NOT wipe the grease from the module or distributor base.

To install:

➡If installing a new module, a packet of silicone grease will be included in the kit. Spread the grease on the metal face of the module and on the distributor base where the module seats. The grease is essential for module cooling.

7. Attach the leads to the module, noting the color code.
8. Install the module and secure with the retaining screws. Tighten the screws to 18 inch lbs. (2 Nm).
9. Install the rotor and distributor cap, as outlined in Section 1 of this manual.
10. If removed, connect the spark plug wires, as tagged during removal.
11. Install the intake manifold plenum extension.
12. Connect the negative battery cable.

Distributor

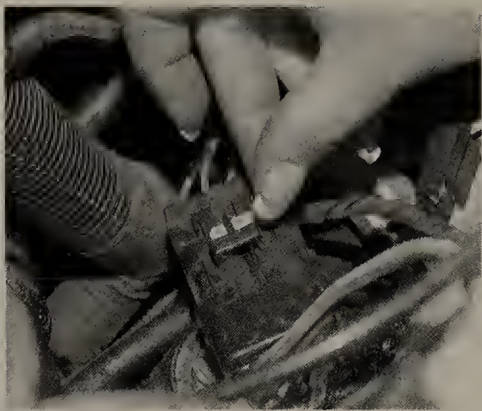
REMOVAL & INSTALLATION

See Figures 14 thru 24

1. Disconnect the negative battery cable.
2. Remove the air cleaner cover and/or intake manifold plenum extension, as necessary.
3. Remove the distributor shield.
4. Disconnect the ignition switch battery feed wire and tachometer lead (if equipped) from the distributor cap.
5. Tag and unplug the coil connectors from the cap. Do NOT use a screwdriver, or equivalent tool to release the locking tabs.
6. Remove the distributor cap by using a screwdriver to turn the 4 retaining latches counterclockwise, or unfastening the 4 retaining screws, depending upon the vehicle. Move the distributor cap out of the way.
7. Detach the 4-terminal ECM harness from the distributor ECM connector.
8. If necessary for access, tag and disconnect the spark plug wires, then release the spark plug wire harness latches, then remove the wiring harness retainer. The spark plug wire numbers are indicated on the retainer.
9. Unfasten the distributor clamp and hold-down clamp. Make sure to mark the position of the rotor in relation of the distributor housing, and the distributor housing to the engine. Pull the distributor up until the rotor just stops turning counterclockwise, then mark the rotor position again.

WARNING

To ensure proper ignition timing, the distributor MUST be installed with the rotor correctly positioned as marked.

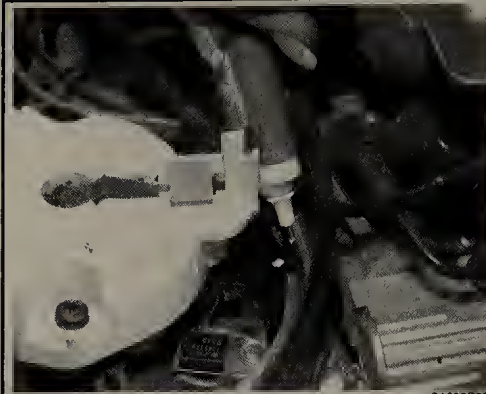


91032P33

Fig. 14 Remove the ECM electrical connector retaining clip . . .

91032P34

Fig. 15 . . . then unplug the 4-terminal ECM connector

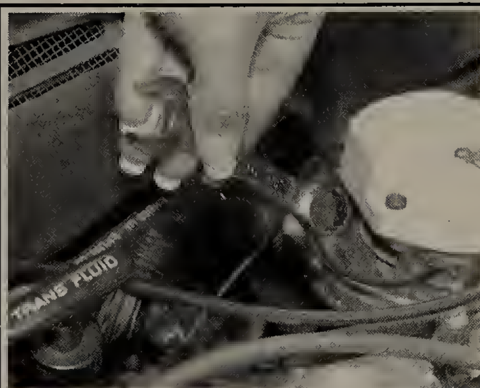


91032P29

Fig. 16 Use a paint marker to matchmark the position of the rotor to the distributor housing

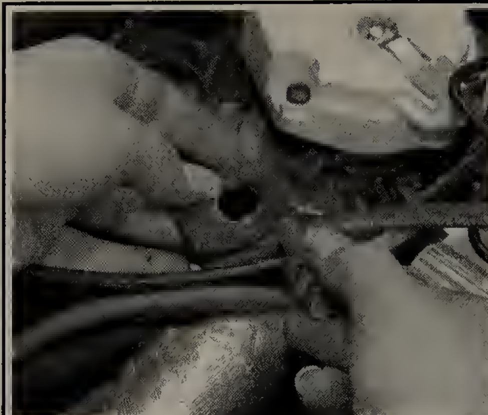
91032P30

Fig. 17 The distributor hold-down bolt is located under the distributor



91032P31

Fig. 18 The easiest way to loosen the distributor hold-down bolt is with a stubby wrench

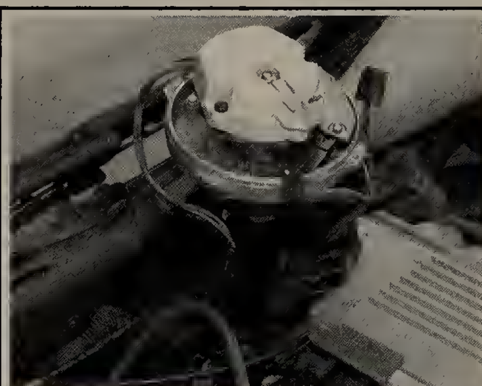


91032P32

Fig. 19 Remove the distributor hold-down bolt and clamp

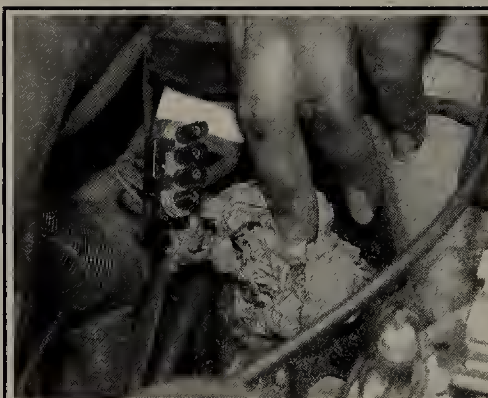
91032P35

Fig. 20 Pull the distributor up until the rotor just stops turning, then mark the rotor position again



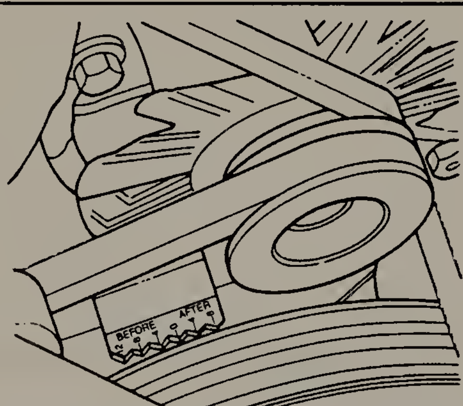
91032P36

Fig. 21 After all the matchmarks are made, the distributor can be pulled up and out of the engine



91032P38

Fig. 22 Place a rag or shop towel in the distributor mounting hole to prevent debris from falling into the engine



91032G12

Fig. 23 Align the timing mark on the crankshaft pulley to "0" (TDC) on the engine timing indicator

91032P37

Fig. 24 The distributor shaft splines must mesh correctly for proper installation

10. Remove the distributor from the engine.

To install:

11. If the engine was accidentally cranked, after the distributor was removed, perform the following steps for installation:
    a. Remove the No. 1 spark plug.
    b. Place vehicles equipped with manual transmissions in "Neutral", or automatic transmissions in "Park". Place your finger over the No. 1 spark plug hole, then slowly crank the engine until compression is felt.
    c. Align the timing mark on the crankshaft pulley to "0" (TDC) on the engine timing indicator.
    d. Turn the distributor rotor to point between the No. 1 and No. 8 spark plug towers.
    e. Install the distributor by following the remaining steps.
12. Install the distributor in the vehicle, positioning the rotor and housing as marked during removal.
13. Install the distributor hold-down clamp and bolt, and hand-tighten.
14. Attach the 4-terminal ECM harness connector.
15. Position the distributor cap over the distributor and secure the 4 latches by turning them clockwise with a screwdriver, or installing the 4 retaining screws, as applicable.
16. Attach the coil connectors to the cap, as tagged during removal. Make sure the locking tabs are fastened securely.
17. Connect the tachometer lead (if equipped) and the ignition switch battery feed wire to the distributor cap.
18. If removed, attach the spark plug wires, as tagged during removal, then install and secure the wire retainers.
19. Connect the negative battery cable. Check the ignition timing, as outlined in Section 1 of this manual.
20. Tighten the distributor hold-down bolt to 25 ft. lbs. (34 Nm).
21. Install the distributor shield.
22. Install the air cleaner cover and/or intake manifold plenum extension, as necessary.

OPTI-SPARK DISTRIBUTOR IGNITION SYSTEM

General Information

See Figures 25, 26 and 27

The 5.7L (VIN P and 5) engines utilize the Opti-Spark distributor ignition system, which consists of a distributor assembly, control circuitry and an external coil. In the Opti-Spark system, all ignition timing is controlled by the Engine Control Module (ECM) or Powertrain Control Module (PCM), based on signals from the distributor's internally mounted optical camshaft position sensor. There is no way to bypass the ECM/PCM control or to adjust/set ignition timing on this system.

➡In later years, this system is referred a simply the Distributor Ignition (DI) system.

The distributor assembly is mounted directly to the front end of the camshaft, next to the water pump. It directs the spark from the ignition coil to the appropriate spark plug secondary wire, through the rotor. The secondary output connectors in the distributor cap are each connected to an individual spark plug. The connectors in the cap are arranged for convenience in routing the spark plug wire harness assemblies. The corresponding cylinder number is molded into the distributor cap next to each output connector.

The distributor also contains a signal disk and 2 optical Camshaft Position (CMP) sensor assemblies. These components send signals to the ECM/PCM for spark timing control.

The ignition coil/ignition control module assembly provides spark to the distributor assembly, timed by signals from the ECM/PCM. The ECM/PCM combines the camshaft position information supplied by the distributor with other system parameters and calculates the required spark advance and coil dwell. The ECM/PCM signals the ignition control module, which turns on, then off, the primary current to the ignition coil. When the primary current flow stops, high voltage induced in the ignition coil secondary winding becomes the spark voltage for the spark plug. The spark voltage is delivered to the distributor assembly through the coil secondary wire, and is then directed to the proper spark plug connector by the distributor rotor.

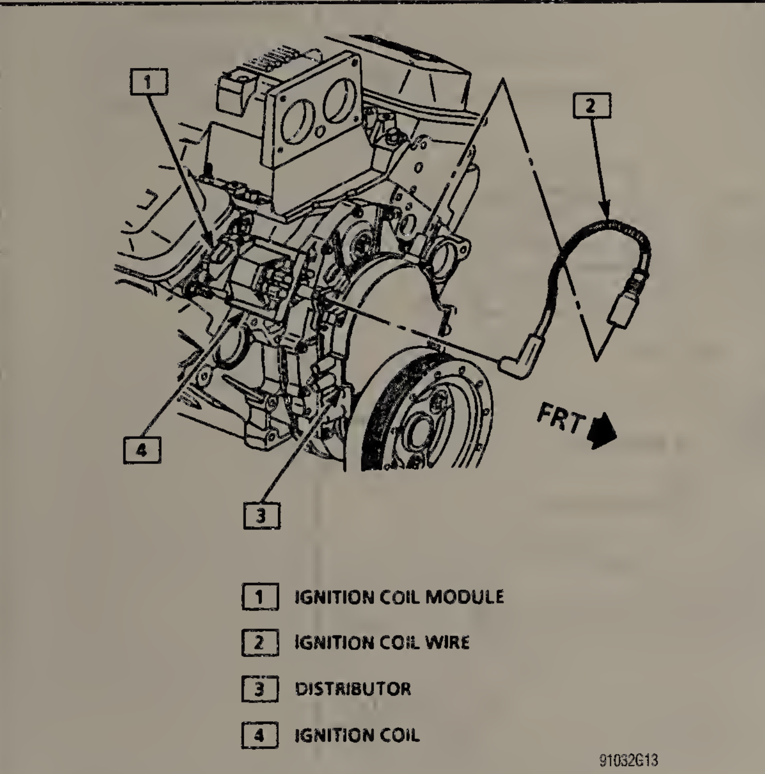


Fig. 25 Opti-Spark distributor ignition system components—5.7L (VIN P and 5) engines

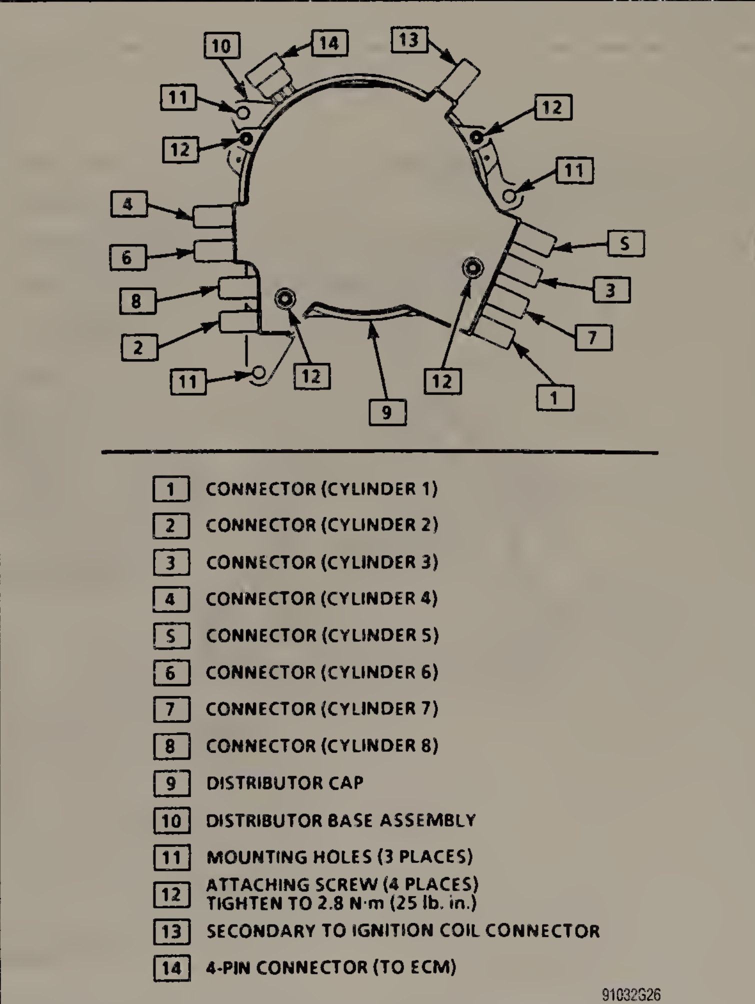
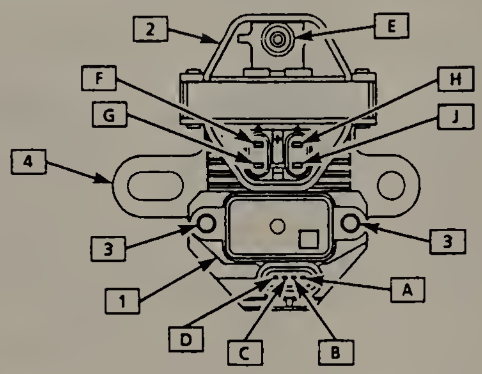


Fig. 26 View of the distributor assembly, including the cylinder identification—5.7L (VIN P and 5) engines



1 IGNITION COIL MODULE
- A TERMINAL "A" (TO IGNITION COIL B +)
- B TERMINAL "B" (TO ECM)
- C TERMINAL "C" (TO ENGINE GROUND)
- D TERMINAL "D" (TO IGNITION COIL)

2 IGNITION COIL
- E SECONDARY TO DISTRIBUTOR CONNECTOR
- F TERMINAL "B" (TO MODULE TERMINAL "A")
- G TERMINAL "A"(TO MODULE TERMINAL "D")
- H TERMINAL "B"(TO COIL FUSE/IGN B +)
- J TERMINAL "A"(TO TACH FILTER)

3 MOUNTING SCREW (2 PLACES) TIGHTEN TO 1.7 N·m (14 lb. in.)

4 BRACKET

91032G27

Fig. 27 Ignition coil and module used on the 5.7L (VIN P and 5) engines

Diagnosis and Testing

SYSTEM TESTING

See Figures 28 thru 37

Effective troubleshooting of the Opti-Spark ignition system requires a logical and systematic approach. The following charts are designed to help diagnose a no-spark condition or erratic spark plug firing. Refer to the system wiring chart before making any tester connections, and follow the steps in their prescribed order.

CAUTION

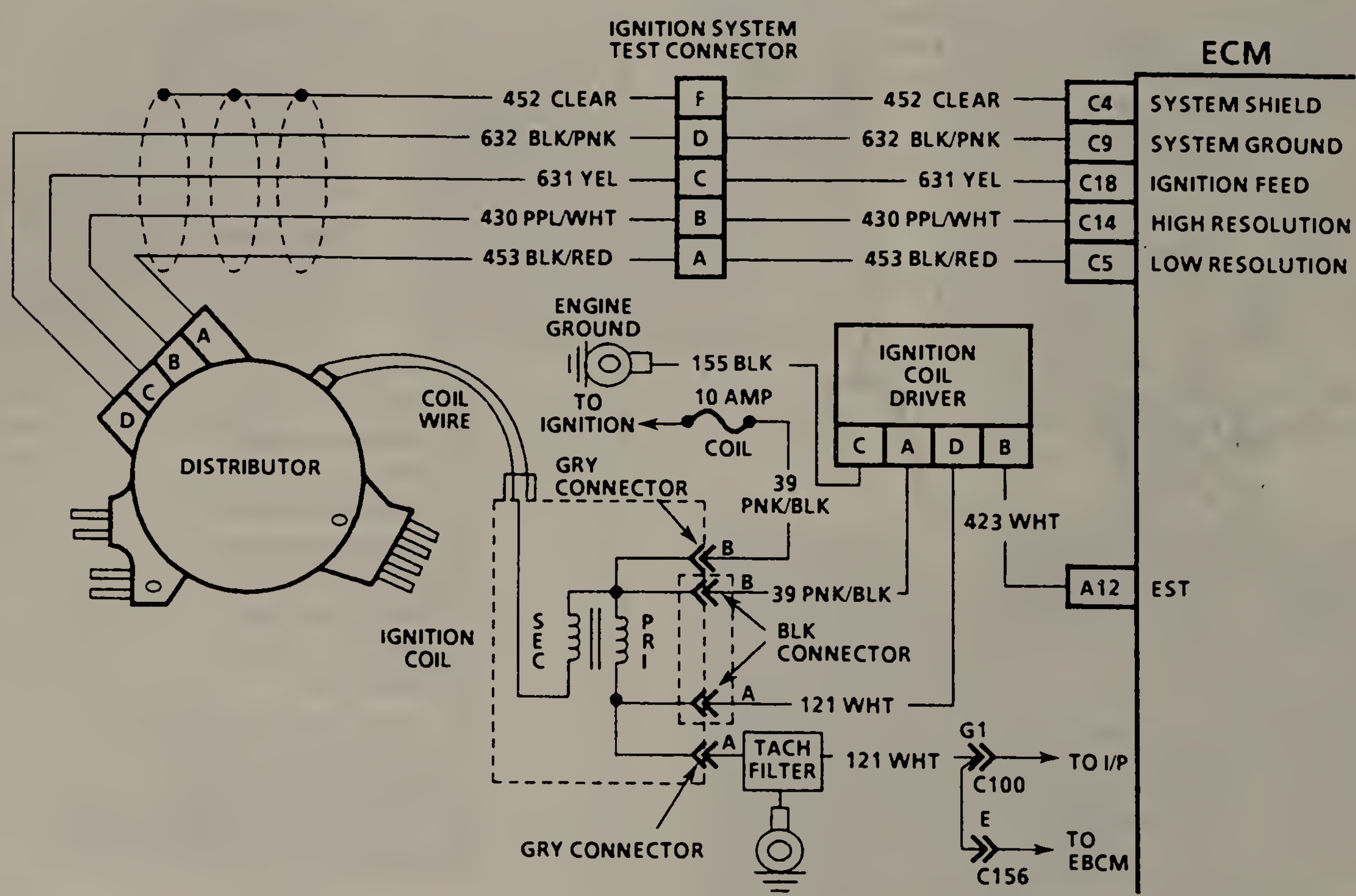
When handling secondary spark plug leads with the engine running or starting, insulated pliers must be used and care exercised to prevent a possible electrical shock.

SPARK TEST

1. With the engine off, disconnect a spark plug wire from a spark plug.
2. Connect the negative battery cable.
3. Connect a spark tester, such as tool ST-125, to the plug wire. Attach the clip to a good ground.
4. Have an assistant crank the engine. Check for spark at the tester. If there is no spark at one wire, check a second wire. It should be a bright blue color; if it is not, the coil may be faulty.

IGNITION COIL

1. Using an ohmmeter (on the high scale), connect the probes between the primary (low voltage) terminal and coil ground. The reading should be very high and infinity; if not, replace the coil.



91032G14

Fig. 28 Ignition system wiring—1992 5.7L (VIN P) engine

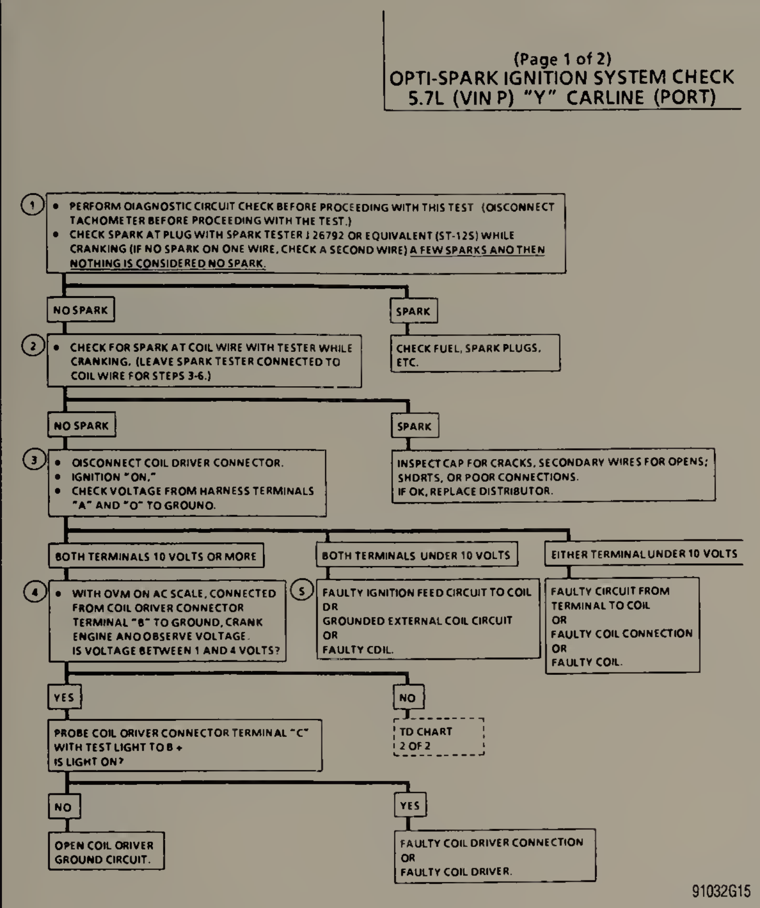


Fig. 29 Ignition system check (1 of 2)—1992 5.7L (VIN P) engine

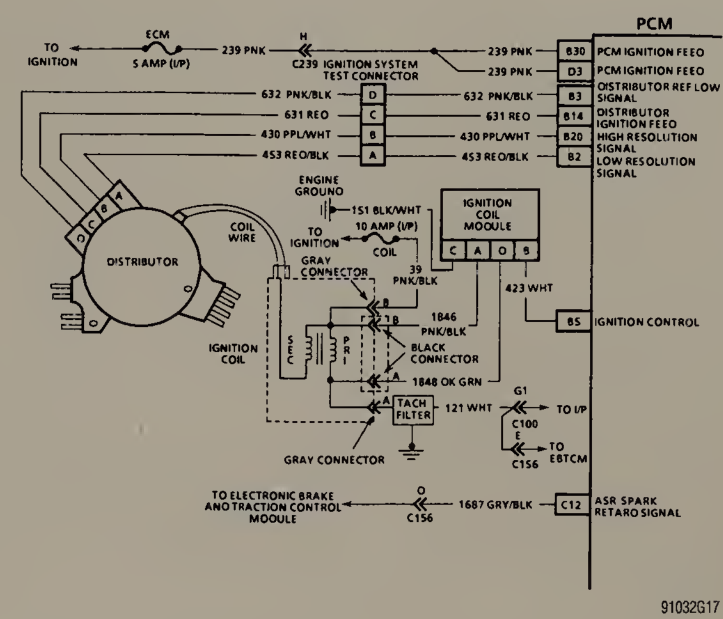


Fig. 31 Ignition system wiring—1993–94 5.7L (VIN P) engine

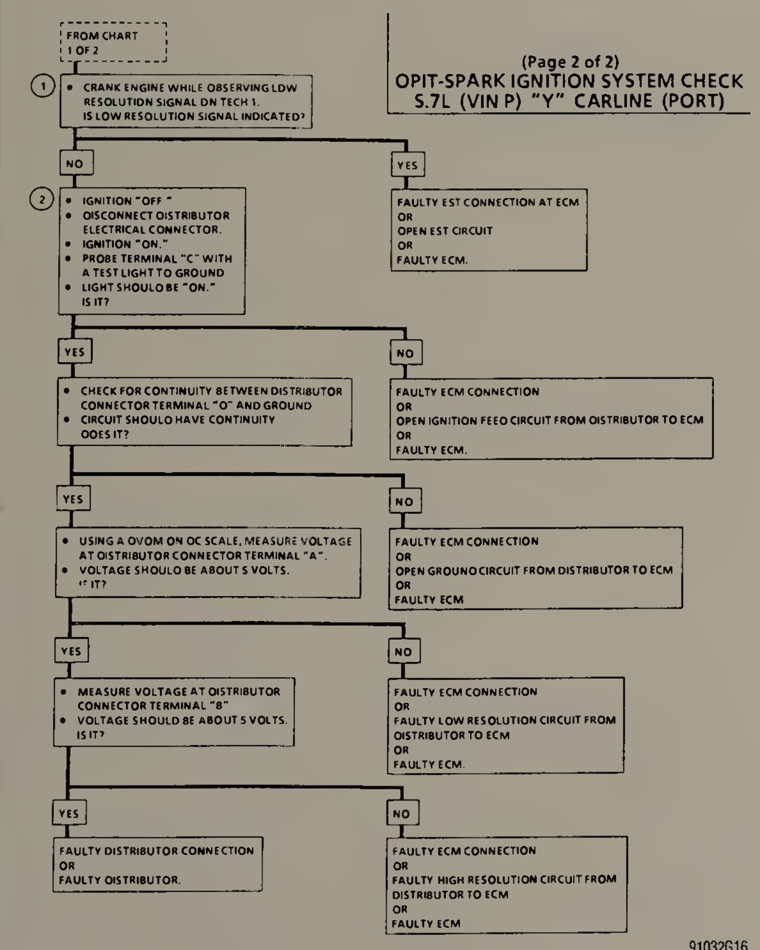


Fig. 30 Ignition system check (2 of 2)—1992 5.7L (VIN P) engine

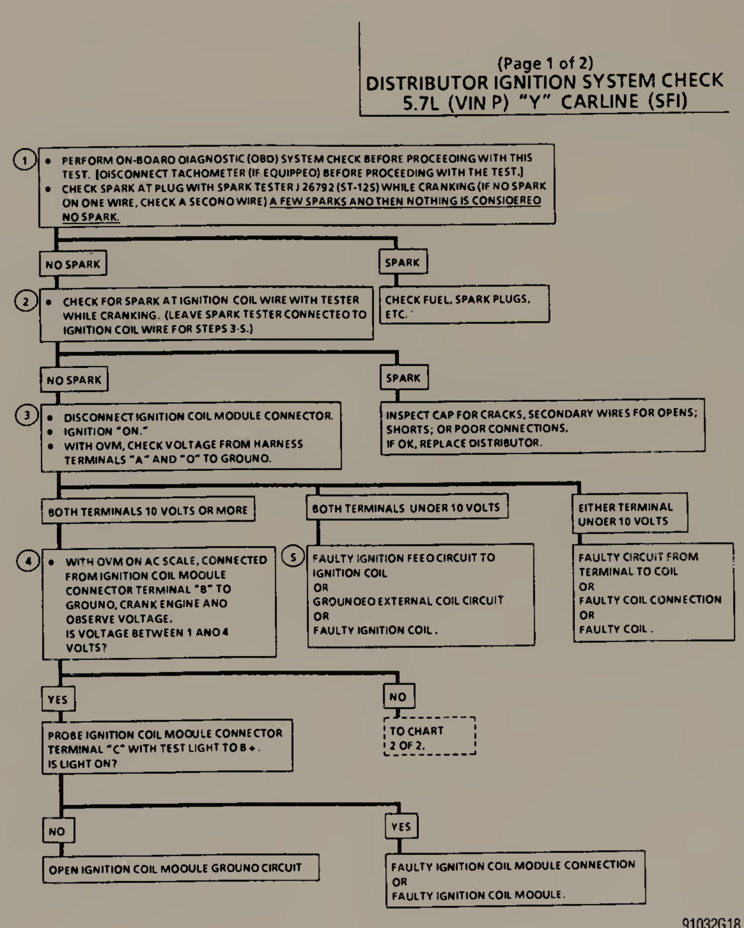


Fig. 32 Ignition system check (1 of 2)—1993–94 5.7L (VIN P) engine

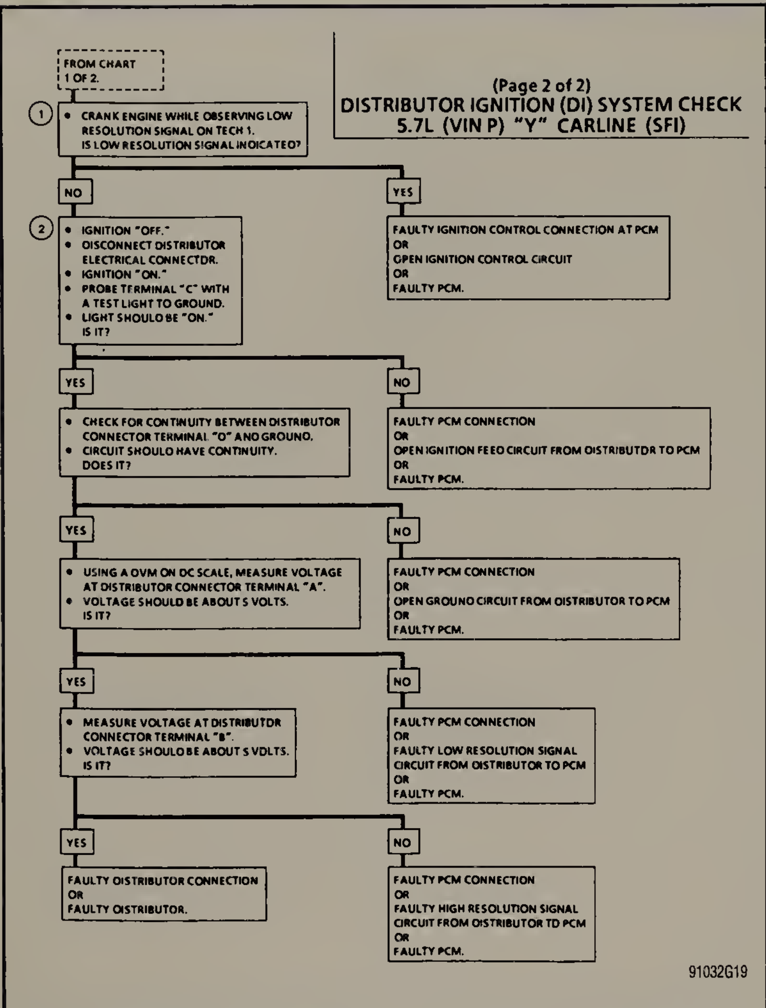


Fig. 33 Ignition system check (2 of 2)—1993-94 5.7L (VIN P) engine

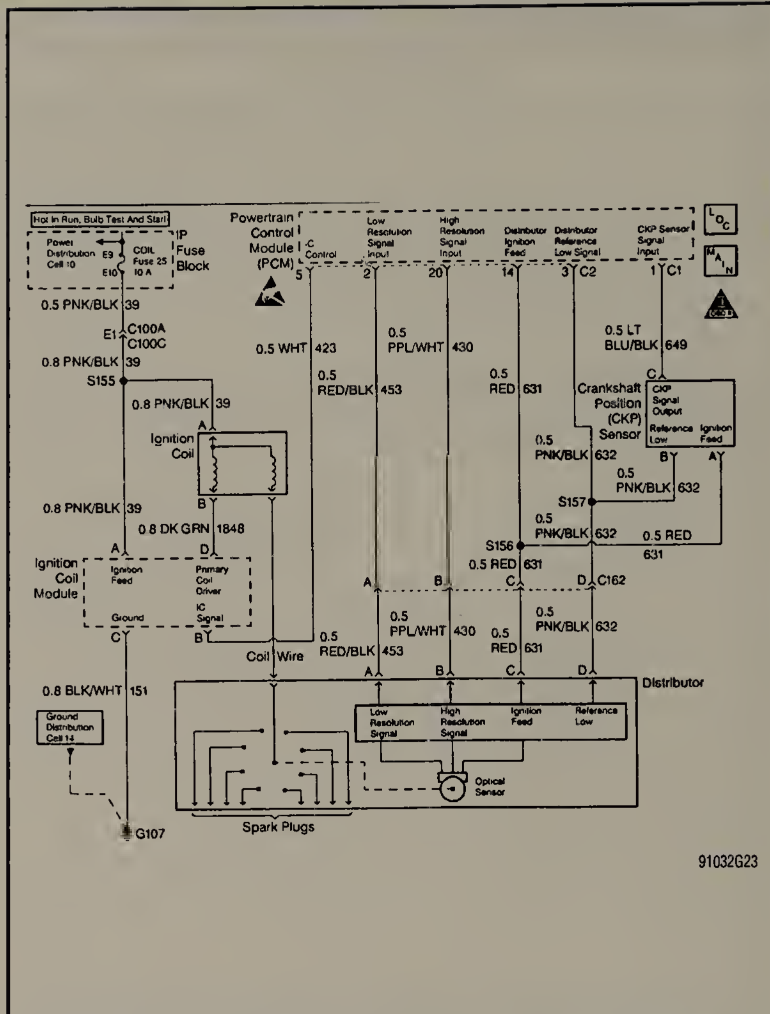


Fig. 35 Ignition system wiring—1996 5.7L (VIN P and 5) engines

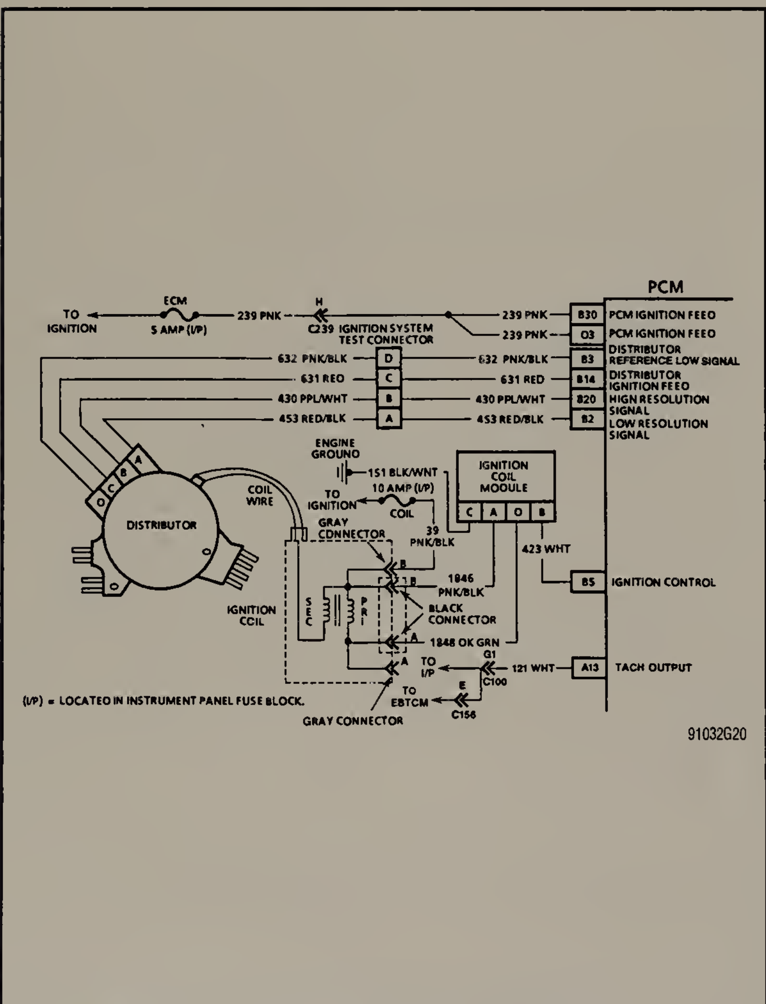


Fig. 34 Ignition system wiring—1995 5.7L (VIN P) engine

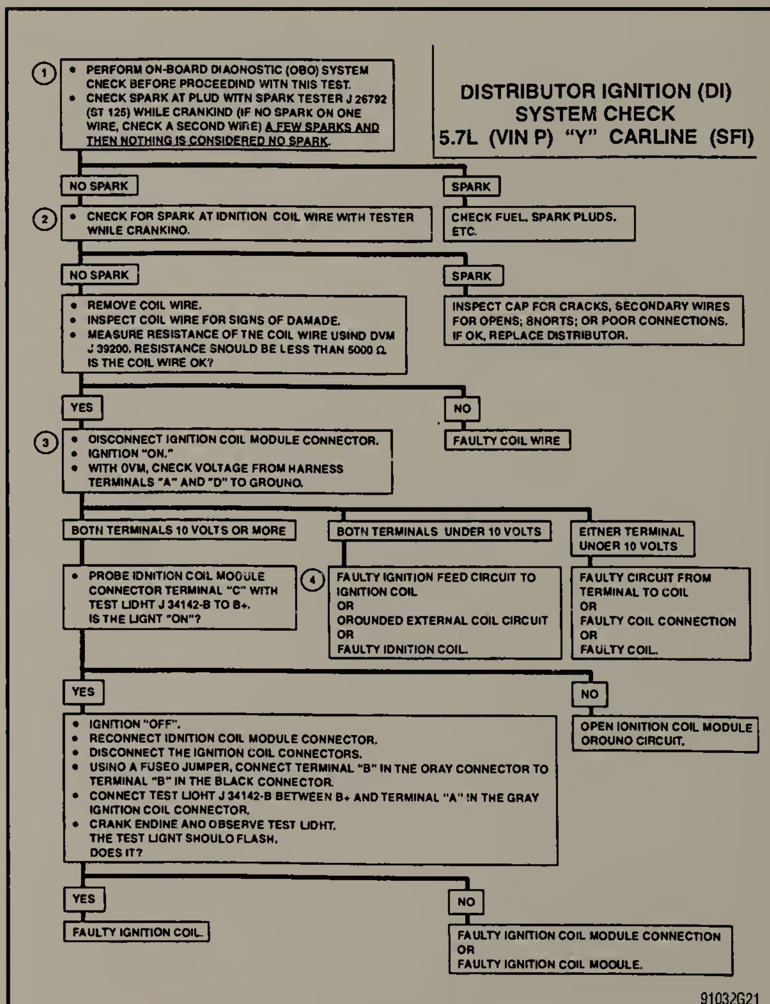


Fig. 36 Ignition system check—1995-96 5.7L (VIN P and 5) engines

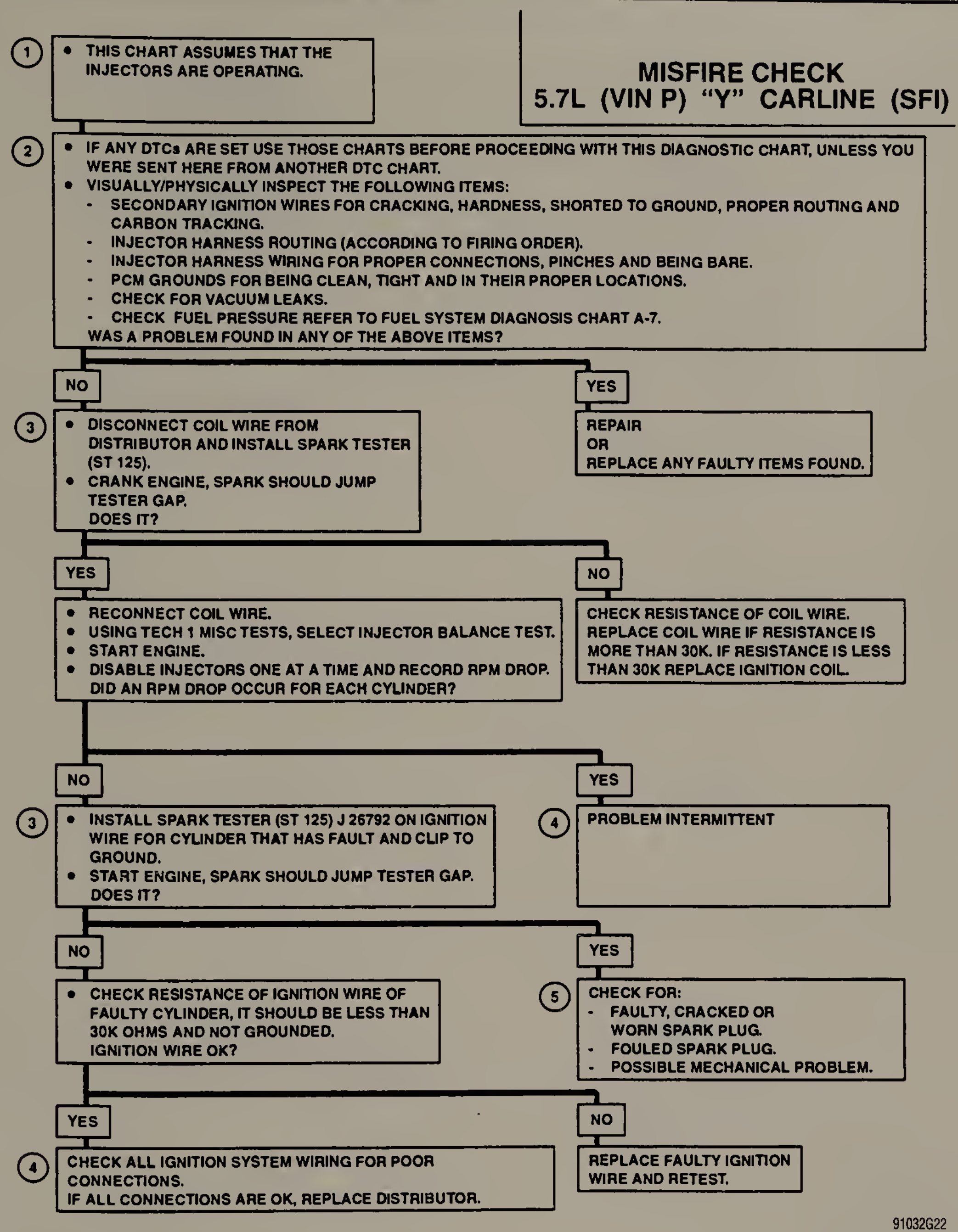


Fig. 37 Ignition system diagnosis for misfire—1994–96 5.7L (VIN P and 5) engines

2. Using an ohmmeter (on the low scale), connect the probes between both primary terminals. The reading should be very low or zero; if not, replace the coil.
3. Using an ohmmeter (on the high scale), connect the probes between a primary terminal and the secondary (high voltage) terminal. The reading should be high (not infinite); if not, replace the coil.

DISTRIBUTOR VENTILATION SYSTEM CHECK

See Figures 38 and 39

The distributor ventilation system is used on 1995–96 vehicles. The distributor ventilation system vacuum harness is connected to the air intake duct, the distributor and the intake manifold. The vacuum harness provides ventilation for the distributor, preventing any moisture from accumulating and causing ignition system problems or failure.

The distributor vacuum harness attaches to the air intake duct and the intake manifold with vacuum fittings. It connects to the distributor at two places with separately sized connectors.

1. Disconnect the distributor vacuum hose from the intake manifold. Connect a hand held vacuum pump to the distributor vacuum hose. Apply vacuum and observe the vacuum pump gauge. The vacuum should not build or should bleed off quickly.
2. If vacuum builds and does not bleed off quickly, check the system for blocked, restricted or collapsed hoses. Check the connections at the distributor cap for blockage. Check for a faulty check valve or check valve/filter.
3. If the vacuum bleeds off quickly, or does not build at all, leave the vacuum pump connected. Disconnect the distributor clean air supply hose from the air intake duct and plug it with a suitable stopper. Apply 10 in. Hg (34 kPa) of vacuum and observe the gauge. The vacuum should hold. If vacuum does not hold, check the system for vacuum leaks, damaged hoses or connections. Check the seal between the distributor cap and distributor and also, check the cap for cracks or damage. If vacuum does hold, proceed with the following steps.
4. Remove the stopper from the clean air supply hose. Disconnect the vacuum pump. Connect the vacuum pump to the clean air supply hose. Apply 10 in. Hg (34 kPa) of vacuum and observe the gauge. The vacuum should hold. If vacuum does NOT hold, the check valve is faulty and must be replaced. If the vacuum does hold, the system is OK, and you should check for a probable blocked or restricted vacuum source.
5. Once you determine the distributor ventilation system vacuum harness is operating properly, disconnect the vacuum gauge and reconnect the vacuum hose to the air intake duct.

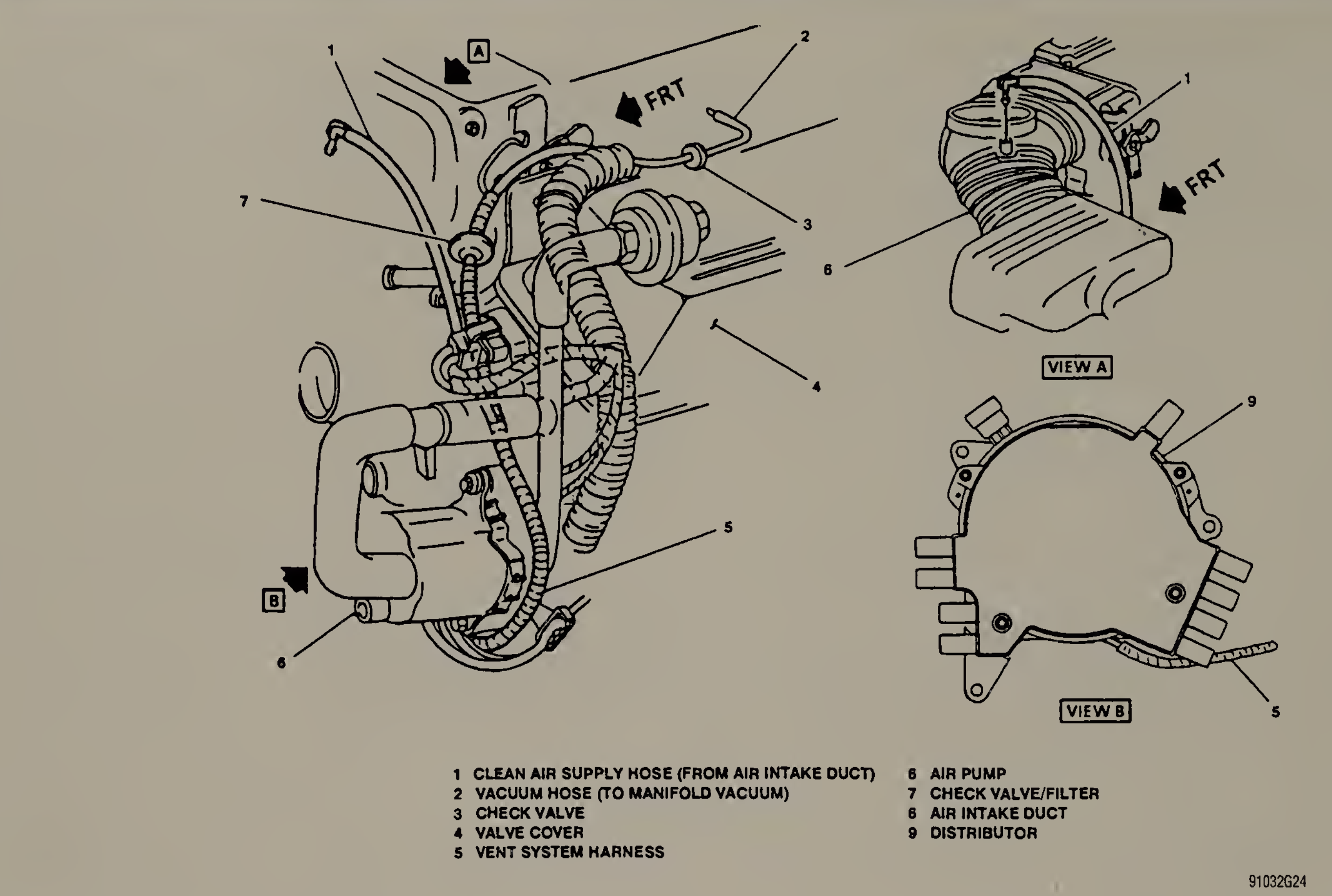


Fig. 38 Distributor ventilation system components—1995 vehicles

Fig. 39 Distributor ventilation system components—1996 vehicles

Ignition Coil and Module/Driver

REMOVAL & INSTALLATION

See Figures 40 and 41

1. Disconnect the negative battery cable.
2. Detach the 4-terminal ECM connector from the driver.
3. Tag and detach the coil connectors.
4. Disconnect the coil secondary wire.

On 1992 vehicles, the module is referred to as the ignition coil driver. On later vehicles, it is called the ignition coil module.

5. Remove the Ignition Coil Module (ICM) retaining bolt and stud from the engine.
6. Remove the ICM and bracket from the vehicle.
7. If necessary, remove the coil from the module and brackets, as follows:
   a. Remove the bolts retaining the coil to the module and brackets. The coil may be held onto the brackets by rivets. If so, drill out the rivets to remove.
   b. Remove the remaining screws and the ignition coil module from the assembly.

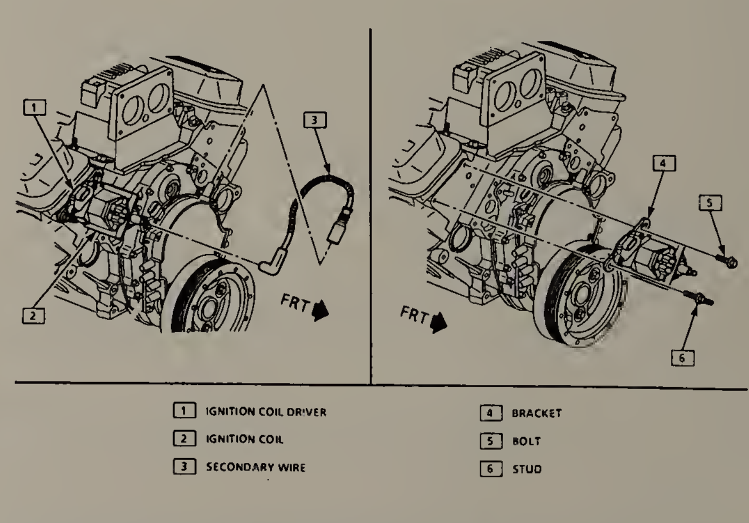


Fig. 40 Exploded view of the ignition coil, driver/module and bracket—5.7L (VIN P) engine

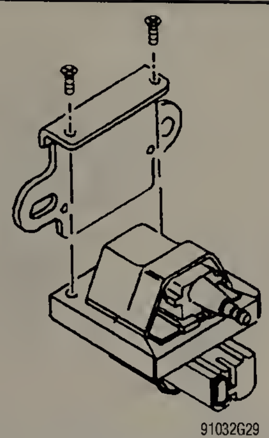


Fig. 41 The ignition coil is mounted to the bracket with 2 retaining screws

➡Do not wipe the silicone grease from the bottom of the ignition coil assembly, if it is to reinstalled.

To install:

8. If installing a new ignition coil module, spread the silicone grease included with the new module on the metal mounting face of the module and on the bracket where it seats. If reusing the old module, confirm that the grease is still present on the module.
9. Position the ignition coil module onto the bracket and install the retainers. Tighten the screws to 15 inch lbs. (1.7 Nm).
10. Install the coil to the brackets and install the screws provided with the replacement coil. Tighten the new screws to 25 inch lbs. (2.8 Nm).
11. Position the coil assembly onto the cylinder head assembly. Install the stud and tighten to 18 ft. lbs. (25 Nm).
12. Install the mounting screw and tighten to 18 ft. lbs. (25 Nm).
13. Engage the ignition coil harness and coil wiring connectors.
14. Attach the four-terminal ECM/PCM connector to the ignition coil module.
15. Connect the negative battery cable.

Ignition Coil Driver/Module

REMOVAL & INSTALLATION

➧ See Figure 40

1. Disconnect the negative battery cable.
2. Unplug the 4-terminal ECM connector from the ignition control module/driver.
3. Unfasten the 2 driver attaching screws.

To install:

➡A package of silicone grease is included with the new driver/module. Spread the grease onto the metal face of the driver, and also on the mounting bracket where the driver seats. The grease is very important to proper driver cooling.

4. Position the driver and secure with the attaching screws. Tighten the screws to 14 inch lbs. (1.7 Nm).
5. Attach the 4-pin connector to the driver/module.
6. Connect the negative battery cable.

Distributor

REMOVAL & INSTALLATION

➧ See Figures 42, 43, 44, 45 and 46

1. For 1995–96 vehicles, inspect the distributor ventilation system for proper ventilation.
2. Be sure the ignition is in the **OFF** or **LOCK** position. Disconnect the negative battery cable.
3. Detach the Intake Air Temperature (IAT) electrical connector.

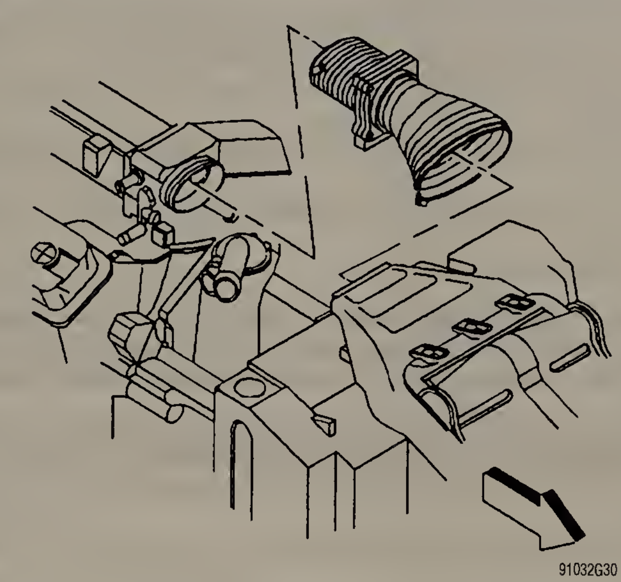


Fig. 42 Unfasten the retainers, then remove the air intake duct

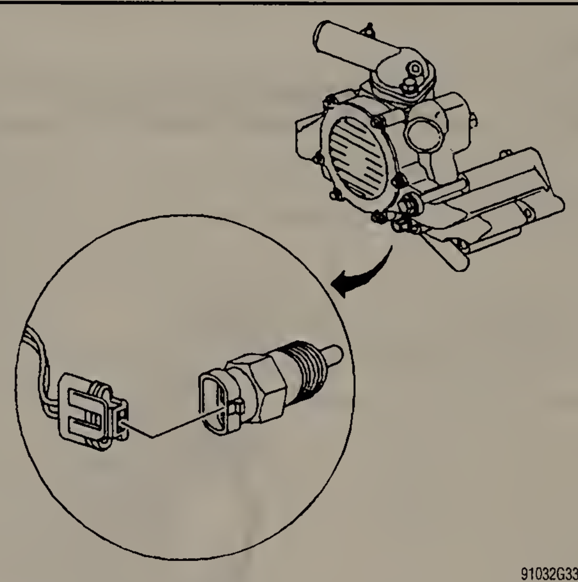


Fig. 43 Unplug the electrical connector from the ECT sensor

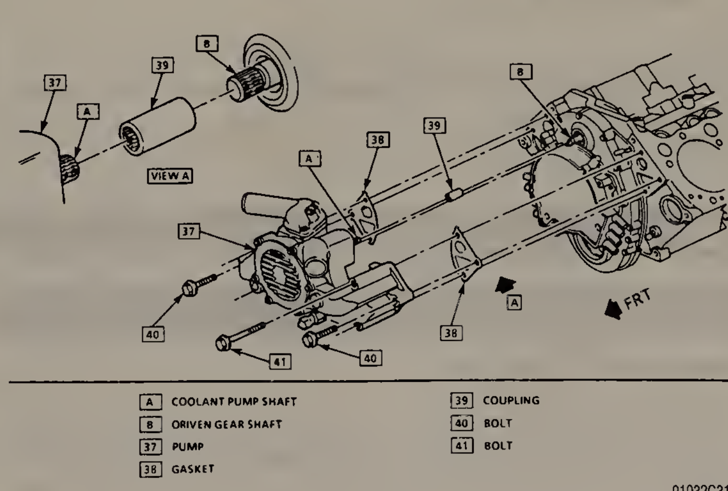


Fig. 44 The water pump must be removed for access to the distributor

4. Remove the air intake duct.
5. Remove the accessory drive belt, as outlined in Section 1 of this manual.
6. Drain the engine cooling system into a suitable container.
7. Disconnect the water pump coolant hoses, and allow any remaining coolant to drain.
8. Detach the Engine Coolant Temperature (ECT) sensor electrical connector.
9. Remove the water pump and crankshaft balancer, as outlined in Section 3 of this manual.
10. Remove the drive belt tensioner.

➡The spark plug wire boots should be twisted ½ turn in each direction while removing. Do not pull on the wires to remove them from the spark plugs. Pull on the boots or use a tool specifically designed for this purpose.

11. Label and disconnect the spark plug wires/harness from the distributor.
12. Unplug the 4-terminal ECM/PCM electrical connector from the distributor.
13. If equipped, disconnect the distributor vacuum harness from the distributor.
14. Loosen and remove the distributor attaching bolts.
15. Pull the distributor assembly forward until the driveshaft disengages from the end of the camshaft.
16. Mark the top surface of the driveshaft for proper alignment during installation.

To install:

➡Replace the O-rings on the coupling shaft or ignition system performance may suffer. Lubricate the O-rings and the end of the camshaft.

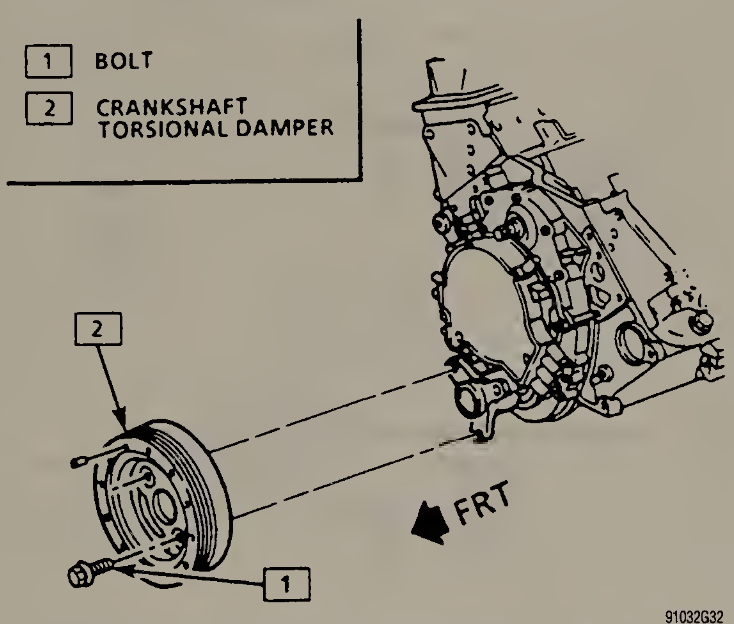


Fig. 45 You must also remove the crankshaft torsional damper, also known as the balancer

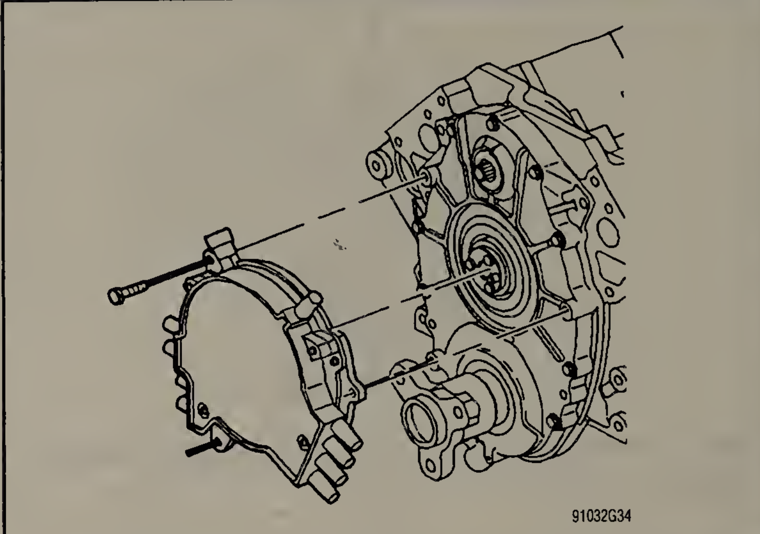


Fig. 46 Exploded view of the distributor mounting—5.7L (VIN P and 5) engines

WARNING

Don't try to fully seat the distributor using the distributor retainers. If the distributor will not seat by hand, it's not properly aligned with the camshaft. Rotate the crankshaft until the engine is at the number 1 cylinder TDC (camshaft sprocket pin at the 9 o'clock position). Rotate the distributor coupling until the camshaft sprocket pin slot aligns with the distributor base timing mark. Install the distributor using hand pressure to fully seat the distributor.

17. Install the distributor assembly into position with the driveshaft in the end of the camshaft. Rotate the distributor coupling until the camshaft sprocket pin slot aligns with the camshaft sprocket pin. Slide the distributor onto the end of the camshaft until fully seated on the engine front cover.
18. Install the distributor mounting bolts. Tighten to 8–9 ft. lbs. (11–12 Nm).
19. Attach the 4-pin ECM/PCM connector.
20. If equipped, attach the distributor vacuum harness to the distributor.
21. Connect the spark plug wires to the distributor, as tagged during removal.
22. Install the drive belt tensioner.
23. Install the crankshaft balancer and water pump, as outlined in Section 3 of this manual.
24. Attach the ECT sensor connector.
25. Refill the cooling system with the proper type and amount of coolant.
26. Install the accessory drive belt.
27. Install the air intake duct and attach the IAT sensor electrical connector.
28. Connect the negative battery cable.

Crankshaft and Camshaft Position Sensors

For information regarding these sensors, please refer to Section 4 of this manual.

DISTRIBUTORLESS IGNITION SYSTEM

General Information

▸ See Figures 47, 48 and 49

The distributorless ignition system, also referred to as Direct Ignition System (DIS) or Electronic Ignition (EI) system is found on 1990–95 vehicles equipped with the 5.7 (VIN J) engine. This system uses a "waste spark" method of spark distribution. Each cylinder is paired with its opposing cylinder in the firing order, so that one cylinder on the compression stroke fires simultaneously with an opposing cylinder which is on the exhaust stroke. Since the cylinder on the exhaust stroke requires little of the available voltage to fire its plug, most of the voltage is used to fire the cylinder on compression. The process reverses when the cylinders reverse roles.

Components of this system include the ignition coil pack, ignition control module, crankshaft position sensor assembly, crankshaft reluctor ring, camshaft sensor and the Engine Control Module (ECM) or Powertrain Control Module (PCM). The coil pack consists of four separate, interchangeable, ignition coils. The ignition module or Ignition Control Module (ICM) is located under the intake plenum and is connected to the ECM/PCM. The ignition coil module controls the primary circuit to the coils, turning them on and off.

A magnetic crankshaft position sensor assembly is used in this system. The sensor protrudes from the engine block, within approximately 0.050 in.

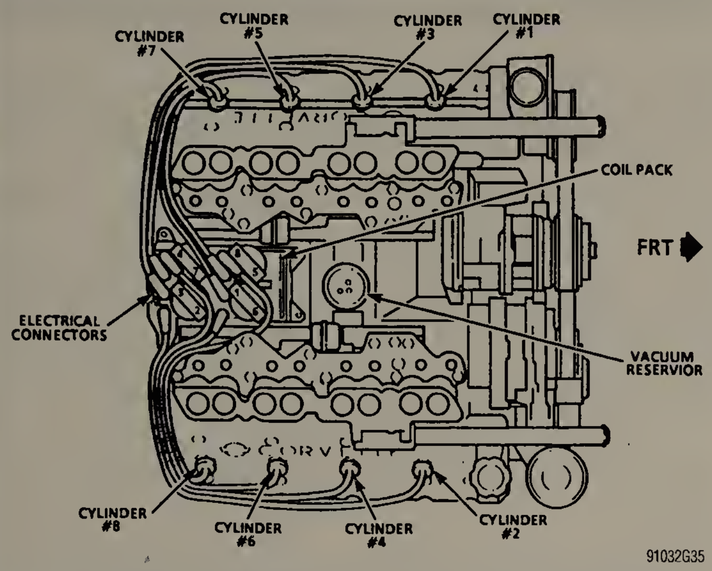


Fig. 47 Location of the ignition coil pack, and cylinder identification—5.7L (VIN J) engine

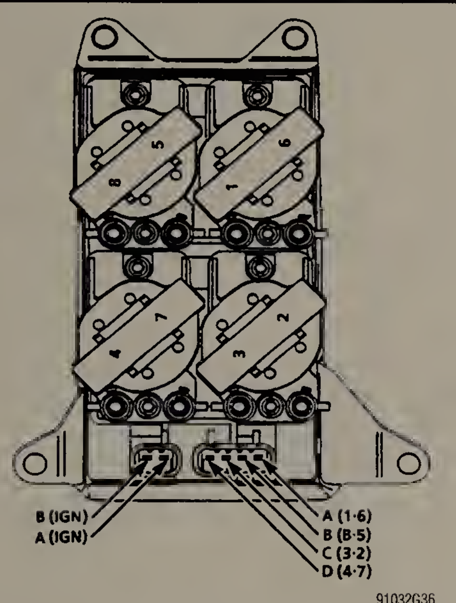


Fig. 48 The ignition coil pack contains 4 separate coils

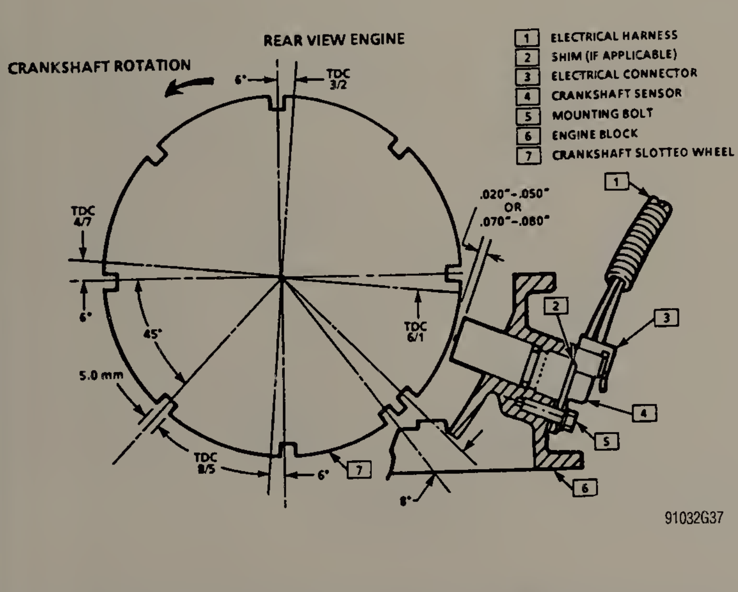


Fig. 49 Crankshaft and sensor operation, based on engine rotation

(1.27mm) of the crankshaft reluctor. The reluctor is a special wheel cast onto the crankshaft assembly that has nine machined slots, eight of which are equally spaced 45 degrees apart, and the ninth is spaced 8 degrees from one of the other slots. As the reluctor rotates with the crankshaft, the slots change the magnetic field of the crankshaft position sensor assembly, causing an induced voltage pulse. By counting the time between pulses, the ignition control module can recognize the pulse of the seventh slot. Based on this pulse caused by the seventh slot, the ignition control module sends the reference signal to the ECM/PCM to calculate crankshaft position, used to fire coils in correct sequence, and engine speed.

Base ignition timing is preset when the engine is manufactured, and no adjustment is possible. Timing advance and retard are accomplished through the ECM/PCM with ignition control and knock sensor systems.

Diagnosis and Testing

SPARK TEST

See Figures 50, 51 and 52

Because of the high voltage produced by the distributorless ignition system and to avoid overstressing the coil/module, an inductive or neon type spark

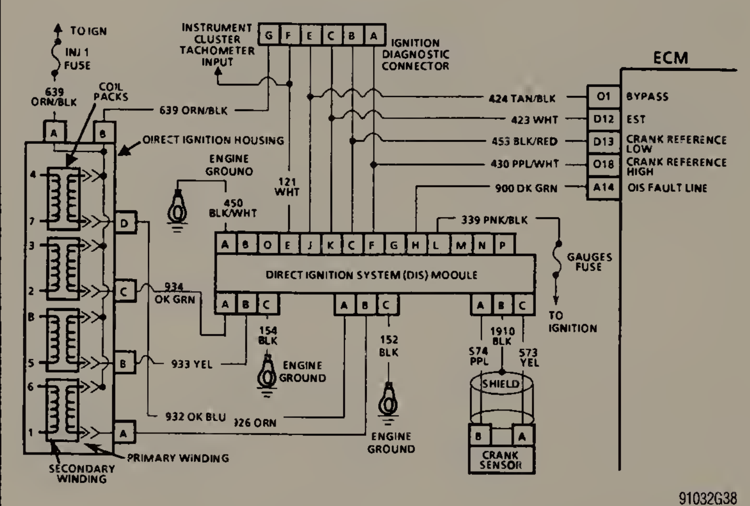


Fig. 50 Ignition system wiring—1990–91 5.7L (VIN J) engine

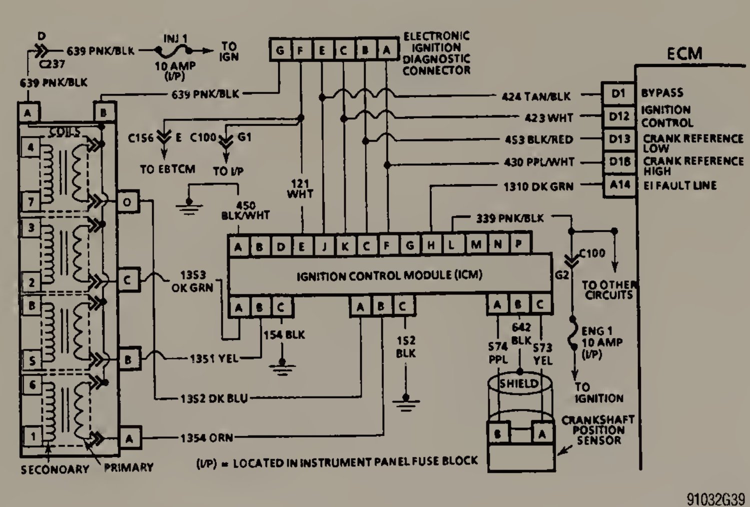


Fig. 51 Ignition system wiring—1992–95 5.7L (VIN J) engine

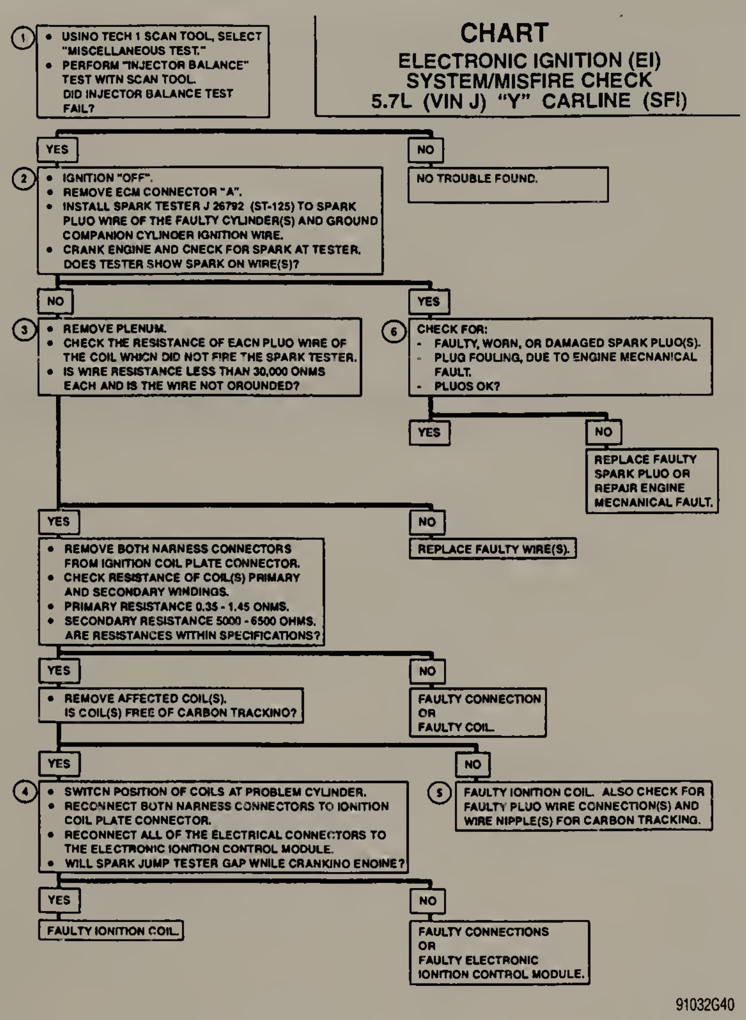


Fig. 52 Ignition system check—5.7L (VIN J) engine

tester should be used to check for spark. These tools are commonly available at most auto parts stores. Follow the tool manufacturer's instructions to test for spark. Follow the diagnosis chart to check the ignition system.

Ignition Coil

TESTING

1. Remove the ignition coil(s).
2. Using an ohmmeter, check the resistance between the primary terminals on the underside of the coil. The resistance should be 0.35–1.45 ohms.
3. Check the resistance between the secondary terminals. It should be 5000–6,500 ohms.
4. If the coil failed either test, replace the coil.

REMOVAL & INSTALLATION

See Figure 48

1. Disconnect the negative battery cable.
2. Remove the intake plenum.
3. Tag and disconnect the spark plug wires from the ignition coil.
4. Unfasten the coil retaining bolts, then remove the coil from the module.

To install:

5. Position the coil to the module and secure with the retaining bolts. Tighten the bolts to 40 inch lbs. (4.5 Nm).
6. Attach the spark plug wires to the ignition coil, as tagged during removal.
7. Install the intake plenum.
8. Connect the negative battery cable.

Ignition Control Module

REMOVAL & INSTALLATION

See Figures 53 and 54

The Ignition Control Module (ICM), is also referred to as simply the ignition module.

Before removing the ignition control module, make sure to properly identify the module, then refer to the instruction sheet packaged with the replacement module.

1. Disconnect the negative battery cable.
2. Remove the intake plenum.
3. Detach the ignition module electrical connectors.
4. Unfasten the 4 retaining bolts, then remove the ignition module from the vehicle.

To install:

5. Apply the silicone dielectric grease, supplied with the replacement kit, to the back of the ignition module, as shown in the accompanying figure.
6. Place the ignition module in position, then secure with the retaining bolts. Tighten the bolts to 89 inch lbs. (10 Nm).
7. Attach the electrical connectors nearest the front of the engine to the ignition control module.

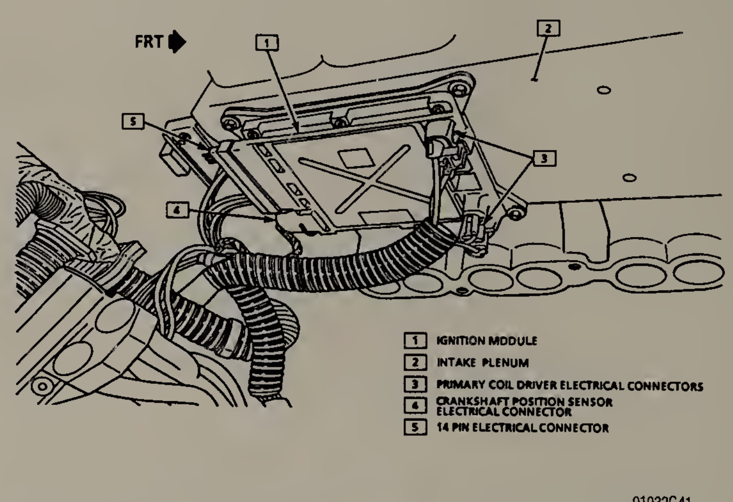


Fig. 53 The Ignition Control Module (ICM) is mounted to the intake plenum

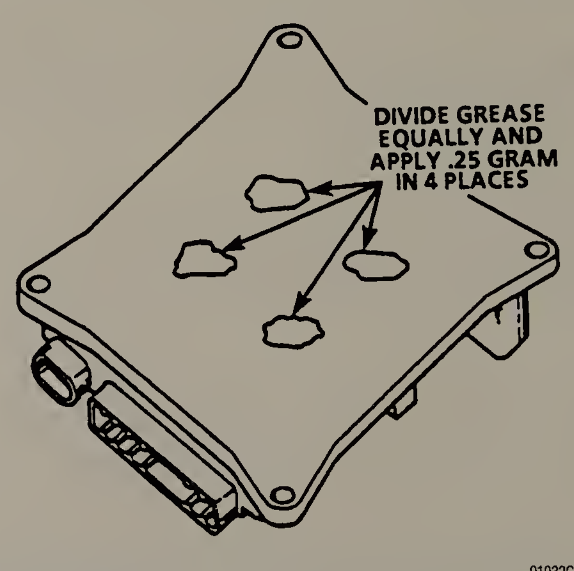


Fig. 54 Divide the silicone grease in 4 parts, then apply evenly to the rear of the module

8. Install the intake plenum.
9. Install the 14-pin connector screw and tighten to 9 inch lbs. (1 Nm).
10. Connect the negative battery cable.

Ignition Coil Plate Connector

REMOVAL & INSTALLATION

➡The ignition coil plate connector may also be referred to as the direct ignition housing.

1. Disconnect the negative battery cable.
2. Remove the intake plenum.
3. Tag and disconnect the spark plug wires from the ignition coil.
4. Detach the electrical connectors.
5. Unfasten the 4 ignition coil bracket retaining bolts.
6. Note the position of the coils, then remove the retaining bolts. There are 2 bolts per coil.
7. Remove the coils from the ignition coil plate connector.
8. Remove the ignition coil plate connector from the bracket.

To install:

9. Place the ignition coil plate connector on the bracket.
10. Install the 4 seals packaged with the ignition coil plate connector.
11. Position the coils on the ignition coil plate connector.
12. Install the coil retaining bolts and tighten to 40 inch lbs. (4.5 Nm).
13. Install the ignition coil plate connector bracket on the engine. Install the retaining bolts and tighten as follows:
    a. M6–16 bolts: 89 inch lbs. (10 Nm).
    b. M8–20 bolts: 19 ft. lbs. (26 Nm).
14. Attach the electrical connectors and spark plug wires, as tagged during removal.
15. Install the intake plenum, then connect the negative battery cable.

Crankshaft and Camshaft Position Sensors

For information regarding these sensors, please refer to Section 4 of this manual.

FIRING ORDERS

➧ See Figures 55, 56 and 57

➡To avoid confusion, remove and tag the spark plug wires one at a time, for replacement.

If a distributor is not keyed for installation with only one orientation, it could have been removed previously and rewired. The resultant wiring would hold the correct firing order, but could change the relative placement of the plug towers in relation to the engine. For this reason it is imperative that you label all wires before disconnecting any of them. Also, before removal, compare the current wiring with the accompanying illustrations. If the current wiring does not match, make notes in your book to reflect how your engine is wired.

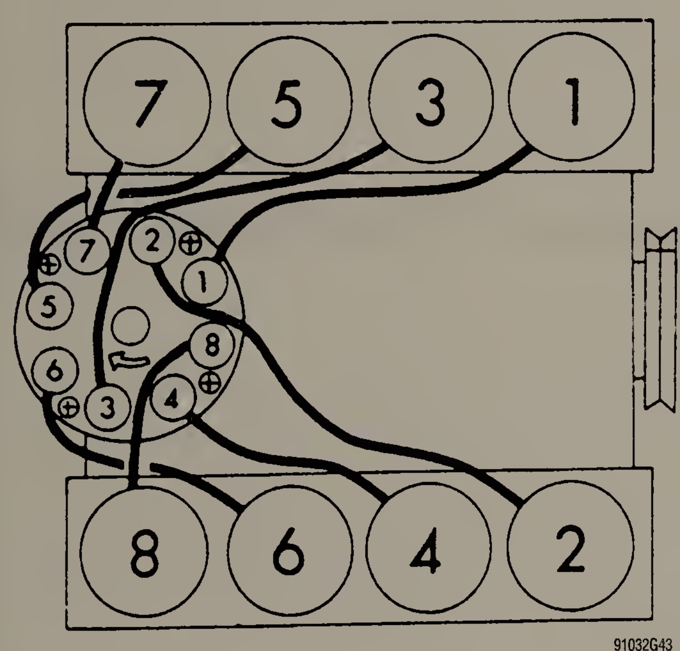


Fig. 55 5.7L (VIN 8) Engines
Engine firing order: 1–8–4–3–6–5–7–2
Distributor rotation: clockwise

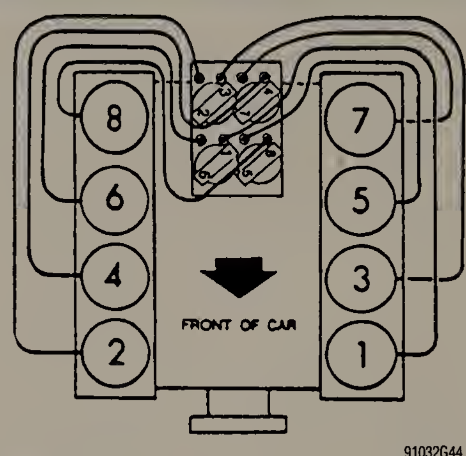


Fig. 56 5.7L (VIN J) Engines
Engine firing order: 1–8–4–3–6–5–7–2
Distributorless Ignition System

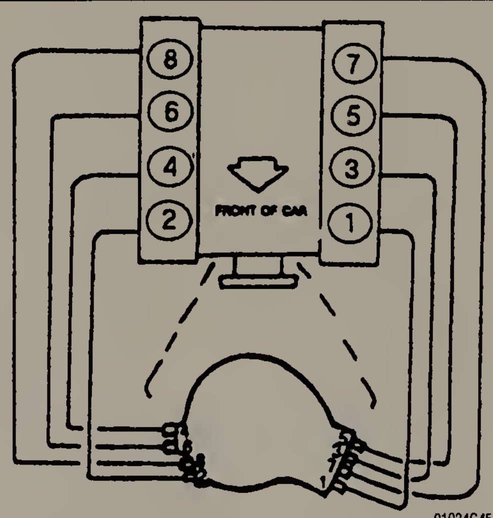


Fig. 57 5.7L (VIN P and 5) Engines
Engine firing order: 1–8–4–3–6–5–7–2
Distributor rotates with camshaft

CHARGING SYSTEM

The automobile charging system provides electrical power for operation of the vehicle's ignition system, starting system and all electrical accessories. The battery serves as an electrical surge or storage tank, storing (in chemical form) the energy originally produced by the engine driven generator. The system also provides a means of regulating output to protect the battery from being overcharged and to avoid excessive voltage to the accessories.

The storage battery is a chemical device incorporating parallel lead plates in a tank containing a sulfuric acid/water solution. Adjacent plates are slightly dissimilar, and the chemical reaction of the two dissimilar plates produces electrical energy when the battery is connected to a load such as the starter motor. The chemical reaction is reversible, so that when the alternator is producing a voltage (electrical pressure) greater than that produced by the battery, electricity is forced into the battery, and the battery is returned to its fully charged state.

Newer automobiles use alternating current alternators, because they are more efficient, can be rotated at higher speeds, and have fewer brush problems. In an alternator, the field usually rotates while all the current produced passes only through the stator winding. The brushes bear against continuous slip rings. This causes the current produced to periodically reverse the direction of its flow. Diodes (electrical one way valves) block the flow of current from traveling in the wrong direction. A series of diodes is wired together to permit the alternating flow of the stator to be rectified back to 12 volts DC for use by the vehicle's electrical system.

The voltage regulating function is performed by a regulator. On these vehicles, the regulator is built in to the alternator; this system is termed an integrated or internal regulator.

An alternator differs from a DC shunt generator in that the armature is stationary, and is called the stator, while the field rotates and is called the rotor. The higher current values in the alternator's stator are conducted to the external circuit through fixed leads and connections, rather than through a rotating commutator and brushes as in a DC generator. This eliminates a major point of maintenance.

The rotor assembly is supported in the drive end frame by a ball bearing and at the other end by a roller bearing. These bearings are lubricated during assembly and require no maintenance. There are six diodes in the end frame assembly. These diodes are electrical check valves that also change the alternating current developed within the stator windings to a Direct Current (DC) at the output (BAT) terminal. Three of these diodes are negative and are mounted flush with the end frame while the other three are positive and are mounted into a strip called a heat sink. The positive diodes are easily identified as the ones within small cavities or depressions.

The alternator charging system is a negative (ñ) ground system which consists of an alternator, a regulator, a charge indicator, a storage battery and wiring connecting the components, and fuse link wire.

The alternator is belt-driven from the engine. Energy is supplied from the alternator/regulator system to the rotating field through two brushes to two slip-rings. The slip-rings are mounted on the rotor shaft and are connected to the field coil. This energy supplied to the rotating field from the battery is called excitation current and is used to initially energize the field to begin the generation of electricity. Once the alternator starts to generate electricity, the excitation current comes from its own output rather than the battery.

The alternator produces power in the form of alternating current. The alternating current is rectified by 6 diodes into direct current. The direct current is used to charge the battery and power the rest of the electrical system.

When the ignition key is turned **ON**, current flows from the battery, through the charging system indicator light on the instrument panel, to the voltage regulator, and to the alternator. Since the alternator is not producing any current, the alternator warning light comes on. When the engine is started, the alternator begins to produce current and turns the alternator light off. As the alternator turns and produces current, the current is divided in two ways: part to the battery (to charge the battery and power the electrical components of the vehicle), and part is returned to the alternator (to enable it to increase its output). In this situation, the alternator is receiving current from the battery and from itself. A voltage regulator is wired into the current supply to the alternator to prevent it from receiving too much current which would cause it to put out too much current. Conversely, if the voltage regulator does not allow the alternator to receive enough current, the battery will not be fully charged and will eventually go dead.

The battery is connected to the alternator at all times, whether the ignition key is turned **ON** or not. If the battery were shorted to ground, the alternator would also be shorted. This would damage the alternator. To prevent this, a fuse link is installed in the wiring between the battery and the alternator. If the battery is shorted, the fuse link melts, protecting the alternator.

An alternator is better that a conventional, DC shunt generator because it is lighter and more compact, because it is designed to supply the battery and accessory circuits through a wide range of engine speeds, and because it eliminates the necessary maintenance of replacing brushes and servicing commutators.

Alternator Precautions

✲✲ CAUTION

To prevent damage to the alternator and possible to yourself, the following precautions should be taken when working with the electrical system.

1. Never reverse the battery connections.
2. Booster batteries for starting must be connected properly: positive-to-positive and negative-to-negative.
3. Disconnect the battery cables before using a fast charger; the charger has a tendency to force current through the diodes in the opposite direction for which they were designed. This burns out the diodes.
4. Never use a fast charger as a booster for starting the vehicle.
5. Never disconnect the voltage regulator while the engine is running.
6. Avoid long soldering times when replacing diodes or transistors. Prolonged heat is damaging to AC (alternating current) generators.
7. Do not use test lamps of more than 12 volts (V) for checking diode continuity.
8. Do not short across or ground any of the terminals of the AC (alternating current) generator.
9. The polarity of the battery, generator, and regulator must be matched and considered before making any electrical connections within the system.
10. Never operate the alternator on an open circuit. Make sure that all connections within the circuit are clean and tight.
11. Disconnect the battery terminals when performing any service on the electrical system. This will eliminate the possibility of accidental reversal of polarity.
12. Disconnect the battery ground cable if arc welding is to be done on any part of the car.

Alternator

TESTING

There are many possible ways in which the charging system can malfunction. Often the source of a problem is difficult to diagnose, requiring special equipment and a good deal of experience. However, when the charging system fails completely and causes the dash board warning light to come on or the battery to become dead the following items may be checked:

1. The battery is known to be good and fully charged.
2. The alternator belt is in good condition and adjusted to the proper tension.
3. All connections in the system are clean and tight.

1984 Vehicles

ON-VEHICLE VOLTAGE REGULATOR TEST

▸ See Figure 58

➡This test is performed with the alternator installed.

1. Connect a fast charger and a voltmeter to the battery as shown in the accompanying figure.
2. Turn the ignition **ON**, and slowly increase the charge rate. The alternator light in the vehicle will dim at the voltage regulator setting. The voltage regulator setting should be a minimum of 13.5 volts and a maximum of 16.0 volts.

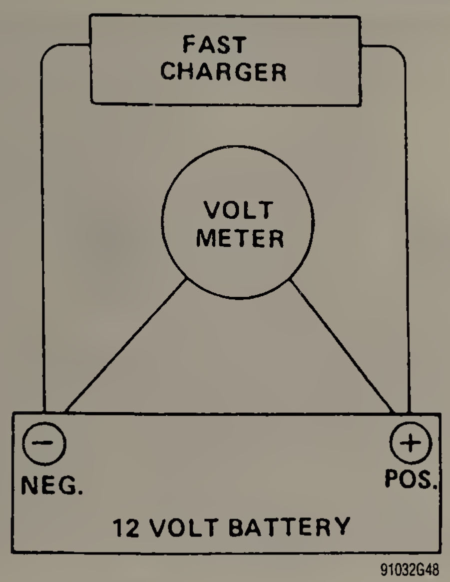


Fig. 58 On vehicle voltage regulator test

3. This test will work even if the rotor circuit is good, even if the stator rectifier bridge or diode trio is bad.

OFF-VEHICLE VOLTAGE REGULATOR TEST

➧ See Figure 59

1. Connect a voltmeter and a fast charger to a 12-volt battery, as shown in the accompanying figure.
2. Connect the regulator and test light as shown, observing battery polarity.
3. The test light should be on.
4. Turn the fast charger on, and slowly increase the charge rate. Observe the voltmeter; the light should go out at the voltage regulator setting.
5. The voltage regulator setting should be a minimum of 13.5 volts and a maximum of 16.0 volts.

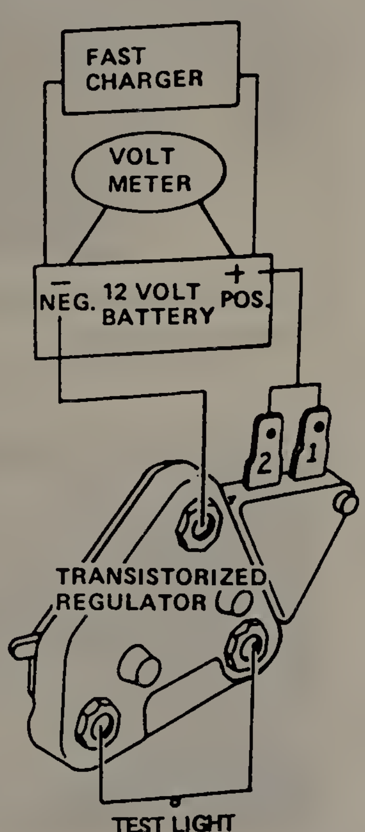


Fig. 59 Off vehicle voltage regulator test connections

1985–96 Vehicles

ALTERNATOR ON-VEHICLE OUTPUT TEST

➡The battery must be fully charged to perform this test.

1. Connect an ammeter in series at the alternator output "BAT" terminal.
2. Connect the voltmeter and carbon pile across the battery terminals.
3. Operate the engine at a moderate speed. With the carbon pile turned "OFF", check the voltage across the battery terminals:
   a. If the reading is above 16 volts, the alternator must be repaired or replaced.
   b. If the reading is below 16 volts, proceed with the test.
4. With the engine still operating at moderate speed, turn the accessories ON, and load the battery with the carbon pile to get the maximum alternator output on the ammeter. Maintain the voltage above 13 volts:
   a. If the output is within 15 amperes of the rated output, the alternator is good.
   b. If the output is not within 15 amperes of the rated output, repair or replace the alternator.

ALTERNATOR BENCH TEST

➧ See Figure 60

➡The alternator must be removed from the vehicle and placed in a suitable test stand to perform this procedure. The battery must be fully charged to perform this test.

1. Remove the alternator from the vehicle and mount it in a suitable test stand, according to the stand's manufacturers instructions. The test stand must be capable of driving the alternator at 6,500 rpm.
2. Make test connections as shown in the accompanying figure, except leave the carbon pile disconnected. The ground polarity of the alternator and battery must be the same. Use a 30–500 ohm resistor between the battery and the "L" terminal of the alternator.
3. Rotate the pulley clockwise, slowly increase the alternator speed to 6500 rpm and observe the voltage.
4. If the voltage is uncontrolled and increases above 16.0 volts, either the rotor field is shorted, the regulator is faulty or both. A shorted rotor field can cause the regulator to malfunction.
5. If the voltage is below 16.0 volts, increase the speed and adjust the carbon pile to obtain maximum amperage output. Maintain the voltage above 13.0 volts.
6. If the output is within 15 amperes of the rated output, the alternator must be repaired or replaced.
7. If the output is not within 15 amperes of the rated output, the alternator must be repaired or replaced.

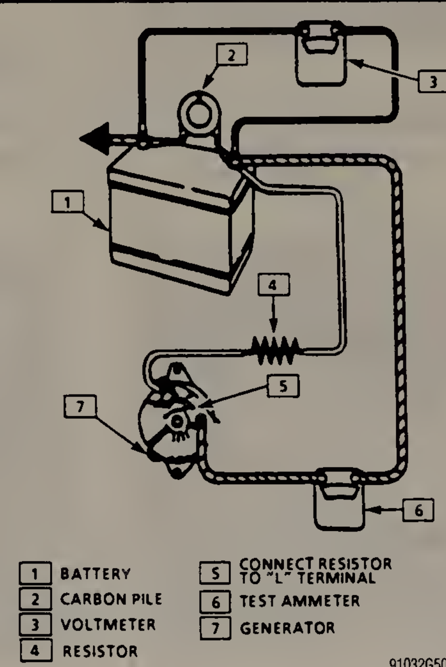


Fig. 60 Alternator bench check test connections—1985–91 vehicles

REMOVAL & INSTALLATION

CAUTION

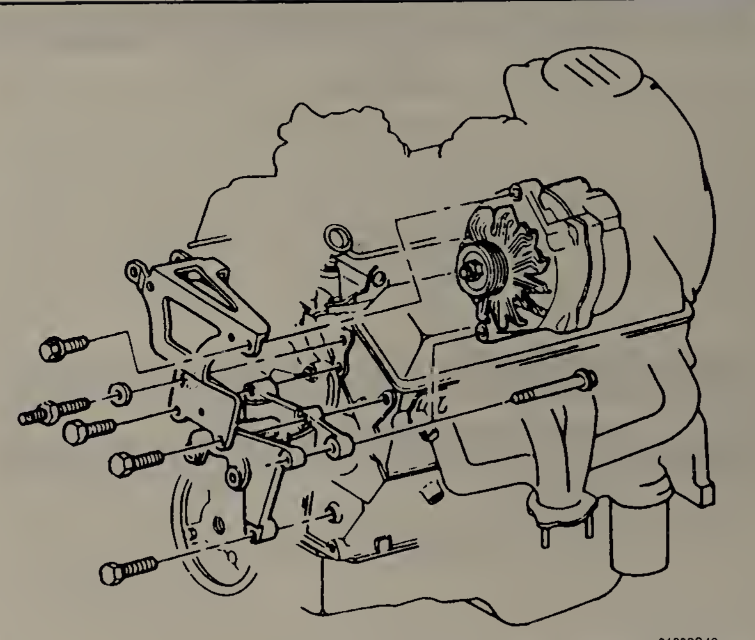
Failure to disconnect the battery cable may result in personal injury. If a tool is shorted at the alternator lead, the tool will heat enough to burn your skin.

5.7L (VIN 8) Engine

1984 VEHICLES

See Figure 61

1. Disconnect the negative battery cable.
2. Remove the air cleaner flex duct.
3. Remove the adjusting brace bolt.
4. Loosen the alternator mounting bolts.
5. Position the alternator to ease belt tension, then remove the belt from the alternator pulley.
6. Remove the alternator mounting bracket through bolt, then remove the alternator.
7. Installation is the reverse of the removal procedure.



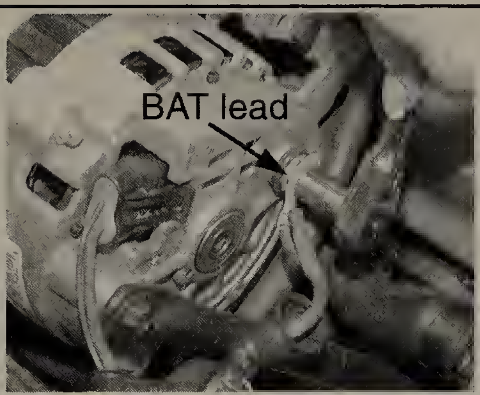
91032G46

Fig. 61 Exploded view of the alternator mounting—1984 vehicle shown

1985–88 VEHICLES

See Figures 62 thru 69

1. Disconnect the negative battery cable.
2. Remove the 2-terminal plug and battery leads from the back of the alternator.
3. Remove the alterantor bracket bolt.
4. Loosen the alternator-to-air pump bracket bolt, then swing the bracket aside.
5. Unfasten the bolt securing the alternator brace to the rear of the alternator.
6. Loosen the bolts, then remove the alternator drive belt.
7. Unfasten the alternator mounting through bolts, then remove the alternator from the vehicle.
8. Installation is the reverse of the removal procedure.

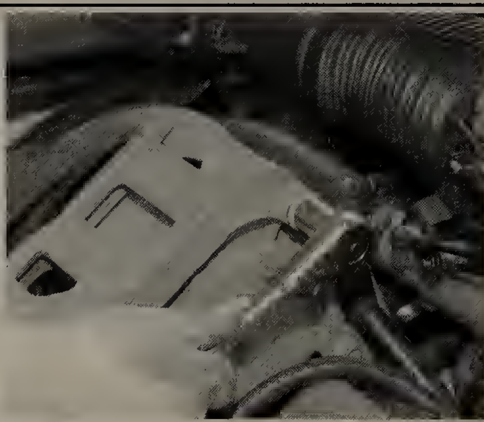


91032P18

Fig. 62 Unfasten the nut securing the battery lead to the rear of the alternator

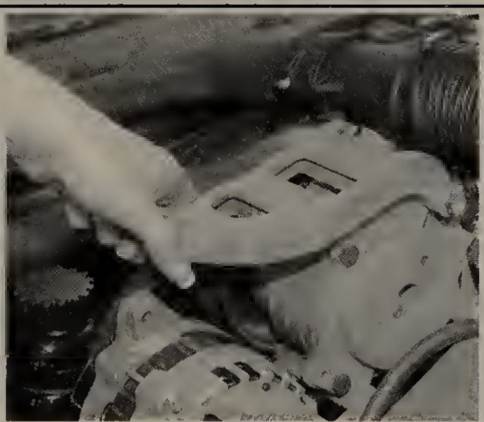
91032P19

Fig. 63 Unplug the remaining electrical connector from the rear of the alternator



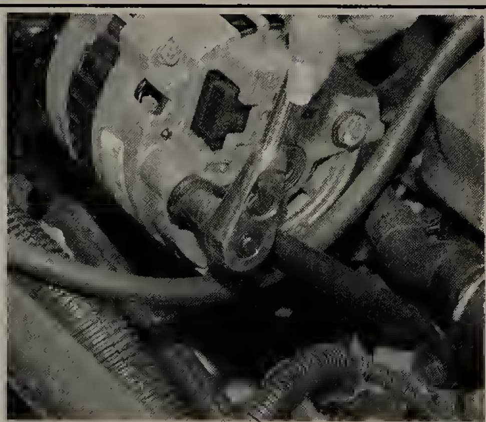
91032P21

Fig. 64 Loosen the bolt securing the bracket to the air pump . . .



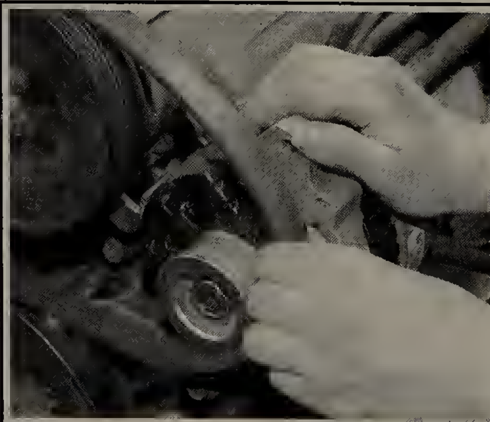
91032P22

Fig. 65 . . . then swing the bracket up and away from the alternator



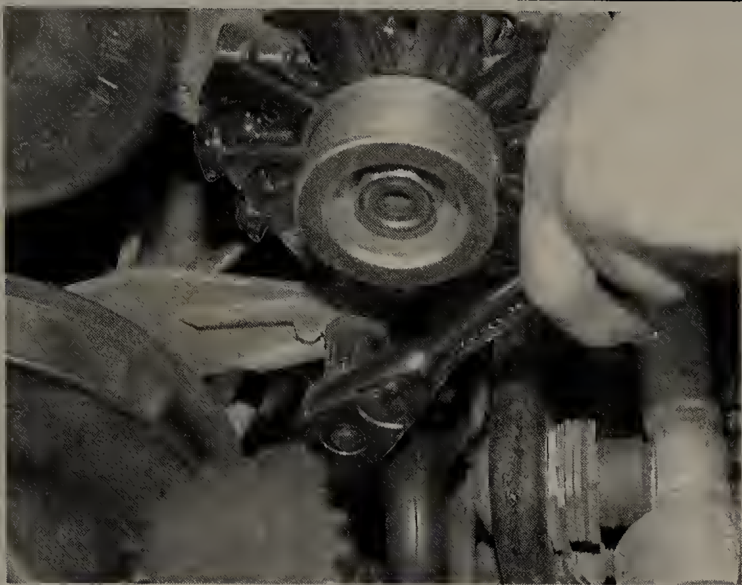
91032P23

Fig. 66 Remove the alternator-to-brace bolt



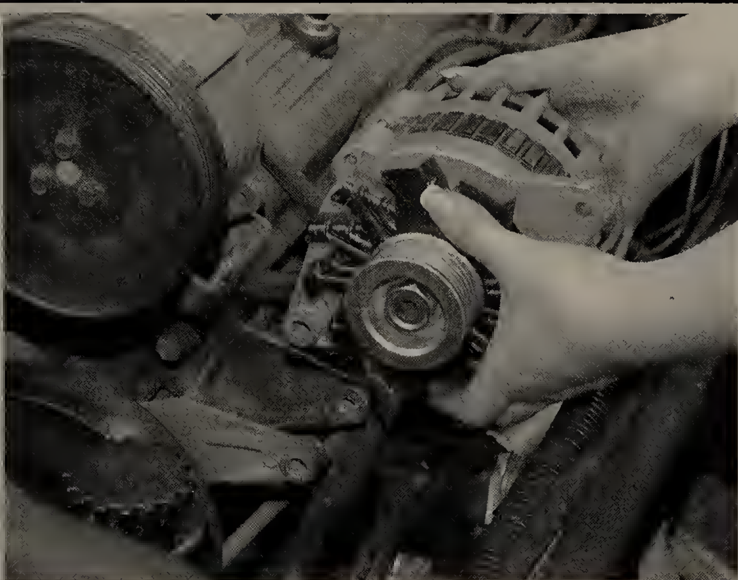
91032P20

Fig. 67 Loosen the bolts and unroute the drive belt from the alternator pulley



91032P24

Fig. 68 Remove the alternator through bolt . . .



91032P25

Fig. 69 . . . then remove the alternator from the vehicle

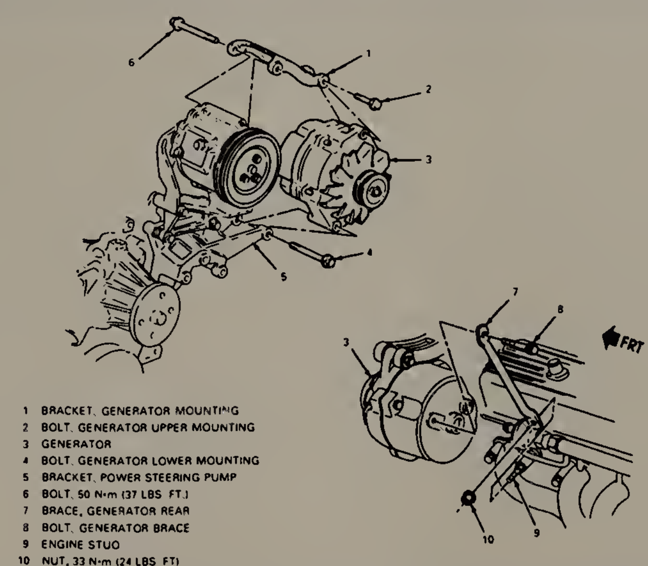
1989–91 VEHICLES

See Figure 70

1. Disconnect the negative battery cable.
2. Detach the regulator connector and battery lead from the back of the alternator.
3. Remove the serpentine drive belt, using a ½ in. breaker bar to rotate the tensioner.
4. Remove the alternator mounting bolts, then remove the alternator from the vehicle. If installing a new alternator, transfer the brackets to the new alternator.

To install:

5. Position the alternator in the vehicle. Install the lower mounting bolt finger-tight.
6. Install the upper alternator mounting bolt and tighten finger-tight.
7. Position the alternator brace onto the rear of the alternator, then install the brace bolt finger-tight.
8. Tighten the alternator bolts as follows:
   a. Lower mounting bolt: 37 ft. lbs. (50 Nm).
   b. Upper mounting bolt: 37 ft. lbs. (50 Nm).
   c. Brace bolt: 17 ft. lbs. (23 Nm).
9. Install the serpentine drive belt.



91032G47

Fig. 70 Exploded view of the alternator and related components—1989–91 5.7L (VIN G) engines

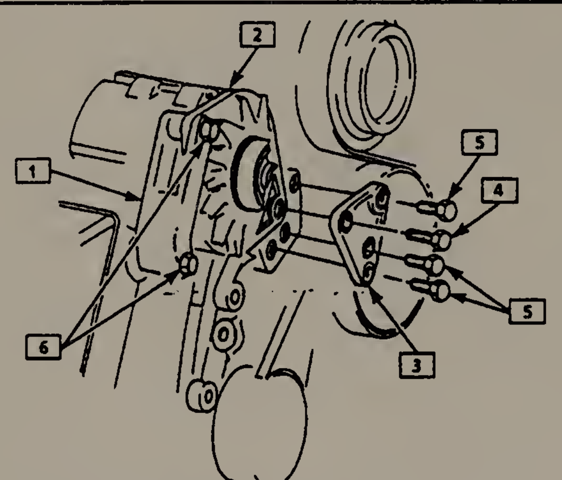
10. Attach the regulator connector and battery lead to the back of the alternator.
11. Connect the negative battery cable.

5.7L (VIN J) Engine

See Figure 71

1990 VEHICLES

1. Disconnect the negative battery cable.
2. Remove the air intake duct and the throttle body extension.
3. Remove the accelerator and cruise control cable clamps from the plenum.
4. Remove the throttle body, gasket and electrical connectors.
5. Position the throttle body aside with the cables attached.
6. Unfasten the water pump pulley bolts.
7. Remove the water pump pulley and serpentine belt by releasing the belt tension.



1 GENERATOR UPPER SUPPORT BRACKET
2 GENERATOR
3 GENERATOR LOWER SUPPORT BRACKET
4 GENERATOR LOWER MOUNTING BOLT
5 GENERATOR LOWER SUPPORT BRACKET BOLT
6 GENERATOR UPPER SUPPORT BRACKET BOLT

91032G51

Fig. 71 Exploded view of the alternator and bracket mounting—5.7L (VIN J) engine

8. Remove the alternator support bracket.
9. Remove the alternator lower mounting bolt.
10. Remove the engine oil temperature sensor.
11. Detach the alternator electrical connectors, then remove the alternator from the vehicle.

To install:

12. Attach the electrical connectors to the alternator, then position the alternator into the vehicle.
13. Apply Loctite® 565 to the threads of the lower mounting bolts, then install the bolts and tighten to 16 ft. lbs. (26 Nm).
14. Apply Loctite® 565 to the threads of the alternator support bracket, then install then bolts and tighten to 19 ft. lbs. (26 Nm).
15. Install the engine oil temperature sensor, making sure to use the proper sealer when installing the sensor.
16. Install the water pump pulley by releasing the belt tension and positioning the pulley onto the water pump flange. Install the pulley bolts and tighten to 89 inch lbs. (10 Nm).
17. Position the throttle body gasket, then install the throttle body. Tighten the throttle body-to-plenum bolts to 11 ft. lbs. (15 Nm).
18. Secure the accelerator and cruise control cable clamps onto the plenum.
19. Install the throttle body extension and tighten the bolts to 53 inch lbs. (6 Nm).
20. Check the serpentine belt tension, as outlined in Section 1 of this manual.
21. Install the air intake duct, then connect the negative battery cable.

1991–95 VEHICLES

1. Disconnect the negative battery cable.
2. Remove the air intake duct and the throttle body extension.
3. Remove the serpentine drive belt.
4. Remove the alternator lower mounting bolt and note the length.
5. Remove the alternator lower support bracket bolts and note the bolt lengths.
6. Remove the upper support bolts, noting the length, and remove the shield.
7. Remove the rear support brace.
8. Detach the oil sender electrical connector, then remove the sender.
9. Unplug the regulator connector and unscrew battery-to-alternator terminal, then remove the alternator from the vehicle.

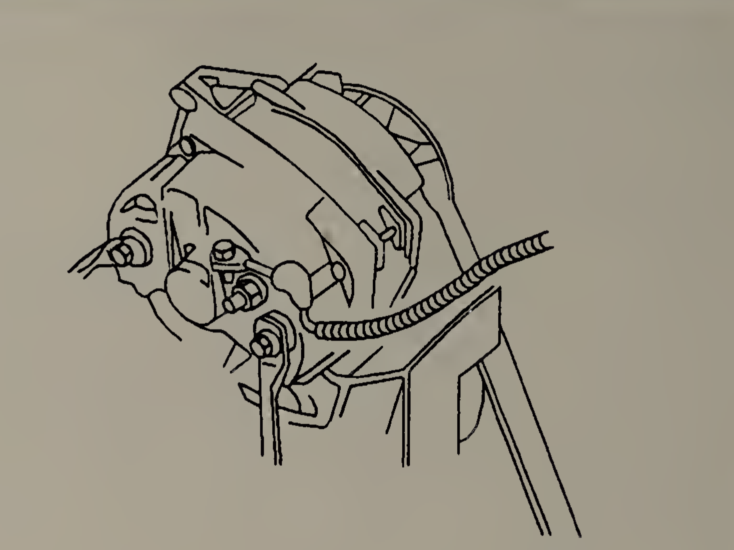
To install:

10. Attach the regulator connector and the battery-to-alternator terminal ("BAT" terminal), then position the alternator in the vehicle. Tighten the "BAT" terminal nut to 71 inch lbs. (8 Nm). Do NOT overtighten.
11. Install the oil sender and attach the electrical connector.
12. Apply Loctite® 565, or equivalent sealant, to all of the mounting bolt threads.
13. Install the rear support brace and bolt. Tighten the bolt to 17 ft. lbs. (23 Nm).
14. Instlal the upper support bracket and bolts.
15. Install the lower support bracket, spacer, support bolts and mounting bolt.
16. Tighten the upper support and lower mounting bolts to 38 ft. lbs. (52 Nm).
17. Tighten the lower support bracket bolts to 19 ft. lbs. (26 Nm).
18. Install the serpentine drive belt.
19. Install the throttle body extension and tighten the bolts to 53 inch lbs. (6 Nm).
20. Install the air intake duct and connect the negative battery cable.

5.7L (VIN P and 5) Engines

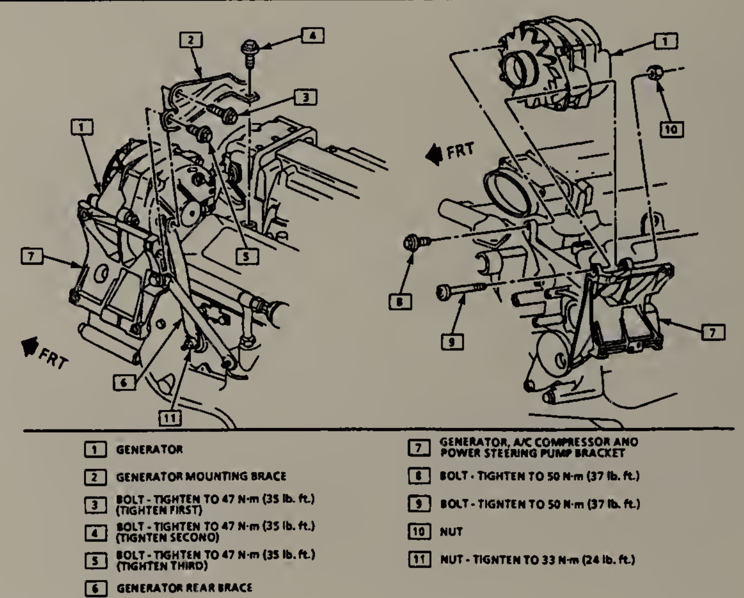
See Figures 72 and 73

1. Disconnect the negative battery cable.
2. Remove the air intake duct.
3. Unplug the regulator connector, and remove the battery-to-alternator terminal from the back of the alternator.
4. Remove the serpentine drive belt by releasing the belt tension.
5. Remove the alternator rear mounting bolt, nut and alternator rear mounting bracket.
6. Unfasten the 2 alternator upper mounting bolts, and remove the alternator upper mounting bracket.



91032G52

Fig. 72 Detach the regulator connector, and disconnect the "BAT" cable from the terminal



91032G53

Fig. 73 Exploded view of the alternator and related components—5.7L (VIN P & 5) engines

7. Remove the two lower alternator mounting bracket bolts, then remove the lower bracket.
8. Remove the alternator from the vehicle.

To install:

9. Position the alternator in the vehicle.
10. Instlal the lower mounting bracket and the two lower mounting bolts. Do NOT tighten the bolts at this time.
11. Install the upper mounting bracket and two retaining bolts. Do NOT tighten the bolts at this time.
12. Install the rear mounting bracket and mounting bolt.
13. Tighten the bolts, as follows:
    a. Alternator lower and upper mounting bolts: 37 ft. lbs. (50 Nm).
    b. Alternator rear mounting bolt: 17 ft. lbs. (23 Nm).
    c. Alternator rear mounting nut: 24 ft. lbs. (33 Nm).
14. Install the serpentine drive belt.
15. Attach the electrical connector to the alternator.
16. Connect the battery-to-alternator terminal to the back of the alternator. Tighten the "BAT" terminal nut to 71 inch lbs. (8 Nm). Do NOT overtighten.
17. Install the air intake duct.
18. Connect the negative battery cable. Tighten the cable bolt/screw to 11 ft. lbs. (15 Nm).

STARTING SYSTEM

General Information

The battery and starting motor are linked by very heavy electrical cables designed to minimize resistance to the flow of current. Generally, the major power supply cable that leaves the battery goes directly to the starter, while other electrical system needs are supplied by a smaller cable. During starter operation, power flows from the battery to the starter and is grounded through the vehicle's frame/body or engine and the battery's negative ground strap.

The starter is a specially designed, direct current electric motor capable of producing a great amount of power for its size. One thing that allows the motor to produce a great deal of power is its tremendous rotating speed. It drives the engine through a tiny pinion gear (attached to the starter's armature), which drives the very large flywheel ring gear at a greatly reduced speed. Another factor allowing it to produce so much power is that only intermittent operation is required of it. Thus, little allowance for air circulation is necessary, and the windings can be built into a very small space.

The starter solenoid is a magnetic device which employs the small current supplied by the start circuit of the ignition switch. This magnetic action moves a plunger which mechanically engages the starter and closes the heavy switch connecting it to the battery. The starting switch circuit usually consists of the starting switch contained within the ignition switch, a neutral safety switch or clutch pedal switch, and the wiring necessary to connect these in series with the starter solenoid or relay.

The pinion, a small gear, is mounted to a one way drive clutch. This clutch is splined to the starter armature shaft. When the ignition switch is moved to the **START** position, the solenoid plunger slides the pinion toward the flywheel ring gear via a collar and spring. If the teeth on the pinion and flywheel match properly, the pinion will engage the flywheel immediately. If the gear teeth butt one another, the spring will be compressed and will force the gears to mesh as soon as the starter turns far enough to allow them to do so. As the solenoid plunger reaches the end of its travel, it closes the contacts that connect the battery and starter, then the engine is cranked.

As soon as the engine starts, the flywheel ring gear begins turning fast enough to drive the pinion at an extremely high rate of speed. At this point, the one-way clutch begins allowing the pinion to spin faster than the starter shaft so that the starter will not operate at excessive speed. When the ignition switch is released from the starter position, the solenoid is de-energized, and a spring pulls the gear out of mesh interrupting the current flow to the starter.

Some starters employ a separate relay, mounted away from the starter, to switch the motor and solenoid current on and off. The relay replaces the solenoid electrical switch, but does not eliminate the need for a solenoid mounted on the starter used to mechanically engage the starter drive gears. The relay is used to reduce the amount of current the starting switch must carry.

Starter

TESTING

No-Load Test

➧ **See Figure 74**

1. With the carbon pile "OFF", make connections as shown in the accompanying figure. Close the switch, adjust the carbon pile to get 10 volts, and compare with the following RPM, current and voltage readings:
   - 1984–87 5.7L (VIN 8) engine: No load test @ 10.6 volts—70–110 amps, RPM at drive pinion—6,500–10,700 rpm
   - 1988 5.7L (VIN 8) engine: No load test @ 10.6 volts—90 amps (max.), RPM at drive pinion—3,300 rpm
   - 1989–90 5.7L (VIN 8) engine: No load test @ 10 volts—45–90 amps, RPM at drive pinion—3,300–5,000 rpm
   - 5.7L (VIN J) engine: No load test @ 10 volts—45–90 amps, RPM at drive pinion—3,300–5,500 rpm
   - 5.7L (VIN P) engine: No load test @ 10 volts—45–90 amps, RPM at drive pinion—2,800–5,000 rpm
   - 5.7L (VIN 5) engine: No load test @ 10 volts—45–90 amps, RPM at drive pinion—3,500–5,000 rpm

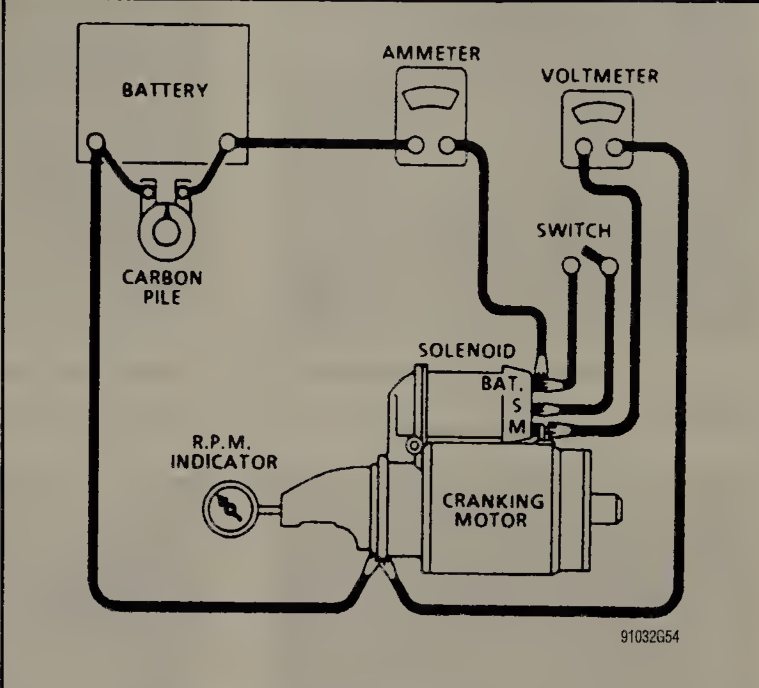


Fig. 74 Starter motor no-load test connections

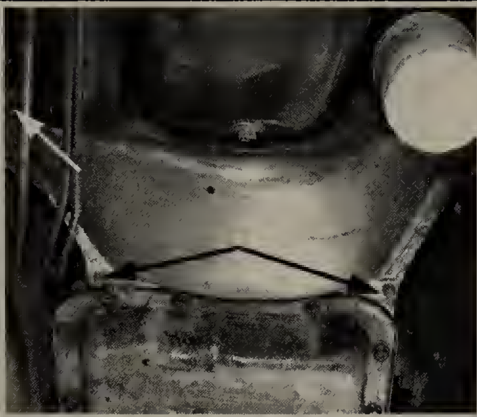
2. Rated current draw and no load speed indicates normal condition of the starter motor.
3. Low free speed and high current draw indicates:
   - Too much friction. Tight, dirty, or worn bushings, bent armature shaft allowing armature to drag.
   - Shorted armature. This can be further checked on a growler after disassembly.
   - Grounded armature or fields. Check further after assembly.
4. Failure to operate with high current draw indicates:
   - A direct ground in the terminal or fields.
   - "Frozen" bearings.
5. Failure to operate with low or no current draw indicates:
   - Open solenoid windings.
   - Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing the circuit with a test lamp.
   - Open armature coils. Inspect the commutator for badly burned bar after disassembly.
   - Broken brush springs, worn brushes, high insulation between the commutator bars of other causes which would prevent good contact between the brushes and commutator.
6. Low no-load speed and low current draw indicates:
   - High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Step 6.
7. High free speed and high current drain usually indicate shorted fields. If shorted fields are suspected, replace the field and frame assembly. Also check for shorted armature using a growler.

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

➧ **See Figures 75 thru 93**

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. For 1984–88 vehicles, perform the following:
   a. Remove the retainers and the flywheel cover.
   b. If necessary for access, unbolt the exhaust system from the manifold and behind the catalytic converter, then remove it from the vehicle.
   c. Unfasten the retainers and remove the rear support brace.
4. Label and disconnect the starter wiring.
5. Remove the starter mounting bolts, then carefully lower and remove the starter from the vehicle. Make sure to note the position of any shims, if used.

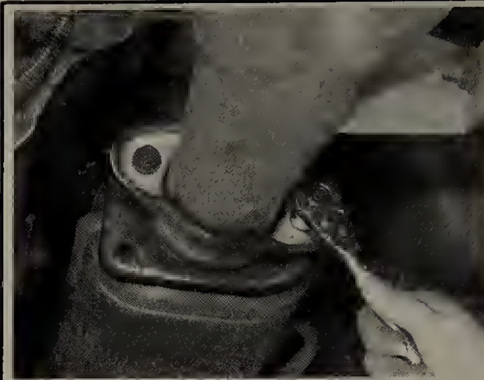


91032P01

Fig. 75 The flywheel cover is retained with 4 bolts

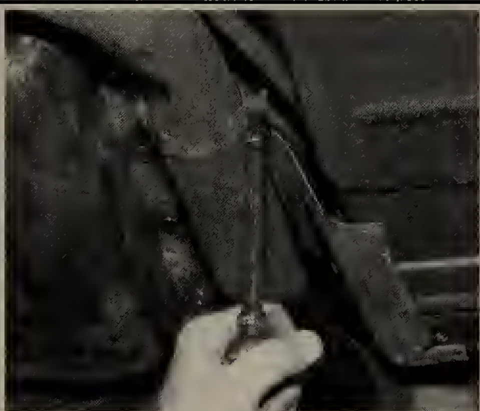
91032P02

Fig. 76 Remove the bolts, then lower the flywheel cover. It will probably take some maneuvering to get the cover out



91032P03

Fig. 77 On some vehicles, it will be necessary to unfasten the exhaust pipe-to-catalytic converter attaching bolts

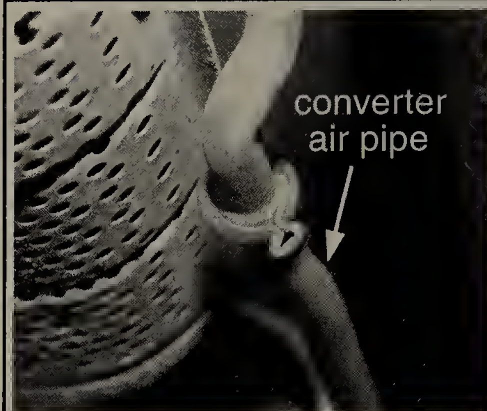


91032P04

Fig. 78 Unfasten the exhaust pipe clamp retaining bolts

91032P05

Fig. 79 Then, unfasten the clamp from the exhaust pipe



91032P06

Fig. 80 You must unfasten the converter air pipe retaining clamp

91032P07

Fig. 81 Then move the clamp aside and separate the converter air pipe for exhaust removal

91032P08

Fig. 82 Unfasten the bolts that are holding the exhaust pipe clamp in place, just below the y-pipe

91032P09

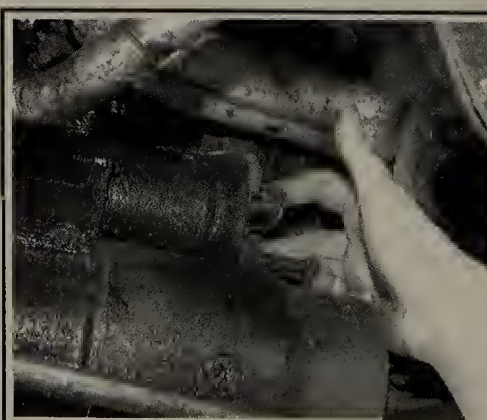
Fig. 83 With the exhaust system supported with jackstands, unfasten the exhaust pipe flange-to-manifold nuts

91032P10

Fig. 84 With the help of at least one assistant, carefully lower the exhaust and place in a safe place

91032P11

Fig. 85 Unfasten the outer electrical wiring retaining nut . . .



91032P12

Fig. 86 . . . then pull the wiring off of the stud

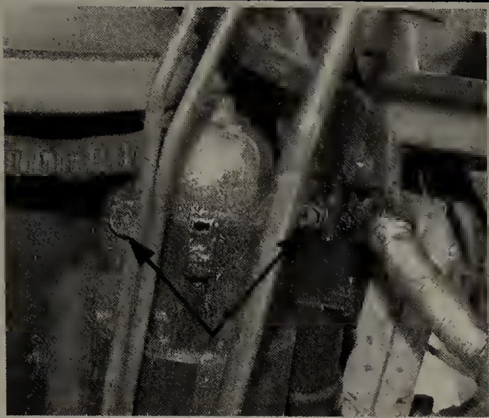


Fig. 87 The starter is secured with 2 mounting bolts

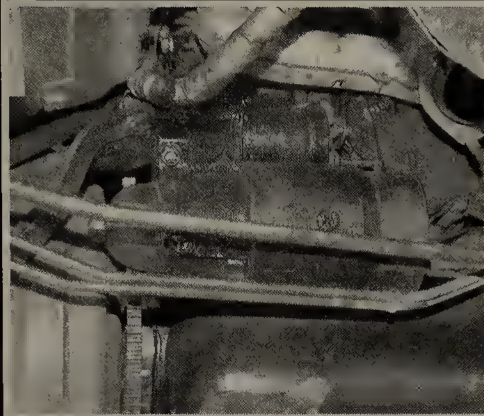


Fig. 88 Overall view of the starter mounting

Fig. 89 Be careful when lowering the starter, because it is heavier than it looks!

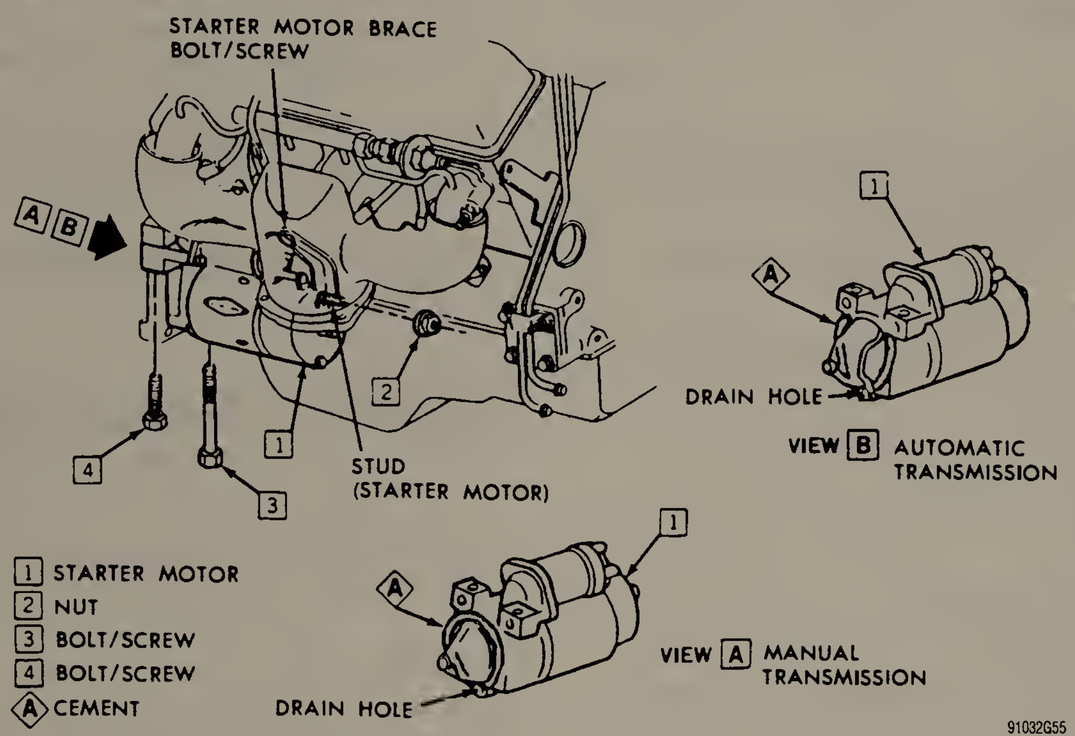


Fig. 90 Exploded view of the starter motor mounting—1984–88 5.7L (VIN 8) engines

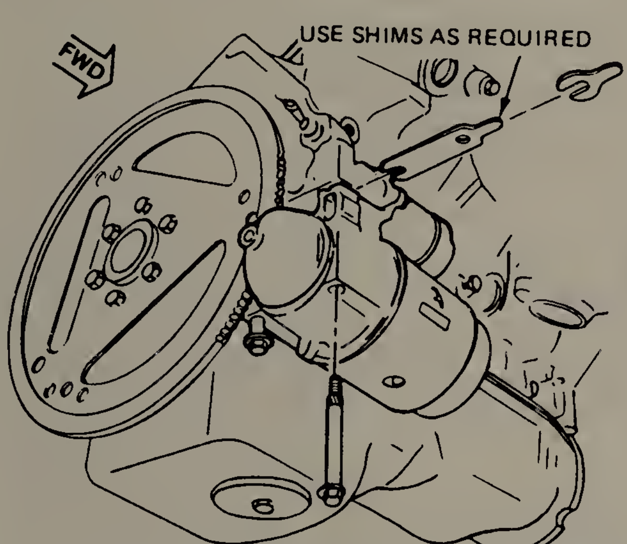


Fig. 91 You must note the location of any shims used, for installation purposes

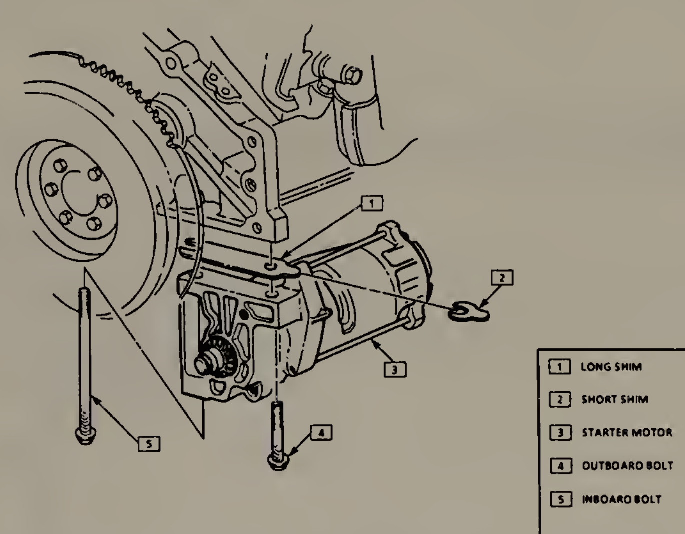


Fig. 92 View of the starter motor mounting—1989–91 5.7L (VIN 8) engines

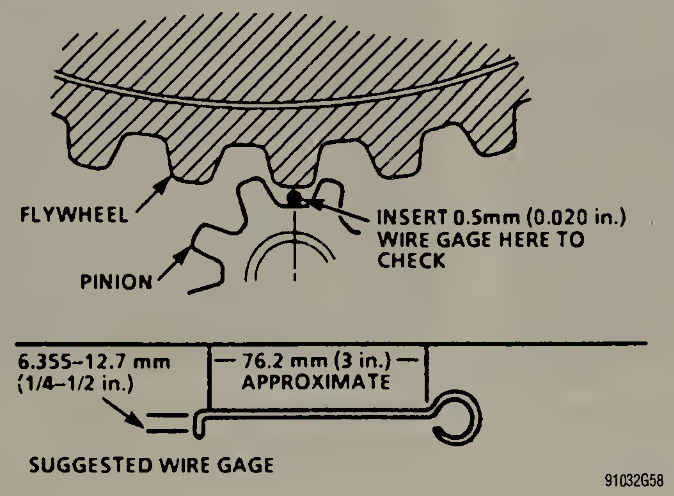


Fig. 93 You must check to be sure the flywheel-to-pinion clearance is sufficient

To install:

6. Position the starter to the vehicle and secure using the mounting bolts. Make sure to replace any shims that were removed. Check the flywheel-to-pinion clearance, as shown in the accompanying figure.
7. Tighten both bolts to 35 ft. lbs. (47 Nm).
8. On 1989–91 vehicles, sealer must be applied after the starter motor is installed.
9. Connect the starter motor wiring.
10. If removed, install the rear support brace and the flywheel cover, securing with the retaining bolts.
11. Carefully lower the vehicle.
12. Connect the negative battery cable.

5.7L (VIN J) Engines

See Figure 94

1. Disconnect the negative battery cable.
2. Remove the intake plenum.
3. Remove the ignition coil pack.
4. Disconnect the positive battery cable and starter motor solenoid connector from the starter.
5. Unfasten the starter motor-to-engine block mounting bolts, then carefully remove the starter motor from the vehicle.

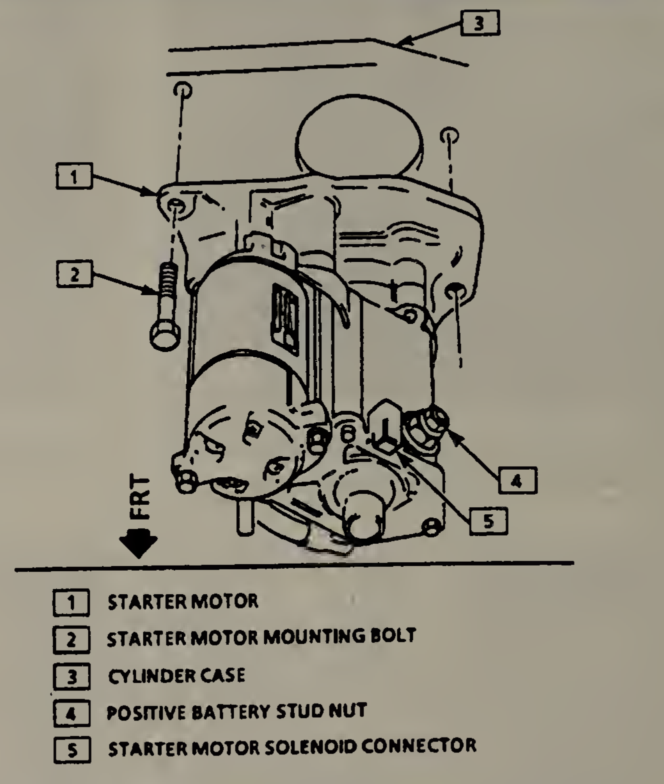


Fig. 94 Exploded view of the starter motor mounting—5.7L (VIN J) engine

To install:

6. Position the starter to the engine block.
7. Coat the starter mounting bolt threads with Loctite® 262, or equivalent, then install the bolts and tighten them to 38 ft. lbs. (52 Nm).
8. Connect the positive battery cable to the starter motor and tighten the stud nut to 10 ft. lbs. (14 Nm).
9. Attach the starter motor solenoid connector.
10. Install the ignition coil pack and intake plenum.
11. Connect the negative battery cable.

5.7L (VIN P & 5) Engine

See Figures 95 and 96

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.

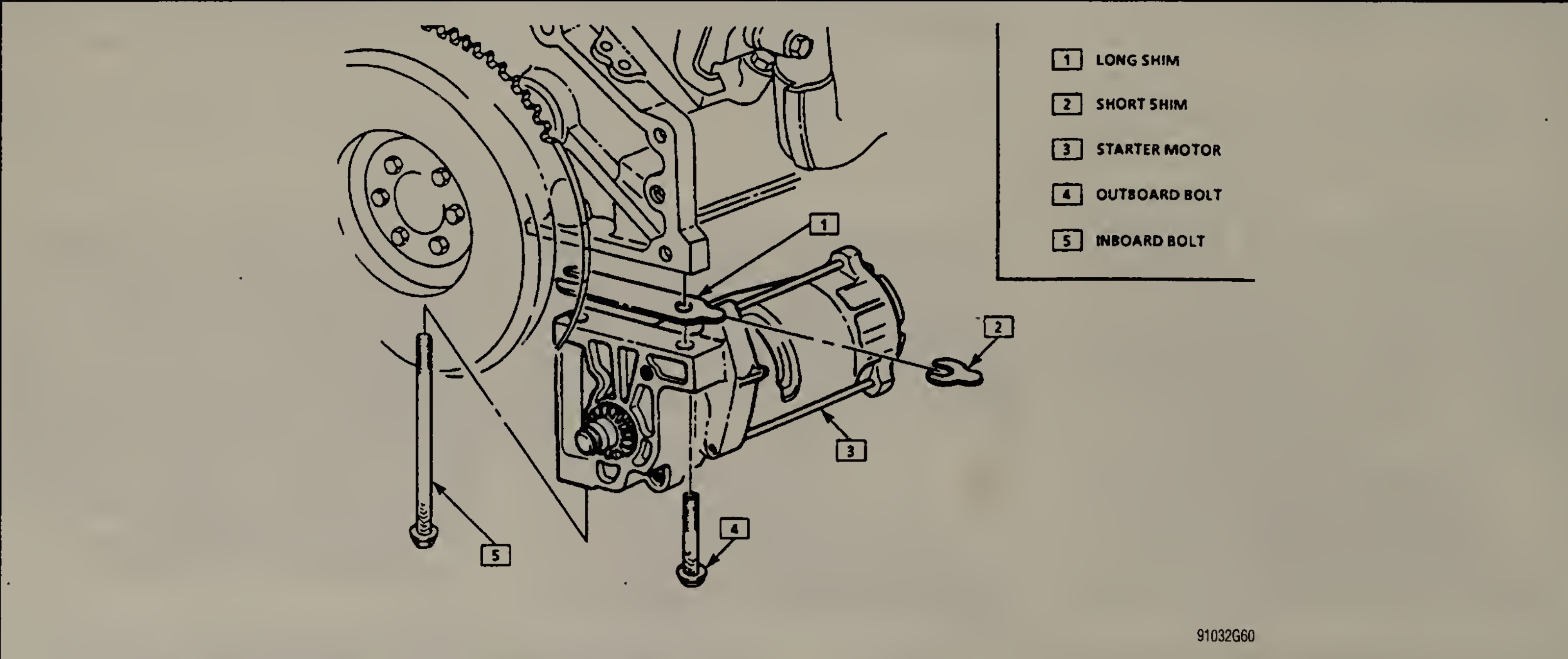


Fig. 95 Exploded view of the starter motor mounting—5.7L (VIN P & 5) engines

3. Disconnect the positive battery cable and the "S" terminal from the starter motor.
4. Remove the starter mounting bolts.
5. Carefully lower and remove the starter motor, sealer and shim(s) from the vehicle. Make sure to note the position of any shims, if used.

To install:

6. Position the starter to the vehicle and secure using the mounting bolts. Make sure to replace any shims that were removed. Check the flywheel-to-pinion clearance, as shown in the accompanying figure.
7. Tighten both bolts to 35 ft. lbs. (47 Nm).
8. Apply a suitable sealer to the front of the starter motor. The sealer MUST be applied after the starter motor is installed.
9. Connect the positive battery cable to the starter and tighten the nut to 10 ft. lbs. (14 Nm).
10. Secure the "S" terminal to the starter and secure with the washer and nut. Tighten the nut to 35 inch lbs. (4 Nm).
11. Carefully lower the vehicle.
12. Connect the negative battery cable.

SENDING UNITS AND SENSORS

➡This section describes the operating principles of sending units, warning lights and gauges. Sensors which provide information to the Electronic Control Module (ECM) are covered in Section 4 of this manual.

Instrument panels contain a number of indicating devices (gauges and warning lights). These devices are composed of two separate components. One is the sending unit, mounted on the engine or other remote part of the vehicle, and the other is the actual gauge or light in the instrument panel.

Several types of sending units exist, however most can be characterized as being either a pressure type or a resistance type. Pressure type sending units convert liquid pressure into an electrical signal which is sent to the gauge. Resistance type sending units are most often used to measure temperature and use variable resistance to control the current flow back to the indicating device. Both types of sending units are connected in series by a wire to the battery (through the ignition switch). When the ignition is turned **ON**, current flows from the battery through the indicating device and on to the sending unit.

Coolant Temperature Sender

OPERATION

The coolant temperature sender changes resistance as the coolant temperature increases and decreases.

TESTING

1. Remove the temperature sender from the engine.
2. Position the water temperature sending unit in such a way that the metal shaft (opposite end from the electrical connectors) is situated in a pot of water. Make sure that the electrical connector is not submerged and that only the tip of the sending unit's body is in the water.
3. Heat the pot of water at a medium rate. While the water is warming, continue to measure the resistance of the terminal and the metal body of the sending unit:
   a. As the water warms up, the resistance exhibited by the ohmmeter goes down in a steady manner: the sending unit is good.
   b. As the water warms up, the resistance does not change or changes in erratic jumps: the sender is bad, replace it with a new one.
4. Install the good or new sending unit into the engine, then connect the negative battery cable.

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Properly drain the engine coolant into a suitable container.
3. Disconnect the sender electrical lead and unscrew it. The sender can be found on the engine block or threaded into the thermostat housing/water outlet.

To install:

4. Install the sensor and tighten until snug.
5. Connect the sensor electrical lead.
6. Connect the battery cable and fill the engine with the proper type and amount of coolant.

Oil Pressure Sender

OPERATION

The oil pressure sender relays to the dash gauge the oil pressure in the engine.

TESTING

1. To test the normally closed oil lamp circuit, disengage the locking connector and measure the resistance between the switch terminal (terminal for the wire to the warning lamp) and the metal housing. The ohmmeter should read 0 ohms.
2. To test the sending unit, measure the resistance between the sending unit terminal and the metal housing. The ohmmeter should read an open circuit (infinite resistance).
3. Start the engine.
4. Once again, test each terminal against the metal housing:
   a. The oil switch terminal-to-housing circuit should read an open circuit if there is oil pressure present.
   b. The sending unit-to-housing circuit should read between 15–80 ohms, depending on the engine speed, oil temperature and oil viscosity.
5. To test the oil pressure sender only, rev the engine and watch the ohms reading, which should fluctuate slightly (within the range of 15–80 ohms) as rpm increases.
6. If the above results were not obtained, replace the sending unit/switch with a new one.

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. If necessary for access, raise and safely support the vehicle.
3. Detach the sensor electrical connector.
4. Remove the sensor.

To install:

5. Coat the first two or three threads with sealer. Install the sensor and tighten until snug. Engage the electrical lead.
6. Carefully lower the vehicle.
7. Connect the negative battery cable and fill the engine with oil.

Fan Switch

OPERATION

When the switch reaches a predetermined temperature, it closes the circuit to the relay. This energizes the relay sending 12 volts to the fan. When the temperature decreases below the set point of the sensor, the circuit opens and the voltage is no longer applied to the fan.

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Disconnect the sensor electrical lead and unscrew the sensor.

To install:

3. Install the sensor or relay and connect the electrical lead.
4. Connect the battery cable.

Troubleshooting Basic Starting System Problems

Problem	Cause	Solution
Starter motor rotates engine slowly	· Battery charge low or battery defective	· Charge or replace battery
	· Defective circuit between battery and starter motor	· Clean and tighten, or replace cables
	· Low load current	· Bench-test starter motor. Inspect for worn brushes and weak brush springs.
	· High load current	· Bench-test starter motor. Check engine for friction, drag or coolant in cylinders. Check ring gear-to-pinion gear clearance.
Starter motor will not rotate engine	· Battery charge low or battery defective	· Charge or replace battery
	· Faulty solenoid	· Check solenoid ground. Repair or replace as necessary.
	· Damaged drive pinion gear or ring gear	· Replace damaged gear(s)
	· Starter motor engagement weak	· Bench-test starter motor
	· Starter motor rotates slowly with high load current	· Inspect drive yoke pull-down and point gap, check for worn end bushings, check ring gear clearance
	· Engine seized	· Repair engine
Starter motor drive will not engage (solenoid known to be good)	· Defective contact point assembly	· Repair or replace contact point assembly
	· Inadequate contact point assembly ground	· Repair connection at ground screw
	· Defective hold-in coil	· Replace field winding assembly
Starter motor drive will not disengage	· Starter motor loose on flywheel housing	· Tighten mounting bolts
	· Worn drive end busing	· Replace bushing
	· Damaged ring gear teeth	· Replace ring gear or driveplate
	· Drive yoke return spring broken or missing	· Replace spring
Starter motor drive disengages prematurely	· Weak drive assembly thrust spring	· Replace drive mechanism
	· Hold-in coil defective	· Replace field winding assembly
Low load current	· Worn brushes	· Replace brushes
	· Weak brush springs	· Replace springs

TCCS2C01

Troubleshooting Basic Charging System Problems

Problem	Cause	Solution
Noisy alternator	· Loose mountings	· Tighten mounting bolts
	· Loose drive pulley	· Tighten pulley
	· Worn bearings	· Replace alternator
	· Brush noise	· Replace alternator
	· Internal circuits shorted (High pitched whine)	· Replace alternator
Squeal when starting engine or accelerating	· Glazed or loose belt	· Replace or adjust belt
Indicator light remains on or ammeter indicates discharge (engine running)	· Broken belt	· Install belt
	· Broken or disconnected wires	· Repair or connect wiring
	· Internal alternator problems	· Replace alternator
	· Defective voltage regulator	· Replace voltage regulator/alternator
Car light bulbs continually burn out—battery needs water continually	· Alternator/regulator overcharging	· Replace voltage regulator/alternator
Car lights flare on acceleration	· Battery low	· Charge or replace battery
	· Internal alternator/regulator problems	· Replace alternator/regulator
Low voltage output (alternator light flickers continually or ammeter needle wanders)	· Loose or worn belt	· Replace or adjust belt
	· Dirty or corroded connections	· Clean or replace connections
	· Internal alternator/regulator problems	· Replace alternator/regulator

TCCS2C02

3

ENGINE AND ENGINE OVERHAUL

ENGINE MECHANICAL

5.7L (VIN 8) ENGINE SPECIFICATIONS

Description	English	Metric
General Information		
Type	90 ° V8 Dual Over Head Cam (DOHC)	
Displacement	350	5.7 (3500)
Number of Cylinders	8	
Bore	4.000	101.6mm
Stroke	3.480	88.39mm
Compression ratio		
1984-89 vehicles	9.0:1	
1990-91 vehicles	10.25:1	
Cylinder Bore		
Diameter		
1984-89 vehicles	3.9995-4.0025 in.	101.59-101.66mm
1990-91 vehicles	4.0000-4.0021 in.	101.60-101.65mm
Out-of-round (max.)		
Production		
1984-89 vehicles	0.010 in.	0.254mm
Service		
1984-89 vehicles	0.020 in.	0.508mm
Radial Cylindricity		
1990-91 vehicles	0.00085 in.	0.02159mm
Taper (max.)		
1984-89 vehicles		
Production Thrust Side	0.005 in.	0.127mm
Production Relief Side	0.010 in.	0.254mm
Service	0.010 in.	0.254mm
Total Taper & Out-of-Round		
1990-91 vehicles	0.0025 in.	0.0635mm
Piston		
Clearance		
Production		
1984-86 vehicles	0.025-0.035 in.	0.635-0.889mm
1987-89 vehicles	0.0007-0.0017 in.	0.0178-0.0432mm
1990-91 vehicles	0.0027 in.	0.0686mm
Service (max.)		
1984-86 vehicles	0.0045 in.	1.143mm
1987-89 vehicles	0.0025 in.	0.0635mm
1990-91 vehicles	0.0027 in.	0.0686mm
Piston Rings		
Compression		
Groove Clearance		
Production 1st		
1984-86 vehicles	0.0012-0.0032 in.	0.0305-0.0813mm
1987-89 vehicles	0.0012-0.0029 in.	0.0305-0.0737mm
1990-91 vehicles	0.0012-0.0039 in.	0.0305-0.0991mm
Production 2nd		
1984-86 vehicles	0.0012-0.0032 in.	0.0305-0.0813mm
1987-89 vehicles	0.0012-0.0029 in.	0.0305-0.0737mm
1990-91 vehicles	0.0012-0.0039 in.	0.0305-0.0991mm
Service		
1984-89 vehicles (high limit production plus)	0.001 in.	0.025mm

91033C01

5.7L (VIN 8) ENGINE SPECIFICATIONS

Description	English	Metric
Piston Rings cont.		
Gap		
Production 1st		
1984-89 vehicles	0.010-0.020 in.	0.254-0.508mm
1990-91 vehicles	0.010-0.030 in.	0.254-0.762mm
Production 2nd		
1984-89 vehicles	0.010-0.025 in.	0.254-0.635mm
1990-91 vehicles	0.013-0.027 in.	0.330-0.686mm
Service		
1984-89 vehicles (high limit production plus)	0.001 in.	0.025mm
Oil		
Groove Clearance		
Production		
1984-86 vehicles	0.002-0.007 in.	0.051-0.178mm
1987-89 vehicles	0.002-0.008 in.	0.0051-0.203mm
1990-91 vehicles	0.0012-0.0039 in.	0.0305-0.0991mm
Service		
1984-89 vehicles (high limit production plus)	0.001 in.	0.025mm
Gap		
Production		
1984-89 vehicles	0.015-0.055 in.	0.381-1.397mm
1990-91	0.010-0.040 in.	0.254-1.016mm
Service		
1984-89 vehicles (high limit production plus)	0.001 in.	0.025mm
Piston Pin		
Diameter		
1984-86 vehicles	0.9270-0.9273 in.	23.546-23.553mm
1987-91 vehicles	0.9269-0.9271 in.	23.543-23.548mm
Clearance		
Production		
1984-89 vehicles	0.00025-0.00035 in.	0.00635-0.0089mm
Service (max.)	0.001 in.	0.025mm
Fit in rod		
1986-89 vehicles	0.0008-0.0016 in.	0.0203-0.0406mm
Crankshaft and Connecting Rods		
Main Journal		
Diameter		
#1	2.4484-2.4493 in.	62.1894-62.2122mm
#2, 3 &4	2.4481-2.4490 in.	62.1818-62.2046mm
#5	2.4479-2.4488 in.	62.1766-62.1995mm
Taper (max.)		
Production	0.0002 in.	0.0508mm
Service	0.0010 in.	0.0254mm
Out-of-Round		
Production	0.0002 in.	0.0508mm
Service	0.0010 in.	0.0254mm
Main Bearing Clearance		
Production		
#1	0.0008-0.0020 in.	0.0203-0.0508mm
#2, 3 &4		
1984-89 vehicles	0.0011-0.0023 in.	0.0279-0.0584mm
1990-91 vehicles	0.0011-0.0033 in.	0.0279-0.0838mm

91033C02

5.7L (VIN 8) ENGINE SPECIFICATIONS

Description	English	Metric
Crankshaft and Connecting Rods cont.		
#5		
1984-89 vehicles	0.0017-0.0032 in.	0.0432-0.0813mm
1990-91 vehicles	0.0017-0.0042 in.	0.0432-0.1067mm
Service		
#1	0.001-0.0015 in	0.025-0.0381mm
#2, 3 &4	0.001-0.0025 in.	0.025-0.0635mm
#5	0.0025-0.0035 in.	0.0635-0.0889mm
Crankshaft End Play	0.002-0.006 in.	0.0508-0.1524mm
Crankpin	0.0003 in.	0.008mm
Diameter	2.0988-3.0998 in.	53.309-78.735mm
Taper (max.)		
Production	0.0003 in.	0.0008mm
Service	0.001 in.	0.0254mm
Out-of-Round		
Production	0.0002 in.	0.0508mm
Service	0.0010 in.	0.0254mm
Rod Bearing Clearance		
Production	0.0013-0.0035 in.	0.0330-0.0889mm
Service (max.)	0.0035 in.	0.0889mm
Rod Side Clearance	0.006-0.014 in.	0.1524-0.3556mm
Camshaft		
Lobe lift		
Intake		
1984-89 vehicles	0.2713-0.2753 in.	5.52-6.99mm
1990-91 vehicles	0.2730-0.0.2770 in.	6.93-7.04mm
Exhaust		
1984-89 vehicles	0.280-0.284 in.	7.112-7.214mm
1990-91 vehicles	0.2836-0.2876 in.	7.203-7.305mm
Journal Diameter	1.8682-1.8692 in.	47.452-47.478mm
Camshaft End Play	0.004-0.012 in.	0.102-0.305mm

91033C03

5.7L (VIN 8) ENGINE SPECIFICATIONS

Description	English	Metric
Valve System		
Lifter	Hydraulic	
Rocker arm ratio	1.50:1	
Face angle	45°	
Seat angle	46°	
Seat runout (max.)	0.002 in.	0.050mm
Seat width		
Intake	0.0312-0.0625 in.	0.7925-1.5875mm
Exhaust	0.0625-0.0937 in.	1.5875-2.3799mm
Stem clearance		
Production		
Exhaust	0.0010-0.0027 in.	0.0254-0.0686mm
Intake	0.0010-0.0027 in.	0.0254-0.0686mm
Valve spring		
Free length	2.03 in.	51.56mm
Pressure Lbs. @ In.		
Closed		
Intake	76-84 lbs. @ 1.70 in	338-374 N @ 43.2mm
Exhaust	76-84 lbs. @ 1.61 in.	338-374 N @ 40.89mm
Open		
Intake	194-206 lbs. @ 1.25 in	863-917 N @ 31.75mm
Exhaust	194-206 lbs. @ 1.16 in.	863-917 N @ 29.46mm
Installed height		
Intake	1.718 in.	43.64mm
Exhaust	1.594 in.	40.49mm
Damper		
Free length	1.86 in.	47.24mm
Approximate # of coils	4	

91033C04

5.7L (VIN J) ENGINE SPECIFICATIONS

Description	English	Metric
General Information		
Type	90 ° V8 OverHead Valve (OHV)	
Displacement	350	5.7 (3500)
Number of Cylinders	8	
Bore	3.897 in.	99.0mm
Stroke	3.661 in.	93.0mm
Compression ratio	11.0:1	
Cylinder Bore		
Diameter	3.897-3.898 in.	98.988-99.012mm
Piston Rings		
Compression		
Groove Clearance		
1st (upper)	0.002-0.003 in.	0.050-0.085mm
2nd (lower)	0.002-0.003 in.	0.050-0.085mm
Gap		
1st (upper)	0.016-0.026 in.	0.40-0.65mm
2nd (lower)	0.031-0.039 in.	0.80-1.0mm
Oil		
Groove		
Clearance	0.001-0.002 in.	0.020-0.055mm
Gap	0.012-0.024 in.	0.30-0.60mm
Piston Pin		
Diameter	0.9841-0.9843 in.	24.995-25.000mm
Fit in piston	0.0002-0.0007 in.	0.006-0.018mm
Fit in rod	0.0005-0.0009 in.	0.012-0.022mm
Crankshaft and Connecting Rods		
Main Journal		
Diameter	2.755-2.756 in.	69.98-70.00mm
Taper	0.0002 in.	0.006mm
Out-of-Round	0.0003 in.	0.008mm
Main Bearing Clearance	0.0007-0.0023 in.	0.018-0.0585mm
Crankshaft End Play	0.0096-0.014 in.	0.25-0.27mm
Rod Journal		
Diameter	2.0993-2.100 in.	53.321-53.340mm
Taper	0.0002 in.	0.006mm
End Play	0.0003 in.	0.008mm

91033C05

5.7L (VIN J) ENGINE SPECIFICATIONS

Description	English	Metric
Camshaft		
Lobe lift (+/- 0.002 in. (0.051mm)		
Intake	0.3898 in.	9.9mm
Exhaust	0.3898 in.	9.9mm
Journal Diameter	1.140-1.141 in.	28.96-28.98mm
Camshaft End Play	0.0055-0.0138 in.	0.14-0.35mm
Valve System		
Lifter	Hydraulic	
Face angle	45°	
Seat angle	44°	
Seat runout	0.003937 in.	0.10mm
Seat width		
Intake	0.0569-0.0734 in.	1.446-1.863mm
Exhaust	0.0569-0.0734 in.	1.446-1.863mm
Stem clearance		
Intake	0.0012-0.0026 in.	0.030-0.065mm
Exhaust	0.0014-0.0030 in.	0.035-0.075mm
Valve spring		
Inner Spring		
Free length	1.54 in.	39.2mm
Installed height	1.18 in.	30.0mm
Pressure Lbs. (N) @ In. (mm)		
Closed	34.2-37.8 lbs. @ 1.18 in.	152-168 N @ 30.0mm
Open	75.5-81.8 lbs. @ 0.79 in.	336-364 N @ 20.0mm
Outer Spring		
Free length	1.71 in.	43.5mm
Installed height	1.34 in.	34.0mm
Pressure Lbs. (N) @ In. (mm)		
Closed	64.1-76.4 lbs. @ 1.34 in.	285-340 N @ 34.0mm
Open	146.8-166.4 lbs. @ 0.95 in.	653-740 N @ 24.0mm

91033C06

5.7L (VIN P & 5) ENGINE SPECIFICATIONS

Description	English	Metric
General Information		
Type	90 ° V8 Over Head Valve (OHV)	
Displacement	350	5.7 (3500)
Number of Cylinders	8	
Bore	4.000	101.6mm
Stroke	3.480	88.39mm
Compression ratio		
1992 vehicles	10.2:1	
1993-96 vehicles	10.5:1	
Cylinder Bore		
Diameter		
1995-96 vehicles	4.0007-4.0017 in.	101.618-101.643mm
Out-of-round (max.)		
Production	0.001 in.	0.02mm
Service	0.002 in.	0.05mm
Taper (max.)		
Production Thrust Side	0.0005 in.	0.012mm
Production Relief Side	0.0010 in.	0.025mm
Service	0.0010 in.	0.025mm
Piston		
Clearance		
Production		
1992 vehicles	0.0007-0.0021 in.	0.018-0.053mm
1993-96 vehicles	0.0010-0.0027 in.	0.025-0.068mm
Service (max.)	0.0027 in.	0.068mm
Piston Rings		
Compression Ring		
Groove Clearance		
Production Top		
1992-94 vehicles	0.0012-0.0032 in.	0.030-0.081mm
1995-96 vehicles	0.0019-0.0035 in.	0.050-0.090mm
Production 2nd		
1992-94 vehicles	0.0012-0.0032 in.	0.030-0.081mm
1995-96 vehicles	0.0019-0.0035 in.	0.050-0.090mm
Service Limit	0.0042 in.	0.107mm
Gap		
Production Top	0.010-0.020 in.	0.25-0.50mm
Production 2nd	0.018-0.026 in.	0.46-0.66mm
Service Limit	0.035 in.	0.88mm
Oil Ring		
Groove Clearance		
Production	0.002-0.007 in.	0.051-0.178mm
Service Limit	0.008 in.	0.20mm
Gap		
Production	0.010-0.030 in.	0.25-0.76mm
Service Limit	0.065 in.	1.65mm
Piston Pin		
Diameter	0.9270-0.9271 in.	23.546-23.548mm
Clearance in Piston		
Production	0.0005-0.0008 in.	0.0127-0.0203mm
Service Limit (max.)	0.001 in.	0.025mm
Fit in rod	0.0008-0.0016 in.	0.021-0.040mm

91033C07

5.7L (VIN P & 5) ENGINE SPECIFICATIONS

Description	English	Metric
Crankshaft		
Main Journal		
Diameter		
#1	2.4484-2.4493 in.	62.1894-62.2122mm
#2, 3 &4	2.4481-2.4490 in.	62.1818-62.2046mm
#5	2.4481-2.4488 in.	62.1770-62.1200mm
Taper (max.)		
Production	0.0002 in.	0.0508mm
Service	0.0010 in.	0.0254mm
Out-of-Round		
Production	0.0002 in.	0.0508mm
Service	0.0010 in.	0.0254mm
Main Bearing Clearance		
Production		
#1	0.0008-0.0020 in.	0.0203-0.0508mm
#2, 3 &4	0.0011-0.0020 in.	0.028-0.051mm
#5	0.0017-0.0032 in.	0.043-0.081mm
Service		
#1	0.0010-0.0015 in	0.025-0.0381mm
#2, 3 &4	0.0010-0.0025 in.	0.025-0.0635mm
#5	0.0025-0.0035 in.	0.0635-0.0889mm
Crankshaft End Play	0.001-0.007 in.	0.03-0.17mm
Crankshaft Runout (at rear flange)	0.0015 in.	0.038mm
Connecting Rod		
Connecting Rod Journal Diameter		
1992-94 vehicles	2.0893-2.0998 in.	53.068-53.334mm
1995-96 vehicles	2.0978-2.0998 in.	53.284-53.334mm
Taper		
Production		
1992-94 vehicles	0.0005 in.	0.013mm
1995-96 vehicles	0.0003 in.	0.007mm
Service Limit	0.0010 in.	0.025mm
Out-of-round (max.)		
Production		
1992-94 vehicles	0.0005 in.	0.013mm
1995-96 vehicles	0.0003 in.	0.007mm
Service Limit	0.0010 in.	0.025mm
Rod Bearing Clearance		
Production	0.0013-0.0035 in.	0.033-0.088mm
Service Limit	0.0030 in.	0.076mm
Rod Side Clearance	0.006-0.014 in.	0.16-0.35mm
Camshaft		
Journal Diameter		
1992-94 vehicles	1.8682-1.8692 in.	47.452-47.477mm
1995-96 vehicles	1.8677-1.8697 in.	47.440-47.490mm
Camshaft End Play	0.004-0.012 in.	0.11-0.30mm
Lobe lift (+/- 0.002 in. (0.050mm)		
Intake		
1992-94 vehicles	0.300 in.	7.62mm
1995-96 vehicles	0.279 in.	7.09mm
Exhaust		
1992-94 vehicles	0.300 in.	7.62mm
1995-96 vehicles	0.2861 in.	7.26mm

91033C08

5.7L (VIN P & 5) ENGINE SPECIFICATIONS

Description	English	Metric
Valve System		
Lifter	Hydraulic	
Rocker arm ratio	1.50:1	
Face angle	45°	
Seat angle	46°	
Seat runout (max.)	0.002 in.	0.050mm
Seat width		
Intake		
1992-94 vehicles	0.030-0.050 in.	0.76-1.27mm
1995-96 vehicles	0.040-0.065 in.	1.02-1.65mm
Exhaust		
1992-94 vehicles	0.060-0.080 in.	1.52-2.03mm
1995-96 vehicles	0.065-0.098 in.	1.65-2.49mm
Stem clearance		
Production		
Intake	0.0011-0.0027 in.	0.027-0.069mm
Exhaust	0.0011-0.0027 in.	0.027-0.069mm
Service		
Intake		
1992-94 vehicles	0.0037 in.	0.093mm
1995-96 vehicles	0.0037 in.	0.093mm
Exhaust		
1992-94 vehicles	0.0047 in.	0.119mm
1995-96 vehicles	0.0047 in.	0.119mm
Valve spring		
Free length		
1992-94 vehicles	2.01 in.	51.1mm
1995-96 vehicles	2.02 in.	5.13mm
Pressure		
Closed		
1992-94 vehicles	81-89 lbs. @ 1.78 in.	360-395 N @ 45.2mm
1995-96 vehicles	76-84 lbs. @ 1.70 in.	338-374 N @ 43.2mm
Open		
1992-94 vehicles	252-272 lbs. @ 1.305 in.	1121-1208 N @ 33.1mm
1995-96 vehicles	187-203 lbs. @ 1.27 in.	832-903 N @ 32.3mm
Installed height		
Intake		
1992-94 vehicles	1.78 in.	45.2mm
1995-96 vehicles	1.70 in.	43.2
Exhaust		
1992-94 vehicles	1.78 in.	45.2mm
1995-96 vehicles	1.70 in.	43.2
Valve Lift		
Intake		
1992-94 vehicles	0.450 in.	11.43mm
1995-96 vehicles	0.418 in	10.62mm
Exhaust		
1992-94 vehicles	0.450 in.	11.43mm
1995-96 vehicles	0.430 in.	10.92mm

91033C09

Engine

REMOVAL & INSTALLATION

In the process of removing the engine, you will come across a number of steps which call for the removal of a separate component or system, such as "disconnect the exhaust system" or "remove the radiator." In most instances, a detailed removal procedure can be found elsewhere in this manual.

It is virtually impossible to list each individual wire and hose which must be disconnected, simply because so many different model and engine combinations have been manufactured. Careful observation and common sense are the best possible approaches to any repair procedure.

Removal and installation of the engine can be made easier if you follow these basic points:

- If you have to drain any of the fluids, use a suitable container.
- Always tag any wires or hoses and, if possible, the components they came from before disconnecting them.
- Because there are so many bolts and fasteners involved, store and label the retainers from components separately in muffin pans, jars or coffee cans. This will prevent confusion during installation.
- After unbolting the transmission, always make sure it is properly supported.
- If it is necessary to disconnect the air conditioning system, have this service performed by a qualified technician using a recovery/recycling station. If the system does not have to be disconnected, unbolt the compressor and set it aside.
- When unbolting the engine mounts, always make sure the engine is properly supported. When removing the engine, make sure that any lifting devices are properly attached to the engine. It is recommended that if your engine is supplied with lifting hooks, your lifting apparatus be attached to them.
- Lift the engine from its compartment slowly, checking that no hoses, wires or other components are still connected.
- After the engine is clear of the compartment, place it on an engine stand or workbench.
- After the engine has been removed, you can perform a partial or full teardown of the engine using the procedures outlined in this manual.

1. Disconnect the negative, then the positive battery cables.
2. Drain the engine coolant into a suitable container.
3. Properly relieve the fuel system pressure, as outlined in Section 5 of this manual.
4. Disconnect the throttle, TV and cruise control cables at the engine.
5. Tag and disconnect he spark plugs wires from the plugs, then remove the cap and wires as an assembly.
6. If necessary for clearance, remove the distributor.
7. Remove the cowl screen.
8. Remove the nut from the wiper motor arm. Disconnect the wiper motor wires, then remove the wiper motor cover.
9. Remove the air intake duct with the Mass Air Flow (MAF) sensor.
10. Disconnect the brake booster vacuum hose.
11. Detach the canister hose at the PCV pipe.
12. Tag and detach the necessary wires and vacuum hoses from the engine.
13. Disconnect the injector harness at the intake manifold.
14. Disconnect the heater hose from the pipe.
15. Disconnect the upper radiator hose from the housing.
16. Remove the serpentine drive belt.
17. Remove the AIR control valve at the A/C compressor.
18. Disconnect the fuel lines from the fuel rail.
19. Remove the catalytic converter AIR pipe.
20. Remove the A/C brace from the exhaust manifold.
21. Remove the A/C compressor mounting bracket.
22. Remove the accumulator from the fan shroud and brace.
23. Disconnect the fuel lines from the block.
24. Disconnect the lower radiator hose and the heater hose from the water pump.
25. Remove the alternator, as outlined in Section 2 of this manual.
26. Remove the AIR pump and bracket assembly.
27. Remove the power steering pump reservoir from the fan shroud and crossmember.
28. Unbolt the power steering pump and wire it aside.
29. Remove the water pump pulley.
30. Remove the crankshaft pulley (balancer/damper).
31. Raise and safely support the vehicle.
32. Detach the wiring from the oxygen, ESC and temperature sensors.
33. Remove the temperature sensor wire retainer from the block.
34. Disconnect the ground wires from the block.
35. Remove the catalytic converter AIR pipe from the manifold.
36. Disconnect and plug the transmission cooler lines from the flywheel cover.
37. Remove the starter motor.
38. Disconnect the front crossover pipe from the exhaust manifolds.
39. Drain the engine oil into a suitable container, then remove the oil filter.
40. Remove the oil cooler adapter from the engine block.
41. Remove the flywheel cover.
42. Disconnect and plug the oil cooler line from the oil pan.
43. Remove the exhaust from the converter hanger.
44. If equipped with a manual transmission, remove the clutch assembly.
45. Remove the engine mount through bolts and nuts.
46. If equipped with an automatic transmission, remove the transmission-to-engine bolts.
47. Carefully lower the vehicle.
48. Support the transmission assembly with a jack, then install a suitable engine lifting device.
49. Make sure that all retainers, wiring and vacuum lines are disconnected, then carefully lift the engine out of the vehicle. Mount the engine on a suitable stand.
50. Installation is the reverse of the removal procedure.

Rocker Arm (Valve) Cover

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

1984 VEHICLES

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Remove the accessory drive belt.
4. To remove the right side rocker arm (valve) cover, perform the following:
   a. Disconnect the AIR hose from the exhaust check valve.
   b. Disconnect the fuel inlet and return lines at the TBI units.
   c. Remove the two rear A/C compressor braces.
   d. Remove the A/C compressor lower mounting bolt.
   e. Unfasten the idler pulley bracket nuts at the water pump, then slide the A/C compressor mounting bracket forward.
   f. Disconnect the wiring from the compressor.
   g. Remove the upper A/C compressor mounting bolts, then position the compressor aside. Do NOT disconnect the refrigerant lines!
5. To remove the left side rocker arm (valve) cover bolts, perform the following:
   a. Disconnect the PCV valve and hose from the intake manifold and rocker arm cover.
   b. Disconnect the brake vacuum pipe from the intake manifold.
   c. Remove the radiator hose bracket from the alternator brace.
   d. Unbolt the alternator and position it aside, out of the way.
   e. Tag and disconnect the spark plug wires from the spark plugs.
6. Remove the rocker arm (valve) cover bolts.
7. If necessary, bend the bracket at the rear of the cylinder head, then remove the cover. If the cover sticks to the cylinder head, shear it off by carefully bumping the end of the rocker arm cover with palm of your hand or a rubber mallet. If the cover still will not come loose, CAREFULLY pry until loose. DO NOT DISTORT THE SEALING FLANGE.

To install:

8. Clean the sealing surface of the cylinder head and rocker cover. Make sure no oil or old gasket is present when applying the new gasket.

⁂ WARNING

When applying the RTV sealant, make sure to keep the sealant out of the bolt holds, as could cause a "hydraulic" condition and damage the head casting.

9. Place a ⅛ in. (3mm) bead of RTV sealant around the perimeter of the cover sealing surface. When going around the attaching bolt holes, always flow the RTV sealant on the inboard side of the holes.
10. Install the cover and secure with the mounting bolts, while the RTV is still wet. Tighten the bolts to 50 inch lbs. (6 Nm).
11. The remainder of installation is the reverse of the removal procedure.
12. Connect the negative battery cable.

1985–88 VEHICLES

See Figure 1

1. Disconnect the negative battery cable.
2. To remove the right side rocker arm (valve) cover, as follows:
   a. Remove the right side exhaust manifold and EGR pipe assembly.
   b. Remove the fresh air pipe.
   c. Loosen the spark plug retainer from the back of the right side cylinder head, then remove the other wire retainers.
   d. Remove the injector harness retaining nuts, then position the harness aside.
   e. Disconnect the heater control valve harness vacuum hose from the intake.
3. To remove the left side rocker arm (valve) cover, as follows:
   a. Disconnect the PCV valve from the rocker arm cover.
   b. Detach the injector harness from the intake.
   c. Disconnect the canister hose from the pipe.
   d. Detach the brake booster vacuum hose at the pipe, and the brake booster pipe from the plenum.
   e. Loosen the AIR pump pulley bolts, then remove the serpentine belt from the AIR pump.
   f. Remove the AIR pump pulley, and the pump lower mounting bolt.
4. Unfasten the rocker arm cover mounting bolts, then remove the cover and gasket.

To install:

5. Clean the sealing surface of the cylinder head and rocker cover. Make sure no oil or old gasket is present when applying the new gasket.
6. Place a new gasket in proper position.
7. Install the cover and secure with the mounting bolts. Tighten the bolts to 80–120 inch lbs. (9–13 Nm) for 1985–87 vehicles or to 60–90 inch lbs. (7–10 Nm) for 1988 vehicles.
8. The remainder of installation is the reverse of the removal procedure.
9. Connect the negative battery cable.

1989–91 VEHICLES

See Figure 2

1. Disconnect the negative battery cable.
2. To remove the right side rocker arm (valve) cover, perform the following:
   a. Drain the engine coolant into a suitable container.
   b. Disconnect the EGR valve and the crankcase vent pipes.
   c. Tag and disconnect the spark plug wires from the spark plugs and the wire retainers from the brackets. Set the wiring harness aside.
   d. Unfasten the nuts securing the injector harness, then set the harness aside.
   e. Disconnect the engine cooling air bleed pipe assembly.
   f. Detach the heater core-to-plenum coolant hose.
   g. Disconnect the AIR hoses at the control valve.
   h. Unbolt the A/C compressor and position it aside. Do NOT disconnect the refrigerant lines from the compressor.
3. To remove the left side rocker arm (valve) cover, perform the following:
   a. Remove the PCV valve and hose.
   b. Unfasten the nuts securing the injector harness, then position the harness aside.
   c. Tag and disconnect the spark plug wires from the spark plugs and the wire retainers from the brackets. Set the wiring harness aside.
   d. Remove the serpentine drive belt from the AIR pump pulley.
   e. Remove the AIR pump pulley and the pump lower mounting bolt.
4. Unfasten the rocker arm cover mounting bolts, then remove the cover and gasket.

To install:

5. Clean the sealing surface of the cylinder head and rocker cover. Make sure no oil or old gasket is present when applying the new gasket.
6. Place a new gasket in proper position. Install the rocker arm cover and secure with the retaining bolts. Tighten the bolts to 89 inch lbs. (10 Nm).
7. If installing the left side rocker arm cover, perform the following:
   a. Install the AIR pump lower mounting bolt and pulley.
   b. Install the serpentine drive belt.
   c. Install the spark plug wire retainers, and connect the wires to the plugs, as tagged during removal.
   d. Install the nuts securing the injector harness.
   e. Install the PCV valve and hose.
8. If installing the right side rocker arm cover, perform the following:
   a. Place the A/C compressor in position and secure with the mounting bolts.
   b. Attach the AIR hoses to the control valve.
   c. Connect the heater core-to-plenum coolant hose.
   d. Install the engine cooling air bleed pipe assembly.
   e. Install the nuts retaining the injector harness.
   f. Install the spark plug wire retainers, then connect the wires to the plugs, as tagged during removal.
   g. Connect the crankcase and EGR pipes.
   h. Refill the engine coolant.
9. Connect the negative battery cable.

5.7L (VIN P) Engines

See Figures 3, 4, 5 and 6

1. Disconnect the negative battery cable.
2. Remove the fuel rail cover(s).
3. To remove the right side rocker arm cover, perform the following:
   a. Remove the fuel rail retaining bolts/screws.
   b. Disconnect the fuel pressure regulator vacuum tube assembly.
   c. Unfasten the retainers, then remove the fuel rail from the intake manifold.

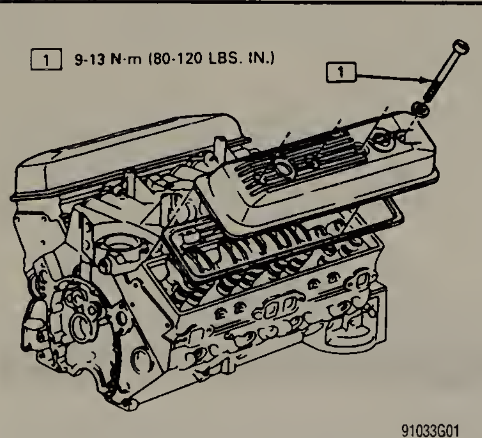


Fig. 1 Exploded view of the rocker arm cover

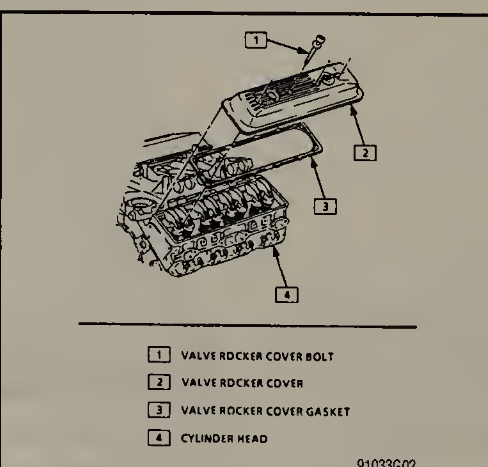


Fig. 2 Exploded view of the rocker arm (valve) cover assembly

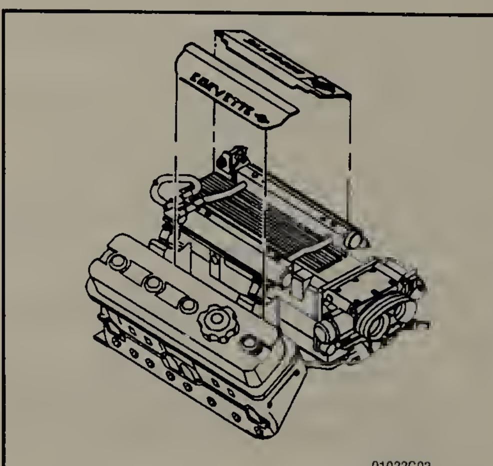


Fig. 3 Unfasten the necessary retainers, then remove the fuel rail cover(s)

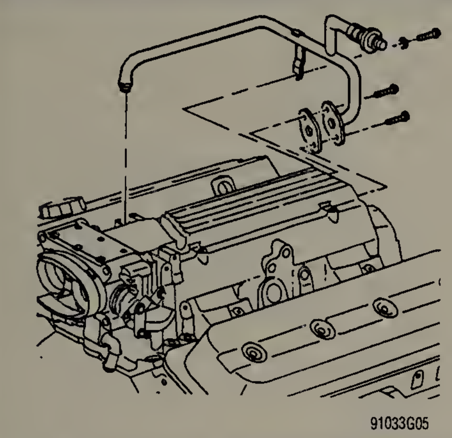


Fig. 4 Remove the secondary air injection check valve pipe from the exhaust manifold

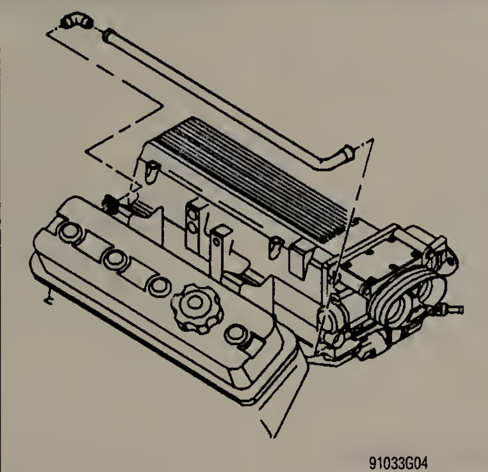


Fig. 5 Disconnect the crankcase vent hose

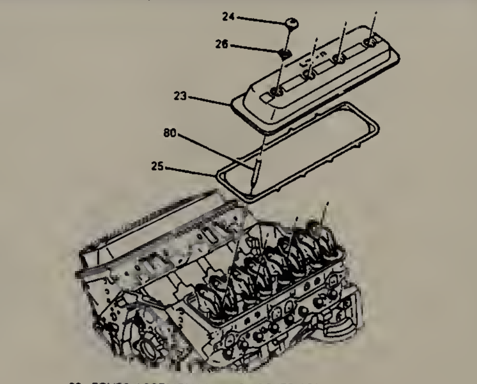


Fig. 6 Exploded view of the rocker arm (valve) cover and related components

d. Remove the fuel rail cover studs, then position the wiring harness aside.

e. Disconnect the secondary air injection pipe and check valve assemblies from the exhaust and intake manifold assemblies.

f. Detach the crankcase vent hose.

4. On 1992–95 vehicles, if removing the left side rocker arm cover perform the following:

a. Unfasten the alternator brace bolts/screws, then remove the brace.

b. Remove the alternator mounting bolts, then position the alternator aside.

c. Disconnect the secondary air injection diverter valve hose from the check valve assembly.

d. Position the wiring harness aside.

5. On 1996 vehicles, if removing the left side rocker arm cover perform the following:

a. Disconnect the brake booster vacuum hose from the intake manifold.

b. Detach the distributor vent hose from the intake manifold.

c. Remove the fuel rail cover attaching studs.

d. Disconnect the secondary air injection diverter valve hose from the check valve assembly.

e. Loosen the secondary air injection check valve tube at the exhaust manifold. Pivot the check valve away from the rocker arm cover.

f. Remove the air intake duct.

g. Remove the serpentine drive belt.

h. Remove the alternator bracket bolts and brace.

i. Unbolt the alternator and position it aside.

6. Unfasten the rocker arm (valve) cover bolts/screws, then remove the cover and gasket.

To install:

7. Clean the sealing surface of the cylinder head and rocker cover. Make sure no oil or old gasket is present when applying the new gasket.

8. Place a new gasket in proper position. Install the rocker arm cover and secure with the retaining bolts. Tighten the bolts to the following specifications:

a. 1992 vehicles: 90 inch lbs. (10 Nm).

b. 1993–95 vehicles: 100 inch lbs. (11 Nm).

c. 1996 vehicles: 106 inch lbs. (12 Nm).

9. For 1992–95 vehicles, if installing the left side rocker arm cover, perform the following:

a. Connect the secondary air injection diverter valve hoses.

b. Install the alternator and secure with the mounting bolts/screws.

c. Install the alternator brace and secure with the mounting bolts/screws.

d. Position the wiring harness and secure with the clips.

10. For 1996 vehicles, if installing the left side rocker arm cover, perform the following:

a. Install alternator and secure with the mounting bolts. Install the alternator bracket and retaining bolts.

b. Connect the secondary air injection check valve to the exhaust manifold. Align and tighten the pipe to 41 ft. lbs. (55 Nm).

c. Attach the secondary air injection check valve hoses to the check valve.

d. Connect the brake booster vacuum hose to the intake manifold.

e. Attach the distributor vent hose to the manifold.

f. Instlal the fuel rail cover studs and wiring harness clips to the intake manifold. Tighten the studs to 106 inch lbs. (12 Nm).

g. Install the fuel rail cover.

h. Install the drive belt.

i. Install the air intake duct.

11. If installing the right side rocker arm cover, perform the following:

a. Connect the crankcase vent hose.

b. Install the secondary air injection pipe and check valve assemblies. Tighten the secondary air injection pipe fitting-to-exhaust manifold to 41 ft. lbs. (55 Nm). Install the secondary air injection pipe flange bolts/screws and tighten to 19 ft. lbs. (26 Nm).

c. Install the fuel rail cover studs and wiring harness clips to the intake manifold.

d. Instlal the fuel rail to the manifold and install the retaining bolts/screws. Tighten to 89 inch lbs. (10 Nm).

e. Connect the fuel pressure regulator vacuum tube.

12. Install the fuel rail covers.

13. Connect the negative battery cable.

Rocker Arms (Shafts)

REMOVAL & INSTALLATION

See Figures 7 and 8

Be sure to keep all the components in the exact order of removal so they may be installed in there original location; adjust the valve lash after replacing the rocker arms. Coat the replacement rocker arm and ball with engine oil before installation.

Rocker arms studs that have damaged threads or are loose in the cylinder heads may be replaced by reaming the bore and installing oversize studs. Oversizes available are 0.003 in. (0.076mm) and 0.013 in (0.33mm). The bore may also be tapped and screw-in studs installed. Several aftermarket companies produce complete rocker arm stud kits with installation tools.

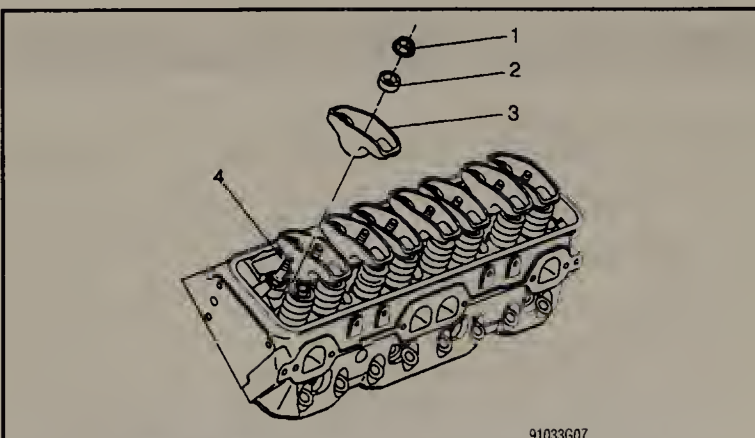


Fig. 7 Exploded view of the rocker arm nut (1), ball (2), rocker arm (3) and stud (4)

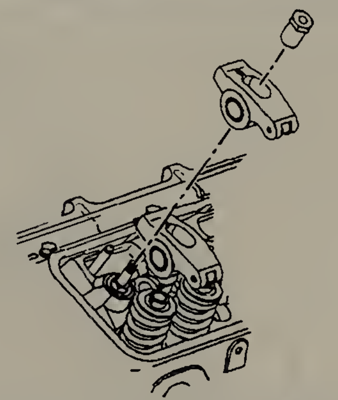


Fig. 8 For 5.7L (VIN 5) engines, unfasten the nut, then remove the rocker arm

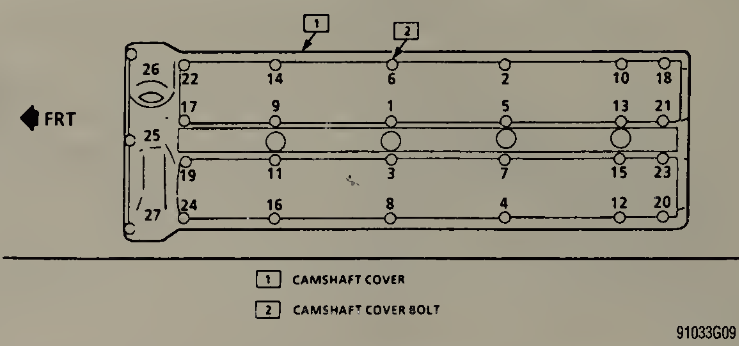


Fig. 9 It is essential to tighten the camshaft cover bolts in the proper sequence—5.7L (VIN J) engine

1. Disconnect the negative battery cable.
2. Remove the rocker arm cover as outlined in this section
3. For all engines, except 1996 5.7L (VIN 5) engines, remove the rocker arm nuts, balls and rocker arms.
4. For 1996 5.7L (VIN 5) engines, remove the rocker and nuts and rocker arms.
5. If necessary, you can remove the pushrods at this time. Place components in a rack so they can be reinstalled in the same location.

To install:

6. Coat the bearings surfaces with a thin coating of Molykote® or its equivalent.
7. Install the pushrods and make sure the rod is properly seated in the lifter seat.
8. Install the rocker arm, balls (if equipped) and nut. For all engines, except the VIN 5, tighten the nut until all lash is eliminated. This can be determined by rotating the pushrod while turning the adjusting nut.
9. For vehicles through 1995, adjust the valves as follows:
   a. The engine must be on the No. 1 firing position before proceeding. This may be determined by placing your fingers on the No. 1 rocker arms as the mark crankshaft damper is rotated towards the "0" on the timing tab. If the arms did not move, it is in the No. 1 firing position. If they did move, turn the crankshaft one full revolution to reach the No. 1 position. Remember, the mark on the crankshaft balancer must be aligned with the "0" on the timing tab.
   b. With the engine on the number 1 firing position, exhaust valves 1, 3, 4 and 8, intake valves 1, 2, 5 and 7 may be adjusted.
   c. Back out the adjusting nut until lash is felt at the pushrod. Tighten the adjusting nut until all lash is removed, then tighten an additional 1 turn to center the lifter plunger.
   d. Turn the engine one revolution until the 0 timing mark is once again aligned. Exhaust valves 2, 5, 6 and 7, intake valves 3, 4, 6 and 8 may be adjusted.
10. For 1996 5.7L (VIN 5) engines, install the rocker arm nuts and tighten to 18 ft. lbs. (25 Nm).
11. Install the rocker arm cover.
12. Connect the negative battery cable.

Camshaft Covers

REMOVAL & INSTALLATION

5.7L (VIN J) Engine

See Figure 9

RIGHT COVER

1. Disconnect the negative battery cable.
2. Drain the engine coolant into a suitable container.
3. Tag and disconnect the spark plug wires from the spark plugs.
4. Detach the electrical connector from the blower motor resistor block.
5. Unfasten the screws securing the evaporator housing quarter panel and panel from the vehicle.
6. Remove the oil pressure sensor from the oil filter housing.
7. Unfasten the bolt retaining the coolant outlet to the injector housing, then position the outlet aside.
8. Remove the upper EGR pipe bolts and pipe.
9. Remove the bolt securing the fresh air pipe bracket to the injector housing.
10. Unfasten the camshaft cover-to-cylinder head, then remove the cover from the head.
11. Thoroughly clean the cylinder head and cover mating surfaces.
12. Inspect the foam inserts for contamination. Remove the inserts and clean or replace them as necessary.
13. Check the secondary chain top guide wear strips.(1.0mm).To check the strips, you must remove the wear strip from the guide located inside the cover at the front. Remove the screws and guide from the camshaft cover. No wear groove should exceed a depth of 0.040 in. After checking, install the guide and screws. Apply Loctite® 262 to the screws and tighten to 53 inch lbs. (6 Nm). Install the wear strip onto the guide.

To install:

14. Apply Permabond® A136 or equivalent to the camshaft cover. Apply Loctite® 565 to the end plugs. Make sure the camshaft end plugs and new spark plug bore O-rings are in place before installing the cover.
15. Install the camshaft cover and bolts. To be sure the camshaft operates properly, the cover retainers MUST be tightened to the following specifications, in the sequence shown in the accompanying figure:
   a. Tighten the 24 M8 bolts to 15 ft. lbs. (20 Nm), 3 times.
   b. Tighten the 3 M6 screws to 89 inch lbs. (10 Nm).
16. Install a new coolant outlet cover gasket, cover and retaining screws. Tighten the screws to 89 inch lbs. (10 Nm).
17. Install the bolt holding the fresh air pipe bracket to the injector housing and tighten the bolt to 19 ft. lbs. (26 Nm).
18. Install the upper EGR pipe and secure with the retaining bolts. Tighten the bolts to 89 inch lbs. (10 Nm).
19. Install the evaporative housing quarter panel and screws.
20. Attach the electrical connector to the blower motor resistor block.
21. Connect the spark plug wires to the spark plugs, as tagged during removal.
22. Refill the cooling system, then connect the negative battery cable.

LEFT COVER

1. Take the vehicle to a reputable repair shop to have the A/C system discharged using the proper equipment.
2. Disconnect the negative battery cable.
3. Remove the power steering pump, as outlined in Section 8 of this manual.
4. Unfasten the bolts securing the A/C suction/discharge hoses to the compressor. Plug or cover the openings to prevent contamination from entering the system.
5. Tag and disconnect the spark plugs wires from the plugs.
6. Detach the ventilation breather pipe from the camshaft cover.
7. Remove the screws holding the control cable hold-down clamp screws to the plenum.
8. Remove the throttle body extension and the coolant outlet pipe.
9. Remove the brake power booster.

10. Unfasten the camshaft cover-to-cylinder head, then remove the cover from the head.
11. Thoroughly clean the cylinder head and cover mating surfaces.
12. Inspect the foam inserts for contamination. Remove the inserts and clean or replace them as necessary.
13. Check the secondary chain top guide wear strips.(1.0mm).To check the strips, you must remove the wear strip from the guide located inside the cover at the front. Remove the screws and guide from the camshaft cover. No wear groove should exceed a depth of 0.040 in. After checking, install the guide and screws. Apply Loctite® 262 to the screws and tighten to 53 inch lbs. (6 Nm). Install the wear strip onto the guide.

To install:

14. Apply Permabond® A136 or equivalent to the camshaft cover. Apply Loctite® 565 to the end plugs. Make sure the camshaft end plugs and new spark plug bore O-rings are in place before installing the cover.
15. Install the camshaft cover and bolts. To be sure the camshaft operates properly, the cover retainers MUST be tightened to the following specifications, in the sequence shown in the accompanying figure:
    a. Tighten the 24 M8 bolts to 15 ft. lbs. (20 Nm), 3 times.
    b. Tighten the 3 M6 screws to 89 inch lbs. (10 Nm).
16. Install the brake power booster.
17. Install the screws holding the cable hold-down clamps onto the plenum and tighten them to 18 inch lbs. (2 Nm).
18. Connect the ventilation breather pipe to the camshaft cover.
19. Attach the spark plug wires to the plugs, as tagged during removal.
20. Unplug the openings, then install the bolts retaining the A/C suction/discharge hoses to the A/C compressor.
21. Install the throttle body extension.
22. Install the coolant outlet pipe. Tighten the throttle body screws to 53 inch lbs. (6 Nm) and the outlet pipe screws to 89 inch lbs. (10 Nm). Tighten the bolt to 24 ft. lbs. (33 Nm).
23. Install the power steering pump and tighten the mounting bolts to 24 ft. lbs. (33 Nm).
24. Connect the negative battery cable. Take your vehicle to a reputable repair shop to have the A/C system charged.

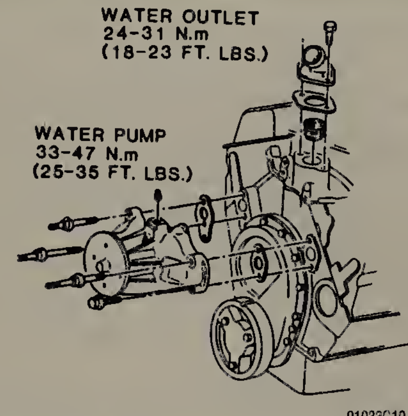
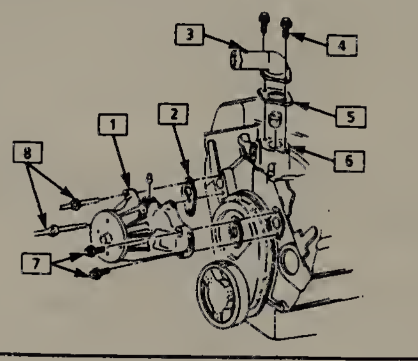


Fig. 10 Exploded view of the thermostat and water pump assembly—1984-89 5.7L (VIN 8) engine



1 COOLANT PUMP
2 COOLANT PUMP GASKET
3 THERMOSTAT HOUSING
4 THERMOSTAT HOUSING BOLT
5 THERMOSTAT HOUSING GASKET
6 THERMOSTAT
7 COOLANT PUMP BOLT
8 COOLANT PUMP STUD

91033G11

Fig. 11 Exploded view of the thermostat and water pump assembly—1990-91 5.7L (VIN 8) engine

Thermostat

REMOVAL & INSTALLATION

CAUTION

Never open, service or drain the radiator or cooling system when hot; serious burns can occur from the steam and hot coolant. Also, when draining engine coolant, keep in mind that cats and dogs are attracted to ethylene glycol antifreeze and could drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantities. Always drain coolant into a sealable container. Coolant should be reused unless it is contaminated or is several years old.

5.7L (VIN 8) Engines

See Figures 10 and 11

1. Disconnect the negative battery cable.
2. Remove the air intake duct and air cleaner assembly.
3. Making sure the engine is cool, remove the surge tank cap.
4. Drain the cooling system, to a level below the thermostat, into a suitable container.
5. Use a suitable pair of pliers to unfasten the hose clamp, then disconnect the upper radiator hose from the outlet.
6. For 1990–91 vehicles, perform the following:
    a. Disconnect the coolant hose from the throttle body.
    b. Detach the electrical connector and vacuum harness at the EGR solenoid.
7. Unfasten the thermostat housing attaching bolts, then remove the housing. Remove the thermostat from the manifold.
8. Thoroughly clean the gasket mating surfaces of the water outlet and upper intake manifold.

To install:

9. For 1984–89 vehicles, perform the following:
    a. Place a ⅛ in. (3mm) bead of RTV sealant, all around the thermostat housing sealing surface on the intake manifold.
    b. Place the thermostat in the intake manifold.
    c. While the RTV is still wet, position the thermostat housing. Tighten the housing retaining bolts to 18–23 ft. lbs. (24–31 Nm).
10. For 1990–91 vehicles, perform the following:
    a. Install the thermostat, a new gasket, and the housing on the manifold.
    b. Install the housing bolts and tighten to 25 ft. lbs. (34 Nm).
    c. Attach the electrical connector and vacuum harness at the EGR solenoid.
    d. Connect the coolant hose to the throttle body.
11. Install the air cleaner assembly and air intake duct.
12. Connect the negative battery cable.
13. Start the engine and run, with the radiator cap removed, until the upper radiator hose is hot (thermostat open).
14. With the engine idling, add a suitable coolant/water mixture until the level reaches the bottom of the radiator filler neck.
15. Install the radiator cap, making sure the arrows line up with the overflow tube.
16. Turn the engine off, then recheck the coolant level and add if necessary, through the recovery reservoir.

5.7L (VIN J) Engine

➧ See Figure 12

➡This procedure covers removal of the thermostat and housing.

1. Disconnect the negative battery cable.
2. Making sure the engine is cool, remove the surge tank cap.
3. Drain the cooling system into a suitable container.
4. Raise and safely support the vehicle.
5. Unfasten the bolts retaining the thermostat housing assembly brackets to the front side member.
6. Use a suitable pair of pliers to unfasten the clamps securing the following hoses from the thermostat:
   - Radiator outlet hose
   - Radiator bypass hose
   - Engine hose
7. Detach the quick-connect fittings at the heater hose-thermostat housing junction.
8. Remove the thermostat housing assembly from the vehicle.
9. Unfasten the housing bolts, then remove the thermostat and seal.
10. Inspect the housing for hairline cracks or other damage. If you are replacing the housing, transfer the necessary parts to the new housing.
11. Thoroughly clean the gasket mating surfaces of the thermostat housing.

To install:

➡The seal on the thermostat MUST be installed with the taper toward the radiator. Make sure the seal remains seated in the housing groove when assembling the housing sections.

12. Place the thermostat and seal in the housing.
13. Install the thermostat housing bolts and tighten to 18 ft. lbs. (25 Nm).
14. Attach the quick-connect fittings at the heater hose-thermostat housing junction.
15. Connect the following hoses and secure with the hose clamps:
   - Radiator outlet hose
   - Radiator bypass hose
   - Engine hose
16. Tighten the hose clamps to 35 inch lbs. (4 Nm).
17. Install the bolts holding the thermostat housing brackets to the front side member. Tighten the bolts to 18 ft. lbs. (25 Nm).
18. Carefully lower the vehicle.
19. Refill the engine cooling system with the proper type and amount of coolant.

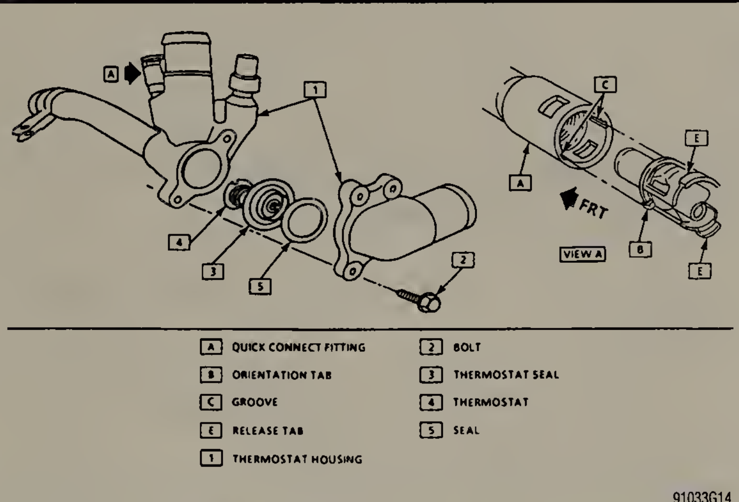


Fig. 12 Exploded view of the thermostat and housing assemblies

5.7L (VIN P and 5) Engines

➧ See Figures 13, 14 and 15

➡On these vehicles, when adding cooling you must use DEX-COOL®, or equivalent orange colored, silicate-free coolant.

1. Disconnect the negative battery cable.
2. Detach the Intake Air Temperature (IAT) sensor electrical connector.
3. Remove the air intake duct and air cleaner.
4. Use a suitable pair of pliers to unfasten the hose clamp, then disconnect the lower radiator hose from the thermostat housing inlet of the water pump.
5. Unfasten the thermostat housing bolts, then remove the housing. Remove the thermostat and the gasket.
6. Throroughly clean the thermostat housing and water pump gasket mating surfaces.

To install:

7. Install the thermostat and gasket with the taper up. Install the housing and bolts to the water pump. Tighten the housing bolts to 89 inch lbs. (10 Nm).
8. Attach the radiator lower hose on the inlet side of the water pump. Secure the hose with the retaining clamp.
9. Fill the cooling system to the proper level with a 50/50 mixture of DEX-COOL® or equivalent, silicate free coolant.
10. Install the air cleaner and air intake duct.
11. Attach the IAT sensor electrical connector.
12. Connect the negative battery cable. Start the engine and check for coolant leaks. Check the coolant level and add if necessary.

Intake Manifold

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

1984 VEHICLES

➧ See Figures 16 and 17

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Disconnect the fuel inlet and return lines.
4. Tag and disconnect the necessary vacuum lines.
5. Label and detach the necessary electrical connections.
6. Disconnect the accelerator, cruise control and detent cables.

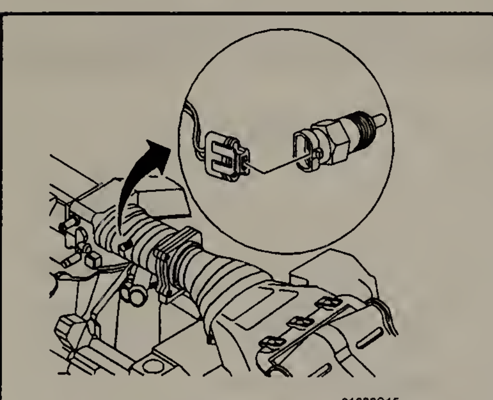


Fig. 13 Unplug the IAT sensor electrical connector. The IAT sensor is located in the air cleaner intake duct

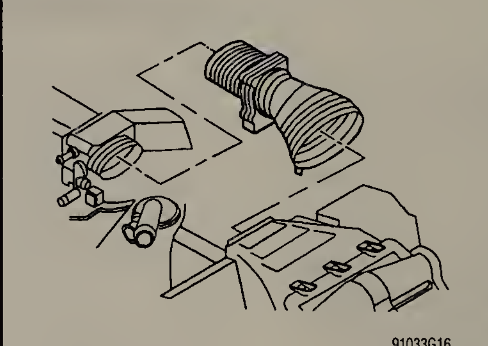


Fig. 14 Unfasten the retainers, then remove the air intake duct

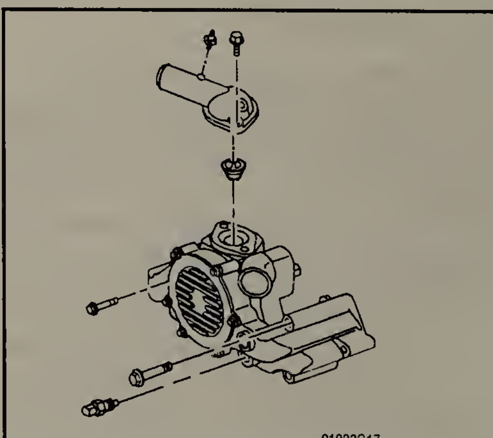
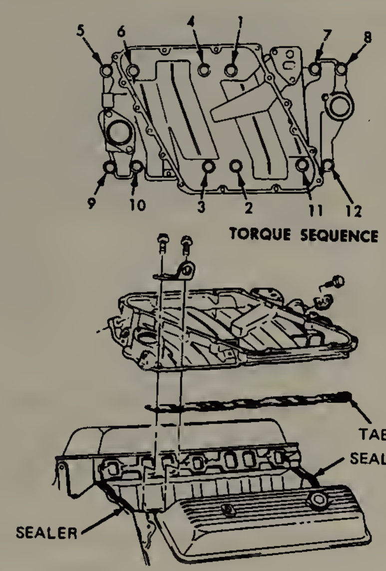
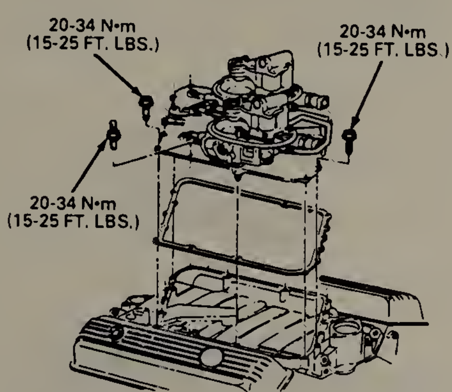


Fig. 15 Exploded view of the thermostat housing and thermostat



91033G18

Fig. 16 Exploded view of the intake manifold and gaskets, and bolt tightening sequence—1984 5.7L (VIN 8) engine



91033G19

Fig. 17 The TBI assembly/intake cover retainers must be tightened to the proper specifications

7. Disconnect the cable from the accelerator bracket.
8. Remove the intake cover nuts and bolts, then remove the cover.
9. Drain the cooling system into a suitable container.
10. Disconnect the radiator hose from the thermostat outlet and alternator brace.
11. Remove the distributor cap.
12. Matchmark the installed position of the distributor, then remove the distributor from the engine.
13. Disconnect the heater hose from the rear of the intake.
14. Remove the accessory drive belt.
15. Remove the AIR pump pulley.
16. Remove the AIR pump valve adapter, pump mounting bolts, then remove the pump.
17. Detach the coolant temperature sensor electrical connector.
18. Unfasten the intake manifold bolts, then remove the intake manifold.
19. Remove the gasket(s), then thoroughly clean the gasket mating surfaces.

To install:

20. Position the gaskets on the cylinder head, with the blocked openings in the gaskets positioned at the rear of the engine.
21. Bend the gasket tab flush with the face of the cylinder head, then apply a $\frac{3}{16}$ in. (5mm) bead of RTV sealant on the front and rear ridges of the cylinder case.
22. Apply Loctite® 1052624 or equivalent to the manifold mounting bolts.
23. Install the intake manifold mounting bolts and tighten, in the sequence shown in the accompanying figure, to 35 ft. lbs. (47 Nm).
24. The remainder of installation is the reverse of the removal procedure.
25. Tighten the intake cover (TBI assembly) retainers to the specifications shown in the accompanying figure.
26. Connect the negative battery cable.
27. Fill the cooling system with the proper type and amount of coolant.

1985–91 VEHICLES

➧ See Figures 18 thru 28

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure, as outlined in section 5 of this manual.
3. Drain the engine coolant into a suitable container.
4. Disconnect the throttle and cruise control cables from the throttle body and bracket.
5. If equipped, disconnect the TV cable from the throttle body and bracket.
6. Remove the bracket from the intake plenum.
7. Detach the electrical connectors from the following components:
• Coolant temperature sensor
• Throttle Position Sensor (TPS)

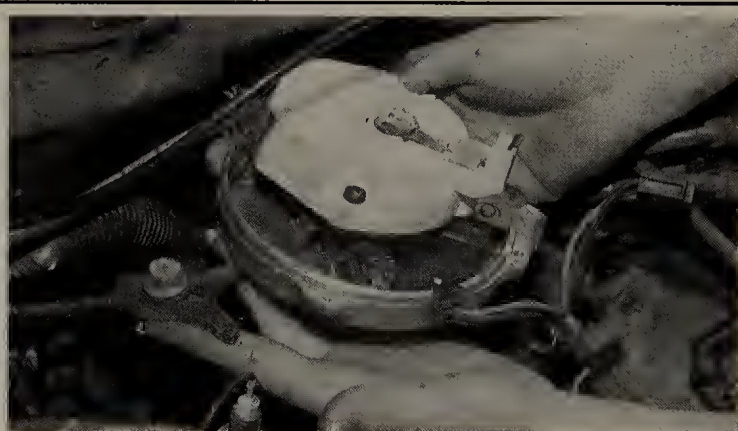

91033P05

Fig. 18 Remove the distributor from the engine

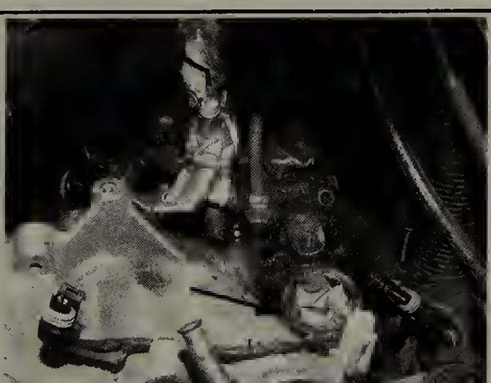

91033P06

Fig. 19 Stuff a rag or shop towel into the distributor opening, to prevent debris from falling into the engine

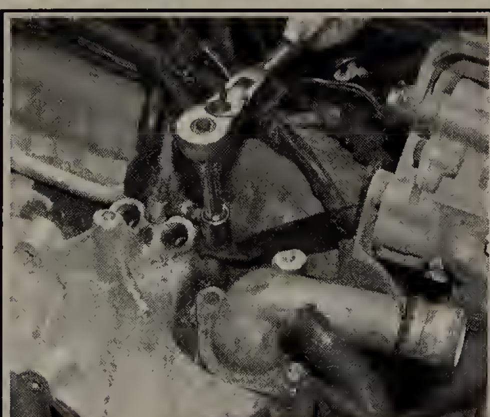

91033P07

Fig. 20 Remove the retaining bolts, then remove the AIR pump brace

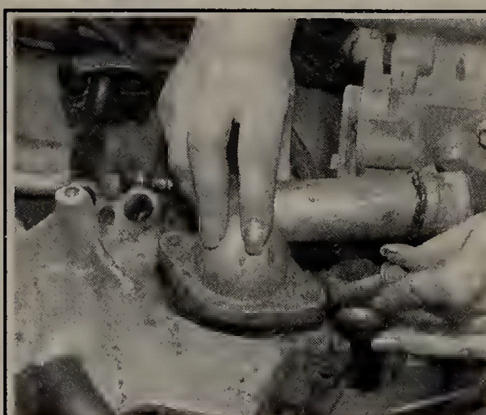
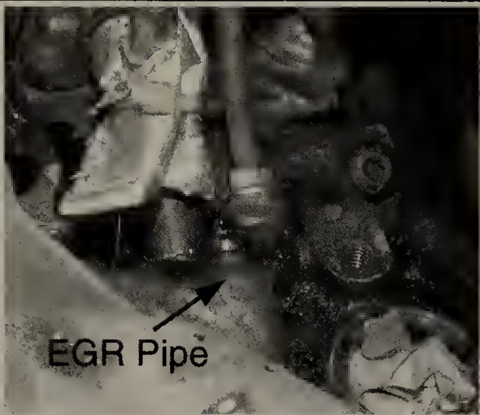

910363P08

Fig. 21 If necessary, unfasten the mounting bolts and remove the coolant outlet

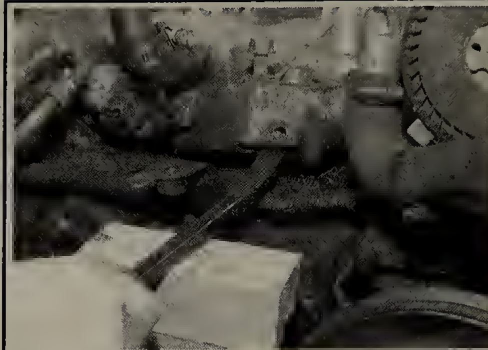


91033P09

Fig. 22 Remove the 2 retaining screws, then position the EGR pipe aside

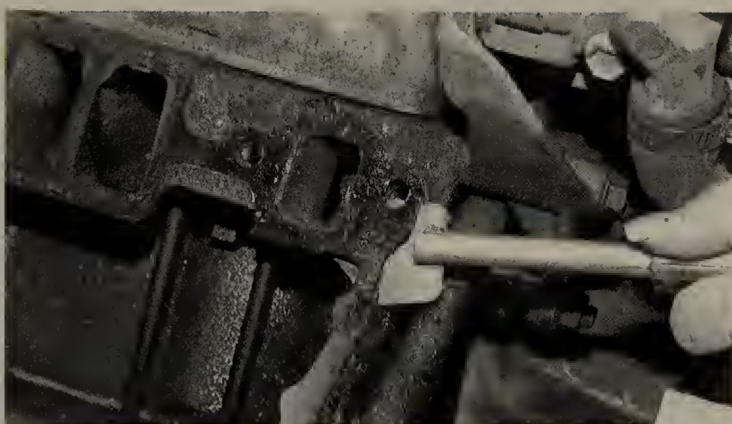
91033P11

Fig. 23 Unplug the electrical connectors from the coolant temperature switch (1) and sensor (2)



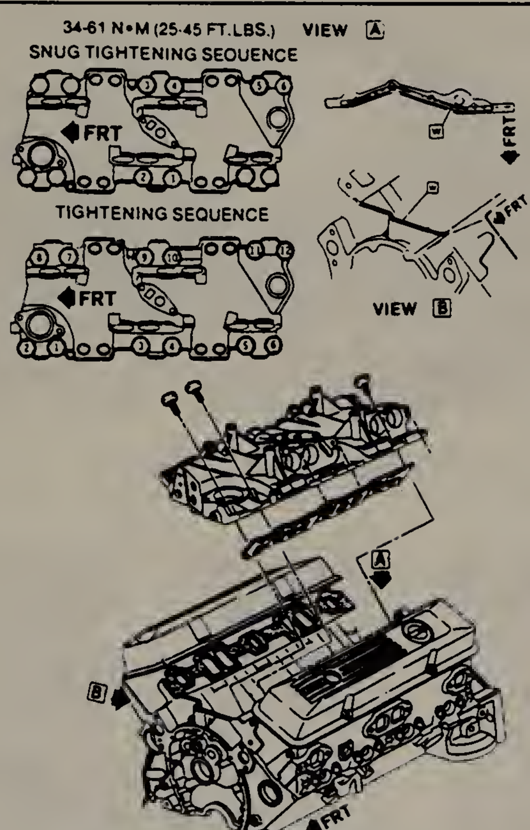
91033P12

Fig. 24 If the manifold sticks to the block, carefully use a block of wood and a pry-tool to carefully pry up on the mounting boss on the end of the manifold



91033P13

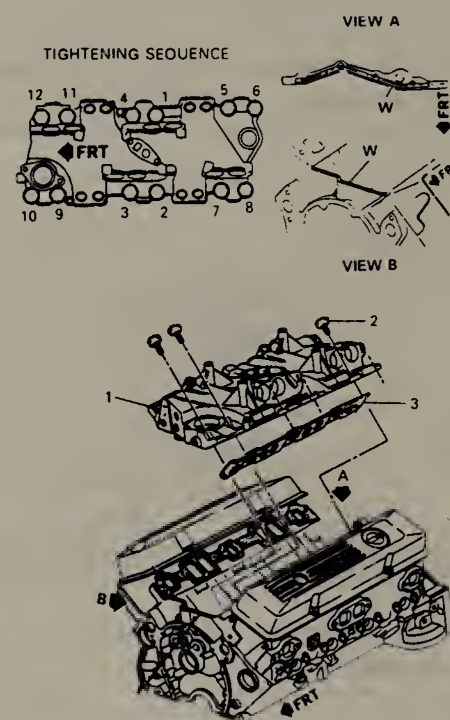
Fig. 25 Remove and discard the intake manifold gaskets



W AT TIME OF INSTALLATION SURFACE AREA MUST BE FREE OF OIL AND SEALING COMPOUND MUST BE WET TO TOUCH WHEN BOLT/SCREWS ARE TORQUED. APPLY SEALING COMPOUND .12 THICK.

91033G20

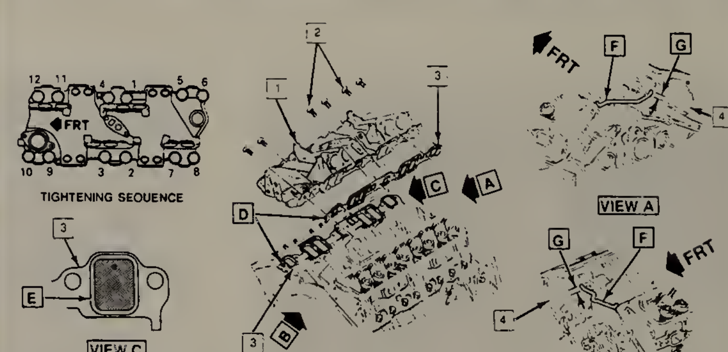
Fig. 26 Exploded view of the intake manifold and bolt tightening sequence—1985–88 vehicles



1 MANIFOLD, INTAKE
2 BOLT, INTAKE MANIFOLD
3 GASKET, INTAKE MANIFOLD

91033G21

Fig. 27 You must tighten the intake manifold bolts in the proper sequence—1989 vehicles



D TAB, INTAKE MANIFOLD GASKET
E COOLANT PASSAGE RESTRICTOR
F SEALER (RTV)
G 13 mm (0.5 in.)
1 MANIFOLD, INTAKE
2 BOLT
3 GASKET, INTAKE MANIFOLD
4 HEAD, CYLINDER

91033G22

Fig. 28 Exploded view of the intake manifold installation and bolt tightening sequence—1990–91 vehicles

- Intake Air Temperature (IAT) sensor
- Idle Air Control (IAC) valve
- Manifold Absolute Pressure (MAP) sensor

8. Remove the air intake duct from the throttle body.
9. Tag and disconnect the vacuum hoses from the throttle body and intake plenum.
10. Disconnect the heater hoses from the throttle body.
11. Remove the power brake vacuum booster fitting from the plenum.
12. Unfasten the runner-to-plenum bolts, then remove the plenum from the engine.
13. Detach the vacuum harness from the EGR solenoid.
14. Remove the EGR solenoid from the coolant outlet, then remove the EGR valve from the manifold.
15. Unfasten the injector harness retaining nuts.
16. Remove the runner-to-manifold bolts, then remove the runner.
17. Detach the injector harness connectors.
18. Disconnect the fuel lines, then remove the fuel rail and injector assembly. For more information, please refer to Section 5 of this manual.
19. Remove the distributor assembly, as outlined in Section 2 of this manual.
20. Remove the AIR pump brace.
21. Disconnect the radiator upper hose at the coolant outlet. If necessary, remove the coolant outlet.
22. Disconnect the EGR pipe and position it aside.
23. Disconnect the PCV valve hose and the crankcase vent tube from the manifold.
24. Detach the coolant temperature sensor and temperature switch electrical connectors.
25. Unfasten the intake manifold mounting bolts, then remove the manifold.. If the manifold is stuck on the cylinder block, carefully use a pry tool on the end mounting boss of the manifold only, to pry the manifold up. Never pry under the sides of the manifold!
26. Remove the gasket(s), then thoroughly clean the gasket mating surfaces.

To install:

27. Position new gaskets on the cylinder head. The coolant passage restrictor in the gaskets must be positioned at the rear of the engine. Bend the gasket tab flush with the front face of the cylinder head.
28. Place a 0.2 in. (5mm) bead of RTV sealant on the front and rear ridges of the cylinder case. Apply a suitable thread locking sealer to the manifold bolts.

➡When installing the manifold, the sealant must still be wet to the touch when installing the bolts.

29. Position the intake manifold, then install the manifold bolts. Tighten, in the sequences shown in the accompanying figure, to the following specifications:
    a. 1985–88 vehicles: 25–45 ft. lbs. (34–61 Nm).
    b. 1989 vehicles: 35 ft. lbs. (47 Nm).
    c. 1990–90 vehicles: all bolts except 1 & 4: 35 ft. lbs. (47 Nm). Bolts 1 & 4 to 45 ft. lbs. (61 Nm).
30. Connect the crankcase vent tube and PCV valve hose to the manifold.
31. Install the EGR valve pipe and the AIR pump brace.
32. Connect the radiator upper hose at the coolant outlet.
33. Install the distributor.
34. Install the fuel rail and injector assembly, then connect the fuel lines.
35. Attach the injector harness connectors.
36. Install the runners, gaskets and the runner-to-manifold bolts and tighten to 25 ft. lbs. (34 Nm).
37. Install the injector harness and nuts. Tighten the nuts to 89 inch lbs. (10 Nm).
38. Install the EGR valve to the manifold and tighten the mounting bolts to 12 ft. lbs. (16 Nm).
39. Install the EGR solenoid on the coolant outlet and tighten the coolant outlet bolt to 25 ft. lbs. (34 Nm).
40. Connect the vacuum harness to the EGR solenoid.
41. Install the plenum and runner-to-plenum bolts. Tighten the bolts to 25 ft. lbs. (34 Nm).
42. Connect the power brake vacuum fitting at the plenum. Tighten the fitting to 108 inch lbs. (12 Nm).
43. Attach the heater hoses to the throttle body.
44. Connect all vacuum hoses, as tagged during removal.
45. Install the air intake duct.
46. Attach the electrical connector to the following components:
    - Manifold Absolute Pressure (MAP) sensor
    - Idle Air Control (IAC) valve
    - Intake Air Temperature (IAT) sensor
    - Throttle Position Sensor (TPS)
    - Coolant temperature sensor
47. Install the cable bracket to the plenum.
48. If equipped, install the TV cable, to the bracket and throttle body.
49. Connect the throttle and cruise control cables to the bracket and throttle body.
50. Connect the negative battery cable.
51. Fill the cooling system with the proper type and amount of coolant.

5.7L (VIN J) Engine

See Figures 29 and 30

➡These vehicles use an intake plenum instead of a conventional intake manifold assembly.

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Drain the engine coolant into a suitable container.
4. Remove the air intake duct.
5. Unfasten the screws and nuts securing the cable shield and shield.
6. Disconnect the control cable from the throttle body.
7. Unfasten the screws securing the cable hold-down clamps from the plenum.
8. Remove the fresh air hose from the left and right side of the throttle body extension.
9. Tag and detach the electrical connections from the following components:
    - Throttle Position Sensor (TPS)
    - Idle Air Control (IAC) valve
    - Manifold Air Temperature (MAT)
10. Disconnect the coolant bleed hose from the plenum.
11. Detach the power brake booster vacuum hose from the plenum.
12. Disconnect the vacuum hose from between the fuel pressure regulator and plenum.
13. Tag and disconnect vacuum hoses from the mid-plenum; left and right sides.
14. Detach the vacuum hose from the MAP sensor and plenum.
15. Disconnect the fuel lines from the fuel rail.
16. Unfasten the bolts securing the plenum to the injector housing.
17. Detach the electrical connectors from the ignition module.
18. Unplug the electrical connector from the MAP sensor.
19. Remove the purge solenoid/PCV valve hose fitting from the plenum.
20. Tag and detach the purge canister hose connectors.
21. Remove the upper EGR pipe bolts and pipe.

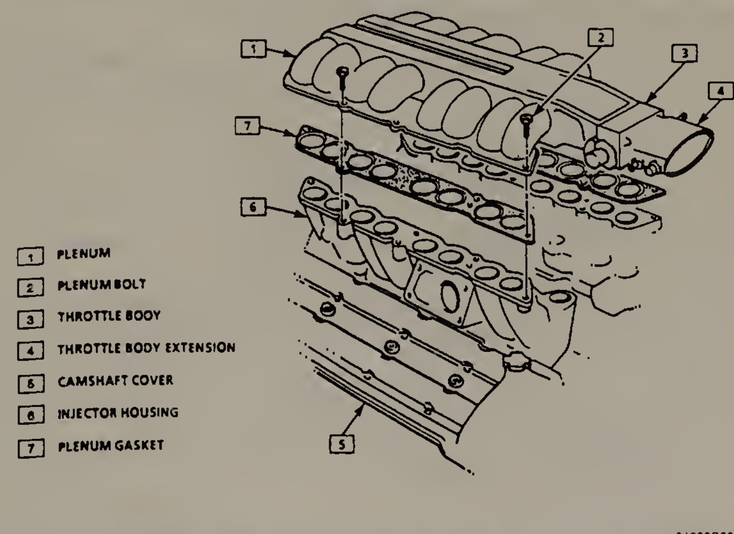


Fig. 29 Exploded view of the intake plenum, gaskets and related components—5.7L (VIN J) engines

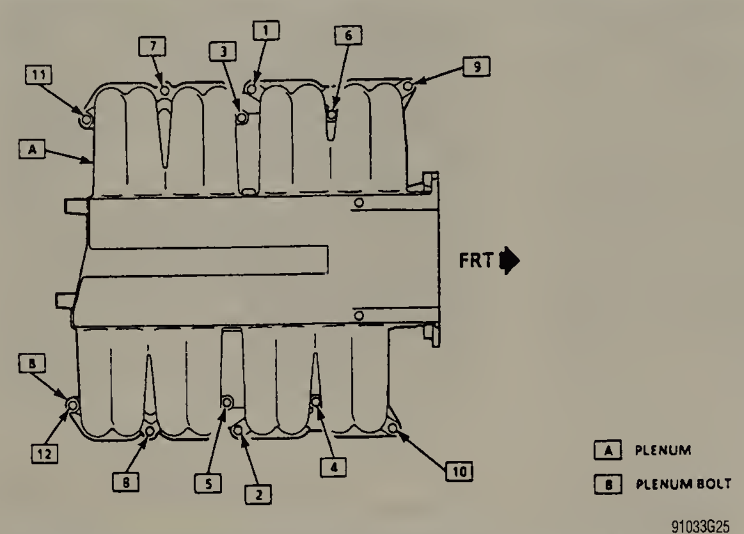


Fig. 30 Intake plenum bolt tightening sequence—5.7L (VIN J) engines

WARNING

You must install some type of cover on the intake openings whenever the plenum is removed.

22. Remove the plenum assembly and gaskets from the vehicle. Cover the injector housing openings with a piece of tape, or something that will keep debris out.
23. If the plenum is being replaced, transfer the following parts to the new plenum:
   a. MAP sensor and bracket; tighten the bracket-to-plenum screws to 89 inch lbs. (10 Nm).
   b. Throttle body; tighten the throttle body-to-plenum screws to 19 ft. lbs. (26 Nm).
   c. Throttle body extension; tighten the extension-to-plenum screws to 53 inch lbs. (6 Nm).
   d. Ignition module; tighten the module-to-plenum screws to 89 inch lbs. (10 Nm).
24. Thoroughly clean the injector housing and intake plenum mating surfaces.

To install:

25. Remove the covering or tape from the injector housings.
26. Attach the electrical connectors onto the ignition module.
27. Position the intake plenum, with the MAP sensor, over the fuel pressure regulator.
28. Attach the MAP sensor electrical connector.
29. Connect the vacuum hose to the MAP sensor and plenum.

➡Before securing the plenum to the injector housings, be sure that the remaining vacuum hoses and wiring are accessible.

30. Position new plenum gaskets, then install the plenum and secure with the retaining bolts. Tighten the bolts, in the sequence shown in the accompanying figure, to 19 ft. lbs. (26 Nm).
31. Connect the vacuum hoses to the mid-plenum.
32. Attach the fuel lines to the fuel rail and tighten the fittings to 19 ft. lbs. (26 Nm).
33. Connect the vacuum hose between the fuel pressure regulator and plenum.
34. Attach the power brake booster vacuum hose onto the plenum.
35. Fasten the fresh air hose onto the left and right side of the throttle body extension.
36. Install the purge solenoid/PCV valve hose fitting onto the plenum.
37. Connect the rear right side purge canister connection.
38. Attach the electrical connectors to:
- Throttle Position Sensor (TPS)
- Idle Air Control (IAC) valve
- Manifold Air Temperature (MAT)

39. Install the screws securing the cable hold-down clamps onto the plenum and tighten to 18 inch lbs. (2 Nm).
40. Connect the coolant bleed hose onto the plenum.
41. Attach the control cable to the throttle body. Install the cable shield, screws and nuts onto the throttle body. Tighten to 27 inch lbs. (3 Nm).
42. Install the upper EGR pipe and bolts and tighten to 89 inch lbs. (10 Nm).
43. Install the air intake duct.
44. Connect the negative battery cable.
45. Fill the cooling system with the proper type and amount of coolant.

5.7L (VIN P and 5) Engines

➧ See Figures 31 and 32

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Drain the engine coolant into a suitable container.
4. Remove the throttle body air duct.
5. Remove the fuel rail covers.
6. Tag and detach the wiring harness connectors from the fuel injectors.
7. Disconnect the left and right wiring harness and position them aside.
8. Remove the accelerator cable bracket bolts/screws, then remove the bracket and cables from the throttle body.
9. Disconnect the secondary air injection diverter valve hoses.
10. Remove the electrical ground strap from the intake manifold assembly.
11. Unfasten the fuel rail bolts/screws, then remove the fuel rail from the manifold and position it aside.
12. Disconnect the vacuum and crankcase vent hoses.
13. Remove the EGR control valve nut, then remove the control valve.
14. Unfasten the emission canister purge control valve bracket nut, then remove the control valve.
15. Unfasten the EGR valve retaining bolts, then remove the EGR valve.

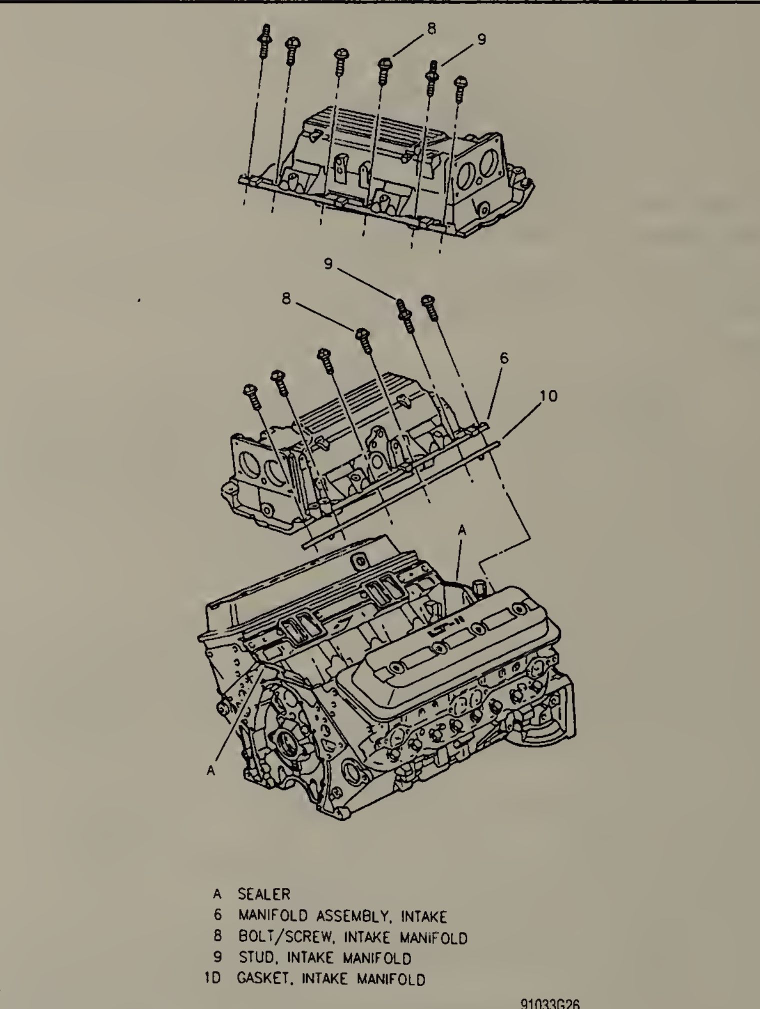


Fig. 31 Exploded view of the intake manifold

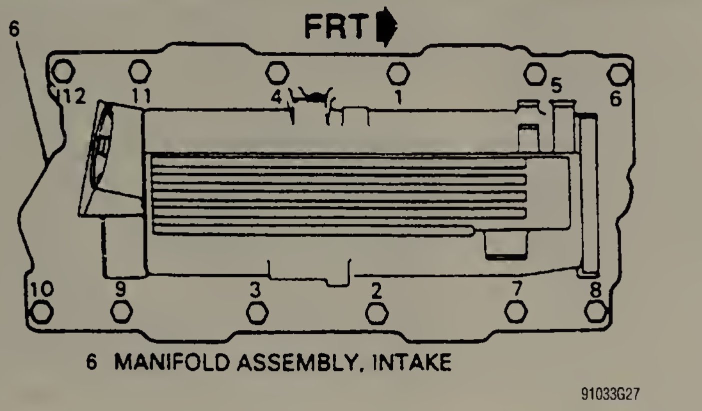


Fig. 32 The intake manifold bolts must be tightened in the proper sequence

16. Disconnect the secondary air injection pipe from the intake and right exhaust manifold assemblies.
17. Unfasten the retainers, then remove the alternator brace.
18. Disconnect the coolant hoses from the throttle body.
19. Unfasten the retaining bolts/screws then remove the throttle body and gasket.
20. Remove the intake manifold bolts/screw and studs, then remove the intake manifold and gaskets. Discard the gaskets and replace with new ones. Clean the intake manifold retaining bolts/screws and studs. Clean the cylinder head, block and intake manifold mating surfaces.

To install:

21. Apply a 3⁄16 in. (5mm) bead of RTV sealant to the front and rear of the engine block. Extend the bead of sealant ½ in. (13mm) up each cylinder head assembly to seal and retain the gaskets.
22. Position new gaskets, then install the cylinder head. Install the intake manifold retaining bolts/screw and studs and tighten, in the sequences shown in the accompanying figure, to the following specifications:
    a. Step 1 (all vehicles): tighten all bolts, in sequence, to 71 inch lbs. (8 Nm).
    b. Step 2 (1992 vehicles): tighten all bolts, in sequence, to 19 ft. lbs. (26 Nm).
    c. Step 2 (1993–96 vehicles): tighten all bolts, in sequence, to 35 ft. lbs. (48 Nm).
23. Install the throttle body gasket, and throttle body and secure with the retaining bolts/screws. Tighten to 18 ft. lbs. (25 Nm).
24. Connect the coolant hoses to the throttle body.
25. Install the alternator brace.
26. Install the accelerator cable bracket and cables. Tighten the cable bracket bolts/screw to 89 inch lbs. (10 Nm).
27. Install the secondary air injection pipe fitting. Tighten the air injection pip exhaust manifold fitting to 41 ft. lbs. (55 Nm). Tighten the air injection pipe flange-to-intake manifold bolts/screws to 19 ft. lbs. (26 Nm). Tighten the air injection pipe bracket-to-cylinder head bolt/screw to 25 ft. lbs. (34 Nm).
28. Install the EGR valve assembly and secure with the retaining bolts/screws. Install the EGR control valve and secure with the retaining nut. Tighten the valve bolts/screws and the nut to 18 ft. lbs. (25 Nm).
29. Install the emission canister purge control valve and nut. Tighten the nut to 15 ft. lbs. (20 Nm).
30. Connect the vacuum and crankcase hoses.
31. Install the fuel rail to the manifold. Connect the fuel pressure regulator vacuum tube. Install the fuel rail bolts/screws and tighten to 89 inch lbs. (10 Nm).
32. Attach the electrical ground strap to the intake manifold.
33. Connect the secondary air injection diverter valve hoses.
34. Attach the wiring harness connectors to the fuel injectors. Make sure to match the proper electrical connector with its corresponding cylinder.
35. Connect the throttle body air duct.
36. Install the fuel rail covers.
37. Connect the negative battery cable.
38. Fill the cooling system with the proper type and amount of coolant.

Exhaust Manifold

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

➧ See Figures 33 and 34

RIGHT SIDE—1984–88 VEHICLES

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Drain the engine cooling system into a suitable container.
4. For 1985–88 vehicles, remove the plenum extension.
5. For 1985–88 vehicles, remove the EGR pipe bolts from the intake manifold.
6. Unfasten the rear A/C compressor brace, then allow the brace to hang at the compressor.
7. For 1985–88 vehicles, disconnect the dipstick tube from the manifold, then remove the dipstick.
8. Disconnect the AIR hose from the exhaust check valve and the converter pipe check valve.
9. For 1984 vehicles, detach the heater hose from the rear of the intake.
10. For 1985–88 vehicles, detach the wire at the temperature sending unit.
11. Tag and disconnect the spark plug wires from the plugs, and at the valve cover.
12. Remove the spark plugs, after the engine has cooled.

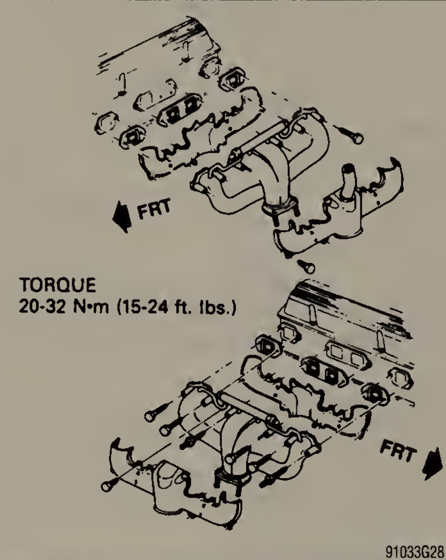


Fig. 33 Exploded view of the exhaust manifold mounting—1984 5.7L (VIN 8) engines

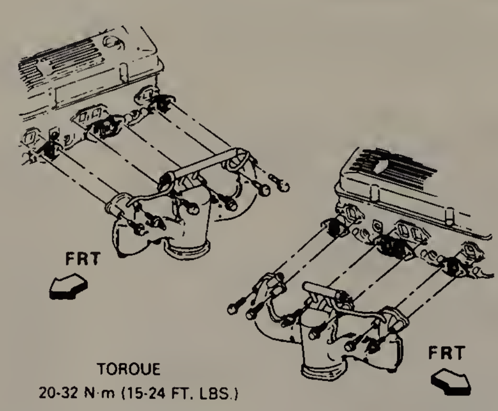


Fig. 34 Exhaust manifold attachment—1985–88 vehicles shown, later years similar

13. For 1984 vehicles, remove the temperature sending unit from the right head.
14. Raise and safely support the vehicle.
15. For 1984 vehicles, perform the following:
  a. Disconnect the exhaust pipe from the manifold.
  b. Detach the AIR pipe from the exhaust manifold.
  c. Unfasten the 2 rear exhaust manifold mounting bolts.
  d. Separate the dipstick tube from the manifold.
  e. Carefully lower the vehicle.
  f. Unfasten the remaining manifold bolts. Remove the exhaust manifold.
16. For 1985–88 vehicles, perform the following:
  a. Raise and safely support the vehicle.
  b. Remove the catalytic converter AIR pipe clamp from the manifold.
  c. Detach the exhaust crossover pie from both manifolds.
  d. Remove the bolts from the catalytic converter front hanger.
  e. Remove the catalytic converter AIR pipe.
  f. Carefully lower the vehicle.
  g. Unfasten the exhaust manifold mounting bolts. Remove the manifold and EGR pipe assembly.
  h. If replacing the manifold, install the EGR pipe and clamp on the new manifold.
17. Remove and discard the manifold gaskets. Thoroughly clean the gasket mating surfaces.

To install:

18. Place new gaskets in position, then install the manifold and secure with the mounting bolts. It may be necessary to install the 2 rear bolts with the vehicle raised. Tighten the bolts to 20 ft. lbs. (27 Nm).
19. Raise and safely support the vehicle.
20. For 1984 vehicles, attach the dipstick tube to the manifold.
21. For 1985–88 vehicles, install the AIR pipe with a new clamp and install the bolts at the converter hanger.
22. Connect the converter AIR pipe to the manifold.
23. Attach the exhaust pipe/crossover pipe to the manifold.
24. Carefully lower the vehicle.
25. Install the temperature sending unit.
26. Install the spark plugs, then attach the wires, as tagged during removal. Make sure the wires are properly routed.
27. If removed, attach the heater hose.
28. Connect the AIR hose, or install the AIR check valve, as applicable.
29. For 1985–88 vehicles, attach the dipstick tube to the manifold and install the dipstick.
30. Install the A/C compressor brace.
31. For 1985–88 vehicles, install the EGR pipe bolts and the manifold, and connect the sensor wire.
32. For 1985–88 vehicles, install the plenum extension.
33. Install the air cleaner assembly.
34. Connect the negative battery cable.
35. Fill the cooling system with the proper type and amount of coolant.

RIGHT SIDE—1989–91 VEHICLES

1. Disconnect the negative battery cable.
2. Remove the EGR valve pipe and position it aside.
3. Unfasten the A/C compressor brace.
4. Remove the oil level indicator and guide tube.
5. Remove the AIR check valve from the manifold.
6. Detach the electrical connector from the temperature sending unit.
7. Tag and disconnect the spark plug wires from the plugs, unroute from the retainers.
8. Remove the spark plugs, after the engine has cooled.
9. Raise and safely support the vehicle.
10. Remove the AIR pipe clamp from the manifold.
11. Unfasten the front crossover pipe-to-manifold flange nuts, from the left and right sides.
12. Carefully lower the vehicle.
13. Unfasten the exhaust manifold mounting bolts, then remove the manifold. Remove and discard the gaskets, then thoroughly clean the gasket mating surfaces.

To install:

14. Position new gaskets, then install the exhaust manifold and secure with the mounting bolts. Tighten the bolts to 19 ft. lbs. (26 Nm).
15. Raise and safely support the vehicle.
16. Install the left and right side front crossover pipe-to-manifold flange nuts and tighten to 15 ft. lbs. (20 Nm).
17. Install the AIR pipe clamp on the manifold.
18. Carefully lower the vehicle.
19. Install the spark plugs, connect the wires and install the retainers.
20. Attach the electrical connector to the temperature sending unit.
21. Install the AIR check valve to the manifold.
22. Attach the guide tube and oil level indicator.
23. Install the A/C compressor brace.
24. Connect the EGR valve pipe.
25. Connect the negative battery cable.

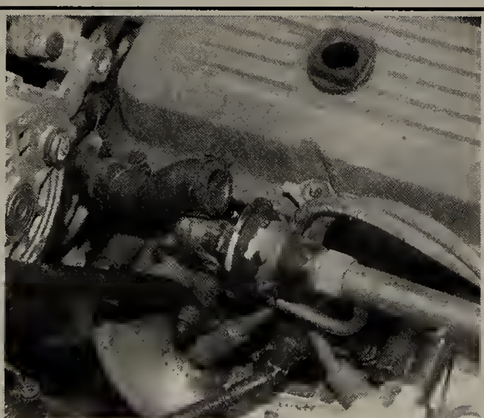
LEFT SIDE—1984–91 VEHICLES

➧ See Figures 35 thru 41

1. Remove the air cleaner assembly.
2. Remove the PCV hose from the intake and rocker cover.

91033P14

Fig. 35 Unfasten the retaining screws . . .

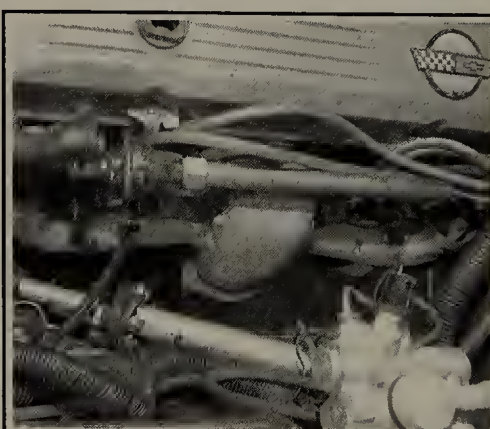


91033P15

Fig. 36 . . . then disconnect the AIR hose from the exhaust check valve

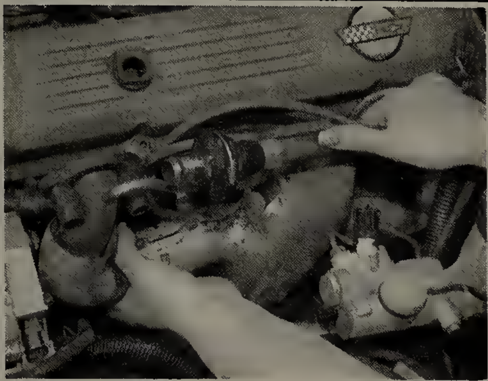
91033P16

Fig. 37 The rear alternator brace is secured with a bolt at the top and a nut at the bottom



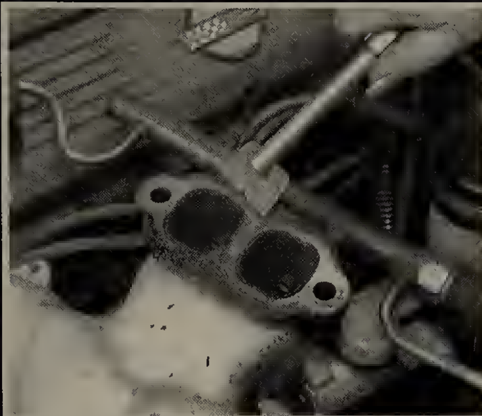
91033P17

Fig. 38 Top view of the exhaust manifold, after the pipe is disconnected



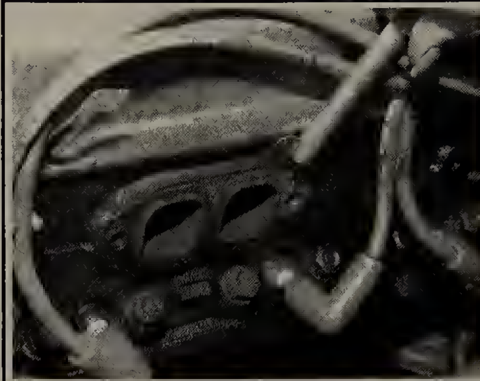
91033P18

Fig. 39 You will probably have to move the check valve pipe aside in order to remove the exhaust manifold



91033P19

Fig. 40 Use a scraper to carefully clean the mating surfaces of the manifold



91033P20

Fig. 41 Also, make sure to thoroughly clean the head-to-manifold mating surfaces

3. Detach the AIR hose from the exhaust check valve.
4. Disconnect the rear alternator brace from the manifold, then let the brace hang from the alternator.
5. For 1989–91 vehicles,
   a. Tag and disconnect the spark plug wires from the plugs, unroute from the retainers.
   b. Remove the spark plugs, after the engine has cooled.
6. Raise and safely support the vehicle.
7. For vehicles through 1988, disconnect the exhaust pipe from the manifold.
8. For 1989–91 vehicles, unfasten the left and right side front crossover pipe-to-manifold flange nuts.
9. Carefully lower the vehicle.
10. Remove the exhaust manifold. Remove and discard the manifold gaskets. Thoroughly clean the gasket mating surfaces.

To install:

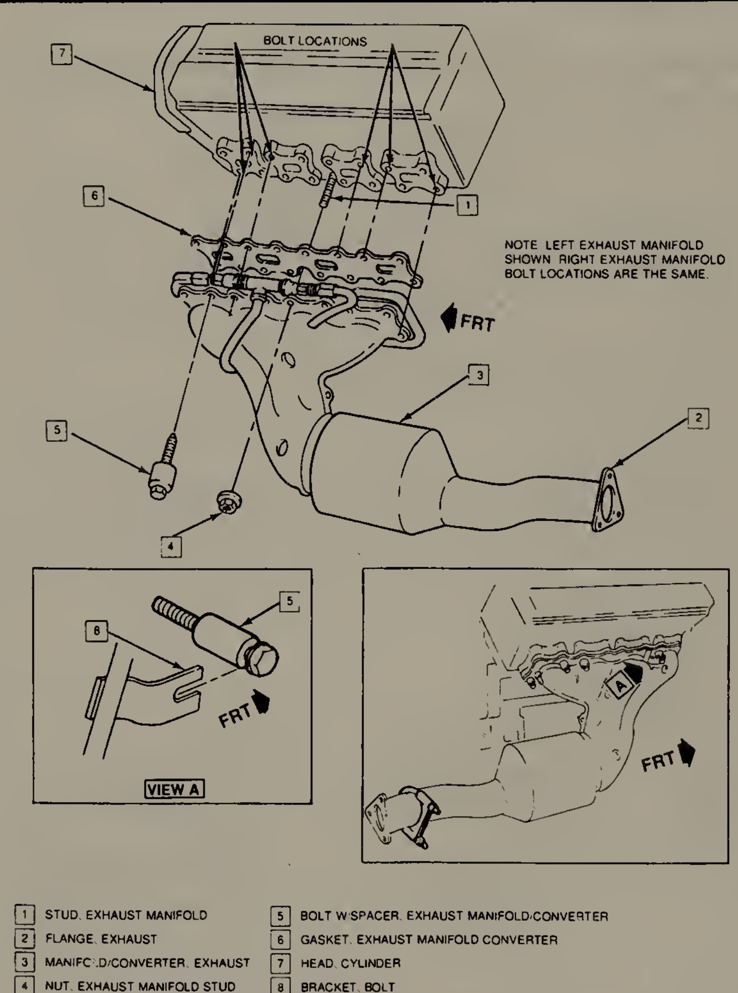
11. Place new gaskets in position, then install the manifold and secure with the mounting bolts. Tighten the bolts to 20 ft. lbs. (27 Nm) for 1984–88 vehicles. For 1989–91 vehicles, tighten the bolts to 19 ft. lbs. (26 Nm).
12. Raise and safely support the vehicle.
13. Attach the exhaust pipe to the manifold, or the crossover pipe-to-manifold flange nuts. Tighten the nuts to 15 ft. lbs. (20 Nm).
14. Carefully lower the vehicle.
15. For 1989–91 vehicles, install the spark plugs, connect the wires and install the retainers.
16. Fasten the alternator brace.
17. Connect the AIR hose.
18. Attach the PCV hose.
19. Install the air cleaner assembly.
20. Connect the negative battery cable.

5.7L (VIN J) Engines

RIGHT SIDE—1990–91 VEHICLES

See Figure 42

1. Disconnect the negative battery cable.
2. Remove the wheelhouse lower rear and center panels.
3. Unfasten the bolt retaining the oil level indicator and guide tube to the exhaust manifold, then remove the indicator/tube assembly from the vehicle.
4. Unfasten the front exhaust manifold-to-cylinder head bolts.
5. Remove the stud nut from the center of the manifold.
6. Raise and safely support the vehicle.
7. Detach the converter oxygen sensor electrical connector. In order to access the connector, the following steps may be necessary:
   a. Remove the bolts from the right front of the oil pan, securing the ignition timing sensor/oxygen sensor connector bracket.
   b. Slide the connector/bracket assembly to the rear.
8. Remove the AIR hose from the manifold.
9. Unfasten the screws retaining the center head shields, then remove the shields from the vehicle.
10. Remove the bolts securing the manifold/converter flanges to the exhaust pipe flanges.



91033G30

Fig. 42 The exhaust manifold/converter assembly is removed as a single unit—1990–91 and early 1992 5.7L (VIN J) engine

11. Remove the bolts at the rear, holding the manifold to the head; remove the gasket and the manifold/converter assembly from the vehicle. Discard the gasket(s).
12. If the manifold is being replaced, transfer the oxygen sensors and heat shields to the new manifold.
13. Thoroughly clean the manifold and head mating surfaces.

To install:

14. Position the manifold/converter assembly to the engine. Install the bolts securing the manifold/converter flanges to the exhaust pipe flanges. Finger-tighten the bolts.
15. Carefully lower the vehicle.
16. Install the manifold gasket on the head.
17. Install the bolts at front, holding the manifold to the head. Finger-tighten the bolts.
18. If the stud at the center of the manifold was removed, or is loose, clean

the threads then apply Loctite® 620 to the threads. Tighten the stud to 11 ft. lbs. (15 Nm).

19. Install the stud nut at the center of the manifold and finger-tighten the nut.
20. Raise and safely support the vehicle.
21. Instlal the bolts at the rear, securing the manifold to the head. Tighten the manifold rear bolts to 11 ft. lbs. (15 Nm) and the exhaust pipe flange bolts to 15 ft. lbs. (20 Nm).
22. Install the converter head shields and screws.
23. Attach the electrical connector to the converter oxygen sensor. If the oxygen sensor bracket was removed, tighten the oil pan bolts to 19 ft. lbs. (26 Nm).
24. Connect the air hose to the manifold.
25. Carefully lower the vehicle.
26. Tighten the manifold front bolts and stud nut to 11 ft. lbs. (15 Nm).
27. Install the wheel house lower rear and center panels.

RIGHT SIDE—1992–95 VEHICLES

See Figure 43

➡Early and late production vehicles in the 1992 vehicles utilized 2 different exhaust manifolds.

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle. Remove the wheel and tire assembly.
3. Remove the wheel house lower rear and center panels.
4. On early 1992 models, remove the center stud nut.
5. On late 1992 and 1993–95 models, remove the manifold outer heat shields.
6. Remove the exhaust system assembly.
7. Remove the engine block heat shield.
8. On late 1992, and 1993–95 models, remove the catalytic converter from the manifold.
9. Detach the oxygen sensor connector.
10. On early 1992 models, remove the converter heat shields.

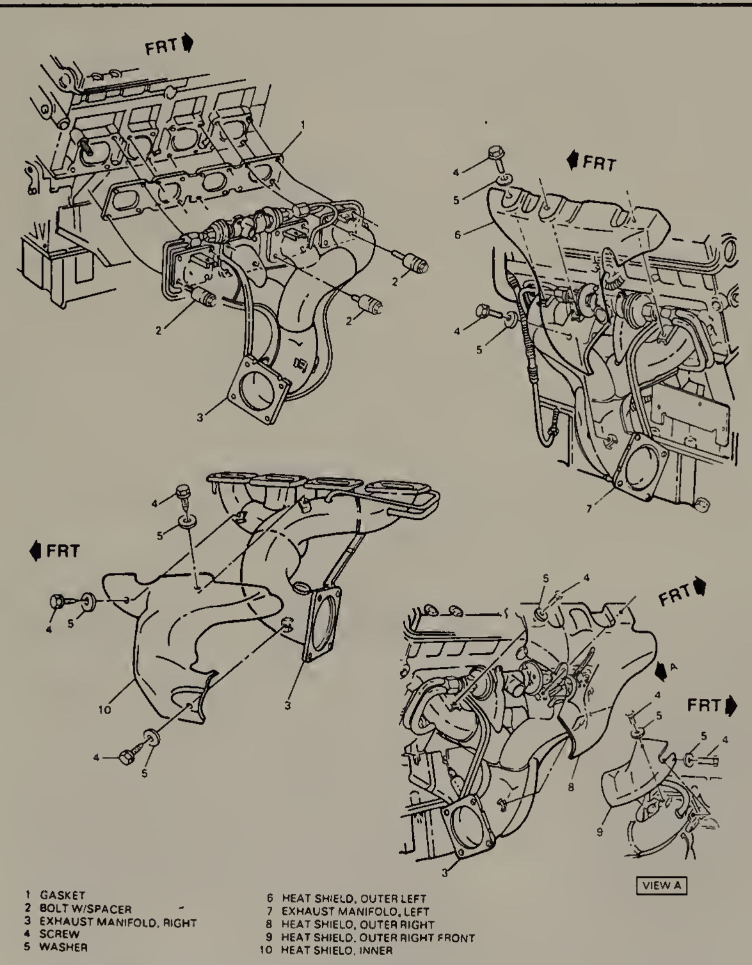


Fig. 43 View of the exhaust manifolds used on late 1992 and 1993–95 vehicles—5.7L (VIN J) engines

11. Remove the rear exhaust manifold bolts, spacers and nuts.
12. Carefully lower the vehicle.
13. Remove the AIR check valve and hose from the manifold.
14. Unfasten the bolt retaining the oil level indicator guide tube.
15. Remove the oil level indicator tube from the engine.
16. Remove the remaining exhaust manifold bolts and spacers.
17. Remove the exhaust manifold and gasket from the vehicle. Discard the gasket. If installing a new manifold, transfer the oxygen sensor and heat shields to the new manifold.
18. Thoroughly clean the manifold and cylinder head mating surfaces.

To install:

19. Position a new gasket, then install the manifold to the engine.
20. Install the front and center manifold bolts and spacers.
21. Install the oil level indicator tube.
22. Tighten the manifold bolts to 18 ft. lbs. (24 Nm).
23. Install the AIR check valve and hoses.
24. Raise and safely support the vehicle.
25. Install the rear manifold bolts, spacers and nuts. Tighten the bolts and nuts to 18 ft. lbs. (24 Nm).
26. If removed, install the converter heat shields.
27. Attach the oxygen sensor electrical connector.
28. If removed, install the catalytic converter and bolts to the manifold. Tighten the bolts to 17 ft. lbs. (23 Nm).
29. Install the engine block heat shield.
30. Install the exhaust system.
31. If removed, install the manifold outer heat shields.
32. Carefully lower the vehicle.
33. If removed, install the center stud nut and tighten to 18 ft. lbs. (24 Nm).
34. Install the wheel house lower rear and center panels.
35. Install the wheel and tire assembly
36. Connect the negative battery cable.

LEFT SIDE—1990–91 VEHICLES

See Figure 42

1. Disconnect the negative battery cable.
2. Remove the wheelhouse lower rear and center panels.
3. Disconnect the AIR hose from the exhaust manifold.
4. Unfasten the bolts retaining the manifold to the head.
5. Remove the stud nut from the center, retaining the manifold to the head.
6. Unfasten the bolts holding the manifold to the head. Remove the gasket from the manifold.
7. Raise and safely support the vehicle.
8. Detach the converter oxygen sensor electrical connector.
9. Unfasten the heat shield retaining screws, then remove the heat shields.
10. Unfasten the bolts retaining the manifold/converter flange to the front exhaust pipe flange. Remove the manifold/converter from the vehicle.
11. If the manifold is being replaced, transfer the oxygen sensors and heat shields to the new manifold.
12. Thoroughly clean the manifold and head mating surfaces.

To install:

13. Position the manifold/converter assembly to the engine. Install the bolts securing the manifold/converter flanges to the exhaust pipe flanges. Finger-tighten the bolts.
14. Carefully lower the vehicle.
15. Install the manifold gasket on the head.
16. Install the bolts securing the manifold to the cylinder head. Finger-tighten the bolts.
17. If the stud at the center of the manifold was removed, or is loose, clean the threads then apply Loctite® 620 to the threads. Tighten the stud to 11 ft. lbs. (15 Nm).
18. Install the stud nut at the center of the manifold and finger-tighten the nut.
19. Raise and safely support the vehicle.
20. Tighten the exhaust pipe flange bolts and tighten to 15 ft. lbs. (20 Nm).
21. Install the heat shields and secure with the retaining screws.
22. Attach the electrical connectors to the converter oxygen sensors.
23. Carefully lower the vehicle.
24. Attach the AIR hose onto the exhaust manifold.
25. Install the wheel house lower rear and center panels.
26. Connect the negative battery cable.

LEFT SIDE—1992–95 VEHICLES

➧ See Figures 42 and 43

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle. Remove the wheel and tire assembly.
3. Remove the wheel house lower rear and center panels.
4. Remove the exhaust system assembly.
5. Remove the left floor pan heat shield.
6. Remove he left heat shield from the frame.
7. Remove the engine block heat shield.
8. Detach the oxygen sensor electrical connector.
9. On early 1992 vehicles, remove the converter heat shields.
10. Remove the AIR check valves, houses and pipe.
11. On late 1992, and 1993–95 vehicles, remove the manifold outer heat shield.
12. On late 1992, and 1993–95 vehicles, remove the catalytic converter from the manifold.
13. Remove the exhaust manifold bolts, spacers and nut.
14. On early 1992 vehicles, remove the center stud nut.
15. Remove the exhaust manifold and gasket from the vehicle. Discard the gasket. If installing a new manifold, transfer the oxygen sensor and heat shields to the new manifold.
16. Thoroughly clean the manifold and cylinder head mating surfaces.

To install:

17. Position a new gasket, then install the manifold to the engine.
18. Install the manifold bolts, spacers and nut.
19. If removed, install the center stud nut.
20. Tighten the bolts and nut to 18 ft. lbs. (24 Nm).
21. If removed, install the catalytic converter and bolts to the manifold and tighten to 17 ft. lbs. (23 Nm).
22. The remainder of installation is the reverse of the removal procedure.
23. Install the wheel house lower rear and center panels.
24. Install the wheel and tire assembly
25. Connect the negative battery cable.

5.7L (VIN P and 5) Engines

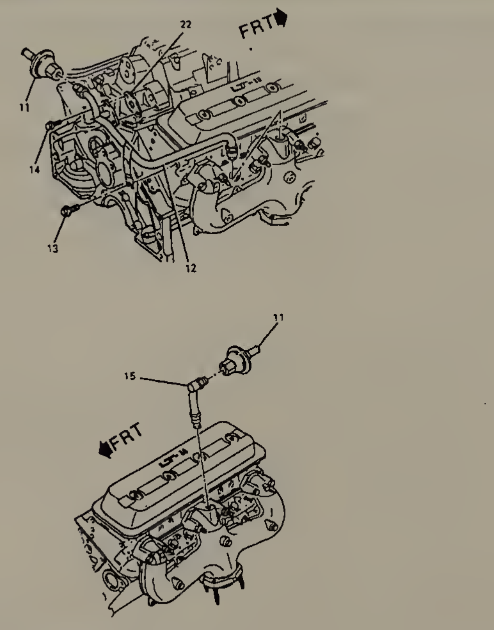
➧ See Figures 44 and 45

RIGHT SIDE

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. On 1993–96 convertibles, remove the underbody crossbrace.
4. Remove the catalytic converter from the exhaust manifold.
5. For 1993–96 vehicles, remove the complete exhaust system.
6. Carefully lower the vehicle.
7. Remove the fuel rail covers.
8. Detach the wiring harness connectors from the fuel injectors.
9. Disconnect the vacuum hose from the fuel pressure regulator.
10. Unfasten the fuel rail mounting bolts, then remove the fuel injectors and fuel rail from the manifold.
11. Tag and disconnect the spark plug wires from the spark plugs, then unfasten the wire clips from the supports.
12. Remove the spark plugs.
13. Remove the front spark plug bracket and bolt.
14. Remove the oil level indicator and tube.
15. Disconnect the AIR pipe (secondary air injection), then remove he gasket and check valve as an assembly from the intake and exhaust manifolds and cylinder head.
16. Unfasten the exhaust manifold studs and bolts, then remove the heat shields, exhaust manifold and gasket. Discard the gasket and replace with new ones during installation. Thoroughly clean the gasket mating surfaces. For 1995–96 vehicles, clean the exhaust manifold bolt holes with a ⅜ in. tag, then flush the holes with a suitable cleaning solvent.

To install:

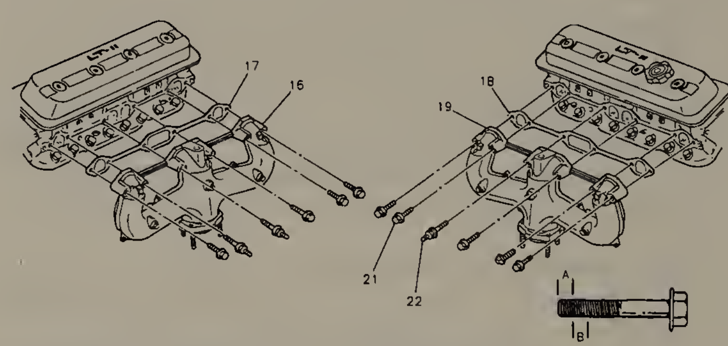
17. Position a new gasket, then install the exhaust manifold and heat shields. For 1995–96 vehicles, apply a ¼ in. (8mm) band of suitable adhesive to the bolt threads.



11 VALVE ASSEMBLY, SECONDARY AIR INJECTION CHECK
12 PIPE ASSEMBLY, SECONDARY AIR INJECTION
13 BOLT/SCREW, SECONDARY AIR INJECTION PIPE
14 BOLT/SCREW, SECONDARY AIR INJECTION PIPE
15 PIPE ASSEMBLY, SECONDARY AIR INJECTION
22 GASKET, SECONDARY AIR INJECTION PIPE

91033G33

Fig. 44 View of the secondary air injection valve and related components—1995 vehicle shown, other years similar



A 1-3 THREADS FREE OF ADHESIVE
B APPLY 8 mm (1/4 INCH) BAND OF ADHESIVE TO THE FULL CIRCUMFERENCE OF THREADS
16 MANIFOLD, EXHAUST
17 GASKET, EXHAUST MANIFOLD
18 GASKET, EXHAUST MANIFOLD
19 MANIFOLD, EXHAUST
20 STUD, EXHAUST MANIFOLD
21 BOLT/SCREW, EXHAUST MANIFOLD

91033G34

Fig. 45 Exploded view of the exhaust manifold assemblies—5.7L (VIN P and 5 engines)

18. For Install the retaining studs and bolts, then tighten to the following specifications:
    a. 1993 vehicles: 26 ft. lbs. (35 Nm)
    b. 1994 vehicles: 35 ft. lbs. (47 Nm)
    c. 1995 vehicles: 26 ft. lbs. (35 Nm)
    d. 1996 vehicles: 30 ft. lbs. (40 Nm).
19. Install the AIR pipe, gasket and check valve and secure with the mounting bolts. Tighten the AIR pipe fitting-to-exhaust manifold to 25 ft. lbs. (34 Nm). Tighten the bracket bolt to 25 ft. lbs. (34 Nm). Tighten the AIR pipe flange bolts to 19 ft. lbs. (26 Nm).
20. Apply a suitable sealant around the oil level indicator tube, about ½ in. (13mm) below the bead. Install the oil level indicator and tube to the cylinder block.
21. Install the front spark plug bracket and bolt. Install the spark plugs. Tighten the bracket bolts to 105 inch lbs. (12 Nm), and the spark plugs to 11 ft. lbs. (15 Nm).
22. Attach the spark plug wires and retaining clips.
23. Install the fuel injector and rail assembly to the intake manifold. Install the mounting bolts and tighten to 15 ft. lbs. (20 Nm).

24. Connect the vacuum hose to the fuel pressure regulator, and attach the wiring harness connectors to the fuel pressure regulator.
25. Install the fuel rail covers.
26. Raise and safely support the vehicle.
27. If removed, install the complete exhaust system.
28. Install the catalytic converter to the exhaust manifold and secure with the retaining nuts. Tighten the nuts to 15 ft. lbs. (21 Nm).
29. On 1993–96 convertibles, install the underbody crossbrace.
30. Carefully lower the vehicle, then connect the negative battery cable.

LEFT SIDE

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. On 1993–96 convertibles, remove the underbody crossbrace.
4. Remove the catalytic converter from the exhaust manifold.
5. For 1993–96 vehicles, remove the complete exhaust system.
6. Carefully lower the vehicle.
7. Remove the air intake duct.
8. Remove the serpentine drive belt.
9. For 1992 vehicles, remove the left wheel well center panel.
10. For 1993–96 vehicles, remove the ASR adjuster from the wheel well center panel and position it aside.
11. For 1992 vehicles, remove the A/C compressor/alternator top brace. Unbolt the A./C compressor and position it aside. Do NOT disconnect the refrigerant lines.
12. For 1993–96 vehicles, unbolt and reposition the alternator and A/C compressor. Do NOT disconnect the refrigerant lines from the compressor.
13. Remove the AIR pipe, check valve and hose as an assembly from the exhaust manifold.
14. Tag and disconnect the spark plug wires from the plugs, then detach the wire clips from the supports.
15. Remove the A/C compressor and accessory bracket braces.
16. Remove the spark plug wire supports, then remove the spark plugs.
17. Unfasten the exhaust manifold studs and bolts. Remove the heat shields, and the exhaust manifold and gasket.
18. Discard the gasket and thoroughly clean the gasket mating surfaces. For 1995–96 vehicles, clean the exhaust manifold bolt holes with a ⅜ in. tag, then flush the holes with a suitable cleaning solvent.

To install:

19. Position a new gasket, then install the exhaust manifold and heat shields. For 1995-96 vehicles, apply a ¼ in. (8mm) band of suitable adhesive to the bolt threads.
20. For Install the retaining studs and bolts, then tighten to the following specifications:
    a. 1993 vehicles: 26 ft. lbs. (35 Nm)
    b. 1994 vehicles: 35 ft. lbs. (47 Nm)
    c. 1995 vehicles: 26 ft. lbs. (35 Nm)
    d. 1996 vehicles: 30 ft. lbs. (40 Nm)
21. Install the spark plug and secure with the spark plug supports. Tighten the spark plugs to 11 ft. lbs. (15 Nm) and the wire supports to 105 inch lbs. (12 Nm).
22. Install the A/C compressor and accessory bracket braces to the exhaust manifold.
23. Connect the spark plug wires and install the retaining clips.
24. Install the AIR pipe, check valve and hose assembly. Tighten the AIR pipe fitting-to-exhaust manifold to 25 ft. lbs. (34 Nm).
25. For 1993–96 vehicles, install the compressor and alternator.
26. For 1992 vehicles, install the A/C compressor and the compressor and alternator top brace.
27. Install the left wheel well center panel or ASR adjuster assembly, as applicable.
28. Install the serpentine drive belt and the air intake duct.
29. Raise and safely support the vehicle.
30. If removed, install the complete exhaust system.
31. Install the catalytic converter to the exhaust manifold and secure with the retaining nuts. Tighten the nuts to 15 ft. lbs. (21 Nm).
32. On 1993–96 convertibles, install the underbody crossbrace.
33. Carefully lower the vehicle.
34. Connect the negative battery cable.

Radiator

REMOVAL & INSTALLATION

⁂ CAUTION

Never open, service or drain the radiator or cooling system when hot; serious burns can occur from the steam and hot coolant. Also, when draining engine coolant, keep in mind that cats and dogs are attracted to ethylene glycol antifreeze and could drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantities. Always drain coolant into a sealable container. Coolant should be reused unless it is contaminated or is several years old.

5.7L (VIN 8) Engines

1984–88 VEHICLES

See Figure 46

1. Disconnect the negative battery cable.
2. Drain the cooling system into a suitable container.
3. Unfasten the hose clamp, then disconnect the upper radiator hose.
4. Remove the lower radiator hose.
5. Disconnect the overflow hose from the radiator.
6. Unbolt the A/C accumulator and position it aside, out of the way.
7. If equipped with an automatic transmission, disconnect and plug the transmission cooler line.
8. Detach the fan wiring from the fan and shroud.
9. Remove the fan in order to gain access to the lower cooler line.
10. If equipped with an automatic transmission, unfasten the transmission cooler line at the fitting, then plug the line.
11. Remove the upper shroud mounting bolts, then remove the upper shroud.
12. Carefully remove the radiator from the vehicle.

To install:

13. Position the radiator on the lower support..
14. If equipped, unplug, then connect the lower transmission cooler line.
15. Install the upper shroud and secure with the mounting bolts.
16. Install the fan and connect the wiring.
17. If equipped, unplug and connect the upper transmission cooler line.
18. Connect the upper and lower radiator hose. Secure with the hose clamps, if applicable.
19. Attach the overflow hose.
20. Place the A/C accumulator in position and secure with the mounting bolts.
21. Fill the radiator with the proper type and amount of coolant.
22. Start the engine, and allow to run (with the radiator cap still removed),

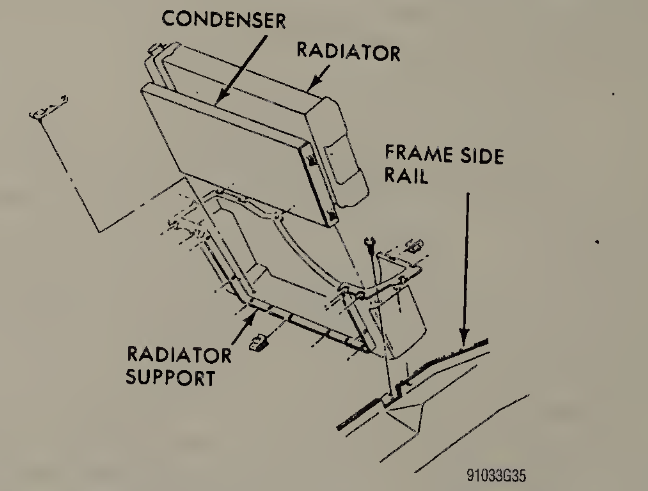


Fig. 46 Exploded view of the radiator mounting—1984–88 vehicles

until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.

23. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

1989–91 VEHICLES

1. Disconnect the negative battery cable.
2. Remove the radiator cap, then drain the cooling system into a suitable container.
3. Remove the air cleaner and intake duct assembly.
4. Detach the Mass Air Flow (MAF) sensor electrical connector.
5. Unfasten the upper and lower hose clamp, then disconnect the hoses.
6. Disconnect the overflow hose from the radiator.
7. Remove the engine cooling fan upper screws from the shroud.
8. Unbolt the A/C accumulator bracket from the shroud and position aside.
9. If equipped with an automatic transmission, disconnect and plug the oil cooler line.
10. Remove the wire harness and relay from the shroud.
11. Unfasten the power steering reservoir bracket bolts from the shroud and frame.
12. Remove the shroud retaining screws, then remove the shroud.
13. Carefully remove the radiator from the vehicle.

To install:

14. Position the radiator into the vehicle.
15. Install the shroud and secure with the retaining screws.
16. Fasten the power steering reservoir bracket bolts at the shroud and frame.
17. Install the wire harness and relay onto the shroud.
18. Unplug and connect the automatic transmission oil cooler line. Tighten the fittings to 20 ft. lbs. (27 Nm).
19. Position the A/C accumulator bracket on the shroud, then install the retainers.
20. Install the cooling fan screws on the shroud.
21. Connect the overflow hose to the radiator.
22. Install the lower and upper radiator hose and secure with the clamps.
23. Install the air cleaner and intake duct assembly.
24. Connect the MAF sensor electrical connector.
25. Fill the radiator with the proper type and amount of coolant.
26. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
27. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

5.7L (VIN J, P and 5) Engines

See Figure 47

1. Disconnect the negative battery cable.
2. Remove the surge tank/radiator pressure cap. Drain the engine coolant into a suitable container.
3. Remove the air cleaner assembly.
4. Remove the radiator upper deflector/shroud.
5. Detach the electrical connectors from the cooling fan relays.
6. Unfasten the bolts securing the A/C accumulator bracket to the radiator upper support, and position the bracket aside.
7. Remove the fan shroud-to-upper support retaining screws.
8. If equipped, remove the rubber access plug from the top of the radiator.
9. Unfasten the radiator air bleed/overflow hose clamp, then disconnect the hose.
10. Remove the nuts and bolt holding the upper support to the front side member.
11. Unfasten the bolts securing the oil cooler lines to the cooler.
12. Remove the seal retainers and seal from the oil cooler and A/C line.
13. If necessary, detach the electrical connection from the AIR pump and horn.
14. Remove the AIR pump.
15. Remove the bolt retaining the AIR pump bracket at the rear and loosen the front bolt.
16. Remove the air pump intake duct.
17. Unfasten the screws retaining the upper support to the lower support, then remove the upper support from the vehicle.

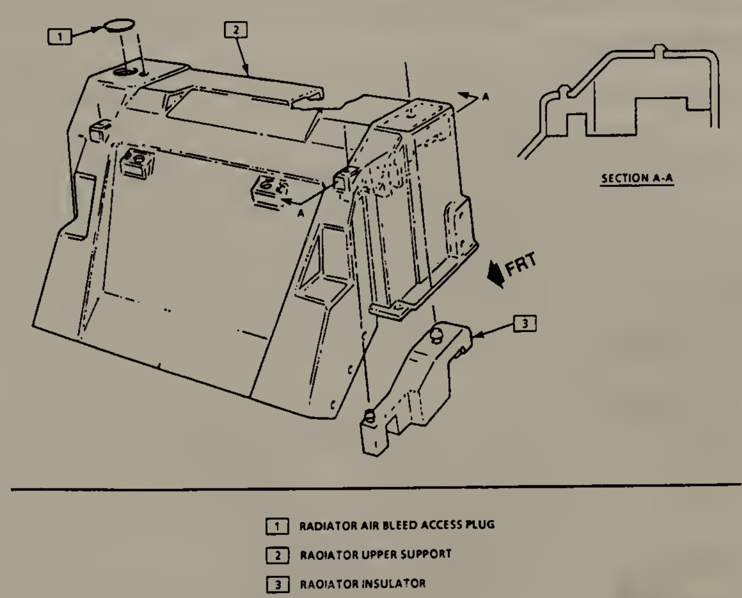


Fig. 47 You must remove the upper support for access to the radiator—5.7L (VIN J, P and 5) engines

18. Loosen the radiator inlet and outlet hose clamps, then disconnect the hoses.
19. Carefully remove the radiator from the vehicle.

To install:

20. Position the radiator in the vehicle.
21. Attach the inlet and outlet hoses and secure with the retaining clamps.
22. Install the upper support and secure with the retaining screws.
23. Instal the nuts and bolts retaining the upper support to the front side member and tighten to 18 ft. lbs. (25 Nm).
24. Install the AIR pump intake duct. Install the bolts retaining the AIR pump bracket, then install the pump. Attach the electrical connectors to the AIR pump and horn, if necessary.
25. Attach the electrical connectors to the cooling fan relays.
26. Install the fan shroud-to-upper support screws and tighten to 80 inch lbs. (9 Nm).
27. Fasten the bolts securing the accumulator bracket to the upper support. Tighten to 80 inch lbs. (9 Nm).
28. Install the retainers to the oil cooler/A/C line seal.
29. Fasten the bolts retaining the oil cooler lines to the cooler and tighten to 89 inch lbs. (10 Nm).
30. Attach the air bleed hose/overflow hose and secure with the retaining clamp.
31. Install the access plug.
32. Attach the upper air deflector.
33. Install the air cleaner assembly.
34. Fill the radiator with the proper type and amount of coolant.
35. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
36. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

Engine Fan

REMOVAL & INSTALLATION

CAUTION

To avoid personal injury, always keep your hands, tools and clothing away from the engine fan. The fan is electric and may come on at anytime, even if the engine is not running. The fan can start automatically in response to a heat sensor with the ignition in the ON position.

5.7L (VIN 8 and J) Engine

1984–88 VEHICLES

➧ See Figure 48

1. Disconnect the negative battery cable.
2. Detach the fan electrical connector from the fan and shroud.
3. Unfasten any necessary retainers, then remove the fan assembly.
4. Installation is the reverse of the removal procedure.

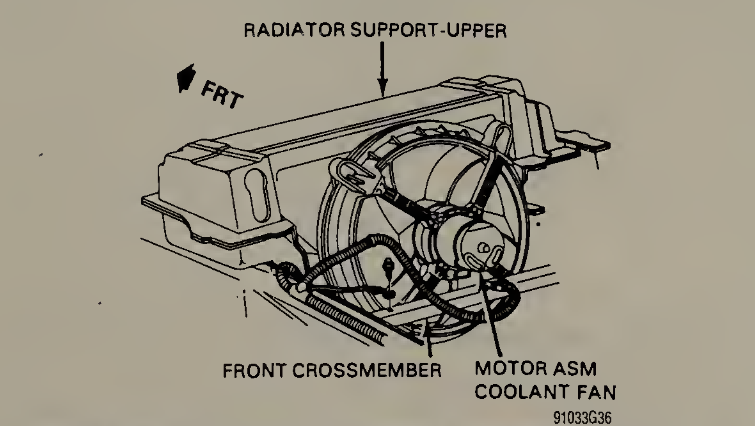


Fig. 48 View of the electric fan assembly mounting—1984 5.7L (VIN 8) engine shown

1989 VEHICLES

➧ See Figure 49

1. Disconnect the negative battery cable.
2. Remove the air cleaner and air intake duct.
3. If removing the engine cooling fan, perform the following:
   a. Detach the MAF sensor electrical connector.
   b. Unplug the electrical connector from the fan motor.
4. If removing the auxiliary cooling fan, perform the following:
   a. Detach the fan electrical connector. Feed the grommet and harness through the baffle.
5. Remove the upper fan assembly screws.
6. Remove the fan lower screw(s).
7. Remove the fan assembly from the vehicle.
8. Installation is the reverse of the removal procedure.

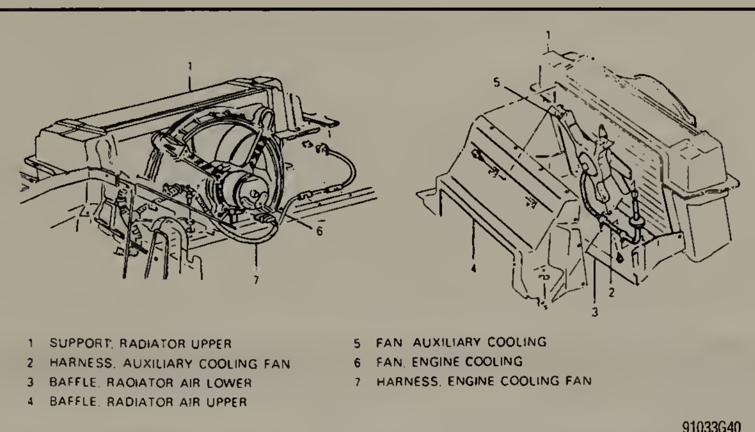


Fig. 49 View of the engine cooling and auxiliary fan mounting—1989 vehicles

1990–95 VEHICLES

➧ See Figure 50

1. Disconnect the negative battery cable.
2. If removing the primary (left) fan, perform the following:
   a. Remove the air intake duct.
   b. Unfasten the power steering pump reservoir bracket-to-front crossmember bolts, then reposition the reservoir.

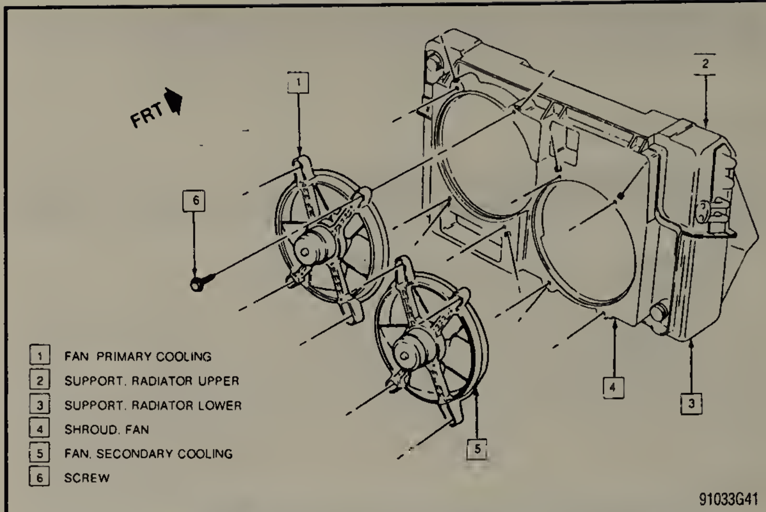


Fig. 50 Exploded view of the primary and secondary cooling fans—1990–91 5.7L (VIN 8), and 5.7L (VIN J, P and 5) engines

   c. Detach the electrical connector from the fan motor.
   d. Unfasten the screws holding the fan motor to the fan support.
   e. Remove the bolts securing the fan assembly to the fan shroud.
   f. Remove the end cap from the power steering pump pulley.
   g. Remove the fan assembly from the vehicle.
3. If removing the secondary (right) fan, perform the following:
   a. Remove the upper right bolt retaining the fan to the fan shroud.
   b. Raise and safely support the vehicle.
   c. Detach the electrical connector from the fan motor.
   d. Unfasten the bolts retaining the fan to the fan shroud, then remove the fan assembly from the vehicle.

To install:

4. If installing the secondary (right) fan, perform the following:
   a. Install the fan and secure with the bolts retaining the fan to the shroud. Tighten the bolts to 89 inch lbs. (10 Nm).
   b. Attach the electrical connector to the fan motor.
   c. Carefully lower the vehicle.
   d. Install the upper right bolt securing the fan to the shroud.
5. If installing the primary (left) fan, perform the following:
   a. Position the fan assembly, then install the bolts holding the fan to the shroud. Tighten the bolts to 89 inch lbs. (10 Nm).
   b. Install the screws securing the fan motor to the motor support and tighten the screws to 89 inch lbs. (10 Nm).
   c. Instlal the power steering pump reservoir bracket-to-front crossmember bolts.
   d. Attach the electrical connector to the fan motor.
   e. Install the end cap on the power steering pump pulley.
   f. Install the air intake duct.
6. Connect the negative battery cable.

5.7L (VIN P and 5) Engines

➧ See Figure 50

1992 VEHICLES

1. Disconnect the negative battery cable.
2. If removing the primary (left) fan, perform the following:
   a. Remove the air intake duct.
   b. Detach the electrical connector from the fan motor.
   c. Unfasten the fan-to-shroud screws, then remove the fan from the vehicle.
3. If removing the secondary (right fan), perform the following:
   a. Remove the upper right bolt retaining the fan to the fan shroud.
   b. Raise and safely support the vehicle.
   c. Detach the electrical connector from the fan motor.
   d. Unfasten the bolts retaining the fan to the fan shroud, then remove the fan assembly from the vehicle.

To install:

4. If installing the secondary (right) fan, perform the following:
   a. Install the fan and secure with the bolts retaining the fan to the shroud. Tighten the bolts to 89 inch lbs. (10 Nm).

b. Attach the electrical connector to the fan motor.
c. Carefully lower the vehicle.
d. Install the upper right bolt securing the fan to the shroud.
5. If installing the primary (left) fan, perform the following:
a. Position the fan assembly and install the bolts securing the fan to the shroud. Tighten to 89 inch lbs. (10 Nm).
b. Install the screws retaining the fan motor to the motor support and tighten to 89 inch lbs. (10 Nm).
c. Attach the electrical connector to the fan motor.
d. Install the air intake duct.
6. Connect the negative battery cable.

1993–96 VEHICLES

1. Disconnect the negative battery cable.
2. If removing the primary (left) fan, perform the following:
a. Remove the surge tank/radiator pressure cap. Drain the engine coolant into a suitable container.
b. Remove the air cleaner assembly.
c. Remove the radiator upper deflector/shroud.
d. Detach the electrical connectors from the cooling fan relays.
e. Unfasten the bolts securing the A/C accumulator bracket to the radiator upper support, and position the bracket aside.
f. Remove the fan shroud-to-upper support retaining screws.
g. If equipped, remove the rubber access plug from the top of the radiator.
h. Unfasten the radiator air bleed/overflow hose clamp, then disconnect the hose.
i. Remove the nuts and bolt holding the upper support to the front side member.
j. Unfasten the bolts securing the oil cooler lines to the cooler.
k. Remove the seal retainers and seal from the oil cooler and A/C line.
l. If necessary, detach the electrical connection from the AIR pump and horn.
m. Remove the AIR pump.
n. Remove the bolt retaining the AIR pump bracket at the rear and loosen the front bolt.
o. Remove the air pump intake duct.
p. Unfasten the screws retaining the upper support to the lower support, then remove the upper support from the vehicle.
q. Remove the shroud upper retaining bolts.
r. Raise and safely support the vehicle.
s. Remove the impact/skid bar.
t. Detach the fan motor electrical connectors.
u. Remove the right fan assembly.
v. Remove the fan shroud with the left fan still attached.
w. Remove the left fan assembly from the shroud, then disassemble the left fan motor and blade, if necessary.
3. If removing the secondary (right) side fan assembly, perform the following:
a. Remove the upper bolts retaining the fan to the shroud.
b. Raise and safely support the vehicle.
c. Remove the bolts retaining the impact bar.
d. Detach the fan electrical connector.
e. Unfasten the lower bolts holding the fan to the shroud.
f. Remove the fan assembly. If necessary disassemble the fan motor and blade.

To install:

4. If installing the secondary (right) side fan assembly, perform the following:
a. Assemble the fan motor and blade, then install the fan assembly.
b. Install the lower bolts securing the fan to the shroud and tighten to 89 inch lbs. (10 Nm).
c. Attach the fan motor electrical connector.
d. Install the bolts securing the impact bar to the front extension and front crossmember. Tighten the bolts to 20 ft. lbs. (27 Nm).
e. Install the upper bolts retaining the fan to the shroud.
5. If installing the primary (left side) cooling fan, perform the following:
a. Install the fan blade and motor, then install the bolts retaining the left fan assembly to the fan shroud. Tighten the bolts to 89 inch lbs. (10 Nm).
b. Install the fan shroud and lower mount bolts and tighten to 80 inch lbs. (9 Nm).
c. Install the bolts retaining the right fan to the fan shroud.
d. Install the bolts retaining the impact/skid bar to the front extension and front crossmember and tighten the bolts to 20 ft. lbs. (27 Nm).
e. Carefully lower the vehicle.
f. Install the upper support and secure with the retaining screws.
g. Instal the nuts and bolts retaining the upper support to the front side member and tighten to 18 ft. lbs. (25 Nm).
h. Install the AIR pump intake duct. Install the bolts retaining the AIR pump bracket, then install the pump. Attach the electrical connectors to the AIR pump and horn, if necessary.
i. Attach the electrical connectors to the cooling fan relays.
j. Install the fan shroud-to-upper support screws and tighten to 80 inch lbs. (9 Nm).
k. Fasten the bolts securing the accumulator bracket to the upper support. Tighten to 80 inch lbs. (9 Nm).
l. Install the retainers to the oil cooler/A/C line seal.
m. Fasten the bolts retaining the oil cooler lines to the cooler and tighten to 89 inch lbs. (10 Nm).
n. Attach the air bleed hose/overflow hose and secure with the retaining clamp.
o. Install the access plug.
p. Attach the upper air deflector.
q. Install the air cleaner assembly.
r. Fill the radiator with the proper type and amount of coolant.
s. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
t. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

Water Pump

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

1984–88 VEHICLES

See Figure 10

1. Take your vehicle to a reputable repair shop to have the A/C system discharged.
2. Disconnect the negative battery cable. Properly relieve the fuel system pressure.
3. Drain the engine cooling system into a suitable container.
4. Remove the serpentine drive belt, as outlined in Section 1 of this manual.
5. Remove the water pump pulley and the AIR pump pulley.
6. Remove the air management valve adapter.
7. Remove the AIR pump.
8. Disconnect the fuel inlet and return lines.
9. Remove the rear A/C compressor braces. Remove the lower A/C compressor mounting bolt. Remove the A/C compressor and idler pulley bracket nuts.
10. Detach the A/C compressor wiring.
11. Slide the mounting bracket forward and remove the rear A/C compressor bolt.
12. Remove the A/C compressor from the vehicle.
13. Remove the right and left AIR hoses at the check valve.
14. Remove the AIR pipe from the intake and power steering reservoir bracket.
15. Remove the power steering reservoir bracket, including the top alternator bolt.
16. Remove the lower AIR bracket from the water pump.
17. Disconnect the lower radiator and heater hoses from the water.
18. Unfasten the retainers, then remove the water pump. Remove and discard the gasket and thoroughly clean the gasket mating surfaces.

To install:

19. If installing a new water pump, transfer the heater hose fitting to the new pump.
20. Install the water pump to the block, with new gaskets, and secure with the attaching bolts. Tighten the bolts to 25–35 ft. lbs. (33–47 Nm).

21. The remainder of installation is the reverse of the removal procedure.
22. Fill the radiator with the proper type and amount of coolant.
23. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
24. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

1989–91 VEHICLES

▶ See Figure 11

1. Disconnect the negative battery cable. Properly relieve the fuel system pressure.
2. Remove the air cleaner and air intake duct assembly.
3. Detach the MAF sensor electrical connector.
4. Remove the surge tank pressure cap, then drain the engine cooling system into a suitable container.
5. Relieve the serpentine belt tension with a ½ in. breaker bar, then remove the belt.
6. Remove the water pump damper and pulley.
7. Unfasten the A/C compressor mounting bolts.
8. Remove the AIR pump mounting bolts.
9. Remove the cover from the AIR control valve.
10. Disconnect the upper hose from the AIR control valve, then detach the electrical connector from the valve.
11. Unfasten the nut retaining the AIR pipe and control valve, then reposition the assembly.
12. Disconnect the heater hose from the pump.
13. Unfasten the belt tensioner bolt.
14. Disconnect the fuel lines.
15. Remove the AIR pump bracket bolts. Unfasten the nut retaining the AIR pump brace.
16. Unfasten the lower radiator hose clamp, then disconnect the hose.
17. Remove the A/C compressor bracket mounting bolts.
18. Remvoe the bolts and stud nuts holding the water pump to the engine block.
19. Unfasten the retainers, then remove the water pump. Remove and discard the gasket and thoroughly clean the gasket mating surfaces.

To install:

20. If installing a new water pump, transfer the heater hose fitting to the new pump and tighten the fitting to 27 ft. lbs. (37 Nm).
21. Install the water pump to the block, with new gaskets, and secure with the attaching bolts. Tighten the bolts to 30 ft. lbs. (40 Nm).
22. Install the AIR pipe retaining bracket bolt and the A/C compressor bracket mounting bolts.
23. Connect the lower radiator hose and secure with the hose clamp.
24. Install the AIR pump bracket retaining bolts.
25. Connect the fuel lines.
26. Install the belt tensioner bolt.
27. Attach the heater hose to the pump and secure with the hose clamp.
28. Attach the control valve electrical connector. Attach the upper hose onto the AIR control valve. Install the AIR control valve cover.
29. Install the AIR pump bolts and the nut retaining the pump brace. Tighten the nut to 25 ft. lbs. (33 Nm).
30. Install the A/C compressor mounting bolts.
31. Install the water pump damper and pulley.
32. Install the serpentine drive belt.
33. Attach the MAF sensor electrical connector.
34. Fill the radiator with the proper type and amount of coolant. Connect the negative battery cable.
35. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
36. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

5.7L (VIN J) Engine

▶ See Figure 51

1. Disconnect the negative battery cable.
2. Drain the engine cooling system into a suitable container.

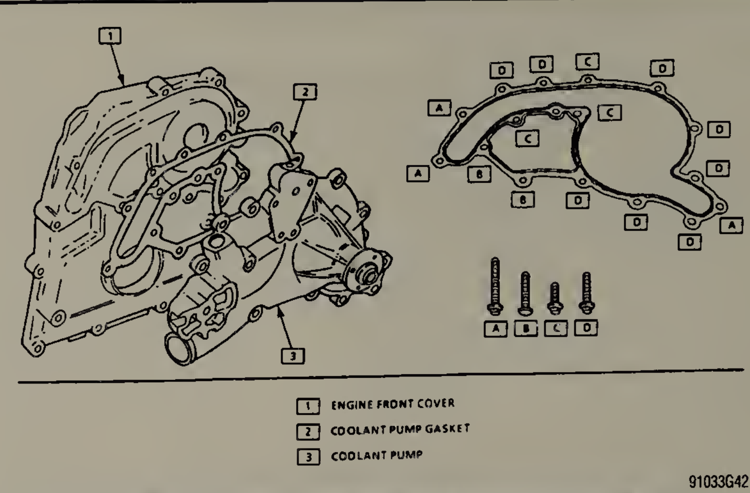


Fig. 51 The water pumps on these vehicles are mounted with 4 different sizes of bolts

3. Remove the air cleaner and air intake duct assembly.
4. Unfasten the screws retaining the throttle body extension to the throttle body, then remove the extension and gasket.
5. Loosen the clamps, then disconnect the hoses from the coolant outlets, radiator inlet and inlet pipe.
6. Remove the hose and inlet pipe assembly from the vehicle.
7. Remove the serpentine drive belt.
8. Unfasten the bolt retaining the belt tensioner to the pump, then remove the tensioner from the vehicle.
9. Loosen the engine hose clamp, then remove the hose from the pump.
10. Unfasten the bolts securing the alternator lower mounting bracket, then remove the bracket from the vehicle.

➡The water pump is secured with 4 different types and sizes of bolts. Make sure to note the installed positions of the bolts before removing them.

11. Remove the water pump-to-front cover mounting bolts.
12. Unfasten the bolt securing the A/C compressor to the water pump, then remove the water pump from the vehicle.
13. If you are installing a new water pump, transfer the water pump pulley to the new pump. Tighten the pulley mounting bolts to 89 inch lbs. (10 Nm).
14. Remove and discard the gasket, then thoroughly clean the mating surfaces.

To install:

15. Position a new gasket, then install the water pump and retaining bolts. Make sure the bolts are in the same position as they were removed. Finger-tighten the mounting bolts.
16. Install the bolt securing the A/C compressor to the water pump and finger-tighten the bolts.
17. Tighten the water pump and A/C compressor bolts to 20 ft. lbs. (27 Nm).
18. Connect the engine hose and secure with the hose clamp.
19. Install the alternator mounting bolt and bracket bolts. Tighten the mounting bolts to 39 ft. lbs. (52 Nm) and the bracket bolts to 20 ft. lbs. (26 Nm).
20. Install the belt tensioner and secure with the mounting bolt. Tighten the tensioner-to-cylinder case bolt to 45 ft. lbs. (60 Nm).
21. Install the serpentine drive belt.
22. Install the hose and inlet pipe assembly and secure with the retaining clamps.
23. Install the throttle body extension gasket, extension and retaining screws. Tighten the screws to 53 inch lbs. (6 Nm).
24. Install the air cleaner and air intake duct assembly.
25. Fill the radiator with the proper type and amount of coolant. Connect the negative battery cable.
26. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
27. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

5.7L (VIN P and 5) Engines

See Figure 52

1. Disconnect the negative battery cable.
2. Detach the Intake Air Temperature (IAT) sensor electrical connector.
3. Remove the air cleaner assembly and air intake duct.
4. Drain the cooling system into a suitable container. If necessary, remove the knock sensors for complete draining.
5. Unfasten the clamps, then disconnect the inlet and outlet radiator hoses from the water pump.
6. Remove the throttle body hose from the T-fitting.
7. Disconnect the heater hose from the water pump.
8. Detach the Engine Coolant Temperature (ECT) sensor electrical connector. Remove the ECT sensor wiring harness retainer from the front of the water pump.
9. Remove the serpentine drive belt.
10. Unfasten the bolts holding the water pump to the engine block, then remove the water pump from the vehicle.
11. Remove and discard the gasket, then thoroughly clean the mating surfaces.
12. Inspect the O-ring seals on the water pump driveshaft and front cover for cracks and dryness. If any of the O-rings are damaged, they must be replaced.
13. If replacing the water pump, transfer the ECT sensor to the new pump. Tighten the sensor to 17 ft. lbs. (23 Nm).

To install:

➡Before you assemble the coupling to the water pump, apply a light coat of grease to the seals and splines.

14. Install the coupling with the groove toward the engine.
15. Install new gaskets with the tabs up, the water pump with the drive coupling and the mounting bolts. Tighten the bolts to 30 ft. lbs. (41 Nm).
16. Install the serpentine drive belt.
17. Instlal the ECT sensor wire harness retainer on the front of the water pump, then attach the electrical connector.
18. Connect the heater hose to the water pump.
19. Attach the inlet and outlet radiator hoses and clamps to the water pump.
20. Install the throttle body hose at the T-fitting.
21. Install the air cleaner and intake duct.

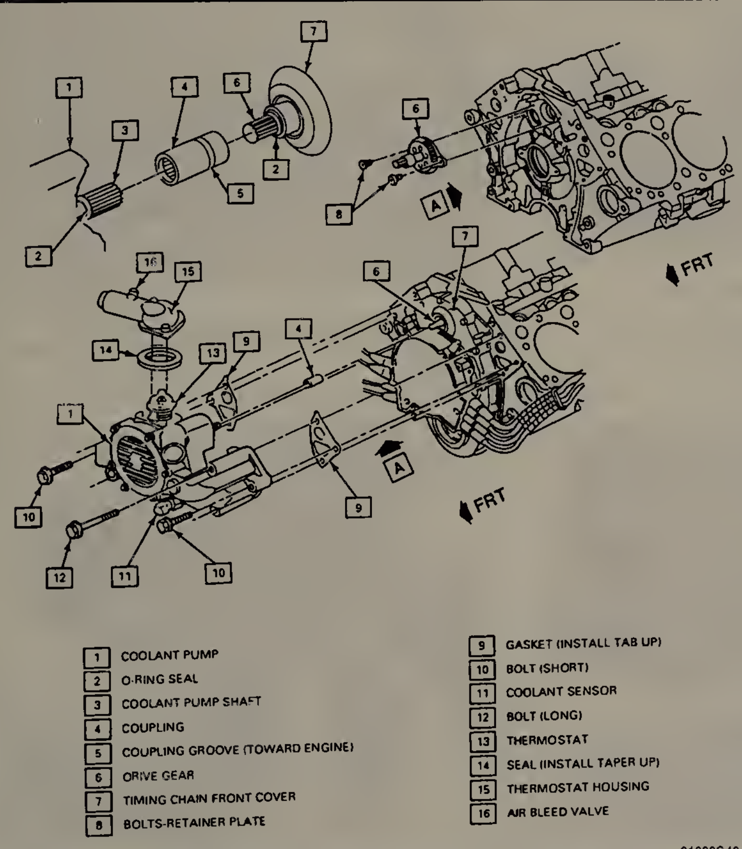


Fig. 52 Exploded view of the water pump and related components—5.7L (VIN P and 5) engines

22. Fill the radiator with the proper type and amount of coolant. Connect the negative battery cable.
23. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
24. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

Cylinder Head

REMOVAL & INSTALLATION

➡When servicing the engine, be absolutely sure to mark or tag vacuum hoses and wiring so that these items may be properly reconnected during installation. Also, when disconnecting fittings of metal lines (fuel, power brake vacuum), always use two flare nut (or line) wrenches. Hold the wrench on the large fitting with pressure on the wrench as if you were tightening the fitting (clockwise), THEN loosen and disconnect the smaller fitting from the larger fitting. If this is not done, damage to the line will result.

5.7L (VIN 8) Engine

See Figure 53

RIGHT SIDE

1. Disconnect the negative battery cable. Drain the engine cooling system into a suitable container.
2. Remove the intake manifold, as outlined earlier in this section.
3. Disconnect the rear A/C brace from the exhaust manifold.
4. Unfasten the dipstick tube from the manifold, then remove the dipstick.
5. Remove the check valve from the manifold.
6. Disconnect the AIR hose from the converter AIR pipe.
7. Detach the wire from the temperature sending unit.
8. Tag and disconnect the spark plug wires from the plugs, head and rocker arm cover, then remove the plugs.
9. Raise and safely support the vehicle.
10. Unfasten the converter AIR pipe clamp from the manifold.
11. Disconnect the exhaust pipe at both manifolds.
12. Remove the front converter hanger bolts.
13. Remove the converter AIR pipe.
14. Carefully lower the vehicle.
15. Unfasten the exhaust manifold bolts, then remove the manifold with the EGR pipe.
16. Remove the spark plug wire retainers.
17. Remove the rocker arm (valve) cover.
18. Remove the serpentine drive belt from the A/C compressor.
19. Detach the electrical wires from the A/C compressor.
20. Loosen the 2 rear A/C compressor mounting bolts.
21. Remove the A/C compressor bracket nuts from the water pump
22. Loosen the front A/C mount bolt, then slide the compressor and bracket forward.

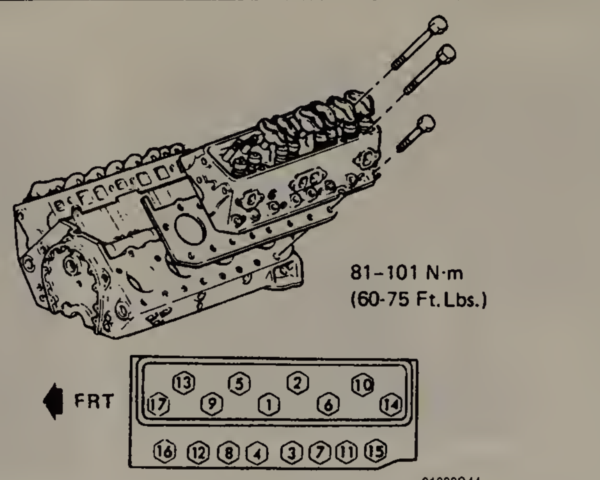


Fig. 53 Cylinder head mounting and bolt tightening sequence—5.7L (VIN 8) engine

➡When removing the pushrods, and all other valve train components, you must keep them in the same order as they were removed. These components MUST be reinstalled in the proper positions.

23. Loosen the rocker arm nuts, then remove the pushrods.
24. Unfasten the head bolts, then remove the cylinder head from the vehicle. Remove and discard the gasket.

The cylinder head should be properly cleaned and inspected before installation. Clean the gasket mating surfaces of all components. Be careful not to nick or scratch any surfaces as this will allow leak paths. Clean the bolt threads in the cylinder block and on the head bolts. Dirt will affect bolt torque. Refer to Engine Reconditioning for further details.

To install:

25. Position a new cylinder head gasket on the block. Place the cylinder head over the locator pins and head gasket.
26. Install the bolts finger-tight.
27. Tighten the long cylinder head bolts, in the sequence shown in the accompanying figure, to 60–75 ft. lbs. (81–101 Nm). Tighten the short cylinder head bolts, in the sequence shown in the accompanying figure to 55–65 ft. lbs. (74–88 Nm).
28. Install the pushrods and rocker arms. Install the rocker arm (valve) cover. Tighten the retaining bolts to the proper specifications.
29. The remainder of installation is the reverse of the removal procedure.
30. Fill the radiator with the proper type and amount of coolant. Connect the negative battery cable.
31. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
32. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

LEFT SIDE

➧ See Figures 54 thru 65

1. Disconnect the negative battery cable.
2. Drain the engine cooling system into a suitable container,
3. Remove the intake manifold, as outlined earlier in this section.
4. Disconnect the AIR hose from the check valve.
5. Remove the alternator brace.
6. Detach the wire from the fan temperature sensor.
7. Raise and safely support the vehicle.
8. Disconnect the exhaust pipe from the manifold.
9. Carefully lower the vehicle.
10. Remove the exhaust manifold bolts, then remove the manifold.
11. Either remove the serpentine drive belt, or you can just loosen it and remove it from the AIR pump pulley.
12. Remove the mounting bolts, then remove the AIR pump with the bracket.
13. Remove the rocker arm (valve) cover.
14. Tag and disconnect the spark plug wires, then remove the plugs.
15. Unfasten the power steering and alternator mounting bracket from the cylinder head.

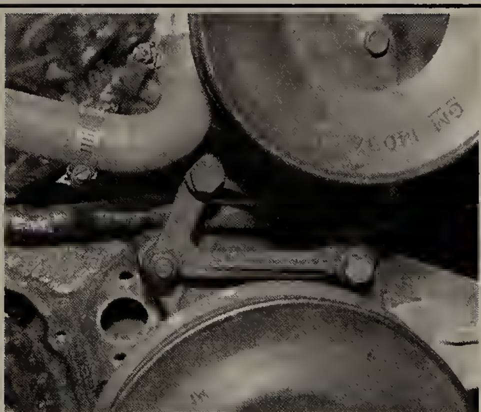
➡When removing the pushrods, and all other valve train components, you must keep them in the same order as they were removed. These components MUST be reinstalled in the proper positions.

16. Loosen or remove the rocker arm nuts, as applicable, then remove the pushrods. Make sure to keep all components in the proper order for installation.
17. Unfasten the head bolts, then remove the cylinder head from the vehicle. Remove and discard the gasket.

The cylinder head should be properly cleaned and inspected before installation. Clean the gasket mating surfaces of all components. Be careful not to nick or scratch any surfaces as this will allow leak paths. Clean the bolt threads in the cylinder block and on the head bolts. Dirt will affect bolt torque. Refer to Engine Reconditioning for further details.

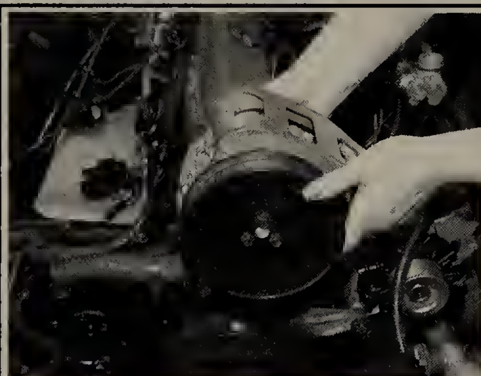
To install:

18. Position a new cylinder head gasket on the block. Place the cylinder head over the locator pins and head gasket.
19. Install the bolts finger-tight.
20. Tighten the long cylinder head bolts, in the sequence shown in the accompanying figure, to 60–75 ft. lbs. (81–101 Nm). Tighten the short cylinder



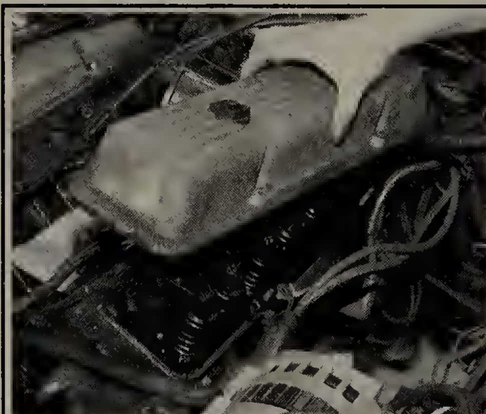
91033P21

Fig. 54 View of the AIR pump and bracket mounting bolts



91033P22

Fig. 55 Unfasten the retainers, then remove the AIR pump and bracket, as an assembly, from the engine



91033P23

Fig. 56 Remove the rocker arm (valve) cover

91033P24

Fig. 57 Remove the power steering and alternator mounting bracket from the cylinder head

91033P25

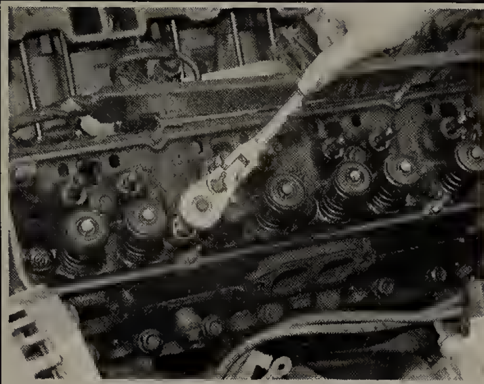
Fig. 58 Loosen the rocker arm nuts (see arrows)

91033P26

Fig. 59 Remove the rocker arm retaining nut (1) and rocker arm (2)

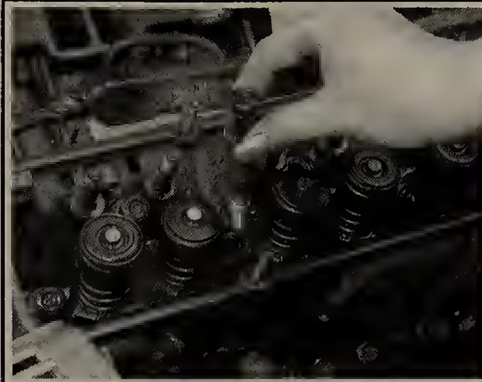
91033P27

Fig. 60 Then, pull the pushrods from the cylinder head



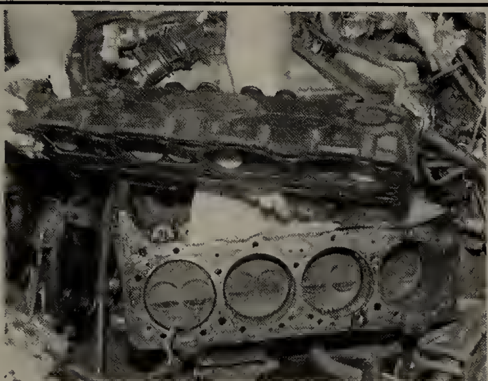
91033P28

Fig. 61 Loosen the cylinder head bolts gradually, starting from the inside and working out



91033P30

Fig. 62 When you remove the cylinder head bolts, keep them in order, because 2 different lengths of bolts are used

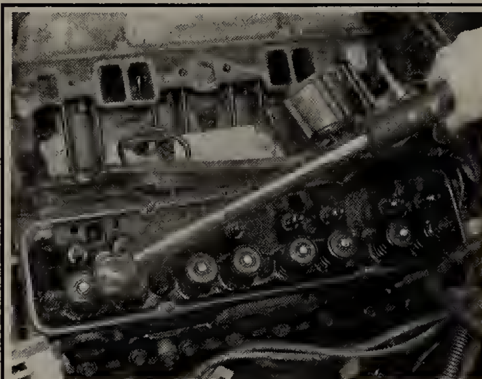


91033P31

Fig. 63 Carefully lift the cylinder head off of the engine block and place on a suitable workbench

91033P32

Fig. 64 Remove and discard the cylinder head gasket, then thoroughly clean the gasket mating surfaces



91033P29

Fig. 65 Always use a torque wrench to tighten the cylinder head bolts to specifications

head bolts, in the sequence shown in the accompanying figure to 55–65 ft. lbs. (74–88 Nm).

21. Install the pushrods and rocker arms. Install the rocker arm (valve) cover. Tighten the retaining bolts to the proper specifications.
22. The remainder of installation is the reverse of the removal procedure.
23. Fill the radiator with the proper type and amount of coolant. Connect the negative battery cable.
24. Start the engine, and allow to run (with the radiator cap still removed), until the upper hose is hot (thermostat is open). With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
25. Install the filler cap. Inspect for leaks. Turn the engine **OFF**.

5.7L (VIN J) Engines

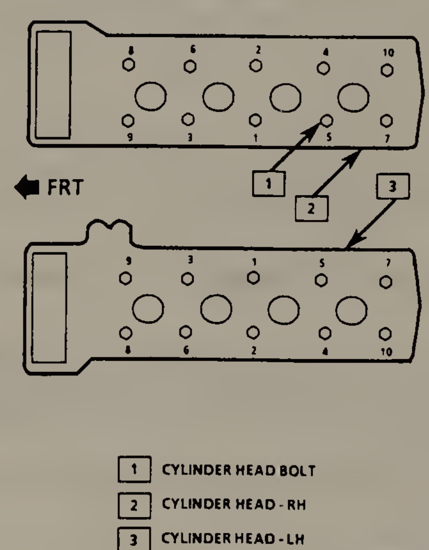
See Figure 66

RIGHT SIDE

1. Disconnect the negative battery cable and properly relieve fuel system pressure.
2. Drain the engine coolant into a suitable container.
3. Remove the intake plenum assembly.
4. Remove the right injector housing.
5. Remove the right bank valve lifters.
6. Remove the alternator assembly.
7. Disconnect the right exhaust manifold from the cylinder head. It is not necessary to completely remove the exhaust manifold from the vehicle for cylinder head removal.
8. If raised, lower the vehicle for underhand access.
9. Remove the vacuum hose from secondary port throttle valve actuator.
10. Remove the access plug from the right cylinder head.
11. Remove the top bolt attaching the right secondary timing chain fixed guide.
12. Remove cylinder head bolts, then remove the cylinder head and gasket from the vehicle. Discard the gasket.

To install:

13. Thoroughly clean the cylinder head and cylinder case mating surfaces. Make sure both surfaces are free of any foreign matter, nicks or scratches. The threads in both the bolts holes and on the bolts must be clean and free of old sealer.



91033G45

Fig. 66 Cylinder head bolt tightening sequence—5.7L (VIN J) engines

➡**Cylinder head gaskets are not interchangeable between cylinder banks.**

14. Install the cylinder head locating dowels into block, if loosened or removed, then position the new gasket in place on the cylinder case.
15. Install the cylinder head over the dowels. Coat bolt threads and washers with clean engine oil and insert.
16. Tighten the cylinder head bolts, in the sequence shown in the accompanying figure, as follows:
    - 1st pass–45 ft. lbs. (60 Nm)

- 2nd pass–74 ft. lbs. (100 Nm)
- 3rd pass–118 ft. lbs. (160 Nm)

17. Apply Loctite® 262 to the fixed guide top bolt threads, install the bolt and tighten to 19 ft. lbs. (26 Nm).
18. Install the access plug into the cylinder head and torque to 15 ft. lbs. (20 Nm).
19. Connect the vacuum hose to the actuator.
20. Raise and support vehicle, drain the engine oil.
21. Install the exhaust manifold.
22. If still supported, lower the vehicle for underhood access.
23. Install the alternator.
24. Install valve lifters.
25. Install the right injector housing assembly.
26. Install the plenum assembly.
27. Fill the engine crankcase with the proper type and amount of engine oil.
28. Tighten the fuel filler cap and properly refill the cooling system.
29. Connect the negative battery cable.
30. If equipped, reset the CHANGE OIL indicator, as outlined in Section 1 of this manual.

LEFT SIDE

1. Disconnect the negative battery cable and properly relieve fuel system pressure.
2. Drain the engine coolant into a suitable container.
3. Remove the intake plenum assembly.
4. Remove the left injector housing.
5. Remove the vacuum hose from the secondary port throttle valve actuator.
6. Remove the power brake booster assembly.
7. Remove the left bank valve lifters.
8. Remove the AIR control valve hoses, then disengage the electrical connector.
9. Remove the camshaft position sensor.
10. Disconnect the left exhaust manifold from the cylinder head. It is not necessary to completely remove the exhaust manifold from the vehicle for cylinder head removal.
11. Remove the access plug from the left cylinder head.
12. Remove the bolt attaching the left secondary timing chain guide.
13. Remove the cylinder head bolts. Remove the cylinder head and gasket from the vehicle. Discard the gasket.

To install:

14. Thoroughly clean the cylinder head and cylinder case mating surfaces. Make sure both surfaces are free of any foreign matter, nicks or scratches. The threads in both the bolts holes and on the bolts must be clean and free of old sealer.

➡Cylinder head gaskets are not interchangeable between cylinder banks.

15. Install the cylinder head locating dowels into block, if loosened or removed, then position the new gasket in place on the cylinder case.
16. Install the cylinder head over the dowels. Coat bolt threads and washers with clean engine oil and insert.
17. Tighten the cylinder head bolts, in the sequence shown in the accompanying figure, as follows:
    - 1st pass–45 ft. lbs. (60 Nm)
    - 2nd pass–74 ft. lbs. (100 Nm)
    - 3rd pass–118 ft. lbs. (160 Nm)
18. Apply Loctite® 262 to the fixed guide bolt threads, install the bolt and tighten to 19 ft. lbs. (26 Nm).
19. Install the access plug into the cylinder head and tighten to 15 ft. lbs. (20 Nm).
20. Connect the vacuum hose to the actuator.
21. Raise and support vehicle, drain the engine oil and lower the vehicle.
22. Install the exhaust manifold.
23. Install the camshaft position sensor.
24. Connect the AIR control valve hoses and electrical connector.
25. Install the valve lifters.
26. Install the left injector housing assembly.
27. Install the plenum assembly.
28. Fill the engine crankcase with the proper type and amount of engine oil.
29. Tighten the fuel filler cap and properly refill the cooling system.
30. Connect the negative battery cable.
31. If equipped, reset the CHANGE OIL indicator, as outlined in Section 1 of this manual.

5.7L (VIN P and 5) Engines

➧ See Figure 67

RIGHT SIDE

1. Disconnect the negative battery cable and properly relieve the fuel system pressure.
2. Raise and support the vehicle safely.
3. Disconnect the catalytic converter.
4. Drain the engine cooling system, then lower the vehicle.
5. Remove the lower radiator and heater hoses from the water pump.
6. Disconnect the power steering pump reservoir from the cylinder head and reposition aside.
7. Remove the coil and bracket assembly.
8. Remove the intake manifold.
9. Remove the spark plug wires from the clips, then remove the front wire bracket.
10. Remove the oil level indicator tube.
11. Disconnect the spark plug wires from the plugs, then remove the spark plugs from the cylinder head.
12. Remove the right exhaust manifold.
13. Using a backup wrench on the pipe fitting, disconnect the coolant air bleed pipe from the left cylinder head.

➡When removing the pushrods, and all other valve train components, you must keep them in the same order as they were removed. These components MUST be reinstalled in the proper positions.

14. Remove the right valve rocker cover, then remove the rocker arm and pushrod assemblies.
15. Remove the cylinder head bolts.
16. Remove the cylinder head along with the coolant air bleed pipe, then remove the head gasket.
17. If necessary, remove the coolant air bleed pipe from the cylinder head.

The cylinder head should be properly cleaned and inspected before installation. Clean the gasket mating surfaces of all components. Be careful not to nick or scratch any surfaces as this will allow leak paths. Clean the bolt threads in the cylinder block and on the head bolts. Dirt will affect bolt torque. Refer to Engine Reconditioning for further details.

To install:

18. Thoroughly clean the cylinder head and cylinder case mating surfaces. Make sure both surfaces are free of any foreign matter, nicks or scratches. The threads in both the bolts holes and on the bolts must be clean and free of old sealer.
19. If removed, install the coolant air bleed pipe to the cylinder head, finger-tight.
20. Position the new gasket in place on the cylinder case with the yellow tab facing up. Install the cylinder head over the dowel pins and gasket.
21. Coat the bolts with 1052080, or an equivalent sealant. Install and tighten the cylinder head bolts, using 3 passes of the proper sequence, to 65 ft. lbs. (88 Nm).

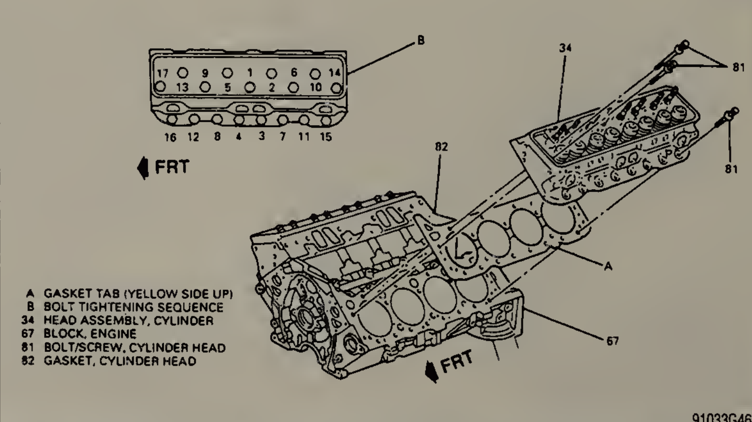


Fig. 67 Exploded view of the cylinder head mounting and bolt tightening sequence—5.7L (VIN P and 5) engine

22. Install the rocker arm and pushrod assemblies.
23. Install the valve rocker cover and tighten the bolts to 75 inch lbs. (8 Nm) for 1992 vehicles or to 100 inch lbs. (11 Nm) for 1993–96 vehicles.
24. Connect the coolant air bleed pipe to the left cylinder head and torque the pipe to both cylinder heads. Using a backup wrench, tighten the coolant air bleed pipe to 30 ft. lbs. (41 Nm).
25. Install the right exhaust manifold.
26. Install the spark plugs and tighten to 11 ft. lbs. (15 Nm).
27. Connect the spark plug wires to the plugs, then install the oil level indicator tube.
28. Install the front wire bracket, then connect the spark plug wire harness assembly to the wire bracket.
29. Install the intake manifold.
30. Install the coil and bracket assembly.
31. Position and secure the power steering pump reservoir.
32. Install the lower radiator and heater hoses to the water pump.
33. Raise and support the vehicle safely.
34. Connect the catalytic converter, then lower the vehicle.
35. Properly fill the cooling system.
36. Tighten the fuel filler cap and connect the negative battery cable.

LEFT SIDE

1. Disconnect the negative battery cable and properly relieve the fuel system pressure.
2. Raise and support the vehicle safely.
3. Disconnect the catalytic converter.
4. Drain the engine cooling system, then lower the vehicle.
5. Remove the upper radiator hose.
6. Remove the serpentine drive belt.
7. Remove the intake manifold.
8. Remove the left wheel well lower center panel.
9. Disconnect the air conditioning compressor from the bracket and position aside. Use care not to kink or damage the refrigerant lines. Remove the compressor and alternator brace.
10. Remove the spark plug wire bracket, disconnect the wires from the spark plugs and remove the spark plugs from the cylinder head.
11. Remove the left exhaust manifold.
12. Remove the remaining alternator brace, then remove the alternator.
13. Disconnect the AIR diverter valve hose.
14. Remove the left valve rocker cover.
15. Remove the drive belt idler pulley, then remove the drive belt tensioner.
16. Disconnect the power steering lines from the pump, then remove the pump. Plug the openings to prevent system contamination or excessive fluid loss.
17. Remove the spark plug and coil wires from the distributor.
18. Remove the accessory mounting bracket.
19. Remove the rocker arm and pushrod assemblies.
20. Disconnect the coolant air bleed pipe from the cylinder head.
21. Remove the cylinder head bolts, then remove the cylinder head and gasket.

To install:

22. Thoroughly clean the cylinder head and cylinder case mating surfaces. Make sure both surfaces are free of any foreign matter, nicks or scratches. The threads in both the bolts holes and on the bolts must be clean and free of old sealer.
23. Position the new gasket in place on the cylinder case with the yellow tab facing up. Install the cylinder head over the dowel pins and gasket.
24. Coat the bolts with 1052080, or an equivalent sealant. Install and tighten the cylinder head bolts, using 3 passes of the proper sequence, to 65 ft. lbs. (88 Nm).
25. Connect the coolant air bleed pipe to the cylinder head and tighten to 30 ft. lbs. (41 Nm).
26. Install the rocker arm and pushrod assemblies.
27. Install the accessory mounting bracket and bolts. Tighten the bolts to 25 ft. lbs. (34 Nm) for 1992 vehicles or to 31 ft. lbs. (42 Nm) for 1993–96 vehicles.
28. Connect the spark plug and coil wires to the distributor.
29. Install the power steering pump, then remove the plugs from the openings and connect the lines.
30. Install the drive belt tensioner, then install the idler pulley. Tighten the tensioner and pulley bolts to 24 ft. lbs. (33 Nm).
31. Install the left valve rocker cover and bolts. Tighten the bolts to 75 inch lbs. (8 Nm) for 1992 vehicles or to 100 inch lbs. (11 Nm) for 1993–96 vehicles.
32. Connect the AIR diverter valve hose and install the alternator lower brace.
33. Install the left exhaust manifold.
34. Install the spark plugs and tighten to 11 ft. lbs. (15 Nm). Connect the spark plug wires to the plugs and insert the wires into the brackets.
35. Install the air conditioning compressor and alternator brace, then install the compressor.
36. Install the left wheel well lower center panel.
37. Install the intake manifold.
38. Install the serpentine drive belt and the upper radiator hose.
39. Raise and safely support the vehicle, then connect the catalytic converter and lower the vehicle.
40. Properly fill the engine cooling system.
41. Tighten the fuel filler cap and connect the negative battery cable.
42. Bleed the power steering system.

Oil Pan

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

See Figures 68 and 69

The 1984–85 vehicles are equipped with separate oil pan side gaskets and end seals which must be replaced every time the oil pan is removed. The 1986 and later vehicles have a one piece gasket/seal, that can be reused if it is not damaged during removal.

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle. Drain the engine oil into a suitable container.

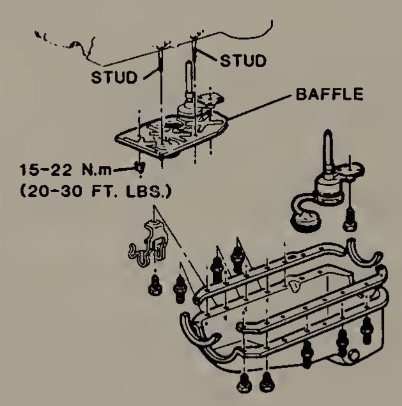


Fig. 68 Exploded view of the oil pan, including the 4-piece gasket/end seal assemblies—1984–85 5.7L (VIN 8) engine

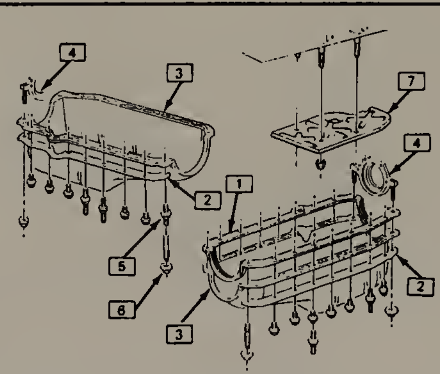


Fig. 69 On 1986–91 vehicles, the oil pan uses a 1-piece gasket which can be reused, if it is not damaged during oil pan removal

3. On 1986–91 vehicles, perform the following:
a. Disconnect the transmission oil cooler lines from the flywheel cover. Plug the lines to avoid contaminating the system.
b. Unfasten the catalytic converter AIR pipe clamps from the manifold and exhaust pipe.
4. Disconnect the starter wiring and remove the starter brace nut.
5. Unfasten the starter mounting bolts, then remove the starter and position it aside.
6. On 1986–91 vehicles, remove the oil filter, then remove the oil cooler adapter from the block.
7. If not already done, remove the retainers, then remove the flywheel cover.
8. On 1986–91 vehicles, disconnect and plug the oil cooler line from the oil pan, and remove the ESC sensor shield, if equipped.
9. On 1986–91 vehicles, if necessary, remove the front crossmember braces.
10. Unfasten the oil pan bolts, noting their sizes and locations for installation, then carefully lower the oil pan and remove if from the vehicle.
11. Thoroughly clean the oil pan and block sealing surfaces.

To install:

12. On 1986–91 vehicles, apply a small amount of RTV sealant to the front and rear corners of the oil pan.
13. Install the oil pan, using new seals and gaskets on 1984–85 vehicles, or reusing the old gasket, if it is in good condition on 1986–91 vehicles.
14. Install the oil pan retainers, in their proper positions, and tighten them as follows:
a. 1984–85 vehicles: 80 inch lbs. (9 Nm).
b. 1986 vehicles: tighten the oil pan-to-crankcase nuts to 14 ft. lbs. (19 Nm) and the oil pan studs to 80 inch lbs. (9 Nm).
c. 1987–88 vehicles: tighten the oil pan-to-crankcase nuts to 16 ft. lbs. (22 Nm), the corner oil pan-to-crankcase studs to 15 inch lbs. (2 Nm) and the oil pan-to-case studs to 8 ft. lbs. (11 Nm).
d. 1989–91 vehicles: 16 ft. lbs. (22 Nm).
15. If removed, install the front crossmember braces and install the ESC sensor shield.
16. Install the flywheel cover/splash shield.
17. Install the starter and secure with the mounting bolts.
18. Attach the starter wiring and install the starter brace.
19. On 1986–91 vehicles, perform the following:
a. Unplug and attach the oil cooler line to the oil pan. Attach the oil cooler adapter to the block, then install a new oil filter.
b. Attach the catalytic converter AIR pipe clamps to the manifold and exhaust pipe.
c. Unplug and connect the transmission oil cooler lines to the flywheel cover.
20. If removed, unplug and connect the transmission oil cooler lines.
21. Carefully lower the vehicle.
22. Fill the engine crankcase with the proper type and amount of clean engine oil.
23. Connect the negative battery cable.

5.7L (VIN J) Engine

See Figures 70 and 71

1. Disconnect negative battery cable and remove the oil lever indicator from the guide tube.
2. Raise and support the vehicle safely, then drain the engine oil.
3. Remove the clutch housing cover attaching bolts, then remove the cover from the vehicle.
4. If equipped, remove the left and right wiring harness heat shields from the oil pan.
5. Disconnect the low oil sensor connection and remove the sensor from the pan.
6. Remove the bolts attaching the AIR pipe bracket to the oil pan, then remove the left and right converter heat shields.
7. Remove the nuts attaching the engine mounts at the front crossmember rear brace on the left and right sides. Remove the bolts attaching the front crossmember to the rear braces.
8. Remove the bolts attaching the left front crossmember rear brace to the left front side member, then remove the brace from the vehicle.

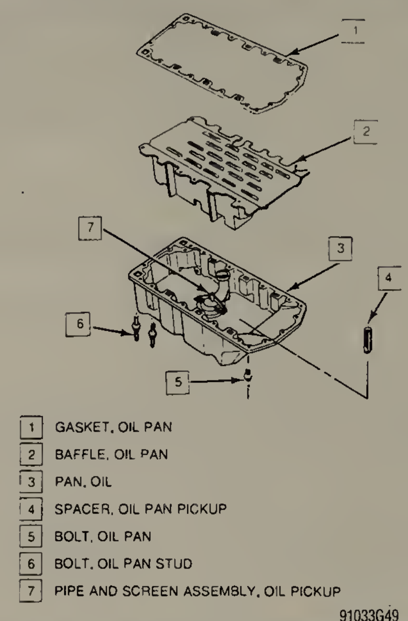


Fig. 70 Exploded view of the oil pan and related components—1990 5.7L (VIN J) engine shown

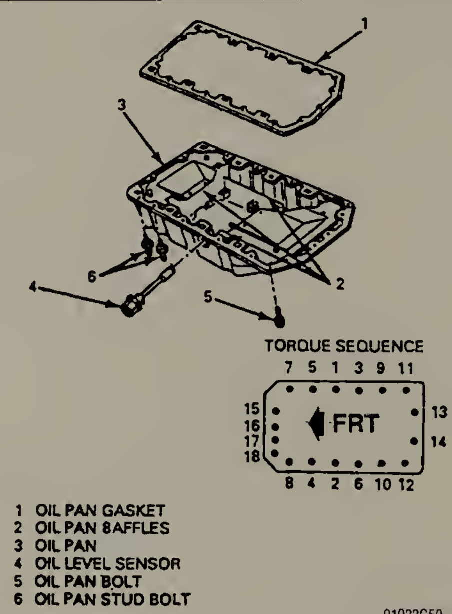


Fig. 71 Oil pan mounting and retainer tightening sequence—1995 5.7L (VIN J) engine shown

9. Remove the bolts attaching the right front crossmember rear brace to the right front side member, then remove the brace from the vehicle.
10. Remove the bolts attaching the oil pan and crankcase. Remove the oil pan and gasket from the vehicle.

To install:

11. Apply Loctite® 242 to the oil pan screw threads.
12. Install the oil pan and new gasket to the engine crankcase. Tighten the oil pan front screws to 106 inch lbs. (12 Nm). Tighten the oil pan bolts to 23 ft. lbs. (31 Nm).
13. Install the front crossmember rear braces and bolts retaining the braces to the front crossmember bolts. Finger-tighten the bolts.
14. Install the bolts retaining the left front crossmember rear brace to the left front side member, finger-tight.
15. Install the bolts retaining the right front crossmember rear brace to the left front side member, finger-tight.
16. Tighten the left and right front crossmember rear brace to front crossmember bolts to 59 ft. lbs. (80 Nm), then tighten the left and right front crossmember rear brace to front side member bolts to 46 ft. lbs. (62 Nm).
17. Install the nuts retaining the engine mounts to the front crossmember and tighten to 40 ft. lbs. (54 Nm).

18. Install the converter heat shields and screws.
19. Install the bolts retaining the AIR pipe bracket to the oil pan and tighten to 89 inch lbs. (10 Nm).
20. Install the oil level sensor in the pan and tighten to 18 ft. lbs. (25 Nm), then engage the wiring harness to the sensor.
21. Install the left and right wiring harness heat shields, if equipped, and tighten the bolts to 89 inch lbs. (10 Nm).
22. Install the clutch housing cover and tighten the bolts to 80 inch lbs. (9 Nm).
23. Lower the vehicle and insert the oil level indicator into the guide tube.
24. Properly fill the crankcase with clean engine oil.
25. Connect the negative battery cable.
26. If equipped, reset the CHANGE OIL indicator, as outlined in Section 1 of this manual.

5.7L (VIN P and 5) Engines

See Figure 72

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely, then drain the engine oil.
3. Disengage the oil level sensor electrical connector and remove the sensor assembly from the side of the oil pan.
4. Remove the oil filter, then remove the oil filter adapter bolts and the adapter assembly.
5. Remove the starter motor assembly.
6. Remove the left catalytic converter.
7. Remove the flywheel cover.
8. Remove the knock sensor retaining nuts and shields.

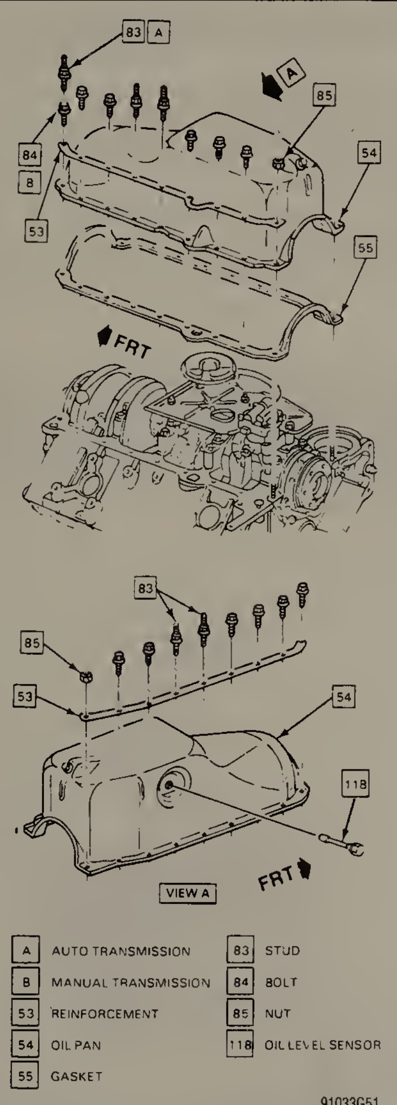


Fig. 72 Exploded view of the oil pan and related components—5.7L (VIN P) engine shown, VIN 5 similar

9. Remove the oil pan bolts, nuts and studs. Be sure to note the location of stud bolts.
10. Remove the oil pan, reinforcements and gasket.

To install:

11. Thoroughly clean all gasket mating surfaces and apply a small amount of 1052914 or equivalent sealer, to the front cover and cylinder block junction and the rear seal retainer and cylinder block junction. Extend the bead of sealer approximately 1 inch (25mm) in either direction of these junctions.
12. Install the gasket onto the oil pan and reinforcements.
13. Install the gasket, pan and reinforcement assembly to the cylinder block with the bolts, studs and nuts.
14. Tighten the corner bolts or stud and nuts to 17 ft. lbs. (23 Nm) on 1992 vehicles or to 15 ft. lbs. (20 Nm) for 1993–96 vehicles. Tighten the remainder of the bolts and studs to 8 ft. lbs. (11 Nm).
15. Install the oil level sensor and tighten to 16 ft. lbs. (22 Nm).
16. Install the knock sensor shields and nuts. Tighten the nuts to 75 inch lbs. (8.5 Nm).
17. Install the flywheel cover.
18. Install the left catalytic converter.
19. Install the starter motor assembly.
20. Engage the wiring harness to the oil level sensor terminal.
21. Install the oil filter adapter and tighten the retainers to 17 ft. lbs. (23 Nm), then install the oil filter.
22. Lower the vehicle and properly fill the crankcase with clean engine oil.
23. Connect the negative battery cable.
24. If equipped, reset the CHANGE OIL indicator, as outlined in Section 1 of this manual.

Oil Pump

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

See Figures 73 and 74

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle, then drain the engine oil into a suitable container.
3. Remove the oil pan, as outlined earlier in this section.
4. Remove the pump-to-rear main bearing cap bolt, then remove the pump and extension shaft.

To install:

5. Assemble the pump and extension shaft to the rear main bearing cap, aligning the slot on the top end of the extension shaft with the drive tang on the lower end of the distributor driveshaft.
6. Install the pump-to-rear bearing cap bolt and tighten to 80 ft. lbs. (108 Nm).
   a. Install the oil pan, as outlined earlier in this section.

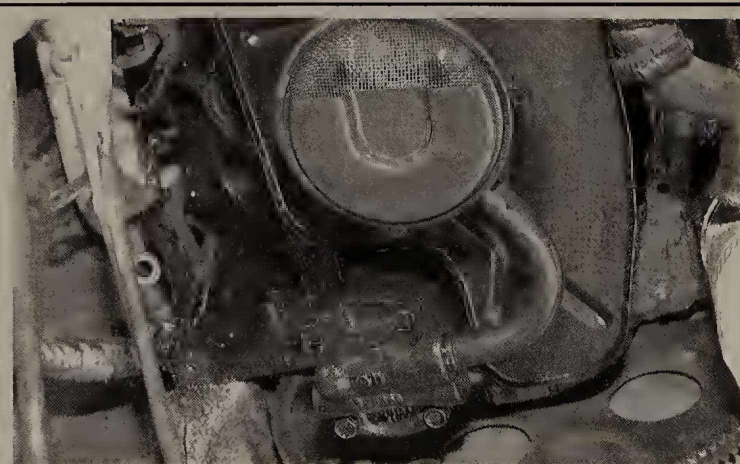


Fig. 73 Once the oil pan is removed, the oil pump can be accessed

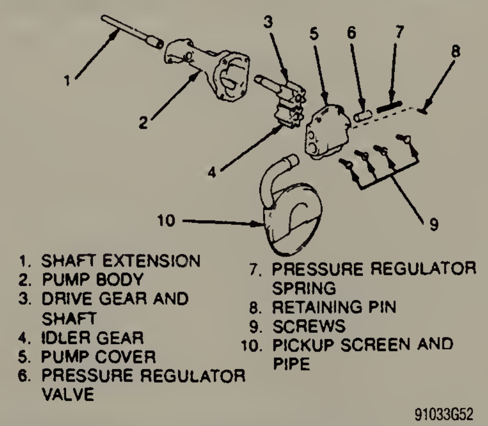


Fig. 74 Exploded view of the oil pump assembly—5.7L (VIN 8) engine

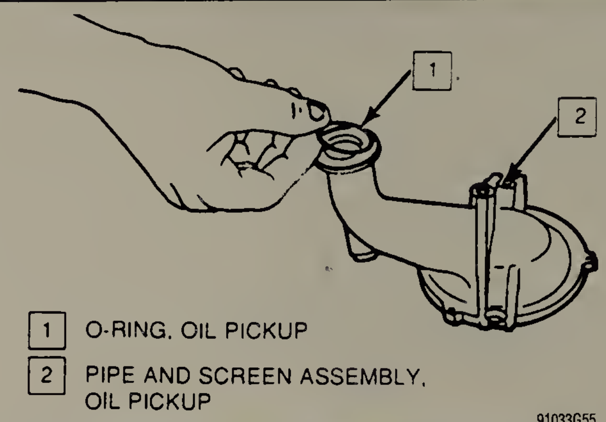


Fig. 77 On 1993–95 vehicles, remove the oil pickup seal—5.7L (VIN J) engine

5.7L (VIN J) Engine

See Figures 75, 76 and 77

1. Disconnect battery negative cable.
2. Remove the primary timing chain and crankshaft sprocket.
3. Remove bolts attaching the oil pump to the cylinder case, then remove the oil pump from the vehicle.
4. Remove O-rings from crankshaft and, if applicable, the oil pump.
5. For 1993–95 vehicles, remove the oil pickup seal.

To install:

6. Install new O-rings onto the crankshaft and oil pump, as applicable.
7. If applicable, install the oil pickup assembly seal.
8. Apply Loctite® 262 to the oil pump bolts and install them along with the oil pump, finger-tight.

➡Make sure the 2 flats of the pump drive gear are aligned with the 2 flats on the crankshaft. Do not force pump onto crankshaft.

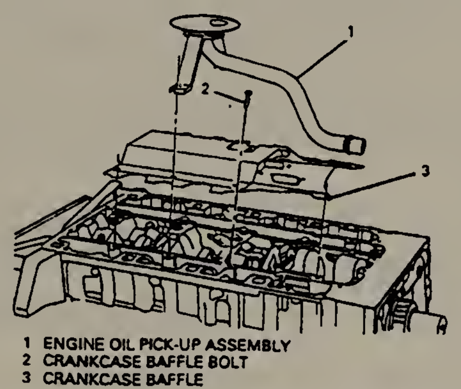


Fig. 75 Exploded view of the oil pick-up and crankcase baffle—5.7L (VIN J) engine

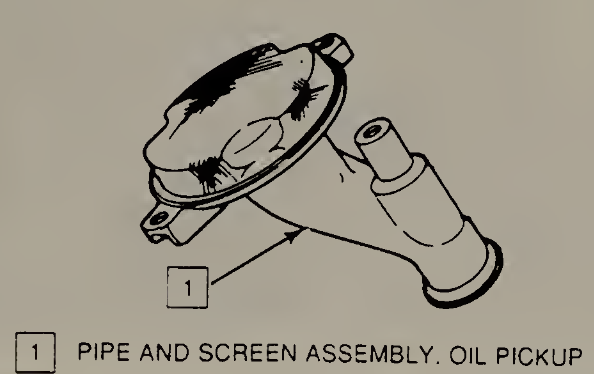


Fig. 76 View of the oil pick-up assembly—5.7L (VIN J) engine

9. Using oil pump aligning tool J–38135 or equivalent pump aligner/seal installer, align oil pump on the crankshaft. Tighten the oil pump bolts to 19 ft. lbs. (26 Nm).
10. Install a new oil pump shaft seal using tools J–38135 and J–38463 or equivalent aligner and seal installer.

➡Install a new oil pump shaft seal whenever the pump is removed from the vehicle.

11. Install the primary timing chain and crankshaft sprocket.
12. Connect the negative battery cable.

5.7L (VIN P and 5) Engines

See Figure 78

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely.
3. Drain the engine oil and remove the oil pan.
4. Remove the oil pan baffle nuts.
5. Support the oil pump by hand and remove the bolt attaching the oil pump to the main bearing cap.
6. Carefully remove the baffle, the oil pump assembly, driveshaft and retainer.

To install:

➡The oil pump pickup should be submerged in oil and the pump primed prior to installation. Failure to prime the pump may result in oil pump failure or internal engine damage. Also, if the pickup screen and pipe assembly was removed from the pump, they must be replaced to assure a proper interference fit.

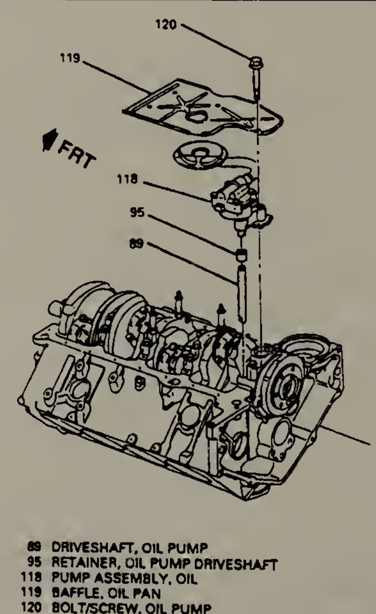


Fig. 78 Exploded view of the oil pump and related components—5.7L (VIN P and 5) engines

7. Install the oil pump assembly, shaft and retainer, aligning the slot on the top of the pump driveshaft with the drive tang on the lower end of the distributor driveshaft.
8. Install the oil pan baffle, then install the bolt to the main bearing cap, followed by the baffle nuts. Tighten the retaining bolt to 65 ft. lbs. (88 Nm) and the baffle nuts to 25 ft. lbs. (34 Nm).
9. Install the oil pan and lower the vehicle.
10. Properly fill the engine crankcase with clean engine oil.
11. Connect the negative battery cable.
12. If equipped, reset the CHANGE OIL indicator, as outlined in Section 1 of this manual.

Crankshaft Damper

REMOVAL & INSTALLATION

➡On some vehicles, the crankshaft damper is also referred to as the balancer.

5.7L (VIN 8) Engine

➧ See Figure 79

1. Disconnect the negative battery cable.
2. If necessary, remove the water pump damper.
3. Remove the retainers, then remove the crankshaft pulley
4. Remove the serpentine drive belt.
5. On some vehicles, it may be necessary to disconnect and plug the power steering line in order to get access to the damper with the removal puller.

✱✱ WARNING

Using any other type of puller, such as a universal claw, which pulls on the outside of the hub, can destroy the damper. The outside ring is permanently bonded to hub. Using the wrong puller could break the bond.

6. Install a harmonic balancer removal tool, or suitable puller on the damper. Turn the puller screw, then remove the damper.
7. Check the front cover seal for damage.

To install:

8. Use clean engine oil to coat the seal contact area on the damper.
9. Place the damper in position over the woodruff key on the crankshaft.
10. Pull the damper onto the crankshaft as follows:
    a. Install the appropriate threaded end of the harmonic balancer tool into the crankshaft. Install the tool in the crankshaft so that at least ½ in. (13mm) of the threads are engaged.
    b. Install the plate, thrust bearing and nut to complete tool installation.
    c. Pull the damper into position.
    d. Remove the tool from the crankshaft, then install the damper retaining bolt. Tighten the bolt to 60 ft. lbs. (81 Nm).

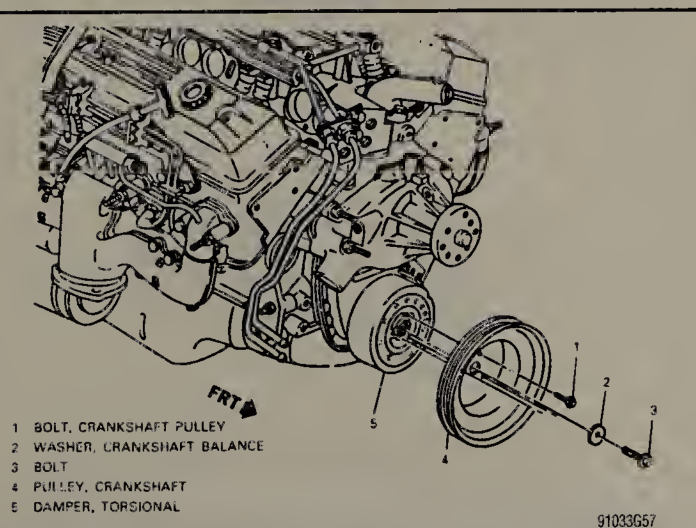


Fig. 79 Exploded view of the crankshaft torsional damper—1989 5.7L (VIN 8) engine shown

11. Install the crankshaft pulley.
12. If removed, unplug and install the power steering line. Tighten the center bolt to 70 ft. lbs. (95 Nm) and the outer bolts to 32 ft. lbs. (43 Nm).
13. If removed, install the water pump damper.
14. Install the serpentine drive belt.
15. Connect the negative battery cable.

5.7L (VIN J) Engine

➧ See Figures 80, 81 and 82

1. Disconnect the negative battery cable.
2. Remove the power steering gear, as outlined in Section 8 of this manual.
3. Remove the serpentine belt.
4. Remove the bolt and washer holding the damper to the crankshaft.
5. Using a suitable puller remove the damper from the crankshaft.
6. Remove the key from the crankshaft.

➡If you are replacing the damper, you must install new balance weights in the same hold locations as found on the old damper.

To install:

7. Install the key in the crankshaft. The key should be check to be sure it is properly seated in the keyway while installing the damper.
8. Install the damper using tool J 38463 or equivalent torsional damper installation tool.

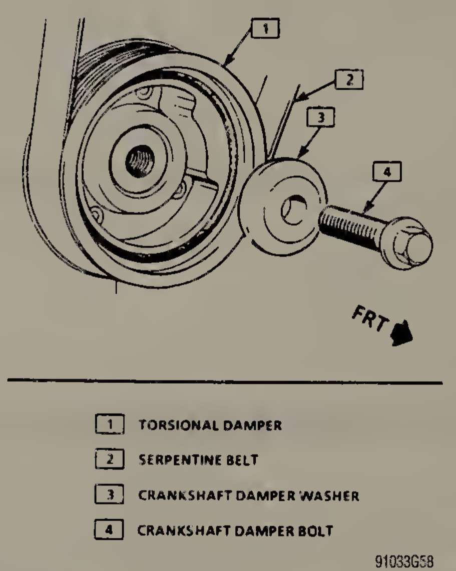


Fig. 80 Remove the damper bolt and washer

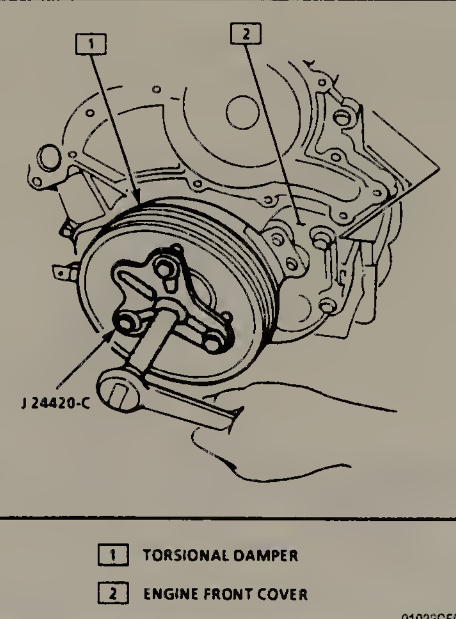


Fig. 81 You MUST use the proper type of puller when removing the damper from the crankshaft

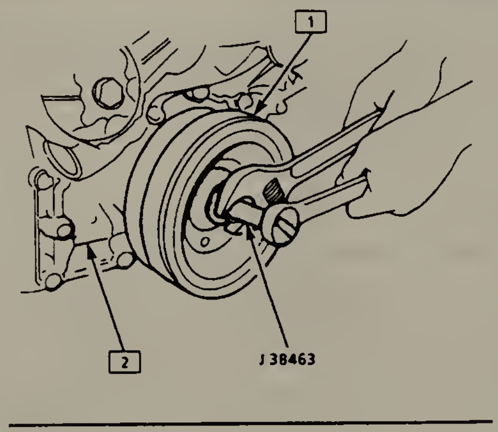


Fig. 82 Installation of the crankshaft damper using the proper tools

9. Apply Loctite® 262, or equivalent to the damper bolts threads, then install the washer and bolt. Tighten the bolt to 148 ft. lbs. (200 Nm).
10. Install the serpentine drive belt.
11. Install the steering gear, as outlined in Section 8 of this manual.

5.7L (VIN P and 5) Engines

See Figure 83

This procedure covers both removal of the crankshaft balancer (damper) and hub assembly.

1. Disconnect the negative battery cable.
2. Remove the air intake duct.
3. Raise and safely support the vehicle.
4. Remove the motor mount nuts.
5. Remove the power steering fluid cooler.

WARNING

When raising and supporting the engine, NEVER place a jack under the oil pan, crankshaft pulley or any sheetmetal. There is a minimal clearance between the oil pan and the pump screen. Jacking against the pan could cause sufficient deformation to damage the oil pickup unit.

6. Raise the engine enough so that you can access the balancer with the removal tool.
7. Unfasten the balancer bolts/screws, then remove the balancer assembly.
8. Disconnect and plug the power steering line from the steering gear.

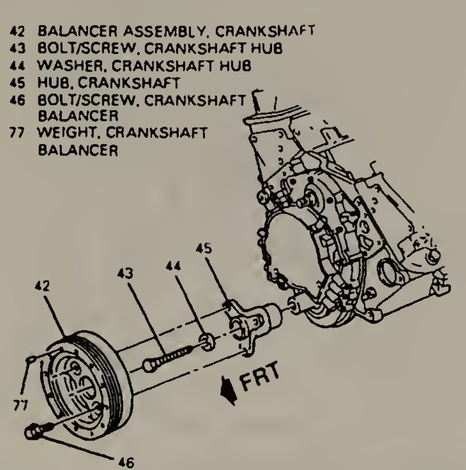


Fig. 83 Exploded view of the crankshaft balancer and hub assemblies

WARNING

Do NOT crank the engine over after marking the hub and front cover. Rotating the crankshaft will misalign the installation of the balancer to the crankshaft and possibly cause engine imbalance.

9. Matchmark the crankshaft hub to the engine front cover.
10. Remove the crankshaft hub bolt/screw and washer.
11. Remove the crankshaft hub using a suitable crankshaft hub removal/installation tool.

To install:

12. If the engine was accidently cranked over after matchmarking the hub and front cover, you must perform the following steps before installing the crankshaft hub:
    a. Set the No. 1 piston to Top Dead Center (TDC).
    b. Install the crankshaft hub with the cast arrow on the hub in the 12 o'clock position.
13. Install the crankshaft hub using a suitable hub removal/installation tool.
14. Install the crankshaft hub washer and bolt/screw.
15. Raise the engine.
16. Install the crankshaft balancer and retaining bolts/screws.
17. Tighten the crankshaft hub bolt to 70–75 ft. lbs. (95–102 Nm), and the balancer bolts/screw to 60 ft. lbs. (81 Nm).
18. Unplug and connect the power steering line to the steering gear.
19. Carefully lower the engine.
20. Install the power steering fluid cooler.
21. Install the motor mount nuts and tighten to 40 ft. lbs. (54 Nm).
22. Carefully lower the vehicle.
23. Install the serpentine drive belt.
24. Install the air intake duct and connect the negative battery cable.
25. Properly bleed the power steering system, as outlined in Section 8 of this manual.

Timing Chain Cover

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

See Figure 84

1. Disconnect the negative battery cable. Properly relieve the fuel system pressure.
2. Drain the engine cooling system and engine oil into suitable containers.
3. Remove the oil pan.
4. Remove the AIR pump pulley.
5. Remove the air management valve adapter.
6. Unfasten the AIR pump bolts, then remove the AIR pump.
7. Disconnect the fuel inlet and return lines from the TBI units. Plug the lines to avoid getting dirt or debris in the fuel system.
8. Remove the rear A/C compressor braces.
9. Remove the lower A/C compressor mounting bolt.

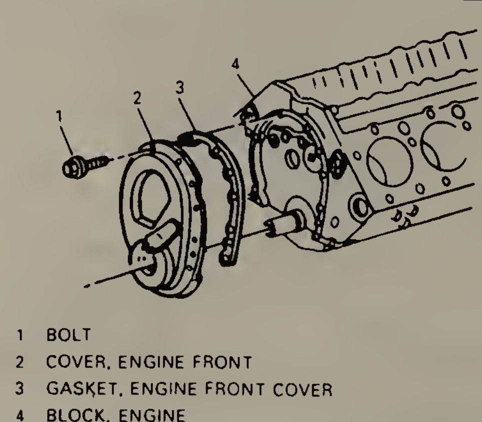


Fig. 84 Exploded view of the timing chain cover—5.7L (VIN 8) engine shown

10. Remove the compressor bracket nuts from the water pump.
11. Slide the mounting bracket forward, then remove the compressor mounting bolt.
12. Detach the wires, then position the compressor aside. Do NOT disconnect the refrigerant lines!
13. Disconnect the AIR hose from the right exhaust manifold.
14. Remove the compressor mounting bracket.
15. Remove the upper AIR pump bracket with the power steering reservoir.
16. Remove the lower AIR pump bracket.
17. Disconnect the radiator and heater hoses from the water pump.
18. Remove the front cover bolts, then remove the front cover.
19. Thoroughly clean the gasket mating surfaces.

To install:

20. Use a sharp knife or other suitable cutting tool to remove any excess oil pan gasket material that may be protruding at the oil-to-engine block junction.
21. Check the front cover for any damage or distortion, and replace if necessary. Apply a ⅛ in. (3mm) bead of RTV sealant to the joint formed at the oil pan and cylinder block. Coat the cover gasket with gasket sealant and position it on the cover.
22. Install the cover and loosely install the cover-to-block upper attaching bolts.
23. Tighten the bolts alternately and evenly while pressing downward on the cover so the dowels in the block align with their corresponding holes in the cover. You must position the cover so the dowels enter the holes in the cover without binding. Do not force the cover over the dowels and cause the cover flange or holes to be distorted.
24. Install the remaining cover bolts and tighten to 80 inch lbs. (9 Nm).
25. Install the oil pan.
26. Install the water pump and crankshaft damper.
27. The remainder of installation is the reverse of the removal procedure.
28. Fill the engine crankcase with the proper type and amount of oil.
29. Connect the negative battery cable, properly fill the engine cooling system and check for leaks.
30. Check the coolant and oil levels, and add if necessary.

5.7L (VIN J) Engine

➧ See Figure 85

1. Take the vehicle to a reputable repair shop and have the A/C system properly discharged and recovered, using the proper tools.
2. Disconnect the negative battery cable and drain the engine coolant into a suitable container.
3. Remove the water pump assembly.

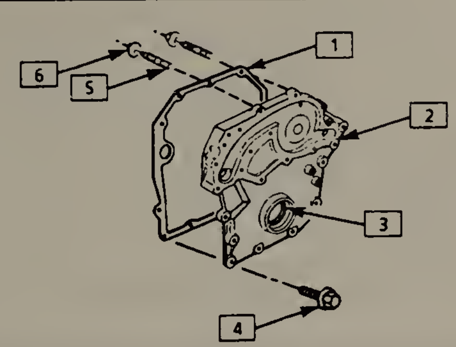


Fig. 85 Exploded view of the front timing chain cover—5.7L (VIN J) engine

4. Remove the air conditioning compressor as follows:
   a. Remove the throttle body.
   b. Remove the serpentine drive belt.
   c. Remove the engine oil temperature sensor.
   d. Remove the alternator.
   e. Remove the refrigerant hose from the A/C compressor, then immediately cap or plug the openings to prevent system contamination and damage.
   f. Remove the compressor mounting bolts and electrical connection.
   g. Remove the compressor from the vehicle.
5. Remove the steering gear for access to the damper.
6. Remove the bolt and washer attaching the torsional damper to the crankshaft.
7. Using tool J–24420–C, or an equivalent torsional damper puller, remove the damper from the crankshaft.
8. Remove the drift key, from the crankshaft.
9. Remove the nuts and/or bolts attaching the front cover to the engine.
10. Remove the front cover and gasket from the vehicle. If necessary, remove the old seal from the front cover using J–29077–A or an equivalent oil seal remover.

To install:

11. Thoroughly clean the cylinder case, front cover and water pump sealing surfaces.
12. Apply Loctite® 262 to the stud threads and Loctite® 565 to the bolt threads.
13. Install a new cover gasket and the cover, nuts and bolts.
14. If removed, install a new front cover oil seal using J–37309 or equivalent front cover seal installer.
15. Tighten the front cover attaching bolts to 19 inch lbs. (26 Nm) and the stud nuts to 21 ft. lbs. (28 Nm).
16. Install the water pump assembly.
17. Install the air conditioning compressor in the reverse order of the removal procedure. Replace the refrigerant line seal washers and coat the new washers with 525 refrigerant oil prior to assembly.
18. Install the key to the crankshaft and, then install the torsional damper using J–38463, or an equivalent torsional damper installer. Check for proper key seating during installation.

➠ If a new balancer is installed, new balancer weights of the same size must be installed in the same hole locations as the original balancer.

19. Remove the tool apply Loctite® 262 to the damper bolt threads. Install the washer and damper bolt, then tighten the bolt to 148 ft. lbs. (200 Nm).
20. Install the serpentine drive belt.
21. Install the steering gear.
22. Connect the negative battery cable, properly fill the engine cooling system and check for leaks.
23. If the engine oil was changed, and if equipped, reset the CHANGE OIL indicator, as outlined in Section 1 of this manual.
24. Take the vehicle to a reputable repair shop to have the A/C system properly evacuated and charged.

5.7L (VIN P and 5) Engines

➧ See Figure 86

1. Disconnect the negative battery cable.
2. Drain the engine oil and coolant into suitable containers.
3. Remove the throttle body air intake duct.
4. Remove the serpentine drive belt.
5. Remove the water pump assembly.
6. Remove the crankshaft balancer and hub.
   a. If not done already, raise and support the vehicle safely, then remove the motor mount nuts.
   b. Remove the power steering fluid cooler, then raise the engine sufficiently for tool access to the crankshaft balancer.

✲✲ WARNING

When raising and supporting the engine, NEVER place a jack under the oil pan, crankshaft pulley or any sheetmetal. There is a minimal clearance between the oil pan and the pump screen. Jacking against the pan could cause sufficient deformation to damage the oil pickup unit.

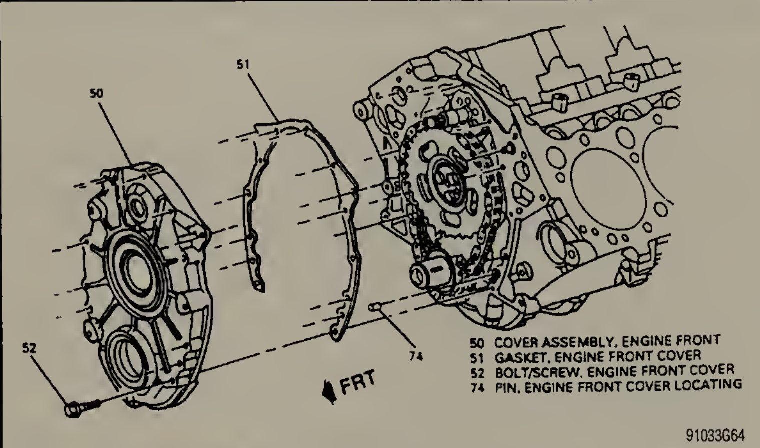


Fig. 86 Exploded view of the front cover and gasket—5.7 (VIN P and 5) engines

c. Remove the balancer bolts, then remove the balancer from the hub.
d. Disconnect the power steering line from the steering gear.
e. Matchmark the crankshaft hub to the engine front cover, then remove the hub bolt and washer.
f. Remove the crankshaft hub using J–39046, or an equivalent hub removal/installation tool. To preserve the relationship between the hub and crankshaft, DO NOT crank the engine over once the hub has been removed. If the hub is not matchmarked and installed in the original position, an engine imbalance could result.

7. Remove the distributor assembly.
8. Remove the oil pan assembly.
9. Remove the engine front cover bolts.
10. Remove the engine front cover and gasket.

To install:

11. Thoroughly clean the engine front cover and cylinder block gasket mating surfaces. Inspect the engine front cover and seals for damage, replace as necessary.
12. Using J–39087 or equivalent shaft gear front cover seal protector, on the water pump driveshaft, install the gasket and front cover into position over the shafts and guide pins.
13. Install the engine front cover bolts and tighten to 100 inch lbs. (11 Nm).
14. Install the oil pan and gasket.
15. Install the distributor assembly.
16. Install the hub and the torsional damper.

a. Align the matchmarks made earlier and install the crankshaft hub. If the engine was cranked and the matchmarks were lost, set the engine to No. 1 TDC, then install the crankshaft hub with the cast arrow in the 12 o'clock position.
b. Install the hub washer and bolt, but do not torque at this time.
c. Raise the engine, as necessary for access, then install the crankshaft balancer assembly. Tighten the crankshaft hub bolt to 75 ft. lbs. (102 Nm) and the balancer bolts to 60 ft. lbs. (81 Nm).

➡ **If a new balancer is installed, new balancer weights of the same size must be installed in the same hole locations as the original balancer.**

d. Install the power steering line to the gear, then lower the engine into position.
e. Install the power steering fluid cooler.
f. Install the motor mount nuts and tighten to 40 ft. lbs. (50 Nm).

17. Install the water pump assembly.
18. Install the serpentine drive belt and the throttle body air duct.
19. Properly fill the engine crankcase with oil.
20. Tighten the fuel filler cap and properly fill the engine cooling system.
21. Connect the negative battery cable, operate the engine and check for leaks.
22. Bleed the power steering hydraulic system, as necessary.
23. If equipped, reset the CHANGE OIL indicator, as outlined in Section 1 of this manual.

Front Cover Oil Seal

REPLACEMENT

5.7L (VIN 8) Engine

➧ **See Figure 87**

COVER REMOVED

1. Remove the front cover from the vehicle.
2. Use a suitable tool to pry the oil seal out of the cover from the front, being very careful not to damage the cover.

To install:

3. Support the rear of the cover at the seal area.
4. Install the seal using tool J 35468 or equivalent front cover aligner and oil seal installer, so that the open end of the seal is toward the inside of the cover.
5. Install the front cover in the vehicle.

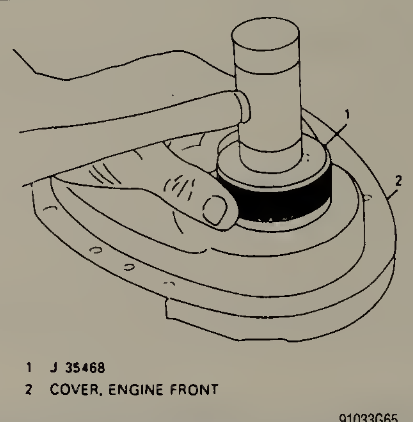


Fig. 87 You must use the suitable tool to drive the seal into the front cover—5.7L (VIN 8) engine

COVER INSTALLED

1. Remove the crankshaft (torsional) damper.
2. Use a suitable tool to pry the oil seal out of the cover from the front, being very careful not to damage the cover.

To install:

3. Install the seal using tool J 35468 or equivalent front cover aligner and oil seal installer, so that the open end of the seal is toward the inside of the cover.

5.7L (VIN J) Engine

➧ **See Figures 88 and 89**

1. Disconnect the battery negative cable.
2. Remove the timing chain front cover assembly.
3. Remove the seal from the front cover using J–29077–A or equivalent seal remover tool.
4. Thoroughly clean the cylinder case, front cover and water pump sealing surfaces.

To install:

5. Apply Loctite® 262 to studs and Loctite® 565 to the bolt threads.
6. Install a new cover gasket and the cover, nuts and bolts.
7. Install the new seal coated with engine oil using tool J–37309 or equivalent.

➡**Do not remove seal installing tool J–37309, until the front cover bolts are tightened.**

8. Tighten the front cover attaching bolts to 19 inch lbs. (26 Nm) and the stud nuts to 21 ft. lbs. (28 Nm).
9. Complete the front cover installation procedure and connect the negative battery cable.

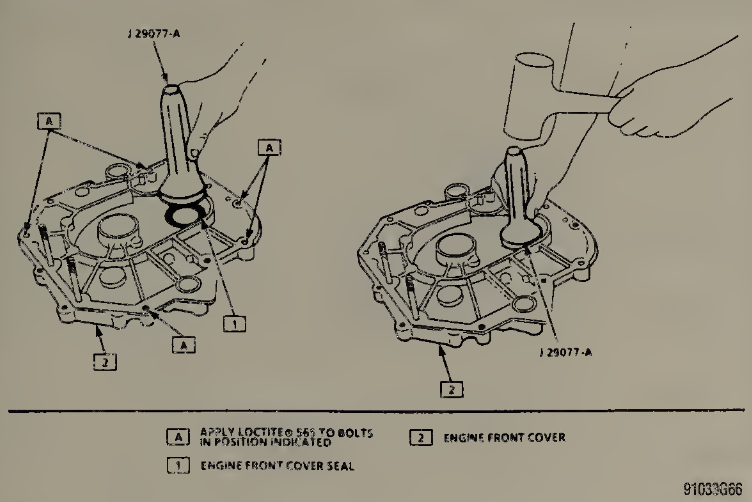


Fig. 88 Removing the timing chain front cover seal, using the proper tools

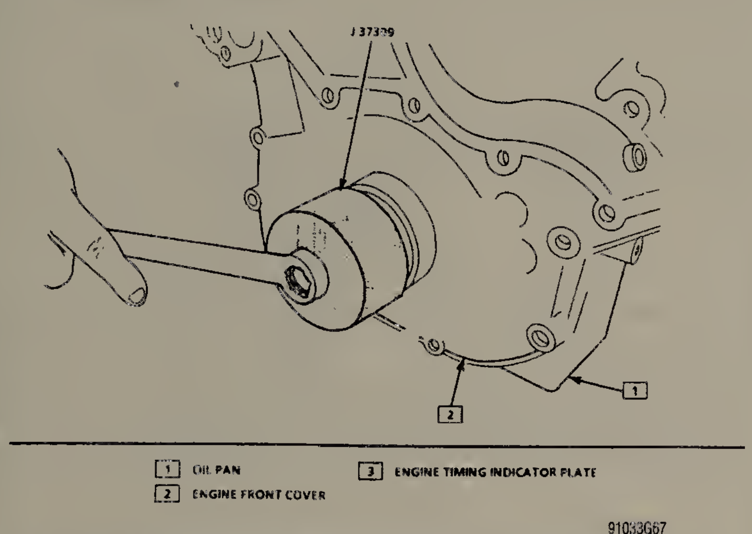


Fig. 89 Installation of the front cover seal—5.7L (VIN J) engine

5.7L (VIN P and 5) Engines

1. Disconnect the battery negative cable.
2. Remove the engine front cover.
3. Using a suitable tool, remove the crankshaft, distributor shaft and/or water pump driven gear shaft seals, as necessary.
4. As applicable; use tool J-35468 or equivalent aligner and installer, to install the crankshaft seal, tool J-39090 or equivalent, to install the distributor shaft seal and/or tool J-39088 or equivalent, to install the water pump shaft seal.
5. Install the engine front cover.
6. Connect the negative battery cable.

Timing Chain and Sprockets

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

➧ See Figures 90 and 91

1. Disconnect the negative battery cable.
2. Remove the engine front cover.
3. Rotate the crankshaft and align the timing marks.
4. Unfasten the camshaft sprocket retaining bolt(s).
5. Remove the timing chain and camshaft sprocket as an assembly.
6. If necessary, remove the crankshaft sprocket using a suitable puller.

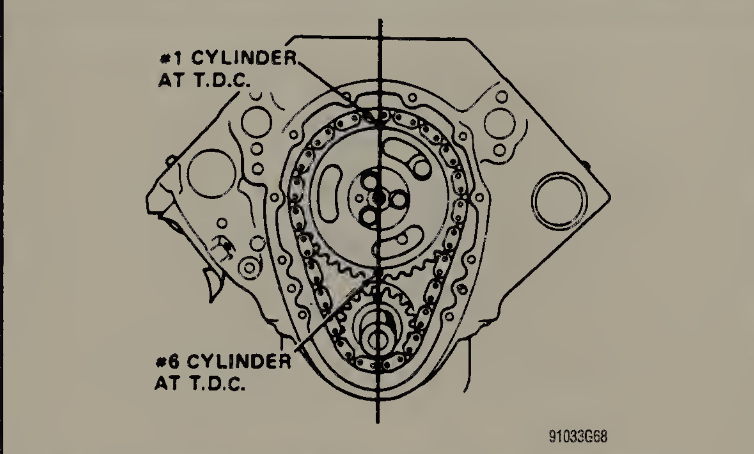


Fig. 90 The timing marks MUST be aligned before proceeding

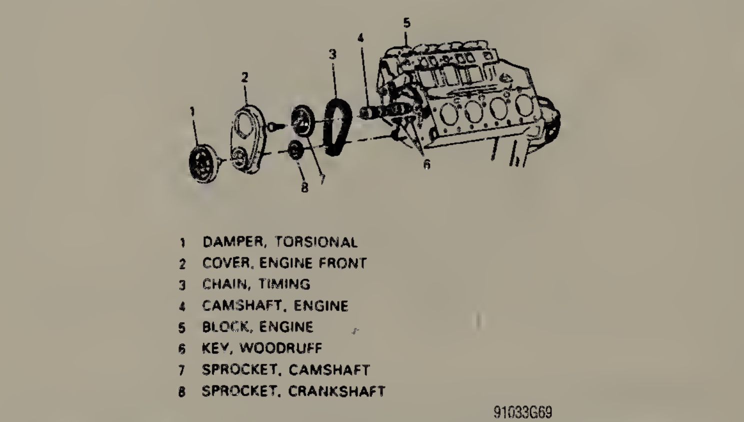


Fig. 91 Exploded view of the timing chain, sprockets and related components

To install:

7. If removed, install the crankshaft sprocket.
8. Align the timing marks on the camshaft and crankshaft sprockets.
9. Install the timing chain and camshaft sprocket.
10. Install the camshaft sprocket retaining bolts and tighten to 20 ft. lbs. (27 Nm).
11. Install the front cover in the vehicle, then connect the negative battery cable.

5.7L (VIN J) Engine

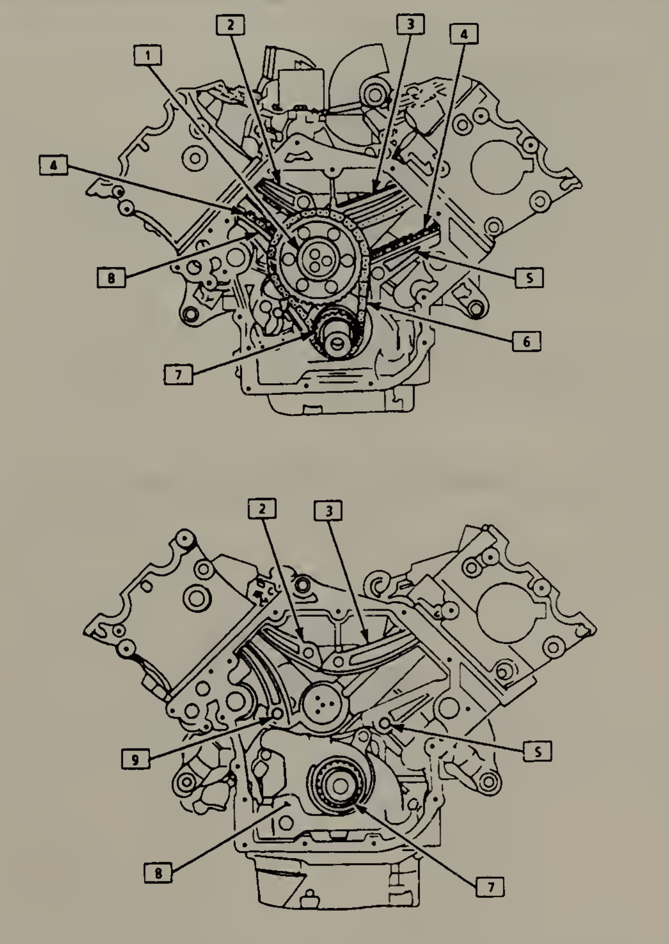
➧ See Figures 92, 93, 94 and 95

PRIMARY TIMING CHAIN AND CRANKSHAFT SPROCKET

1. Disconnect the negative battery cable.
2. Remove the timing chain front cover assembly.
3. Remove the left and right intake camshafts.
4. Remove the bolts attaching the primary chain guide to the oil pump, then remove the guide from the vehicle.
5. Remove the idler sprocket assembly attaching bolts, then disengage the primary timing chain from the idler and crankshaft sprockets. Remove the chain from the vehicle.
6. Using the crankshaft torsional damper puller along with J-38211 or equivalent sprocket tool, remove the crankshaft sprocket. Note which side of the sprocket faces forward for installation purposes.
7. Remove the key and oil pump seal seat from the crankshaft.

To install:

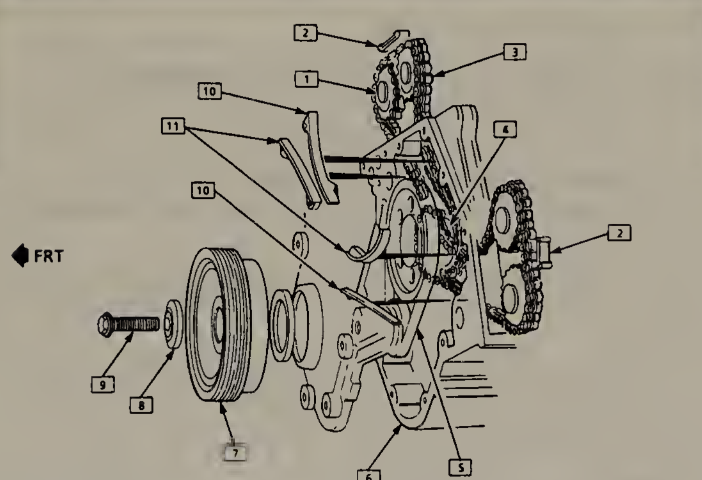
8. Inspect the primary chain guide for excessive wear. Wear groove should not exceed a depth of 0.040 inch (1.0mm). If necessary, replace wear strip.
9. Install oil pump seal seat and key onto the crankshaft.
10. Install the crankshaft sprocket using J-38132 or equivalent sprocket installer. Make sure sprocket is installed with same side to the front as noted during removal, this should be the wide shoulder.
11. Engage the primary chain onto the idler and crankshaft sprocket.



1 CAMSHAFT TIMING CHAIN IDLER SPROCKET ASSEMBLY
2 CAMSHAFT SECONDARY TIMING CHAIN FIXED GUIDE - RH
3 CAMSHAFT SECONDARY TIMING CHAIN PIVOT GUIDE - LH
4 CAMSHAFT SECONDARY TIMING CHAIN
5 CAMSHAFT SECONDARY TIMING CHAIN FIXED GUIDE - LH
6 CAMSHAFT PRIMARY TIMING CHAIN
7 CRANKSHAFT SPROCKET
8 OIL PUMP
9 CAMSHAFT TIMING CHAIN PIVOT GUIDE - RH

91033G70

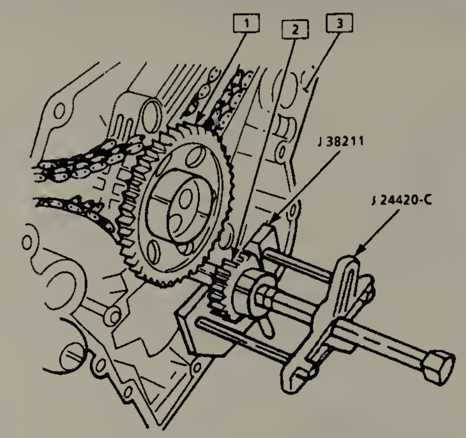
Fig. 92 Primary and secondary timing chain assembly—5.7L (VIN J) engine



1 CAMSHAFT SPROCKET
2 CAMSHAFT SECONDARY TIMING CHAIN TOP GUIDE
3 CAMSHAFT SECONDARY TIMING CHAIN
4 CAMSHAFT TIMING CHAIN IDLER SPROCKET ASSEMBLY
5 CAMSHAFT PRIMARY TIMING CHAIN
6 CYLINDER CASE
7 TORSIONAL DAMPER
8 CRANKSHAFT DAMPER WASHER
9 CRANKSHAFT DAMPER BOLT
10 CAMSHAFT SECONDARY TIMING CHAIN FIXED GUIDE
11 CAMSHAFT SECONDARY TIMING CHAIN PIVOT GUIDE

91033G71

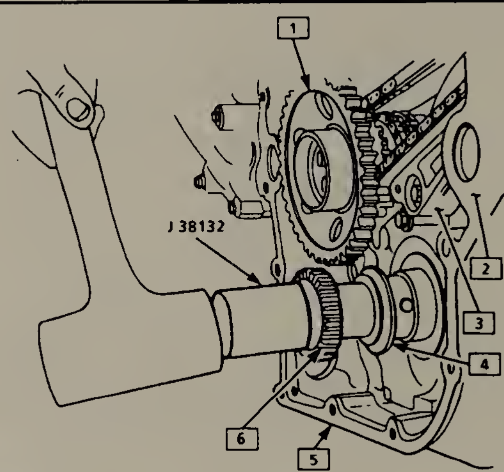
Fig. 93 Timing chain assembly—5.7L (VIN J) engine



1 CAMSHAFT TIMING CHAIN IDLER SPROCKET
2 CRANKSHAFT SPROCKET
3 CYLINDER CASE

91033G72

Fig. 94 Crankshaft sprocket removal—5.7L (VIN J) engine



1 CAMSHAFT TIMING CHAIN IDLER SPROCKET
2 CYLINDER CASE
3 CAMSHAFT SECONDARY TIMING CHAIN FIXED GUIDE - LH
4 OIL PUMP SEAL SEAT
5 CRANKCASE
6 CRANKSHAFT SPROCKET

91033G73

Fig. 95 Installing the crankshaft sprocket—5.7L (VIN J) engine

12. Apply Loctite® 262 or equivalent, to the idler sprocket assembly bolts and tighten to 19 ft. lbs. (26 Nm).
13. Apply Loctite® 262 or equivalent, to the primary chain guide bolts. Install the guide and bolts. Push the guide so the slack is removed from the chain and tighten the bolts to 89 inch lbs. (10 Nm).

➡When installing guide, do not use any leverage tools, finger pressure is sufficient.

14. Install the left and right intake camshafts.
15. Install the timing chain front cover.
16. Connect the negative battery cable.

SECONDARY TIMING CHAINS AND IDLER SPROCKET ASSEMBLY

1. Disconnect the negative battery cable.
2. Remove the camshafts.
3. Remove the primary timing chain and crankshaft sprocket.
4. Disengage the left and right secondary chains from the idler sprocket.
5. Remove the idler sprocket assembly.
6. Remove the left and right secondary chains from the vehicle.

To install:

7. Inspect chains and sprockets for abnormal wear or damage. If abnormal wear or damage is present on either the secondary timing chain, cam sprockets or idler sprockets, the entire assembly must be replaced.

8. Inspect the idler sprocket shaft bearings for wear or damage. If necessary, replace idler sprocket shaft bearings as follows:
 a. Remove the idler sprocket screw, washer and shaft.
 b. Using tool J-37328 or equivalent, remove bearings from idler sprocket.
 c. When installing bearings, ensure the manufacture's name and part Nos. are visible from either end of the sprocket assembly.
 d. Using a press, carefully push in the bearings until they are flush with idler sprocket. Apply minimum pressure to obtain a fit 0.0–1.3mm below the surface.
9. Install the shorter (inner) secondary chain through the right head and install J-38099 or equivalent timing chain retaining tool.
10. Locate the right chain onto the rear idler sprocket.
11. Install the longer (outer) secondary chain through the left head and install J-38099 or equivalent timing chain retaining tool.
12. Locate the left chain onto the middle idler sprocket.
13. Install the primary timing chain.
14. Install the camshafts.
15. Connect the negative battery cable.

5.7L (VIN P and 5) Engines

See Figures 96 and 97

1. Disconnect the negative battery cable.
2. Remove the timing chain front cover.
3. Rotate the crankshaft until the timing marks on the timing chain sprockets are aligned nearest each other. The camshaft sprocket mark should be at the 6 o'clock position while the mark on the crankshaft sprocket should be at the 12 o'clock position.
4. Remove the camshaft sprocket bolts.
5. Remove the camshaft sprocket and timing chain.

To prevent piston or valve damage, do not turn the crankshaft after the timing chain has been removed.

6. Remove the water pump bearing retainer bolts, then remove the driveshaft assembly using J-39243 or equivalent driven gear assembly remover.
7. Remove the crankshaft sprocket using J-5825-A or equivalent crankshaft sprocket remover.
8. If necessary, remove the crankshaft key.

To install:

9. If removed, install the crankshaft key.
10. Install the crankshaft sprocket using a suitable installation tool.
11. Install the water pump driveshaft assembly using a suitable tool. Install the retainer bolts and tighten to 108 inch lbs. (12 Nm).
12. Align the timing marks and install the camshaft sprocket and timing chain. The gears of the camshaft sprocket and water pump driveshaft must mesh or damage to the thrust plate retainer could occur.
13. Install the camshaft sprocket bolts and tighten to 21 ft. lbs. (28 Nm).
14. Install a new O-ring to the water pump driven gear shaft using a suitable seal installation tool.
15. Install the timing chain front cover and connect the negative battery cable.

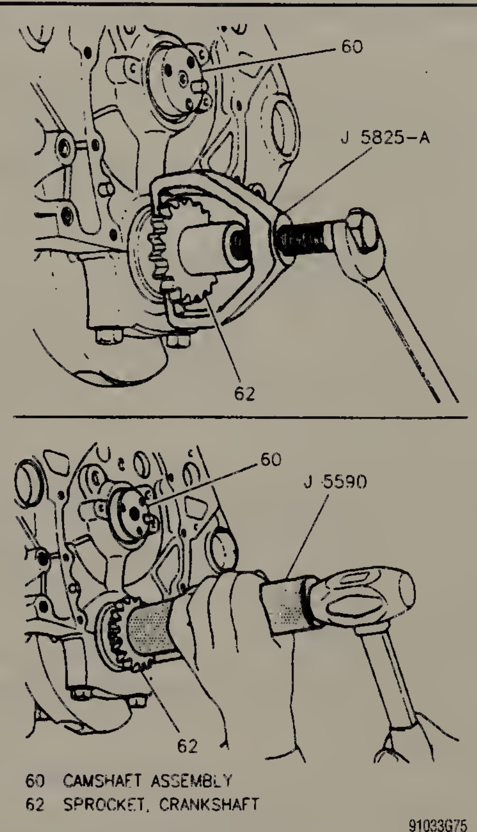


Fig. 97 Removal and installation of the crankshaft sprocket—5.7L (VIN P and 5) engines

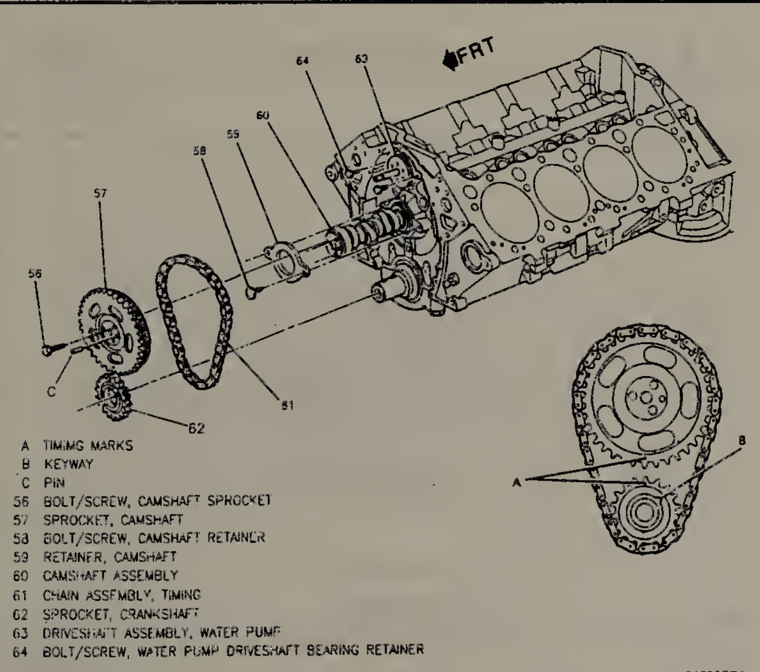


Fig. 96 Exploded view of the timing chain, sprockets and related components—5.7L (VIN P and 5) engines

Camshaft, Bearings and Lifters

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

See Figure 98

1. Take the vehicle to a reputable repair shop and have the A/C system properly discharged and recovered, using the proper tools.
2. Disconnect the negative battery cable. Drain the engine cooling system into a suitable container.
3. Remove the air cleaner assembly.

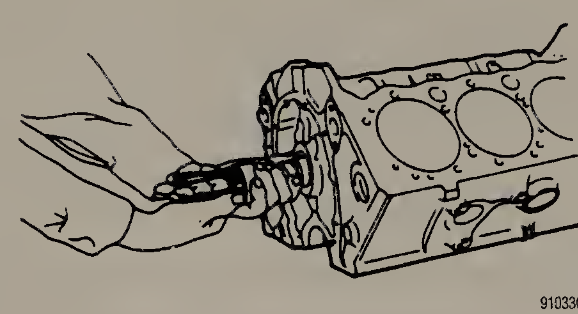


Fig. 98 Carefully pull the camshaft out, using the bolts threaded into the camshaft

4. Remove the radiator, as outlined in this section.
5. Remove the A/C condenser, as follows:
 a. Unbolt the accumulator attaching screw(s), then reposition the accumulator away from the condenser,
 b. Remove the accumulator bracket.
 c. Disconnect the accumulator hose and compressor hose from the condenser, then cap or plug the hoses and openings immediately to prevent contaminating the A/C system.
 d. Remove the condenser from the vehicle.
6. Remove the intake manifold from the vehicle.
7. Remove the rocker arm covers, then remove the rocker arms.
8. Remove the valve lifters, and place them in a rack, so they may installed in the proper position. The lifters must be installed in the same bores as they were removed from.
9. Remove the timing chain.
10. Remove the camshaft assembly, as follows:
 a. Install three 5/16-18 x 4-inch bolts in the camshaft bolt holes.
 b. Carefully rotate and pull the camshaft assembly out of the bearings.
11. Inspect the bearings for scratches, pits or loose fit. If necessary, remove the camshaft bearings as follows:
 a. Drive the camshaft rear plug from the cylinder block.
 b. Using tool J 6098-01, or equivalent camshaft bearing removal and installation tool, with the nut and thrust washer installed to the end of the threads, index the pilot in the camshaft front bearing and install the puller screw through the pilot.
 c. Install the tool with the shoulder toward the bewaring, making sure enough there are enough threads engaged.
 d. Using 2 wrenches, hold the puller screw while turning the nut. When the bearing has been pulled from the bore, remove the tool and bearing from the puller screw.
 e. Remove the remaining bearings (except front and rear) using the same procedure. It will be necessary to index the pilot in the camshaft rear bearing to remove the rear intermediate bearing.
 f. Assemble the tool on the driver handle and remove the camshaft front and rear bearings by driving towards the center of the cylinder block.

To install:

12. Install new camshaft bearings, as follows:

➡The front and rear bearings should be installed first. They will act as guide for the pilot, and center the remaining bearings being pulled into place.

 a. Assemble the removal and installation tool on the driver handle, then install the camshaft front and rear bearings by driving toward the center of the cylinder block.
 b. Using the camshaft bearing removal and installation tool set, with the nut and thrust washer installed to each end of the threads, index the pilot in the camshaft front bearing and install the puller screw through the pilot.
 c. Index the camshaft bearing in the bore (with the oil hole aligned as outlined later), then install the removal and installation tool on the puller screw with the should toward the bearing.

- The No. 1 cam bearing oil hole must be positioned so that the oil holes are at the 1 and 5 o'clock positions.
- The No. 2–4 bearing oil holes must be positioned at the 5 o'clock position (toward the left side of the engine and at a position even with the bottom of the cylinder bore).
- The No. 5 bearing oil hole must be in the 12 o'clock position.

 d. Using 2 wrenches, hold the puller screw while turning the nut. After the bearing has been pulled into the bore, remove the tool from the screw and check alignment of the oil hole in the camshaft bearing.
 e. Install the remaining bearings in the same manner. It will be necessary to index the pilot in the camshaft rear bearing to install the rear intermediate bearing.
 f. Coat a new camshaft rear plug outside diameter with sealant, then install flush to 0.031 in. (0.8mm) depth.

➡When a new camshaft is installed, install a new oil filter and new oil.

13. When installing a new camshaft assembly, coat the camshaft lobes with "Molykote" or equivalent. When installing a new camshaft, replace all valve lifters to ensure durability of the camshaft lobes and lifter rollers.
14. Lubricate all camshaft journals with engine oil, then carefully install the camshaft assembly.
15. Install the timing chain.
16. Coat the lifters with a suitable prelube, then install them in the same positions as they were removed from.
17. Install the rocker arms and covers.
18. Install the intake manifold.
19. Install the condenser as follows:
 a. Position the condenser in the vehicle.
 b. Unplug or uncap the accumulator and condenser hoses, then connect the hoses to the condenser.
 c. Install the accumulator bracket, then place the accumulator in position and install the attaching screw(s).
20. Install the radiator and the air cleaner assembly.
21. Fill the cooling system with the proper type and amount of coolant.
22. Connect the negative battery cable.
23. Take the vehicle to a reputable repair shop to have the A/C system properly evacuated and charged.

5.7L (VIN J) Engine

➧ See Figures 99 and 100

The VIN J engine utilizes 4 overhead camshafts. Certain shafts will have identifying bands between the first journal and lobe to distinguish between the right and left, intake and exhaust camshafts. The right intake has 1 flat band. The right exhaust has 1 raised band. The left intake has 1 flat and 1 raised band. The left exhaust has 2 raised bands.

1. If removing the left bank camshafts, take the vehicle to a reputable repair shop and have the A/C system properly discharged and recovered, using the proper tools.

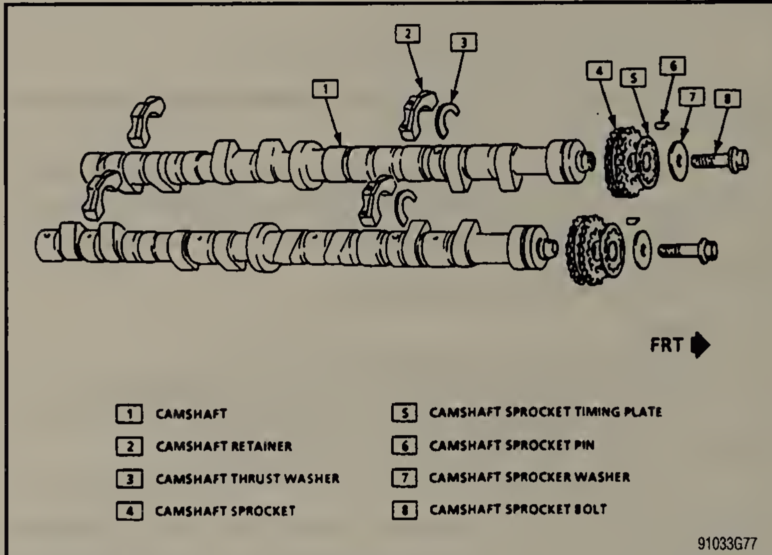


Fig. 99 View of 2 of the 4 camshafts used on the 5.7L (VIN J) engine

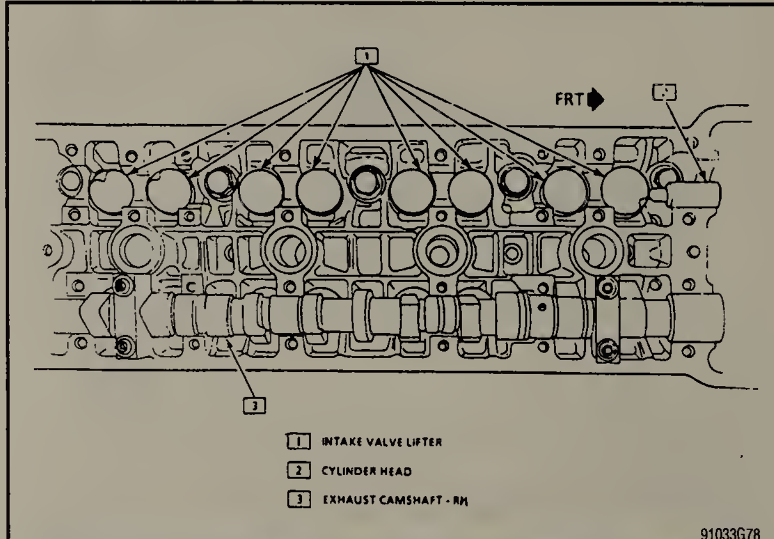


Fig. 100 Valve lifters MUST be install in the same bore as they were removed from

2. Disconnect battery negative cable and drain the engine coolant into a suitable container.

3. To gain access to the right camshafts, remove the oil filter housing and right camshaft cover as follows:

a. Remove the air intake duct.

b. Remove the hoses and clamps from the coolant outlets, radiator inlet and inlet pipe.

c. Remove the hoses and inlet pipe assembly from the vehicle.

d. Remove the water pump pulley.

e. Release the belt tensioner and remove the serpentine belt.

f. Remove the retaining bolt and the belt tensioner from the engine.

g. Remove the oil filter.

h. Disengage the electrical connectors from the oil pressure sensor, oil temperature sensor and the low oil pressure switch.

i. Remove the oil pressure sensor from the oil filter housing.

j. Remove the alternator bracket from the oil filter housing.

k. Disconnect and plug the oil cooler lines from the filter housing.

l. Remove the oil filter housing mounting bolts and remove the assembly.

➡If equipped with a 1 piece front cover/oil filter housing gasket, cut the old gasket along the front cover.

m. Remove spark plug wires from plugs in the right cylinder head.

n. Disengage the electrical connector from the blower motor resistor block.

o. Remove the screws attaching the evaporator housing quarter panel, then remove the panel.

p. Remove the bolts attaching the coolant outlet pipe bracket to the alternator bracket and the coolant outlet to the injector housing, then position aside.

q. For 1993–95 vehicles, remove the upper EGR pipe bolts and pipe.

r. Remove the bolt attaching the fresh air pipe bracket to the injector housing.

s. Remove the camshaft cover attaching bolts and the camshaft cover.

4. To gain access to the left camshafts, remove the air conditioning compressor and left valve cover as follows:

a. Remove the throttle body assembly and the serpentine drive belt.

b. Remove the engine oil temperature sensor.

c. Remove the alternator assembly.

d. Remove the refrigerant hose from the A/C compressor, then immediately cap or plug the openings to prevent system contamination and damage.

e. Remove the compressor mounting bolts and electrical connection.

f. Remove the compressor from the vehicle.

g. Remove the power steering pump from the engine.

h. Remove the spark plug wires from the plugs in the left cylinder head.

i. Remove the ventilation breather pipe from the camshaft cover.

j. Remove the throttle and cruise control cable or control cable hold-down clamps from the plenum.

k. If not done already, remove the throttle body extension and coolant outlet pipe.

l. Remove the vacuum hose from the power brake booster and, if necessary, remove the booster assembly.

m. Remove the left camshaft cover attaching bolts and remove the cover.

5. Raise and support the vehicle safely.

6. Disengage the electrical connector from the crankshaft ignition timing sensor.

7. Remove the ignition timing sensor from the cylinder case.

8. Install the crankshaft timing slot locator tool J–38098 or equivalent, into the ignition timing sensor opening. Make sure the tool head is fully seated with the indicating pin inserted into the deep notch of the crankshaft timing disc.

9. Lower vehicle.

10. Remove the bolts attaching the secondary timing chain tensioner housing to the cylinder head, then remove the housing, O-ring and tensioner from the cylinder case.

11. Remove the bolts and washers attaching the camshaft to the sprockets.

➡Install a wrench on the rear camshaft hex when removing the sprocket bolts, to prevent the camshafts from exerting force on the crankshaft timing slot locator tool.

12. Remove the camshaft timing plates and pins.

13. Remove the camshaft retainers and thrust washers.

14. Remove the camshafts and sprockets from the vehicle. Install timing chain retainers J–38099 or equivalent, to retain secondary chain loops.

15. Remove lifters from bores and inspect. Make sure any lifters, to be reused, are retained in proper order so each one can be returned to its original bore.

To install:

16. Inspect the camshaft bearing journals for wear or damage.

17. Inspect the camshaft bearing surfaces in the cylinder head and camshaft cover for wear or damage.

➡The camshaft cover and cylinder head must be replaced as a set if excessive wear or damage to the bearing surfaces is found.

18. Install the each camshaft and lifter assembly, 1 at a time:

a. Lubricate lifters and bores with clean engine oil, then install lifters into bores. If a camshaft is replaced, new lifters must also be used.

b. Install the camshaft sprocket onto the secondary timing chain, while removing the timing chain retainer.

c. Slide the camshaft into the sprocket, noting the position of the alignment hole for timing pin tool installation. Position the camshaft in the neutral position, no valves opened.

d. Lubricate camshaft journals, lobes, thrust washers and retainers with clean engine oil.

e. Install the camshaft thrust washers, retainers and bolts. Torque bolts to 89 inch lbs. (10 Nm).

f. Repeat Steps a–e for the remaining camshafts.

19. Install timing pins J–37326 into camshaft retainers and the indexing holes in the camshafts. Camshafts can be rotated using the cast hex at the camshaft rear.

20. Install the camshaft secondary chain pre-tensioner, J–37305 or equivalent. Hand-tighten to remove slack from the timing chain, but do not over-tighten.

21. Install timing plates, pins and washers. If no holes line up on the timing plate, reverse the plate.

22. Apply Loctite® 262 or equivalent, on the NEW camshaft sprocket bolts, then install and finger-tighten the bolts. New camshaft bolts should be used each time the camshaft is removed. Tighten the bolts to 18 ft. lbs. (25 Nm) and turn 80–85 degrees using a torque angle meter. A backup wrench should be used on the rear camshaft hex to prevent damaging the timing pins.

23. Remove timing pins J–37326.

24. Remove the secondary timing chain pre-tensioner tool and install the new secondary timing chain tensioner, housing, new O-ring and bolts. Lubricate tensioner with engine oil. Make sure the oil hole in the tensioner piston be installed in a vertical position and that the fork on the end of the tensioner is properly engaged onto the chain guide. After installing, use a blunt punch to release the plunger. Torque chain tensioner bolts to 89 inch lbs. (10 Nm).

25. Raise and support the vehicle safely.

26. Remove crankshaft timing slot locator J–38098 from the cylinder case.

27. Install the crankshaft position sensor into the cylinder case and tighten the retainer(s) to 71 inch lbs. (8 Nm).

28. Engage the timing sensor electrical connector and lower the vehicle.

29. Apply Permabond® A136 or equivalent, to the camshaft covers and Loctite® 565 or equivalent, to the end plugs. Install the end plugs and new spark plug bore O-rings prior to cover installation.

30. Install the camshaft covers in the reverse order of removal. The camshaft cover retainers must be tightened in the proper sequence in order to assure proper camshaft operation. Tighten the M8 bolts to 15 ft. lbs. (20 Nm), repeat 3 times. Tighten the M6 screws to 89 inch lbs. (10 Nm). Also, be sure to install a new coolant outlet cover gasket and tighten the cover screws to 89 inch lbs. (10 Nm).

31. For the right bank camshafts, install oil filter housing assembly.

32. For the left bank camshafts, install the air conditioning compressor assembly.

33. Reconnect the negative battery cable and properly fill the engine cooling system.

34. If the left bank camshafts were removed, take the vehicle to a reputable repair shop to have the A/C system properly evacuated and charged.

5.7L (VIN P and 5) Engines

See Figure 101

1. Disconnect the negative battery cable and remove the air cleaner assembly.
2. Remove the timing chain front cover.
3. Remove the intake manifold.
4. Remove the retaining bolt and lift the oil pump driveshaft assembly from the rear of the lifter valley.
5. Remove the rocker arm and pushrod assemblies.
6. Remove the camshaft sprocket from the engine.
7. Remove the valve lifters.
8. Remove the high fill reservoir hose from the radiator.
9. Remove the relay bracket from the left side of the radiator support.
10. Remove the AIR pump intake duct and bolts, then reposition the AIR pump.
11. Remove the retaining nuts and screws, then remove the upper radiator support.
12. Remove the radiator.
13. Raise and support the vehicle safely.
14. Unplug the cooling fan electrical connector.
15. Remove the lower fan shroud bolts and lower the vehicle.
16. Remove the fan shroud and fan assembly.
17. Disconnect the A/C condenser line bracket at the front crossmember.
18. Raise the front of the engine with a suitable lifting device.

When raising and supporting the engine, NEVER place a jack under the oil pan, crankshaft pulley or any sheetmetal. There is a minimal clearance between the oil pan and the pump screen. Jacking against the pan could cause sufficient deformation to damage the oil pickup unit.

19. Remove the camshaft retainer bolts and retainer.
20. Install three 5⁄16–18 x 4 inch bolts into the camshaft bolt holes.
21. Using the bolts, carefully rotate the camshaft and pull from the bearings. All camshaft journals are the same diameter so care must be used to avoid damaging the bearings. Remove the camshaft from the vehicle.

To install:

22. Inspect the camshaft and bearings, replace as necessary.
23. If installing a new camshaft, coat the lobes with Molykote® or equivalent pre-lube and be sure to replace all lifters to assure camshaft durability.
24. Lubricate all camshaft journals with clean engine oil and carefully insert the camshaft into the engine block.
25. Install the camshaft retainer and tighten the bolts to 108 inch lbs. (12 Nm).
26. Lower the front of the engine and connect the A/C condenser line bracket to the front crossmember.
27. Install the fan and shroud assembly.
28. Raise and support the vehicle safely, then install the lower fan shroud bolts.
29. Engage the cooling fan electrical connections and lower the vehicle.
30. Install the radiator, followed by the upper radiator support, nuts and screws.

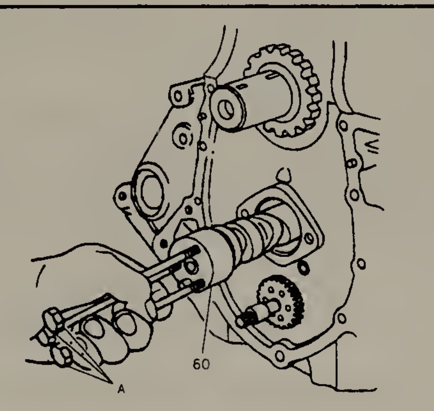


Fig. 101 Thread screws into the end of the camshaft and carefully pull it straight out of the block—5.7L (VIN P and 5) engines

31. Install the AIR pump, bolts and intake duct.
32. Install the relay bracket to the left side of the radiator support.
33. Connect the high fill reservoir hose to the radiator.
34. Install the valve lifters.
35. Install the camshaft sprocket.
36. Install the valve rocker arm and pushrod assemblies.
37. Install the oil pump driveshaft assembly and bolt. Tighten the bolt to 13 ft. lbs. (18 Nm).
38. Install the intake manifold.
39. Install the timing chain front cover.
40. Install the air cleaner assembly and connect the negative battery cable.

INSPECTION

Camshaft Lobe Lift

Check the lift of each lobe in consecutive order and make a note of the reading.

1. Remove the fresh air inlet tube and the air cleaner. Remove the heater hose and crankcase ventilation hoses. Remove valve rocker arm cover(s).
2. Remove the rocker arm stud nut or fulcrum bolts, fulcrum seat and rocker arm.
3. Make sure the pushrod is in the valve tappet socket. Install a dial indicator so that the actuating point of the indicator is in the pushrod socket (or the indicator ball socket adapter tool is on the end of the pushrod) and in the same plane as the pushrod movement.
4. Disable the ignition and fuel systems.
5. Install a remote starter switch. Crank the engine with the ignition and fuel system disabled. Turn the crankshaft over until the tappet is on the base circle of the camshaft lobe. At this position, the pushrod will be in its lowest position.
6. Zero the dial indicator. Continue to rotate the crankshaft slowly until the pushrod is in the fully raised position.
7. Compare the total lift recorded on the dial indicator with the specification shown on the specification charts in this section.

To check the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero. If the lift on any lobe is below specified wear limits listed, the camshaft and the valve tappet operating on the worn lobe(s) must be replaced.

8. Install the rocker arm, fulcrum seat and stud nut or fulcrum bolts. Adjust the valves, if required (refer to the valves procedure in this section).
9. Install the valve rocker arm cover(s) and the air cleaner.

Camshaft End Play

On all gasoline V8 engines, prying against the aluminum-nylon camshaft sprocket, with the valve train load on the camshaft, can break or damage the sprocket. Therefore, the rocker arm adjusting nuts must be backed off, or the rocker arm and shaft assembly must be loosened sufficiently to free the camshaft. After checking the camshaft end play, check the valve clearance. Adjust if required (refer to procedure in this section).

1. Push the camshaft toward the rear of the engine. Install a dial indicator or equivalent so that the indicator point is on the camshaft sprocket attaching screw.
2. Zero the dial indicator. Position a prybar between the camshaft gear and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with the specifications.
3. If the end play is excessive, check the spacer for correct installation before it is removed. If the spacer is correctly installed, replace the thrust plate.
4. Remove the dial indicator.

Rear Main Seal

REMOVAL & INSTALLATION

5.7L (VIN 8, P and 5) Engine

The rear main seal on 1984–85 vehicles is a 2-piece seal. On 1986–91 vehicles, the rear main seal is a 1-piece seal.

1984–85 VEHICLES

See Figures 102, 103, 104 and 105

➡Always replace the upper and lower seal as a unit. On these vehicles, both halves of the seal can be replaced without removing the crankshaft. Be very careful when installing the seal to protect the sealing bead located in the channel on the outer diameter of the seal. There is an installation tool which can be used to protect the seal during positioning.

1. Remove the oil pan and oil pump.
2. Remove the oil seal from the bearing cap by carefully prying it from the bottom with a small prytool.
3. To remove the upper half of the seal, use a small hammer to tap a brass punch on one end of the seal until it protrudes far enough to be removed with pliers.
4. Use a non abrasive cleaner to removal all of the sealant and foreign material from the cylinder case bearing cap and crankshaft.
5. Inspect the components for nicks, scratches, burrs and/or machining defects at all sealing surfaces, case assembly and crankshaft.
6. Coat the seal lips and seal bead with light engine oil, but keep the oil off the seal mating ends.
7. Position the tip of the installation tool between the crankshaft and seal seat in the cylinder case.
8. Place the seal between the crankshaft and tip of the tool so the seal bead contacts the tip of the tool. Make sure the oil seal lip is positioned toward the front of the engine.
9. Roll the seal around the crankshaft, using the tool as a "shoe horn" to protect the seal bead from the sharp corner of the seal seat surface in the cylinder case. The tool must remain in position until the seal is properly positioned with both ends flush with the block.
10. Remove the tool, being careful not to withdraw the seal.
11. Install the seal half in the bearing cap, again using the tool as a "shoe horn", feeding the seal into the cap using light pressure with your thumb and finger.
12. Install the bearing cap to the case with sealant applied to the cap-to-case interface, being careful to keep the sealant off the seal split line.
13. Install the rear main bearing cap (with new seal) and tighten to 10–12 ft. lbs. (14–16 Nm). Tap the end of the crankshaft rearward then forward with a lead hammer. This will line up the thrust surfaces.

1986–96 VEHICLES

See Figures 106, 107 and 108

1. Disconnect the negative battery cable.
2. Remove the transmission assembly.
3. For manual transmission vehicles, remove the clutch cover and disc assembly.
4. Remove the flywheel bolts and remove the flywheel from the vehicle.
5. Using the notches provided in the seal retainer and a small suitable tool, pry the old seal from the engine. Be careful not to nick the crankshaft sealing surface when removing the seal.

To install:

6. Lubricate the inside and outside of a new seal with clean engine oil.
7. Install the seal on tool J–35621 or equivalent rear main seal installer.
8. Thread the screws of the tool into the rear of the crankshaft and tighten the screws snugly to assure proper seal alignment and installation.
9. Tighten the tool wingnut until it bottoms and then remove the tool.
10. Install the flywheel and tighten the bolts to 74 ft. lbs. (100 Nm).
11. If equipped, install the clutch cover and disc assembly.
12. Install the transmission assembly.
13. Lower the vehicle and connect the negative battery cable.

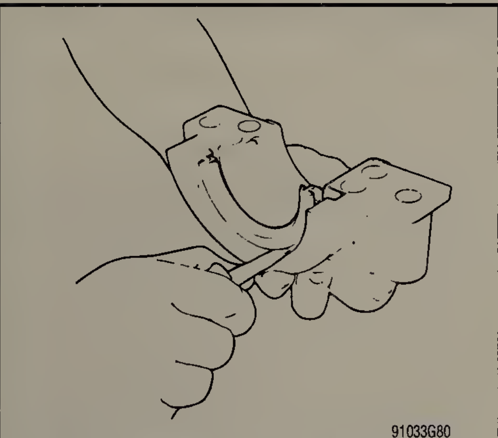


Fig. 102 Carefully pry the lower half of the seal out of the bearing cap

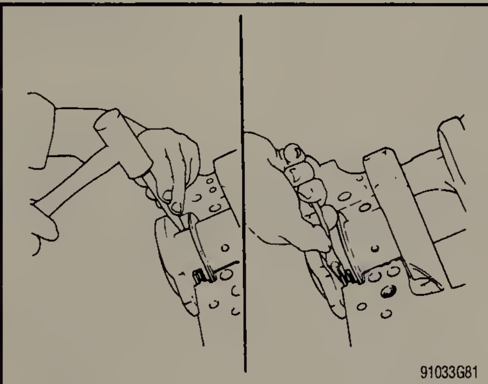


Fig. 103 Tap the upper half of the seal with a hammer and drift, then remove the seal with pliers

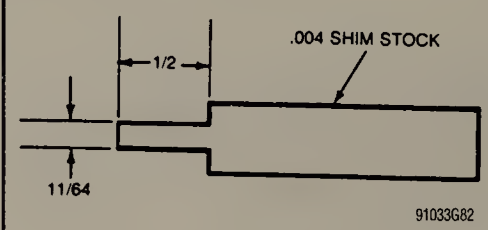


Fig. 104 Oil seal installation tool

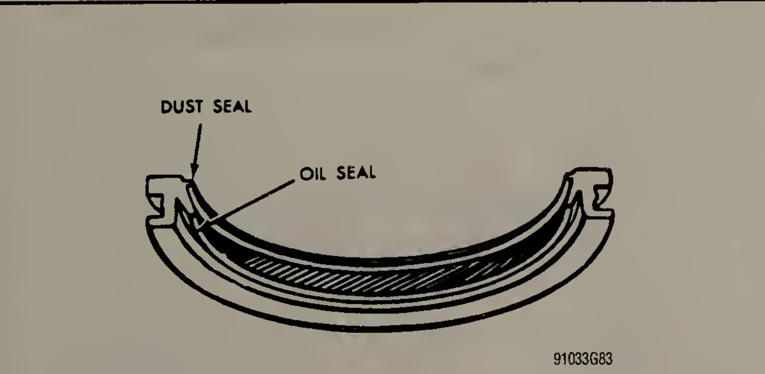


Fig. 105 During installation, make sure the oil seal lip is toward the front of the engine

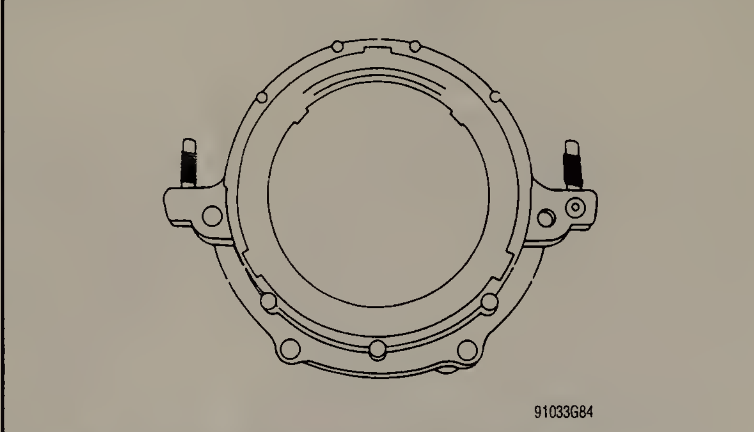


Fig. 106 Rear main seal removal—1986–91 vehicles, except 5.7L (VIN J) engine

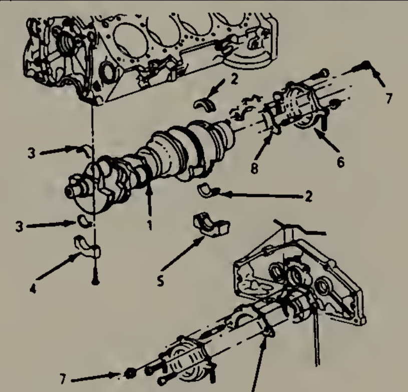


Fig. 107 Exploded view of the rear main seal and related components

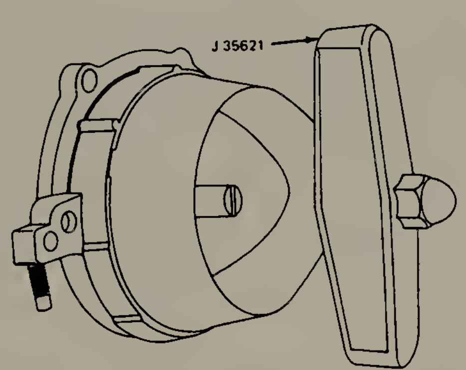


Fig. 108 Use the proper tool to install the rear main seal

5.7L (VIN J) Engine

See Figure 109

1. Disconnect the negative battery cable.
2. Remove transmission assembly.
3. Remove the clutch cover and disc assembly.

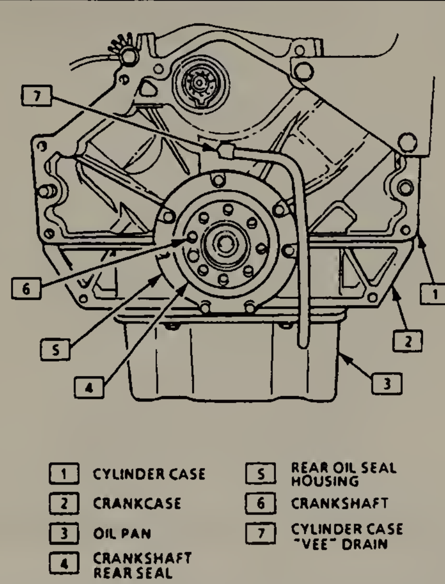


Fig. 109 Location of the crankshaft rear main seal—5.7L (VIN J) engine

4. Remove the flywheel bolts and flywheel.
5. Remove the screws attaching the crankshaft rear main oil seal/housing assembly to the cylinder case.
6. Remove the retaining screws, then remove the seal/housing assembly from the engine.
7. Remove the seal from the housing.

To install:

8. Lubricate the seal lip with engine oil.
9. Install seal into housing using crankshaft rear seal tool J–37312 or equivalent. Make sure the seal is installed 1.0–1.5mm below the housing surface.
10. Install the housing and tighten the bolts to 89 inch lbs. (10 Nm).
11. Apply Loctite® 242 or equivalent, to the bolts threads, then install the flywheel and tighten the bolts to 74 ft. lbs. (100 Nm).
12. Install the clutch cover and disc assembly.
13. Install the transmission assembly.
14. Connect the negative battery cable.

Flywheel/Flexplate

REMOVAL & INSTALLATION

See Figures 110 and 111

1. For 5.7L (VIN 8) engines, remove the clutch cover assembly and clutch disc.
2. Remove the transmission.
3. Unfasten the bolts attaching the flywheel to the crankshaft flange. If may be necessary to use tool J 37096 or equivalent to hold the flywheel in place when removing the bolts. Remove the flywheel.
4. Inspect the flywheel for cracks, and inspect the ring gear for burrs or worn teeth. Replace the flywheel if any damage is apparent. Remove burrs with a mill file.

To install:

5. Install the flywheel. The flywheel will only attach to the crankshaft in one position, as the bolt holes are unevenly spaced.
6. Install the bolts and tighten the bolts in a crisscross pattern to 74 ft. lbs. (100 Nm).
7. Install the transmission.
8. If removed, install the clutch disc and clutch cover assembly.

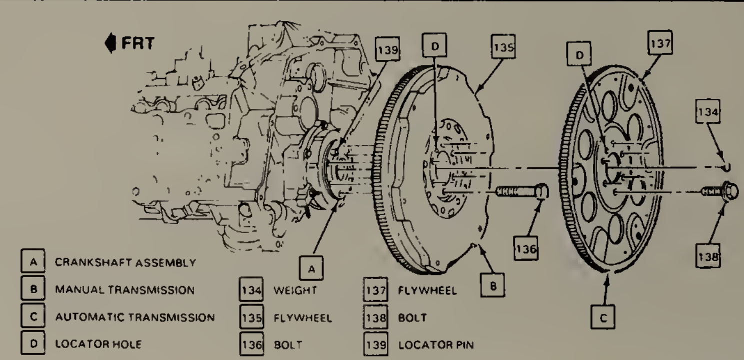


Fig. 110 Manual and automatic transmission flywheel applications—1992 vehicle shown

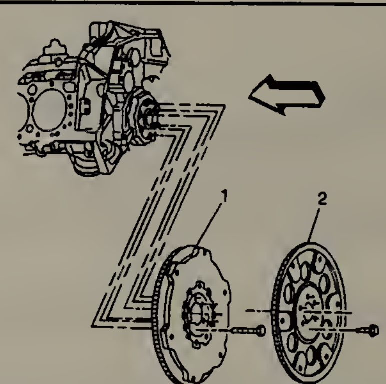


Fig. 111 Exploded view of the flywheel mounting—1996 vehicle shown

EXHAUST SYSTEM

Inspection

See Figures 112 thru 118

Safety glasses should be worn at all times when working on or near the exhaust system. Older exhaust systems will almost always be covered with loose rust particles which will shower you when disturbed. These particles are more than a nuisance and could injure your eye.

CAUTION

DO NOT perform exhaust repairs or inspection with the engine or exhaust hot. Allow the system to cool completely before attempting any work. Exhaust systems are noted for sharp edges, flaking metal and rusted bolts. Gloves and eye protection are required. A healthy supply of penetrating oil and rags is highly recommended.

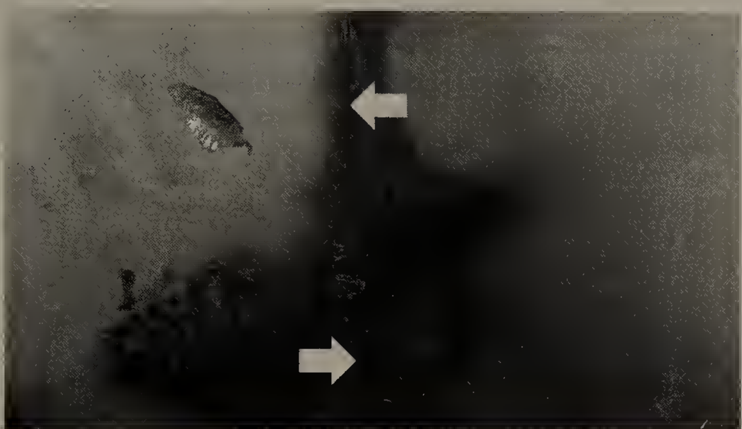

TCCA3P73

Fig. 112 Cracks in the muffler are a guaranteed leak

Your vehicle must be raised and supported safely to inspect the exhaust system properly. By placing 4 safety stands under the vehicle for support should provide enough room for you to slide under the vehicle and inspect the system completely. Start the inspection at the exhaust manifold or turbocharger pipe where the header pipe is attached and work your way to the back of the vehicle. On dual exhaust systems, remember to inspect both sides of the vehicle. Check the complete exhaust system for open seams, holes loose connections, or other deterioration which could permit exhaust fumes to seep into the passenger compartment. Inspect all mounting brackets and hangers for deterioration, some models may have rubber O-rings that can be overstretched and non-supportive. These components will need to be replaced if found. It has always been a practice to use a pointed tool to poke up into the exhaust system where the deterioration spots are to see whether or not they crumble. Some models may have heat shield covering certain parts of the exhaust system , it will be necessary to remove these shields to have the exhaust visible for inspection also.

REPLACEMENT

See Figures 119 and 120

There are basically two types of exhaust systems. One is the flange type where the component ends are attached with bolts and a gasket in-between. The other exhaust system is the slip joint type. These components slip into one another using clamps to retain them together.

CAUTION

Allow the exhaust system to cool sufficiently before spraying a solvent exhaust fasteners. Some solvents are highly flammable and could ignite when sprayed on hot exhaust components.

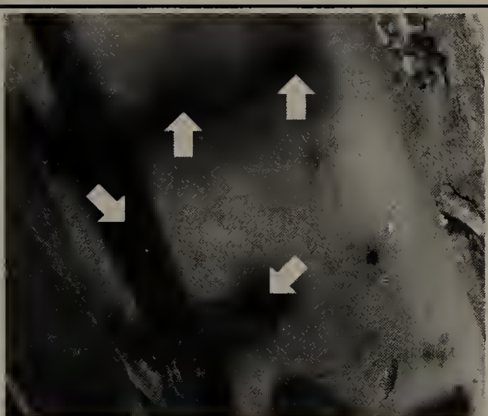

TCCA3P74

Fig. 113 Check the muffler for rotted spot welds and seams


TCCA3P77

Fig. 114 Make sure the exhaust components are not contacting the body or suspension

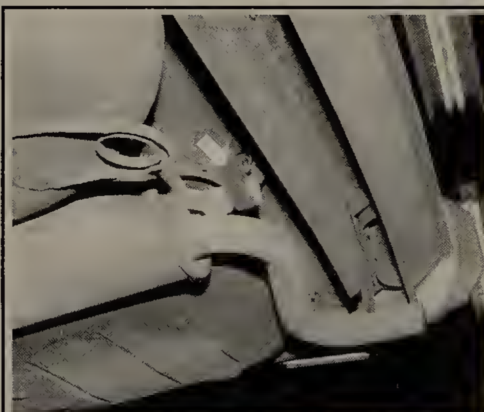

TCCA3P78

Fig. 115 Check for overstretched or torn exhaust hangers

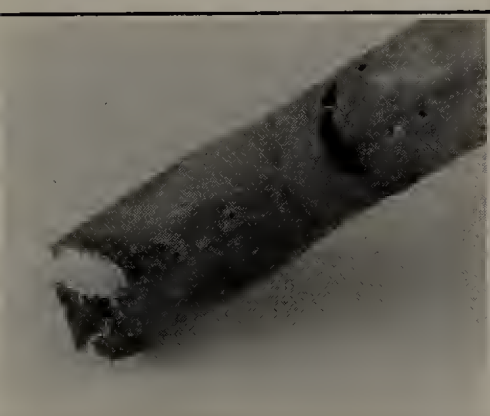

TCCA3P75

Fig. 116 Example of a badly deteriorated exhaust pipe

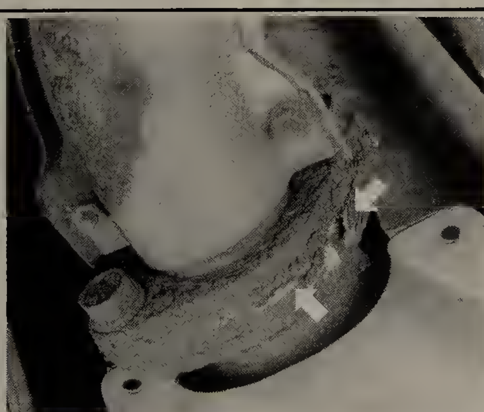
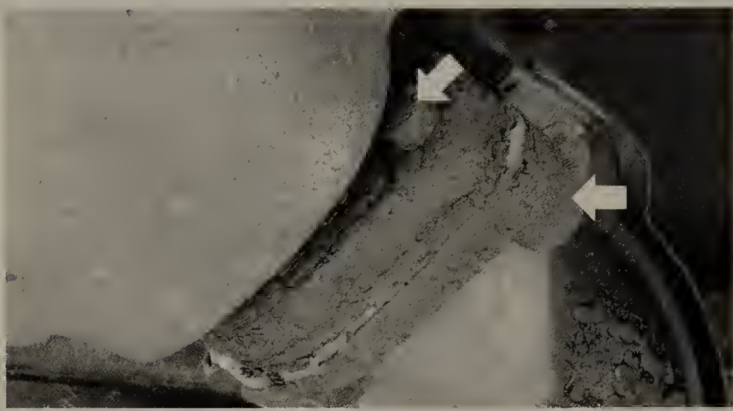

TCCA3P71

Fig. 117 Inspect flanges for gaskets that have deteriorated and need replacement

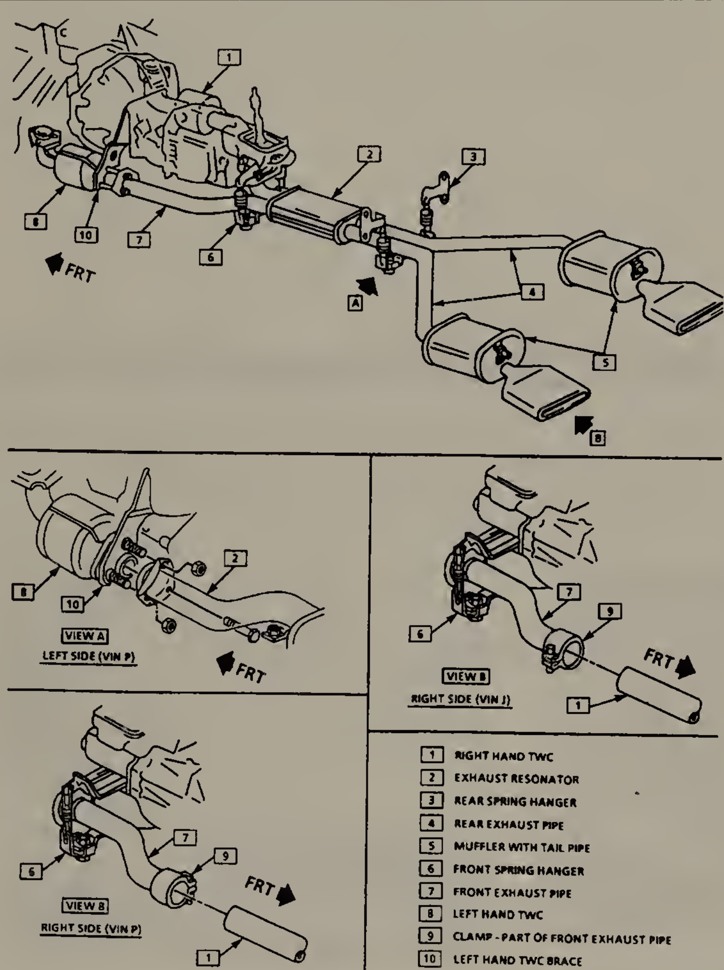

TCCA3P76

Fig. 118 Some systems, like this one, use large O-rings (donuts) in between the flanges



TCCA3P70

Fig. 119 Nuts and bolts will be extremely difficult to remove when deteriorated with rust



91033G90

Fig. 120 Typical exhaust system found on Corvettes

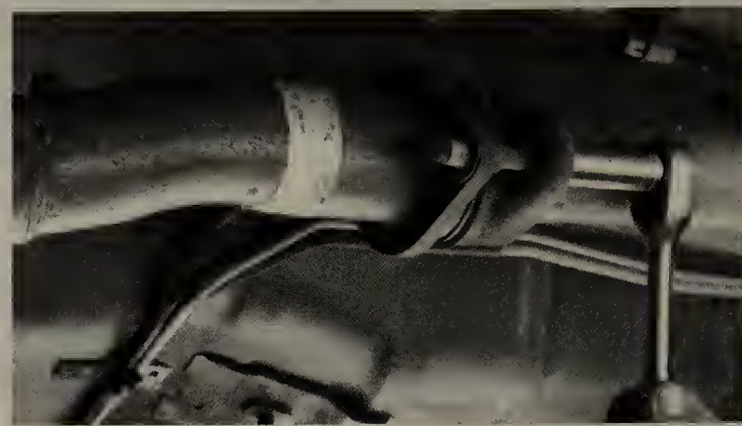
Before removing any component of the exhaust system, ALWAYS squirt a liquid rust dissolving agent onto the fasteners for ease of removal. A lot of knuckle skin will be saved by following this rule. It may even be wise to spray the fasteners and allow them to sit overnight.

Flange Type

▸ See Figure 121

CAUTION

Do NOT perform exhaust repairs or inspection with the engine or exhaust hot. Allow the system to cool completely before attempting any work. Exhaust systems are noted for sharp edges, flaking metal and rusted bolts. Gloves and eye protection are required. A healthy supply of penetrating oil and rags is highly recommended. Never spray liquid rust dissolving agent onto a hot exhaust component.



TCCA3P72

Fig. 121 Example of a flange type exhaust system joint

Before removing any component on a flange type system, ALWAYS squirt a liquid rust dissolving agent onto the fasteners for ease of removal. Start by unbolting the exhaust piece at both ends (if required). When unbolting the headpipe from the manifold, make sure that the bolts are free before trying to remove them. if you snap a stud in the exhaust manifold, the stud will have to be removed with a bolt extractor, which often means removal of the manifold itself. Next, disconnect the component from the mounting; slight twisting and turning may be required to remove the component completely from the vehicle. You may need to tap on the component with a rubber mallet to loosen the component. If all else fails, use a hacksaw to separate the parts. An oxy-acetylene cutting torch may be faster but the sparks are DANGEROUS near the fuel tank, and at the very least, accidents could happen, resulting in damage to the under-car parts, not to mention yourself.

Slip Joint Type

▸ See Figure 122

Before removing any component on the slip joint type exhaust system, ALWAYS squirt a liquid rust dissolving agent onto the fasteners for ease of removal. Start by unbolting the exhaust piece at both ends (if required). When unbolting the headpipe from the manifold, make sure that the bolts are free before trying to remove them. if you snap a stud in the exhaust manifold, the stud will have to be removed with a bolt extractor, which often means removal of the manifold itself. Next, remove the mounting U-bolts from around the exhaust pipe you are extracting from the vehicle. Don't be surprised if the U-bolts break while removing the nuts. Loosen the exhaust pipe from any mounting brackets retaining it to the floor pan and separate the components.

TCCA3P79

Fig. 122 Example of a common slip joint type system

ENGINE RECONDITIONING

Determining Engine Condition

Anything that generates heat and/or friction will eventually burn or wear out (for example, a light bulb generates heat, therefore its life span is limited). With this in mind, a running engine generates tremendous amounts of both; friction is encountered by the moving and rotating parts inside the engine and heat is created by friction and combustion of the fuel. However, the engine has systems designed to help reduce the effects of heat and friction and provide added longevity. The oiling system reduces the amount of friction encountered by the moving parts inside the engine, while the cooling system reduces heat created by friction and combustion. If either system is not maintained, a break-down will be inevitable. Therefore, you can see how regular maintenance can affect the service life of your vehicle. If you do not drain, flush and refill your cooling system at the proper intervals, deposits will begin to accumulate in the radiator, thereby reducing the amount of heat it can extract from the coolant. The same applies to your oil and filter; if it is not changed often enough it becomes laden with contaminates and is unable to properly lubricate the engine. This increases friction and wear.

There are a number of methods for evaluating the condition of your engine. A compression test can reveal the condition of your pistons, piston rings, cylinder bores, head gasket(s), valves and valve seats. An oil pressure test can warn you of possible engine bearing, or oil pump failures. Excessive oil consumption, evidence of oil in the engine air intake area and/or bluish smoke from the tailpipe may indicate worn piston rings, worn valve guides and/or valve seals. As a general rule, an engine that uses no more than one quart of oil every 1000 miles is in good condition. Engines that use one quart of oil or more in less than 1000 miles should first be checked for oil leaks. If any oil leaks are present, have them fixed before determining how much oil is consumed by the engine, especially if blue smoke is not visible at the tailpipe.

COMPRESSION TEST

See Figure 123

A noticeable lack of engine power, excessive oil consumption and/or poor fuel mileage measured over an extended period are all indicators of internal engine wear. Worn piston rings, scored or worn cylinder bores, blown head gaskets, sticking or burnt valves, and worn valve seats are all possible culprits. A check of each cylinder's compression will help locate the problem.

➡A screw-in type compression gauge is more accurate than the type you simply hold against the spark plug hole. Although it takes slightly longer to use, it's worth the effort to obtain a more accurate reading.

1. Make sure that the proper amount and viscosity of engine oil is in the crankcase, then ensure the battery is fully charged.
2. Warm-up the engine to normal operating temperature, then shut the engine **OFF**.
3. Disable the ignition system.
4. Label and disconnect all of the spark plug wires from the plugs.
5. Thoroughly clean the cylinder head area around the spark plug ports, then remove the spark plugs.

TCCS3801

Fig. 123 A screw-in type compression gauge is more accurate and easier to use without an assistant

6. Set the throttle plate to the fully open (wide-open throttle) position. You can block the accelerator linkage open for this, or you can have an assistant fully depress the accelerator pedal.
7. Install a screw-in type compression gauge into the No. 1 spark plug hole until the fitting is snug.

✻✻ WARNING

Be careful not to crossthread the spark plug hole.

8. According to the tool manufacturer's instructions, connect a remote starting switch to the starting circuit.
9. With the ignition switch in the **OFF** position, use the remote starting switch to crank the engine through at least five compression strokes (approximately 5 seconds of cranking) and record the highest reading on the gauge.
10. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes and/or time as the first.
11. Compare the highest readings from each cylinder to that of the others. The indicated compression pressures are considered within specifications if the lowest reading cylinder is within 75 percent of the pressure recorded for the highest reading cylinder. For example, if your highest reading cylinder pressure was 150 psi (1034 kPa), then 75 percent of that would be 113 psi (779 kPa). So the lowest reading cylinder should be no less than 113 psi (779 kPa).
12. If a cylinder exhibits an unusually low compression reading, pour a tablespoon of clean engine oil into the cylinder through the spark plug hole and repeat the compression test. If the compression rises after adding oil, it means that the cylinder's piston rings and/or cylinder bore are damaged or worn. If the pressure remains low, the valves may not be seating properly (a valve job is needed), or the head gasket may be blown near that cylinder. If compression in any two adjacent cylinders is low, and if the addition of oil doesn't help raise compression, there is leakage past the head gasket. Oil and coolant in the combustion chamber, combined with blue or constant white smoke from the tailpipe, are symptoms of this problem. However, don't be alarmed by the normal white smoke emitted from the tailpipe during engine warm-up or from cold weather driving. There may be evidence of water droplets on the engine dipstick and/or oil droplets in the cooling system if a head gasket is blown.

OIL PRESSURE TEST

Check for proper oil pressure at the sending unit passage with an externally mounted mechanical oil pressure gauge (as opposed to relying on a factory installed dash-mounted gauge). A tachometer may also be needed, as some specifications may require running the engine at a specific rpm.

1. With the engine cold, locate and remove the oil pressure sending unit.
2. Following the manufacturer's instructions, connect a mechanical oil pressure gauge and, if necessary, a tachometer to the engine.
3. Start the engine and allow it to idle.
4. Check the oil pressure reading when cold and record the number. You may need to run the engine at a specified rpm, so check the specifications chart located earlier in this section.
5. Run the engine until normal operating temperature is reached (upper radiator hose will feel warm).
6. Check the oil pressure reading again with the engine hot and record the number. Turn the engine **OFF**.
7. Compare your hot oil pressure reading to that given in the chart. If the reading is low, check the cold pressure reading against the chart. If the cold pressure is well above the specification, and the hot reading was lower than the specification, you may have the wrong viscosity oil in the engine. Change the oil, making sure to use the proper grade and quantity, then repeat the test.

Low oil pressure readings could be attributed to internal component wear, pump related problems, a low oil level, or oil viscosity that is too low. High oil pressure readings could be caused by an overfilled crankcase, too high of an oil viscosity or a faulty pressure relief valve.

Buy or Rebuild?

Now that you have determined that your engine is worn out, you must make some decisions. The question of whether or not an engine is worth rebuilding is largely a subjective matter and one of personal worth. Is the engine a popular one, or is it an obsolete model? Are parts available? Will it get acceptable gas mileage once it is rebuilt? Is the car it's being put into worth keeping? Would it be less expensive to buy a new engine, have your engine rebuilt by a pro, rebuild it yourself or buy a used engine from a salvage yard? Or would it be simpler and less expensive to buy another car? If you have considered all these matters and more, and have still decided to rebuild the engine, then it is time to decide how you will rebuild it.

➡The editors at Chilton feel that most engine machining should be performed by a professional machine shop. Don't think of it as wasting money, rather, as an assurance that the job has been done right the first time. There are many expensive and specialized tools required to perform such tasks as boring and honing an engine block or having a valve job done on a cylinder head. Even inspecting the parts requires expensive micrometers and gauges to properly measure wear and clearances. Also, a machine shop can deliver to you clean, and ready to assemble parts, saving you time and aggravation. Your maximum savings will come from performing the removal, disassembly, assembly and installation of the engine and purchasing or renting only the tools required to perform the above tasks. Depending on the particular circumstances, you may save 40 to 60 percent of the cost doing these yourself.

A complete rebuild or overhaul of an engine involves replacing all of the moving parts (pistons, rods, crankshaft, camshaft, etc.) with new ones and machining the non-moving wearing surfaces of the block and heads. Unfortunately, this may not be cost effective. For instance, your crankshaft may have been damaged or worn, but it can be machined undersize for a minimal fee.

So, as you can see, you can replace everything inside the engine, but, it is wiser to replace only those parts which are really needed, and, if possible, repair the more expensive ones. Later in this section, we will break the engine down into its two main components: the cylinder head and the engine block. We will discuss each component, and the recommended parts to replace during a rebuild on each.

Engine Overhaul Tips

Most engine overhaul procedures are fairly standard. In addition to specific parts replacement procedures and specifications for your individual engine, this section is also a guide to acceptable rebuilding procedures. Examples of standard rebuilding practice are given and should be used along with specific details concerning your particular engine.

Competent and accurate machine shop services will ensure maximum performance, reliability and engine life. In most instances it is more profitable for the do-it-yourself mechanic to remove, clean and inspect the component, buy the necessary parts and deliver these to a shop for actual machine work.

Much of the assembly work (crankshaft, bearings, piston rods, and other components) is well within the scope of the do-it-yourself mechanic's tools and abilities. You will have to decide for yourself the depth of involvement you desire in an engine repair or rebuild.

TOOLS

The tools required for an engine overhaul or parts replacement will depend on the depth of your involvement. With a few exceptions, they will be the tools found in a mechanic's tool kit (see Section 1 of this manual). More in-depth work will require some or all of the following:

- A dial indicator (reading in thousandths) mounted on a universal base
- Micrometers and telescope gauges
- Jaw and screw-type pullers
- Scraper
- Valve spring compressor
- Ring groove cleaner
- Piston ring expander and compressor
- Ridge reamer
- Cylinder hone or glaze breaker
- Plastigage®
- Engine stand

The use of most of these tools is illustrated in this section. Many can be rented for a one-time use from a local parts jobber or tool supply house specializing in automotive work.

Occasionally, the use of special tools is called for. See the information on Special Tools and the Safety Notice in the front of this book before substituting another tool.

OVERHAUL TIPS

Aluminum has become extremely popular for use in engines, due to its low weight. Observe the following precautions when handling aluminum parts:

- Never hot tank aluminum parts (the caustic hot tank solution will eat the aluminum.
- Remove all aluminum parts (identification tag, etc.) from engine parts prior to the tanking.
- Always coat threads lightly with engine oil or anti-seize compounds before installation, to prevent seizure.
- Never overtighten bolts or spark plugs especially in aluminum threads.

When assembling the engine, any parts that will be exposed to frictional contact must be prelubed to provide lubrication at initial start-up. Any product specifically formulated for this purpose can be used, but engine oil is not recommended as a prelube in most cases.

When semi-permanent (locked, but removable) installation of bolts or nuts is desired, threads should be cleaned and coated with Loctite® or another similar, commercial non-hardening sealant.

CLEANING

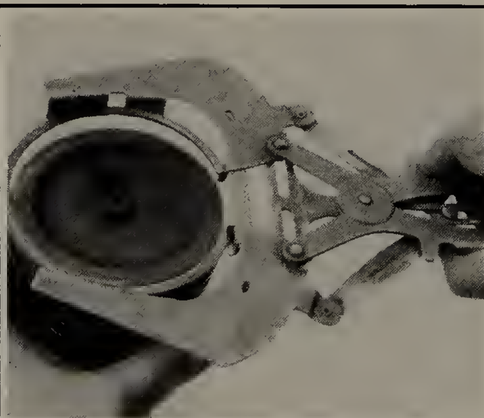
➧ See Figures 124, 125, 126 and 127

Before the engine and its components are inspected, they must be thoroughly cleaned. You will need to remove any engine varnish, oil sludge and/or carbon deposits from all of the components to insure an accurate inspection. A crack in the engine block or cylinder head can easily become overlooked if hidden by a layer of sludge or carbon.

Most of the cleaning process can be carried out with common hand tools and readily available solvents or solutions. Carbon deposits can be chipped away using a hammer and a hard wooden chisel. Old gasket material and varnish or sludge can usually be removed using a scraper and/or cleaning solvent.

TCCS3132

Fig. 124 Use a gasket scraper to remove the old gasket material from the mating surfaces



TCCS3211

Fig. 125 Use a ring expander tool to remove the piston rings

TCCS3208

Fig. 126 Clean the piston ring grooves using a ring groove cleaner tool, or . . .

TCCS3911

Fig. 127 . . . use a piece of an old ring to clean the grooves. Be careful, the ring can be quite sharp

Extremely stubborn deposits may require the use of a power drill with a wire brush. If using a wire brush, use extreme care around any critical machined surfaces (such as the gasket surfaces, bearing saddles, cylinder bores, etc.). USE OF A WIRE BRUSH IS NOT RECOMMENDED ON ANY ALUMINUM COMPONENTS. Always follow any safety recommendations given by the manufacturer of the tool and/or solvent. You should always wear eye protection during any cleaning process involving scraping, chipping or spraying of solvents.

An alternative to the mess and hassle of cleaning the parts yourself is to drop them off at a local garage or machine shop. They will, more than likely, have the necessary equipment to properly clean all of the parts for a nominal fee.

CAUTION

Always wear eye protection during any cleaning process involving scraping, chipping or spraying of solvents.

Remove any oil galley plugs, freeze plugs and/or pressed-in bearings and carefully wash and degrease all of the engine components including the fasteners and bolts. Small parts such as the valves, springs, etc., should be placed in a metal basket and allowed to soak. Use pipe cleaner type brushes, and clean all passageways in the components. Use a ring expander and remove the rings from the pistons. Clean the piston ring grooves with a special tool or a piece of broken ring. Scrape the carbon off of the top of the piston. You should never use a wire brush on the pistons. After preparing all of the piston assemblies in this manner, wash and degrease them again.

WARNING

Use extreme care when cleaning around the cylinder head valve seats. A mistake or slip may cost you a new seat.

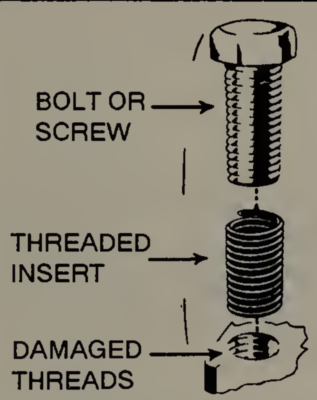
When cleaning the cylinder head, remove carbon from the combustion chamber with the valves installed. This will avoid damaging the valve seats.

REPAIRING DAMAGED THREADS

See Figures 128, 129, 130, 131 and 132

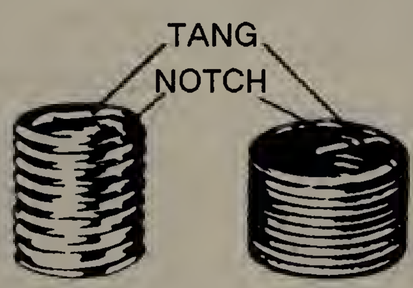
Several methods of repairing damaged threads are available. Heli-Coil® (shown here), Keensert® and Microdot® are among the most widely used. All involve basically the same principle—drilling out stripped threads, tapping the hole and installing a prewound insert—making welding, plugging and oversize fasteners unnecessary.

Two types of thread repair inserts are usually supplied: a standard type for most inch coarse, inch fine, metric course and metric fine thread sizes and a spark lug type to fit most spark plug port sizes. Consult the individual tool manufacturer's catalog to determine exact applications. Typical thread repair kits will contain a selection of prewound threaded inserts, a tap (corresponding to the outside diameter threads of the insert) and an installation tool. Spark plug



TCCS3039

Fig. 128 Damaged bolt hole threads can be replaced with thread repair inserts

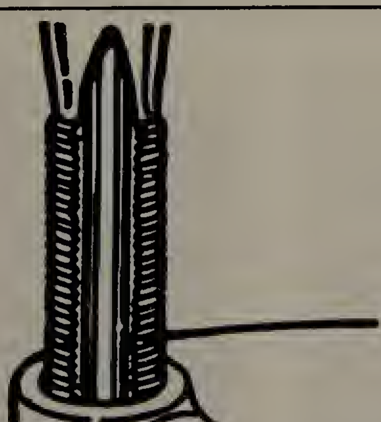


TCCS3040

Fig. 129 Standard thread repair insert (left), and spark plug thread insert

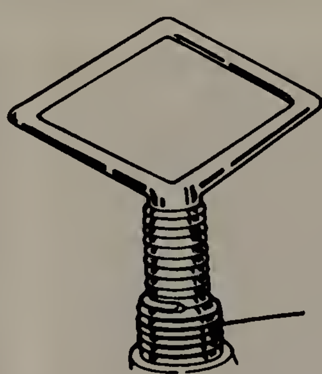
TCCS3041

Fig. 130 Drill out the damaged threads with the specified size bit. Be sure to drill completely through the hole or to the bottom of a blind hole



TCCS3042

Fig. 131 Using the kit, tap the hole in order to receive the thread insert. Keep the tap well oiled and back it out frequently to avoid clogging the threads



TCCS3043

Fig. 132 Screw the insert onto the installer tool until the tang engages the slot. Thread the insert into the hole until it is ¼–½ turn below the top surface, then remove the tool and break off the tang using a punch

inserts usually differ because they require a tap equipped with pilot threads and a combined reamer/tap section. Most manufacturers also supply blister-packed thread repair inserts separately in addition to a master kit containing a variety of taps and inserts plus installation tools.

Before attempting to repair a threaded hole, remove any snapped, broken or damaged bolts or studs. Penetrating oil can be used to free frozen threads. The offending item can usually be removed with locking pliers or using a screw/stud extractor. After the hole is clear, the thread can be repaired, as shown in the series of accompanying illustrations and in the kit manufacturer's instructions.

Engine Preparation

To properly rebuild an engine, you must first remove it from the vehicle, then disassemble and diagnose it. Ideally you should place your engine on an engine stand. This affords you the best access to the engine components. Follow the manufacturer's directions for using the stand with your particular engine. Remove the flywheel or flexplate before installing the engine to the stand.

Now that you have the engine on a stand, and assuming that you have drained the oil and coolant from the engine, it's time to strip it of all but the necessary components. Before you start disassembling the engine, you may want to take a moment to draw some pictures, or fabricate some labels or containers to mark the locations of various components and the bolts and/or studs which fasten them. Modern day engines use a lot of little brackets and clips which hold wiring harnesses and such, and these holders are often mounted on studs and/or bolts that can be easily mixed up. The manufacturer spent a lot of time and money designing your vehicle, and they wouldn't have wasted any of it by haphazardly placing brackets, clips or fasteners on the vehicle. If it's present when you disassemble it, put it back when you assemble, you will regret not remembering that little bracket which holds a wire harness out of the path of a rotating part.

You should begin by unbolting any accessories still attached to the engine, such as the water pump, power steering pump, alternator, etc. Then, unfasten any manifolds (intake or exhaust) which were not removed during the engine removal procedure. Finally, remove any covers remaining on the engine such as the rocker arm, front or timing cover and oil pan. Some front covers may require the vibration damper and/or crank pulley to be removed beforehand. The idea is to reduce the engine to the bare necessities (cylinder head(s), valve train, engine block, crankshaft, pistons and connecting rods), plus any other 'in block' components such as oil pumps, balance shafts and auxiliary shafts.

Finally, remove the cylinder head(s) from the engine block and carefully place on a bench. Disassembly instructions for each component follow later in this section.

Cylinder Head

There are two basic types of cylinder heads used on today's automobiles: the Overhead Valve (OHV) and the Overhead Camshaft (OHC). The latter can also be broken down into two subgroups: the Single Overhead Camshaft (SOHC) and the Dual Overhead Camshaft (DOHC). Generally, if there is only a single camshaft on a head, it is just referred to as an OHC head. Also, an engine with an OHV cylinder head is also known as a pushrod engine.

Most cylinder heads these days are made of an aluminum alloy due to its light weight, durability and heat transfer qualities. However, cast iron was the material of choice in the past, and is still used on many vehicles today. Whether made from aluminum or iron, all cylinder heads have valves and seats. Some use two valves per cylinder, while the more hi-tech engines will utilize a multi-valve configuration using 3, 4 and even 5 valves per cylinder. When the valve contacts the seat, it does so on precision machined surfaces, which seals the combustion chamber. All cylinder heads have a valve guide for each valve. The guide centers the valve to the seat and allows it to move up and down within it. The clearance between the valve and guide can be critical. Too much clearance and the engine may consume oil, lose vacuum and/or damage the seat. Too little, and the valve can stick in the guide causing the engine to run poorly if at all, and possibly causing severe damage. The last component all cylinder heads have are valve springs. The spring holds the valve against its seat. It also returns the valve to this position when the valve has been opened by the valve train or camshaft. The spring is fastened to the valve by a retainer and valve locks (sometimes called keepers). Aluminum heads will also have a valve spring shim to keep the spring from wearing away the aluminum.

An ideal method of rebuilding the cylinder head would involve replacing all of the valves, guides, seats, springs, etc. with new ones. However, depending on how the engine was maintained, often this is not necessary. A major cause of valve, guide and seat wear is an improperly tuned engine. An engine that is running too rich, will often wash the lubricating oil out of the guide with gasoline, causing it to wear rapidly. Conversely, an engine which is running too lean will place higher combustion temperatures on the valves and seats allowing them to wear or even burn. Springs fall victim to the driving habits of the individual. A driver who often runs the engine rpm to the redline will wear out or break the springs faster then one that stays well below it. Unfortunately, mileage takes it toll on all of the parts. Generally, the valves, guides, springs and seats in a cylinder head can be machined and re-used, saving you money. However, if a valve is burnt, it may be wise to replace all of the valves, since they were all operating in the same environment. The same goes for any other component on the cylinder head. Think of it as an insurance policy against future problems related to that component.

Unfortunately, the only way to find out which components need replacing, is to disassemble and carefully check each piece. After the cylinder head(s) are disassembled, thoroughly clean all of the components.

DISASSEMBLY

See Figures 133 thru 138

Before disassembling the cylinder head, you may want to fabricate some containers to hold the various parts, as some of them can be quite small (such as keepers) and easily lost. Also keeping yourself and the components organized will aid in assembly and reduce confusion. Where possible, try to maintain a components original location; this is especially important if there is not going to be any machine work performed on the components.

1. If you haven't already removed the rocker arms and/or shafts, do so now.
2. Position the head so that the springs are easily accessed.
3. Use a valve spring compressor tool, and relieve spring tension from the retainer.

Due to engine varnish, the retainer may stick to the valve locks. A gentle tap with a hammer may help to break it loose.

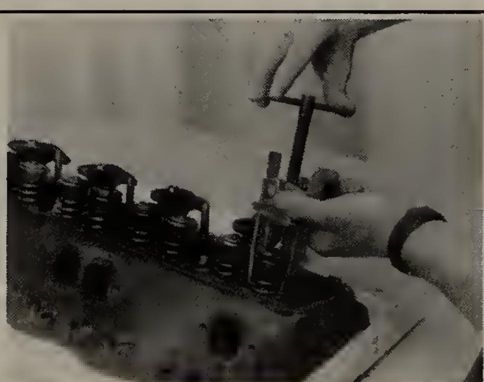

TCCS3137

Fig. 133 When removing an OHV valve spring, use a compressor tool to relieve the tension from the retainer

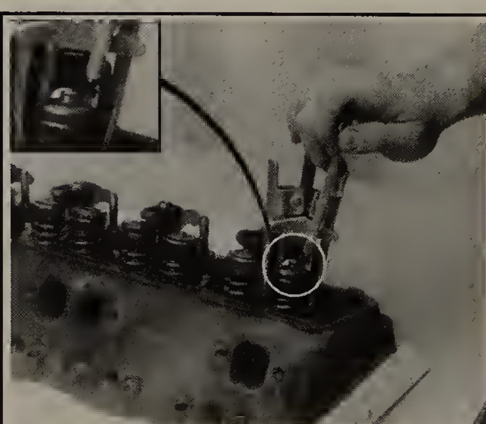

TCCS3138

Fig. 134 A small magnet will help in removal of the valve locks


TCCS3139

Fig. 135 Be careful not to lose the small valve locks (keepers)

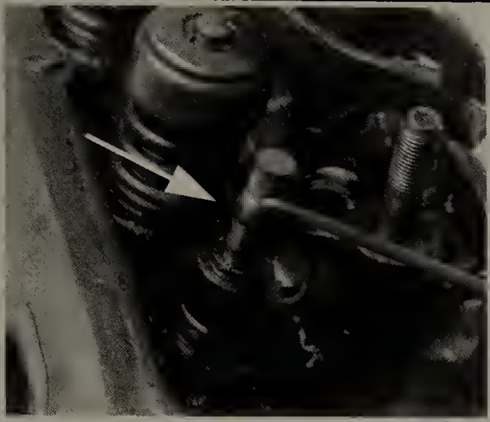

TCCS3140

Fig. 136 Remove the valve seal from the valve stem—O-ring type seal shown


TCCS3252

Fig. 137 Removing an umbrella/positive type seal


TCCS3141

Fig. 138 Invert the cylinder head and withdraw the valve from the valve guide bore

4. Remove the valve locks from the valve tip and/or retainer. A small magnet may help in removing the locks.
5. Lift the valve spring, tool and all, off of the valve stem.
6. If equipped, remove the valve seal. If the seal is difficult to remove with the valve in place, try removing the valve first, then the seal. Follow the steps below for valve removal.
7. Position the head to allow access for withdrawing the valve.

➡Cylinder heads that have seen a lot of miles and/or abuse may have mushroomed the valve lock grove and/or tip, causing difficulty in removal of the valve. If this has happened, use a metal file to carefully remove the high spots around the lock grooves and/or tip. Only file it enough to allow removal.

8. Remove the valve from the cylinder head.
9. If equipped, remove the valve spring shim. A small magnetic tool or screwdriver will aid in removal.
10. Repeat Steps 3 though 9 until all of the valves have been removed.

INSPECTION

Now that all of the cylinder head components are clean, it's time to inspect them for wear and/or damage. To accurately inspect them, you will need some specialized tools:

- A 0–1 in. micrometer for the valves
- A dial indicator or inside diameter gauge for the valve guides
- A spring pressure test gauge

If you do not have access to the proper tools, you may want to bring the components to a shop that does.

Valves

➧ See Figures 139 and 140

The first thing to inspect are the valve heads. Look closely at the head, margin and face for any cracks, excessive wear or burning. The margin is the best place to look for burning. It should have a squared edge with an even width all around the diameter. When a valve burns, the margin will look melted and the edges rounded. Also inspect the valve head for any signs of tulipping. This will show as a lifting of the edges or dishing in the center of the head and will usually not occur to all of the valves. All of the heads should look the same, any that seem dished more than others are probably bad. Next, inspect the valve lock grooves and valve tips. Check for any burrs around the lock grooves, especially if you had to file them to remove the valve. Valve tips should appear flat, although slight rounding with high mileage engines is normal. Slightly worn valve tips will need to be machined flat. Last, measure the valve stem diameter with the micrometer. Measure the area that rides within the guide, especially towards the tip where most of the wear occurs. Take several measurements along its length and compare them to each other. Wear should be even along the length with little to no taper. If no minimum diameter is given in the specifications, then the stem should not read more than 0.001 in. (0.025mm) below the specification. Any valves that fail these inspections should be replaced.

Springs, Retainers and Valve Locks

➧ See Figures 141 and 142

The first thing to check is the most obvious, broken springs. Next check the free length and squareness of each spring. If applicable, insure to distinguish between intake and exhaust springs. Use a ruler and/or carpenter's square to measure the length. A carpenter's square should be used to check the springs for squareness. If a spring pressure test gauge is available, check each springs rating and compare to the specifications chart. Check the readings against the specifications given. Any springs that fail these inspections should be replaced.

The spring retainers rarely need replacing, however they should still be checked as a precaution. Inspect the spring mating surface and the valve lock retention area for any signs of excessive wear. Also check for any signs of cracking. Replace any retainers that are questionable.

Valve locks should be inspected for excessive wear on the outside contact area as well as on the inner notched surface. Any locks which appear worn or broken and its respective valve should be replaced.


TCCS3144

Fig. 139 Valve stems may be rolled on a flat surface to check for bends

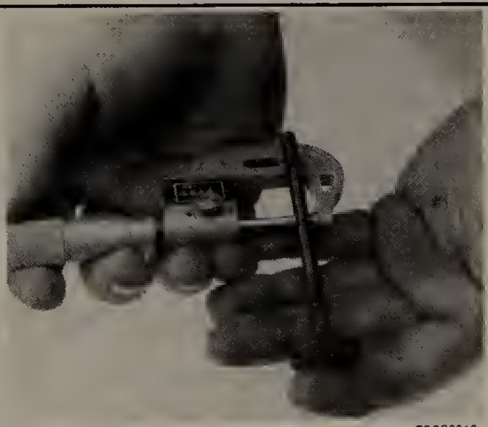

TCCS3910

Fig. 140 Use a micrometer to check the valve stem diameter


TCCS3907

Fig. 141 Use a caliper to check the valve spring free-length

TCCS3908

Fig. 142 Check the valve spring for squareness on a flat surface; a carpenter's square can be used

Cylinder Head

There are several things to check on the cylinder head: valve guides, seats, cylinder head surface flatness, cracks and physical damage.

VALVE GUIDES

➧ See Figure 143

Now that you know the valves are good, you can use them to check the guides, although a new valve, if available, is preferred. Before you measure anything, look at the guides carefully and inspect them for any cracks, chips or breakage. Also if the guide is a removable style (as in most aluminum heads), check them for any looseness or evidence of movement. All of the guides should appear to be at the same height from the spring seat. If any seem lower (or higher) from another, the guide has moved. Mount a dial indicator onto the spring side of the cylinder head. Lightly oil the valve stem and insert it into the cylinder head. Position the dial indicator against the valve stem near the tip and zero the gauge. Grasp the valve stem and wiggle towards and away from the dial indicator and observe the readings. Mount the dial indicator 90 degrees from the initial point and zero the gauge and again take a reading. Compare the two readings for a out of round condition. Check the readings against the specifications given. An Inside Diameter (I.D.) gauge designed for valve guides will give you an accurate valve guide bore measurement. If the I.D. gauge is used, compare the readings with the specifications given. Any guides that fail these inspections should be replaced or machined.

VALVE SEATS

A visual inspection of the valve seats should show a slightly worn and pitted surface where the valve face contacts the seat. Inspect the seat carefully for severe pitting or cracks. Also, a seat that is badly worn will be recessed into the cylinder head. A severely worn or recessed seat may need to be replaced. All cracked seats must be replaced. A seat concentricity gauge, if available, should be used to check the seat run-out. If run-out exceeds specifications the seat must be machined (if no specification is given use 0.002 in. or 0.051mm).

CYLINDER HEAD SURFACE FLATNESS

➧ See Figures 144 and 145

After you have cleaned the gasket surface of the cylinder head of any old gasket material, check the head for flatness.

Place a straightedge across the gasket surface. Using feeler gauges, determine the clearance at the center of the straightedge and across the cylinder head at several points. Check along the centerline and diagonally on the head surface. If the warpage exceeds 0.003 in. (0.076mm) within a 6.0 in. (15.2cm) span, or 0.006 in. (0.152mm) over the total length of the head, the cylinder head must be resurfaced. After resurfacing the heads of a V-type engine, the intake manifold flange surface should be checked, and if necessary, milled proportionally to allow for the change in its mounting position.

CRACKS AND PHYSICAL DAMAGE

Generally, cracks are limited to the combustion chamber, however, it is not uncommon for the head to crack in a spark plug hole, port, outside of the head or in the valve spring/rocker arm area. The first area to inspect is always the hottest: the exhaust seat/port area.

A visual inspection should be performed, but just because you don't see a crack does not mean it is not there. Some more reliable methods for inspecting for cracks include Magnaflux®, a magnetic process or Zyglo®, a dye penetrant. Magnaflux® is used only on ferrous metal (cast iron) heads. Zyglo® uses a spray on fluorescent mixture along with a black light to reveal the cracks. It is strongly recommended to have your cylinder head checked professionally for cracks, especially if the engine was known to have overheated and/or leaked or consumed coolant. Contact a local shop for availability and pricing of these services.

Physical damage is usually very evident. For example, a broken mounting ear from dropping the head or a bent or broken stud and/or bolt. All of these defects should be fixed or, if unrepairable, the head should be replaced.

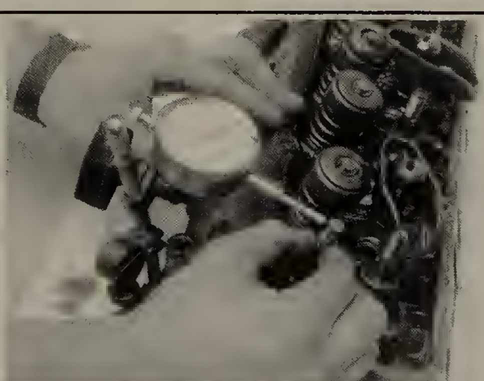
REFINISHING & REPAIRING

Many of the procedures given for refinishing and repairing the cylinder head components must be performed by a machine shop. Certain steps, if the inspected part is not worn, can be performed yourself inexpensively. However, you spent a lot of time and effort so far, why risk trying to save a couple bucks if you might have to do it all over again?

Valves

Any valves that were not replaced should be refaced and the tips ground flat. Unless you have access to a valve grinding machine, this should be done by a machine shop. If the valves are in extremely good condition, as well as the valve seats and guides, they may be lapped in without performing machine work.

It is a recommended practice to lap the valves even after machine work has been performed and/or new valves have been purchased. This insures a positive seal between the valve and seat.

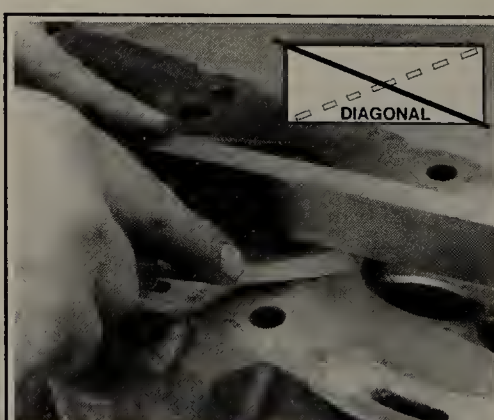


TCCS3142

Fig. 143 A dial gauge may be used to check valve stem-to-guide clearance; read the gauge while moving the valve stem

TCCS3919

Fig. 144 Check the head for flatness across the center of the head surface using a straightedge and feeler gauge



TCCS3918

Fig. 145 Checks should also be made along both diagonals of the head surface

LAPPING THE VALVES

➡Before lapping the valves to the seats, read the rest of the cylinder head section to insure that any related parts are in acceptable enough condition to continue.

➡Before any valve seat machining and/or lapping can be performed, the guides must be within factory recommended specifications.

1. Invert the cylinder head.
2. Lightly lubricate the valve stems and insert them into the cylinder head in their numbered order.
3. Raise the valve from the seat and apply a small amount of fine lapping compound to the seat.
4. Moisten the suction head of a hand-lapping tool and attach it to the head of the valve.
5. Rotate the tool between the palms of both hands, changing the position of the valve on the valve seat and lifting the tool often to prevent grooving.
6. Lap the valve until a smooth, polished circle is evident on the valve and seat.
7. Remove the tool and the valve. Wipe away all traces of the grinding compound and store the valve to maintain its lapped location.

WARNING

Do not get the valves out of order after they have been lapped. They must be put back with the same valve seat with which they were lapped.

Springs, Retainers and Valve Locks

There is no repair or refinishing possible with the springs, retainers and valve locks. If they are found to be worn or defective, they must be replaced with new (or known good) parts.

Cylinder Head

Most refinishing procedures dealing with the cylinder head must be performed by a machine shop. Read the sections below and review your inspection data to determine whether or not machining is necessary.

VALVE GUIDE

➡If any machining or replacements are made to the valve guides, the seats must be machined.

Unless the valve guides need machining or replacing, the only service to perform is to thoroughly clean them of any dirt or oil residue.

There are only two types of valve guides used on automobile engines: the replaceable-type (all aluminum heads) and the cast-in integral-type (most cast iron heads). There are four recommended methods for repairing worn guides.

- Knurling
- Inserts
- Reaming oversize
- Replacing

Knurling is a process in which metal is displaced and raised, thereby reducing clearance, giving a true center, and providing oil control. It is the least expensive way of repairing the valve guides. However, it is not necessarily the best, and in some cases, a knurled valve guide will not stand up for more than a short time. It requires a special knurlizer and precision reaming tools to obtain proper clearances. It would not be cost effective to purchase these tools, unless you plan on rebuilding several of the same cylinder head.

Installing a guide insert involves machining the guide to accept a bronze insert. One style is the coil-type which is installed into a threaded guide. Another is the thin-walled insert where the guide is reamed oversize to accept a split-sleeve insert. After the insert is installed, a special tool is then run through the guide to expand the insert, locking it to the guide. The insert is then reamed to the standard size for proper valve clearance.

Reaming for oversize valves restores normal clearances and provides a true valve seat. Most cast-in type guides can be reamed to accept an valve with an oversize stem. The cost factor for this can become quite high as you will need to purchase the reamer and new, oversize stem valves for all guides which were reamed. Oversizes are generally 0.003 to 0.030 in. (0.076 to 0.762mm), with 0.015 in. (0.381mm) being the most common.

To replace cast-in type valve guides, they must be drilled out, then reamed to accept replacement guides. This must be done on a fixture which will allow centering and leveling off of the original valve seat or guide, otherwise a serious guide-to-seat misalignment may occur making it impossible to properly machine the seat.

Replaceable-type guides are pressed into the cylinder head. A hammer and a stepped drift or punch may be used to install and remove the guides. Before removing the guides, measure the protrusion on the spring side of the head and record it for installation. Use the stepped drift to hammer out the old guide from the combustion chamber side of the head. When installing, determine whether or not the guide also seals a water jacket in the head, and if it does, use the recommended sealing agent. If there is no water jacket, grease the valve guide and its bore. Use the stepped drift, and hammer the new guide into the cylinder head from the spring side of the cylinder head. A stack of washers the same thickness as the measured protrusion may help the installation process.

VALVE SEATS

➡Before any valve seat machining can be performed, the guides must be within factory recommended specifications.

➡If any machining or replacements were made to the valve guides, the seats must be machined.

If the seats are in good condition, the valves can be lapped to the seats, and the cylinder head assembled. See the valves section for instructions on lapping.

If the valve seats are worn, cracked or damaged, they must be serviced by a machine shop. The valve seat must be perfectly centered to the valve guide, which requires very accurate machining.

CYLINDER HEAD SURFACE

If the cylinder head is warped, it must be machined flat. If the warpage is extremely severe, the head may need to be replaced. In some instances, it may be possible to straighten a warped head enough to allow machining. In either case, contact a professional machine shop for service.

CRACKS AND PHYSICAL DAMAGE

Certain cracks can be repaired in both cast iron and aluminum heads. For cast iron, a tapered threaded insert is installed along the length of the crack. Aluminum can also use the tapered inserts, however welding is the preferred method. Some physical damage can be repaired through brazing or welding. Contact a machine shop to get expert advice for your particular dilemma.

ASSEMBLY

The first step for any assembly job is to have a clean area in which to work. Next, thoroughly clean all of the parts and components that are to be assembled. Finally, place all of the components onto a suitable work space and, if necessary, arrange the parts to their respective positions.

OHV Engines

1. Lightly lubricate the valve stems and insert all of the valves into the cylinder head. If possible, maintain their original locations.
2. If equipped, install any valve spring shims which were removed.
3. If equipped, install the new valve seals, keeping the following in mind:
   - If the valve seal presses over the guide, lightly lubricate the outer guide surfaces.
   - If the seal is an O-ring type, it is installed just after compressing the spring but before the valve locks.
4. Place the valve spring and retainer over the stem.
5. Position the spring compressor tool and compress the spring.
6. Assemble the valve locks to the stem.
7. Relieve the spring pressure slowly and insure that neither valve lock becomes dislodged by the retainer.
8. Remove the spring compressor tool.
9. Repeat Steps 2 through 8 until all of the springs have been installed.

Engine Block

GENERAL INFORMATION

A thorough overhaul or rebuild of an engine block would include replacing the pistons, rings, bearings, timing belt/chain assembly and oil pump. For OHV engines also include a new camshaft and lifters. The block would then have the cylinders bored and honed oversize (or if using removable cylinder sleeves, new sleeves installed) and the crankshaft would be cut undersize to provide new wearing surfaces and perfect clearances. However, your particular engine may not have everything worn out. What if only the piston rings have worn out and the clearances on everything else are still within factory specifications? Well, you could just replace the rings and put it back together, but this would be a very rare example. Chances are, if one component in your engine is worn, other components are sure to follow, and soon. At the very least, you should always replace the rings, bearings and oil pump. This is what is commonly called a "freshen up".

Cylinder Ridge Removal

Because the top piston ring does not travel to the very top of the cylinder, a ridge is built up between the end of the travel and the top of the cylinder bore.

Pushing the piston and connecting rod assembly past the ridge can be difficult, and damage to the piston ring lands could occur. If the ridge is not removed before installing a new piston or not removed at all, piston ring breakage and piston damage may occur.

➡It is always recommended that you remove any cylinder ridges before removing the piston and connecting rod assemblies. If you know that new pistons are going to be installed and the engine block will be bored oversize, you may be able to forego this step. However, some ridges may actually prevent the assemblies from being removed, necessitating its removal.

There are several different types of ridge reamers on the market, none of which are inexpensive. Unless a great deal of engine rebuilding is anticipated, borrow or rent a reamer.

1. Turn the crankshaft until the piston is at the bottom of its travel.
2. Cover the head of the piston with a rag.
3. Follow the tool manufacturers instructions and cut away the ridge, exercising extreme care to avoid cutting too deeply.
4. Remove the ridge reamer, the rag and as many of the cuttings as possible. Continue until all of the cylinder ridges have been removed.

DISASSEMBLY

◆ See Figures 146 and 147

The engine disassembly instructions following assume that you have the engine mounted on an engine stand. If not, it is easiest to disassemble the engine on a bench or the floor with it resting on the bell housing or transmission mounting surface. You must be able to access the connecting rod fasteners and turn the crankshaft during disassembly. Also, all engine covers (timing, front, side, oil pan, whatever) should have already been removed. Engines which are seized or locked up may not be able to be completely disassembled, and a core (salvage yard) engine should be purchased.

If not done during the cylinder head removal, remove the pushrods and lifters, keeping them in order for assembly. Remove the timing gears and/or timing chain assembly, then remove the oil pump drive assembly and withdraw the camshaft from the engine block. Remove the oil pick-up and pump assembly. If equipped, remove any balance or auxiliary shafts. If necessary, remove the cylinder ridge from the top of the bore. See the cylinder ridge removal procedure earlier in this section.

Rotate the engine over so that the crankshaft is exposed. Use a number punch or scribe and mark each connecting rod with its respective cylinder number. The cylinder closest to the front of the engine is always number 1. However, depending on the engine placement, the front of the engine could either be the flywheel or damper/pulley end. Generally the front of the engine faces the front of the vehicle. Use a number punch or scribe and also mark the main bearing caps from front to rear with the front most cap being number 1 (if there are five caps, mark them 1 through 5, front to rear).

TCCS3803

Fig. 146 Place rubber hose over the connecting rod studs to protect the crankshaft and cylinder bores from damage

TCCS3804

Fig. 147 Carefully tap the piston out of the bore using a wooden dowel

⁂ WARNING

Take special care when pushing the connecting rod up from the crankshaft because the sharp threads of the rod bolts/studs will score the crankshaft journal. Insure that special plastic caps are installed over them, or cut two pieces of rubber hose to do the same.

Again, rotate the engine, this time to position the number one cylinder bore (head surface) up. Turn the crankshaft until the number one piston is at the bottom of its travel, this should allow the maximum access to its connecting rod. Remove the number one connecting rods fasteners and cap and place two lengths of rubber hose over the rod bolts/studs to protect the crankshaft from damage. Using a sturdy wooden dowel and a hammer, push the connecting rod up about 1 in. (25mm) from the crankshaft and remove the upper bearing insert. Continue pushing or tapping the connecting rod up until the piston rings are out of the cylinder bore. Remove the piston and rod by hand, put the upper half of the bearing insert back into the rod, install the cap with its bearing insert installed, and hand-tighten the cap fasteners. If the parts are kept in order in this manner, they will not get lost and you will be able to tell which bearings came form what cylinder if any problems are discovered and diagnosis is necessary. Remove all the other piston assemblies in the same manner. On V-style engines, remove all of the pistons from one bank, then reposition the engine with the other cylinder bank head surface up, and remove that banks piston assemblies.

The only remaining component in the engine block should now be the crankshaft. Loosen the main bearing caps evenly until the fasteners can be turned by hand, then remove them and the caps. Remove the crankshaft from the engine block. Thoroughly clean all of the components.

INSPECTION

Now that the engine block and all of its components are clean, it's time to inspect them for wear and/or damage. To accurately inspect them, you will need some specialized tools:

- Two or three separate micrometers to measure the pistons and crankshaft journals
- A dial indicator
- Telescoping gauges for the cylinder bores
- A rod alignment fixture to check for bent connecting rods

If you do not have access to the proper tools, you may want to bring the components to a shop that does.

Generally, you shouldn't expect cracks in the engine block or its components unless it was known to leak, consume or mix engine fluids, it was severely overheated, or there was evidence of bad bearings and/or crankshaft damage. A visual inspection should be performed on all of the components, but just because you don't see a crack does not mean it is not there. Some more reliable methods for inspecting for cracks include Magnaflux®, a magnetic process or Zyglo®, a dye penetrant. Magnaflux® is used only on ferrous metal (cast iron). Zyglo® uses a spray on fluorescent mixture along with a black light to reveal the cracks. It is strongly recommended to have your engine block checked professionally for cracks, especially if the engine was known to have overheated and/or leaked or consumed coolant. Contact a local shop for availability and pricing of these services.

Engine Block

ENGINE BLOCK BEARING ALIGNMENT

Remove the main bearing caps and, if still installed, the main bearing inserts. Inspect all of the main bearing saddles and caps for damage, burrs or high spots. If damage is found, and it is caused from a spun main bearing, the block will need to be align-bored or, if severe enough, replacement. Any burrs or high spots should be carefully removed with a metal file.

Place a straightedge on the bearing saddles, in the engine block, along the centerline of the crankshaft. If any clearance exists between the straightedge and the saddles, the block must be align-bored.

Align-boring consists of machining the main bearing saddles and caps by means of a flycutter that runs through the bearing saddles.

DECK FLATNESS

The top of the engine block where the cylinder head mounts is called the deck. Insure that the deck surface is clean of dirt, carbon deposits and old gasket material. Place a straightedge across the surface of the deck along its centerline and, using feeler gauges, check the clearance along several points. Repeat the checking procedure with the straightedge placed along both diagonals of the deck surface. If the reading exceeds 0.003 in. (0.076mm) within a 6.0 in. (15.2cm) span, or 0.006 in. (0.152mm) over the total length of the deck, it must be machined.

CYLINDER BORES

See Figure 148

The cylinder bores house the pistons and are slightly larger than the pistons themselves. A common piston-to-bore clearance is 0.0015–0.0025 in. (0.0381mm–0.0635mm). Inspect and measure the cylinder bores. The bore should be checked for out-of-roundness, taper and size. The results of this inspection will determine whether the cylinder can be used in its existing size and condition, or a rebore to the next oversize is required (or in the case of removable sleeves, have replacements installed).

TCCS3209

Fig. 148 Use a telescoping gauge to measure the cylinder bore diameter—take several readings within the same bore

The amount of cylinder wall wear is always greater at the top of the cylinder than at the bottom. This wear is known as taper. Any cylinder that has a taper of 0.0012 in. (0.305mm) or more, must be rebored. Measurements are taken at a number of positions in each cylinder: at the top, middle and bottom and at two points at each position; that is, at a point 90 degrees from the crankshaft centerline, as well as a point parallel to the crankshaft centerline. The measurements are made with either a special dial indicator or a telescopic gauge and micrometer. If the necessary precision tools to check the bore are not available, take the block to a machine shop and have them mike it. Also if you don't have the tools to check the cylinder bores, chances are you will not have the necessary devices to check the pistons, connecting rods and crankshaft. Take these components with you and save yourself an extra trip.

For our procedures, we will use a telescopic gauge and a micrometer. You will need one of each, with a measuring range which covers your cylinder bore size.

1. Position the telescopic gauge in the cylinder bore, loosen the gauges lock and allow it to expand.

➡Your first two readings will be at the top of the cylinder bore, then proceed to the middle and finally the bottom, making a total of six measurements.

2. Hold the gauge square in the bore, 90 degrees from the crankshaft centerline, and gently tighten the lock. Tilt the gauge back to remove it from the bore.
3. Measure the gauge with the micrometer and record the reading.
4. Again, hold the gauge square in the bore, this time parallel to the crankshaft centerline, and gently tighten the lock. Again, you will tilt the gauge back to remove it from the bore.
5. Measure the gauge with the micrometer and record this reading. The difference between these two readings is the out-of-round measurement of the cylinder.
6. Repeat steps 1 through 5, each time going to the next lower position, until you reach the bottom of the cylinder. Then go to the next cylinder, and continue until all of the cylinders have been measured.

The difference between these measurements will tell you all about the wear in your cylinders. The measurements which were taken 90 degrees from the crankshaft centerline will always reflect the most wear. That is because at this position is where the engine power presses the piston against the cylinder bore the hardest. This is known as thrust wear. Take your top, 90 degree measurement and compare it to your bottom, 90 degree measurement. The difference between them is the taper. When you measure your pistons, you will compare these readings to your piston sizes and determine piston-to-wall clearance.

Crankshaft

Inspect the crankshaft for visible signs of wear or damage. All of the journals should be perfectly round and smooth. Slight scores are normal for a used crankshaft, but you should hardly feel them with your fingernail. When measuring the crankshaft with a micrometer, you will take readings at the front and rear of each journal, then turn the micrometer 90 degrees and take two more readings, front and rear. The difference between the front-to-rear readings is the journal taper and the first-to-90 degree reading is the out-of-round measurement. Generally, there should be no taper or out-of-roundness found, however, up to 0.0005 in. (0.0127mm) for either can be overlooked. Also, the readings should fall within the factory specifications for journal diameters.

If the crankshaft journals fall within specifications, it is recommended that it be polished before being returned to service. Polishing the crankshaft insures that any minor burrs or high spots are smoothed, thereby reducing the chance of scoring the new bearings.

Pistons and Connecting Rods

PISTONS

See Figure 149

The piston should be visually inspected for any signs of cracking or burning (caused by hot spots or detonation), and scuffing or excessive wear on the skirts. The wrist pin attaches the piston to the connecting rod. The piston should move freely on the wrist pin, both sliding and pivoting. Grasp the connecting rod securely, or mount it in a vise, and try to rock the piston back and forth along the centerline of the wrist pin. There should not be any excessive play evident between the piston and the pin. If there are C-clips retaining the pin in the piston then you have wrist pin bushings in the rods. There should not be any excessive play between the wrist pin and the rod bushing. Normal clearance for the wrist pin is approx. 0.001–0.002 in. (0.025mm–0.051mm).

Use a micrometer and measure the diameter of the piston, perpendicular to the wrist pin, on the skirt. Compare the reading to its original cylinder measurement obtained earlier. The difference between the two readings is the piston-to-wall clearance. If the clearance is within specifications, the piston may be used as is. If the piston is out of specification, but the bore is not, you will need a new piston. If both are out of specification, you will need the cylinder rebored and oversize pistons installed. Generally if two or more pistons/bores are out of specification, it is best to rebore the entire block and purchase a complete set of oversize pistons.

CONNECTING ROD

You should have the connecting rod checked for straightness at a machine shop. If the connecting rod is bent, it will unevenly wear the bearing and piston, as well as place greater stress on these components. Any bent or twisted connecting rods must be replaced. If the rods are straight and the wrist pin clearance is within specifications, then only the bearing end of the rod need be checked. Place the connecting rod into a vice, with the bearing inserts in place, install the cap to the rod and torque the fasteners to specifications. Use a telescoping gauge and carefully measure the inside diameter of the bearings. Compare this reading to the rods original crankshaft journal diameter measurement. The difference is the oil clearance. If the oil clearance is not within specifications, install new bearings in the rod and take another measurement. If the clearance is still out of specifications, and the crankshaft is not, the rod will need to be reconditioned by a machine shop.

➡You can also use Plastigage® to check the bearing clearances. The assembling section has complete instructions on its use.

Camshaft

Inspect the camshaft and lifters/followers as described earlier in this section.

Bearings

All of the engine bearings should be visually inspected for wear and/or damage. The bearing should look evenly worn all around with no deep scores or pits. If the bearing is severely worn, scored, pitted or heat blued, then the bearing, and the components that use it, should be brought to a machine shop for inspection. Full-circle bearings (used on most camshafts, auxiliary shafts, balance shafts, etc.) require specialized tools for removal and installation, and should be brought to a machine shop for service.

Oil Pump

➡The oil pump is responsible for providing constant lubrication to the whole engine and so it is recommended that a new oil pump be installed when rebuilding the engine.

Completely disassemble the oil pump and thoroughly clean all of the components. Inspect the oil pump gears and housing for wear and/or damage. Insure that the pressure relief valve operates properly and there is no binding or sticking due to varnish or debris. If all of the parts are in proper working condition, lubricate the gears and relief valve, and assemble the pump.

REFINISHING

See Figure 150

Almost all engine block refinishing must be performed by a machine shop. If the cylinders are not to be rebored, then the cylinder glaze can be removed with a ball hone. When removing cylinder glaze with a ball hone, use a light or penetrating type oil to lubricate the hone. Do not allow the hone to run dry as this may cause excessive scoring of the cylinder bores and wear on the hone. If new pistons are required, they will need to be installed to the connecting rods. This should be performed by a machine shop as the pistons must be installed in the correct relationship to the rod or engine damage can occur.

Pistons and Connecting Rods

See Figure 151

Only pistons with the wrist pin retained by C-clips are serviceable by the home-mechanic. Press fit pistons require special presses and/or heaters to remove/install the connecting rod and should only be performed by a machine shop.

All pistons will have a mark indicating the direction to the front of the engine and the must be installed into the engine in that manner. Usually it is a notch or arrow on the top of the piston, or it may be the letter F cast or stamped into the piston.

TCCS3210

Fig. 149 Measure the piston's outer diameter, perpendicular to the wrist pin, with a micrometer

TCCS3913

Fig. 150 Use a ball type cylinder hone to remove any glaze and provide a new surface for seating the piston rings

TCCS3814

Fig. 151 Most pistons are marked to indicate positioning in the engine (usually a mark means the side facing the front)

C-CLIP TYPE PISTONS

1. Note the location of the forward mark on the piston and mark the connecting rod in relation.
2. Remove the C-clips from the piston and withdraw the wrist pin.

➡Varnish build-up or C-clip groove burrs may increase the difficulty of removing the wrist pin. If necessary, use a punch or drift to carefully tap the wrist pin out.

3. Insure that the wrist pin bushing in the connecting rod is usable, and lubricate it with assembly lube.
4. Remove the wrist pin from the new piston and lubricate the pin bores on the piston.
5. Align the forward marks on the piston and the connecting rod and install the wrist pin.
6. The new C-clips will have a flat and a rounded side to them. Install both C-clips with the flat side facing out.
7. Repeat all of the steps for each piston being replaced.

ASSEMBLY

Before you begin assembling the engine, first give yourself a clean, dirt free work area. Next, clean every engine component again. The key to a good assembly is cleanliness.

Mount the engine block into the engine stand and wash it one last time using water and detergent (dishwashing detergent works well). While washing it, scrub the cylinder bores with a soft bristle brush and thoroughly clean all of the oil passages. Completely dry the engine and spray the entire assembly down with an anti-rust solution such as WD-40® or similar product. Take a clean lint-free rag and wipe up any excess anti-rust solution from the bores, bearing saddles, etc. Repeat the final cleaning process on the crankshaft. Replace any freeze or oil galley plugs which were removed during disassembly.

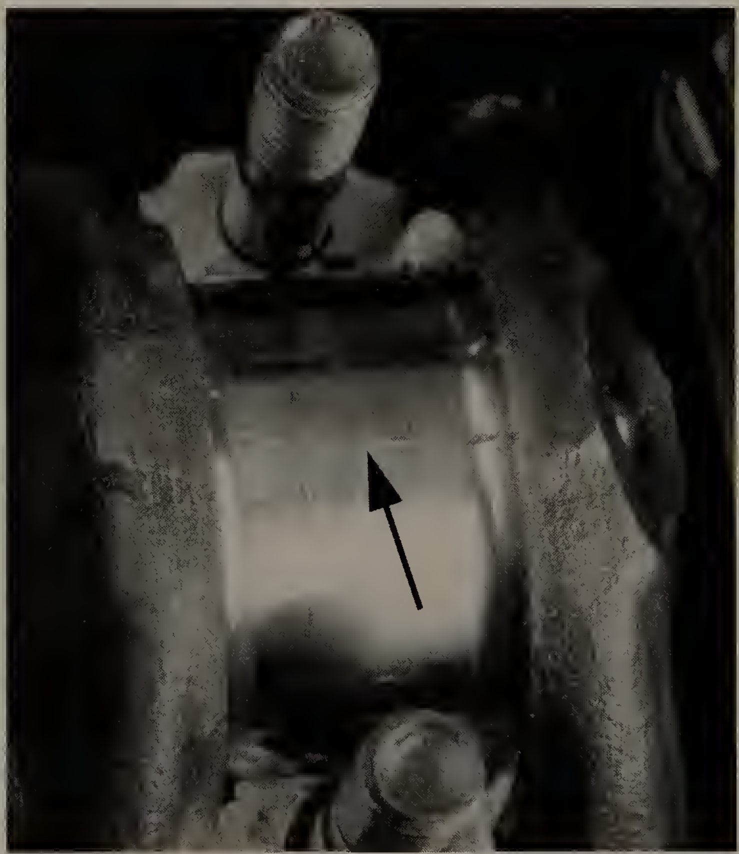
Crankshaft

➧ See Figures 152, 153, 154 and 155

1. Remove the main bearing inserts from the block and bearing caps.
2. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearing. Be sure that the bearing inserts and bearing bores are clean. Foreign material under inserts will distort bearing and cause failure.
3. Place the upper main bearing inserts in bores with tang in slot.

➡The oil holes in the bearing inserts must be aligned with the oil holes in the cylinder block.

4. Install the lower main bearing inserts in bearing caps.
5. Clean the mating surfaces of block and rear main bearing cap.
6. Carefully lower the crankshaft into place. Be careful not to damage bearing surfaces.
7. Check the clearance of each main bearing by using the following procedure:
   a. Place a piece of Plastigage® or its equivalent, on bearing surface across full width of bearing cap and about ¼ in. off center.
   b. Install cap and tighten bolts to specifications. Do not turn crankshaft while Plastigage® is in place.
   c. Remove the cap. Using the supplied Plastigage® scale, check width of Plastigage® at widest point to get maximum clearance. Difference between readings is taper of journal.
   d. If clearance exceeds specified limits, try a 0.001 in. or 0.002 in. undersize bearing in combination with the standard bearing. Bearing clearance must be within specified limits. If standard and 0.002 in. undersize bearing does not bring clearance within desired limits, refinish crankshaft journal, then install undersize bearings.
8. Install the rear main seal.
9. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings. Install the rear main bearing cap. Install all bearing caps except the thrust bearing cap. Be sure that main bearing caps are installed in original locations. Tighten the bearing cap bolts to specifications.
10. Install the thrust bearing cap with bolts finger-tight.
11. Pry the crankshaft forward against the thrust surface of upper half of bearing.
12. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This aligns the thrust surfaces of both halves of the bearing.

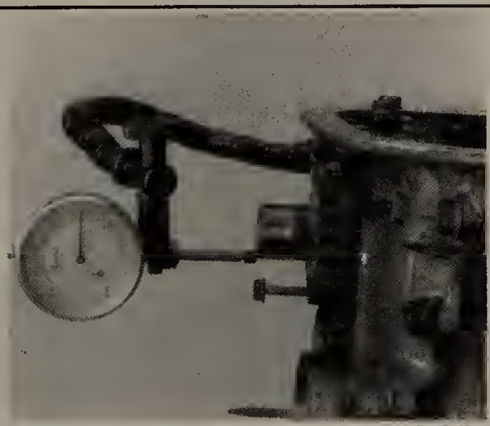


TCCS3243

Fig. 152 Apply a strip of gauging material to the bearing journal, then install and torque the cap

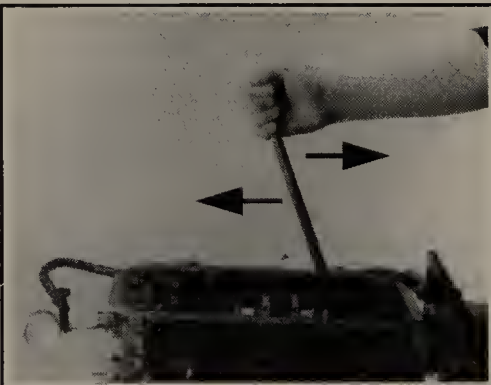
TCCS3912

Fig. 153 After the cap is removed again, use the scale supplied with the gauging material to check the clearance



TCCS3805

Fig. 154 A dial gauge may be used to check crankshaft end-play



TCCS3806

Fig. 155 Carefully pry the crankshaft back and forth while reading the dial gauge for end-play

13. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications.
14. Measure the crankshaft end-play as follows:
a. Mount a dial gauge to the engine block and position the tip of the gauge to read from the crankshaft end.
b. Carefully pry the crankshaft toward the rear of the engine and hold it there while you zero the gauge.
c. Carefully pry the crankshaft toward the front of the engine and read the gauge.
d. Confirm that the reading is within specifications. If not, install a new thrust bearing and repeat the procedure. If the reading is still out of specifications with a new bearing, have a machine shop inspect the thrust surfaces of the crankshaft, and if possible, repair it.
15. Rotate the crankshaft so as to position the first rod journal to the bottom of its stroke.

Pistons and Connecting Rods

See Figures 156, 157, 158 and 159

1. Before installing the piston/connecting rod assembly, oil the pistons, piston rings and the cylinder walls with light engine oil. Install connecting rod bolt protectors or rubber hose onto the connecting rod bolts/studs. Also perform the following:

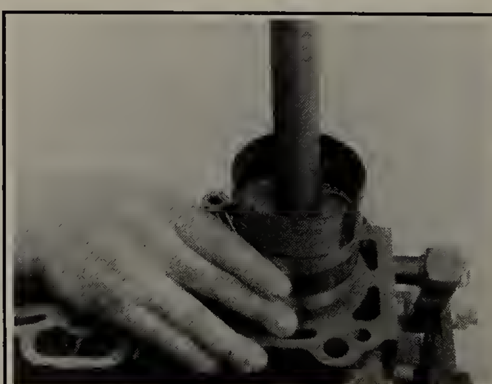

TCCS3923
Fig. 156 Checking the piston ring-to-ring groove side clearance using the ring and a feeler gauge

a. Select the proper ring set for the size cylinder bore.
b. Position the ring in the bore in which it is going to be used.
c. Push the ring down into the bore area where normal ring wear is not encountered.
d. Use the head of the piston to position the ring in the bore so that the ring is square with the cylinder wall. Use caution to avoid damage to the ring or cylinder bore.
e. Measure the gap between the ends of the ring with a feeler gauge. Ring gap in a worn cylinder is normally greater than specification. If the ring gap is greater than the specified limits, try an oversize ring set.
f. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land according to specification. The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. If the lower lands have high steps, the piston should be replaced.

2. Unless new pistons are installed, be sure to install the pistons in the cylinders from which they were removed. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one engine or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number. The notch on the piston head goes toward the front of the engine.
3. Install all of the rod bearing inserts into the rods and caps.
4. Install the rings to the pistons. Install the oil control ring first, then the second compression ring and finally the top compression ring. Use a piston ring expander tool to aid in installation and to help reduce the chance of breakage.
5. Make sure the ring gaps are properly spaced around the circumference of the piston. Fit a piston ring compressor around the piston and slide the piston and connecting rod assembly down into the cylinder bore, pushing it in with the wooden hammer handle. Push the piston down until it is only slightly below the top of the cylinder bore. Guide the connecting rod onto the crankshaft bearing journal carefully, to avoid damaging the crankshaft.
6. Check the bearing clearance of all the rod bearings, fitting them to the crankshaft bearing journals. Follow the procedure in the crankshaft installation above.
7. After the bearings have been fitted, apply a light coating of assembly oil to the journals and bearings.
8. Turn the crankshaft until the appropriate bearing journal is at the bottom of its stroke, then push the piston assembly all the way down until the connecting rod bearing seats on the crankshaft journal. Be careful not to allow the bearing cap screws to strike the crankshaft bearing journals and damage them.
9. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each crankshaft journal.
10. Prime and install the oil pump and the oil pump intake tube.
11. Install the auxiliary/balance shaft(s)/assembly(ies).
12. Install the camshaft.
13. Install the lifters/followers into their bores.
14. Install the timing gears/chain assembly.
15. Install the cylinder head(s) using new gaskets.
16. Assemble the rest of the valve train (pushrods and rocker arms and/or shafts).


TCCS3917
Fig. 157 The notch on the side of the bearing cap matches the tang on the bearing insert


TCCS3222
Fig. 158 Most rings are marked to show which side of the ring should face up when installed to the piston


TCCS3914
Fig. 159 Install the piston and rod assembly into the block using a ring compressor and the handle of a hammer

Engine Start-up and Break-in

STARTING THE ENGINE

Now that the engine is installed and every wire and hose is properly connected, go back and double check that all coolant and vacuum hoses are connected. Check that you oil drain plug is installed and properly tightened. If not already done, install a new oil filter onto the engine. Fill the crankcase with the proper amount and grade of engine oil. Fill the cooling system with a 50/50 mixture of coolant/water.

1. Connect the vehicle battery.
2. Start the engine. Keep your eye on your oil pressure indicator; if it does not indicate oil pressure within 10 seconds of starting, turn the vehicle off.

WARNING

Damage to the engine can result if it is allowed to run with no oil pressure. Check the engine oil level to make sure that it is full. Check for any leaks and if found, repair the leaks before continuing. If there is still no indication of oil pressure, you may need to prime the system.

3. Confirm that there are no fluid leaks (oil or other).
4. Allow the engine to reach normal operating temperature (the upper radiator hose will be hot to the touch).
5. If necessary, set the ignition timing.
6. Install any remaining components such as the air cleaner (if removed for ignition timing) or body panels which were removed.

BREAKING IT IN

Make the first miles on the new engine, easy ones. Vary the speed but do not accelerate hard. Most importantly, do not lug the engine, and avoid sustained high speeds until at least 100 miles. Check the engine oil and coolant levels frequently. Expect the engine to use a little oil until the rings seat. Change the oil and filter at 500 miles, 1500 miles, then every 3000 miles past that.

KEEP IT MAINTAINED

Now that you have just gone through all of that hard work, keep yourself from doing it all over again by thoroughly maintaining it. Not that you may not have maintained it before, heck you could have had one to two hundred thousand miles on it before doing this. However, you may have bought the vehicle used, and the previous owner did not keep up on maintenance. Which is why you just went through all of that hard work. See?

TORQUE SPECIFICATIONS

Component	ft. lbs.	Inch lbs.	Nm
Rocker Arm Cover			
VIN 8 Engines			
1984 vehicles		50	6
1985-87 vehicles		80-120	9-13
1988 vehicles		60-90	7-10
1989-91 vehicles		89	10
VIN P & 5 Engines			
1992 vehicles		90	10
1993-95 vehicles		100	11
1996 vehicles		106	12
Camshaft Cover			
VIN J Engines			
Camshaft Cover Bolts			
24 M8 bolts (3 times)	15		20
3 M6 screws (3 times)		89	10
Coolant outlet cover screws		89	10
Fresh air pipe bracket-to-injector housing bolt	19		26
Upper EGR pipe bolts		89	10
Cable hold-down clamp-to-plenum screws		18	2
Throttle body screws		53	6
Power steering pump bolts	24		33
Thermostat Housing			
VIN 8 Engines			
1984-89 vehicles	18-23		24-31
1990-91 vehicles	25		34
VIN J Engines			
Hose clamp screws		35	4
Thermostat housing bracket bolts	18		25
VIN P & 5 Engines		89	10
Intake Manifold			
VIN 8 Engines			
1984 vehicles	35		47
1985-88 vehicles	25-45		34-61
1989 vehicles	35		47
1990-91 vehicles			
All bolts except nos. 1 & 4	35		47
Bolt no. 1 & 4	45		61
VIN J Engines			
MAP sensor bracket-to-plenum screws		89	10
Throttle body-to-plenum screws	19		26
Throttle body extension-to-plenum screws		53	6
Ignition module-to-plenum screws		89	10
Intake plenum bolts	19		26
VIN P & 5			
Step 1 (all vehicles)		71	8
Step 2 (1992 vehicles)	19		26
Step 2 (1993-96 vehicles)	35		48

91033C10

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Exhaust Manifold			
VIN 8 Engines			
1984-88 vehicles	20		27
1989-91 vehicles			
Exhaust manifold bolts	19		26
Front crossover pipe-to-manifold flange nuts	15		20
VIN J Engines			
1990-91 vehicles			
Stud	11		15
Manifold rear bolts	11		15
Exhaust pipe flange bolts	15		20
Manifold front bolts and stud nut	11		15
1992-95			
Manifold bolts	18		25
Rear manifold bolts, spacers and nuts	18		25
Catalytic converter bolts	17		23
VIN P & 5 Engines			
1993 vehicles	26		35
1994 vehicles	35		47
1995 vehicles	26		35
1996 vehicles	30		40
Radiator			
VIN 8			
Automatic transmission oil cooler line fittings	20		27
VIN J, P & 5			
Upper support-to-front side member nuts and bolts	18		25
Fan shroud-to-upper support screws		80	9
Accumulator bracket-to-upper support retainers		80	9
Oil cooler line fittings		89	10
Fan			
VIN 8 & J Engines		89	10
VIN P & 5			
1992 vehicles		89	10
1993-96 vehicles			
Lower fan-to-shroud bolts		89	10
Impact bar-to-front extension and front crossmember bolts		20	27
Fan assembly-to-fan shroud bolts and screws		89	10
Water Pump			
VIN 8 Engines			
1984-88 vehicles	25-35		33-47
1989-91 vehicles			
Heater hose-to-pump fitting	27		37
Water pump-to-block bolts	30		40
VIN J Engines			
Water pump and A/C compressor bolts	20		27
Alternator mounting bolts	39		52
Alternator bracket bolts	20		27
Belt tensioner-to-cylinder case bolt	45		60
VIN P & 5 Engines	30		41

91033C11

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Cylinder Head			
VIN 8 Engines			
Long cylinder head bolts	60-75		81-101
Short cylinder head bolts	55-65		74-88
VIN J Engines			
1st pass	45		60
2nd pass	74		100
3rd pass	118		160
Fixed guide bolt	19		26
VIN P & 5 Engines			
Cylinder head bolts, using 3 passes	65		88
Oil Pan			
VIN 8 Engines			
1984-85 vehicles		80	9
1986 vehicles			
Oil pan-to-crankcase nuts	14		19
Oil pan studs		80	9
1987-88 vehicles			
Oil pan-to-crankcase nuts	16		22
Corner oil pan-to-crankcase studs		15	2
Oil pan-to-case studs	8		11
1989-91 vehicle	16		22
VIN J Engines			
Oil pan front screws		106	12
Oil pan bolts	23		31
Left and right front crossmember rear brace to front crossmember bolts	59		80
Left and right front crossmember rear brace to front side member bolts	46		62
Engine mounts-to-front crossmember bolts	40		54
AIR pipe bracket-to-oil pan bolts		89	10
Oil level sensor	18		25
Left and right wiring harness heat shield bolts		89	10
Clutch housing cover bolts	80		9
VIN P & 5 Engines			
Corner bolts or stud and nuts			
1992 vehicles	17		23
1993-96 vehicles	15		20
Remaining bolts and studs	8		11
Oil level sensor	16		22
Knock sensor shield nuts		75	8.5
Oil filter adapter retainers	17		23
Oil Pump			
VIN 8 Engines			
Oil pump-to-rear bearing cap bolt	80		108
VIN J Engines			
Oil pump bolts	19		26
VIN P & 5 Engines			
Oil pump bolts	65		88
Baffle nuts	25		34

91033 C12

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Crankshaft Damper			
VIN 8 Engines	60		81
VIN J Engines	148		200
VIN P & 5 Engines			
Crankshaft hub bolt	70-75		95-102
Balancer bolts/screw	60		81
Timing Chain Cover			
VIN 8 Engines		80	9
VIN J Engines			
Front cover attaching bolts	19		26
Stud nuts	21		28
VIN P & 5 engines		100	11
Timing Chain & Sprockets			
VIN 8 Engines			
Camshaft sprocket bolts	20		27
VIN J Engines			
Primary chain guide bolts		89	10
VIN P & 5 Engines			
Water pump driveshaft retainer bolts		108	12
Camshaft sprocket bolts	21		28
Rear Main Seal			
VIN 8, P & 5 Engines			
1984-85 vehicles			
Rear main bearing cap bolts	10-12		14-16
Flywheel			
Flywheel retaining bolts	74		100

91033C13

4

DRIVEABILITY AND EMISSION CONTROLS

AIR EMISSIONS

The earth's atmosphere, at or near sea level, consists approximately of 78 percent nitrogen, 21 percent oxygen and 1 percent other gases. If it were possible to remain in this state, 100 percent clean air would result. However, many varied sources allow other gases and particulates to mix with the clean air, causing our atmosphere to become unclean or polluted.Some of these pollutants are visible while others are invisible, with each having the capability of causing distress to the eyes, ears, throat, skin and respiratory system. Should these pollutants become concentrated in a specific area and under certain conditions, death could result due to the displacement or chemical change of the oxygen content in the air. These pollutants can also cause great damage to the environment and to the many man made objects that are exposed to the elements.To better understand the causes of air pollution, the pollutants can be categorized into 3 separate types, natural, industrial and automotive.

Natural Pollutants

Natural pollution has been present on earth since before man appeared and continues to be a factor when discussing air pollution, although it causes only a small percentage of the overall pollution problem. It is the direct result of decaying organic matter, wind born smoke and particulates from such natural events as plain and forest fires (ignited by heat or lightning), volcanic ash, sand and dust which can spread over a large area of the countryside.Such a phenomenon of natural pollution has been seen in the form of volcanic eruptions, with the resulting plume of smoke, steam and volcanic ash blotting out the sun's rays as it spreads and rises higher into the atmosphere. As it travels into the atmosphere the upper air currents catch and carry the smoke and ash, while condensing the steam back into water vapor. As the water vapor, smoke and ash travel on their journey, the smoke dissipates into the atmosphere while the ash and moisture settle back to earth in a trail hundreds of miles long. In some cases, lives are lost and millions of dollars of property damage result.

Industrial Pollutants

Industrial pollution is caused primarily by industrial processes, the burning of coal, oil and natural gas, which in turn produce smoke and fumes. Because the burning fuels contain large amounts of sulfur, the principal ingredients of smoke and fumes are sulfur dioxide and particulate matter. This type of pollutant occurs most severely during still, damp and cool weather, such as at night. Even in its less severe form, this pollutant is not confined to just cities. Because of air movements, the pollutants move for miles over the surrounding countryside, leaving in its path a barren and unhealthy environment for all living things.Working with Federal, State and Local mandated regulations and by carefully monitoring emissions, big business has greatly reduced the amount of pollutant introduced from its industrial sources, striving to obtain an acceptable level. Because of the mandated industrial emission clean up, many land areas and streams in and around the cities that were formerly barren of vegetation and life, have now begun to move back in the direction of nature's intended balance.

Automotive Pollutants

The third major source of air pollution is automotive emissions. The emissions from the internal combustion engines were not an appreciable problem years ago because of the small number of registered vehicles and the nation's small highway system. However, during the early 1950's, the trend of the American people was to move from the cities to the surrounding suburbs. This caused an immediate problem in transportation because the majority of suburbs were not afforded mass transit conveniences. This lack of transportation created an attractive market for the automobile manufacturers, which resulted in a dramatic increase in the number of vehicles produced and sold, along with a marked increase in highway construction between cities and the suburbs. Multi-vehicle families emerged with a growing emphasis placed on an individual vehicle per family member. As the increase in vehicle ownership and usage occurred, so did pollutant levels in and around the cities, as suburbanites drove daily to their businesses and employment, returning at the end of the day to their homes in the suburbs.It was noted that a smoke and fog type haze was being formed and at times, remained in suspension over the cities, taking time to dissipate. At first this "smog," derived from the words "smoke" and "fog," was thought to result from industrial pollution but it was determined that automobile emissions shared the blame. It was discovered that when normal automobile emissions were exposed to sunlight for a period of time, complex chemical reactions would take place.It is now known that smog is a photo chemical layer which develops when certain oxides of nitrogen (NOx) and unburned hydrocarbons (HC) from automobile emissions are exposed to sunlight. Pollution was more severe when smog would become stagnant over an area in which a warm layer of air settled over the top of the cooler air mass, trapping and holding the cooler mass at ground level. The trapped cooler air would keep the emissions from being dispersed and diluted through normal air flows. This type of air stagnation was given the name "Temperature Inversion."

TEMPERATURE INVERSION

In normal weather situations, surface air is warmed by heat radiating from the earth's surface and the sun's rays. This causes it to rise upward, into the atmosphere. Upon rising it will cool through a convection type heat exchange with the cooler upper air. As warm air rises, the surface pollutants are carried upward and dissipated into the atmosphere.When a temperature inversion occurs, we find the higher air is no longer cooler, but is warmer than the surface air, causing the cooler surface air to become trapped. This warm air blanket can extend from above ground level to a few hundred or even a few thousand feet into the air. As the surface air is trapped, so are the pollutants, causing a severe smog condition. Should this stagnant air mass extend to a few thousand feet high, enough air movement with the inversion takes place to allow the smog layer to rise above ground level but the pollutants still cannot dissipate. This inversion can remain for days over an area, with the smog level only rising or lowering from ground level to a few hundred feet high. Meanwhile, the pollutant levels increase, causing eye irritation, respiratory problems, reduced visibility, plant damage and in some cases, even disease.This inversion phenomenon was first noted in the Los Angeles, California area. The city lies in terrain resembling a basin and with certain weather conditions, a cold air mass is held in the basin while a warmer air mass covers it like a lid.Because this type of condition was first documented as prevalent in the Los Angeles area, this type of trapped pollution was named Los Angeles Smog, although it occurs in other areas where a large concentration of automobiles are used and the air remains stagnant for any length of time.

HEAT TRANSFER

Consider the internal combustion engine as a machine in which raw materials must be placed so a finished product comes out. As in any machine operation, a certain amount of wasted material is formed. When we relate this to the internal combustion engine, we find that through the input of air and fuel, we obtain power during the combustion process to drive the vehicle. The by-product or waste of this power is, in part, heat and exhaust gases with which we must dispose.The heat from the combustion process can rise to over 4000°F (2204°C). The dissipation of this heat is controlled by a ram air effect, the use of cooling fans to cause air flow and a liquid coolant solution surrounding the combustion area to transfer the heat of combustion through the cylinder walls and into the coolant. The coolant is then directed to a thin-finned, multi-tubed radiator, from which the excess heat is transferred to the atmosphere by 1 of the 3 heat transfer methods, conduction, convection or radiation.The cooling of the combustion area is an important part in the control of exhaust emissions. To understand the behavior of the combustion and transfer of its heat, consider the air/fuel charge. It is ignited and the flame front burns progressively across the combustion chamber until the burning charge reaches the cylinder walls. Some of the fuel in contact with the walls is not hot enough to burn, thereby snuffing out or quenching the combustion process. This leaves unburned fuel in the combustion chamber. This unburned fuel is then forced out of the cylinder and into the exhaust system, along with the exhaust gases.Many attempts have been made to minimize the amount of unburned fuel in the combustion chambers due to quenching, by increasing the coolant temperature and lessening the contact area of the coolant around the combustion area. However, design limitations within the combustion chambers prevent the complete burning of the air/fuel charge, so a certain amount of the unburned fuel is still expelled into the exhaust system, regardless of modifications to the engine.

AUTOMOTIVE EMISSIONS

Before emission controls were mandated on internal combustion engines, other sources of engine pollutants were discovered along with the exhaust emissions. It was determined that engine combustion exhaust produced approximately 60 percent of the total emission pollutants, fuel evaporation from the fuel tank and carburetor vents produced 20 percent, with the final 20 percent being produced through the crankcase as a by-product of the combustion process.

Exhaust Gases

The exhaust gases emitted into the atmosphere are a combination of burned and unburned fuel. To understand the exhaust emission and its composition, we must review some basic chemistry.When the air/fuel mixture is introduced into the engine, we are mixing air, composed of nitrogen (78 percent), oxygen (21 percent) and other gases (1 percent) with the fuel, which is 100 percent hydrocarbons (HC), in a semi-controlled ratio. As the combustion process is accomplished, power is produced to move the vehicle while the heat of combustion is transferred to the cooling system. The exhaust gases are then composed of nitrogen, a diatomic gas (N_2), the same as was introduced in the engine, carbon dioxide (CO_2), the same gas that is used in beverage carbonation, and water vapor (H_2O). The nitrogen (N_2), for the most part, passes through the engine unchanged, while the oxygen (O_2) reacts (burns) with the hydrocarbons (HC) and produces the carbon dioxide (CO_2) and the water vapors (H_2O). If this chemical process would be the only process to take place, the exhaust emissions would be harmless. However, during the combustion process, other compounds are formed which are considered dangerous. These pollutants are hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NOx) oxides of sulfur (SOx) and engine particulates.

HYDROCARBONS

Hydrocarbons (HC) are essentially fuel which was not burned during the combustion process or which has escaped into the atmosphere through fuel evaporation. The main sources of incomplete combustion are rich air/fuel mixtures, low engine temperatures and improper spark timing. The main sources of hydrocarbon emission through fuel evaporation on most vehicles used to be the vehicle's fuel tank and carburetor float bowl.To reduce combustion hydrocarbon emission, engine modifications were made to minimize dead space and surface area in the combustion chamber. In addition, the air/fuel mixture was made more lean through the improved control which feedback carburetion and fuel injection offers and by the addition of external controls to aid in further combustion of the hydrocarbons outside the engine. Two such methods were the addition of air injection systems, to inject fresh air into the exhaust manifolds and the installation of catalytic converters, units that are able to burn traces of hydrocarbons without affecting the internal combustion process or fuel economy.To control hydrocarbon emissions through fuel evaporation, modifications were made to the fuel tank to allow storage of the fuel vapors during periods of engine shut-down. Modifications were also made to the air intake system so that at specific times during engine operation, these vapors may be purged and burned by blending them with the air/fuel mixture.

CARBON MONOXIDE

Carbon monoxide is formed when not enough oxygen is present during the combustion process to convert carbon (C) to carbon dioxide (CO_2). An increase in the carbon monoxide (CO) emission is normally accompanied by an increase in the hydrocarbon (HC) emission because of the lack of oxygen to completely burn all of the fuel mixture.Carbon monoxide (CO) also increases the rate at which the photo chemical smog is formed by speeding up the conversion of nitric oxide (NO) to nitrogen dioxide (NO_2). To accomplish this, carbon monoxide (CO) combines with oxygen (O_2) and nitric oxide (NO) to produce carbon dioxide (CO_2) and nitrogen dioxide (NO_2). ($CO + O_2 + NO = CO_2 + NO_2$).The dangers of carbon monoxide, which is an odorless and colorless toxic gas are many. When carbon monoxide is inhaled into the lungs and passed into the blood stream, oxygen is replaced by the carbon monoxide in the red blood cells, causing a reduction in the amount of oxygen supplied to the many parts of the body. This lack of oxygen causes headaches, lack of coordination, reduced mental alertness and, should the carbon monoxide concentration be high enough, death could result.

NITROGEN

Normally, nitrogen is an inert gas. When heated to approximately 2500°F (1371°C) through the combustion process, this gas becomes active and causes an increase in the nitric oxide (NO) emission.Oxides of nitrogen (NOx) are composed of approximately 97–98 percent nitric oxide (NO). Nitric oxide is a colorless gas but when it is passed into the atmosphere, it combines with oxygen and forms nitrogen dioxide (NO_2). The nitrogen dioxide then combines with chemically active hydrocarbons (HC) and when in the presence of sunlight, causes the formation of photo-chemical smog.

Ozone

To further complicate matters, some of the nitrogen dioxide (NO_2) is broken apart by the sunlight to form nitric oxide and oxygen. (NO_2+ sunlight = NO + O). This single atom of oxygen then combines with diatomic (meaning 2 atoms) oxygen (O_2) to form ozone (O_3). Ozone is one of the smells associated with smog. It has a pungent and offensive odor, irritates the eyes and lung tissues, affects the growth of plant life and causes rapid deterioration of rubber products. Ozone can be formed by sunlight as well as electrical discharge into the air.The most common discharge area on the automobile engine is the secondary ignition electrical system, especially when inferior quality spark plug cables are used. As the surge of high voltage is routed through the secondary cable, the circuit builds up an electrical field around the wire, which acts upon the oxygen in the surrounding air to form the ozone. The faint glow along the cable with the engine running that may be visible on a dark night, is called the "corona discharge." It is the result of the electrical field passing from a high along the cable, to a low in the surrounding air, which forms the ozone gas. The combination of corona and ozone has been a major cause of cable deterioration. Recently, different and better quality insulating materials have lengthened the life of the electrical cables.Although ozone at ground level can be harmful, ozone is beneficial to the earth's inhabitants. By having a concentrated ozone layer called the "ozonosphere," between 10 and 20 miles (16–32 km) up in the atmosphere, much of the ultra violet radiation from the sun's rays are absorbed and screened. If this ozone layer were not present, much of the earth's surface would be burned, dried and unfit for human life.

OXIDES OF SULFUR

Oxides of sulfur (SOx) were initially ignored in the exhaust system emissions, since the sulfur content of gasoline as a fuel is less than 1⁄10 of 1 percent. Because of this small amount, it was felt that it contributed very little to the overall pollution problem. However, because of the difficulty in solving the sulfur emissions in industrial pollution and the introduction of catalytic converters to automobile exhaust systems, a change was mandated. The automobile exhaust system, when equipped with a catalytic converter, changes the sulfur dioxide (SO_2) into sulfur trioxide (SO_3).When this combines with water vapors (H_2O), a sulfuric acid mist (H_2SO_4) is formed and is a very difficult pollutant to handle since it is extremely corrosive. This sulfuric acid mist that is formed, is the same mist that rises from the vents of an automobile battery when an active chemical reaction takes place within the battery cells.When a large concentration of vehicles equipped with catalytic converters are operating in an area, this acid mist may rise and be distributed over a large ground area causing land, plant, crop, paint and building damage.

PARTICULATE MATTER

A certain amount of particulate matter is present in the burning of any fuel, with carbon constituting the largest percentage of the particulates. In gasoline, the remaining particulates are the burned remains of the various other compounds used in its manufacture. When a gasoline engine is in good internal condition, the particulate emissions are low but as the engine wears internally, the particulate emissions increase. By visually inspecting the tail pipe emissions, a determination can be made as to where an engine defect may exist. An engine with light gray or blue smoke emitting from the tail pipe normally indicates an increase in the oil consumption through burning due to internal engine wear Black smoke would indicate a defective fuel delivery system, causing the engine to operate in a rich mode. Regardless of the color of the smoke, the internal part of the engine or the fuel delivery system should be repaired to prevent excess particulate emissions.Diesel and turbine engines emit a darkened plume of smoke from the exhaust system because of the type of fuel used. Emission control regulations are mandated for this type of emission and more stringent measures are being used to prevent excess emission of the particulate matter. Electronic components are being introduced to control the injection of the fuel at precisely the proper time of piston travel, to achieve the optimum in fuel ignition and fuel usage. Other particulate after-burning components are being tested to achieve a cleaner emission.Good grades of engine lubricating oils should be used, which meet the manufacturer's specification. Cut-rate oils can contribute to the particulate emission problem because of their low flash or ignition temperature point. Such oils burn prematurely during the combustion process causing emission of particulate matter.The cooling system is an important factor in the reduction of particulate matter. The optimum combustion will occur, with the cooling system operating at a temperature specified by the manufacturer. The cooling system must be maintained in the same manner as the engine oiling system, as each system is required to perform properly in order for the engine to operate efficiently for a long time.

Crankcase Emissions

Crankcase emissions are made up of water, acids, unburned fuel, oil fumes and particulates. These emissions are classified as hydrocarbons (HC) and are formed by the small amount of unburned, compressed air/fuel mixture entering the crankcase from the combustion area (between the cylinder walls and piston rings) during the compression and power strokes. The head of the compression and combustion help to form the remaining crankcase emissions.Since the first engines, crankcase emissions were allowed into the atmosphere through a road draft tube, mounted on the lower side of the engine block. Fresh air came in through an open oil filler cap or breather. The air passed through the crankcase mixing with blow-by gases. The motion of the vehicle and the air blowing past the open end of the road draft tube caused a low pressure area (vacuum) at the end of the tube. Crankcase emissions were simply drawn out of the road draft tube into the air.To control the crankcase emission, the road draft tube was deleted. A hose and/or tubing was routed from the crankcase to the intake manifold so the blow-by emission could be burned with the air/fuel mixture. However, it was found that intake manifold vacuum, used to draw the crankcase emissions into the manifold, would vary in strength at the wrong time and not allow the proper emission flow. A regulating valve was needed to control the flow of air through the crankcase.Testing, showed the removal of the blow-by gases from the crankcase as quickly as possible, was most important to the longevity of the engine. Should large accumulations of blow-by gases remain and condense, dilution of the engine oil would occur to form water, soots, resins, acids and lead salts, resulting in the formation of sludge and varnishes. This condensation of the blow-by gases occurs more frequently on vehicles used in numerous starting and stopping conditions, excessive idling and when the engine is not allowed to attain normal operating temperature through short runs.

Evaporative Emissions

Gasoline fuel is a major source of pollution, before and after it is burned in the automobile engine. From the time the fuel is refined, stored, pumped and transported, again stored until it is pumped into the fuel tank of the vehicle, the gasoline gives off unburned hydrocarbons (HC) into the atmosphere. Through the redesign of storage areas and venting systems, the pollution factor was diminished, but not eliminated, from the refinery standpoint. However, the automobile still remained the primary source of vaporized, unburned hydrocarbon (HC) emissions.Fuel pumped from an underground storage tank is cool but when exposed to a warmer ambient temperature, will expand. Before controls were mandated, an owner might fill the fuel tank with fuel from an underground storage tank and park the vehicle for some time in warm area, such as a parking lot. As the fuel would warm, it would expand and should no provisions or area be provided for the expansion, the fuel would spill out of the filler neck and onto the ground, causing hydrocarbon (HC) pollution and creating a severe fire hazard. To correct this condition, the vehicle manufacturers added overflow plumbing and/or gasoline tanks with built in expansion areas or domes.However, this did not control the fuel vapor emission from the fuel tank. It was determined that most of the fuel evaporation occurred when the vehicle was stationary and the engine not operating. Most vehicles carry 5–25 gallons (19–95 liters) of gasoline. Should a large concentration of vehicles be parked in one area, such as a large parking lot, excessive fuel vapor emissions would take place, increasing as the temperature increases.To prevent the vapor emission from escaping into the atmosphere, the fuel systems were designed to trap the vapors while the vehicle is stationary, by sealing the system from the atmosphere. A storage system is used to collect and hold the fuel vapors from the carburetor (if equipped) and the fuel tank when the engine is not operating. When the engine is started, the storage system is then purged of the fuel vapors, which are drawn into the engine and burned with the air/fuel mixture.

EMISSION CONTROLS

Crankcase Ventilation System

See Figure 1

The Positive Crankcase Ventilation (PCV) system is used to control crankcase blow-by vapors. The gases are recycled in the following way:

As the engine is running, clean, filtered air is drawn through the air filter and into the crankcase. As the air passes through the crankcase, it picks up the combustion gases and carries them out of the crankcase, through the PCV valve, and into the induction system. As they enter the intake manifold, they are drawn into the combustion chamber where they are reburned.

The most critical component in the system is the PCV valve. This valve controls the amount of gases which are recycled into the combustion chamber. At low engine speeds, the valve is partially closed, limiting the flow of gases into the intake manifold. As engine speed increases, the valve opens to admit greater quantities of gases into the intake manifold. If the PCV valve becomes clogged, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase tube into the air cleaner to be consumed by normal combustion.

The Positive Crankcase Ventilation (PCV) system must be operating correctly to provide complete removal of the crankcase vapors. Fresh air is supplied to the crankcase from the air filter, mixed with the internal exhaust gases, passed through the PCV valve and into the intake manifold.

The PCV valve meters the flow at a rate depending upon the manifold vacuum. If the manifold vacuum is high, the PCV restricts the flow to the intake manifold. If abnormal operating conditions occur, excessive amounts of internal exhaust gases back flow through the crankcase vent tube into the air filter to be burned by normal combustion.

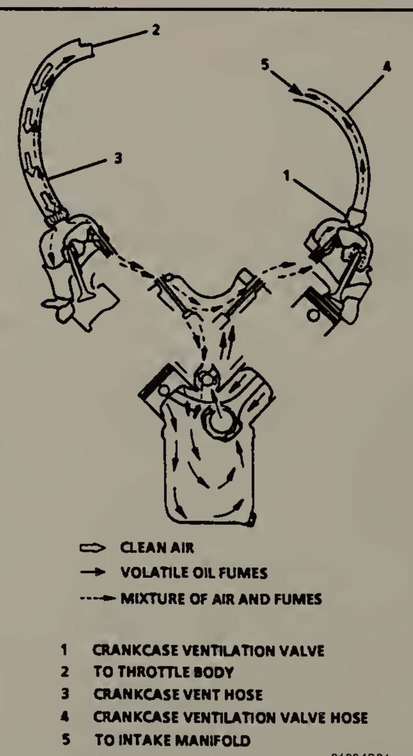


Fig. 1 Typical Positive Crankcase Ventilation (PCV) system airflow schematic—except 5.7L (VIN J) engine

TESTING

➡**Never operate an engine without a PCV valve or a ventilation system, except as directed by testing procedures, for it can become damaged.**

Incorrect operation of the PCV system can cause multiple driveability symptoms.

A plugged valve or hose may cause:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Sludge in engine

A leaking valve or hose would cause:

- Rough idle
- Stalling
- High idle speed

PCV Valve

1. Remove the PCV valve from the intake manifold or valve cover.
2. Run the engine at idle.
3. Place your thumb over the end of the valve. Check for vacuum. If there is no vacuum at the valve, check for plugged valve or vacuum lines.
4. Shut off the engine. Shake the valve and listen for the rattle. If valve doesn't rattle, replace it.

System Functional Check

1. Check the crankcase ventilation valve for correct application.
2. Run engine until normal operating temperature is obtained.
3. Block off crankcase ventilation system fresh air intake passage.
4. Remove the engine oil dipstick and install a vacuum gage on the dipstick tube.
5. Run the engine at 1500 rpm for 30 seconds, then read the vacuum gage while at 1500 rpm. If vacuum is present, the crankcase ventilation system is functioning properly. No vacuum indicates the engine may not be sealed and/or is drawing in outside air. Check valve cover and oil pan gaskets for leaks and repair, as required. If the vacuum gage registers a pressure or the vacuum gage is pushed out of the dipstick tube, check for the correct crankcase ventilation valve, a plugged hose or excessive engine blow-by.

REMOVAL & INSTALLATION

PCV Valve

EXCEPT 5.7L (VIN J) ENGINES

➧ **See Figures 2, 3 and 4**

1. Disconnect the negative battery cable.
2. Unfasten the hose clamps, if necessary, then disconnect the hoses from the PCV valve.
3. Remove the PCV valve from the grommet in the valve cover.

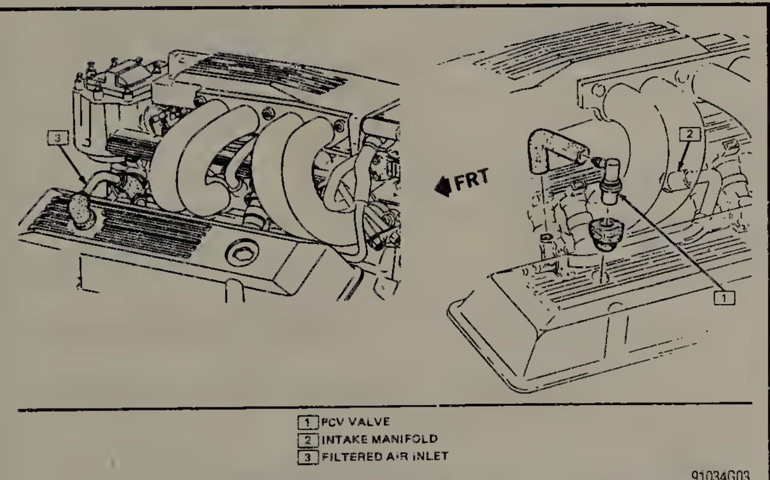


Fig. 2 Location of the PCV valve and related components—1987 vehicle shown

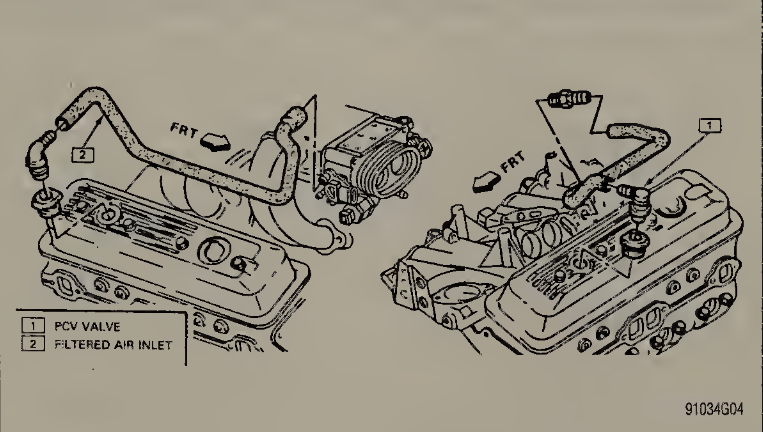


Fig. 3 PCV valve mounting—1990 5.7L (VIN 8) engine

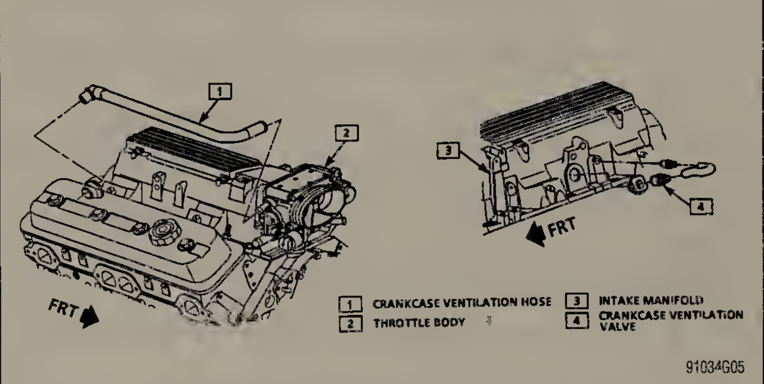


Fig. 4 Exploded view of the PCV valve and related hoses—5.7L (VIN P and 5) engines

To install:

4. Insert the PCV valve into the grommet in the valve cover.
5. Connect the hoses to the PCV valve, then install the hose clamps, if equipped.
6. Connect the negative battery cable.

5.7L (VIN J) ENGINE

➧ **See Figure 5**

➡**This engine is equipped with dual PCV valves.**

1. Disconnect the negative battery cable.
2. Unplug the PCV molded vacuum hose.

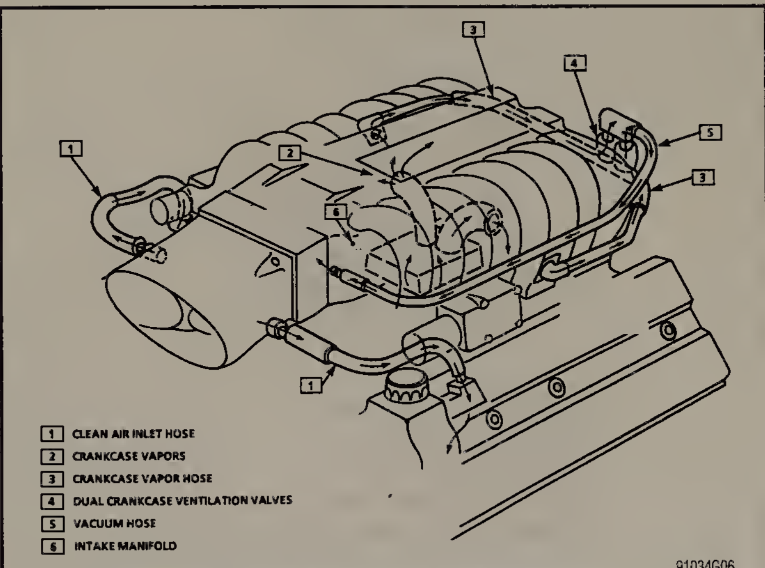


Fig. 5 Schematic of the PCV air flow and valve location—5.7L (VIN J) engine

➡Make sure to note the position of the PCV valves, because they are not interchangeable.

3. Remove the PCV valve(s).

To install:

4. Place the PCV valve(s) into the proper location.
5. Attach the molded vacuum hose to the valve(s).
6. Connect the negative battery cable.

Cylinder Case Ventilation Cover

5.7L (VIN J) ENGINE

◆ See Figures 6 and 7

1. Take your vehicle to a reputable repair shop and have the A/C system discharged using the proper equipment.
2. Disconnect the negative battery cable.
3. Remove the intake plenum assembly.
4. Tag and disconnect the ignition wires from the coil pack.
5. Remove the bolts retaining the ignition coil pack bracket to the ventilation cover and cylinder case.
6. Detach the coil pack electrical connectors, then remove the coil pack from the vehicle.
7. Tag and disconnect the vacuum hoses from the vacuum reservoir.
8. Remove the nuts and washers retaining the vacuum reservoir to the ventilation cover, then remove the reservoir from the vehicle.
9. Tag and disconnect the vacuum hoses from the secondary air inlet solenoid valve.
10. Unfasten the screws retaining the secondary air inlet solenoid valve to the ventilation cover and remove the solenoid valve from the vehicle.
11. Tag and disconnect the vacuum hoses from the secondary air inlet valve actuators.
12. Unfasten the nuts securing the actuators to the brackets.
13. Remove the retaining clips, then remove the actuators from the vehicle.
14. Unfasten the screws retaining the control assembly covers to the actuator brackets, then remove the covers from the vehicle.
15. Remove the link assembly from the lever assembly.
16. Detach the electrical connectors from the Engine Coolant Temperature (ECT) sensor (ECM connected) and the engine coolant temperature gauge sensor.
17. Remove the ECT sensor, and the engine coolant temperature sensor gauge from the injector housing.
18. Remove the serpentine drive belt.

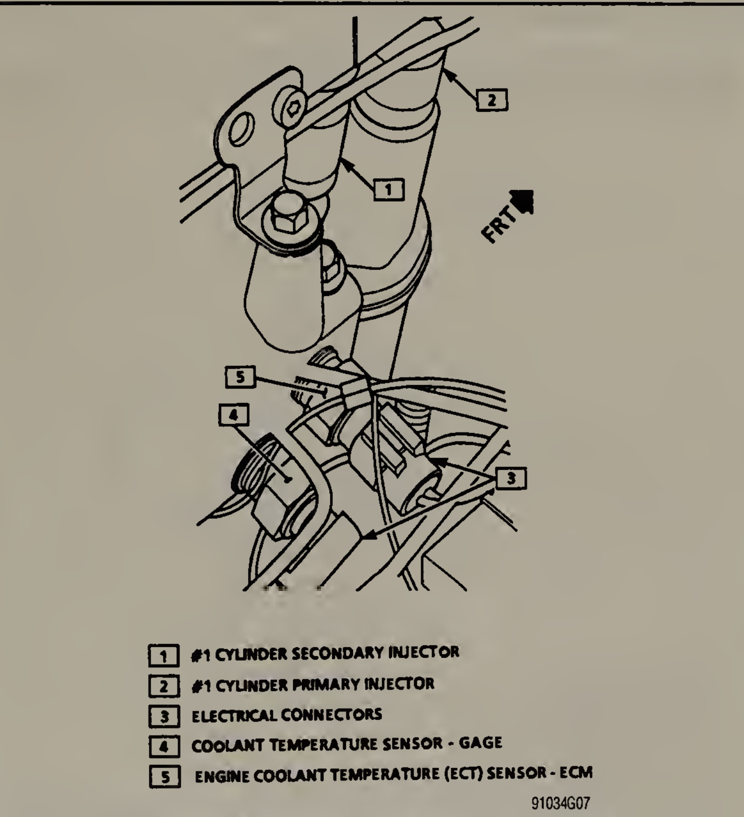


Fig. 6 Location of the engine coolant temperature sensors—5.7L (VIN J) engine

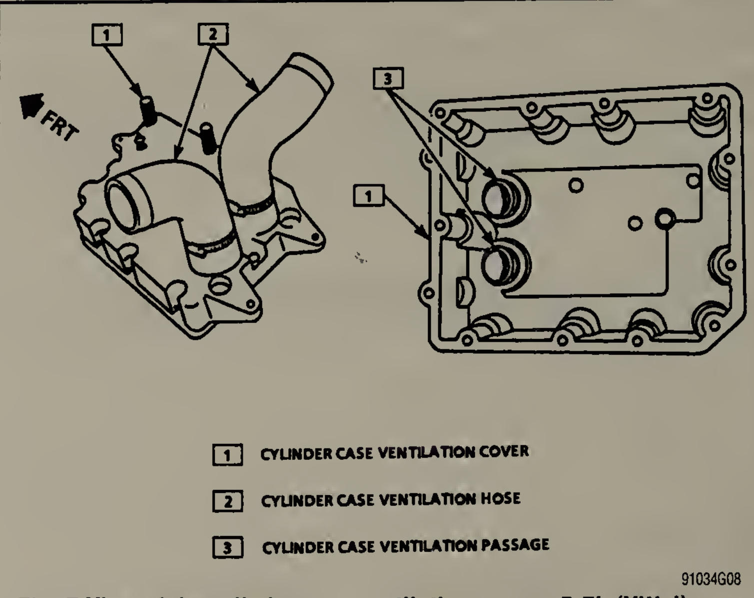


Fig. 7 View of the cylinder case ventilation cover—5.7L (VIN J) engine

⁂ WARNING

When removing the A/C compressor, be careful to avoid damaging the system.

19. Remove the A/C compressor.
20. Disconnect the cylinder case ventilation hoses.
21. Unfasten the bolts/screws securing the cylinder case ventilation cover to the cylinder case.
22. Remove the cover and gasket from the vehicle. Thoroughly clean the gasket mating surfaces. Be careful not to gouge the machined aluminum surfaces when cleaning.

To install:

23. Position the gasket, then install the cylinder case ventilation cover and secure with the retaining bolts. Tighten to 89 inch lbs. (10 Nm).
24. Attach the cylinder case ventilation hoses.
25. Install the A/C compressor and secure with the retaining bolts.
26. Apply Loctite® 565 to the sensors, then install the engine coolant temperature sensors. Attach the electrical connectors.
27. Instal the link assembly onto the lever assembly.
28. Install the actuator covers and screws, then install the actuator and secure with the retaining clips.
29. Install the nut retaining the actuators to the brackets.
30. Connect the vacuum hoses onto the actuators.
31. Install the solenoid valve and screw.
32. Install the vacuum reservoir tank, washers and nuts onto the ventilation cover. Tighten the nuts to 45 inch lbs. (5 Nm).
33. Attach the electrical connectors to the coil pack. Install the nuts retaining the coil pack bracket and tighten to 89 inch lbs. (10 Nm).
34. Connect the spark plug wires to the ignition coil.
35. Instlal the plenum assembly.
36. Connect the negative battery cable.
37. Take the vehicle to a reputable repair shop to have the A/C system recharged.

Cylinder Case Ventilation Baffle

5.7L (VIN J) ENGINE

◆ See Figure 8

1. Remove the cylinder case ventilation cover, as outlined earlier in this section.
2. Unfasten the bolts securing the ventilation baffle to the cylinder case, then remove the baffle from the vehicle.

To install:

3. Apply Loctite® 262 to the baffle retaining bolt threads.
4. Install the baffle and secure with the retaining bolts.
5. Instlal the cylinder case ventilation cover.

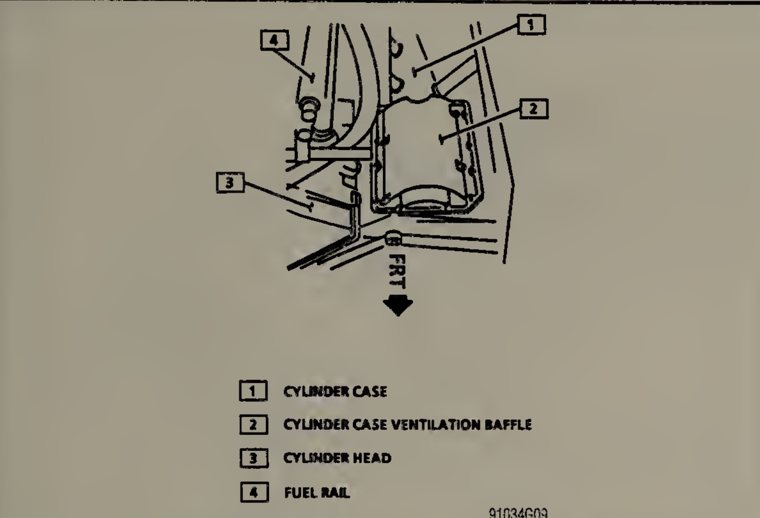


Fig. 8 The cylinder case ventilation baffle is located under the ventilation cover—5.7L (VIN J) engine

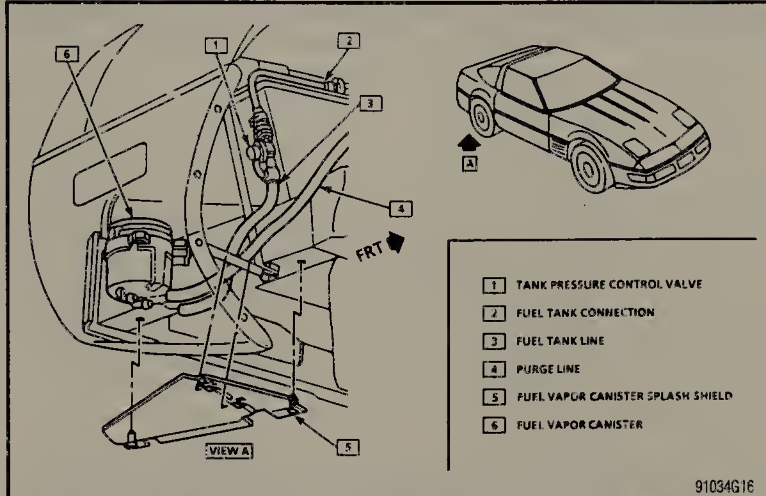


Fig. 10 The canister is located inside the right rear wheel well on 1991–96 vehicles

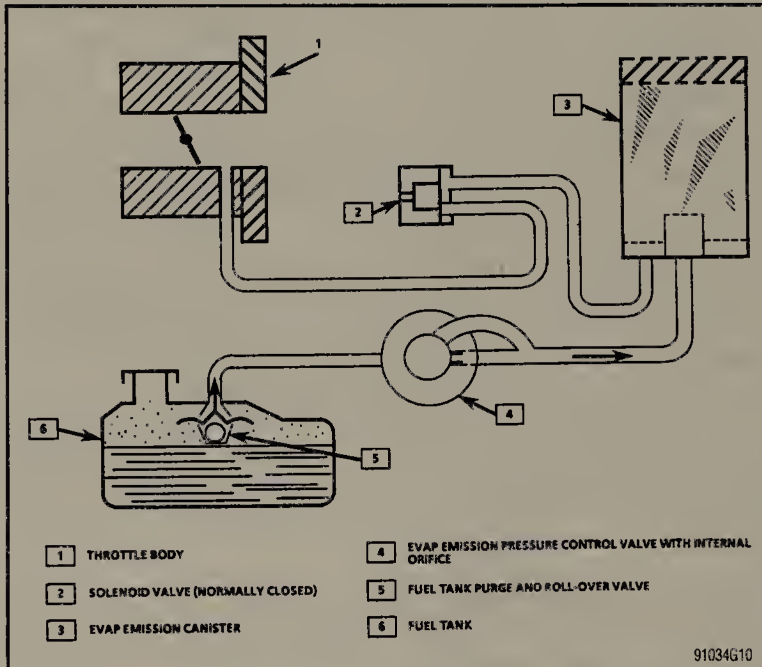


Fig. 11 Typical evaporative emission control system schematic

Evaporative Emission Controls

OPERATION

See Figures 9, 10 and 11

The Evaporative Emission Control (EVAP) System is designed to prevent fuel tank vapors from being emitted into the atmosphere. When the engine is not running, gasoline vapors from the tank are stored in a charcoal canister, mounted either in the left front of the engine compartment on 1984–90 vehicles, or mounted inside the right rear wheel well on 1991–96 vehicles. The charcoal canister absorbs the gasoline vapors and stores them until certain engine conditions are met and the vapors can be purged and burned by the engine. In some vehicles with fuel injection, any liquid fuel entering the canister goes into a reservoir in the bottom of the canister to protect the integrity of the carbon element in the canister above. Three different methods are used to control the purge cycle of the charcoal canister.

First, the charcoal canister purge cycle is controlled by throttle position without the use of a valve on the canister. A vacuum line connects the canister to a ported vacuum source on the throttle body. When the throttle is at any position above idle, fresh air is drawn into the bottom of the canister and the fuel vapors are carried into the throttle body at that port. The air/vapor flow volume is only what can be drawn through the vacuum port and is fairly constant.

Second, the flow volume is modulated with throttle position through a vacuum valve. The ported vacuum from the throttle body is used to open a diaphragm valve on top of the canister. When the valve is open, air and vapors are drawn into the intake manifold, usually through the same manifold port as the PCV system. With this method, the purge valve cycle is slaved to the throttle opening; more throttle opening, more purge air flow.

And third, the charcoal canister purge valve cycle is controlled by the ECM through a solenoid valve on the canister. When the solenoid is activated, full manifold vacuum is applied to the top of the purge valve diaphragm to open the valve all the way. A high volume of fresh air is drawn into the canister and the gasoline vapors are purged quickly. The ECM activates the solenoid valve when the following conditions are met:

- The engine is at normal operating temperature.
- After the engine has been running a specified period of time.
- Vehicle speed is above a predetermined speed.
- Throttle opening is above a predetermined value.

A vent pipe allows fuel vapors to flow to the charcoal canister. On some vehicles, the tank is isolated from the charcoal canister by a tank pressure control valve, located either in the tank or in the vapor line near the canister. It is a combination roll-over, integral pressure and vacuum relief valve. When the vapor pressure in the tank exceeds 0.72 psi (5 kPa), the valve opens to allow vapors to vent to the canister. The valve also provides vacuum relief to protect against vacuum build-up in the fuel tank and roll-over spill protection.

Poor engine idle, stalling and poor driveability can be caused by an inoperative canister purge solenoid, a damaged canister or split, damaged or improperly connected hoses.

The most common symptom of problems in this system is fuel odors coming from under the hood. If there is no liquid fuel leak, check for a cracked or dam-

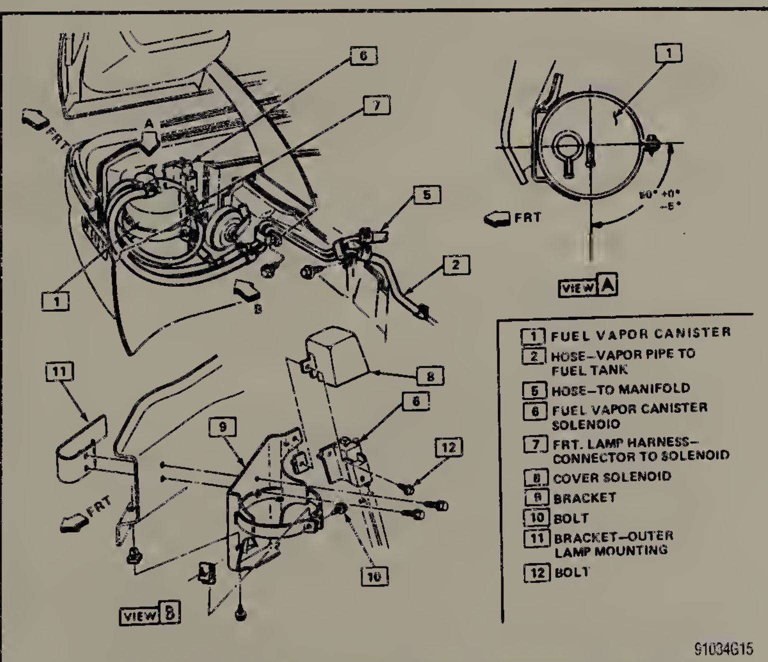


Fig. 9 On 1984–90 vehicles, the canister is mounted in the front drivers side corner of the engine compartment

aged vapor canister, inoperative or always open canister control valve, disconnected, misrouted, kinked or damaged vapor pipe or canister hoses; or a damaged air cleaner or improperly seated air cleaner gasket.

TESTING

Charcoal Canister

1. Visually check the canister for cracks or damage.
2. If fuel is leaking from the bottom of the canister, replace canister and check for proper hose routing.
3. Check the filter at the bottom of the canister. If dirty, replace the filter.

Tank Pressure Control Valve

1. Using a hand-held vacuum pump, apply a vacuum of 15 in. Hg (51 kPa) through the control vacuum signal tube to the purge valve diaphragm. If the diaphragm does not hold vacuum for at least 20 seconds, the diaphragm is leaking. Replace the control valve.
2. With the vacuum still applied to the control vacuum tube, attach a short piece of hose to the valve's tank tube side and blow into the hose. Air should pass through the valve. If it does not, replace the control valve.

Canister Purge Control Valve

1. Connect a clean length of hose to the fuel tank vapor line connection on the canister and attempt to blow through the purge control valve. It should be difficult or impossible to blow through the valve. If air passes easily, the valve is stuck open and should be replaced.
2. Connect a hand-held vacuum pump to the top vacuum line fitting of the purge control valve. Apply a vacuum of 15 in. Hg (51 kPa) to the purge valve diaphragm. If the diaphragm does not hold vacuum for at least 20 seconds the diaphragm is leaking. Replace the control valve. If it is impossible to blow through the valve, it is stuck closed and must be replaced.
3. On vehicles with a solenoid activated purge control valve, unplug the connector and use jumper wires to supply 12 volts to the solenoid connections on the valve. With the vacuum still applied to the control vacuum tube, the purge control valve should open and it should be easy to blow through. If not, replace the valve.

REMOVAL & INSTALLATION

EVAP Canister

➧ **See Figures 10, 12 and 13**

1. Disconnect the negative battery cable.
2. For 1991–96 vehicles, perform the following:

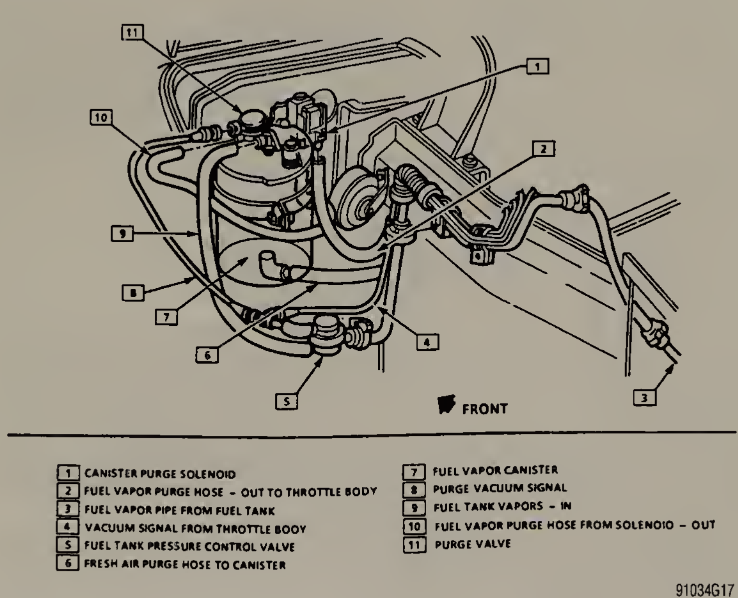


Fig. 12 EVAP canister location and mounting—1990 vehicle shown

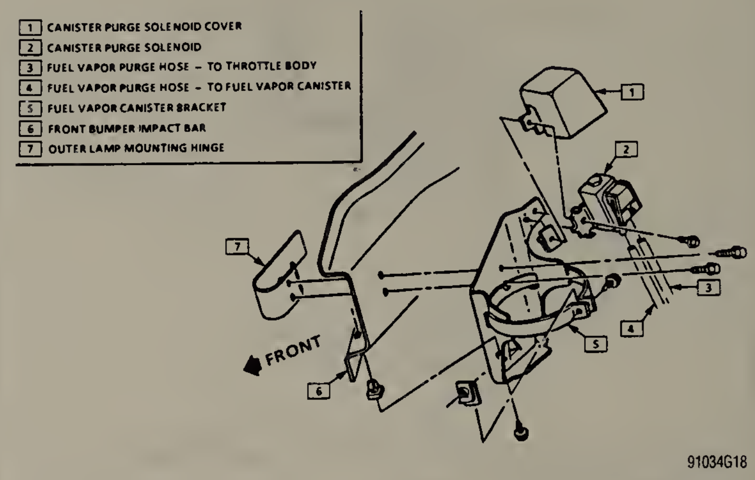


Fig. 13 The EVAP canister and purge solenoid/valve are secured to a mounting bracket—1990 vehicle shown

a. Raise and safely support the vehicle.
b. Remove the right rear tire and wheel assembly.
c. Remove the canister splash shield or access panel.

3. Tag and disconnect the vacuum hoses from the canister.
4. Loosen the screw or release the latch securing the canister retaining bracket.
5. Remove the canister from the vehicle.

To install:

6. Install the canister into the retaining bracket.
7. Tighten the screw or fasten the latch securing the canister retaining bracket, as applicable.
8. Connect the hoses to the canister as tagged during removal.
9. For 1991–96 vehicles, perform the following:

a. Install the access panel or canister splash shield.
b. Install the right rear tire and wheel assembly, then carefully lower the vehicle.

10. Connect the negative battery cable.

EVAP Canister Purge Solenoid/Valve

1984–90 VEHICLES

➧ **See Figure 13**

1. Disconnect the negative battery cable.
2. Unfasten the bolt, then remove the cover and solenoid.
3. Detach the solenoid electrical connector, then remove the solenoid from the vehicle.

To install:

4. Install the solenoid, cover and retaining bolt. Tighten the bolt to 51 inch lbs. (6 Nm).
5. Attach the hoses and electrical connector to the solenoid.
6. Connect the negative battery cable.

1991–96 VEHICLES

➧ **See Figure 14**

1. Disconnect the negative battery cable.
2. If necessary, remove the fastener from the ignition test connector.
3. Detach the electrical connector and hoses from the solenoid valve.
4. Remove the bracket and solenoid from the intake manifold.

To install:

5. Install the solenoid valve on the intake manifold. Install the retaining bolt to the manifold and tighten to 52 inch lbs. (5.8 Nm).
6. Attach the electrical connector and hoses to the solenoid valve.
7. If removed, install the ignition test connector to the bracket.
8. Connect the negative battery cable.

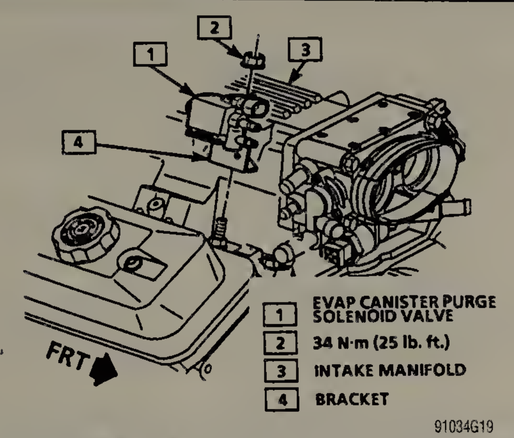


Fig. 14 Exploded view of the canister purge solenoid valve mounting—1991–96 vehicles

EVAP Purge Vacuum Switch

1996 VEHICLES

➧ See Figures 15 and 16

1. Disconnect the negative battery cable.
2. Detach the switch electrical connector.
3. Disconnect the vacuum lines from the EVAP vacuum switch and the vacuum control solenoid.
4. Remove the EVAP vacuum switch from the bracket.

To install:

5. Install the EVAP vacuum switch on the bracket.
6. Connect the vacuum lines to the vacuum switch and control solenoid.
7. Attach the electrical connector.
8. Connect the negative battery cable.

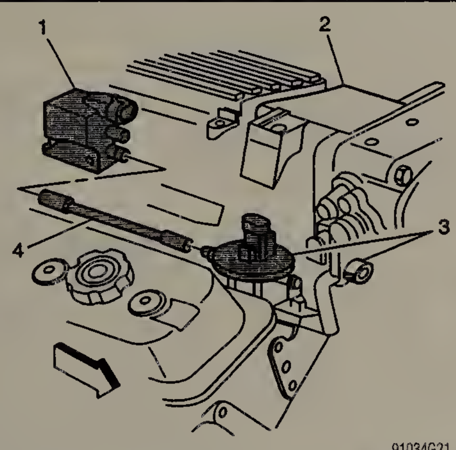


Fig. 15 Disconnect the vacuum lines (4) from the vacuum switch (3) and the vacuum control solenoid (1)

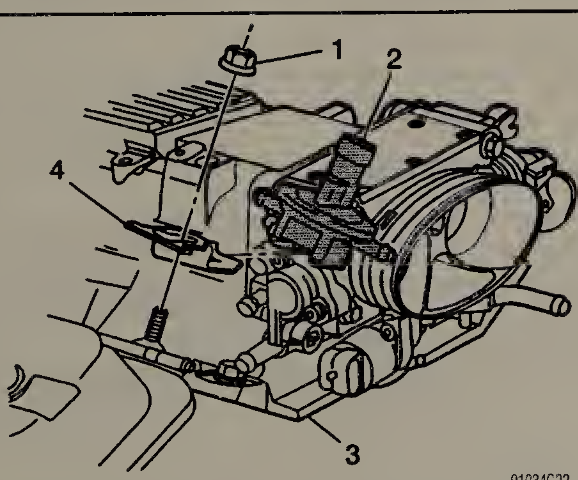


Fig. 16 Remove the EVAP vacuum switch (2) from the bracket (4)

Exhaust Gas Recirculation System

OPERATION

All models, except 1990–92 5.7L (VIN J) engines, are equipped with an EGR system, which consists of a metering valve and cast-in exhaust passages in the intake manifold. The EGR valve opens and closes in response to vacuum or electrical signals to admit exhaust gases into the air/fuel mixture. The exhaust gases lower peak combustion temperatures, reducing the formation of NOx. The valve is closed at idle and wide open throttle, but is open between the two extreme positions.

There are two types of types of EGR systems used on these vehicles: Negative Backpressure and Linear. The principle of the two systems are the same; the only difference is in the method used to control how the EGR valve opens.

Too much EGR flow at idle, cruise or during cold operation may result in the engine stalling after cold start, the engine stalling at idle after deceleration, vehicle surge during cruise and rough idle. If the EGR valve is always open, the vehicle may not idle. Too little or no EGR flow allows combustion temperatures to rise, which could result in spark knock (detonation), engine overheating and/or emission test failure.

A vacuum control solenoid may sometimes be used in combination with the EGR valve. The vacuum control solenoid uses Pulse Width Modulation (PWM) to turn the solenoid ON and OFF numerous times a second and varies the amount of ON time (pulse width) to vary the amount of ported vacuum supplied the EGR valve.

Negative Backpressure Valve

➧ See Figures 17 and 18

The negative backpressure EGR valve is used on 1984–96 5.7L (VIN 8, P and 5) engines.

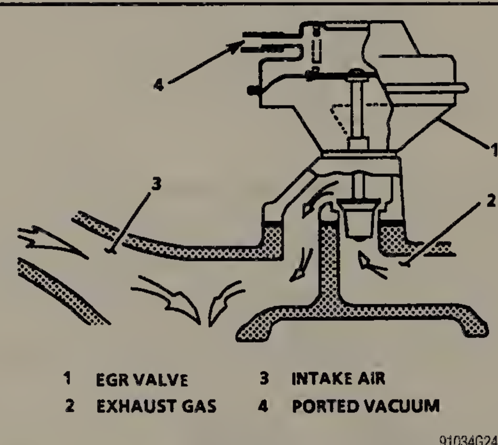


Fig. 17 Negative backpressure EGR valve airflow schematic

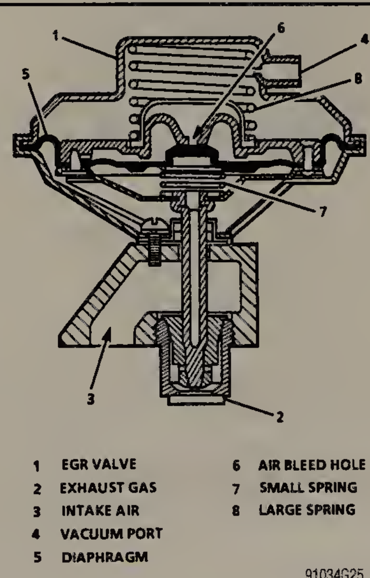


Fig. 18 Cross-sectional view of the negative backpressure EGR valve

This EGR valve varies the amount of exhaust gas flow into the intake manifold depending on manifold vacuum and variations in exhaust backpressure. An air bleed valve, located inside the EGR valve assembly acts as a vacuum regulator. The bleed valve controls the amount of vacuum in the vacuum chamber by bleeding vacuum to outside air during the open phase of the cycle. The diaphragm on the valve has an internal air bleed hole which is held closed by a small spring when there is no exhaust backpressure. Engine vacuum opens the EGR valve against the pressure of a spring. When manifold vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes. This valve will open if vacuum is applied with the engine not running.

Linear EGR System

➧ See Figures 19 and 20

➡The 1990–92 5.7L (VIN J) engine does not use an EGR valve.

The linear EGR valve, used on 1993–95 5.7L (VIN J) engines, is designed to accurately supply EGR to an engine, independent of intake manifold vacuum.

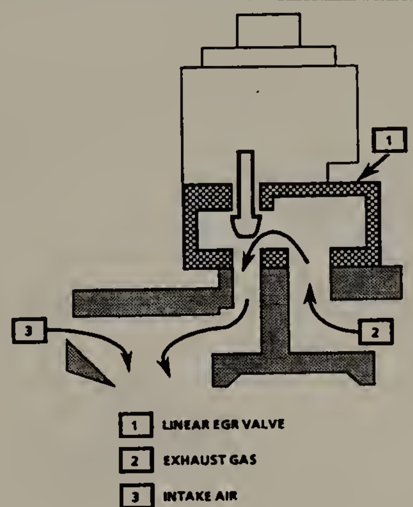


Fig. 19 Schematic of the linear EGR system air flow

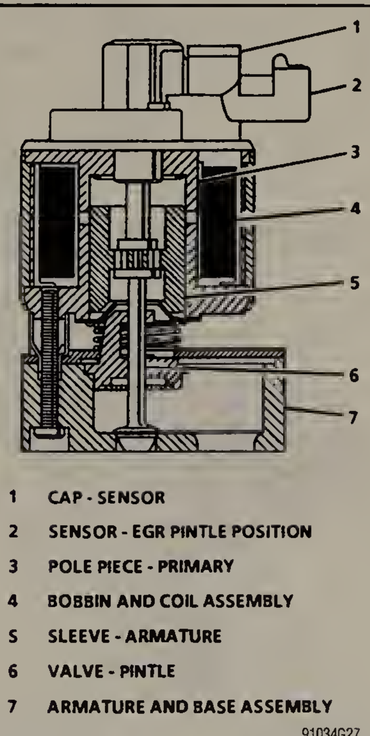


Fig. 20 Cross-sectional view of the linear EGR valve

The valve controls EGR flow from the exhaust to the intake manifold through an orifice with a PCM controlled pintle. During operation, the PCM controls pintle position by monitoring the pintle position feedback signal. The PCM uses information from the Engine Coolant Temperature (ECT) sensor, Throttle Position (TP) sensor and the Mass Air Flow (MAF) sensor to determine the appropriate rate of flow for a particular engine operating condition.

TESTING

Negative Backpressure EGR Valve

1. Inspect all passages and moving parts for plugging, sticking and deposits.
2. Inspect the entire system (hoses, tubes, connections, etc.) for leakage. Replace any part that is leaking, hardened, cracked, or melted.
3. Run the engine to normal operating temperature, and allow the engine to idle for 2 minutes. Quickly accelerate the engine to 2,500 rpm. Visible movement of the EGR stem should occur indicating proper system function. If no movement occurs, check the vacuum source and hose.
4. To determine if gas is flowing through the system, connect a vacuum pump to the valve.
5. With the engine idling, slowly apply vacuum. Engine speed should start to decrease when applied vacuum reaches 3 in. Hg. (10 kPa) The engine speed may drop quickly and could even stall; this indicates proper function.
6. If engine speed does not drop off, remove the EGR valve and check for plugged passages. If everything checks out, replace the valve.

Linear EGR Valve

➧ See Figures 21, 22 and 23

To check this system, refer to the accompanying diagnostic chart.

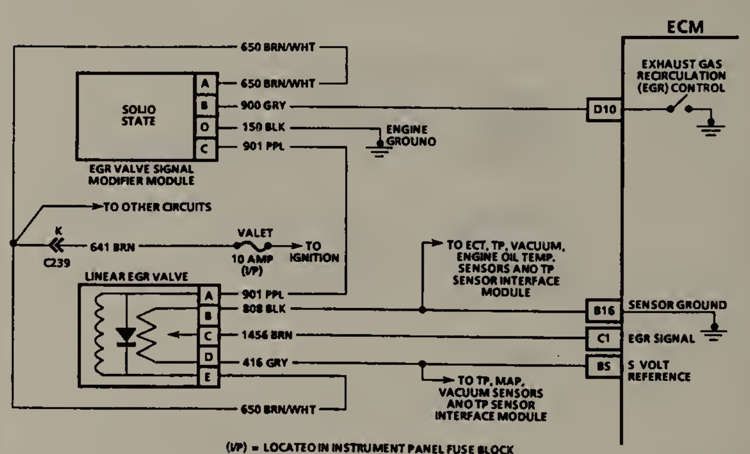


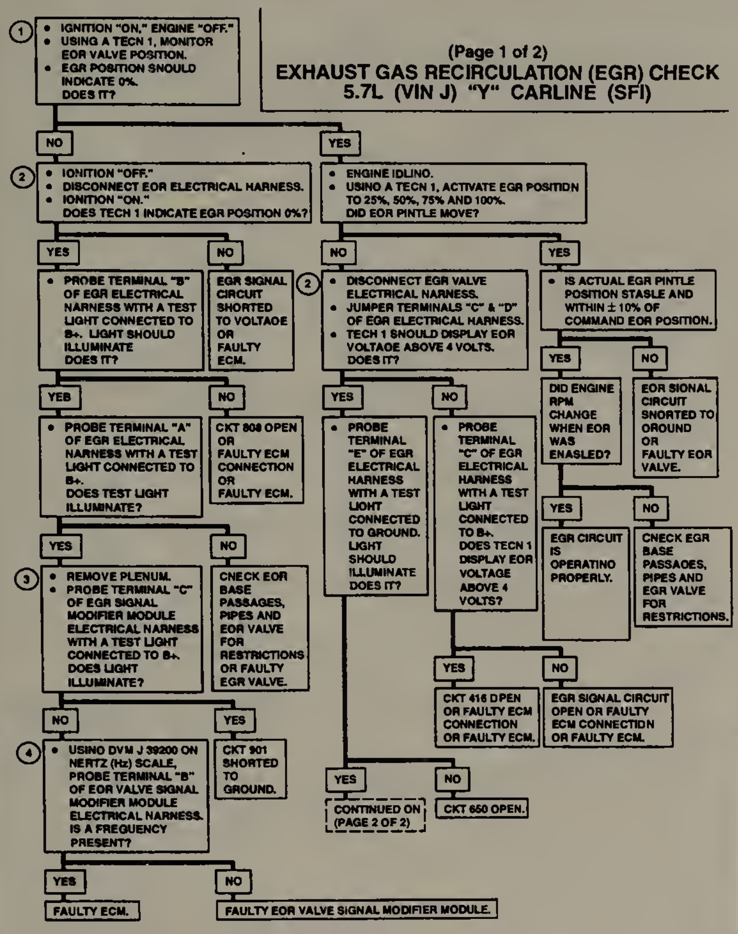
Fig. 21 Linear EGR system schematic

REMOVAL & INSTALLATION

5.7L (VIN 8, P and 5) Engines

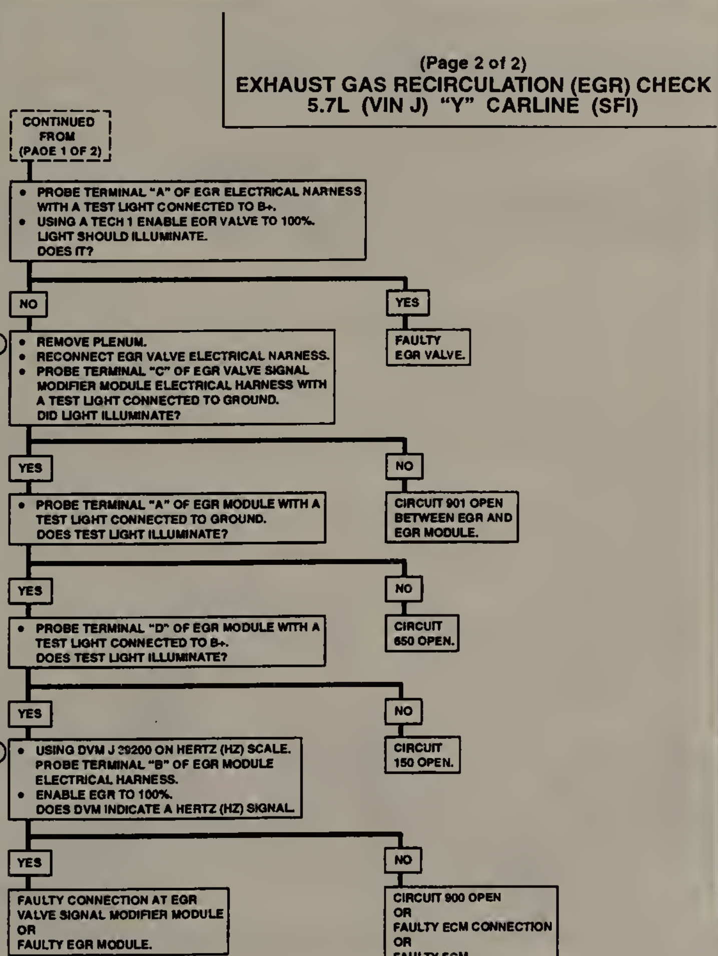
➧ See Figures 24, 25 and 26

1. Disconnect the negative battery cable.
2. Remove the air cleaner.
3. If necessary for access, either remove the intake plenum, or, remove the left fuel rail cover and disconnect the hose from the AIR check valve.
4. Disconnect the vacuum hose from the EGR valve.
5. Unfasten the retaining bolts, then remove the EGR valve from the manifold.



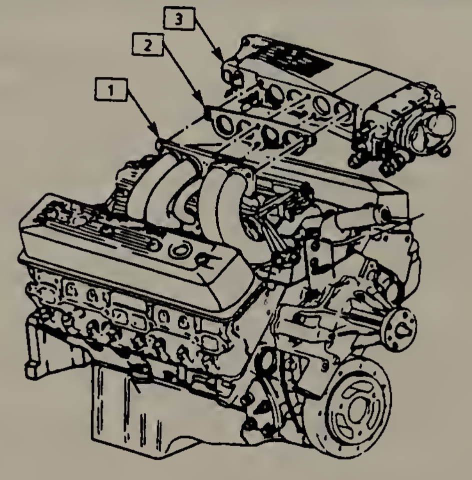
91034G29

Fig. 22 Linear EGR system check—1 of 2



91034G30

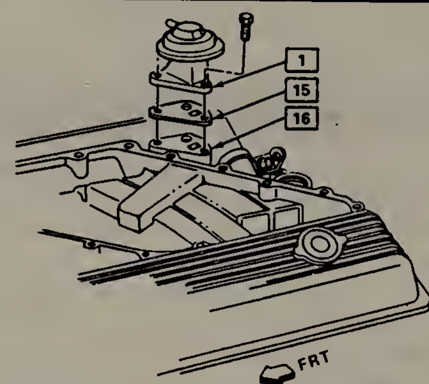
Fig. 23 Linear EGR system check—2 of 2



1 RIGHT INTAKE RUNNER
2 GASKET
3 INTAKE MANIFOLD PLENUM

91034G32

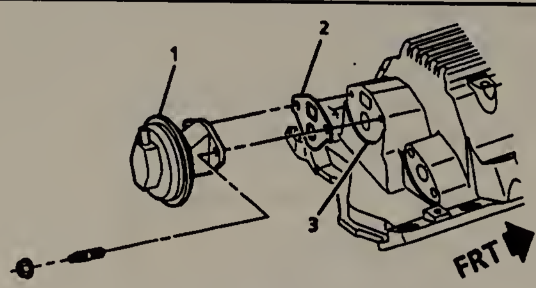
Fig. 24 On some vehicles it is necessary to remove the intake plenum to remove the EGR valve



1 EGR VALVE
15 GASKET
16 MOUNTING SURFACE

91034G31

Fig. 25 Exploded view of the EGR valve mounting—1984 vehicle shown



1 EGR VALVE
2 GASKET
3 INTAKE MANIFOLD

91034G33

Fig. 26 Location of the EGR valve mounting—1995 vehicle shown

6. If the EGR passages show an excessive build up of deposits, you must clean the passages. Make sure all loose particles are completely removed to prevent them from clogging the EGR valve or being drawn into the engine. Clean the EGR passages as follows:

a. Hold the valve in your hand. Tap on the end of the round pintle using a light snapping action with a plastic hammer. This will remove the exhaust deposits from the valve seal. Remove all of the loose particles.

b. Clean the mounting surface of the valve with a wire wheel or brush and the pintle with a wire brush.
c. Depress the valve diaphragm and check the seating area for cleanliness and signs of rubbing by looking through the valve outlet. If the pintle and/or seal aren't clean, repeat the 2 previous steps.
d. Hold the bottom of the valve securely and try to rotate the top of the valve back and forth. Replace the valve if any looseness is felt.
e. Check the valve for deposits. Remove any deposit build up with a suitable scraping tool.
7. Clean the manifold mounting surface.

To install:

8. Position a new gasket, then install the valve.
9. Install the retaining bolts and tighten to 16 ft. lbs. (22 Nm).
10. Connect the vacuum hose to the EGR valve.
11. If removed, connect the hose to the AIR check valve and install the left fuel rail cover.
12. If removed, install the intake plenum.
13. Install the air cleaner assembly.
14. Connect the negative battery cable.

5.7L (VIN J) Engines

See Figure 27

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Remove the right side engine mount retaining nut.
4. Loosen the left side engine mount retaining nut.
5. Carefully lower the vehicle.

WARNING

When raising the engine, do NOT use the catalytic converters as a lifting point, as this could damage the converters.

6. Using a floor jack, with a piece of wood on the pad of the jack, position the jack under the oil pan on the right side of the engine. Raise the engine on the right side, only enough for sufficient clearance.
7. Detach the electrical connector from the EGR valve.
8. Unfasten the retaining bolts, then remove the EGR valve from the vehicle.
9. Thoroughly clean the gasket mating surfaces. If the EGR passages in the intake plenum and EGR base show an excessive deposit build up, you must clean the passages. Make sure all loose particles are completely removed to prevent them from clogging the EGR valve or being drawn into the engine. Clean the EGR passages as follows:
a. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
b. Look for exhaust deposits in the valve outlet. Remove any deposit build up with a suitable scraping tool.
c. Clean the mounting surfaces of the EGR base and valve assembly.

To install:

10. Position a new gasket, then install the EGR valve. Install the retaining bolts and tighten to 16 ft. lbs. (22 Nm).

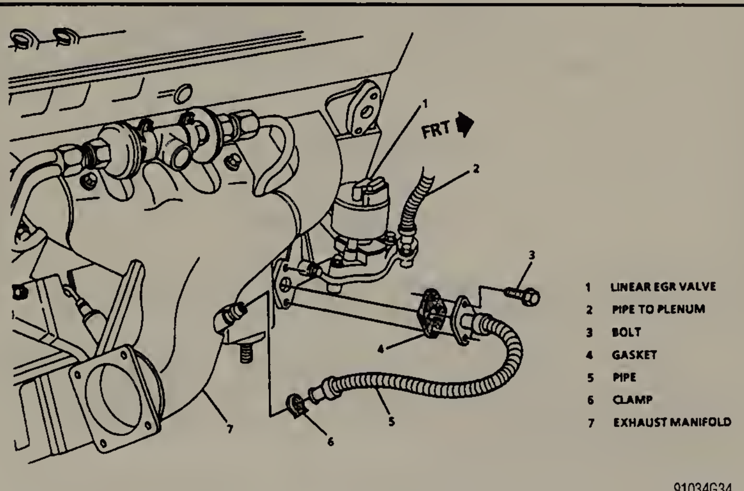


Fig. 27 Linear EGR valve mounting and location

11. Attach the electrical connector to the EGR valve.
12. Slowly and carefully lower the engine.
13. Raise and safely support the vehicle.
14. Install the right side engine mount retaining nut. Tighten the left side engine mounting retaining nut.
15. Carefully lower the vehicle.
16. Connect the negative battery cable.

EGR Control Solenoid

5.7L (VIN 8, P AND 5) ENGINE

See Figures 28, 29 and 30

On later models, it is also referred to as the EGR vacuum control signal solenoid valve.

1. Disconnect the negative battery cable.
2. Remove the air cleaner.
3. If necessary, remove the intake plenum or left fuel rail cover as necessary.
4. Detach the electrical connector from the solenoid.
5. Disconnect the vacuum hoses.
6. Unfasten the retaining nut, then remove the solenoid.

To install:

7. Install the solenoid and bracket. Install the retaining nut and tighten to 17 ft. lbs. (24 Nm).
8. Attach the vacuum hoses and electrical connector.
9. If removed, install the left fuel rail cover as necessary.
10. Install the air cleaner.
11. Connect the negative battery cable.

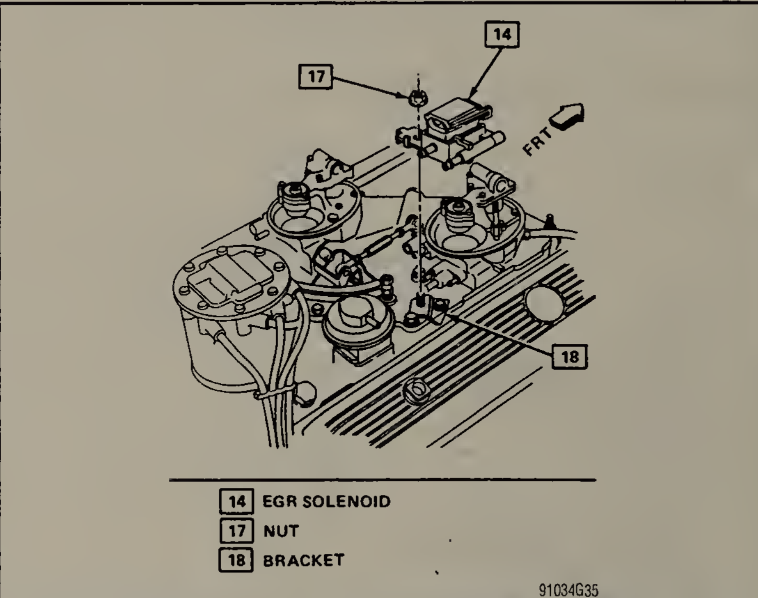


Fig. 28 Exploded view of the EGR control solenoid mounting—1984 vehicle shown

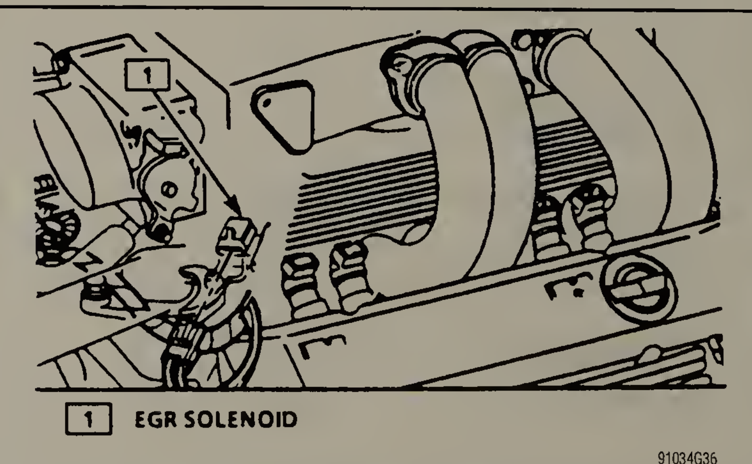


Fig. 29 EGR control solenoid location—1990 vehicle shown

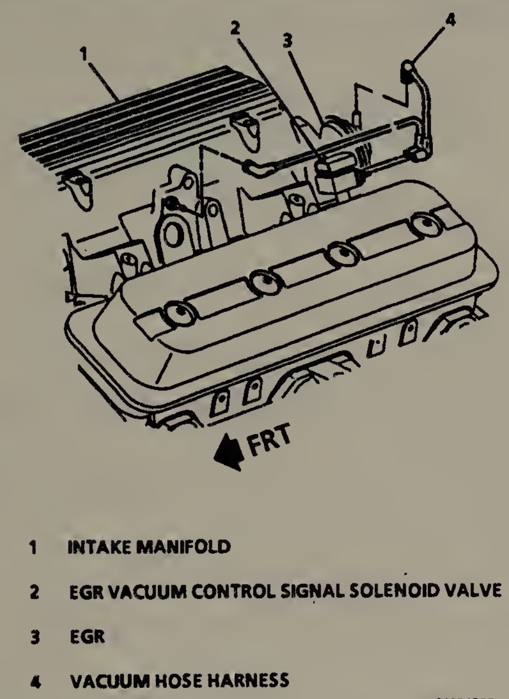


Fig. 30 EGR control signal solenoid valve location—1995 vehicle shown, others similar

EGR Valve Signal Modifier Module

5.7L (VIN J) ENGINE

1. Disconnect the negative battery cable.
2. Remove the intake plenum.
3. Detach the electrical connector.
4. Unfasten the retaining bolts, then remove the EGR valve signal modifier module.

To install:

5. Position the EGR valve signal modifier module and secure with the mounting bolts. Tighten to 18 inch lbs. (2 Nm).
6. Attach the electrical connector.
7. Install the intake plenum.
8. Connect the negative battery cable.

Air Injection (AIR) System

OPERATION

The Air Injection Reaction (AIR) system, also called the Secondary Air Injection (AIR) system on later model vehicles, helps reduce Hydrocarbon (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NO_x) exhaust emissions. It also causes the oxidation catalytic converter to heat quickly which allows the conversion of exhaust gases to occur sooner.

The AIR pump is mounted to either the front of the engine or located in the left front corner of the engine compartment and supplies the air for the system. The electric air pump pressurizes air from the air cleaner and pumps it to the check valves located near the exhaust manifolds. By providing the ground, the PCM completes the circuit which energizes the pump relay and turns both the pump and the integral stop valve on. When the PCM turns the pump off, it also de-energizes the integral stop valve solenoid so no air is directed into the exhaust ports.

Anytime the engine coolant temperature is above 59°F (15°C) after startup, the PCM will enable this system and operate it for a maximum of about 3 to 4 minutes or until the system enters "Closed Loop". The following are some of the conditions which will cause the PCM to disable the system:

- When engine rpm is below 400 rpm
- Under heavy acceleration
- The catalytic converter is overheating
- Engine coolant temperature is less than 59°F (15°C)
- Fuel control is not within normal ranges
- Engine rpm is above 2825 rpm (5.7L) or 3200 rpm (3.4L) for more than 5 seconds
- When the PCM detects a problem in the system and sets a diagnostic trouble code (DTC)

SERVICE

AIR Pump

1. Inspect the hoses, tubes and all connections for possible leaks and proper routing.
2. Check for air flow to the exhaust ports.
3. Check the pump for proper mounting.

Hoses and Pipes

1. Check for deterioration or holes in the hoses and pipes.
2. Make sure all connections and clamps are tight.
3. Check for proper routing as interference may cause premature wear.

Check Valve

1. Blow through the check valve towards the cylinder head, then attempt to suck back through the valve (or blow through the other side).
2. Flow should only be in one direction (towards the exhaust manifold). Replace as necessary.

REMOVAL & INSTALLATION

CAUTION

Make sure the engine is cool before attempting to service the secondary AIR system to avoid being severely burned.

AIR Pump

5.7L (VIN 8) ENGINE

See Figures 31 and 32

1. Disconnect the negative battery cable.
2. Hold the pump pulley from turning by compressing the drive belt, then loosen the pump pulley bolts.
3. Lift the drive belt tensioner to the raised position and remove the belt.
4. If necessary, insert needle-nose pliers and pull the filter fan from the hub.
5. Disconnect the hoses, vacuum and electrical connections from the AIR control valve.
6. Unfasten the AIR pump mounting bolts, then remove the pump assembly.
7. If the pump is being replaced, transfer the air injection control valve to the new pump.

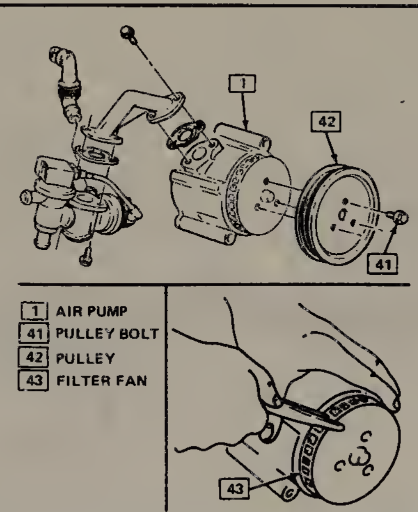


Fig. 31 AIR pump filter fan removal—1984 5.7L (VIN 8) engine shown

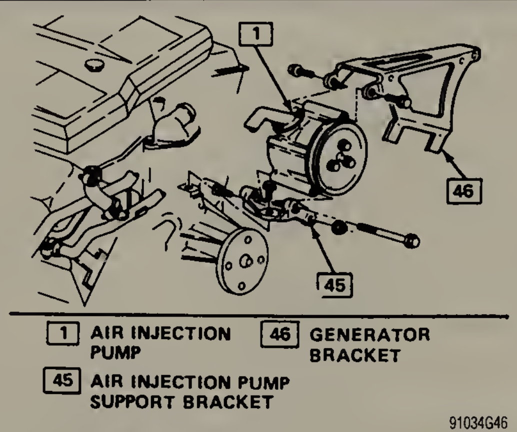


Fig. 32 Exploded view of the air pump removal—1984 5.7L (VIN 8) engine shown

To install:

8. Position the AIR pump assembly and secure with the mounting bolts.
9. Attach the hoses, vacuum and electrical connections and control valve.
10. Install a new filter fan on the pump hub.
11. Place the pump pulley against the centrifugal filter fan.
12. Instlal the pump pulley bolts and tighten equally and evenly to 100 inch lbs. (12 Nm). This will compress the fan onto the pump hole. Do not try to drive the fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new fan is installed, it may squeal when it is first operated, until the sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
13. Install the serpentine drive belt.
14. Instlal the AIR pump pulley and secure with the retaining bolts.
15. Connect the negative battery cable and check the AIR system for proper operation.

5.7L (VIN J) AND 1992–93 5.7L (VIN P) ENGINE

▸ **See Figure 33**

1. Disconnect the negative battery cable.
2. Detach the electrical connector from the electric air pump.
3. Disconnect the outlet hose.
4. Unfasten the electric air pump mounting bolts from the front member.
5. Loosen the inlet silencer clamp.
6. Remove the electric air pump mounting bolts, then remove the air pump.
7. If replacing the air pump, remove the pump from the bracket.

To install:

8. If removing, install the electric AIR pump mounting bracket to the electric AIR pump assembly.
9. Install the mounting bolts and tighten to 50 inch lbs. (5.6 Nm).
10. Install the electric air pump and inlet silencer and tighten the inlet silencer clamp to 2 inch lbs. (0.2 Nm).
11. Install the air pump mounting bolts to the front member and tighten to 89 inch lbs. (10 Nm).
12. Connect the outlet hose and tighten the hose clamp to 2 inch lbs. (0.2 Nm).
13. Attach the electrical connectors to the air pump.
14. Connect the negative battery cable, then check the system for proper operation.

1994–96 5.7L (VIN P AND 5) ENGINES

▸ **See Figure 34**

1. Disconnect the negative battery cable.
2. Detach the electrical connector from the air pump.
3. Disconnect the outlet and inlet hoses.
4. Remove the air pump mounting bolts from the bracket, then remove the pump from the bracket.

To install:

5. Position the air pump to the bracket and secure with the mounting bolts. Tighten the bolts to 50 inch lbs. (5.6 Nm).
6. Connect the outlet and inlet hoses to the pump.
7. Attach the air pump electrical connector.
8. Connect the negative battery cable, then check for proper system operation.

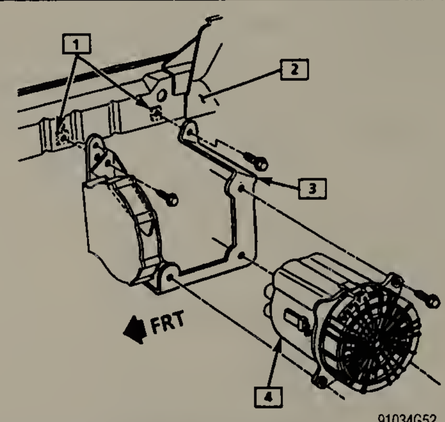


Fig. 34 Exploded view of the air pump mounting—1994–96 5.7L (VIN P and 5) engines

Air Injection Control Valve

5.7L (VIN 8) ENGINE

▸ **See Figure 35**

1. Disconnect the negative battery cable.
2. Remove the adapter bolts.
3. Disconnect the air outlet hoses from the valve.
4. Remove the air cleaner cover.

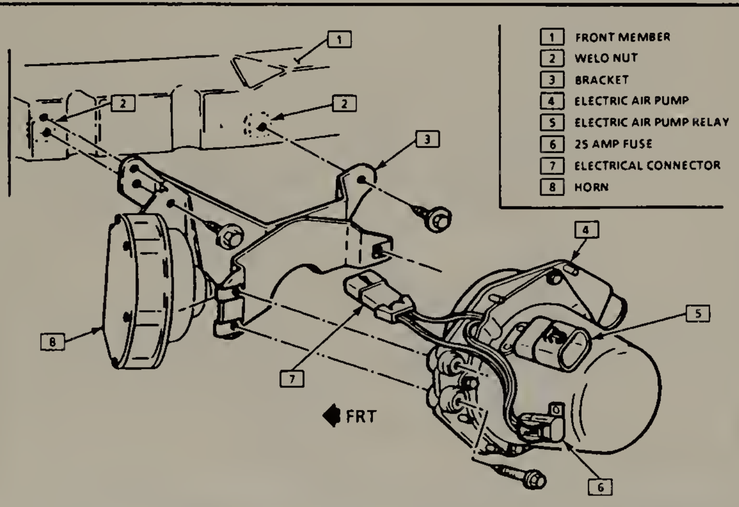


Fig. 33 Exploded view of the AIR pump mounting—5.7L (VIN J) engine shown, 1992–93 5.7L (VIN 8) similar

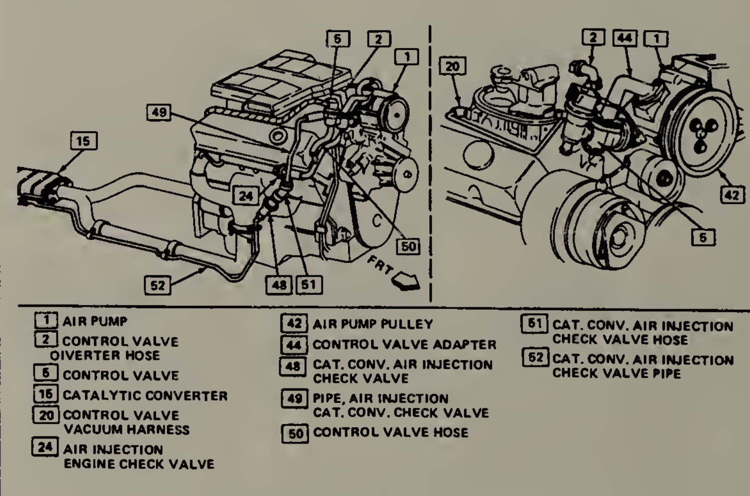


Fig. 35 Location of the AIR system control and check valves and related components—5.7L (VIN 8) engine

5. Remove the adapter.
6. Detach the electrical connectors and vacuum hoses from the valve.
7. Remove the control valve from the vehicle.
8. Installation is the reverse of the removal procedure.

AIR Electric Diverter Valve (EDV)

5.7L (VIN J) AND 1992–93 5.7L (VIN P) ENGINES

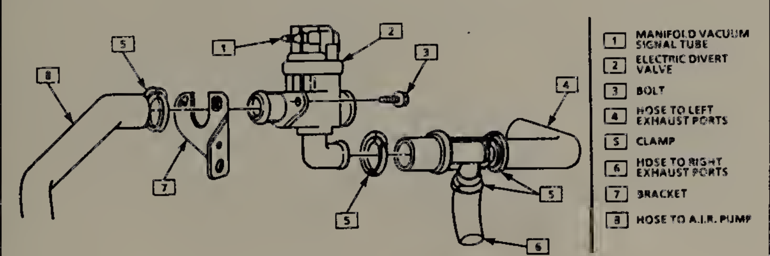
See Figure 36

On later models, the valve is also referred to as the Electric Switching Valve (ESV)

1. Disconnect the negative battery cable.
2. Unfasten the mounting bracket bolt.
3. Disconnect the air inlet and outlet hoses from the valve.
4. Detach the electric connector and vacuum hose from the valve.
5. Unfasten the electric diverter valve mounting bracket bolts, then remove the valve.

To install:

6. Position the diverter valve to the mounting bracket and secure with the retaining bolts. Tighten the bolts to 17 ft. lbs. (24 Nm).
7. Attach the electrical connector and vacuum hose. Connect the air hoses to the valve.
8. Install the mounting bracket bolt(s) and tighten to 106 inch lbs. (12 Nm).
9. Connect the negative battery cable, then check the AIR system for proper operation.



91034G51

Fig. 36 Exploded view of the Electric Diverter Valve (EDV)

Air Check Valve

5.7L (VIN 8) ENGINE

See Figure 35

1. Release the clamp and disconnect the air hoses from the check valve.
2. Unscrew the check valve from the air injection pipe.

To install:

3. Screw the check valve onto the air injection pipe.
4. Position the air hose on the check valve and secure with the clamp.

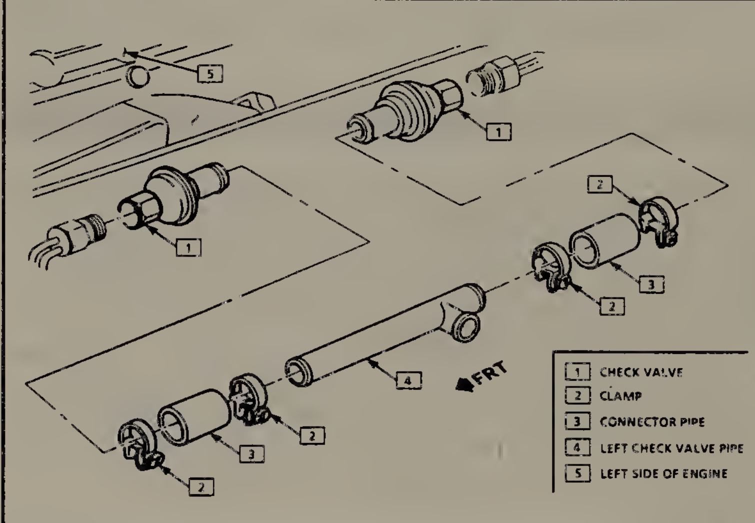
5.7L (VIN J, P AND 5)

See Figures 37 and 38

1. Disconnect the negative battery cable.
2. Remove the clamp and air hoses from the EDV left check valve pipe, or AIR system right pipe, as applicable.
3. Remove the check valve clamps.
4. Slide the connector pipes together.
5. Remove the left or right check valve pipe, as applicable.
6. Unscrew the check valve from the air injection pipe.

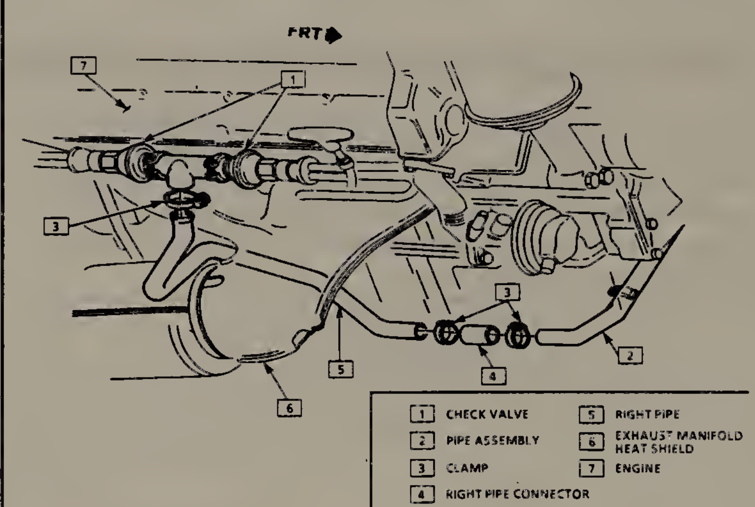
To install:

7. Screw the check valve onto the air injection pipe. Tighten the check valves to 14 ft. lbs. (19 Nm).
8. If installing the left check valve, place the valve pipe assembly between the check valves and push the connector pipes out.
9. If removed, install the right check valve pipe.
10. Position the clamps and tighten to 15 inch lbs. (1.7 Nm).
11. Connect the air hose to the left or right check valve pipe, as applicable.
12. Position the clamp and tighten to 15 inch lbs. (1.7 Nm).
13. Connect the negative battery cable.



91034G49

Fig. 37 Exploded view of the left check valve assembly—5.7L (VIN J) shown, others similar



91034G50

Fig. 38 Location of the right check valve and pipes—5.7L (VIN J) shown, others similar

ELECTRONIC ENGINE CONTROLS

Engine Control Module (ECM)

OPERATION

Whenever the term Electronic Control Module (ECM) is used in this manual, it will refer to the engine control computer, whether it is a Powertrain Control Module (PCM) or Electronic Control Module (ECM).

The heart of the electronic control system, which is found on the vehicles covered by this manual, is a computer control module. The module gathers information from various sensors, then controls fuel supply and engine emission systems. Most early model vehicles are equipped with an Engine Control Module (ECM) which, as its name implies, controls the engine and related emissions systems. Later model vehicles may be equipped with a Powertrain Control Module (PCM). This is similar to the original ECMs, but is designed to control additional systems as well. The PCM may control the manual transmission shift lamp or the shift functions of the electronically controlled automatic transmission.

Regardless of the name, all computer control modules are serviced in a similar manner. Care must be taken when handling these expensive components in order to protect them from damage. Carefully follow all instructions included with the replacement part. Avoid touching pins or connectors to prevent damage from static electricity.

All of these computer control modules contain a Programmable Read Only Memory (PROM) chip, MEM-CAL or EEPROM that contains calibration information specific to the vehicle application. For all applications except those equipped with an EEPROM, this chip is not supplied with a replacement module, and must be transferred to the new module before installation. If equipped with an Electronically Erasable Programmable Read Only Memory (EEPROM), it must be reprogrammed after installation. Some later model vehicles have a Knock Sensor (KS) module, mounted in the PCM. The KS module contains the circuitry that allows the PCM to utilize the Knock Sensor signal to diagnose the circuitry.

WARNING

To prevent the possibility of permanent control module damage, the ignition switch MUST always be OFF when disconnecting power from or reconnecting power to the module. This includes unplugging the module connector, disconnecting the negative battery cable, removing the module fuse or even attempting to jump start your dead battery using jumper cables.

In the event of an ECM failure, the system will default to a pre-programmed set of values. These are compromise values which allow the engine to operate, although at a reduced efficiency. This is variously known as the default, limp-in or back-up mode. Driveability is almost always affected when the ECM enters this mode.

REMOVAL & INSTALLATION

See Figures 39, 40, 41 and 42

1. Make sure the ignition switch is turned **OFF**, then disconnect the negative battery cable.

CAUTION

To prevent the possibility of permanent control module damage, the ignition switch MUST always be OFF when disconnecting power from or reconnecting power to the module. This includes unplugging the module connector, disconnecting the negative battery cable, removing the module fuse or even attempting to jump your dead battery using jumper cables.

2. Locate the computer control module. On 1984–89 vehicles, it is located in the passenger compartment, under the right hand (passenger's) side of the instrument panel. On 1990–96 vehicles, the module is located in the engine

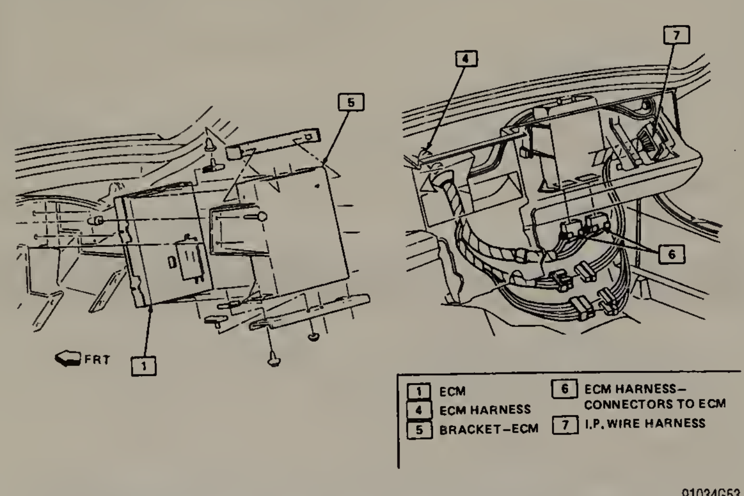


Fig. 39 Exploded view of the Engine Control Module (ECM) location—1984 vehicle shown

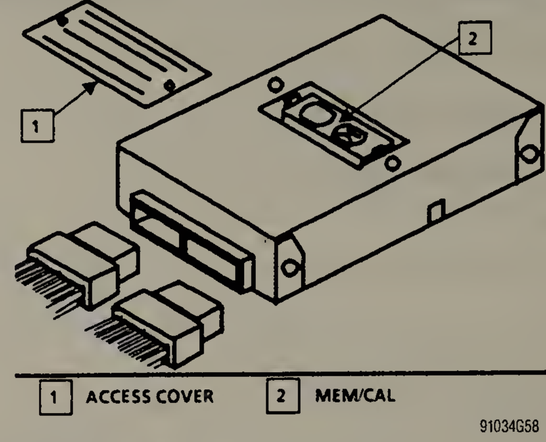


Fig. 40 View of the ECM—1985–89 vehicles

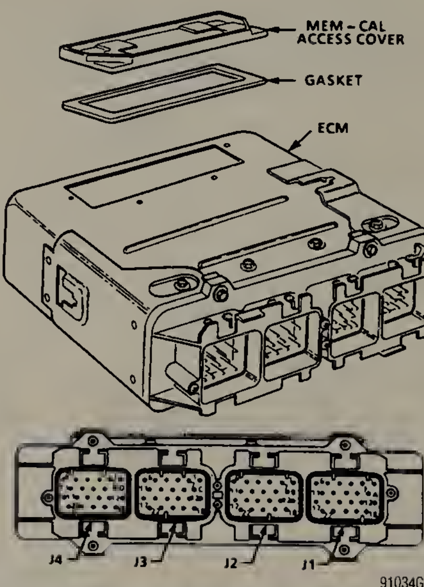


Fig. 41 Exploded view of the ECM with the cover and MEM-CAL—1990–95 vehicles, except 1994–95 VIN P

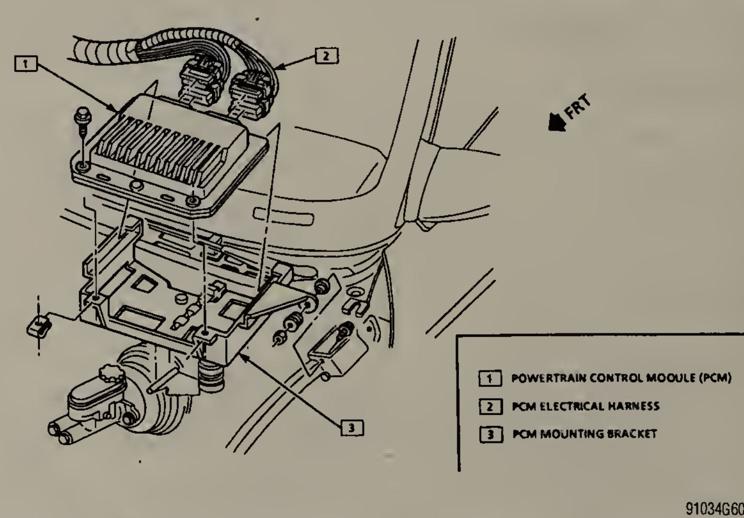


Fig. 42 PCM location and mounting—1994–96 VIN P & 5 engines

compartment, mounted against the left hand (driver's) side of the firewall, near the brake master cylinder and booster.

3. For 1984–89 vehicles, unfasten the retainers, then remove the right side kick/hush panel.
4. Remove the computer control module mounting hardware.
5. If equipped, remove the electrical connector cover.
6. Detach the electrical connectors from the control module.
7. Remove the computer control module from the passenger or engine compartment.

To install:

➡If the control module is being replaced, the PROM, MEM-CAL or Knock Sensor (KS) module must be transferred to the new module, as outlined later in this section. Also, make sure the service number on the new module is the same as the defective module.

8. Attach the electrical connectors to the computer control module.
9. Position the control module in its mounting location and secure with the mounting hardware.
10. If equipped, install the electrical connector cover.
11. For 1984–89 vehicles, install the right side kick-hush panel and secure with the retainers.

➡On 1994–96 vehicles equipped with a VIN P or 5 engine, the replacement PCM is not supplied with an EEPROM program. The replacement PCM must be reprogrammed with a Tech 1®, or equivalent scan tool, with the proper software application for your vehicle. If the PCM is not reprogrammed, the car will not run.

12. Check that the ignition switch is **OFF**, then connect the negative battery cable.

PROM, MEM-CAL & KS MODULE REPLACEMENT

See Figures 43 thru 50

1. For 1984 vehicles equipped with a PROM, remove it from the ECM as follows:
   a. Turn the ECM so the bottom cover is facing up.
   b. Remove the slide off PROM access cover.
   c. Use a suitable PROM removal tool to carefully grasp the PROM carrier at the narrow ends, as shown in the accompanying figure. Gently rock the carrier from end to end while applying a firm upward force and remove the PROM from the ECM. Make sure to note the reference end of the PROM carrier, then carefully position the PROM carrier aside.

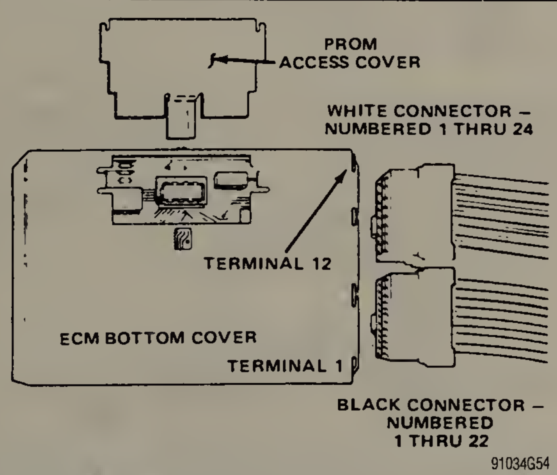


Fig. 43 The PROM cover slides off for access to the PROM carrier—1984 vehicles

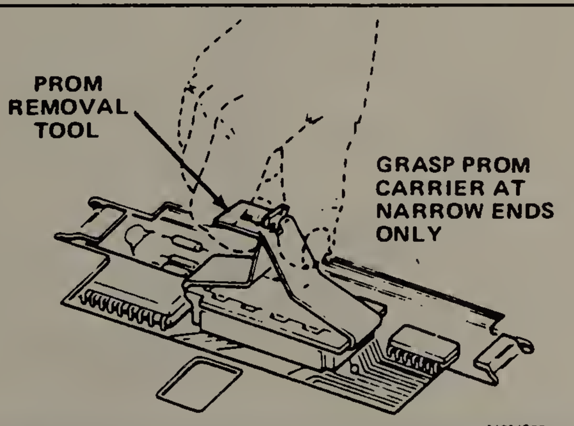


Fig. 44 You will need a suitable tool to rock the PROM carrier out of the ECM

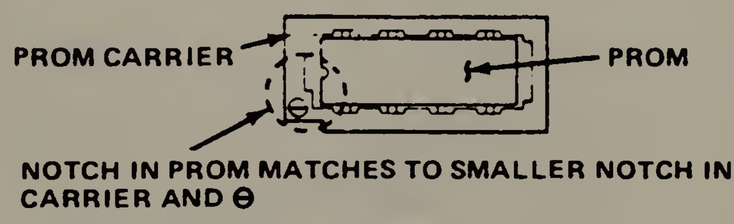


Fig. 45 You must note the reference end of the PROM for proper installation

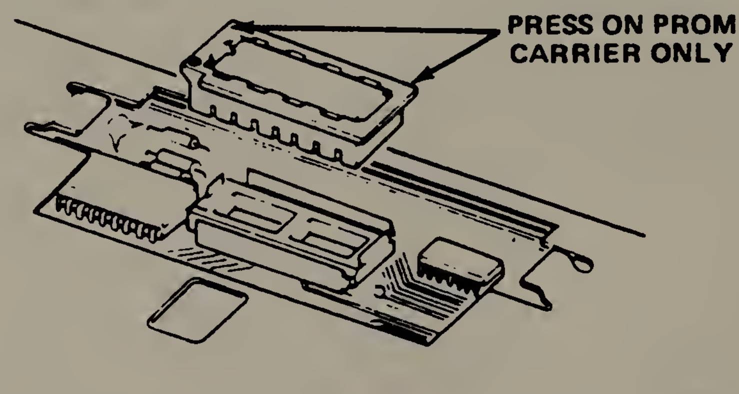


Fig. 46 Press the PROM carrier squarely into the socket

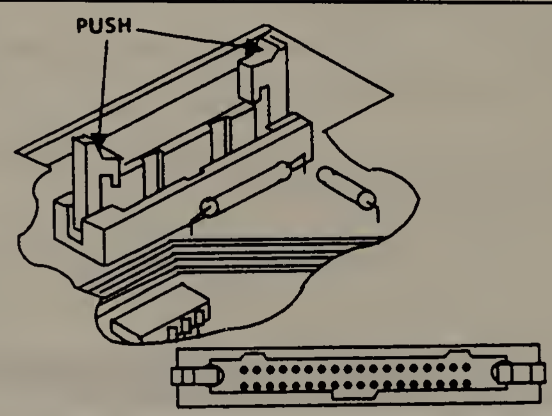


Fig. 47 Use 2 fingers to push the retaining clips away from the MEM-CAL or PROM to remove it

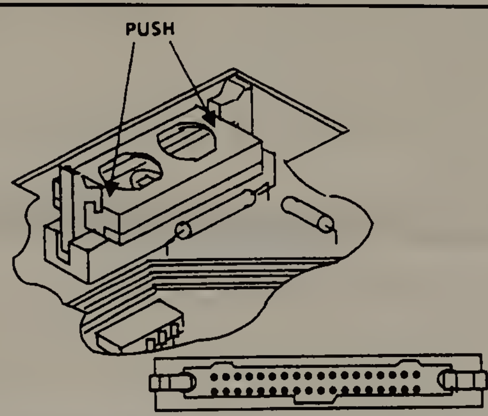


Fig. 48 When installing the MEM-CAL or PROM, push it in on the ends, NOT the middle

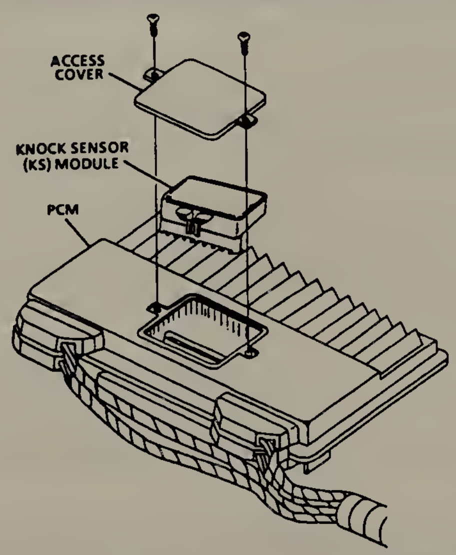


Fig. 49 Unfasten the retainers, then remove the KS module access cover

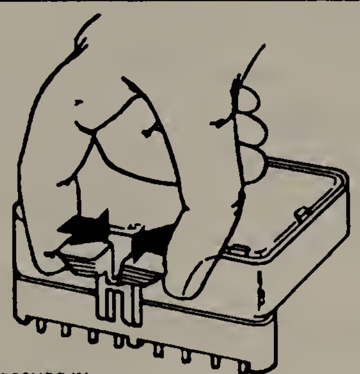


Fig. 50 Push the KS module retaining tabs toward each other, then lift the module out of the PCM

➡If installing a new PROM, make sure the notch in the PROM is matched to the small notch in the carrier.

d. Take the PROM (which is mounted in the PROM carrier), and position the carrier squarely over the PROM socket with the small notched end of the carrier aligned with the small notch socket at the pin 1 end. Press on the PROM carrier until it is firmly seated in it's socket.

WARNING

If the PROM is installed backward and the ignition switch is turned ON, the PROM will be destroyed.

e. Reinstall the access cover on the ECM.

2. For 1985–95 vehicles equipped (except 1994–95 VIN P engines) with a MEM-CAL or PROM, transfer it as follows:

a. Remove the access cover.

b. Using 2 fingers, push both retaining clips back away from the MEM-CAL. At the same time, grasp the MEM-CAL at both ends then carefully lift it up out of the socket.

WARNING

Do NOT remove the MEM-CAL cover.

c. Note the MEM-CAL alignment notches for installation.

d. Place the MEM-CAL in the socket, pressing on the ends of the MEM-CAL only. The small notches must be aligned.

e. Press on the ends of the MEM-CAL until the retaining clips snap into the ends of the MEM-CAL. Do NOT press on the middle of the MEM-CAL, only press on the ends.

f. Install the access cover, then install the ECM, as outlined earlier in this section.

3. For 1994–96 VIN P or 5 engine, equipped with a Knock Sensor (KS) module, remove the control module access cover, then remove the KS module by pressing the clips in toward each other and lifting the module out.

Oxygen Sensor

OPERATION

See Figures 51 and 52

There are two types of oxygen sensors used in these vehicles. They are the single wire oxygen sensors (O2S) and the heated oxygen sensor (HO2S). The oxygen sensor is a spark plug shaped device that is threaded into the exhaust manifold or exhaust pipe and protrudes into the exhaust stream which monitors the oxygen content of the exhaust gases. The difference between the oxygen content of the exhaust gases and that of the outside air generates a voltage signal that is sent to the computer control module. The control module monitors this voltage and, depending upon the value of the signal received, issues a command to adjust for a rich or a lean condition.

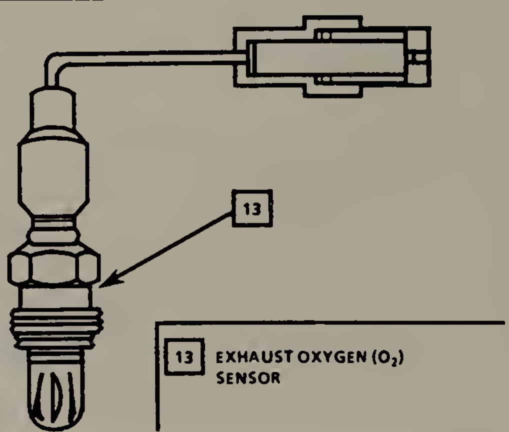


Fig. 51 Typical oxygen sensor used on an early model vehicle

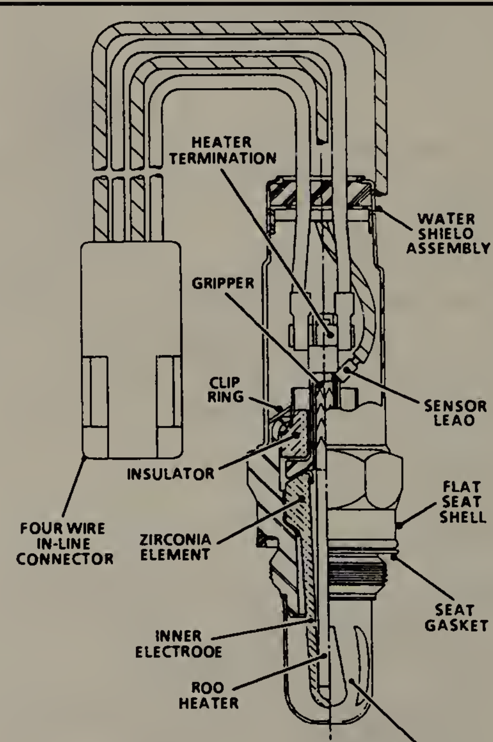


Fig. 52 Later model vehicles use one or more heated oxygen sensors

➡Some vehicles are equipped with more than one oxygen sensor.

No attempt should ever be made to measure the voltage output of the sensor. The current drain of any conventional voltmeter would be such that it would permanently damage the sensor.

The proper operation of the oxygen sensor depends upon three basic conditions:

1. Good electrical connections. Since the sensor generates low currents, good clean electrical connections at the sensor are a must.
2. Outside air supply. Air must circulate to the internal portion of the sensor. When servicing the sensor, do not restrict the air passages.
3. Proper operating temperatures. The computer control module will not recognize the sensor's signals until the sensor reaches about 600°F (316°C).

TESTING

Oxygen Sensor (O2S)

➧ See Figure 53

1. Perform a visual inspection of the connector, making sure it is engaged properly and all of the terminals are straight, tight and free of corrosion.
2. Check the O2S sensor voltage between the terminal and ground. Voltage should be between 350–500 millivolts. If the voltage doesn't fall within this range, the sensor is faulty.
3. If the voltage is within specifications, recheck the voltage after starting the engine and running until it reaches normal operating temperature. With the engine running at 1200 rpm, then voltage should vary rapidly between 100–900 millivolts. If the voltage is not varying or not within the range, the sensor is faulty.
4. If the voltage is within specifications, check the circuits back to the PCM for continuity.
5. If the sensor and circuits are functioning properly, the PCM may be faulty.

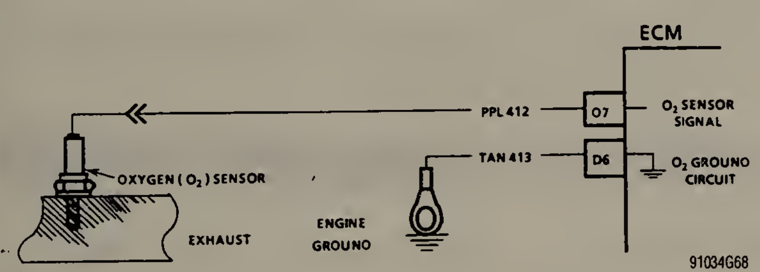


Fig. 53 Oxygen sensor circuit—1988 vehicle shown, other years similar

Heated Oxygen Sensor

VIN J ENGINES

➧ See Figure 54

1. Disconnect the 02 sensor connector and install jumper wires from the sensor connector to the wiring harness.
2. Start the engine and allow it to reach operating temperature. This should take about ten minutes. Turn the engine OFF.
3. Connect the positive lead of a multimeter to the 02 sensor signal wire and the negative lead to the engine ground. Re-start the engine.
4. The voltage reading should be fluctuating rapidly as the 02 sensor detects varying levels of oxygen in the exhaust stream.
5. If the 02 sensor voltage does not fluctuate, the sensor may be defective or mixture could be extremely out of range.

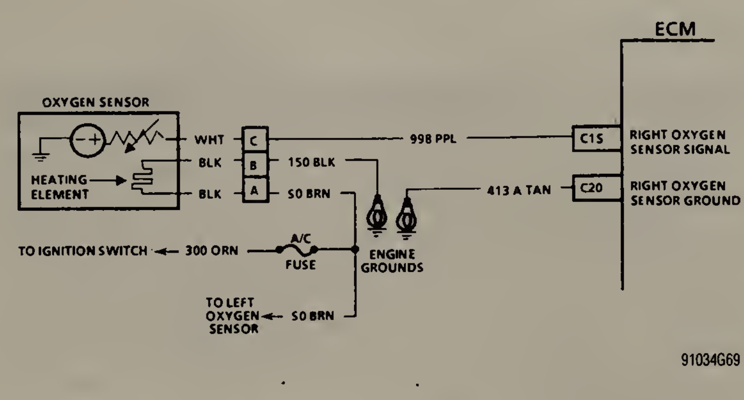


Fig. 54 Heated oxygen sensor circuit—VIN J engine

6. If the 02 sensor reads above 550 millivolts constantly, the fuel mixture is probably too rich. If the (02) sensor voltage reads below 350 millivolts constantly, the fuel mixture may be too lean or you may have an exhaust leak near the sensor.
7. Under normal conditions the 02 sensor should fluctuate high and low. Prior to condemning the 02 sensor, try forcing the system rich by restricting the air intake or lean by removing a vacuum line. If this causes the oxygen sensor to momentarily respond, look for problems in other areas of the system.

VIN P AND 5 ENGINES

➧ See Figure 55

1. Visually check the connector, making sure it is engaged properly and all of the terminals are straight, tight and free of corrosion.
2. Detach the sensor electrical connector and check resistance between terminals C and D. Resistance should be 10–15 ohms at 79°F. If resistance is not within specifications, the sensor heater is faulty.
3. If resistance is within specification, check for battery positive (B+) between connector terminals C and D with the ignition **ON**. If battery positive (B+) is not present, check the circuit continuity back to the PCM. If the circuits are functioning properly, the PCM may be faulty.
4. Check the HO2S sensor voltage between terminals A and B with the engine **OFF**. The voltage should be between 350–500 millivolts. If the voltage doesn't fall within that range, the sensor is faulty.
5. If the voltage is within specifications, recheck the voltage after heating the engine to normal operating temperature. With the engine running at 1200 rpm, then voltage should vary rapidly between 100–900 millivolts. If the voltage is not varying or not within the range, the sensor is faulty.
6. If the voltage is within specifications, check the circuits back to the PCM for continuity.
7. If the sensor and circuits are functioning properly, the PCM may be faulty.

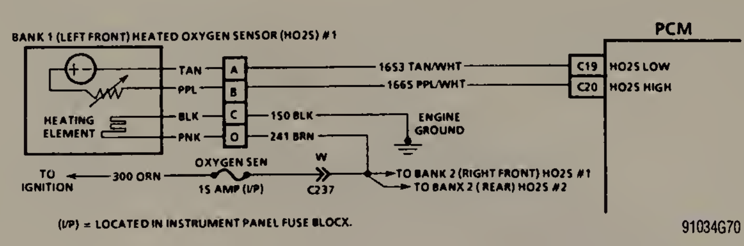


Fig. 55 Heated Oxygen Sensor (HO2S) sensor circuit—VIN P and 5 engines

REMOVAL & INSTALLATION

See Figures 56, 57 and 58

WARNING

The sensors use a permanently attached pigtail and connector. This pigtail should not be removed from the sensor. Damage or removal of the pigtail or connector could affect proper operation of the oxygen sensor. Keep the electrical connector and louvered end of the sensor clean and free of grease. NEVER use cleaning solvents of any type on the sensor! The sensor may be difficult to remove when the engine temperature is below 120°F (48°C). Excessive removal force may damage the threads in the exhaust manifold or pipe; follow the removal procedure carefully.

1. Make sure the ignition is **OFF**, then disconnect the negative battery cable.
2. Locate the oxygen sensor. It protrudes from the exhaust manifold or exhaust pipe (it looks somewhat like a spark plug). It may be necessary to raise and safely support the vehicle to access the sensor.
3. Unplug the sensor electrical connector.

There are special wrenches, either socket or open-end available from reputable retail outlets for removing the oxygen sensor. These tools make the job much easier and often prevent unnecessary damage.

4. Carefully unscrew the sensor, then remove the oxygen sensor from the manifold or pipe.

To install:

5. During and after the removal, be very careful to protect the tip of the sensor if it is to be reused. Do not let it to come in contact with fluids or dirt. Do not clean it or wash it.
6. Apply a coat of anti-seize compound to the bolt threads but DO NOT allow any to get on the tip of the sensor.

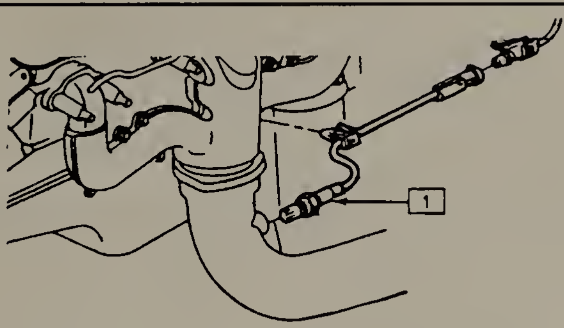


Fig. 56 Typical oxygen sensor location and mounting—1990 VIN 8 shown

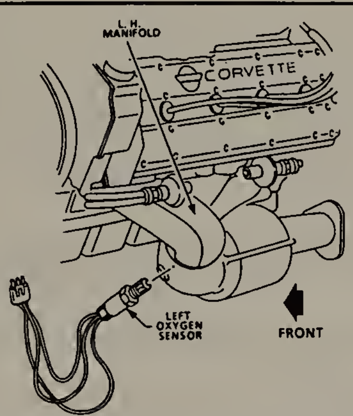


Fig. 57 Some vehicles, such as this 1990 VIN J, use a left and right bank oxygen sensor—left shown, right similar

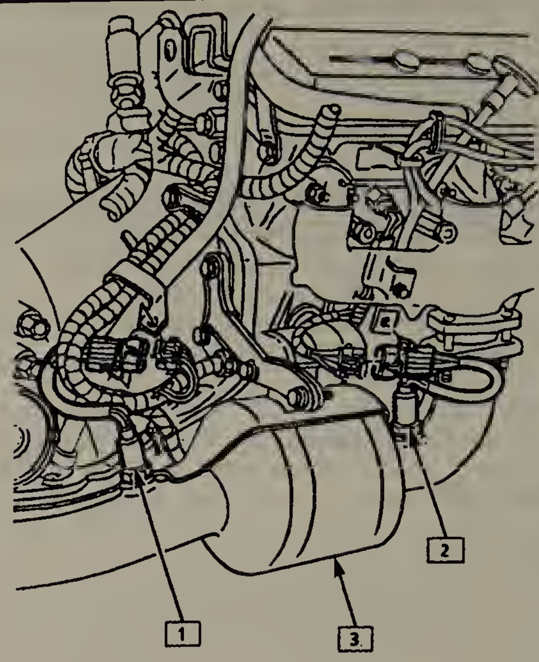


Fig. 58 Later model vehicles equipped with heated oxygen sensors may have 2 sensors on each bank

7. Install the sensor in the manifold or exhaust pipe. Tighten the sensor to 30 ft. lbs. (41 Nm) for VIN 8, P or 5 engines, or to 42 ft. lbs. (55 Nm) for VIN J engines.
8. Attach the electrical connector and ensure a clean, tight connection.
9. If raised, carefully lower the vehicle.
10. Connect the negative battery cable.

Idle Air Control Valve

OPERATION

Engine idle speeds are controlled by the PCM through the IAC valve mounted on the throttle body. The PCM sends voltage pulses to the IAC motor windings causing the IAC motor shaft and pintle to move in or out a given distance (number of steps) for each pulse (called counts). The movement of the pintle controls the airflow around the throttle plate, which in turn, controls engine idle speed. IAC valve pintle position counts can be observed using a scan tool. Zero counts correspond to a fully closed passage, while 140 counts or more corresponds to full flow.

Idle speed can be categorized in 2 ways: actual (controlled) idle speed and minimum idle speed. Controlled idle speed is obtained by the PCM positioning the IAC valve pintle. Resulting idle speed is determined by total air flow (IAC/passage + PCV + throttle valve + calibrated vacuum leaks). Controlled idle speed is specified at normal operating conditions, which consists of engine coolant at normal operating temperature, air conditioning compressor **OFF**, manual transmission in neutral or automatic transmission in **D**.

Minimum idle air speed is set at the factory with a stop screw. This setting allows a certain amount of air to bypass the throttle valves regardless of IAC valve pintle positioning. A combination of this air flow and IAC pintle positioning allows the PCM to control engine idle speed. During normal engine idle operation, the IAC valve pintle is positioned a calibrated number of steps (counts) from the seat. No adjustment is required during routine maintenance. Tampering with the minimum idle speed adjustment may result in premature failure of the IAC valve or improperly controlled engine idle operation.

TESTING

➧ See Figures 59 and 60

1. Visually check the connector, making sure it is connected properly and all of the terminals are straight, tight and free of corrosion.
2. Unplug the IAC connector and check resistance between the IAC terminals. Resistance between terminals A to B and terminals C to D should be 40–80 ohms. If resistance is not within specification, the IAC valve must be replaced.
3. Check resistance between the IAC terminals A to C, A to D, B to C and B to D. Resistance should be infinite. If not, the IAC valve is faulty.
4. If the resistance is within specification, check the IAC circuits back to the PCM for continuity.
5. If the valve and circuits are functional, the computer control module may be faulty.

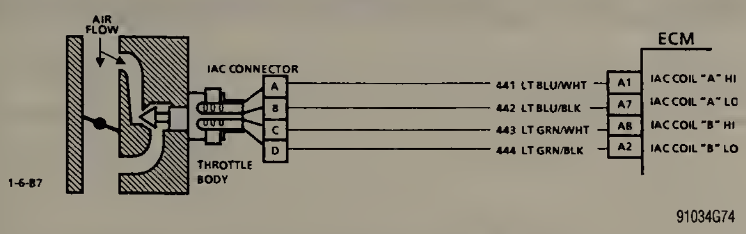


Fig. 59 Idle Air Control (IAC) valve circuit—VIN 8 engines

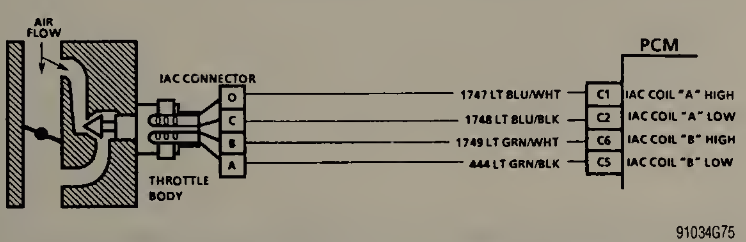


Fig. 60 Idle Air Control (IAC) valve circuit—VIN J, P & 5 engines

REMOVAL & INSTALLATION

➧ See Figures 61, 62 and 63

➡On some models it may be necessary to remove the air inlet assembly.

1. Disconnect the negative battery cable.
2. Detach the IAC valve electrical connector.
3. Remove the IAC valve by performing the following:
   a. On thread-mounted units, use a 1¼ in. (32mm) wrench.
   b. On flange-mounted units, remove the mounting screw assemblies.
4. Remove the IAC valve, then remove the and discard the IAC valve gasket or O-ring.

To install:

5. Clean the mounting surfaces by performing the following:

✲✲ WARNING

NEVER soak the IAC valve in any liquid cleaner or solvent!

   a. If servicing a thread-mounted valve, remove the old gasket material from the surface of the throttle body to ensure proper sealing of the new gasket.
   b. If servicing a flange-mounted valve, clean the IAC valve surfaces on the throttle body to assure proper seal of the new O-ring and contact of the IAC valve flange.
6. If installing a new IAC valve, measure the distance between the tip of the IAC valve pintle and the mounting flange. If the distance is greater than 1.102 in. (28mm), use finger pressure to slowly retract the pintle. The force required to retract the pintle of a new valve will not cause damage to the valve. If reinstalling the original IAC valve, do not attempt to adjust the pintle in this manner.
7. Install the IAC valve into the throttle body by performing the following:

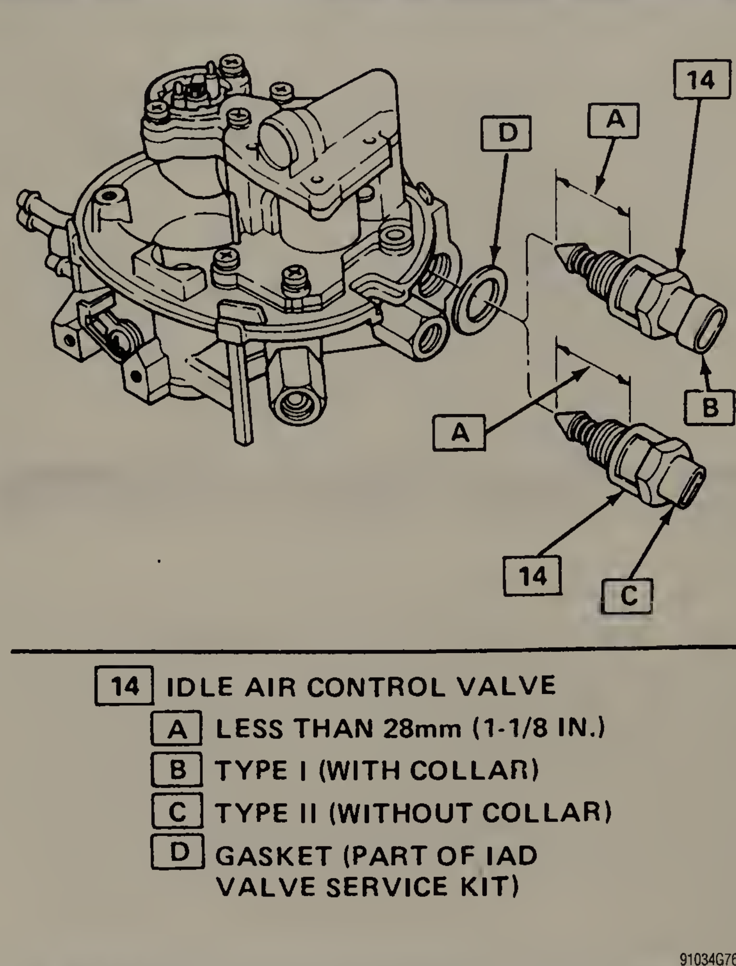


Fig. 61 View of the 2 types of thread mounted IAC valves used on early Corvettes

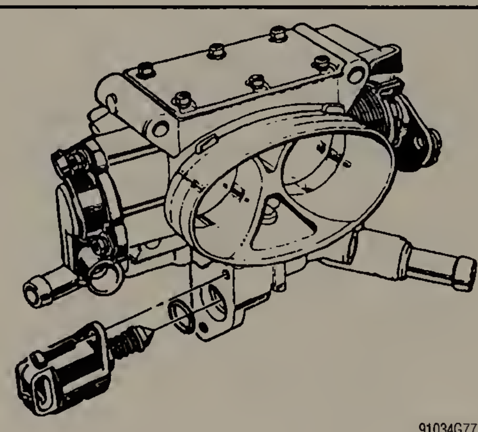


Fig. 62 Later vehicles use IAC valves which are secured with screws

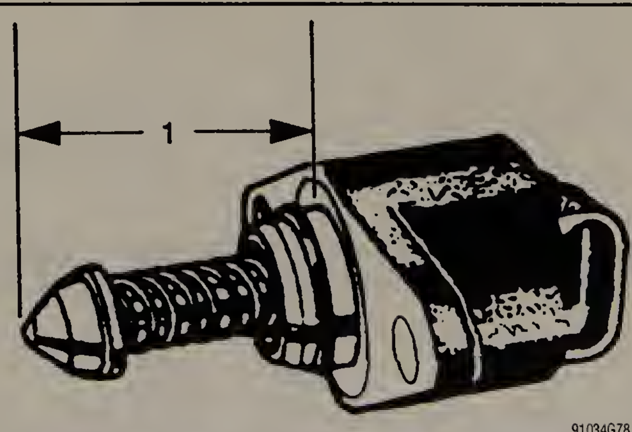


Fig. 63 If installing a new IAC valve, measure the distance of the pintle extension (1)

a. With thread-mounted valves, install with a new gasket. Using a 1¼ in. (32mm) wrench, tighten to 13 ft. lbs. (18 Nm).

b. With flange-mounted valves, lubricate a new O-ring with transmission fluid and install on the IAC valve. Install the IAC valve to the throttle body. Install the mounting screws using a suitable thread locking compound. Tighten to 27 inch lbs. (3 Nm).

8. Attach the IAC valve electrical connector.
9. Connect the negative battery cable.
10. No physical adjustment of the IAC valve assembly is required after installation. Reset the IAC valve pintle position by performing the following:
   a. Depress the accelerator pedal slightly.
   b. Start the engine and run for 5 seconds.
   c. Turn the ignition switch to the **OFF** position for 10 seconds.
   d. Restart the engine and check for proper idle operation.

Engine Coolant Temperature (ECT) Sensor

OPERATION

Most engine functions are affected by the coolant temperature. Determining whether the engine is hot or cold is largely dependent on the temperature of the coolant. An accurate temperature signal to the PCM is supplied by the coolant temperature sensor or Engine Coolant Temperature (ECT) sensor. The coolant temperature sensor is a thermistor mounted in the engine coolant stream. A thermistor is an electrical device that varies its resistance in relation to changes in temperature. Low coolant temperature produces a high resistance and high coolant temperature produces low resistance. The PCM supplies a signal of 5 volts to the coolant temperature sensor through a resistor in the PCM and measures the voltage. The voltage will be high when the engine is cold and low when the engine is hot.

TESTING

See Figure 64

1. Remove the ECT sensor from the vehicle.
2. Immerse the tip of the sensor in a container of water.
3. Connect a digital ohmmeter to the two terminals of the sensor.
4. Using a calibrated thermometer, compare the resistance of the sensor to the temperature of the water. Refer to the accompanying resistance value chart.

TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)

°C	°F	OHMS
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

91034G80

Fig. 64 Engine Coolant Temperature (ECT) sensor and Intake Air Temperature (IAT) sensor temperature vs. resistance values

5. Repeat the test at two other temperature points, heating or cooling the water as necessary.
6. If the sensor does not meet specifications, it must be replaced.

REMOVAL & INSTALLATION

See Figures 65, 66 and 67

1. Disconnect the negative battery cable.
2. If necessary, raise and safely support the vehicle, then drain the cooling system into a suitable container, to a level below the ECT sensor.
3. If raised, lower the vehicle.
4. For VIN 8, P and 5 engine, remove the air inlet duct.
5. For VIN J engines, remove the intake plenum as outlined in Section 3 of this manual.
6. Unplug the ECT electrical connector.

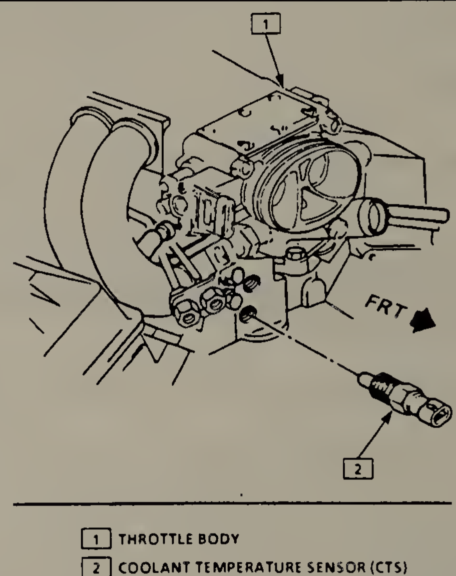
WARNING

Be careful when handling the ECT sensor. Damaging the sensor could adversely affect fuel injection system operation.

7. Carefully unthread the ECT sensor.

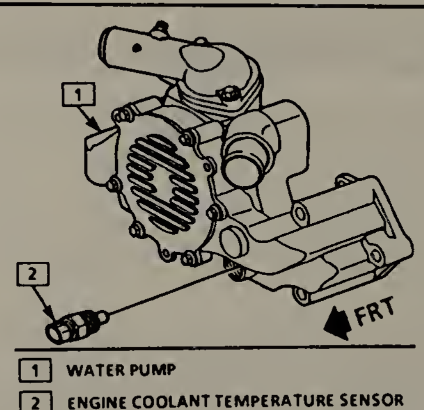
To install:

8. Coat the threads of the sensor with a suitable sealer.
9. Install the coolant temperature sensor and tighten as follows:
   a. VIN 8 engine: 9 ft. lbs. (12 Nm)
   b. VIN P & 5 engines: 17 ft. lbs. (23 Nm)
   c. VIN J engine: 20 ft. lbs. (27 Nm).
10. Attach the electrical connector.
11. For VIN J engines, install the intake plenum.



91034G81

Fig. 65 Location of the ECT sensor—VIN 8 engine



91034G82

Fig. 66 The Engine Coolant Temperature (ECT) sensor is located in the water pump on VIN P & 5 engines

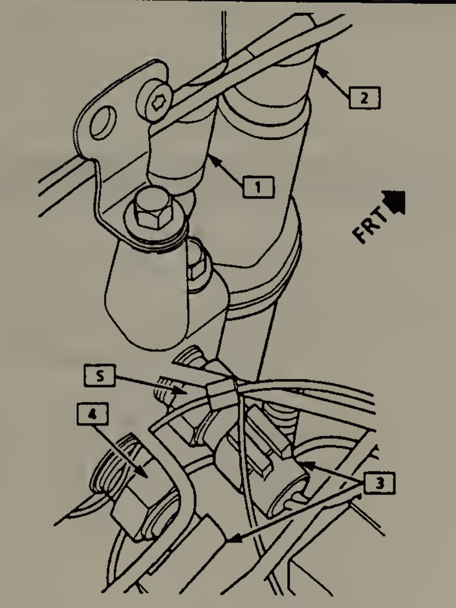


Fig. 67 On VIN J engines, the ECT sensor is located under the intake plenum

12. For the VIN 8, P and 5 engines, install the rear air intake duct.
13. Fill the cooling system as required.
14. Connect the negative battery cable.
15. Start the engine and check for leaks.

Intake Air Temperature (IAT) Sensor

OPERATION

➡On earlier model vehicles, the sensor is referred to as the Manifold Air Temperature (MAT) sensor.

The IAT sensor is a thermistor which supplies intake air temperature information to the PCM. The sensor produces high resistance at low temperatures and low resistance at high temperatures. The PCM supplies a 5 volt signal to the sensor and measures the output voltage. The voltage signal will be low when the air is cold and high when the air is hot. The IAT is located in or near the air intake duct.

TESTING

➧ See Figure 64

1. Remove the Intake Air Temperature (IAT) sensor from the vehicle.
2. Connect a digital ohmmeter to the two terminals of the sensor.
3. Using a calibrated thermometer, compare the resistance of the sensor to the temperature of the ambient air. Refer to the temperature vs. resistance chart.
4. Repeat the test at two other temperature points, heating or cooling the air as necessary with a hair dryer or other suitable tool.
5. If the sensor does not meet specifications, it must be replaced.

REMOVAL & INSTALLATION

VIN 8 Engine

➧ See Figure 68

1. Disconnect the negative battery cable.
2. Remove the intake plenum, as outlined in Section 3 of this manual..
3. Detach the electrical connector.
4. Carefully back the sensor out of the plenum.
5. Installation is the reverse of the removal prôcedure.

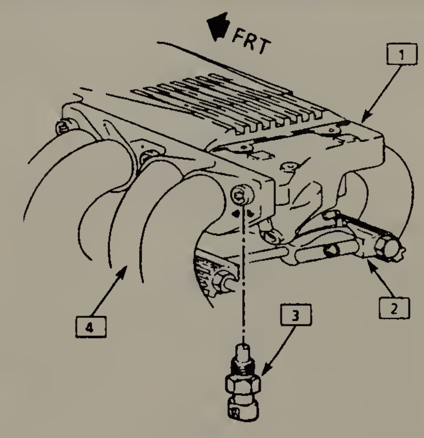


Fig. 68 On VIN 8 engines, the MAT (or IAT) is mounted in the intake plenum

VIN J, P and 5 Engines

➧ See Figure 69

1. Disconnect the negative battery cable.
2. Detach the sensor electrical connector locking tab and/or unplug detach the connector.
3. If equipped, unfasten the retaining clamp.
4. Carefully remove the sensor from the throttle body extension.

To install:

5. Install the sensor.
6. Attach the electrical connector.
7. Connect the negative battery cable.

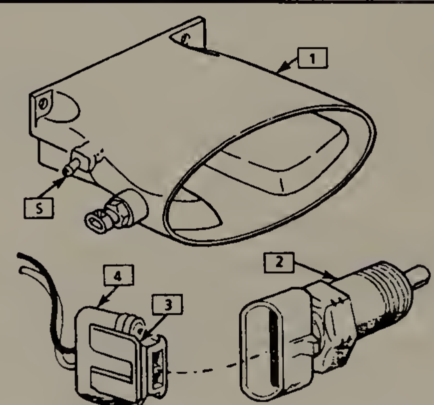


Fig. 69 On most vehicles, the IAT sensor is threaded into the throttle body extension

Mass Air Flow (MAF) Sensor

OPERATION

The Mass Air Flow (MAF) sensor, found on some engines, measures the amount of air passing through it. The PCM uses this information to determine the operating condition of the engine, to control fuel delivery. A large quantity of air indicates acceleration, while a small quantity indicates deceleration or idle.

The MAF sensor used on these vehicles is of the hot-wire type. Current is supplied to the sensing wire to maintain a calibrated temperature, and as air flow increases or decreases the current will vary. This varying current is directly proportional to air mass.

TESTING

▶ See Figures 70 and 71

1. Visually check the connector, making sure it is connected properly and all of the terminals are straight, tight and free of corrosion.
2. With the engine running, lightly tap on the MAF sensor and wiggle the wires at the connector and watch for the idle to change. A common problem is MAF sensor wire damage.
3. Backprobe using a DVOM set to the Hertz scale between terminals A and B. Simulate operating conditions by blowing air across the sensor. There should be a frequency swing from the air crossing the wire in the sensor. A normal flow signal wili be close to 12 hertz. If the frequency is not shown, or not proportionate to the air blown across the sensor, the sensor is faulty.
4. Check for battery positive (B+) on terminal C and ground on terminal B. If voltage or ground are not present. check the circuits back to the PCM for continuity.
5. If you receive the proper amount of voltage at the electrical connector and still have a driveability problem, replace the MAF sensor.
6. If the sensor and circuits are functional, the PCM may be faulty.

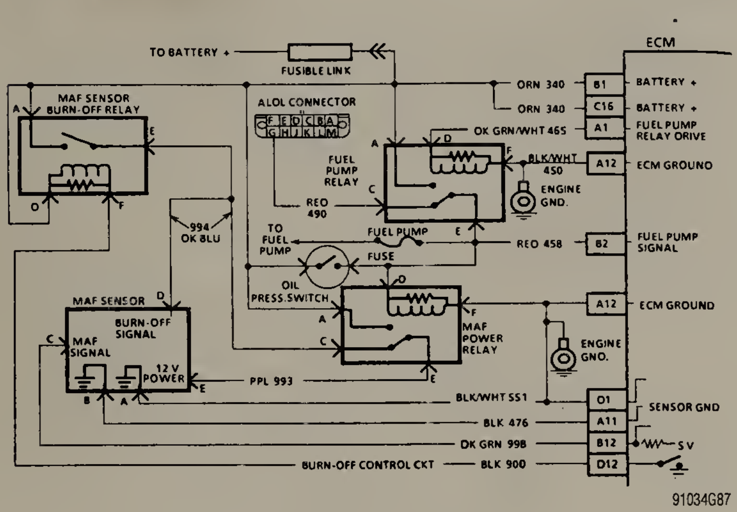


Fig. 70 Mass Air Flow (MAF) sensor circuit—VIN 8 engines

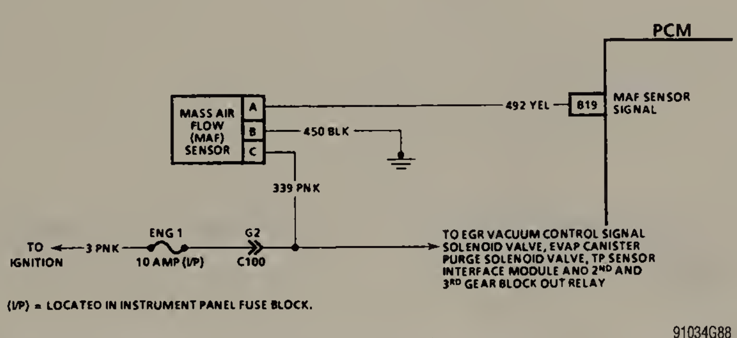


Fig. 71 Mass Air Flow (MAF) sensor circuit—VIN P engines

REMOVAL & INSTALLATION

▶ See Figure 72

1. Disconnect the negative battery cable.

⁂ WARNING

Be extremely careful when handling the MAF sensor. Do not dent, or puncture the honeycell located at the air inlet end of the MAF sensor. Don't touch the sensing elements or allow anything to contact them. Do not drop the MAF sensor or handle it roughly.

2. Detach the sensor electrical connection.
3. Carefully spread the clamps and remove the air intake ducts from the MAF sensor.
4. Remove the sensor from the vehicle.

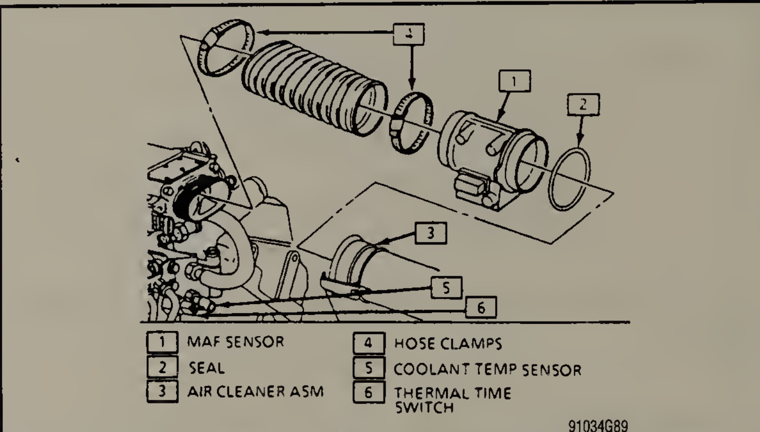


Fig. 72 Exploded view of the MAF sensor mounting—VIN 8 engine shown

To install:

➡The arrows on the MAF sensor indicate air flow and MUST point toward the engine.

5. Position the MAF sensor into the air ducts and tighten the clamps to 36 inch lbs. (4 Nm) or crimp the clamps, as applicable. If necessary, you can use a very small amount of lubricant on the air duct to help ease installation. Be careful not to get the lubricant in the sensor.
6. Attach the sensor electrical connector.
7. Connect the negative battery cable.

Manifold Absolute Pressure (MAP) Sensor

OPERATION

The MAP sensor measures the changes in intake manifold pressure, which result from engine load/speed changes and converts this information to a voltage output. The MAP sensor reading is the opposite of a vacuum gauge reading: when manifold pressure is high, MAP sensor value is high and vacuum is low. A MAP sensor will produce a low output on engine coast-down with a closed throttle while a wide open throttle will produce a high output. The high output is produced because the pressure inside the manifold is the same as outside the manifold, so 1 percent of the outside air pressure is measured.

The MAP sensor is also used to measure barometric pressure under certain conditions, which allows the PCM to automatically adjust for different altitudes.

The MAP sensor changes the 5 volt signal supplied by the PCM, which reads the change and uses the information to control fuel delivery and ignition timing.

TESTING

➧ **See Figures 73 and 74**

1. Visually check the connector, making sure it is properly attached and all of the terminals are straight, tight and free of corrosion.
2. With the ignition **ON**, check the voltage between terminals A and B. It should be above 4 volts. Apply 15 in. Hg of vacuum at the MAP vacuum port and check the voltage again. The voltage should be 2 volts now.

➡**When pumping up and releasing the vacuum, check to make sure the voltage readings are smooth. When applying vacuum to the sensor, the change in voltage should happen instantly. A slow change in voltage could point to a faulty sensor.**

3. If the sensor voltage is not within specification, check for a 5 volt reference at terminal C. If the reference signal is found, the sensor is faulty.
4. If the sensor and circuits are functional, the PCM may be faulty.

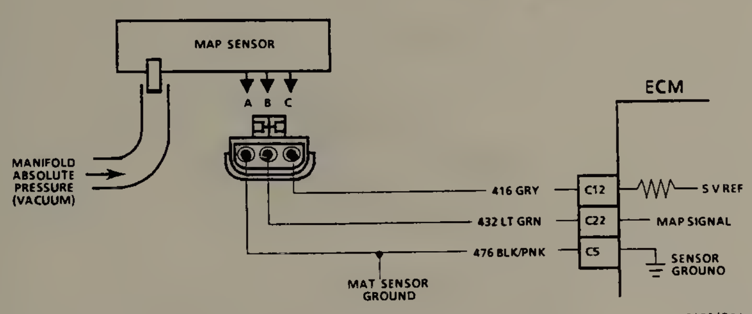


Fig. 73 Manifold Absolute Pressure (MAP) sensor circuit

MAP

kPa	100	90	80	70	60	50	40	30	20	10	0
Hg	29.6	26.6	23.7	20.7	17.7	14.8	11.8	8.9	5.9	2.9	0
V	4.9	4.4	3.8	3.3	2.7	2.2	1.7	1.1	0.6	0.3	0.3

91034G92

Fig. 74 MAP sensor voltage specifications

REMOVAL & INSTALLATION

Except VIN J Engines

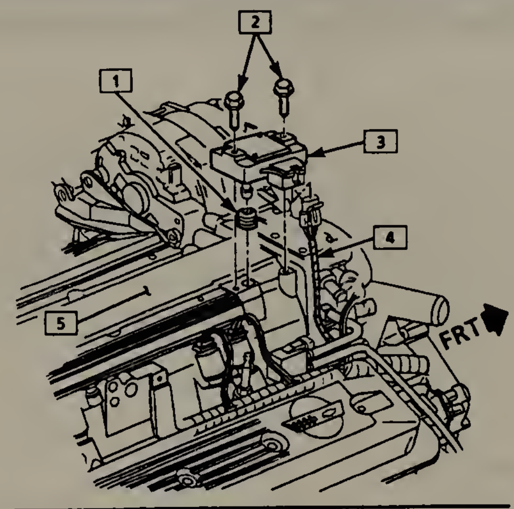
➧ **See Figure 75**

1. Disconnect the negative battery cable.
2. Detach the MAP sensor electrical connector.
3. Unfasten the 2 sensor hold-down bolts, then remove the MAP sensor from the intake manifold.

To install:

➡**If equipped, lightly coat the seal on the MAP sensor with clean engine oil.**

4. Install the MAP sensor on the intake manifold.
5. Install the retaining bolts and tighten to 50 inch lbs. (6 Nm).



1 MAP SENSOR SEAL
2 6 N·m (50 lb. in.)
3 MAP SENSOR
4 MAP SENSOR HARNESS
5 INTAKE MANIFOLD

91034G93

Fig. 75 Exploded view of the MAP sensor—1994 VIN P shown

6. Attach the sensor electrical connector.
7. Connect the negative battery cable.

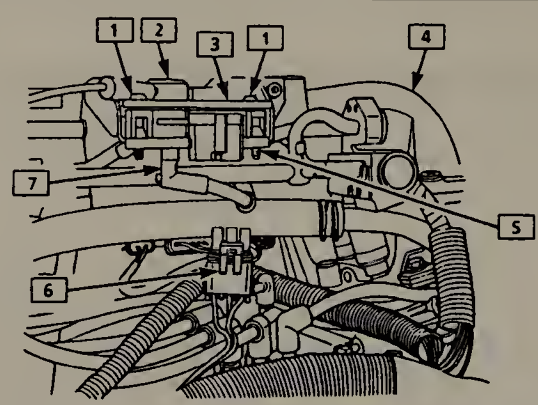
VIN J Engines

➧ **See Figure 76**

1. Disconnect the negative battery cable.
2. Remove the sensor hold-down bolts.
3. Remove the protective cover.
4. Detach the electrical connector and unplug the vacuum hose.
5. Remove the MAP sensor.

To install:

6. Instlal the MAP sensor.
7. Attach the vacuum hose and electrical connector.
8. Install the protective cover.
9. Install the hold-down bolts and tighten to 50 inch lbs. (6 Nm).
10. Connect the negative battery cable.



1 ATTACHING SCREW
2 FUEL PRESSURE REGULATOR
3 PROTECTIVE COVER
4 INTAKE PLENUM
5 MANIFOLD ABSOLUTE PRESSURE SENSOR
6 MAP SENSOR ELECTRICAL CONNECTOR
7 VACUUM HOSE

91034G94

Fig. 76 Location of the MAP sensor—VIN J engines

Throttle Position Sensor

OPERATION

The TP sensor is mounted to the throttle body, opposite the throttle lever and is connected to the throttle shaft. Its function is to sense the current throttle valve position and relay that information to the PCM. Throttle position information allows the PCM to generate the required injector control signals. The TP sensor consists of a potentiometer which alters the flow of voltage according to the position of a wiper on the variable resistor windings, in proportion to the movement of the throttle shaft.

TESTING

➧ See Figures 77 and 78

1. Visually check the connector, making sure it is properly attached and all of the terminals are straight, tight and free of corrosion.
2. With the ignition in the **ON** position, check the voltage at terminal B for VIN 8 and J, or terminal C for VIN P & 5 engines. The voltage should read less that 0.5 volts.
3. Operate the throttle, while watching the voltage. The voltage should increase smoothly to 5 volts as the throttle is opened.
4. If the voltage is not within specification, check the 5 volt reference signal circuit at terminal C for VIN 8 & J engines or terminal A for VIN P & 5 engines and ground the circuit at terminal B for the proper signal. If the correct signal is found, the sensor is faulty. If the proper signal is not found, check the circuits back to the computer control module for continuity.
5. If the circuits are functional, the PCM may be faulty.

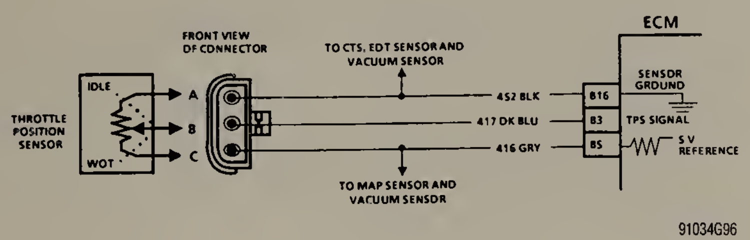


Fig. 77 Throttle Position (TP) sensor circuit—VIN 8 and J engines

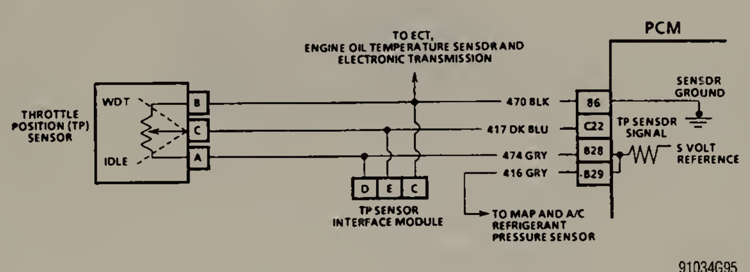


Fig. 78 Throttle Position (TP) sensor circuit—VIN P and 5 engines

REMOVAL & INSTALLATION

➧ See Figure 79

1. Disconnect the negative battery cable.
2. Detach the TPS electrical connector.
3. Remove the mounting screws.
4. Remove the TPS and, if equipped, sensor seal from the throttle body.

To install:

5. With the throttle valve in the normal closed idle position, install the throttle position on the throttle body, making sure that sensor pickup lever lines up with the tang on the throttle actuator lever.
6. Place the TP sensor in position. Align the TP sensor lever with the sensor drive lever on the throttle body.
7. Install the TP sensor mounting screws and tighten to 18 inch lbs. (2 Nm).
8. Attach the electrical connector.
9. Connect the negative battery cable.

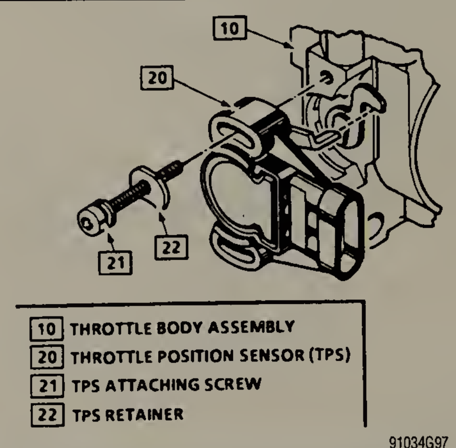


Fig. 79 Typical Throttle Position (TP) sensor mounting

Camshaft Position Sensor

OPERATION

➡The 5.7L (VIN J) engine is the only engine which uses a Camshaft Position (CMP) sensor.

The PCM uses the CMP sensor to determine the position of the No. 1 piston during its power stroke. This signal is used by the PCM to calculate fuel injection mode of operation.

If the cam signal is lost while the engine is running, the fuel injection system will shift to a calculated fuel injected mode based on the last fuel injection pulse, and the engine will continue to run.

TESTING

VIN J Engines

➡The best method to test this sensor is by using an oscilloscope.

The camshaft position sensor used on these engines is a 3-wire, Hall effect type sensor. The sensor requires power and ground to function. When performing this test, backprobe all connectors.

1. Visually check the connector, making sure it is connected properly and all of the terminals are straight, tight and free of corrosion.
2. With the ignition in the **ON** position, check the sensor voltage using an oscilloscope. When the starter is briefly operated, a square wave pattern, alternating from 0–12 volts should be seen at terminal B. If the voltage is within specification, the sensor is functional

3. If the sensor voltage is not within specifications, use a DVOM to check terminal A for battery positive (B+). If battery positive (B+) is not present, check the circuit continuity and repair as necessary.
4. If battery positive (B+) is present at terminal A, check terminal C for proper ground. If ground is not present check the circuit for continuity and repair as necessary.
5. If the sensor and circuits are functional, the PCM may be faulty.

REMOVAL & INSTALLATION

VIN J Engine

➧ See Figure 80

1. Disconnect the negative battery cable.
2. If necessary, remove the intake manifold.
3. Detach the CMP sensor electrical connector.
4. Clean the area around the CMP sensor to avoid getting debris in the engine.
5. Remove the CMP sensor retaining bolt, then remove the sensor from the engine.

To install:

6. Install the CMP sensor and retaining bolt. Tighten the bolt to 18 ft. lbs. (25 Nm).
7. Attach the CMP sensor electrical connector.
8. Install the intake manifold.
9. Connect the negative battery cable.

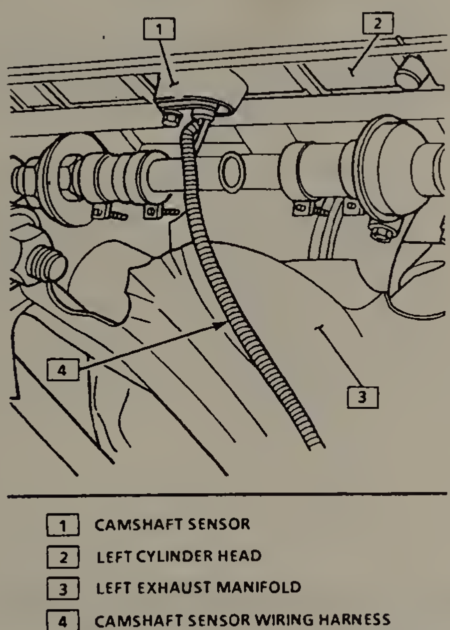


Fig. 80 Location of the Camshaft Position (CMP) sensor—5.7L (VIN J) engine

Crankshaft Position Sensor

OPERATION

➧ See Figures 81 and 82

The CKP sensor provides a signal through the ignition module which the PCM uses as a reference to calculate RPM and crankshaft position.

TESTING

➡**The best method to test this sensor is by using an oscilloscope.**

1. Visually check the connector, making sure it is connected properly and all of the terminals are straight, tight and free of corrosion.
2. If a Tech 1® or equivalent scan tool is available, scan the CKP or RPM parameter while cranking the engine. If signals are indicated, the CKP sensor is functioning properly.

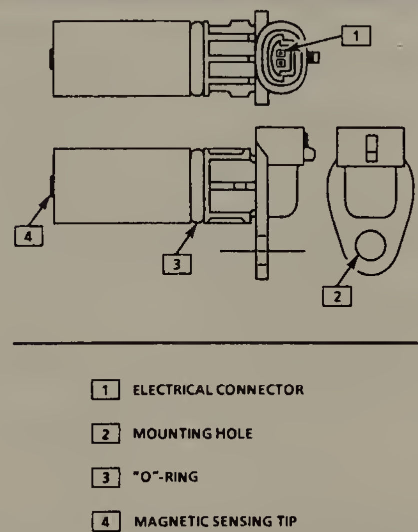


Fig. 81 View of the Crankshaft Position (CKP) sensor used on VIN J engines

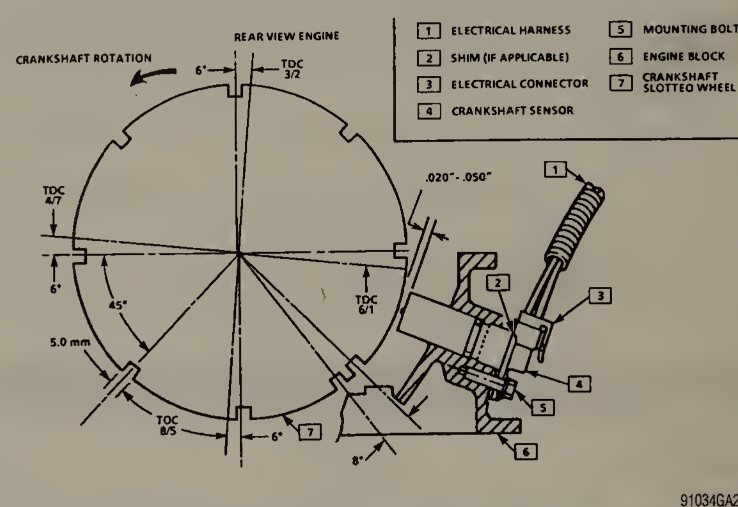


Fig. 82 Crankshaft and CKP sensor relation—VIN J engine

3. If the scan tool is not available, use a digital multimeter set to the ohms setting, then check the resistance across the sensor terminals. The resistance should measure about 5–12 ohms at about 70° F. The resistance will vary with temperature.

➡**This test must be performed with the ignition ON and the engine OFF.**

4. Using a thin piece of steel, check the tip of the sensor to see if it is magnetized.
5. Using a digital multimeter set to the millivolts AC scale, connect the test probes to the sensor.
6. Rotate the reluctor ring to activate the sensor signal. Use the starter to crank the engine.
7. Voltage should be seen as the reluctor ring is rotated. If the reluctor is rotated quickly, a signal of at least 2 millivolts AC should be seen.
8. If the sensor and circuits are functional, the PCM may be faulty.

REMOVAL & INSTALLATION

VIN J Engine

➧ See Figure 83

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Unfasten any necessary retainers, then remove CKP sensor shield.
4. Detach the CKP sensor electrical connector.
5. Unfasten the CKP sensor mounting bolt, then remove the sensor from the vehicle.
6. If equipped, remove the sensor shim.

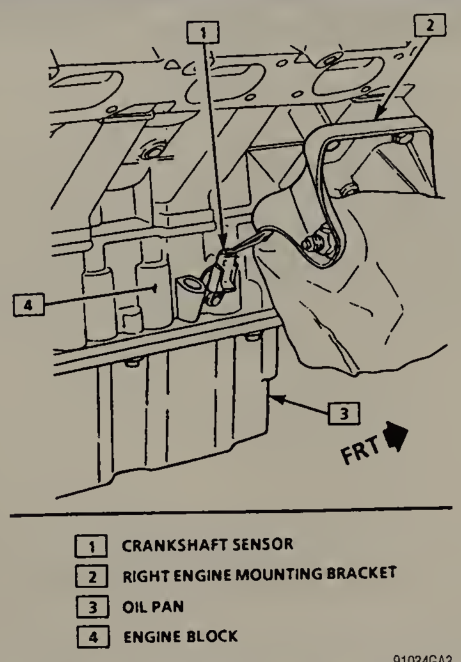


Fig. 83 The CKP sensor is mounted in the lower right side of the engine block, between cylinders 4 & 6, just above the oil pan

To install:

7. Lubricate the CKP sensor O-ring with clean engine oil. If used, install the sensor shim.
8. Position the CKP sensor and install the mounting bolt. Tighten the bolt to 71 inch lbs. (8 Nm).
9. Attach the sensor electrical connector.
10. Install the CKP sensor shield, securing with the retainers as necessary.
11. Carefully lower the vehicle, then connect the negative battery cable.

Knock Sensor (KS)

OPERATION

See Figure 84

Some vehicles use two knock sensors.

The knock sensor is usually mounted to the right and/or left lower side of the engine block. When spark knock or pinging is present, the sensor produces a voltage signal which is sent to the PCM. The PCM will then retard the ignition timing based on these signals.

TESTING

1. Connect a timing light to the vehicle, then start the engine.
2. Check that the timing is correct before testing the knock sensor operation.

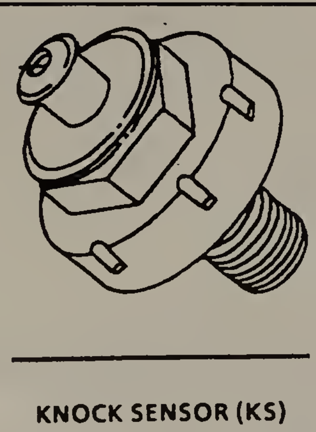


Fig. 84 View of a typical Knock Sensor (KS)

3. If the timing is correct, tap on the front of the engine block with a metal object while observing the timing to see if the timing retards.
4. If the timing does not retard, the knock sensor may be defective.

REMOVAL & INSTALLATION

See Figures 85, 86 and 87

1. Disconnect the negative battery cable.
2. Raise and properly support the vehicle.
3. Position a suitable drain pan under the vehicle, then drain the engine coolant.
4. If equipped, remove the knock sensor shield.
5. Disconnect the knock sensor wiring harness.
6. Remove the knock sensor from the engine block.

CAUTION

The knock sensor is mounted in the engine block cooling passage. Engine coolant in the block will drain when the sensor is removed.

7. Installation is the reverse of removal. Prior to installing the sensor, Do NOT apply any thread sealer to the KS threads. The sensor is coated at the factory and any additional sealant you may apply will negatively affect the ability of the sensor to detect knocking or pinging. Tighten the sensor to 14 ft. lbs. (19Nm).

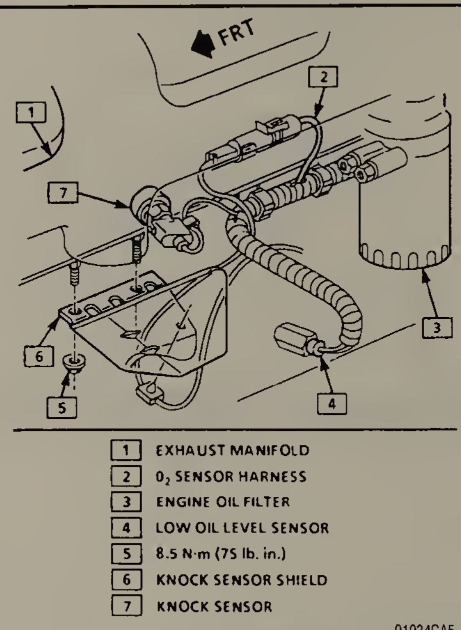


Fig. 85 Location of the left knock sensor on VIN P engines

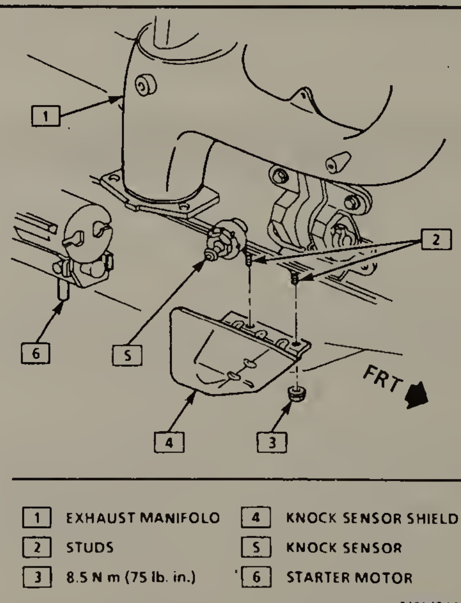


Fig. 86 The VIN P engine also has a right side knock sensor

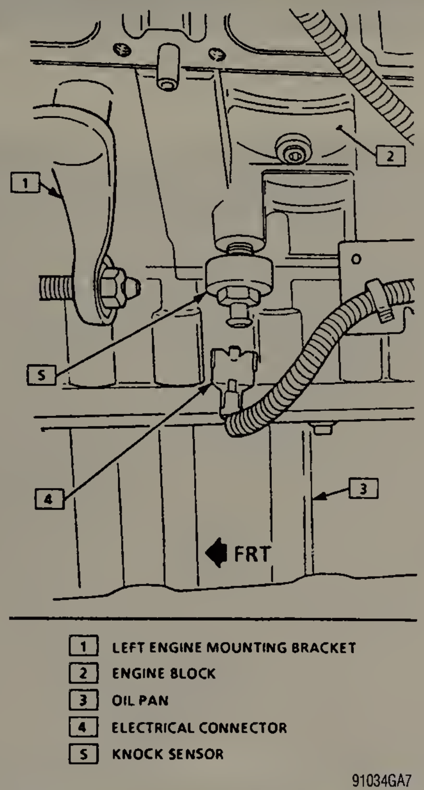


Fig. 87 Location of the knock sensor on VIN J engines

Vehicle Speed Sensor

OPERATION

The Vehicle Speed Sensor (VSS) is a pulse counter type input sensor which tells the PCM how fast the vehicle is being driven. An inductive sensor mounted in the tail housing of the transmission and a toothed reluctor wheel on the tail shaft. As the reluctor rotates, the teeth alternately interfere with the magnetic field of the sensor, creating an induced voltage pulse. The VSS produces an AC voltage signal increased with vehicle speed. The PCM processes this information, then sends a signal to the instrument panel, radio, chime module, and cruise control module.

TESTING

See Figure 88

1. Visually check the connector, making sure it is connected properly and all of the terminals are straight, tight and free of corrosion.
2. Detach the VSS electrical connector, the measure the voltage between the terminals while the rear wheels of the vehicle are rotated. The sensor should generate a sine wave voltage signal that increases in amplitude and frequency as the vehicle speed increases. If the voltage measures less than 0.5 volts, the sensor is bad and must be replaced.
3. Check the resistance between the sensor terminals. It should measure between 13–1950 ohms. If not within the range, the sensor is bad and must be replaced.
4. Check the resistance between the VSS and transmission case. The resistance should be more than 10 megaohm. If the resistance is not within specifications, the sensor is faulty.
5. If the resistance and voltage are within the proper ranges, check the sensor circuits for continuity.
6. If the sensor and circuits are OK, the PCM may be faulty.

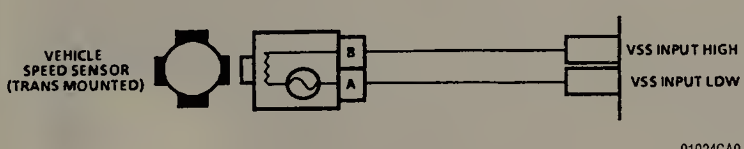


Fig. 88 Vehicle Speed Sensor (VSS) circuit

REMOVAL & INSTALLATION

See Figures 89 and 90

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Unplug the VSS electrical connector.
4. Unfasten the retainer bolt, the remove the sensor retainer, and spacer.
5. Remove the VSS from the transmission case.
6. If necessary, remove the O-ring seal and the speedometer driven gear from the sensor.
7. Installation is the reverse of the removal procedure. Tighten the mounting bolt to 89 inch lbs. (10 Nm).

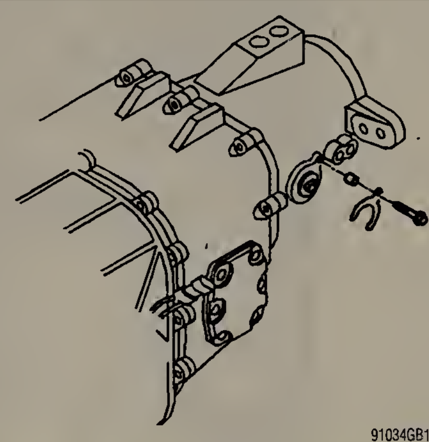


Fig. 89 Remove the mounting bolt, the retainer and spacer

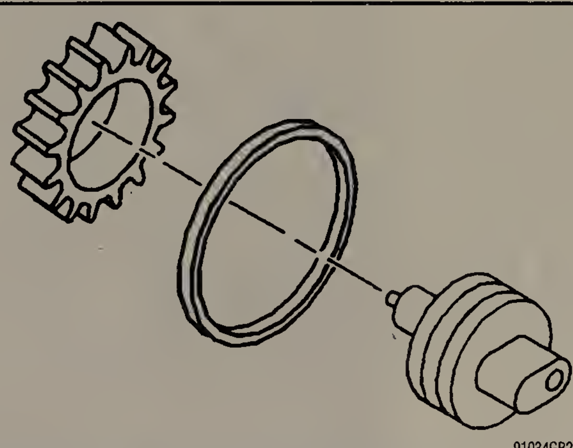
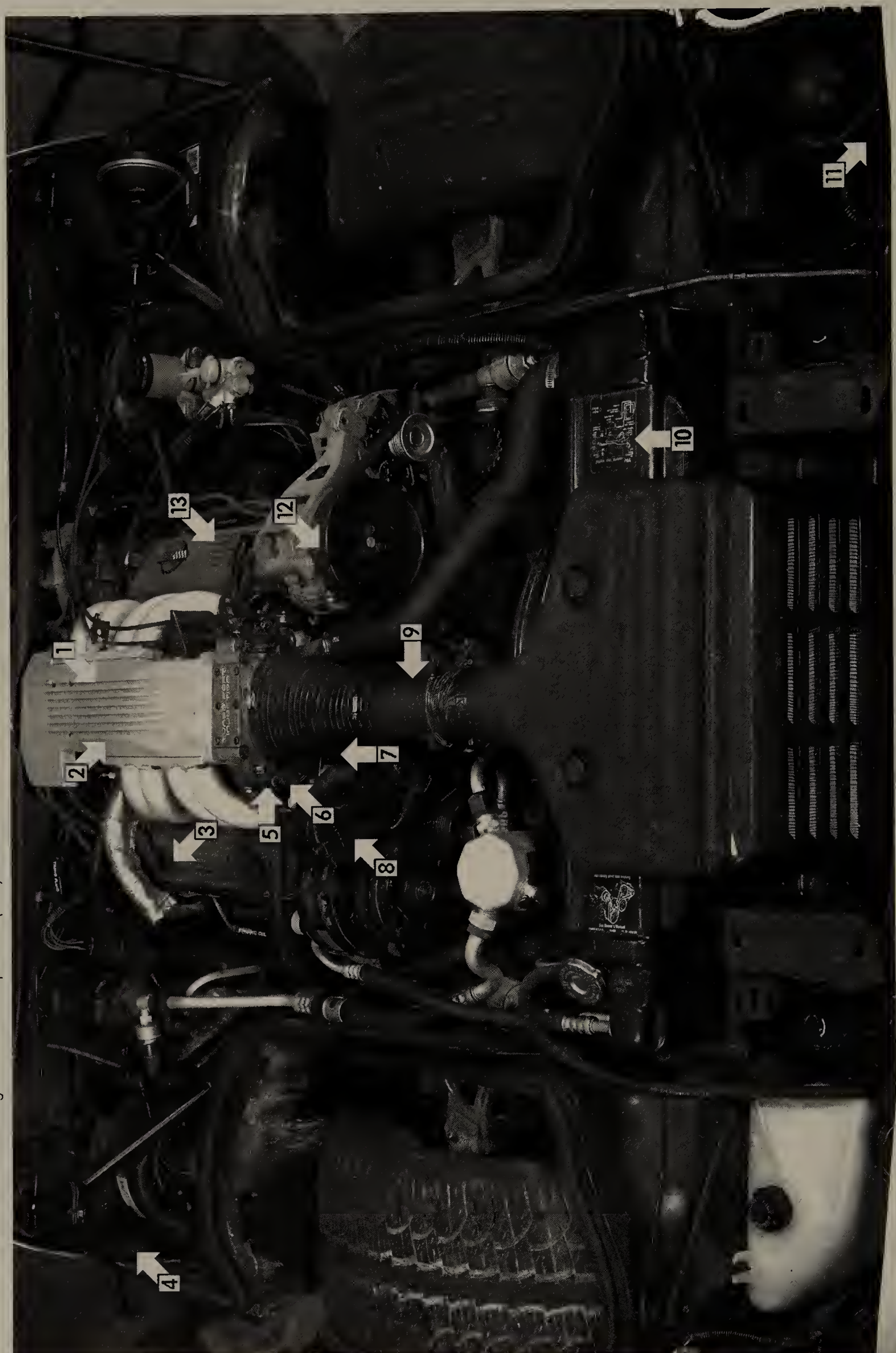


Fig. 90 Exploded view of the O-ring, gear and sensor

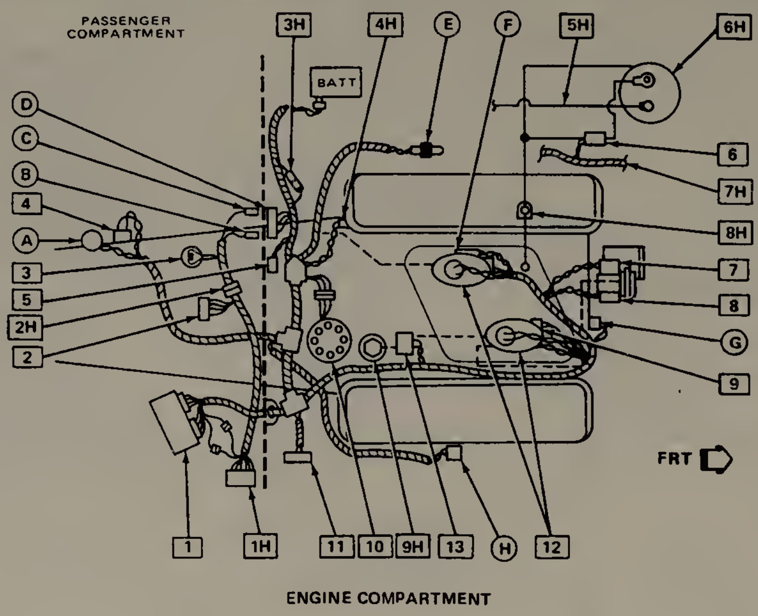
COMPONENT LOCATIONS

EMISSION COMPONENT LOCATIONS

1. Manifold Air Temperature (MAT) sensor (located under plenum)
2. Exhaust Gas Recirculation (EGR) valve (located under plenum)
3. Positive Crankcase Ventilation (PCV) valve
4. Electronic Spark Control (ESC) module
5. Throttle Position (TP) sensor
6. Idle Air Control (IAC) valve
7. Engine Coolant Temperature (ECT) sensor
8. Air control divert valve
9. Mass Air Flow (MAF) sensor
10. Vehicle Emission Control Information (VECI) sensor
11. Evaporative canister (located in front corner of engine compartment)
12. Air injection pump
13. Oxygen sensor (threaded into exhaust pipe)



91034PC1



1984 CORVETTE ENGINE
5.7L (350 CID) V-8 RPO: L83 V.I.N. CODE: 8
VEHICLE EMISSION CONTROL INFORMATION LABEL
FEDERAL: EIG 5.7 V5 NBM3 CALIFORNIA: EIG 5.7 V5 NBM8

INFORMATION SENSORS/SWITCHES

- A Vehicle Speed Sensor
- B Brake Switch
- C P/N Switch
- D Manifold Pressure Sensor (MAP)
- E Exhaust Oxygen Sensor
- F Throttle Position Sensor (TPS)
- G Coolant Sensor
- H ESC Sensor (Knock)

ECM CONTROLLED COMPONENTS

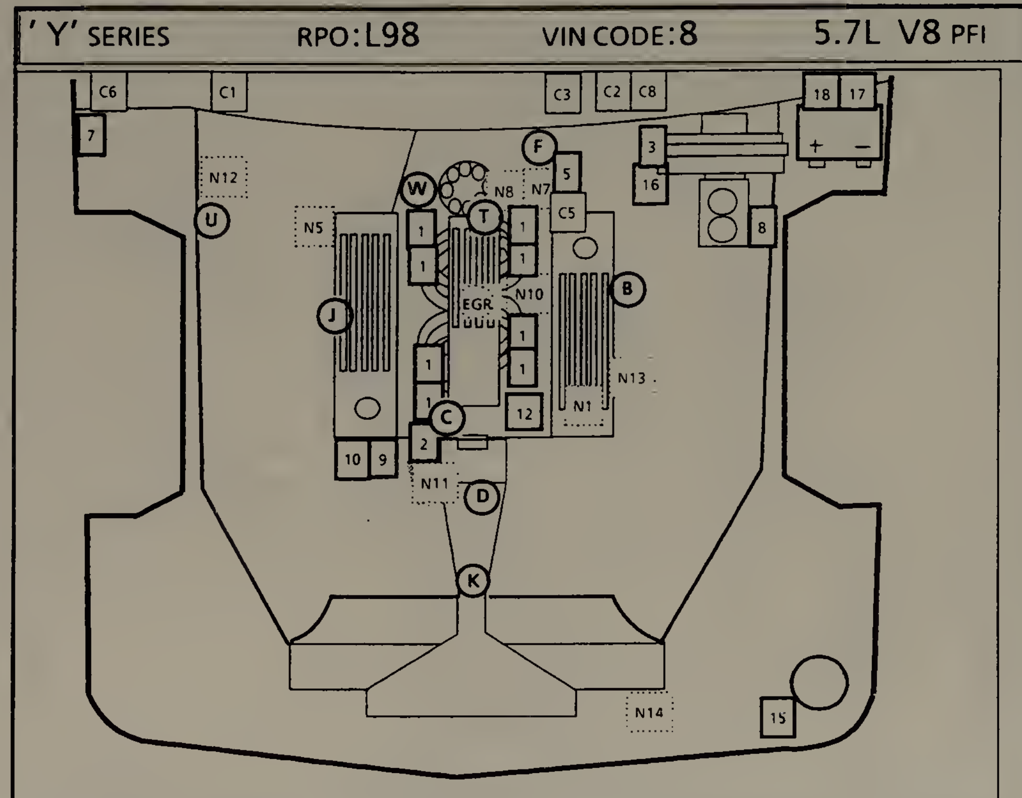
- 1 Electronic Control Module (ECM)
- 2 ALCL Connector
- 3 "CHECK ENGINE" Light
- 4 Trans. Conv. Clutch
- 5 Fuel Pump Relay
- 6 Canister Purge Solenoid Valve
- 7 Air Control Solenoid Valve
- 8 Air Switching Solenoid Valve
- 9 Idle Air Control
- 10 Electronic Spark Timing
- 11 Electronic Spark Control (ESC)
- 12 Throttle Body Injector
- 13 Exhaust Gas Recirculation Solenoid Valve
- 14 To Air Cleaner THERMAC

HARNESS CONNECTIONS, ETC.

- 1H Fuse Panel
- 2H Cold Start Module
- 3H Base Timing Set Connector
- 4H ECM Ground (2 Places)
- 5H From Fuel Tank
- 6H Vapor Canister
- 7H Front Lamp Harness
- 8H PCV Valve
- 9H EGR Valve

91034C01

Fig. 91 Component locations—1984–85 5.7L (VIN 8) engine



COMPUTER HARNESS

- C1 Electronic control module (ECM)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector (ALDL "G")

NOT ECM CONNECTED

- N1 Crankcase vent valve (PCV)
- N5 Engine temp. sensor (gage.overheat)
- N7 Oil pressure sensor (gage)
- N8 Oil pressure switch (fuel pump)
- N10 Cold start valve
- N11 Cold start fuel injection switch
- N12 A/C pressure cycling switch
- N13 Fan switch (H.D. cooling)
- N14 H.D. cooling fan relay

CONTROLLED DEVICES

- 1 Fuel injector
- 2 Idle air control motor
- 3 Fuel pump relay
- 5 Trans. converter clutch connector
- 7 Electronic spark control module
- 8 Engine fan relay
- 9 Air injection divert solenoid
- 10 Air injection port solenoid
- 12 Exh. gas recirc. vacuum solenoid
- 15 Fuel vapor canister solenoid
- 16 Transmission overdrive relay (M/T)
- 17 MAF sensor power relay
- 18 MAF sensor burn-off relay

INFORMATION SENSORS

- B Exhaust oxygen
- C Throttle position
- D Coolant temperature
- F Vehicle speed
- J ESC knock
- K Mass air flow
- T Manifold air temperature
- U A/C pressure switch
- W EGR diagnostic temp. switch

91034C02

Fig. 92 Component locations—1986–89 5.7L (VIN 8) engine

Fig. 93 Component locations—1990–91 5.7L (VIN 8) engine

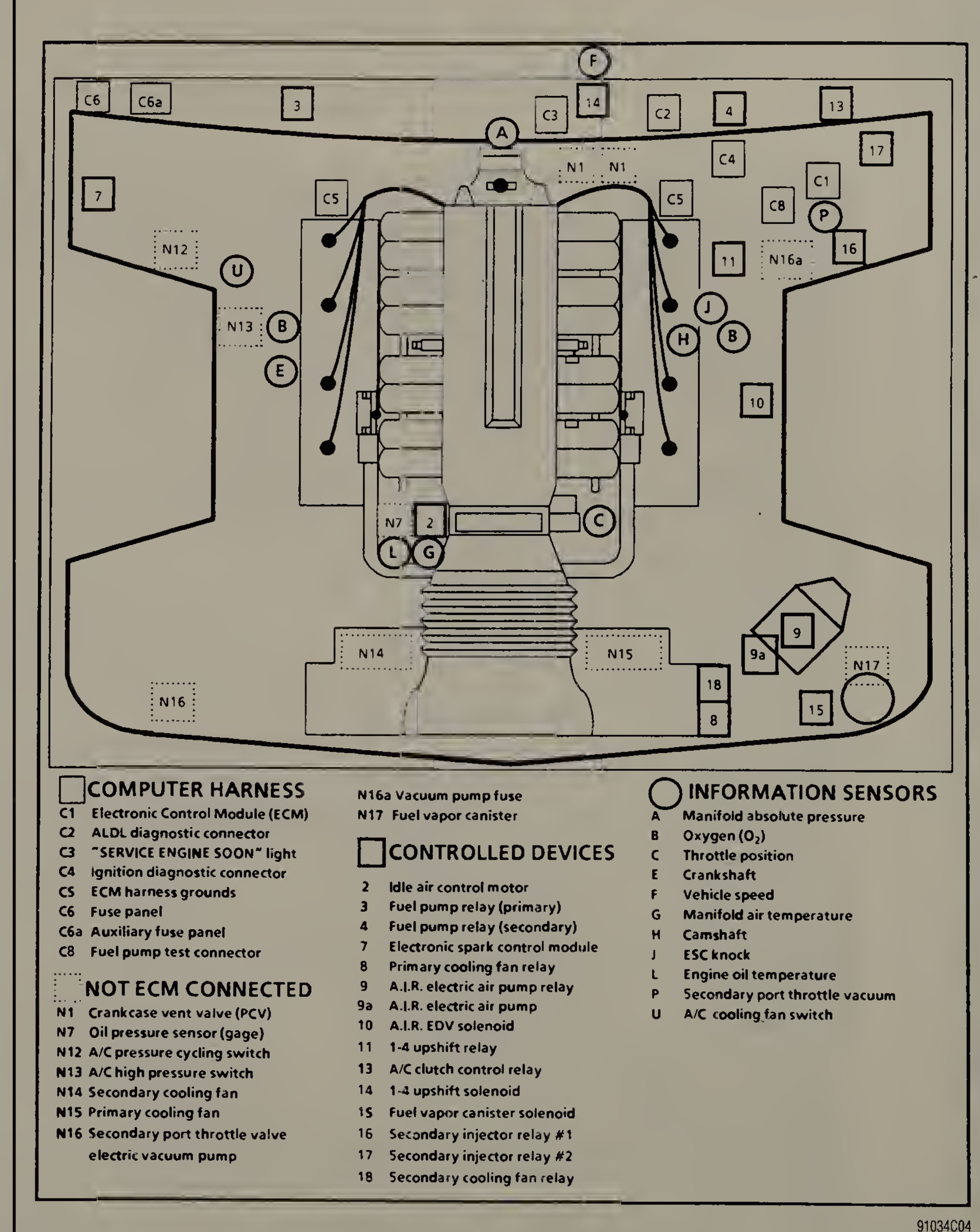
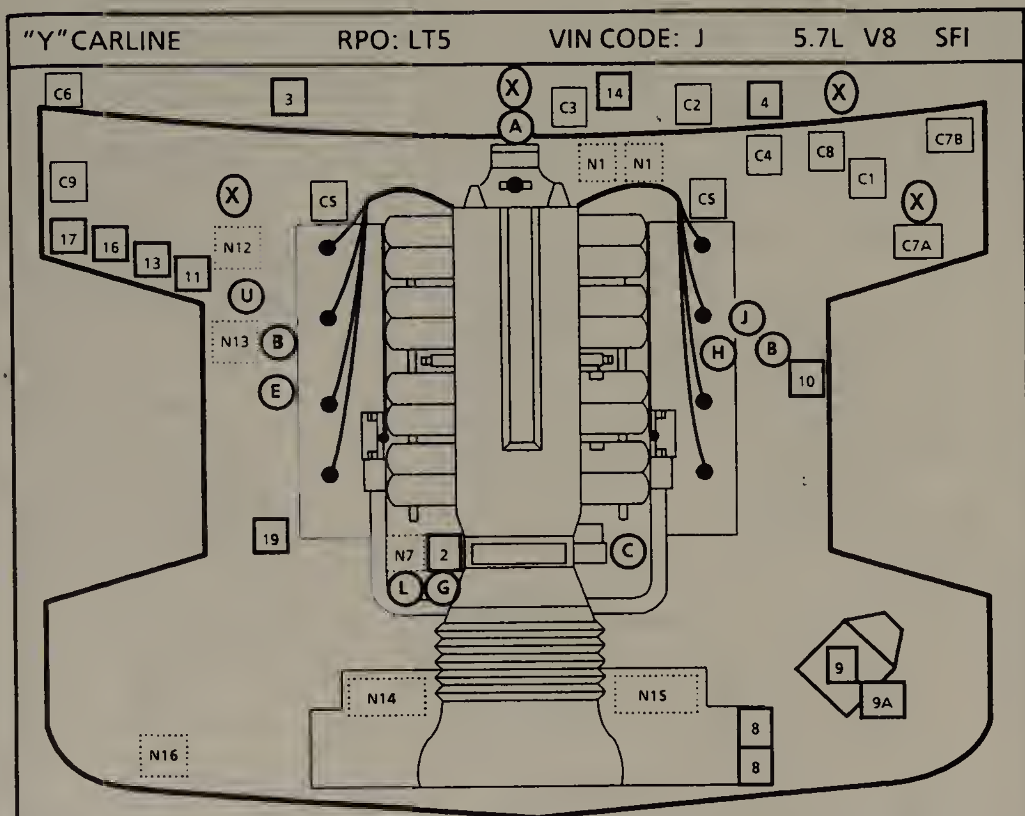


Fig. 94 Component locations—1990–91 5.7L (VIN J) engine



COMPUTER HARNESS

- C1 Engine Control Module (ECM)
- C2 Data link connector (DLC)
- C3 Malfunction Indicator Lamp (MIL)
- C4 Electronic Ignition diagnostic connector
- C5 ECM harness grounds
- C6 I/P Fuse panel
- C7A Underhood fuse block
- C7B Underhood fuse block
- C8 Fuel pump test connector
- C9 TP sensor interface module

NOT ECM CONNECTED

- N1 Crankcase ventilation valve
- N7 Oil pressure sensor (gage)
- N12 A/C pressure cycling switch
- N13 A/C high pressure switch
- N14 Secondary cooling fan (FAN 2)
- N15 Primary cooling fan (FAN 1)
- N16 Secondary air inlet valve electric vacuum pump

CONTROLLED DEVICES

- 2 Idle air control (IAC) valve
- 3 Fuel pump (FP) relay (primary)
- 4 Fuel pump (FP) relay (secondary)
- 8 Cooling fan relay (s)
- 9 Secondary Air Injection (AIR) pump
- 9A Air pump relay
- 10 Air bypass valve
- 11 2nd & 3rd gear block out relay
- 13 A/C clutch relay
- 14 2nd & 3rd gear block out solenoid
- 16 Secondary SFI control module #1
- 17 Secondary SFI control module #2
- 19 Linear EGR valve

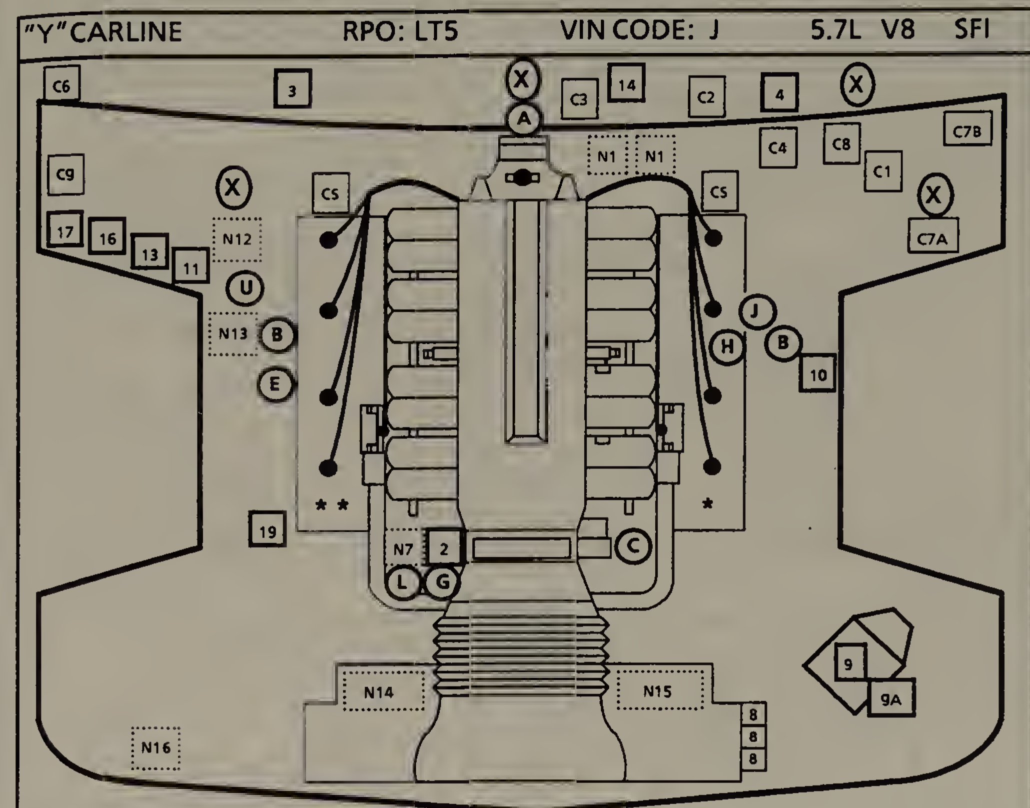
INFORMATION SENSORS

- A Manifold Absolute Pressure (MAP) sensor
- B Heated Oxygen Sensor (HO2S)
- C Throttle Position (TP) sensor
- E Crankshaft Position sensor
- F Vehicle Speed Sensor (VSS) (mounted on transmission, not shown)
- G Intake Air Temperature (IAT) sensor
- H Camshaft Position sensor
- J Knock Sensor (KS)
- L Engine oil temperature sensor
- U A/C cooling fan switch

X SIR System Components.

91034C05

Fig. 95 Component locations—1992–94 5.7L (VIN J) engine



COMPUTER HARNESS

- C1 Engine Control Module (ECM)
- C2 Data link connector (DLC)
- C3 Malfunction Indicator Lamp (MIL)
- C4 Electronic Ignition diagnostic connector
- C5 ECM harness grounds
- C6 I/P Fuse panel
- C7A Underhood fuse block
- C7B Underhood fuse block
- C8 Fuel pump test connector
- C9 TP sensor interface module

NOT ECM CONNECTED

- N1 Crankcase ventilation valve
- N7 Oil pressure sensor (gage)
- N12 A/C pressure cycling switch
- N13 A/C high pressure switch
- N14 Secondary cooling fan (FAN 2)
- N15 Primary cooling fan (FAN 1)
- N16 Secondary air inlet valve electric vacuum pump

CONTROLLED DEVICES

- 2 Idle air control (IAC) valve
- 3 Fuel pump (FP) relay (primary)
- 4 Fuel pump (FP) relay (secondary)
- 8 Cooling fan relay (s)
- 9 Secondary Air Injection (AIR) pump
- 9A Air pump relay
- 10 Air bypass valve
- 11 2nd & 3rd gear block out relay
- 13 A/C clutch relay
- 14 2nd & 3rd gear block out solenoid
- 16 Secondary SFI control module #1
- 17 Secondary SFI control module #2
- 19 Linear EGR valve

* Bank 1: 1, 3, 5, 7

* * Bank 2: 2, 4, 6, 8

FIRING ORDER: 1-8-4-3-6-5-7-2

INFORMATION SENSORS

- A Manifold Absolute Pressure (MAP) sensor
- B Heated Oxygen Sensor (HO2S)
- C Throttle Position (TP) sensor
- E Crankshaft Position sensor
- F Vehicle Speed Sensor (VSS) (mounted on transmission, not shown)
- G Intake Air Temperature (IAT) sensor
- H Camshaft Position sensor
- J Knock Sensor (KS)
- L Engine oil temperature sensor
- U A/C cooling fan switch

X SIR System Components.

91034C06

Fig. 96 Component locations—1995 5.7L (VIN J) engine

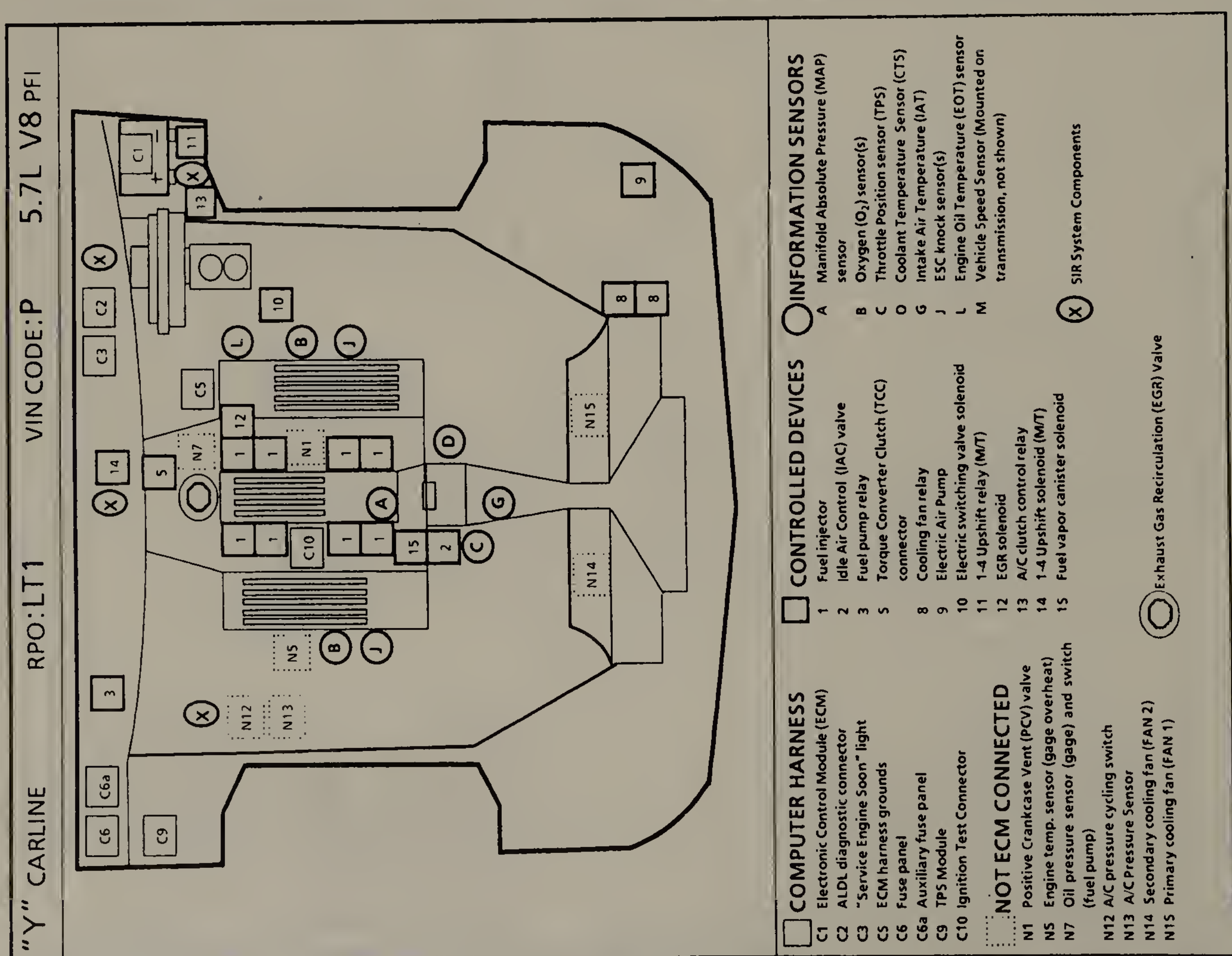


Fig. 97 Component locations—1992 5.7L (VIN P) engine

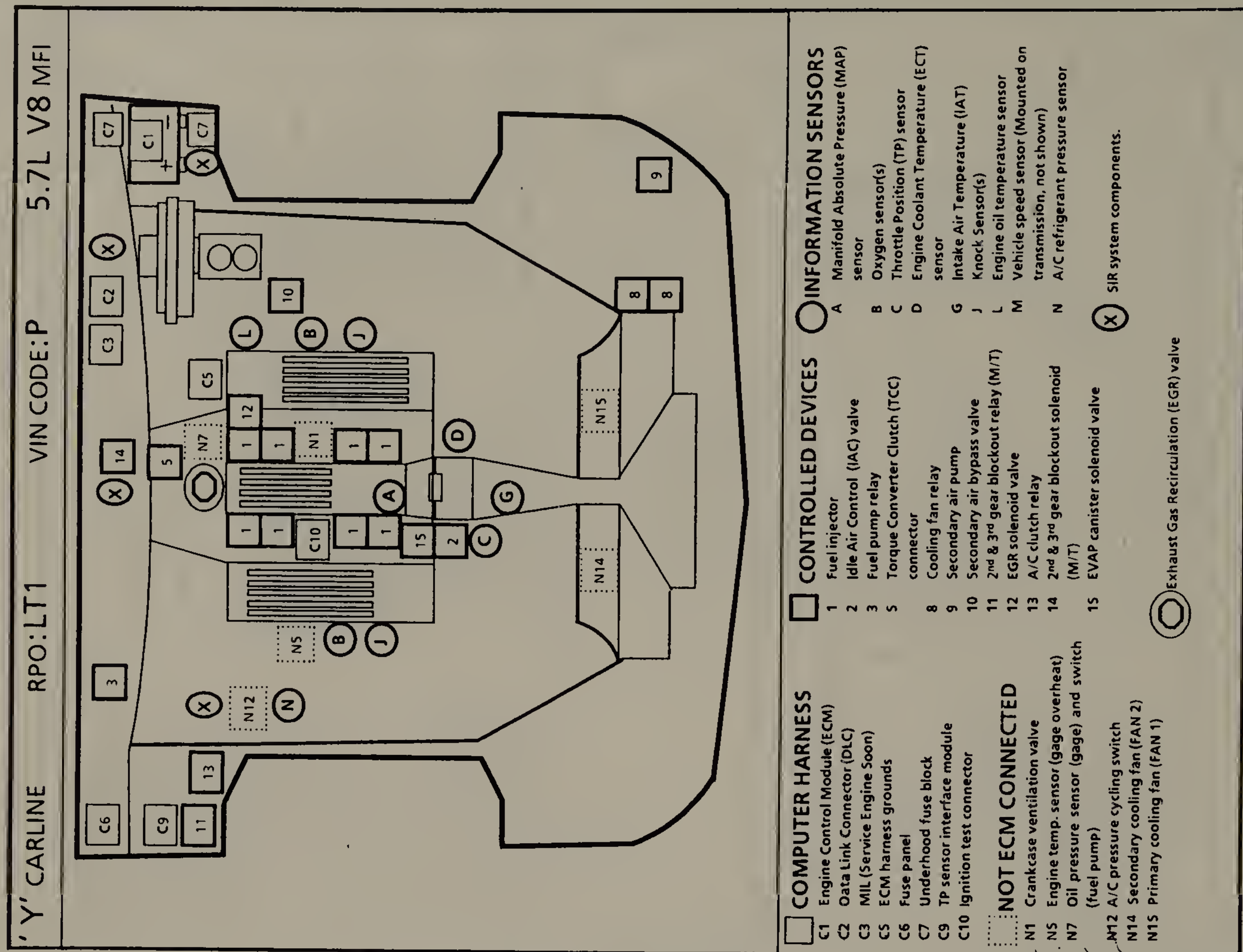


Fig. 98 Component locations—1993 5.7L (VIN P) engine

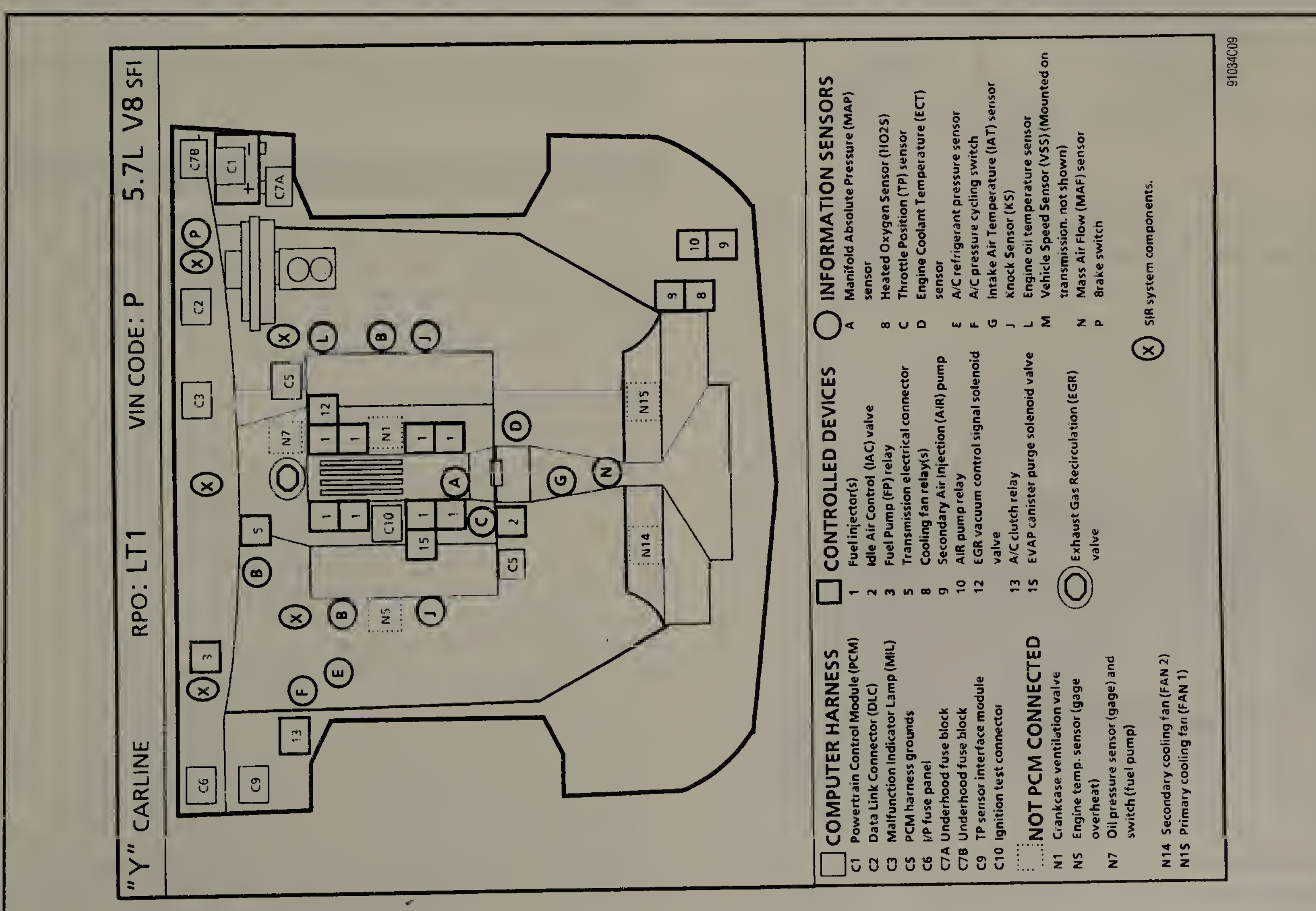


Fig. 99 Component locations—1994 5.7L (VIN P) engine

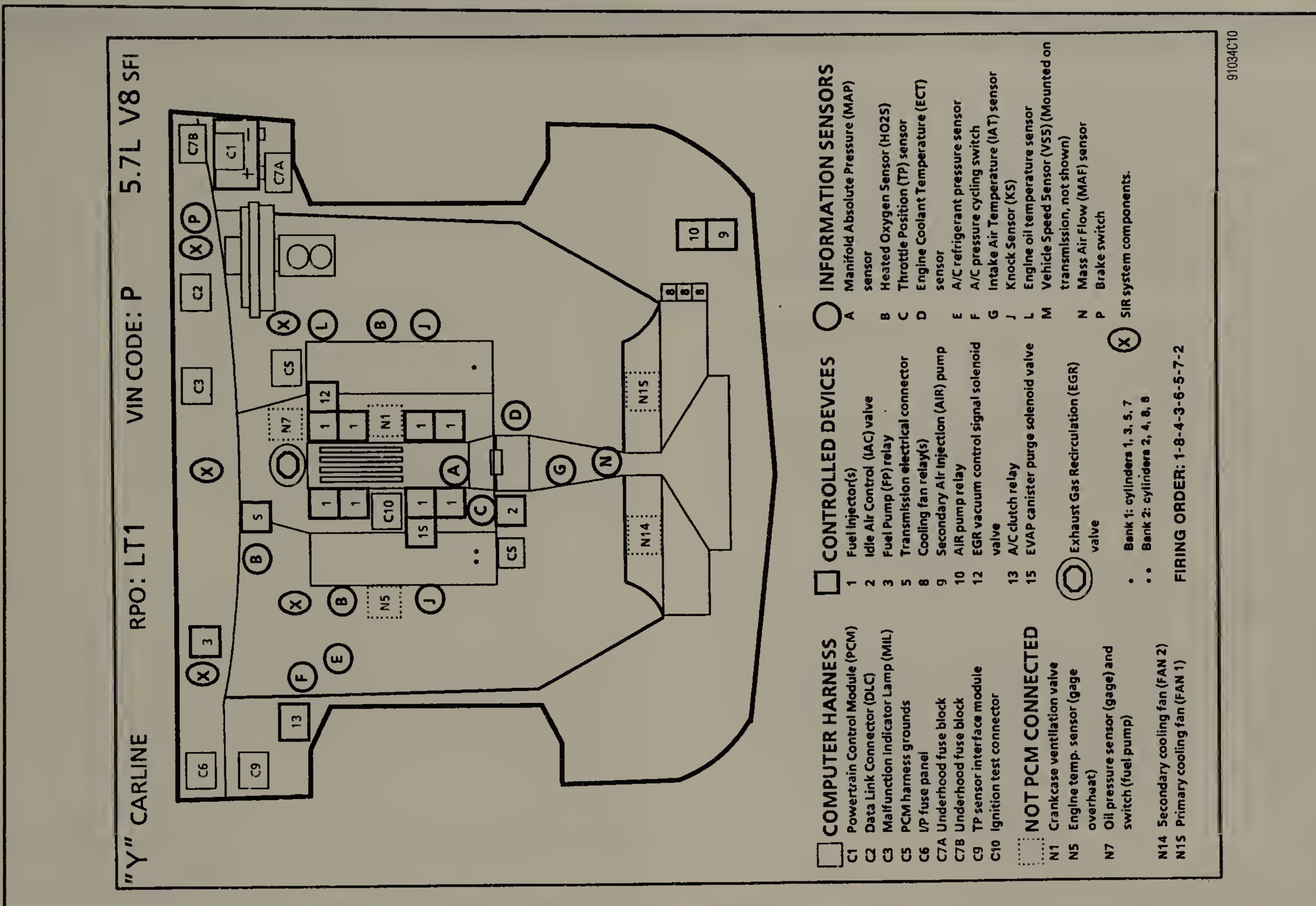


Fig. 100 Component locations—1995–96 5.7L (VIN P and 5) engines

TROUBLE CODES

Since the computer control module is programmed to recognize the presence and value of electrical inputs, it will also note the lack of a signal or a radical change in values. It will, for example, react to the loss of signal from the vehicle speed sensor or note that engine coolant temperature has risen beyond acceptable (programmed) limits. Once a fault is recognized, a numeric code is assigned and held in memory. The dashboard warning lamp: CHECK ENGINE or SERVICE ENGINE SOON (SES), will illuminate to advise the operator that the system has detected a fault. This lamp is also known as the Malfunction Indicator Lamp (MIL).

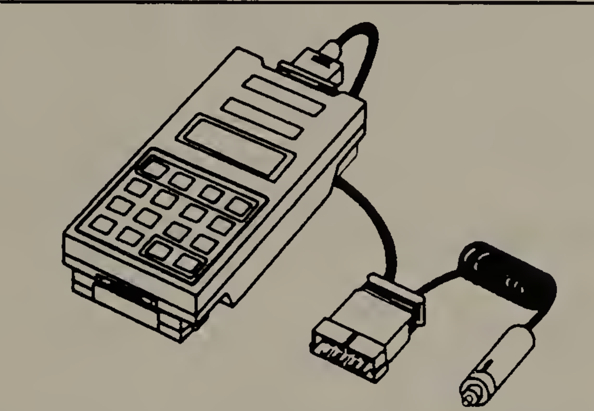
More than one code may be stored. Keep in mind not every engine uses every code. Additionally, the same code may carry different meanings relative to each engine or engine family.

In the event of an computer control module failure, the system will default to a pre-programmed set of values. These are compromise values which allow the engine to operate, although possibly at reduced efficiency. This is variously known as the default, limp-in or back-up mode. Driveability is almost always affected when the ECM enters this mode.

SCAN TOOLS

See Figures 101 and 102

On most models, the stored codes may be read with only the use of a small jumper wire, however the use of a hand-held scan tool such as GM's TECH-1® or equivalent is recommended. On 1994–96 vehicles with the 16-pin DLC, an OBD-II compliant scan tool must be used. There are many manufacturers of these tools; a purchaser must be certain that the tool is proper for the intended use. If you own a scan type tool, it probably came with comprehensive instructions on proper use. Be sure to follow the instructions that came with your unit if they differ from what is given here; this is a general guide with useful information included.



91034GB3

Fig. 101 A Tech 1®, or equivalent scan tool must be used to retrieve codes from 1994–96 models with the 16-pin DLC connector

TCCS4P12

Fig. 102 Inexpensive scan tools, such as this Auto Xray®, are available to interface with your General Motors vehicle

The scan tool allows any stored codes to be read from the ECM or PCM memory. The tool also allows the operator to view the data being sent to the computer control module while the engine is running. This ability has obvious diagnostic advantages; the use of the scan tool is frequently required for component testing. The scan tool makes collecting information easier; the data must be correctly interpreted by an operator familiar with the system.

An example of the usefulness of the scan tool may be seen in the case of a temperature sensor which has changed its electrical characteristics. The ECM is reacting to an apparently warmer engine (causing a driveability problem), but the sensor's voltage has not changed enough to set a fault code. Connecting the scan tool, the voltage signal being sent to the ECM may be viewed; comparison to normal values or a known good vehicle reveals the problem quickly.

ELECTRICAL TOOLS

The most commonly required electrical diagnostic tool is the digital multimeter, allowing voltage, ohmage (resistance) and amperage to be read by one instrument. The multimeter must be a high-impedance unit, with 10 megohms of impedance in the voltmeter. This type of meter will not place an additional load on the circuit it is testing; this is extremely important in low voltage circuits. The multimeter must be of high quality in all respects. It should be handled carefully and protected from impact or damage. Replace batteries frequently in the unit.

A digital storage oscilloscope is become increasingly necessary to diagnose today's cars. Although they are expensive to purchase, you may be able to rent one from an auto parts store. The oscilloscope is capable of displaying an electrical pattern rather then just measuring its value. This enables you to catch intermittent problems which a digital multimeter will miss.

Other necessary tools include an unpowered test light, a quality tachometer with an inductive (clip-on) pick up, and the proper tools for releasing GM's Metri-Pack, Weather Pack and Micro-Pack terminals as necessary. The Micro-Pack connectors are used at the ECM electrical connector. A vacuum pump/gauge may also be required for checking sensors, solenoids and valves.

Diagnosis and Testing

Diagnosis of a driveability and/or emissions problems requires attention to detail and following the diagnostic procedures in the correct order. Resist the temptation to perform any repairs before performing the preliminary diagnostic steps. In many cases this will shorten diagnostic time and often cure the problem without electronic testing.

The proper troubleshooting procedure for these vehicles is as follows:

VISUAL/PHYSICAL INSPECTION

This is possibly the most critical step of diagnosis and should be performed immediately after retrieving any codes. A detailed examination of connectors, wiring and vacuum hoses can often lead to a repair without further diagnosis. Performance of this step relies on the skill of the technician performing it; a careful inspector will check the undersides of hoses as well as the integrity of hard-to-reach hoses blocked by the air cleaner or other component. Wiring should be checked carefully for any sign of strain, burning, crimping, or terminal pull-out from a connector. Checking connectors at components or in harnesses is required; usually, pushing them together will reveal a loose fit.

INTERMITTENTS

If a fault occurs intermittently, such as a loose connector pin breaking contact as the vehicle hits a bump, the ECM will note the fault as it occurs and energize the dash warning lamp. If the problem self-corrects, as with the terminal pin again making contact, the dash lamp will extinguish after 10 seconds but a code will remain stored in the computer control module's memory.

When an unexpected code appears during diagnostics, it may have been set during an intermittent failure that self-corrected; the codes are still useful in diagnosis and should not be discounted.

CIRCUIT/COMPONENT REPAIR

The fault codes and the scan tool data will lead to diagnosis and checking of a particular circuit. It is important to note that the fault code indicates a fault or loss of signal in an ECM-controlled system, not necessarily in the specific component.

Refer to the appropriate Diagnostic Code chart to determine the codes meaning. The component may then be tested following the appropriate component test procedures found in this section. If the component is OK, check the wiring for shorts or opens. Further diagnoses should be left to an experienced driveability technician.

If a code indicates the ECM to be faulty and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections: The terminals may have to be removed from the connector in order to check them properly.
- The ECM or PROM is not correct for the application: The incorrect ECM or PROM may cause a malfunction and may or may not set a code.
- The problem is intermittent: This means that the problem is not present at the time the system is being checked. In this case, make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil or harness: Solenoids and relays are turned on and off by the ECM using internal electronic switches called drivers. Each driver is part of a group of four called Quad-Drivers. A shorted solenoid, relay coil or harness may cause an ECM to fail, and a replacement ECM to fail when it is installed. Use a short tester, J34696, BT 8405, or equivalent, as a fast, accurate means of checking for a short circuit.
- The Programmable Read Only Memory (PROM) or MEM-CAL may be faulty: Although the PROM rarely fails, it operates as part of the ECM. Therefore, it could be the cause of the problem. Substitute a known good PROM/MEM-CAL.
- The replacement ECM may be faulty: After the ECM is replaced, the system should be rechecked for proper operation. If the diagnostic code again indicates the ECM is the problem, substitute a known good ECM. Although this is a very rare condition, it could happen.

Reading Codes

VEHICLES WITH 12-PIN DIAGNOSTIC CONNECTORS

See Figure 103

The following procedures apply only to 1984–95 vehicles with the 12-pin diagnostic connector only. A scan tool, such as GM's Tech 1® must be used to retrieve diagnostic trouble codes from 1995–96 vehicles with the 16-pin diagnostic connector. When using a scan tool, make sure to carefully follow all instructions supplied by the manufacturer.

Listings of the trouble for the various engine control system covered in this manual are located in this section. Remember that a code only points to the faulty circuit NOT necessarily to a faulty component. Loose, damaged or corroded connections may contribute to a fault code on a circuit when the sensor or component is operating properly. Be sure that the components are faulty before replacing them, especially the expensive ones.

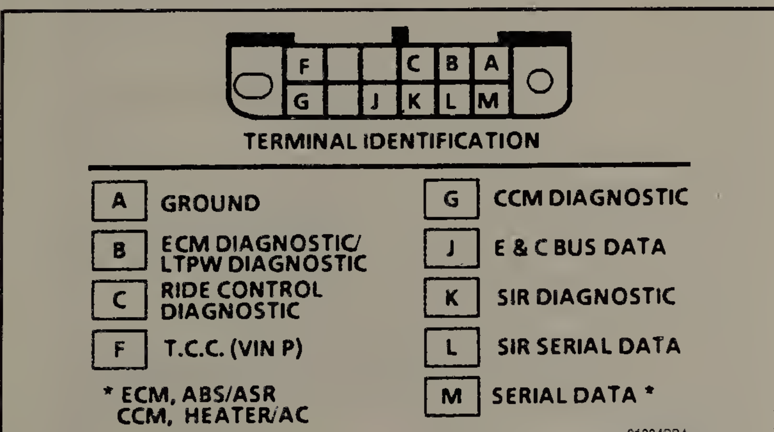


Fig. 103 The 12-pin Data Link Connector (DLC) is located under the dash

The DLC is also referred to as the Assembly Line Communication Link (ALCL), or Assembly Line Diagnostic Link (ALDL) on earlier vehicles.

The Data Link Connector (DLC) may be located under the dash and sometimes covered with a plastic cover labeled DIAGNOSTIC CONNECTOR.

1. The diagnostic trouble codes can be read by grounding test terminal **B**. The terminal is most easily grounded by connecting it to terminal **A** (internal ECM ground). This is the terminal to the right of terminal **B** on the top row of the DLC connector.
2. Once the terminals have been connected, the ignition switch must be moved to the **ON** position with the engine not running.
3. The Service Engine Soon or Check Engine light should be flashing. If it isn't, turn the ignition **OFF** and remove the jumper wire. Turn the ignition **ON** and confirm that light is now on. If it is not, replace the bulb and try again. If the bulb still will not light, or if it does not flash with the test terminal grounded, the system should be diagnosed by an experienced driveability technician. If the light is OK, proceed as follows.
4. The code(s) stored in memory may be read through counting the flashes of the dashboard warning lamp. The dash warning lamp should begin to flash Code 12. The code will display as one flash, a pause and two flashes. Code 12 is not a fault code. It is used as a system acknowledgment or handshake code; its presence indicates that the ECM can communicate as requested. Code 12 is used to begin every diagnostic sequence. Some vehicles also use Code 12 after all diagnostic codes have been sent.
5. After Code 12 has been transmitted 3 times, the fault codes, if any, will each be transmitted 3 times. The codes are stored and transmitted in numeric order from lowest to highest.

The order of codes in the memory does not indicate the order of occurrence.

6. If there are no codes stored, but a driveability or emissions problem is evident, the system should be diagnosed by an experienced driveability technician.
7. If one or more codes are stored, record them. Refer to the applicable Diagnostic Code chart in this section.
8. Switch the ignition **OFF** when finished with code retrieval or scan tool readings.

After making repairs, clear the trouble codes and operate the vehicle to see if it will reset, indicating further problems.

VEHICLES WITH 16-PIN DIAGNOSTIC CONNECTORS

See Figure 104

On 1994–96 vehicles with a 16-pin diagnostic connector, an OBD-II compliant scan tool must be used to retrieve the trouble codes. Follow the scan tool

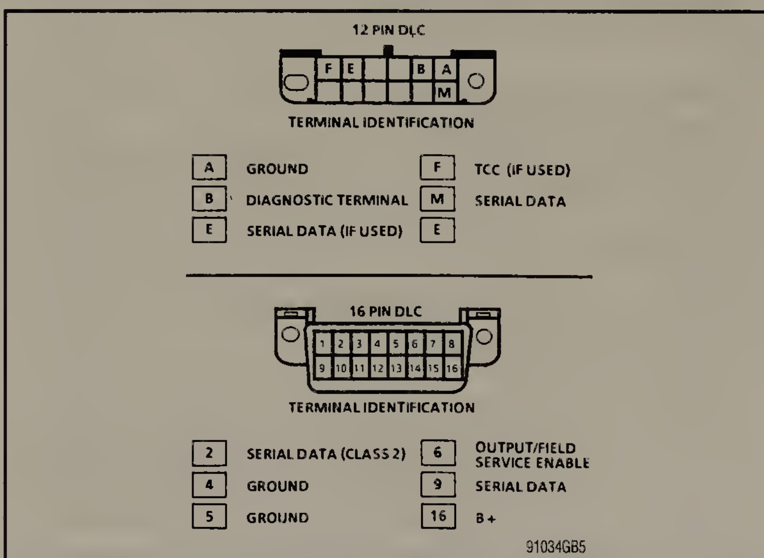


Fig. 104 The 1994–96 vehicles may use either a 12 or 16-pin DLC. If equipped with a 16-pin connector, you MUST use an OBD-II scan tool to retrieve

manufacturer's instructions on how to connect the scan tool to the vehicle and how to retrieve the codes.

OBD-I DIAGNOSTIC TROUBLE CODES (DTCS)

➡The the following code list covers 1984–95 vehicles. The 1994–95 5.7L (VIN P) engine also utilizes some OBD-II codes.

Code 12 No engine RPM reference pulses—System Normal
Code 13 Oxygen Sensor (02S) circuit open—left side on 2 sensor system
Code 14 Engine Coolant Temperature (ECT) sensor -possible circuit high or shorted sensor
Code 15 Engine Coolant Temperature (ECT) sensor -circuit low or open circuit
Code 16 Direct ignition system (DIS), fault line circuit or Distributor ignition system (low resolution pulse) or Missing 2x reference circuit or OPTI-Spark ignition timing system (low resolution pulse) or System voltage out of range
Code 17 Camshaft Position Sensor (OPS) or spark reference circuit error
Code 18 Crank/Cam error
Code 19 Crankshaft Position Sensor (CPS) circuit
Code 21 Throttle Position (TP) sensor circuit—signal voltage out of range, probably high
Code 22 Throttle Position (TP) sensor circuit—signal voltage low
Code 23 Intake Air Temperature (IAT or MAT) sensor circuit temperature out of range, low or Open or grounded M/C solenoid Feedback Carburetor system
Code 24 Vehicle Speed Sensor (VSS) circuit
Code 25 Intake Air Temperature (IAT or MAT) sensor circuit temperature out of range, high
Code 26 Quad-Driver Module #1 circuit or Transaxle gear switch circuit
Code 27 Quad-Driver Module circuit or Transaxle gear switch, probably 2nd gear switch circuit
Code 28 Quad-Driver Module (QDM) #2 circuit or Transaxle gear switch, probably 3rd gear switch circuit
Code 29 Transaxle gear switch, probably 4th gear switch circuit
Code 31 Camshaft sensor circuit fault or Park/Neutral Position (PNP) switch circuit or Wastegate circuit signal
Code 32 Exhaust Gas Recirculation (EGR) circuit fault or Barometric Pressure Sensor circuit low Feedback Carburetor system
Code 33 Manifold Absolute Pressure (MAP) sensor—signal voltage out of range, high or Mass Air Flow (MAE) sensor—signal voltage out of range, probably high
Code 34—Manifold Absolute Pressure (MAP) sensor—circuit out of range voltage, low or Mass Air Flow (MAF) sensor circuit (gm/sec low)
Code 35—Idle Air Control (IAC) or idle speed error or Idle Speed Control (ISO) circuit throttle switch shorted Feedback Carburetor system
Code 36 Ignition system circuit error or Transaxle shift problem—4T60E Transaxle
Code 38 Brake input circuit fault—Torque converter clutch signal
Code 39 Clutch input circuit fault—Torque converter clutch signal
Code 41 Cam sensor or cylinder select circuit fault ignition control (IC) reference pulse system fault or Electronic Spark Timing (EST) circuit open or shorted
Code 42 Electronic Spark Timing (EST) circuit grounded or Ignition Control (IC) circuit grounded or faulty bypass line
Code 43 Knock Sensor (KS) or Electronic Spark Control (ESC) circuit fault
Code 44 Oxygen Sensor (02S), left side on 2 sensor system lean exhaust indicated
Code 45 Oxygen Sensor (02S), left side on 2 sensor system rich exhaust indicated
Code 46 Personal Automotive Security System (PASSKey II) circuit or Power Steering Pressure Switch (PSPS) circuit
Code 47 PCM-BCM data circuit
Code 48 Misfire diagnosis
Code 51 Calibration error, faulty MEM-CAL, ECM or EEPROM failure
Code 52 Engine oil temperature sensor circuit, low temperature indicated or Fuel Calpac missing or Over voltage condition or EGR Circuit fault
Code 53 Battery voltage error or EGR problem or Personal Automotive Security System (PASS-Key) circuit
Code 54 EGR #2 problem or Fuel pump circuit (low voltage) or Shorted mixture control solenoid circuit Feedback Carburetor system
Code 55 A/D Converter error, PCM error or not grounded, EGR #3 problem, Fuel lean monitor, Grounded voltage reference, faulty oxygen sensor or fuel lean Feedback Carburetor system
Code 56 Quad-Driver Module (QDM) #2 circuit or Secondary air inlet valve actuator vacuum sensor circuit signal high 5.7L (VIN J)
Code 57 Boost control problem
Code 58 Vehicle Anti-theft System fuel enable circuit
Code 61 A/C system performance or Cruise vent solenoid circuit fault or Oxygen Sensor (02S) degraded signal or Secondary port throttle valve system fault 5.7L (VIN J) or Transaxle gear switch signal
Code 62 Cruise vacuum solenoid circuit fault or Engine oil temperature sensor, high temperature indicated or Transaxle gear switch signal circuit fault
Code 63 Oxygen Sensor (02S), right side circuit open or Cruise system problem (speed error) or Manifold Absolute Pressure (MAP) sensor circuit out of range
Code 64 Oxygen Sensor (02S), right side—lean exhaust indicated
Code 65 Oxygen Sensor (02S), right side—rich exhaust indicated or Cruise servo position circuit or Fuel injector circuit low current
Code 66 A/C pressure sensor circuit fault, probably low pressure or Engine power switch, voltage high or low or PCM fault 5.7L (VIN J)
Code 67 A/C pressure sensor circuit, sensor or A/C clutch circuit failure or Cruise switch circuit fault
Code 68 A/C compressor relay (shorted circuit) or Cruise system fault
Code 69 A/C clutch circuit or head pressure high
Code 70 A/C refrigerant pressure sensor circuit (high pressure)
Code 71 A/C evaporator temperature sensor circuit (low temperature)
Code 72 Gear selector switch circuit
Code 73 A/C evaporator temperature sensor circuit (high temperature)
Code 75 Digital EGR #1 solenoid error
Code 76 Digital EGR #2 solenoid error
Code 77 Digital EGR #3 solenoid error
Code 79 Vehicle Speed Sensor (VSS) circuit signal high
Code 80 Vehicle Speed Sensor (VSS) circuit signal low
Code 81 Brake input circuit fault—Torque converter clutch signal
Code 82 Ignition Control (IC) 3X signal error
Code 85 PROM error
Code 86 Analog/Digital ECM error
Code 87 EEPROM error
Code 99 Power management

OBD-II DIAGNOSTIC TROUBLE CODES (DTCS)

➡The following code list covers all 1994–96 vehicles, except for the 1994 5.7L (VIN J) engine. Some 1994–95 vehicles also utilize some OBD-I codes.

P01 Mass or Volume Air Flow Circuit Malfunction
P0101 Mass or Volume Air Flow Circuit Range/Performance Problem
P0102 Mass or Volume Air Flow Circuit Low Input
P0103 Mass or Volume Air Flow Circuit High Input
P0104 Mass or Volume Air Flow Circuit Intermittent
P0105 Manifold Absolute Pressure/Barometric Pressure Circuit Malfunction
P0106 Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance Problem
P0107 Manifold Absolute Pressure/Barometric Pressure Circuit Low Input
P0108 Manifold Absolute Pressure/Barometric Pressure Circuit High Input
P0109 Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent
P0110 Intake Air Temperature Circuit Malfunction
P0111 Intake Air Temperature Circuit Range/Performance Problem
P0112 Intake Air Temperature Circuit Low Input
P0113 Intake Air Temperature Circuit High Input
P0114 Intake Air Temperature Circuit Intermittent
P0115 Engine Coolant Temperature Circuit Malfunction
P0116 Engine Coolant Temperature Circuit Range/Performance Problem
P0117 Engine Coolant Temperature Circuit Low Input
P0118 Engine Coolant Temperature Circuit High Input
P0119 Engine Coolant Temperature Circuit Intermittent
P0120 Throttle/Pedal Position Sensor/Switch "A" Circuit Malfunction
P0121 Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance Problem
P0122 Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input
P0123 Throttle/Pedal Position Sensor/Switch "A" Circuit High Input

P0124 Throttle/Pedal Position Sensor/Switch "A" Circuit Intermittent
P0125 Insufficient Coolant Temperature For Closed Loop Fuel Control
P0126 Insufficient Coolant Temperature For Stable Operation
P0130 02 Circuit Malfunction (Bank no. 1 Sensor no. 1)
P0131 02 Sensor Circuit Low Voltage (Bank no. 1 Sensor no. 1)
P0132 02 Sensor Circuit High Voltage (Bank no. 1 Sensor no. 1)
P0133 02 Sensor Circuit Slow Response (Bank no. 1 Sensor no. 1)
P0134 02 Sensor Circuit No Activity Detected (Bank no. 1 Sensor no. 1)
P0135 02 Sensor Heater Circuit Malfunction (Bank no. 1 Sensor no. 1)
P0136 02 Sensor Circuit Malfunction (Bank no. 1 Sensor no. 2)
P0137 02 Sensor Circuit Low Voltage (Bank no. 1 Sensor no. 2)
P0138 02 Sensor Circuit High Voltage (Bank no. 1 Sensor no. 2)
P0139 02 Sensor Circuit Slow Response (Bank no. 1 Sensor no. 2)
P0140 02 Sensor Circuit No Activity Detected (Bank no. 1 Sensor no. 2)
P0141 02 Sensor Heater Circuit Malfunction (Bank no. 1 Sensor no. 2)
P0142 02 Sensor Circuit Malfunction (Bank no. 1 Sensor no. 3)
P0143 02 Sensor Circuit Low Voltage (Bank no. 1 Sensor no. 3)
P0144 02 Sensor Circuit High Voltage (Bank no. 1 Sensor no. 3)
P0145 02 Sensor Circuit Slow Response (Bank no. 1 Sensor no. 3)
P0146 02 Sensor Circuit No Activity Detected (Bank no. 1 Sensor no. 3)
P0147 02 Sensor Heater Circuit Malfunction (Bank no. 1 Sensor no. 3)
P0150 02 Sensor Circuit Malfunction (Bank no. 2 Sensor no. 1)
P0151 02 Sensor Circuit Low Voltage (Bank no. 2 Sensor no. 1)
P0152 02 Sensor Circuit High Voltage (Bank no. 2 Sensor no. 1)
P0153 02 Sensor Circuit Slow Response (Bank no. 2 Sensor no. 1)
P0154 02 Sensor Circuit No Activity Detected (Bank no. 2 Sensor no. 1)
P0155 02 Sensor Heater Circuit Malfunction (Bank no. 2 Sensor no. 1)
P0156 02 Sensor Circuit Malfunction (Bank no. 2 Sensor no. 2)
P0157 02 Sensor Circuit Low Voltage (Bank no. 2 Sensor no. 2)
P0158 02 Sensor Circuit High Voltage (Bank no. 2 Sensor no. 2)
P0159 02 Sensor Circuit Slow Response (Bank no. 2 Sensor no. 2)
P0160 02 Sensor Circuit No Activity Detected (Bank no. 2 Sensor no. 2)
P0161 02 Sensor Heater Circuit Malfunction (Bank no. 2 Sensor no. 2)
P0162 02 Sensor Circuit Malfunction (Bank no. 2 Sensor no. 3)
P0163 02 Sensor Circuit Low Voltage (Bank no. 2 Sensor no. 3)
P0164 02 Sensor Circuit High Voltage (Bank no. 2 Sensor no. 3)
P0165 02 Sensor Circuit Slow Response (Bank no. 2 Sensor no. 3)
P0166 02 Sensor Circuit No Activity Detected (Bank no. 2 Sensor no. 3)
P0167 02 Sensor Heater Circuit Malfunction (Bank no. 2 Sensor no. 3)
P0170 Fuel Trim Malfunction (Bank no. 1)
P0171 System Too Lean (Bank no. 1)
P0172 System Too Rich (Bank no. 1)
P0173 Fuel Trim Malfunction (Bank no. 2)
P0174 System Too Lean (Bank no. 2)
P0175 System Too Rich (Bank no. 2)
P0176 Fuel Composition Sensor Circuit Malfunction
P0177 Fuel Composition Sensor Circuit Range/Performance
P0178 Fuel Composition Sensor Circuit Low Input
P0179 Fuel Composition Sensor Circuit High Input
P0180 Fuel Temperature Sensor "A" Circuit Malfunction
P0181 Fuel Temperature Sensor "A" Circuit Range/Performance
P0182 Fuel Temperature Sensor "A" Circuit Low Input
P0183 Fuel Temperature Sensor "A" Circuit High Input
P0184 Fuel Temperature Sensor "A" Circuit Intermittent
P0185 Fuel Temperature Sensor "B" Circuit Malfunction
P0186 Fuel Temperature Sensor "B" Circuit Range/Performance
P0187 Fuel Temperature Sensor "B" Circuit Low Input
P0188 Fuel Temperature Sensor "B" Circuit High Input
P0189 Fuel Temperature Sensor "B" Circuit Intermittent
P0190 Fuel Rail Pressure Sensor Circuit Malfunction
P0191 Fuel Rail Pressure Sensor Circuit Range/Performance
P0192 Fuel Rail Pressure Sensor Circuit Low Input
P0193 Fuel Rail Pressure Sensor Circuit High Input
P0194 Fuel Rail Pressure Sensor Circuit Intermittent
P0195 Engine Oil Temperature Sensor Malfunction
P0196 Engine Oil Temperature Sensor Range/Performance
P0197 Engine Oil Temperature Sensor Low
P0198 Engine Oil Temperature Sensor High
P0199 Engine Oil Temperature Sensor Intermittent
P02 Injector Circuit Malfunction
P03 Random/Multiple Cylinder Misfire Detected
P0323 Ignition/Distributor Engine Speed Input Circuit Intermittent
P0325 Knock Sensor no. 1—Circuit Malfunction (Bank no. 1 or Single Sensor)
P0327 Knock Sensor no. 1—Circuit Low Input (Bank no. 1 or Single Sensor)
P0332 Knock Sensor no. 2—Circuit Low Input (Bank no. 2)
P0335 Crankshaft Position Sensor "A" Circuit Malfunction
P0336 Crankshaft Position Sensor "A" Circuit Range/Performance
P0337 Crankshaft Position Sensor "A" Circuit Low Input
P04 Exhaust Gas Recirculation Flow Malfunction
P0403 Exhaust Gas Recirculation Circuit Malfunction
P0410 Secondary Air Injection System Malfunction
P0412 Secondary Air Injection System Switching Valve "A" Circuit Malfunction
P0420 Catalyst System Efficiency Below Threshold (Bank no. 1)
P0430 Catalyst System Efficiency Below Threshold (Bank no. 2)
P0441 Evaporative Emission Control System Incorrect Purge Flow
P0443 Evaporative Emission Control System Purge Control Valve Circuit Malfunction
P05 Vehicle Speed Sensor Malfunction
P0506 Idle Control System RPM Lower Than Expected
P0507 Idle Control System RPM Higher Than Expected
P0530 A/C Refrigerant Pressure Sensor Circuit Malfunction
P0531 A/C Refrigerant Pressure Sensor Circuit Range/Performance
P0562 System Voltage Low
P0563 System Voltage High
P0601 PCM Memory
P0602 PCM not programmed
P1107 MAP Sensor Voltage Intermittently Low
P1111 IAT Sensor Circuit Intermittent High Voltage
P1112 IAT Sensor Circuit Intermittent Low Voltage
P1114 ECT Sensor Circuit Intermittent Low Voltage
P1115 ECT Sensor Circuit Intermittent High Voltage
P1121 TP Sensor Voltage Intermittently High
P1122 TP Sensor Voltage Intermittently Low
P1133 HO_2S Insufficient Switching Sensor
P1133 HO_2S Insufficient Switching Bank #1, Sensor #1
P1134 HO_2S #1 Transition Time Ratio
P1134 HO_2S Transition Time Ratio Bank #1, Sensor #1
P1153 HO_2S Insufficient Switching Sensor Bank #2, Sensor #1
P1154 HO_2S Transition Time Ratio Bank #2, Sensor #1
P1345 Crankshaft/Camshaft (CKP/CMP) Correlation
P1350 Ignition Control (IC) Circuit Malfunction
P1351 Ignition Control (IC) Circuit High Voltage
P1361 Ignition Control (IC) Circuit Not Toggling
P1361 Ignition Control (IC) Circuit Low Voltage
P1380 Electronic Brake Control Module (EBCM) DTC Detected Rough Road Data Unusable
P1381 Misfire Detected, No EBCM/PCM/VCM Serial Data
P1406 EGR Pintle Position Circuit Fault
P1415 AIR System Bank #1
P1416 AIR System Bank #2
P1441 EVAP Control System Flow During Non-Purge
P1508 IAC System Low RPM
P1509 IAC System High RPM
P1520 PNP Circuit
P1530 Ignition Timing Adjustment Switch Circuit
P16 PCM Battery Circuit Fault
P1635 5-Volt Reference "A" Circuit
P1639 5-Volt Reference "B" Circuit
P1641 MIL Control Circuit
P1651 Fan #1 Relay Control Circuit
P1652 Fan #2 Relay Control Circuit
P1654 A/C Relay Control
P1655 EVAP Purge Solenoid Control Circuit
P1672 Low Engine Oil Level Light Control Circuit

Clearing Codes

Stored fault codes may be erased from memory at any time by removing power from the ECM for at least 30 seconds. It may be necessary to clear stored codes during diagnosis to check for any recurrence during a test drive, but the stored codes must be written down when retrieved. The codes may still be required for subsequent troubleshooting. Whenever a repair is complete, the stored codes must be erased and the vehicle test driven to confirm correct operation and repair.

⁂ WARNING

The ignition switch must be OFF any time power is disconnected or restored to the ECM. Severe damage may result if this precaution is not observed.

Depending on the electrical distribution of the particular vehicle, power to the ECM may be disconnected by removing the ECM fuse in the fusebox, disconnecting the in-line fuse holder near the positive battery terminal or disconnecting the ECM power lead at the battery terminal. Disconnecting the negative battery cable to clear codes is not recommended as this will also clear other memory data in the vehicle such as radio presets.

The codes may also be cleared through a scan tool. Follow the scan tool manufacturer's instructions.

VACUUM DIAGRAMS

Following are vacuum diagrams for most of the engine and emissions package combinations covered by this manual. Because vacuum circuits will vary based on various engine and vehicle options, always refer first to the vehicle emission control information label, if present. Should the label be missing, or should vehicle be equipped with a different engine from the vehicle's original equipment, refer to the diagrams below for the same or similar configuration.

If you wish to obtain a replacement emissions label, most manufacturers make the labels available for purchase. The labels can usually be ordered from a local dealer.

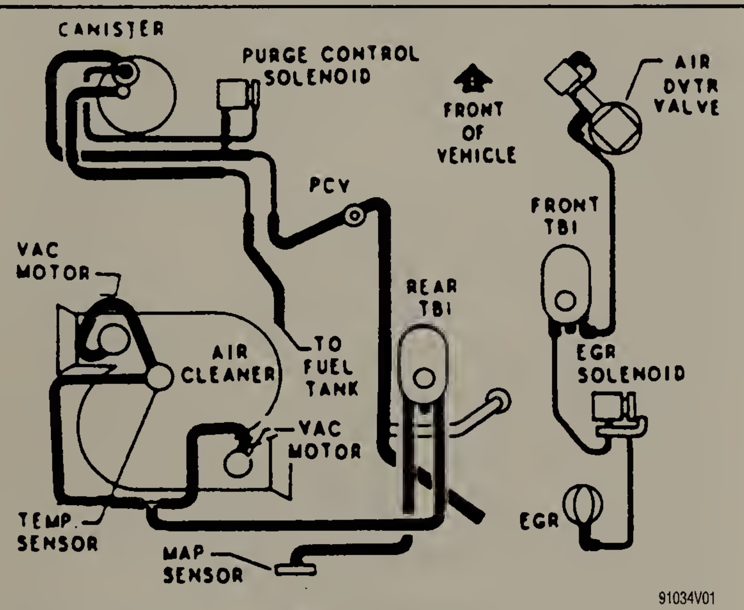


Fig. 105 1984 5.7L engine with manual transmission and overdrive—Federal

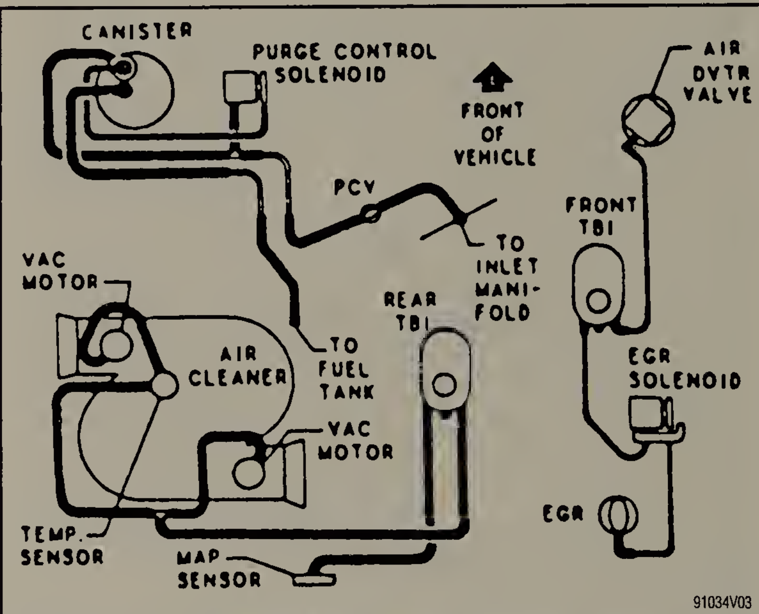


Fig. 107 1984 5.7L engine with manual transmission and overdrive—California and Export

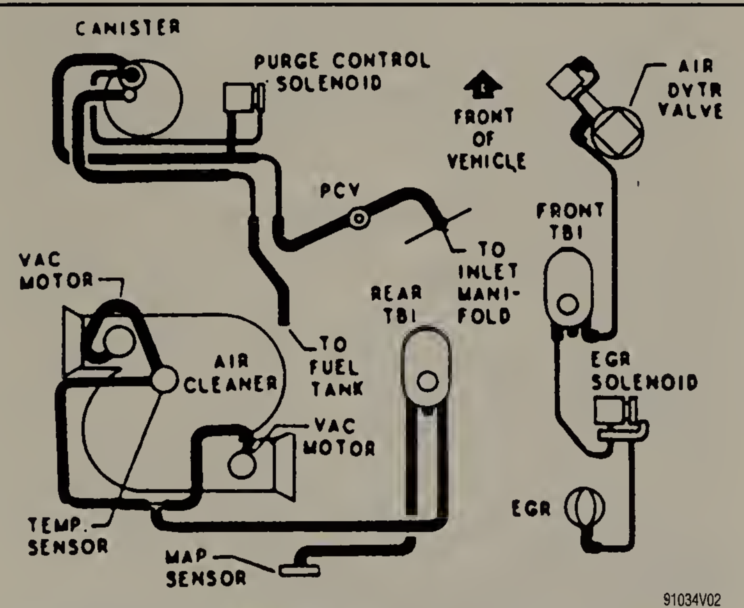


Fig. 106 1984 5.7L engine with automatic transmission—Federal and California

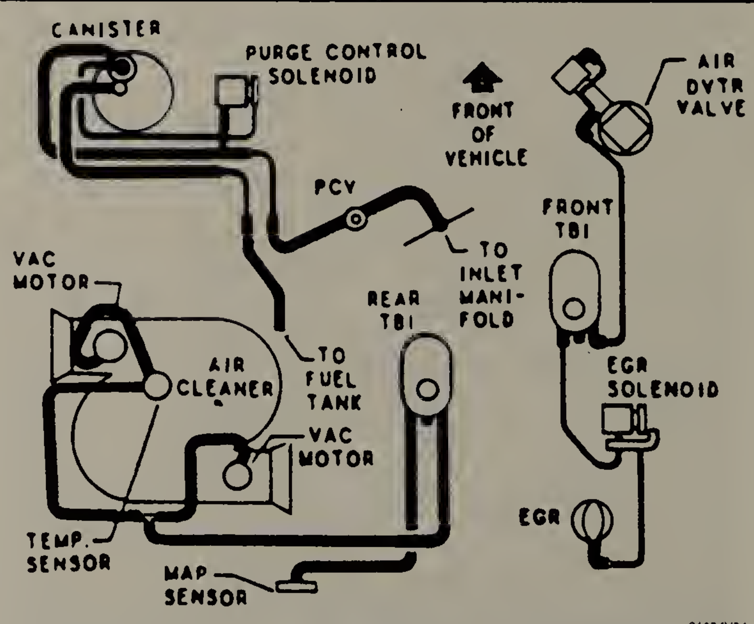


Fig. 108 1984 5.7L engine with automatic transmission—Export

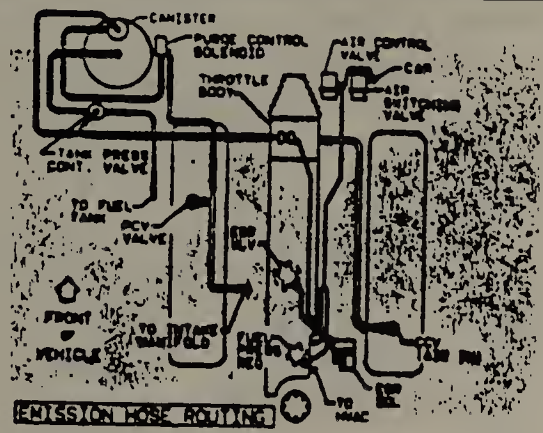


Fig. 109 1985 5.7L engine—Federal and California

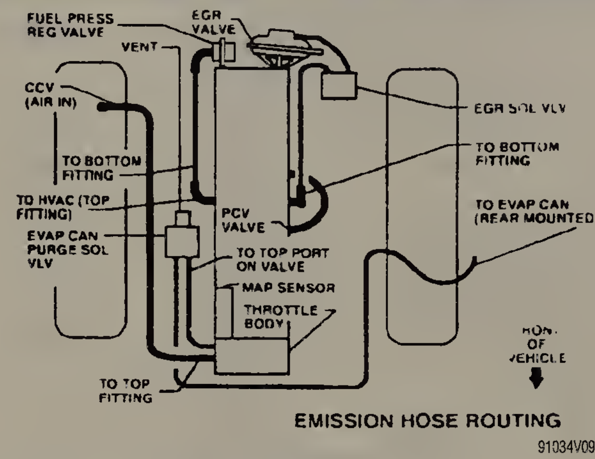


Fig. 113 1994 5.7L engine—California

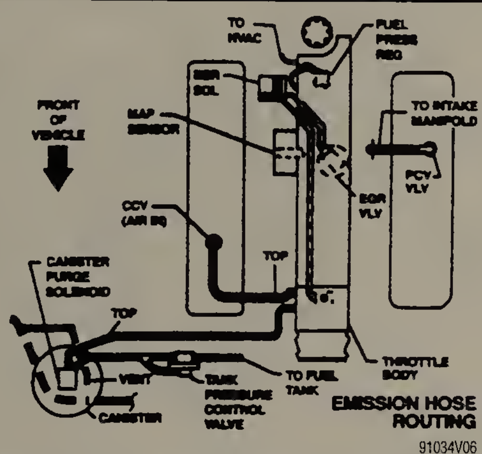


Fig. 110 1990–91 5.7L (VIN 8) engine—Federal and California

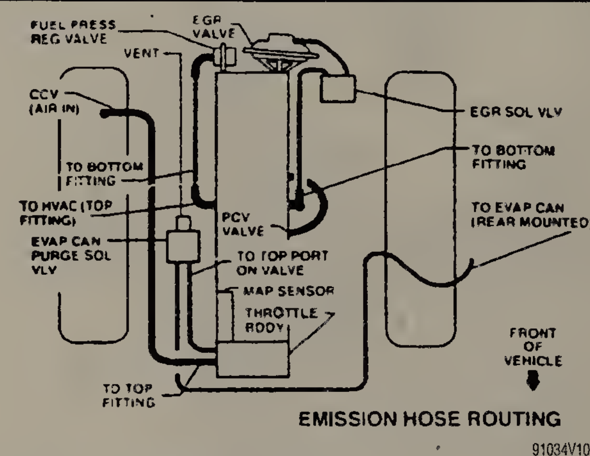


Fig. 114 1994 5.7L engine—Federal

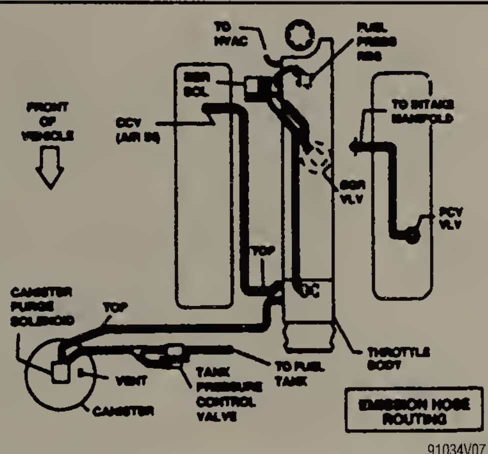


Fig. 111 1990–91 5.7L (VIN 8) engine—Federal and California

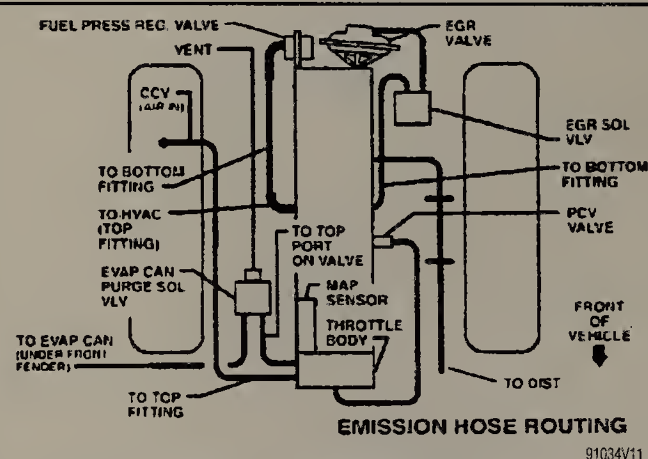


Fig. 115 1994 5.7L engine—Federal and California

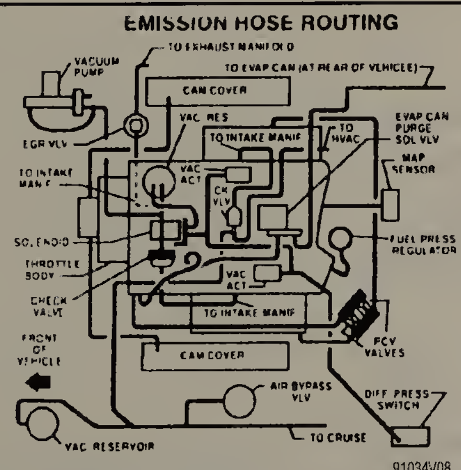


Fig. 112 1994 5.7L engine—Federal

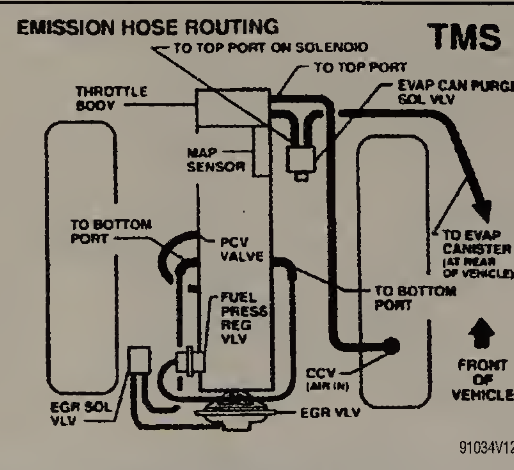


Fig. 116 1994 5.7L engine—Federal and California

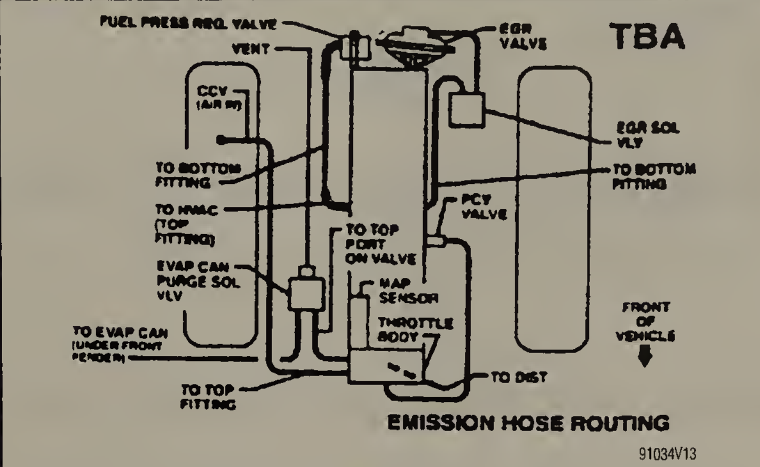


Fig. 117 1994 5.7L engine—Federal

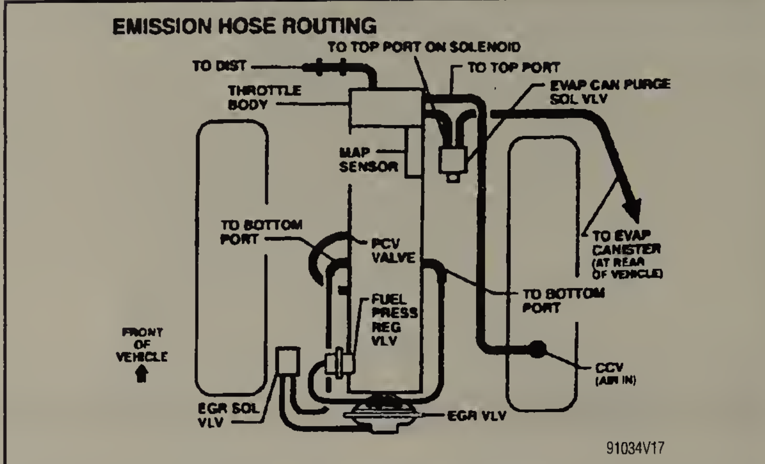


Fig. 121 1995 5.7L engine—Federal and California

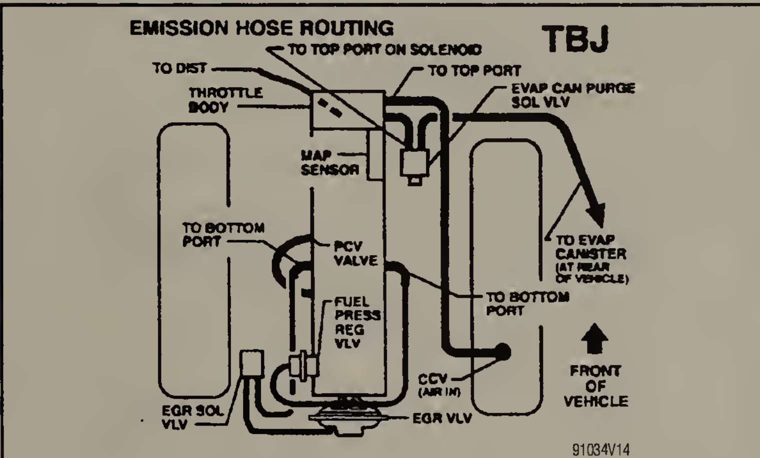


Fig. 118 1994 5.7L engine—Federal and California

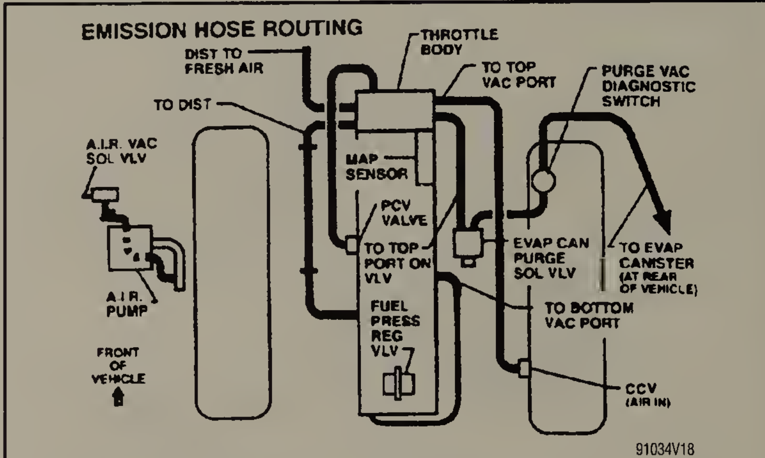


Fig. 122 1996 5.7L engine—Federal and California

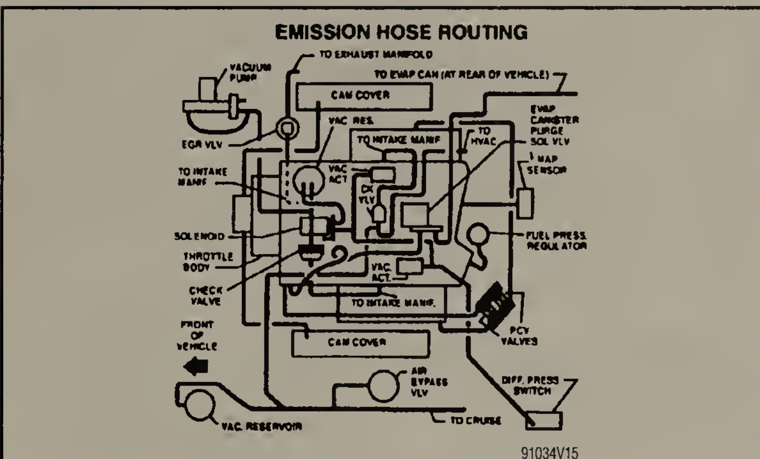


Fig. 119 1995 5.7L engine—Federal and California

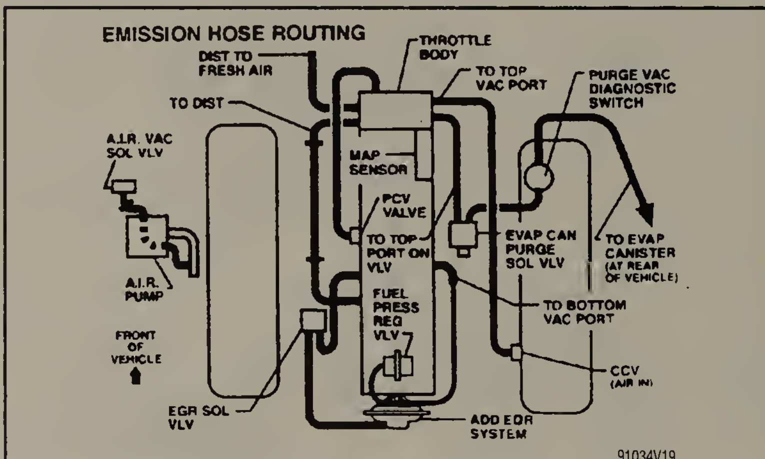


Fig. 123 1996 5.7L engine—Federal and California

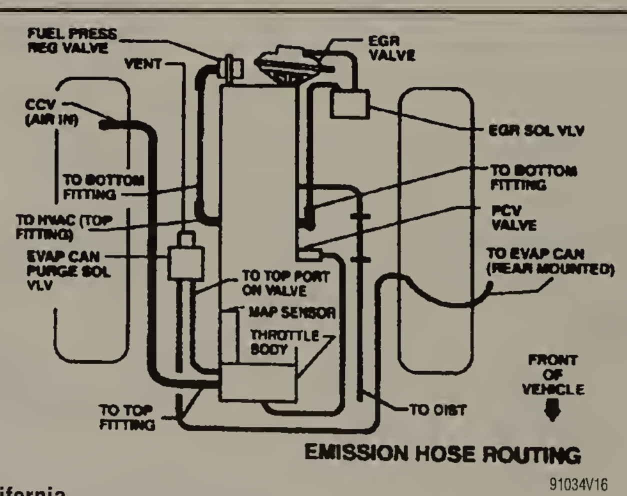


Fig. 120 1995 5.7L engine—Federal and California

5

FUEL SYSTEM

BASIC FUEL SYSTEM DIAGNOSIS

When there is a problem starting or driving a vehicle, two of the most important checks involve the ignition and the fuel systems. The questions most mechanics attempt to answer first, "is there spark?" and "is there fuel?" will often lead to solving most basic problems. For ignition system diagnosis and testing, please refer to the information on engine electrical components and ignition systems found earlier in this manual. If the ignition system checks out (there is spark), then you must determine if the fuel system is operating properly (is there fuel?).

FUEL LINES AND FITTINGS

Quick-Connect Fittings

REMOVAL & INSTALLATION

See Figures 1 thru 6

➡This procedure requires tool J37088 or an equivalent fuel line quick-connect separator.

1. Grasp both sides of the fitting. Twist the female connector ¼ turn in each direction to loosen any dirt within the fittings. Using compressed air, blow out the dirt from the quick-connect fittings at the end of the fittings.

CAUTION

Safety glasses MUST be worn when using compressed air to avoid eye injury due to flying dirt particles!

2. For plastic (hand releasable) fittings, squeeze the plastic retainer release tabs, then pull the connection apart.
3. For metal fittings, choose the correct size tool for the fitting to be disconnected. Insert the proper tool into the female connector, then push inward to release the locking tabs. Pull the connection apart.
4. If it is necessary to remove rust or burrs from the male tube end of a quick-connect fitting, use emery cloth in a radial motion with the tube end to prevent damage to the O-ring sealing surfaces. Using a clean shop towel, wipe off the male tube ends. Inspect all connectors for dirt and burrs. Clean and/or replace if required.

To install:

5. Apply a few drops of clean engine oil to the male tube end of the fitting.
6. Push the connectors together to cause the retaining tabs/fingers to snap into place.
7. Once installed, pull on both ends of each connection to make sure they are secure.

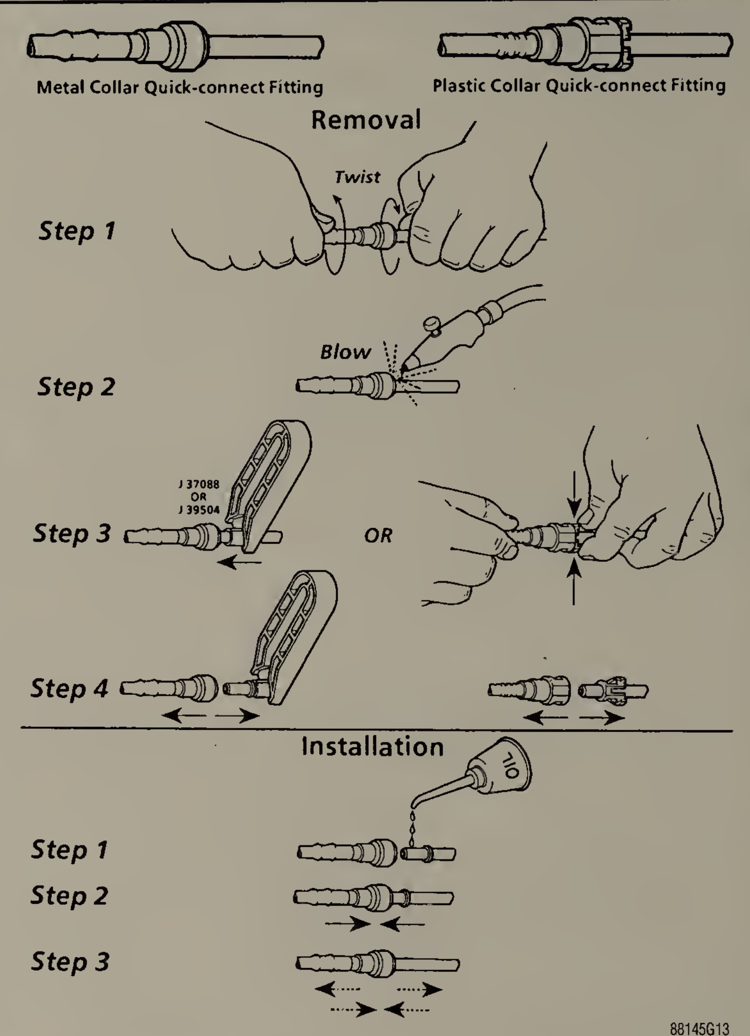
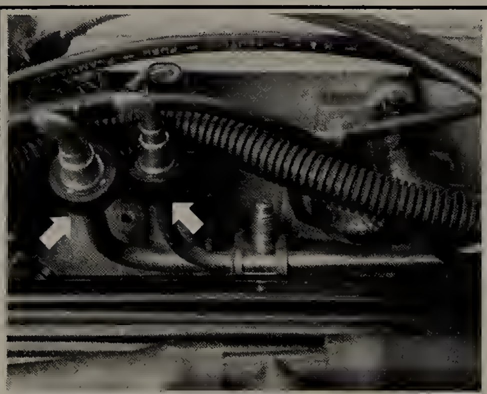


Fig. 1 Quick-connect fuel line fitting removal and installation



88145PR1

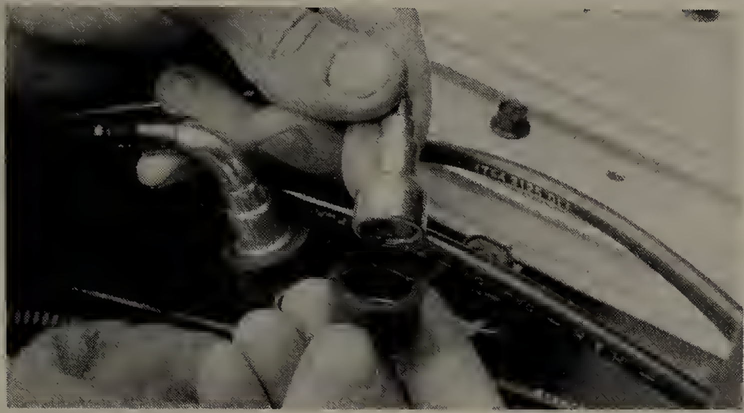
Fig. 2 Before disconnecting any fuel lines, make sure to clean all the dirt from around the fittings (see arrows)

88145P02

Fig. 3 For metal fittings, insert the tool into the female connector . . .

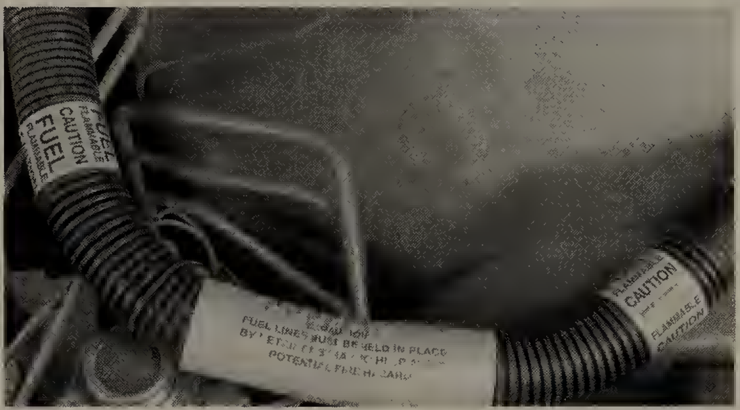
88145P03

Fig. 4 . . . then push inward to release the locking tabs and pull the connection apart



88145P04

Fig. 5 View of the female connector (A) and O-ring seal (B), once the line is disconnected



88145P15

Fig. 6 Always be sure the fuel lines are routed properly. Improper routing can become a fire hazard

CROSS-FIRE INJECTION SYSTEM

General Information

See Figure 7

The 1984 5.7L (VIN 8) engine is equipped with a Model 400 Throttle Body Injection (TBI) system, also referred to as the Cross-fire Injection system. This system consists of a pair of throttle body units which are mounted in front and rear positions on a single manifold. This arrangement lets each TBI unit supply the proper air/fuel mixture through a tuned crossover runner in the intake manifold to the bank of cylinders on the opposite side of the engine. This is the reason for the name "Crossfire injection". Each TBI unit feeds the cylinders on the opposite side. The front TBI gets the fuel from the fuel pump. The fuel then goes through a fuel pressure compensator, through a separate line to the rear TBI, then through the fuel pressure regulator then returns to the fuel tank.

Each TBI unit has its own fuel injector which are controlled individually by the ECM. Each TBI has its own IAC valve, which operate together. A throttle rod connects the throttle valves together. A single Throttle Position Sensor (TPS) is used on the rear TBI unit only. Also, a throttle bore tube is located under the manifold cover, below each throttle valve to help in mixture distribution. The throttle body portion of each TBI unit has several tubes which supply a manifold vacuum signal required for the operation of related engine and emission control systems. A vacuum port, located above the throttle valve is connected to the capped tubes used for on vehicle service air flow balancing, for final throttle valve synchronization. The amount of fuel delivered to the injectors is determined by an electronic signal supplied by the ECM. The TBI unit does not control, but is controlled by, the ECM. The ECM monitors several engine and vehicle conditions needed to calculate the fuel delivery time of the injectors.

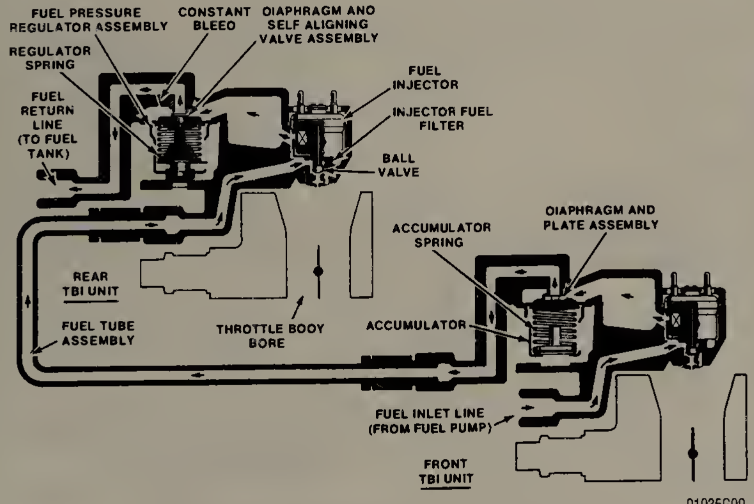


Fig. 7 Cross-fire Fuel Injection fuel meter system schematic

Delivery time may be modified by the ECM to reflect various operating conditions, such as cranking, cold starting, altitude, acceleration and deceleration. Each TBI unit has its own fuel injector which are controlled individually by the ECM.

Relieving Fuel System Pressure

CAUTION

Observe all applicable safety precautions when working around fuel. Whenever servicing the fuel system, always work in a well ventilated area. Do not allow fuel spray or vapors to come in contact with a spark or open flame. Keep a dry chemical fire extinguisher near the work area. Always keep fuel in a container specifically designed for fuel storage; also, always properly seal fuel containers to avoid the possibility of fire or explosion.

1. Place the transmission in PARK (automatic transmissions) or NEUTRAL (manual transmission), then set the parking brake and block the drive wheels.
2. Loosen the fuel filler cap to relieve tank pressure.
3. Remove the FUEL PUMP fuse from the fuse block in the passenger compartment.
4. Start the engine and allow to run until it stops due to lack of fuel.
5. Engage the starter (turn key to start) for three seconds to dissipate all pressure in the fuel lines.
6. Turn the ignition **OFF**, then re-engage the connector at the fuel tank or install the fuel pump fuse.
7. Disconnect the negative battery cable to prevent accidental fuel spillage should the ignition key accidentally be turned **ON** with a fuel fitting disconnected.
8. When fuel service is finished, tighten the fuel filler cap and connect the negative battery cable.

CAUTION

To reduce the chance of personal injury when disconnecting a fuel line, always cover the fuel line with cloth to collect escaping fuel, then place the cloth in an approved container for disposal.

Fuel Pump

REMOVAL & INSTALLATION

See Figures 8, 9 and 10

The electric fuel pump is located in the fuel tank, attached to the fuel gauge sending unit, and may be serviced separately.

1. Disconnect the negative battery cable.
2. Remove the fuel filler door.

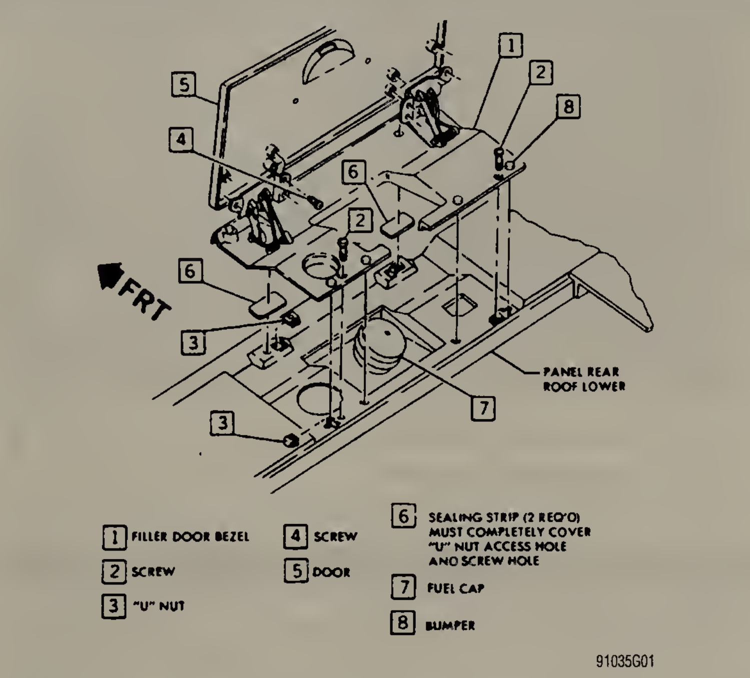


Fig. 8 Exploded view of the fuel filler door mounting

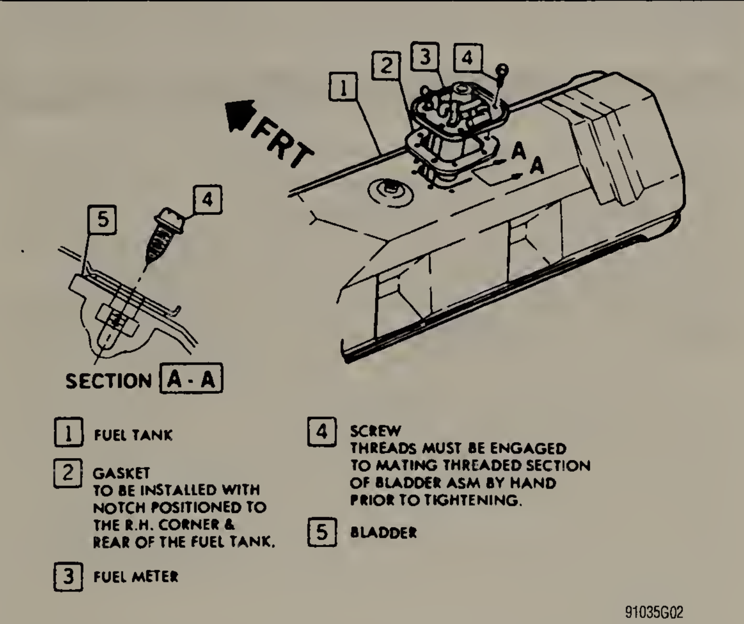


Fig. 9 Fuel tank filler neck

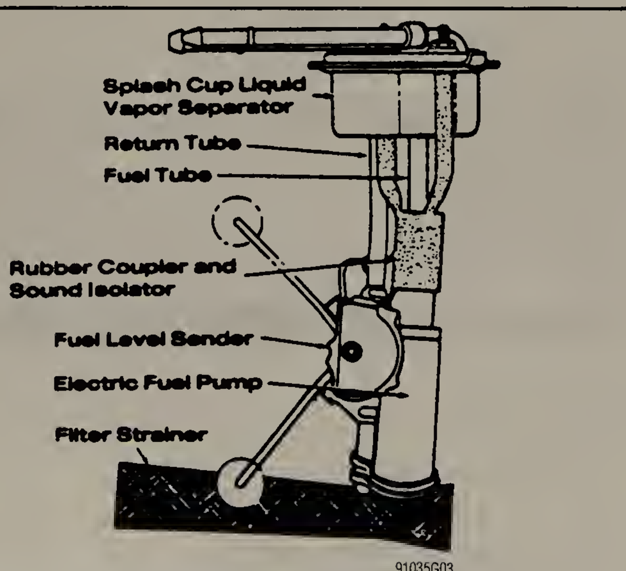


Fig. 10 View of the fuel meter and pump

3. Remove the fuel cap.
4. Remove the fuel tank filler neck housing, then disconnect the drain hose.
5. Unfasten the screws attaching the fuel meter/fuel pump to the tank.
6. Disconnect the fuel lines, fuel vapor line and electrical connector.
7. Remove the fuel meter/fuel pump and gasket.
8. Remove the fuel pump.
9. Installation is the reverse of the removal procedure.

TESTING

See Figures 11, 12, 13 and 14

For fuel system testing, please refer to the accompanying charts.

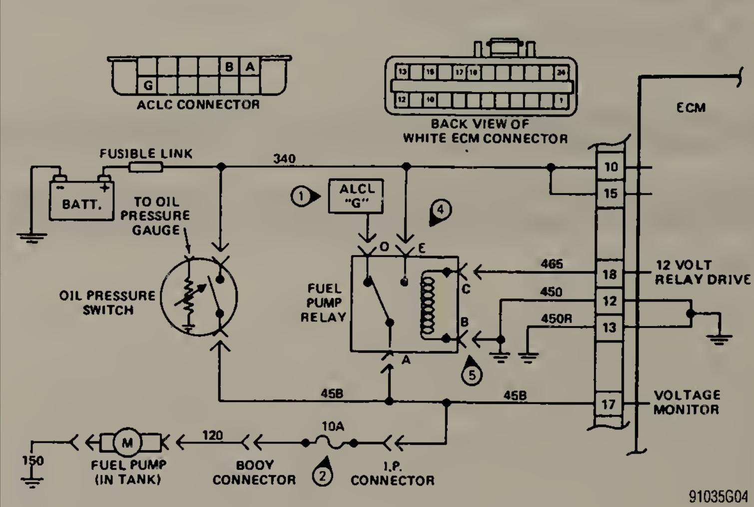


Fig. 11 Fuel system electrical schematic

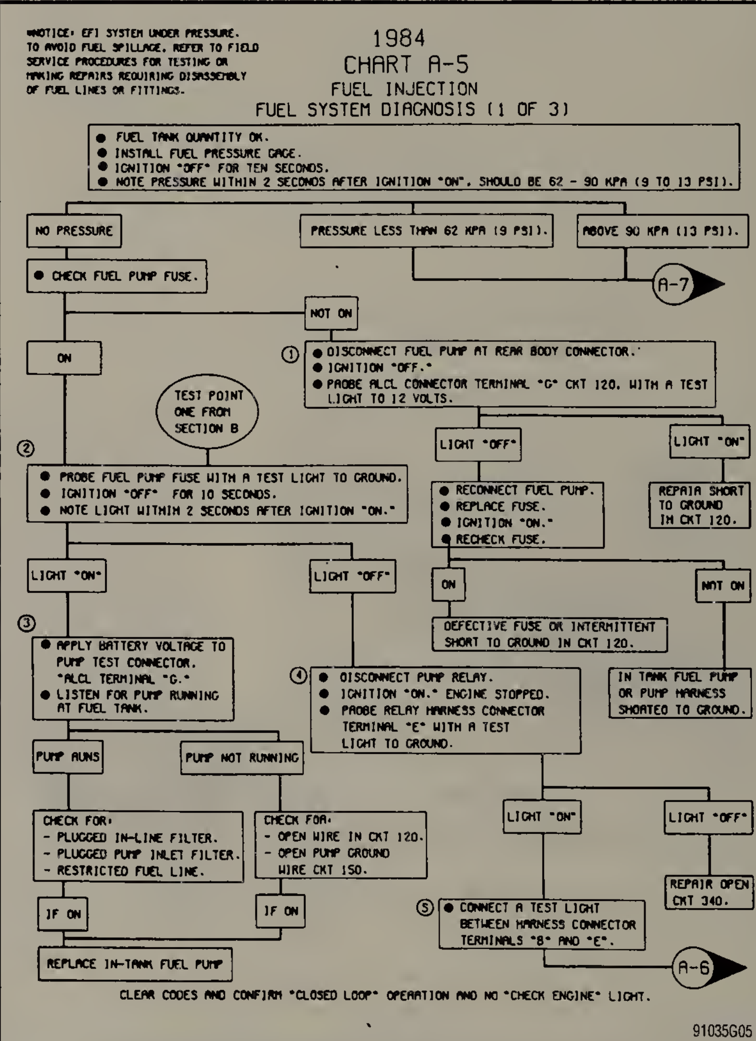


Fig. 12 Fuel system diagnosis—page 1 of 3

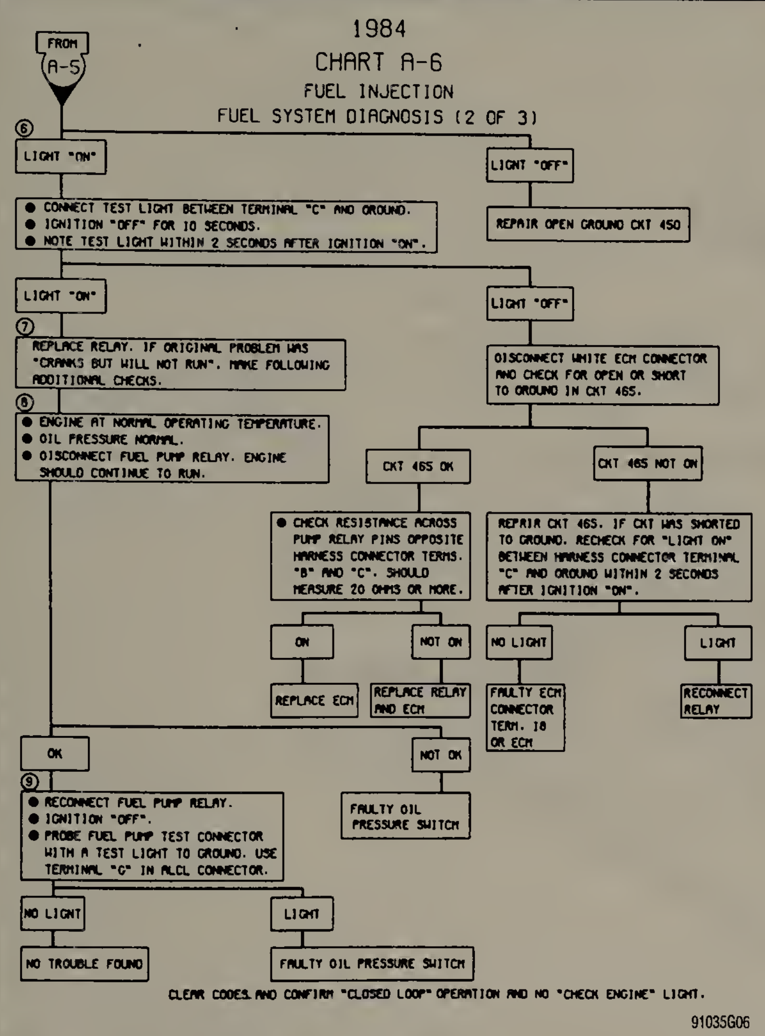


Fig. 13 Fuel system diagnosis—page 2 of 3

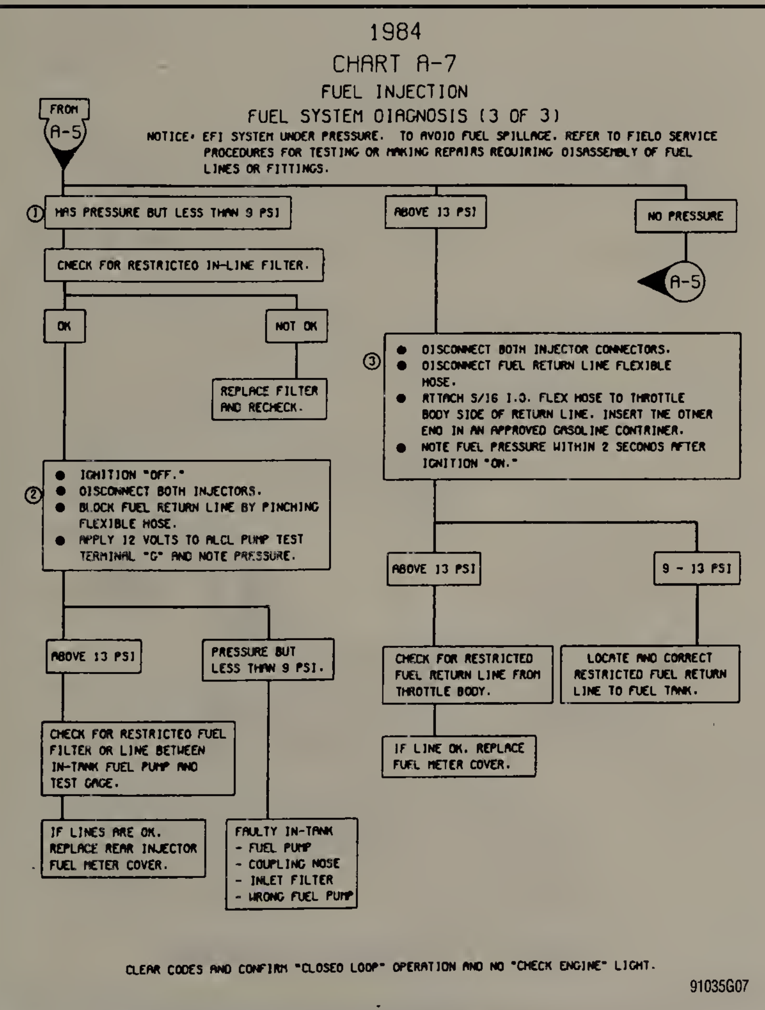


Fig. 14 Fuel system diagnosis—page 3 of 3

Throttle Body

REMOVAL & INSTALLATION

See Figures 15, 16, 17 and 18

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. Detach the electrical connectors from the injector, Idle Air Control (IAC) valve and Throttle Position Sensor (TPS). Remove the wiring harness from the throttle body.
4. Tag and disconnect the related vacuum lines from the TBI assembly.
5. Remove the throttle cable, and also the transmission detent and cruise control cables as applicable.

CAUTION

When the fuel line is disconnected, a small quantity of fuel may be released. To lower the risk of personal injury, make sure to cover the fuel line fitting with the a rag to absorb the fuel, then place the rag in a suitable container.

6. Using a back-up wrench to prevent the fuel nuts from turning on the TBI units, disconnect the fuel inlet and return lines, then remove the fuel tube between the 2 TBI units.
7. If removing the TBI unit for replacement, perform the following:
   a. Remove the bolts and nuts from the inlet manifold cover, then remove the TBI unit assembly.
   b. Place a protective covering over the "swirl" plates located below each throttle plate.
8. If removing the TBI unit for disassembly, perform the following:
   a. Remove and discard the throttle rod retaining clip from the front TBI throttle lever stud. A new clip, which is supplied in the service kit, must be used when reassembling the separated front and rear throttle bodies. One throttle rod end bearing is permanently attached to the throttle lever stud of the rear unit, and must not be removed from it. If the throttle rod and bearing assembly needs replacement, the entire rear throttle body must be replaced.
   b. Remove the TBI-to-cover mounting bolts from the front unit. Then, remove the TBI-to-cover mounting bolts from the rear unit.
   c. Lift the rear TBI unit off the manifold cover locator pins, and raise it above the front unit. Slide the throttle rod end bearing off the front unit throttle lever stud.
   d. Remove the front TBI unit and mounting gasket.

To install:

9. If the TBI unit was removed for replacement, installation is the reverse of the removal procedure. Tighten the retaining bolts and nuts to 10–14 ft. lbs. (14–19 Nm).

If the TBI unit was removed for disassembly, perform the following steps, as applicable.

10. Reinstalling the units with the original front and rear throttle bodies on the original manifold cover:
   a. Install new front and rear throttle body mounting gaskets.
   b. Install the front TBI unit on the manifold cover locator pins. Tighten the mounting bolts to 8–14 ft. lbs. (11–19 Nm).
   c. Holding the rear unit above the front unit, install the throttle rod end bearing on the front unit throttle lever stud. Install the rear TBI unit onto the manifold cover locator pines. Tighten the mounting bolts to 8–14 ft. lbs. (11–19 Nm).
   d. Use needle-nose pliers to carefully install a new throttle rod and bearing retaining clip.
   e. Proceed to the Final Assembly steps.
11. If you replaced the manifold cover, TBI unit(s) or throttle bodies, perform the following. This section must be followed because replacement of one or more of the assemblies requires throttle valve synchronizing and checking the throttle rod alignment.
   a. If the tamper resistant plugs covering the throttle stop screws are in place, remove the plugs. Replacement throttle bodies do not have throttle stop screw plugs installed. Use a punch to bet the located, over the center line of the throttle stop screw, for a hole to be drilled. Drill a 5/32 in. (4mm) diameter hole plug through the throttle body casting, to the hardened plug.

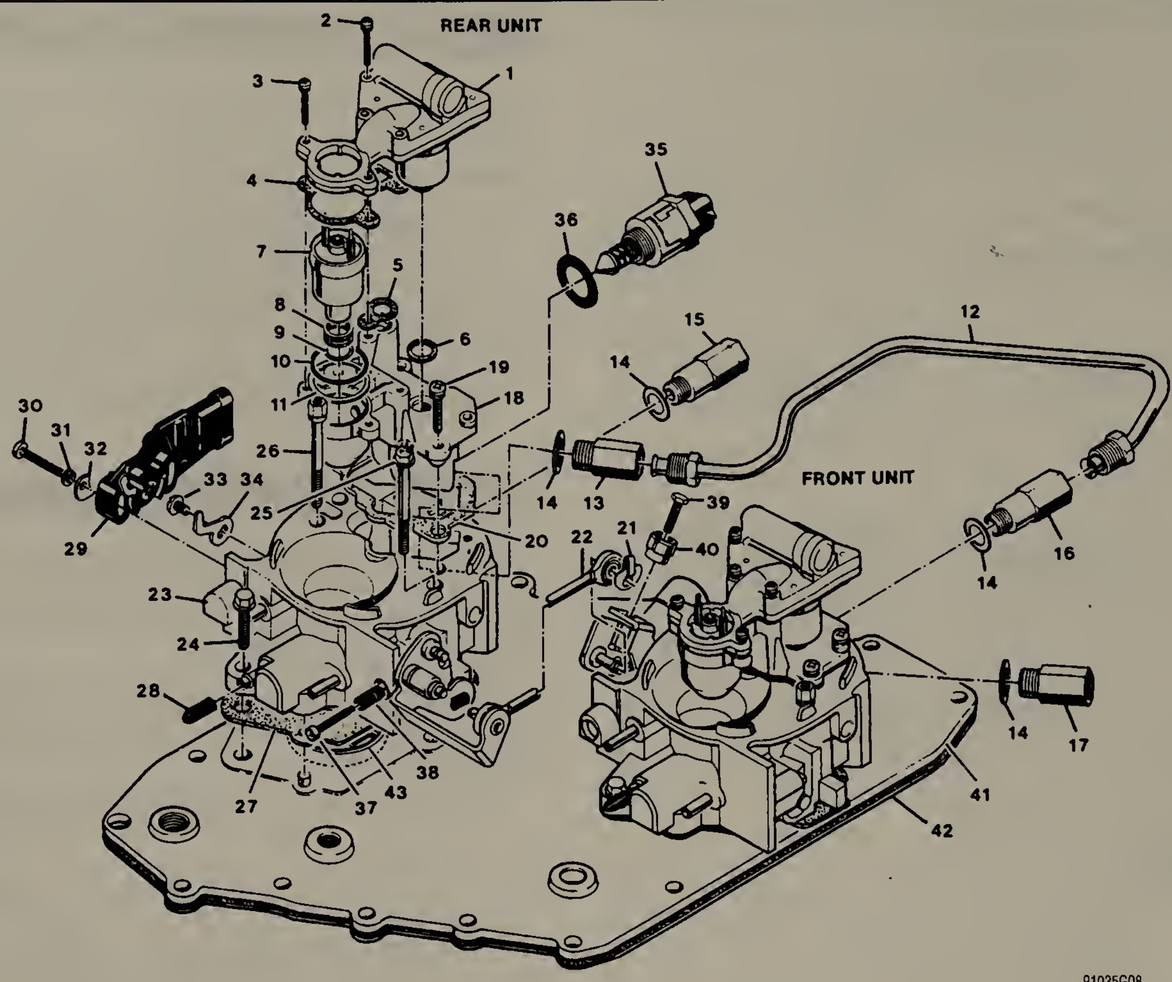


Fig. 15 Exploded view of the front and rear TBI unit components—1 of 2

ALL PARTS ARE COMMON BETWEEN FRONT AND REAR TBI UNITS EXCEPT THOSE MARKED F (FRONT) OR R (REAR). REAR UNIT EXPLODED VIEW IS TYPICAL ILLUSTRATION.

FUEL METERING PARTS

1 FUEL METER COVER & PRESSURE REGULATOR-R
2 SCREW & WASHER ASM.-LONG (3)
3 SCREW & WASHER ASM.-SHORT (2)
4 GASKET-FUEL METER COVER
5 GASKET-FUEL METER OUTLET
6 DUST SEAL-PRESSURE REGULATOR-R
7 FUEL INJECTOR
8 FILTER-FUEL INJECTOR
9 SEAL-SMALL "O" RING
10 SEAL-LARGE "O" RING
11 BACK-UP WASHER-FUEL INJECTOR
12 FUEL TUBE ASSEMBLY
13 NUT-FUEL INLET-R
14 GASKET-FUEL NUT (2)
15 NUT-FUEL RETURN-R
16 NUT-FUEL RETURN-F
17 NUT-FUEL INLET-F
18 FUEL METER BODY ASM.
19 SCREW & WASHER ASM.-ATTACHING (3)
20 GASKET-FUEL METER BODY

THROTTLE BODY PARTS

21 CLIP-THROTTLE ROD RETAINING-F
22 THROTTLE ROD & BEARING ASSEMBLY-R
23 THROTTLE BODY ASSEMBLY
24 BOLT-TBI ATTACHING-SHORT
25 STUD/BOLT-TBI/AIR CLEANER ATTACHING
26 STUD-TBI & AIR CLEANER ATTACHING
27 GASKET-TBI MOUNTING
28 CAP-TUBE
29 THROTTLE POSITION SENSOR (TPS)-R
30 SCREW-TPS ATTACHING (2)-R
31 WASHER-TPS SCREW (2)-R
32 RETAINER-TPS (2)-R
33 SCREW-TPS LEVER ATTACHING-R
34 LEVER-TPS-R
35 IDLE AIR CONTROL (IAC) ASSEMBLY
36 GASKET-IAC ASSEMBLY
37 SCREW-THROTTLE STOP
38 SPRING-THROTTLE STOP SCREW
39 SCREW-THROTTLE SYNCHRONIZING-F
40 COLLAR-THROTTLE SYNCHRONIZING SCREW-F

INLET MANIFOLD PARTS

41 INLET MANIFOLD COVER
42 GASKET-INLET MANIFOLD COVER
43 THROTTLE BORE TUBE (OR SWIRL PLATE)-MANIFOLD COVER

91035G15

Fig. 16 Front and rear TBI unit component key list—2 of 2

Use a 1⁄16 in. (2mm) diameter punch to drive through the bottom of the drilled hole and knock out the plug.

b. If the front TBI unit throttle synchronizing screw has a welded retaining collar, grind off the weld. A replacement throttle body may have a throttle synchronizing screw with a non-welded collar.

c. Block possible movement of the throttle lever, as shown in the accompanying figure, relieving the force of the heavy spring against the throttle synchronizing screw, to prevent the levers from coming into contact.

➡If a lever is not blocked before the throttle synchronizing screw, the screw may be damaged, and reinstallation will be difficult.

d. Remove the synchronizing screw and collar, discard the collar and reinstall the screw. Remove the blocking from the throttle lever.

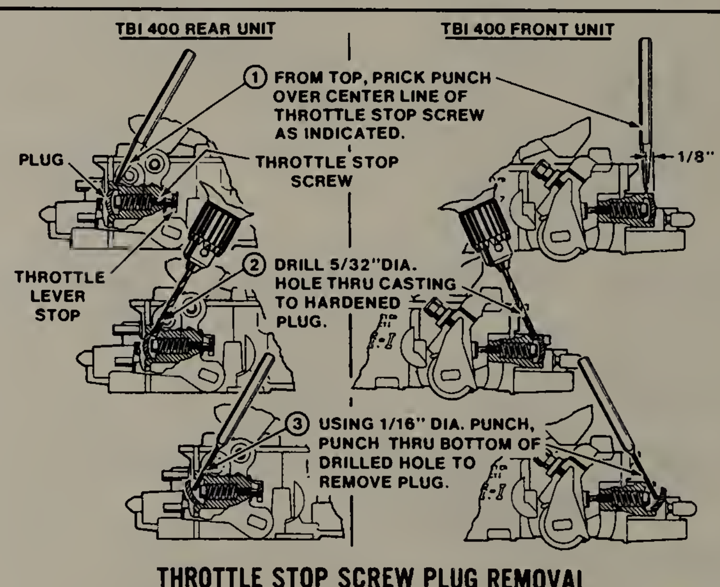


Fig. 17 Steps for removing the throttle stop screw plug

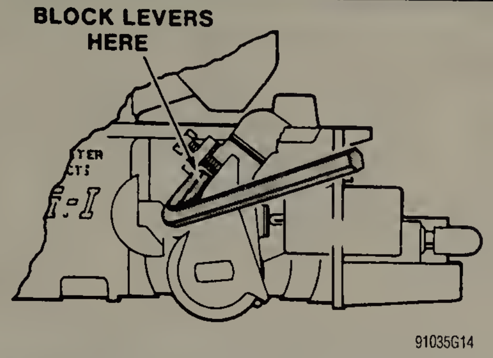


Fig. 18 Removal of the throttle synchronizing screw collar

12. Install the necessary throttle body mounting gaskets.
13. With either throttle body in place, install the throttle rod end bearing on the front unit throttle lever stud.
14. Install the other throttle body on the manifold cover locator pins. Tighten the mounting bolts to 8–14 ft. lbs. (11–19 Nm).
15. Perform the throttle valve synchronizing or throttle rod alignment check, as necessary.

➡**The following steps are the "Final Assembly" steps.**

16. Reinstall the connecting fuel tube between the front and rear TBI units. Tighten to 24 ft. lbs. (32 Nm), using a back-up wrench.
17. Attach the fuel inlet and return lines, using a back-up wrench on the fuel nuts.
18. Connect the throttle cable, and the transmission detent and cruise control cables, if applicable.
19. Attach the vacuum lines, as tagged during removal.
20. Attach the electrical connectors to the injectors, IAC and TPS. Reinstall the wiring harness on the throttle body.
21. Install the air cleaner assembly.
22. With the engine **OFF**, depress the accelerator pedal to the floor and release, checking for free return of the pedal.

Throttle Valve Synchronizing—Preliminary Adjustment

➧ See Figure 19

The model 400 TBI preliminary throttle valve synchronizing adjustment may be performed with the assembly on the vehicle, or removed from the vehicle, as a bench procedure.

1. Turn both front unit and rear unit throttle stop screws counterclockwise enough to break contact with the related throttle lever tangs.
2. Adjust the throttle synchronizing screw to allow BOTH throttle valves to close. The throttle rod end bearing will move freely on FRONT unit throttle lever stud when both valves are closed.
3. Turn the FRONT throttle stop screw clockwise slowly unit it makes contact with the throttle lever tang. Turn clockwise ¼ additional turn.
4. Turn the REAR throttle stop screw clockwise slowly until it makes contact with the throttle lever tang. Turn clockwise an additional ½ turn.
5. Final adjustments are made with the assembly on the vehicle and the vehicle running.

Throttle Rod Alignment Check

➧ See Figures 20 and 21

1. Actuator the rear unit throttle lever to bring both units to the wide open throttle position by loading the throttle valve as shown. Move the throttle rod toward the front unit casting boss.
2. Check the clearance between the shoulder of the stud and the side of the ball surface. Maximum clearance must not exceed 0.20 in. (5.0mm). If the clearance is greater, the replacement assembly (manifold cover, TBI unit, or throttle body) must be exchanged, and the preliminary throttle valve synchronizing adjustment repeated.
3. Use needle-nose pliers to install carefully a NEW throttle rod and bearing assembly retaining clip supplied in the replacement kit.
4. Move both the front and rear throttle levers through the total throttle travel, locating the throttle valves.
5. Check the clearance between the throttle rod and front throttle body casting boss. If the minimum clearance is less than 0.040 in. (1.02mm), replacement assembly must be exchanged. If the minimum clearance is at least 0.040 in. (1.02mm) go to the final assembly.
6. If assemblies were replaced, repeat the throttle valve synchronization and throttle valve alignment check.

Fuel Injector

REMOVAL & INSTALLATION

➧ See Figures 22, 23, 24 and 25

➡**Before performing any service on the front or rear TBI unit, you must place the unit in a suitable holding fixture such as J-9789-118, BT-30-15, or equivalent. If you don't place the unit in a suitable fixture, the throttle valve may be damaged.**

1. Disconnect the negative battery cable.
2. Remove the TBI unit from the vehicle, and place it in a suitable holding fixture.
3. Remove the fuel meter cover, as follows:
   a. Remove the 5 fuel meter cover attaching screws and lockwashers.
   b. Lift off the fuel meter cover with the fuel pressure regulator (rear unit) or accumulator (front unit), noting their positions for reassembly.
   c. Remove and discard the fuel outlet passage only. Leave the fuel meter cover gasket on the fuel meter body.

⁂ CAUTION

Do NOT remove the 4 screws securing the fuel pressure regulator or accumulator to the fuel meter cover. The regulator or accumulator includes a large spring under heavy compression which, if accidentally released, could cause personal injury. The fuel meter cover is serviced as a complete assembly only. On the rear unit, the fuel meter cover includes the fuel pressure regulator which was calibrated and plugged at the factory.

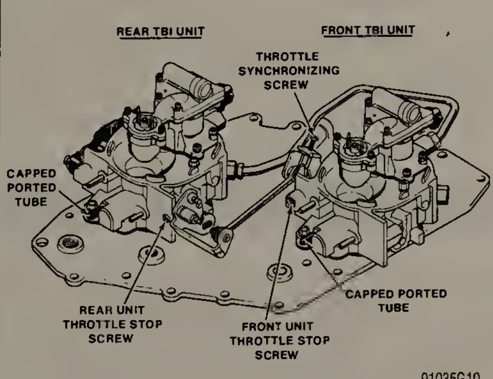


Fig. 19 Location of the throttle stop screws and synchronizing screw

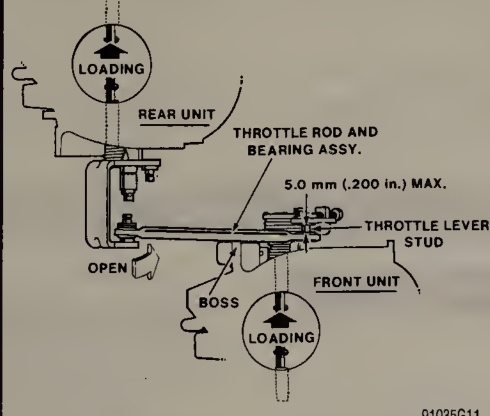


Fig. 20 Maximum shoulder-to-ball clearance check

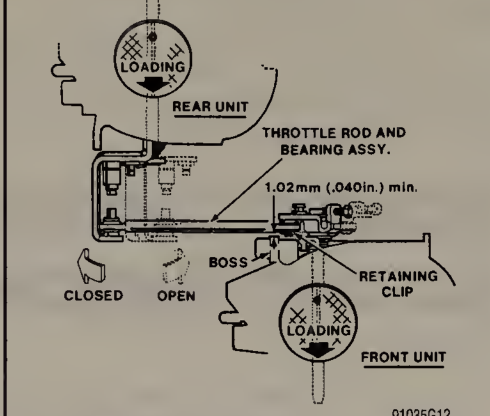


Fig. 21 Minimum throttle rod-to-casting clearance check

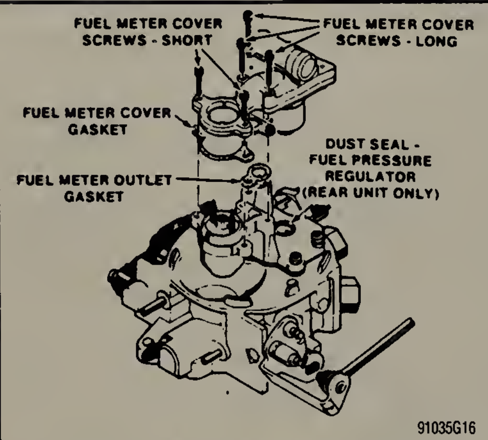


Fig. 22 Exploded view of the fuel meter cover attachment

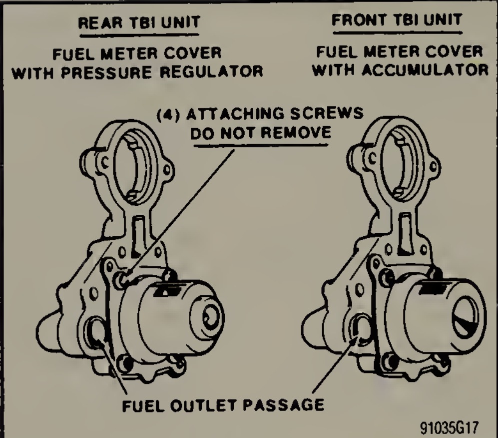


Fig. 23 Bottom view of the front and rear fuel meter covers

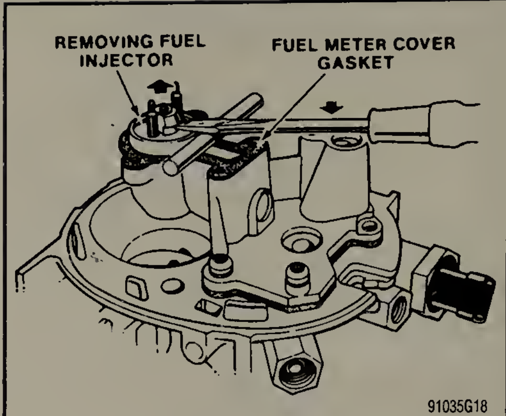


Fig. 24 Carefully pry the fuel injector out of the fuel meter body

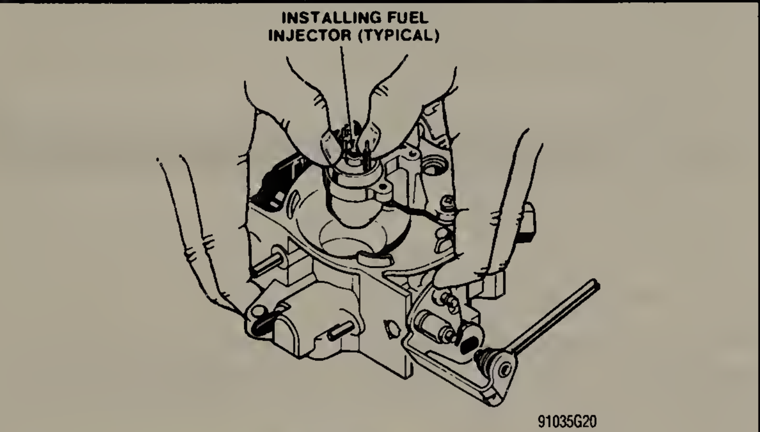


Fig. 25 Installation of the fuel injector

➡Do not immerse the fuel meter cover (with the pressure regulator or accumulator) in any type of cleaner. Immersion will damage the internal diaphragms and gaskets.

d. Remove the foam pressure regulator sealing ring (dust seal) from the rear throttle body.

➡When removing the injector, be careful to avoid damaging the electrical terminals on top of the injector, injector fuel filter and nozzle. Do NOT use pliers to remove the injector, as this could cause damage. The injector cannot be disassembled and is serviced as a complete assembly only. As it is an electrical component, it should not be submerged in any type of cleaner.

4. With the fuel meter cover gasket in place to protect the casting, use a suitable prytool and a fulcrum, as shown in the accompanying figure, to carefully lift the injector until to is free from the fuel meter body.
5. Remove the injector. If removing both injectors, make sure to mark them front and rear, so they can be reinstalled in the proper position. The injectors are NOT interchangeable and cannot be switched during installation.
6. Carefully rotate the injector fuel filter back and forth, then remove the filter from the base of the injector.
7. Remove and discard the fuel meter cover gasket.
8. Remove the large O-ring and steel back-up washer in the top counterbore of the fuel meter body injector cavity. Remove the small O-ring located at the bottom of the injector cavity.

To install:

9. Install the fuel filter on the nozzle end of the injector, using a slight twisting motion to position the filter against the injector base. The filter is cone-shaped. The large end of the filter faces up (toward the electrical terminals), so that the filter covers the raised rib at the base of the injector.
10. Lubricate the new small O-ring with automatic transmission fluid. Push the small O-ring on the nozzle end of the injector, pressing the ring up against the injector fuel filter.

➡Do not reverse this procedure and install the back-up washer and O-ring after the injector is in the cavity. This would prevent sealing of the O-ring in the cavity counterbore.

11. Install the steel back-up washer in the top counterbore of the fuel meter body injector cavity. Lubricate a new large O-ring with automatic transmission fluid. Install the O-ring directly above the back-up washer, and press the O-ring down in the cavity counterbore. Make sure the O-ring is located properly, and that it is flush with the top of the fuel meter body casting surface.
12. Install the injector in the cavity (making sure it is the proper injector), aligning the raised lug on the injector base with the cast-in notch in the fuel meter body. Push down on the injector until it is fully seated in the cavity (the electrical terminals of injector will be approximately parallel to the throttle shaft.
13. Install the fuel meter cover, as follows:
    a. Install a new dust seal (for the fuel pressure regulator) into the recess on the fuel meter body of the rear unit.
    b. Install a new fuel meter cover and fuel meter outlet gaskets.
14. Place the fuel meter cover with the fuel pressure regulator on the rear unit, and the fuel meter cover with the accumulator on the front unit. Apply Loctite® 262, or equivalent thread locking compound to the threads on the fuel 5 fuel meter cover attaching screws for each units. Install the fuel meter cover attaching screws and lockwashers and tighten to 28 inch lbs. (3 Nm). The 2 short screws go next to the fuel injector.

Fuel Pressure Regulator

REMOVAL & INSTALLATION

On these vehicles, the fuel pressure regulator is integral with the fuel meter cover. Refer to the fuel injector removal and installation procedure for the fuel meter cover/fuel pressure regulator procedure.

TUNED PORT INJECTION (TPI)

General Information

➧ See Figure 26

The Tuned Port Injection (TPI), Multi-port Fuel Injection (MFI) and Sequential multi-port Fuel Injection (SFI) systems were used on all 1985–96 vehicles covered by this manual. Even though the systems have different names, they are similar in operation.

The systems are controlled by an Engine Control Module (ECM) which monitors the engine operations and generates output signals to provide the correct air/fuel mixture, ignition timing and idle speed. Input information to the ECM is provided by the oxygen sensor, temperature sensors, detonation sensor, mass air flow sensor and throttle position sensor. A system may use all or some of these sensors, depending on the year and engine application. The ECM also receives information concerning engine rpm, road speed, transmission gear position, power steering and air conditioning status.

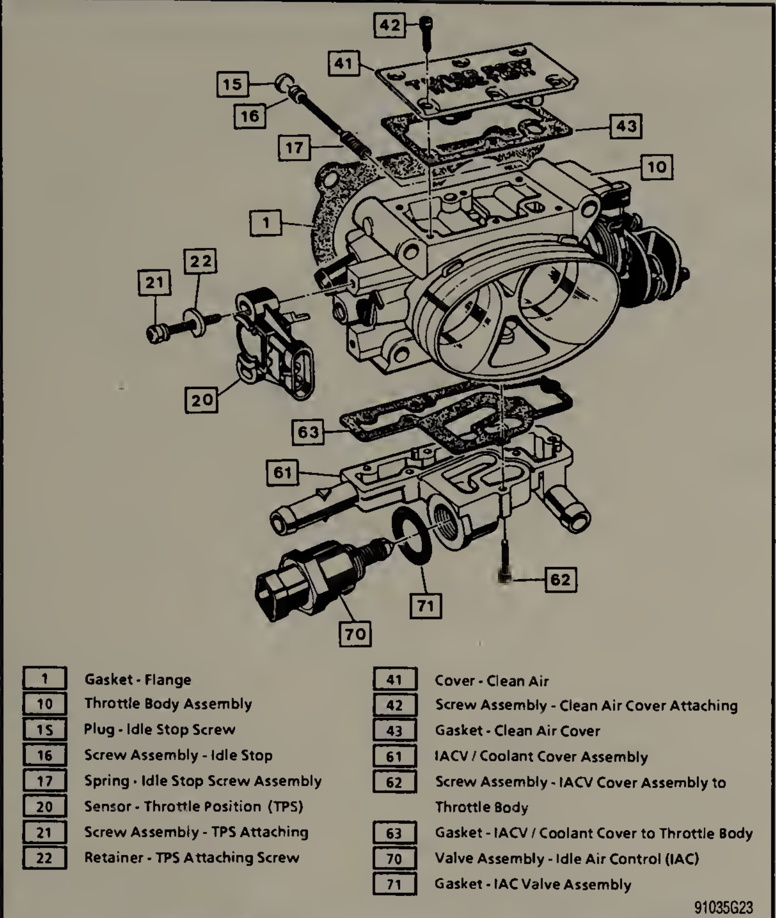


Fig. 26 Exploded view of the throttle body used on the 5.7L (VIN 8) engine

All of the systems use multiple injectors, aimed at the intake valve at each intake port. The injectors are mounted on a fuel rail and are activated by a signal from the ECM. The injector is a solenoid-operated valve which remains open depending on the width of the electronic pulses (length of the signal) from the ECM; the longer the open time, the more fuel is injected. In this manner, the air/fuel mixture can be precisely controlled for maximum performance with minimum emissions.

There are two different types of fuel management systems used on the multi-port fuel injection engines. The mass air flow system and the speed density system.

The mass air flow systems measure the mass of air that is drawn into the engine cylinders, rather than just the volume. The sensor contains a hot-wire sensing unit, which is made up of an electronic balanced bridge network. Whenever current is supplied to the sensor, the bridge is energized and the sensing hot-wire is heated. As the air enters the mass air flow sensor, it passes over and cools the hot wire. When the hot wire is cooled, additional current is needed to keep the bridge network balanced. This increase in current is sent to the computer as a voltage signal and is used to calculate the mass of the incoming air. The ECM uses this information to determine the duration of fuel injection pulse, ignition timing and EGR operation.

The speed density systems calculate the volume of air moving through the intake. The ECM establishes the speed factor through a signal from the ignition module. The Manifold or Intake Air Temperature (MAT/IAT) and the Engine Coolant Temperature (ECT) sensors work together to assure that proper temperature information gets to the ECM while the Manifold Absolute Pressure (MAP) sensor monitors the changes in manifold pressure which results from changes in engine loading. These three sensors contribute to the density factor. Together, these inputs (engine speed, coolant temperature sensor, etc . . .) are the major determinants of the air/fuel mixture delivered by the fuel injection system.

Relieving Fuel System Pressure

1. Disconnect the negative battery cable to prevent fuel discharge if the key is accidentally turned to the **RUN** position.
2. Loosen the fuel filler cap to relieve the tank pressure and do not tighten until service has been completed.
3. If equipped, remove the fuel pressure connection valve cap.
4. Connect fuel pressure gauge J–34730–1, or equivalent, to the fuel pressure test valve. Wrap a shop towel around the fitting while connecting the gauge to prevent spillage.
5. Place the end of the bleed hose into a suitable container and open the valve to relieve the fuel system pressure.
6. Drain any remaining fuel into an approved container.

Fuel Pump

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

1985–89 VEHICLES

See Figures 27 and 28

The fuel pump(s) are mounted to the fuel lever meter inside the fuel tank.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure.
3. Remove the fuel tank filler door and drain tube.
4. Disconnect the feed, return and vapor hoses from the sending unit.
5. Remove the license plate to gain access for removal of the 2 bolts securing the fascia to impact bar.
6. Raise the vehicle and support it safely.
7. Remove the spare tire and carrier from the frame.
8. Disconnect the intermediate exhaust pipe at the converter. Remove the intermediate pipe and mufflers as an assembly from the vehicle.
9. Remove both rear inner fender braces at the frame.
10. Remove both rear inner fender panels.

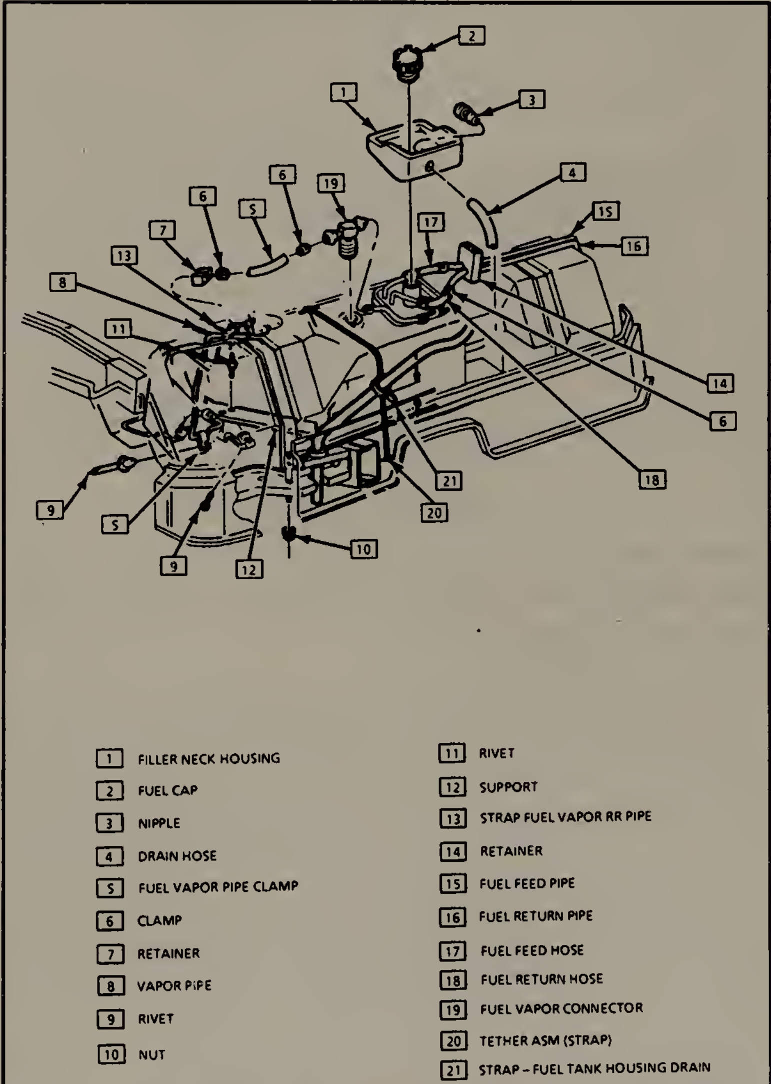


Fig. 27 View of the fuel tank mounting—1985–89 5.7L (VIN 8) engine

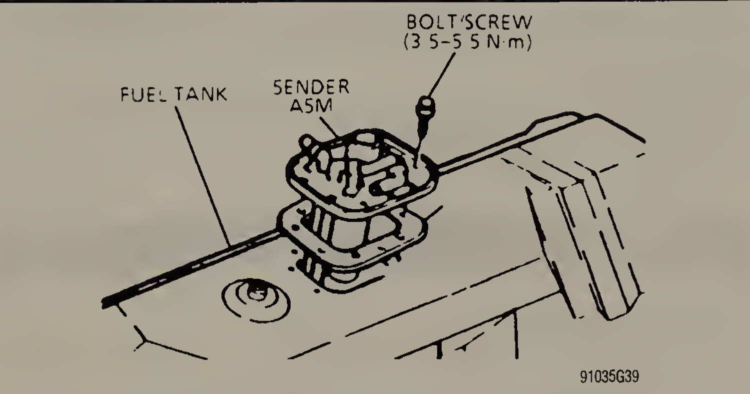


Fig. 28 Fuel sender location—1985–89 5.7L (VIN 8) engine

11. Remove the antenna ground strap and clip.
12. Disconnect the fuel vapor pipe from the left hand fuel tank strap.
13. Disconnect the fuel tank cables from the rear stabilizer shaft brackets.
14. Remove the screws securing the bottom edge of the fascia to the energy absorber pad.
15. Remove all rear lamps.
16. Disconnect each side of the fascia from the horizontal body retainer.
17. Disconnect the right and left vertical retainers securing the fascia to the body.
18. Remove the 6 frame bolts and loosen the 2 front frame bolts.
19. Remove the front frame bolts. Pull the tank and frame assembly to the rear pushing the cover outward and letting the rear of the frame assembly down to clear the cover.
20. Remove the vapor hose from the vapor connector and remove the tank and frame assembly.
21. Remove the fuel sending unit and pump assembly by turning the cam lock ring counterclockwise. Lift the assembly from the fuel tank.
22. Disconnect the fuel pump from the fuel level sending unit.

To install:

23. Reverse the removal procedure, noting the following:
    a. Always use a new gasket when the sending unit is removed from the vehicle.
    b. Do not fold or twist the strainer when installing the sending, as this could cause fuel restriction.
    c. Ensure to install insulator pads on the top of the fuel tank to reduce rattle or any noises.
    d. Peel off release paper on rear insulators and apply to the tank or underbody.
    e. Tighten the fuel tank retaining strap bolts to 26 ft. lbs. (35 Nm).
    f. Ttighten the rear strap bolts to 8 ft. lbs. (11 Nm).

➡Install the left hand side tank strap first, to prevent the tank flange from grounding out against the tank strap bracket.

    g. Connect the negative battery cable and check for leaks.

1990–91 VEHICLES

➡The fuel pump(s) are mounted on the sending unit, therefore, removal of the gas tank is unnecessary.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure.
3. Remove the filler door bezel attaching screws, then the filler door bezel.
4. Remove gas cap, then lift the fuel tank filler neck housing and disconnect the drain hose.
5. Remove filler neck housing, then disconnect the fuel pipes and fuel vapor pipe.
6. Detach the sending unit electrical connector, remove the attaching bolts, then the sending unit assembly from the vehicle.
7. Installation is the reverse of the removal procedure. Connect the negative battery cable.

5.7L (VIN P, 5 and J) Engines

➧ See Figures 29, 30 and 31

➡Vehicles equipped with the 5.7L (VIN J) engine use a fuel sender assembly which is equipped with 2 fuel pumps. The strainers and pumps are not serviced separately from the sender and, if 1 component is damaged, the sender assembly must be replaced as a unit.

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure and drain the fuel tank.
3. Remove the 4 filler door bezel attaching screws, then remove the filler door bezel.
4. Lift the fuel tank filler neck housing and disconnect the drain hose from the nipple. Remove filler neck housing.
5. Clean the area around all fuel fittings to prevent system contamination, then disconnect and plug the fuel pipes and fuel vapor pipe.
6. Unplug the sending unit electrical connector, remove the attaching bolts and remove the sending unit assembly from the vehicle.
7. If equipped with the VIN J engine, replace fuel sender assembly.
8. If equipped with the VIN P engines, service the sender assembly, as necessary:
    a. Note the position of the fuel strainer on the pump.
    b. Support the pump with one hand and grasp the strainer with the other. Turn the strainer in one direction, pull the strainer off the pump and discard it.
    c. Unplug the fuel pump electrical connection.

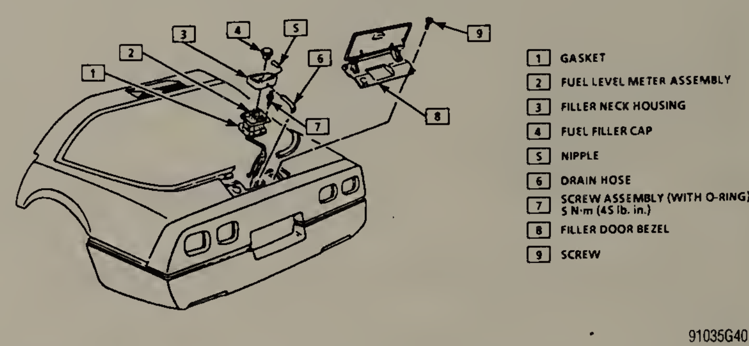


Fig. 29 Typical fuel sender assembly replacement

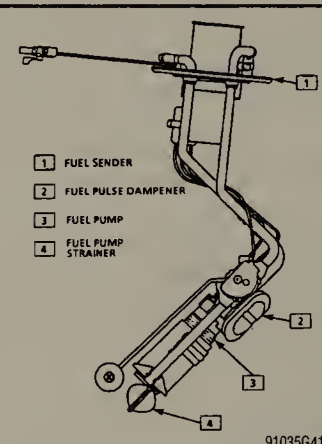


Fig. 30 Fuel sender for a 1994 5.7L (VIN P) engine shown

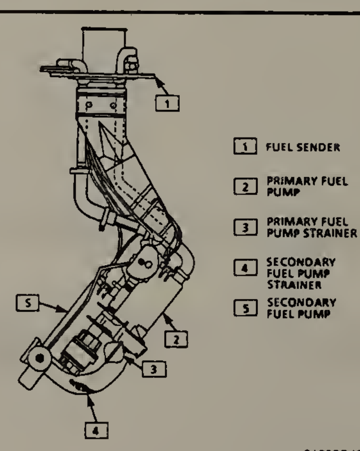


Fig. 31 Fuel sender assembly—5.7L (VIN J) engine shown

d. Place the fuel sender assembly upside down on a flat bench.
e. Pull the fuel pump downward to remove it from the mounting bracket, then tilt the pump outward and remove it from the pulse dampener.
f. Note the position of the dampener on the inlet tube, then remove the dampener from the tube. Shake the dampener and listen for fuel, if fuel is heard inside the dampener, it must be replaced.

To install:

9. If equipped with the VIN P engines, assemble the sender for installation, as necessary:
a. Install the fuel pulse dampener in the same position as noted during disassembly.
b. Assemble the rear bumper and insulator onto the fuel pump.
c. Position the fuel sender assembly upside down on a flat bench and install the fuel pump between the fuel pulse dampener and mounting bracket.
d. Engage the pump electrical connector.
e. Install the new fuel strainer into the same position as noted during disassembly. Push on the outer edge of ferrule until fully seated.
10. Position a new gasket on the fuel tank with the notch facing forward in the right corner of the fuel tank.
11. Carefully fold the strainer to allow it to fit through the opening in the tank. Make sure the strainer unfolds in the tank and lower the fuel sender assembly into position.
12. Install the fuel sender assembly attaching screws and tighten alternately and evenly to 45 inch lbs. (5 Nm).
13. Engage the fuel sender assembly electrical connector.
14. Connect all sender assembly fuel and vapor hoses.
15. Connect the fuel drain hose to the nipple on the rubber filler neck housing, then position the housing around the fuel tank filler neck.
16. Install the filler door bezel with the attaching screws.
17. Add fuel, tighten the filler cap and connect the negative battery cable.
18. Turn the ignition **ON** for 2 seconds, **OFF** for 10 seconds, then **ON** again and inspect the system for leaks.

TESTING

1. Properly relieve fuel system pressure.
2. With ignition **OFF**, install J–34730–1 or an equivalent fuel pressure gauge, to the fuel rail pressure connection.
3. For the VIN J engine, test the primary fuel pump by removing the secondary fuel pump fuse **FP2** or test the secondary fuel pump by removing the primary fuel pump fuse **FP1**.
4. Turn the ignition switch **ON,** but with the engine not running. The fuel pump will operate for 2 seconds and then turn **OFF**. It may be necessary to cycle the ignition a few times to build system pressure. If this is necessary, make sure the ignition remains **OFF** for at least 10 seconds between cycles.
5. With the pump running, fuel pressure should be 41–47 psi, if equipped with the VIN P engine or 48–55 psi, if equipped with the VIN J engine.
6. When the pump stops, the pressure may vary slightly, but then should hold steady with little or no pressure drop.
7. Start the engine and the pressure should drop approximately 3–10 psi.

Throttle Body

REMOVAL & INSTALLATION

5.7L (VIN 8, P & 5) Engines

See Figure 32

1. Disconnect the negative battery cable.
2. Partially drain the coolant, into a suitable container, in order to allow the throttle body hoses to be disconnected.
3. Disconnect the MAF sensor electrical connector, then remove the air inlet duct.
4. If necessary, disconnect the crankcase ventilation hose and EVAP canister purge solenoid valve vacuum hose from the throttle body.
5. Tag and detach the IAC valve and TPS electrical connectors.
6. Label and disconnect the vacuum lines from the throttle body.
7. Disconnect the coolant hoses from the throttle body.
8. Disconnect the throttle, TV and cruise control cables.

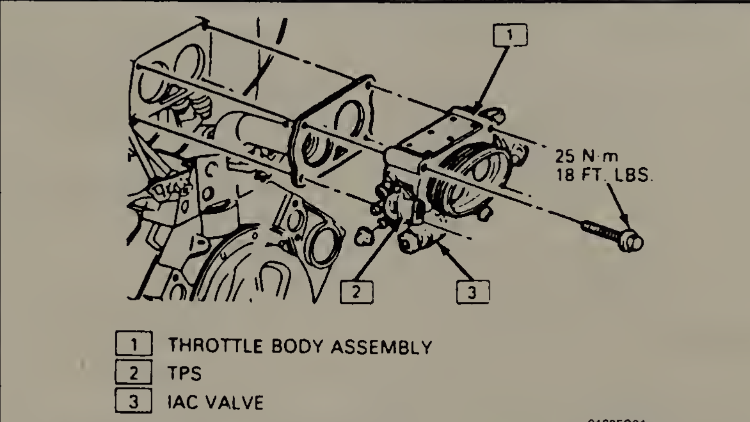


Fig. 32 Exploded view of the throttle body mounting—1985–91 5.7L (VIN 8) engines shown, VIN P & 5 similar

9. Unfasten the retaining bolts, then remove the throttle body assembly and flange gasket assembly. Discard the gasket and replace with new one during installation.
10. Thoroughly clean the gasket mating surfaces.

To install:

11. Position a new flange gasket, then install the throttle body. Tighten the throttle body mounting bolts to 18 ft. lbs. (25 Nm).
12. Connect the throttle, TV and cruise control cables. Make sure that the cables do not hold the throttle open.
13. Attach the coolant hoses and vacuum lines to the throttle body.
14. Attach the IAC valve and TPS electrical connectors.
15. Install the air inlet duct.
16. Fill the cooling system with the proper type and amount of coolant.
17. Connect the negative battery cable. With the engine **OFF**, Depress and release the accelerator pedal to make sure the operates freely and does not stick.

5.7L (VIN J) Engine

See Figure 33

1. Disconnect the negative battery cable.
2. Partially drain the coolant, into a suitable container. Coolant circulates through the throttle body and must be partially drained before removing the throttle body.
3. Remove the air intake duct.

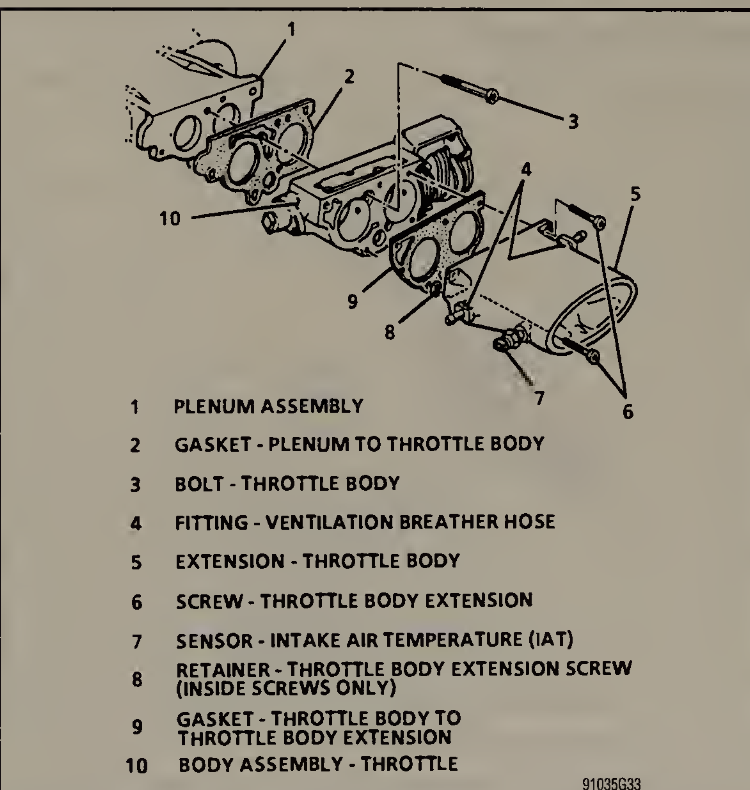


Fig. 33 View of the throttle body mounting—5.7L (VIN J) engine

4. Unplug the electrical connector from the IAT sensor.
5. Unfasten the throttle cable cover retainers, then remove the cover.
6. Remove/loosen the throttle body extension retaining screws. The inside screws will not come out completely, but will disengage from the throttle body.
7. Grasp the throttle body extension, then disconnect the left and right fresh air hoses and canister vacuum signal hose.
8. Remove the throttle body extension and gasket, then discard the gasket.
9. Disconnect the throttle body cable from the throttle body.
10. Remove the throttle body cable hold-down clamp.
11. Detach the electrical connectors from the IAC valve and TP sensor.
12. Unfasten the throttle body-to-plenum bolts, then remove the throttle body and gasket. Discard the gasket.
13. Thoroughly clean the gasket mating surfaces, but be careful not to scratch or gouge the sealing surfaces.
14. Installation is the reverse of the removal procedure. Tighten the throttle body mounting bolts to 11 ft. lbs. (15 Nm).
15. After installation is complete, connect the negative battery cable. With the engine **OFF**, Depress and release the accelerator pedal to make sure the operates freely and does not stick.
16. Reset the IAC valve pintle position as follows:
    a. Slightly depress the accelerator pedal.
    b. Start and run the engine for 5 seconds.
    c. Turn the engine **OFF** for 5 seconds.
    d. Restart the engine, then check for proper idle operation.

Fuel Injector(s)

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

See Figure 34

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Remove the intake plenum and runners.
4. Remove the fuel rail assembly, as outlined later in this section.
5. Rotate the injector retaining clip to the release position.
6. Remove the injector by pulling it from the fuel rail assembly.
7. Remove and discard the retaining clip, and the O-ring seals from each end of the injector.

To install:

Always replace injectors using the identical part number which is inscribed on the old injector.

8. Lightly lubricate new injector O-rings with clean engine oil, then install onto the injector.
9. Install a new injector retaining clip onto the injector.
10. Install the injector to the fuel rail socket with the electrical connector facing outward.
11. Rotate the injector retaining clip to the locked position/
12. Install the fuel rail.
13. Temporarily connect the negative battery cable. With the engine **OFF** and the ignition **ON**, check for fuel leaks. Disconnect the negative battery cable.
14. Install the intake plenum and runners, then connect the negative battery cable.

5.7L (VIN P and 5) Engine

See Figures 35 and 36

1. Disconnect the negative battery cable and properly relieve fuel system pressure.
2. Remove the fuel rail cover(s).
3. Disengage the quick-connect fittings at the fuel rail feed and return pipes as follows:
    a. Grasp both ends of a connection and twist ¼ turn in each direction to loosen any dirt. Repeat for other fitting.
    b. While wearing safety glasses, use compressed air to blow out dirt from the fitting.
    c. Insert a fuel line separator tool, into the female connector, then push inward to release the male connector and repeat for the other fitting.

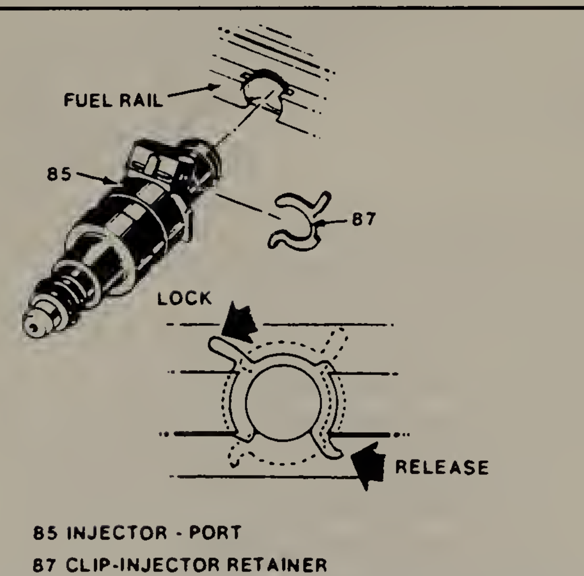


Fig. 34 The injector is secured in the fuel rail socket with a metal retaining clip

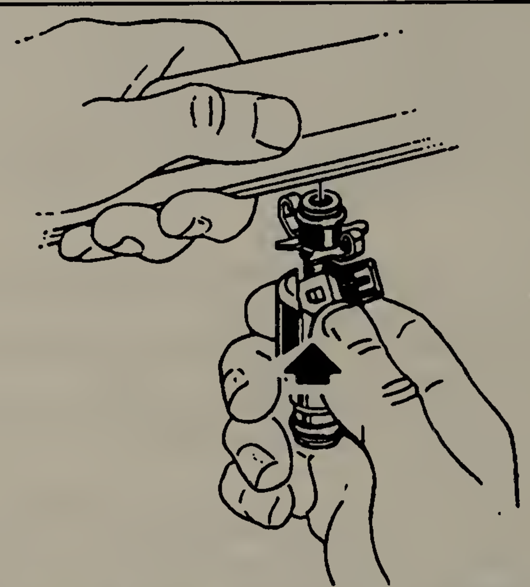


Fig. 35 Pulling the fuel injection from the fuel rail—5.7L (VIN P and 5) engines

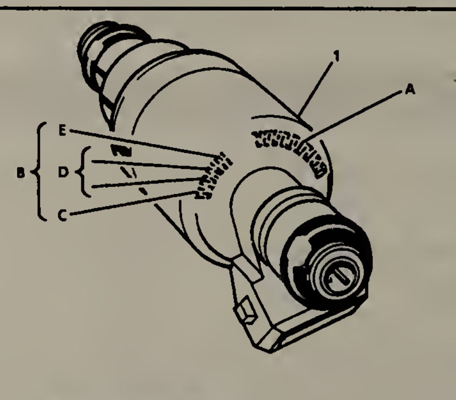


Fig. 36 Always make sure you are using the proper part number when installing a new injector

4. Disconnect the vacuum line at the pressure regulator.
5. Tag and unplug the injector electrical connectors.
6. Remove the fuel rail attaching bolts and carefully remove the fuel rail assembly along with the injectors, from the top of the intake.
7. Rotate the injector retaining clip to the release position and remove the injector from the fuel rail assembly.
8. Remove and discard the O-ring seals from either side of the injector.
9. Remove and discard the injector retaining clip.

To install:

10. Lubricate the new injector O-rings with clean engine oil and install onto the injector.

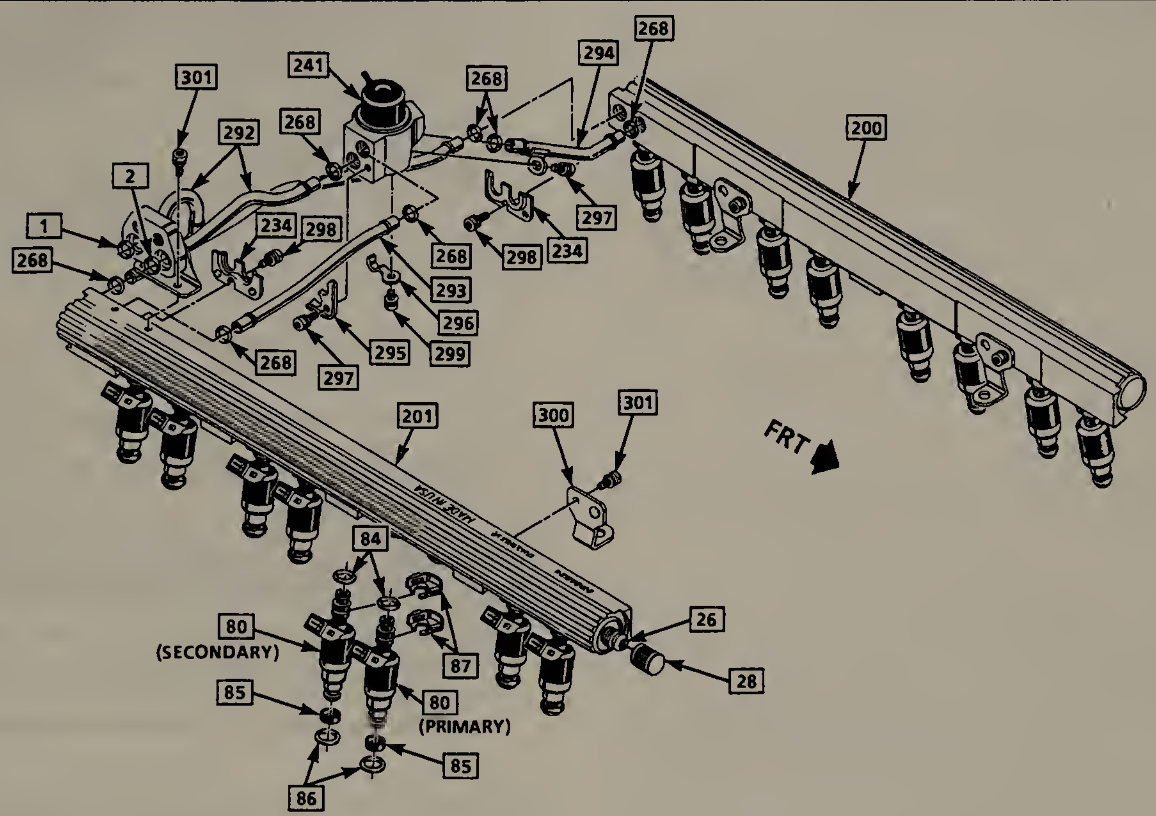
➡Always replace injectors using an identical part number as inscribed in the old injector.

11. Fasten a new retainer clip onto the fuel injector and install the injector to the fuel rail assembly. Rotate the injector retaining clip to the lock position.
12. Install the fuel rail assembly to the intake manifold. Tighten the attaching bolts to 15 ft. lbs. (20 Nm).
13. Rotate the fuel injectors as necessary to avoid stretching the wire harnesses and connect the injector electrical connections.
14. Connect the vacuum line to the pressure regulator.
15. Apply a few drops of clean engine oil to the male ends of the fuel line quick-connect fittings. Engage the fittings by pushing the connectors together until the retaining tabs snap into place. Pull gently on both sides of each fitting to be sure the connection is secure.
16. Tighten the fuel filler cap and connect the negative battery cable.
17. Turn the ignition **ON** for 2 seconds, **OFF** for 10 seconds, then **ON** again and inspect the system for leaks.

5.7L (VIN J) Engine

See Figures 37 and 38

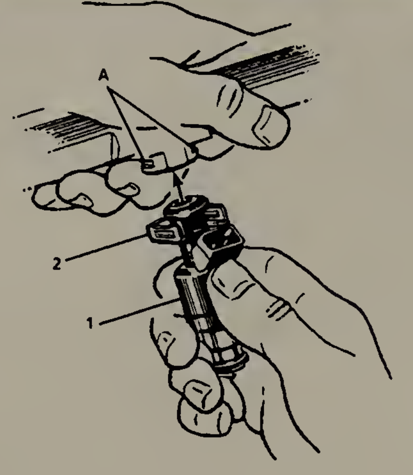
1. Disconnect the negative battery cable and properly relieve fuel system pressure.
2. Drain the cooling system into a suitable container.
3. Remove the intake plenum assembly.
4. If not done already when removing the intake plenum, disconnect the fuel feed and return lines from the fuel rail. Remove and discard the old O-rings from the fittings. Disconnect the vacuum line to the pressure regulator.
5. Unplug the fuel injector wire connectors.
6. Remove the bolts securing the fuel rail to the injector housing.
7. Carefully remove the fuel rails making sure not to damage the injector



- 1 O-RING - FUEL INLET LINE
- 2 O-RING - FUEL RETURN LINE
- 26 CONNECTION ASSEMBLY - FUEL PRESSURE
- 28 CAP - FUEL PRESSURE CONNECTION ASSEMBLY
- 80 INJECTOR ASSEMBLY - FUEL: (P) PRIMARY, (S) SECONDARY
- 84 O-RING - UPPER INJECTOR (BLACK)
- 85 BACKUP - O-RING
- 86 O-RING - LOWER INJECTOR (BROWN)
- 87 CLIP - INJECTOR RETAINER
- 200 RAIL ASSEMBLY - FUEL (LH)
- 201 RAIL ASSEMBLY - FUEL (RH)
- 234 RETAINER - CROSSOVER TUBE
- 241 REGULATOR ASSEMBLY - FUEL PRESSURE
- 268 SEAL - O-RING
- 292 TUBE ASSEMBLY - FUEL INLET AND OUTLET
- 293 TUBE - FUEL RETURN (RH)
- 294 TUBE - FUEL RETURN (LH)
- 295 RETAINER - REGULATOR TUBE
- 296 RETAINER - FUEL INLET TUBE
- 297 SCREW - FUEL RETURN TUBE RETAINER ATTACHING
- 298 SCREW - CROSSOVER TUBE RETAINER ATTACHING
- 299 SCREW - FUEL INLET TUBE RETAINER ATTACHING
- 300 BRACKET - FUEL RAIL MOUNTING
- 301 SCREW - BRACKET ATTACHING

91035G35

Fig. 37 Exploded view of the fuel rail, injectors, pressure regulator and pressure connection valve—5.7L (VIN J) engine



1 INJECTOR ASSEMBLY - FUEL
2 RETAINER CLIP - INJECTOR
A MACHINED SLOTS IN RAIL

91035G36

Fig. 38 Installing the fuel injector on the fuel rail

connector terminals or spray tips. Remove the spacers, if equipped. Note the routing of the vacuum hoses around the fuel rail before removing the rail.

8. Remove the injector retaining clip, then remove the injector.
9. Remove and discard the injector O-ring seals.

To install:

10. Lubricate new injector O-rings with engine oil and install the injector with retaining clip onto fuel rail. Make sure the injector wire connection is facing outward and push the injector onto the rail sufficiently to engage the clip with the machined slots on the rail socket.

➡Each injector is calibrated for a specific flow rate and must be replaced with an identical part number.

11. Install the fuel rail into the injector housing, routing the vacuum lines in their previous positions around the rail.
12. If equipped, be sure the spacers are properly positioned under the rail mounting bracket.
13. Install the fuel rail bolts and tighten to 20 ft. lbs. (26 Nm).
14. Engage the injector electrical connectors, turning the injectors if necessary to avoid stretching the wire harnesses.
15. Install new O-rings to the fuel feed and return pipes.
16. Connect the fuel feed and return lines with the retaining bolts tightened to 13 ft. lbs. (18 Nm). Temporarily connect the negative battery cable and turn the ignition switch **ON** for 2 seconds, then **OFF** for 10 seconds. Cycle the ignition once again to assure proper system pressure, then disconnect the battery negative cable and inspect the fuel system for leaks.
17. Install the plenum assembly. It may be necessary to disconnect the fuel lines for proper installation; if so be sure to relieve the system pressure before disconnecting any fuel fitting.
18. Tighten the fuel filler cap and connect the negative battery terminal.
19. Properly refill the engine cooling system.

TESTING

➧ See Figures 39 and 40

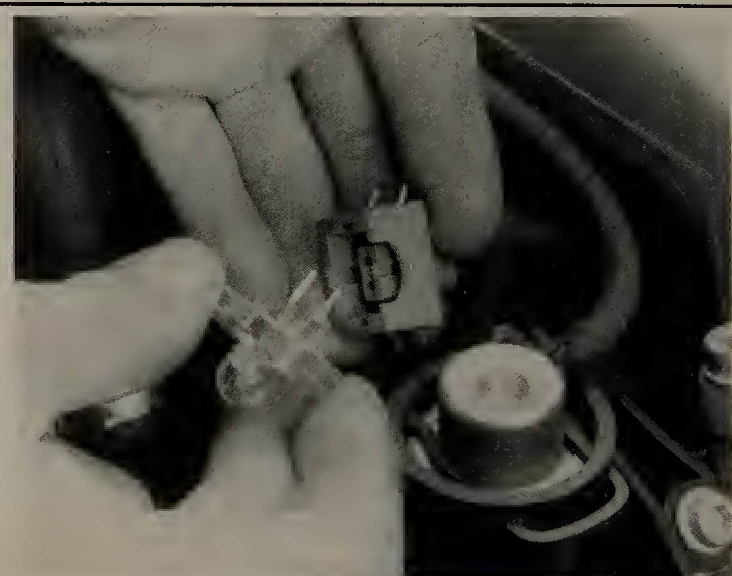
The injectors can be tested by installing a 'noid light', (headlamp bulb may work) into the injector electrical connector, which confirms voltage when the light flashes.

1. Start the engine and listen to each fuel injector individually for a 'clicking' sound.
2. Turn the engine off and disconnect the electrical connector from the injector(s) that did not have a 'clicking' sound.
3. Check the injector for continuity across the terminals. Compare the resistance value to a known good injector. The readings should be similar, if so proceed to the next step. If readings differ greatly, replace the injector.

TCCS5P03

Fig. 39 Fuel injector testers can be purchased or sometimes rented

4. Check between each injector terminal and ground. If continuity exists, replace the injector.
5. Disconnect the fuel injector connector and connect a noid light to the wiring harness connector. Crank the engine, while watching the light. Perform this test on at least two injectors before proceeding. If the light does not flash, check the injector power supply and ground control circuitry. If the light flashes proceed to the next step.
6. If the light flashes, remove the fuel rail from the engine and following the procedure below check the injector operation:
   a. Using mechanic's wire, secure the injector to the fuel rail.
   b. Place a clear plastic container around each injector.



TCCS5P01

Fig. 40 A noid light can be attached to the fuel injector harness in order to test for injector pulse

⁂ CAUTION

Prior to performing this test, all fuel safety precautions must be followed. Make certain the container is approved to handle fuel and is securely positioned around the injector. Do NOT use a glass container. Glass containers can be easily damaged, resulting in a serious fire hazard.

c. With the help of an assistant or using a remote starter button, crank the engine for 15 seconds while observing the injector operation. The injector should produce a cone shaped spray pattern and all containers should retain equal amounts of fuel.

d. Once the cranking test is complete leave the fuel rail pressurized and observe the injectors for leakage.

7. Replace any injector which is leaking or fails to provide a cone shaped spray pattern when energized.

Fuel Rail Assembly

REMOVAL & INSTALLATION

⁂ CAUTION

Observe all applicable safety precautions when working around fuel. Whenever servicing the fuel system, always work in a well ventilated area. Do not allow fuel spray or vapors to come in contact with a spark or open flame. Keep a dry chemical fire extinguisher near the work area. Always keep fuel in a container specifically designed for fuel storage; also, always properly seal fuel containers to avoid the possibility of fire or explosion.

5.7L (VIN 8) Engine

➧ See Figures 41 and 42

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure, as outlined earlier in this section.
3. Remove the intake plenum, as outlined in Section 3 of this manual.

⁂ WARNING

Always use a back-up wrench whenever you remove or install fuel line nuts. This will prevent the fuel lines from twisting, warping and/or weakening.

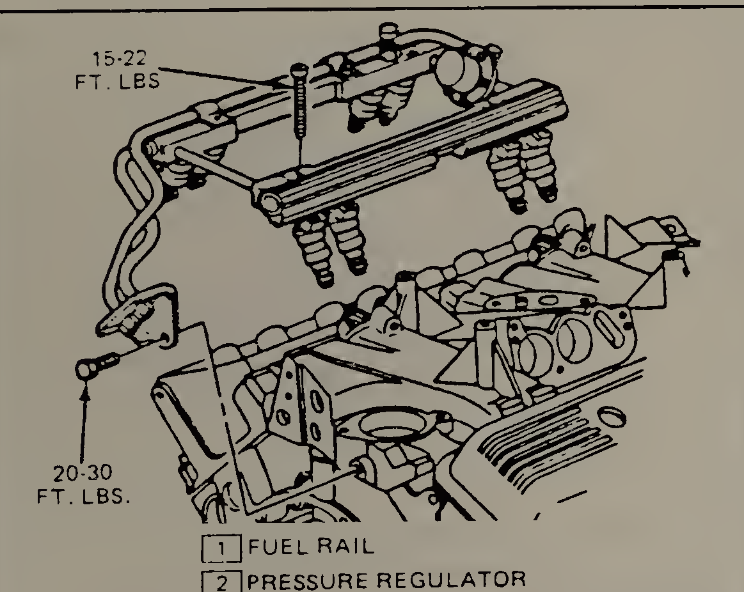
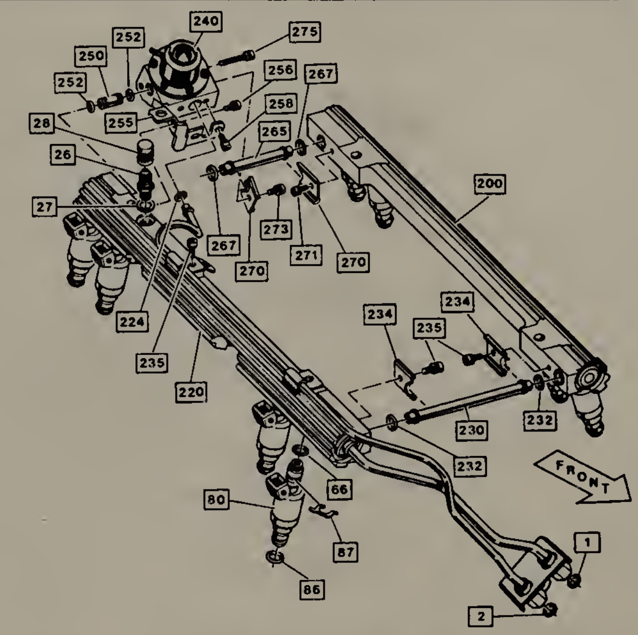


Fig. 41 Fuel rail assembly mounting—5.7L (VIN 8) engine



1	O-ring - Fuel Inlet Line	235	Screw Assembly - Retainer Attaching
2	O-ring - Fuel Return Line	240	Pressure Regulator and Base Assembly
26	Fuel Pressure Connection Assembly	250	Connector - Base to Rail
27	Seal - Fuel Pressure Connection	252	Seal - O-ring - Connector
28	Cap - Fuel Pressure Connection	255	Bracket - Pressure Regulator and Base Assembly
80	MPFI Injector Assembly	256	Screw Assembly - Bracket to Rail Attaching
86	Seal - O-ring - Injector	258	Screw Assembly - Bracket to Base Attaching
87	Clip - Injector Retainer	265	Tube - Rear Crossover
200	Fuel Rail and Plug Assembly (LH	267	Seal - O-ring - Crossover Tube
220	Fuel Rail and Tube Assembly (RH)	270	Retainer - Rear Crossover Tube
224	Seal - O-ring - Fuel Outlet Tube	271	Screw Assembly - Retainer to LH Rail
230	Tube - Front Crossover	273	Screw Assembly - Retainer to Base
232	Seal - O-ring - Front Crossover Tube	275	Screw Assembly - Base to RH Rail
234	Retainer - Crossover Tube		

91035G25

Fig. 42 Exploded view of the fuel rail, injectors and pressure regulator

4. Disconnect the fuel feed and return lines, using a back-up wrench to avoid twisting or warping the fuel lines. Remove and discard the fuel line O-rings.
5. If equipped, disconnect the cold start line, then remove the cold start valve.
6. If equipped, remove the fuel tube bracket bolt.
7. Disconnect the vacuum line from the pressure regulator, then unplug the injector electrical connectors.
8. Loosen the fuel rail retaining bolts, then raise the rail.
9. Remove the intake runners.
10. Remove the fuel rail and injectors.
11. Remove and discard the O-ring seal from the spray tip of each injector.

To install:

12. Lightly coat new injector O-rings with clean engine oil, then install on the spray tip of each injector.
13. Installation is the reverse of the removal procedure. Tighten the attaching bolts as follows:
    a. Fuel rail attaching bolts: 15 ft. lbs. (20 Nm).
    b. Fuel tube bracket bolt: 25 ft. lbs. (34 Nm).
    c. Fuel line nuts: 20 ft. lbs. (27 Nm), using a back-up wrench.

➡When attaching the injector electrical connectors, rotate the injectors as necessary to avoid stretching the wire harness.

14. Connect the negative battery cable, then turn the ignition to the **ON** position and check for fuel leaks.

5.7L (VIN P) Engine

➧ See Figures 43 and 44

1. Disconnect the negative battery cable and properly relieve fuel system pressure.
2. Remove the fuel rail cover(s).
3. Disengage the quick-connect fittings at the fuel rail feed and return pipes as follows:

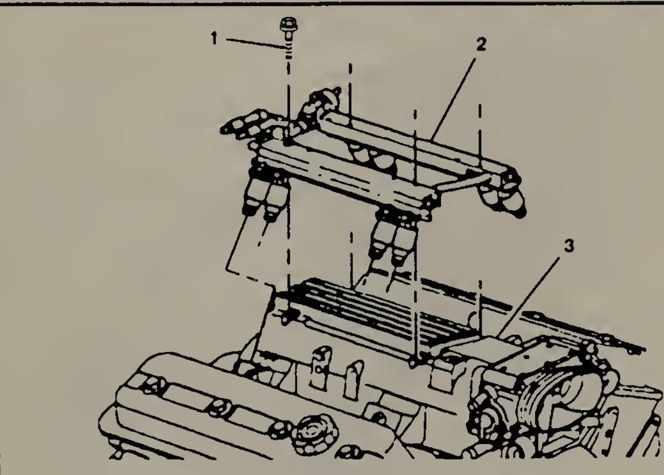


Fig. 43 Fuel rail assembly mounting—5.7L (VIN P and 5) engines

a. Grasp both ends of a connection and twist ¼ turn in each direction to loosen any dirt. Repeat for other fitting.

b. While wearing safety glasses, use compressed air to blow out dirt from the fitting.

c. Insert a fuel line separator tool, into the female connector, then push inward to release the male connector and repeat for the other fitting.

4. Disconnect the vacuum line at the pressure regulator.
5. Tag and unplug the injector electrical connectors.
6. Remove the fuel rail attaching bolts and carefully remove the fuel rail assembly along with the injectors, from the top of the intake.

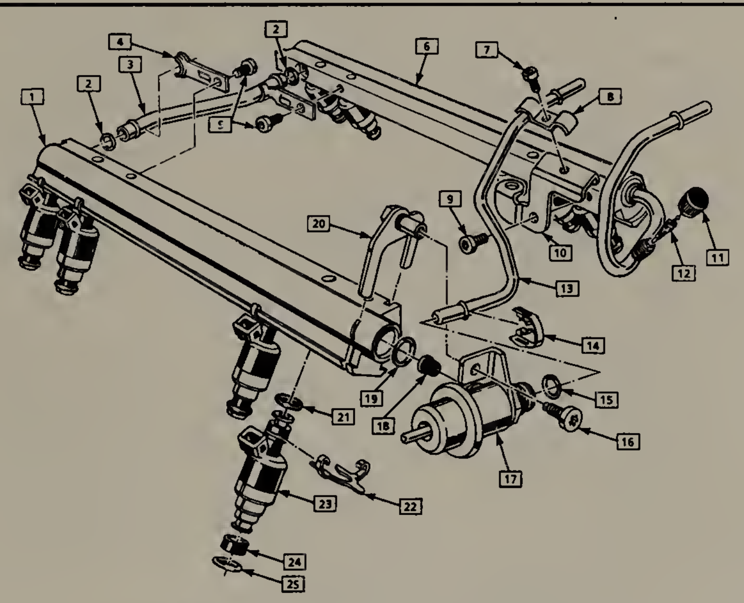


Fig. 44 Exploded view of the fuel rail, injectors, pressure regulator and fuel pressure connection valve—5.7L (VIN P and 5)

➡The fuel injector lower O-ring uses a nylon collar, called the O-ring backup, which properly positions the O-ring on the injector. Make sure you reinstall the back up, or the sealing O-ring may move on the injector when installing the fuel rail and result in a possible vacuum leak.

7. Remove and discard the injector lower (brown) O-rings from the spray tip end of each injector. Make sure to save the O-ring backups.

To install:

8. Lightly lubricate new lower (brown) injector O-rings, then install on the spray tip of each injector.
9. Install the fuel rail assembly to the intake manifold. Tighten the attaching bolts to 15 ft. lbs. (20 Nm) for 1992–93 vehicles or to 89 inch lbs. (10 Nm) for 1994–96 vehicles.
10. Rotate the fuel injectors as necessary to avoid stretching the wire harnesses and connect the injector electrical connections.
11. Connect the vacuum line to the pressure regulator.
12. Apply a few drops of clean engine oil to the male ends of the fuel line quick-connect fittings. Engage the fittings by pushing the connectors together until the retaining tabs snap into place. Pull gently on both sides of each fitting to be sure the connection is secure.
13. Tighten the fuel filler cap and connect the negative battery cable.
14. Turn the ignition **ON** for 2 seconds, **OFF** for 10 seconds, then **ON** again and inspect the system for leaks.

5.7L (VIN J) Engine

➧ See Figures 37 and 45

1. Disconnect the negative battery cable and properly relieve fuel system pressure.
2. Drain the cooling system into a suitable container.
3. Remove the intake plenum assembly.
4. If not done already when removing the intake plenum, disconnect the fuel feed and return lines from the fuel rail. Remove and discard the old O-rings from the fittings. Disconnect the vacuum line to the pressure regulator.
5. Tag and unplug the fuel injector wire connectors.
6. Remove the bolts securing the fuel rail to the injector housing.
7. Carefully remove the fuel rails making sure not to damage the injector connector terminals or spray tips. Remove the spacers, if equipped. Note the routing of the vacuum hoses around the fuel rail before removing the rail.

➡The fuel injector lower O-ring uses a nylon collar, called the O-ring backup, which properly positions the O-ring on the injector. Make sure you reinstall the back up, or the sealing O-ring may move on the injector when installing the fuel rail and result in a possible vacuum leak.

8. Remove and discard the injector lower (brown) O-rings from the spray tip end of each injector. Make sure to save the O-ring backups.

To install:

9. Lightly lubricate new lower (brown) injector O-rings, then install on the spray tip of each injector.

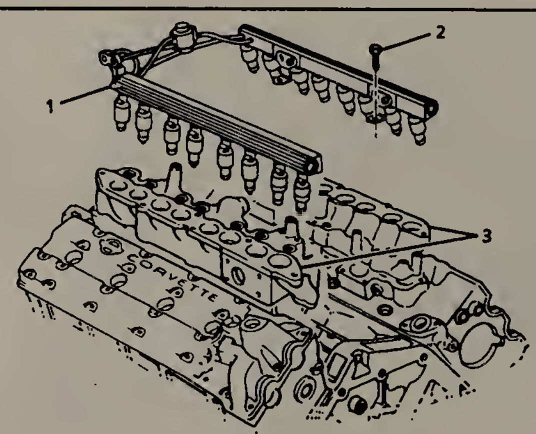


Fig. 45 Exploded view of the fuel rail mounting—5.7L (VIN J) engine

10. Install the fuel rail into the injector housing, routing the vacuum lines in their previous positions around the rail.
11. If equipped, be sure the spacers are properly positioned under the rail mounting bracket.
12. Install the fuel rail bolts and tighten to 20 ft. lbs. (26 Nm).
13. Engage the injector electrical connectors, turning the injectors if necessary to avoid stretching the wire harnesses.
14. Install new O-rings to the fuel feed and return pipes.
15. Connect the fuel feed and return lines with the retaining bolts tightened to 13 ft. lbs. (18 Nm). Temporarily connect the negative battery cable and turn the ignition switch **ON** for 2 seconds, then **OFF** for 10 seconds. Cycle the ignition once again to assure proper system pressure, then disconnect the battery negative cable and inspect the fuel system for leaks.
16. Install the plenum assembly. It may be necessary to disconnect the fuel lines for proper installation; if so be sure to relieve the system pressure before disconnecting any fuel fitting.
17. Tighten the fuel filler cap and connect the negative battery terminal.
18. Properly refill the engine cooling system.

Fuel Pressure Regulator

REMOVAL & INSTALLATION

5.7L (VIN 8) Engine

➧ See Figures 42 and 46

➡The pressure regulator and base are factory adjusted and serviced as a complete assembly only. Do not try to remove the regulator cover.

1985–88 VEHICLES

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Remove the fuel rail from the vehicle, as outlined earlier in this section.
4. Remove the front crossover tube retaining attaching screw and crossover tube retainer from the right hand rail side.
5. Unfasten the retainer-to-base screw assembly and rear crossover tube retaining from the pressure regulator and base assembly.
6. Separate the left hand fuel rail and plug assembly from the right hand fuel rail and plug assembly.
7. Remove the bracket-to-rail attaching screw, 2 bracket-to-base screws and the regulator and base bracket.
8. Unfasten the screw that attaches the fuel outlet tube to the right hand rail.
9. Remove the base-to-right hand rail assembly.
10. Twist the regulator and base assembly to the remove it from the fuel outlet tube.
11. Unplug the base-to-rail connector.

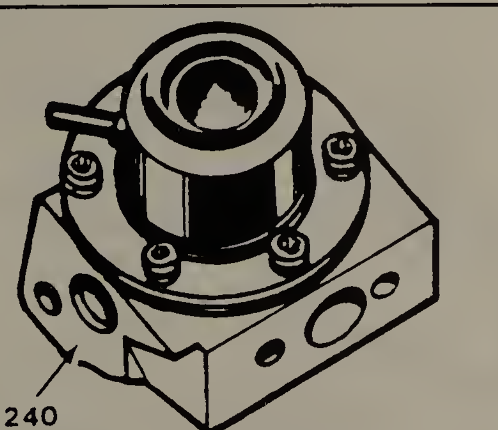


Fig. 46 Typical fuel pressure regulator assembly—5.7L (VIN 8) engine

12. Remove and discard the O-ring seals from the following components, noting the location and sizes of the O-rings to ensure proper placement during installation:
    - Connector
    - Fuel outlet tube
    - Rear crossover tube
    - Front crossover tube
13. Check the O-rings and sealing surfaces for damage that may prevent proper sealing.
14. Installation is the reverse of the removal procedure. Tighten the retaining screws to 44 inch lbs. (5 Nm).
15. Connect the negative battery cable, then turn the ignition to the **ON** position and check for fuel leaks.

1989–91 VEHICLES

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Remove the fuel rail from the vehicle, as outlined earlier in this section.
4. Remove the rear crossover retainer-to-regulator base attaching screw and retainer.
5. Disconnect the rear crossover tube and O-ring from the regulator base. Discard the O-ring.
6. Unfasten the pressure regulator bracket screws, then remove the bracket.
7. Remove the regulator base-to-rail screw.
8. Remvoe the pressure regulator and base assembly. Separate the regulator base from the fuel rail, then disconnect from the fuel outlet tube.
9. Remove and discard the fuel outlet tube O-ring.
10. Detach the base-to-rail connector. Remove and discard the O-rings.
11. Installation is the reverse of the removal procedure. Tighten the retaining screws to 44 inch lbs. (5 Nm).
12. Connect the negative battery cable, then turn the ignition to the **ON** position and check for fuel leaks.

5.7L (VIN P and 5) Engines

➧ See Figure 44

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Remove the left fuel rail cover from the vehicle.
4. Disconnect the pressure regulator vacuum line.
5. Remove the fuel outlet tube retainer clip, then disconnect the fuel outlet tube from the pressure regulator.
6. Unfasten the pressure regulator attaching screw, then remove the regulator from the fuel rail.
7. Remove and discard the pressure regulator inlet O-ring and the fuel outlet tube O-ring.
8. Chech the filter screen for contamination and replace if dirty.

To install:

9. Lubricate new O-rings with clean engine oil, then install on the pressure regulator and fuel outlet tube.
10. Push the pressure regulator into the fuel rail.
11. Install the pressure regulator attaching screw and tighten to 89 inch lbs.
12. Install the fuel outlet tube into the regulator, then secure with the retaining clip. Tighten the tube retainer screw to 44 inch lbs. (5 Nm).
13. Connect the vacuum line to the regulator.
14. Tighten the fuel filler cap, then connect the negative battery cable.
15. Turn the ignition **ON** for 2 seconds, **OFF** for 10 seconds, then **ON** again and inspect the system for leaks.
16. Install the left fuel rail cover.

5.7L (VIN J) Engine

➧ See Figure 37

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Remove the intake plenum and fuel rail assembly.
4. Remove and discard the O-ring seals from the injector housings.

➡To remove the pressure regulator, you must remove the left hand fuel rail and left hand fuel return tube. The fuel inlet and outlet tube can stay attached to the right hand fuel rail.

5. Remove the crossover tube retaining screw and retainer from the left hand rail.
6. Remove the left hand fuel rail assembly.
7. Remove the left hand fuel return tube retainer attaching screw.
8. Remove the left hand fuel return tube.
9. Remove the fuel inlet tube retainer attaching screw and retainer from the regulator base.
10. Remove the fuel return tube retainer attaching screw (right hand side) and tube retainer.
11. Remove the pressure regulator assembly. Remove and discard the O-rings from the fuel tubes.

To install:

CAUTION

To reduce the chance of fire and/or personal injury, do NOT tighten the crossover tube retainer attaching screws until left hand fuel rail has been installed. Failure to do so could cause damage to the O-ring seals or inlet/outlet tube, causing a fuel leak.

12. Lubricate new O-rings with clean engine oil, then install on the fuel tubes.
13. Install the pressure regulator assembly to the right hand fuel return tube and fuel outlet tube.
14. Install the regulator tube retainer and fuel return tube retainer attaching screw (right side). Finger tighten the attaching screw.
15. Install the fuel inlet tube retainer and attaching screw to the regulator, then finger tighten the screw.
16. Attach the left hand fuel return tube to the regulator base.
17. Install the left hand fuel return tube retainer attaching screw and finger tighten the screw.
18. Instal the left hand fuel tail assembly.
19. Instlal the crossover tube and attaching screw.

➡When tighten the fuel inlet tube retainer screw, hold the pressure regulator and fuel inlet tube retainer in place to avoid side loading the regulator/fuel tube O-rings and inlet/outlet tube assembly.

20. Tighten the fuel inlet tube retainer attaching screws to 44 inch lbs. (5 Nm). Tighten the remaining retainer attaching screw to 44 inch lbs. (5 Nm).
21. Lubricate new injector housing O-ring seals with clean engine oil, then install.
22. Instlal the fuel rail, then connect the negative battery cable.
23. Turn the ignition **ON** for 2 seconds, **OFF** for 10 seconds, then **ON** again and inspect the system for leaks. Disconnect the negative battery cable.
24. Instal the intake plenum, tighten the fuel filler cap, then connect the negative battery cable.

Pressure Relief Valve

REMOVAL & INSTALLATION

➧ See Figures 44 and 47

1. Clean the area around the fuel pressure connection with a suitable spray cleaner.
2. Disconnect the negative battery cable.
3. Properly relieve the fuel system pressure, as outlined earlier in this section.
4. Remove the fuel pressure connection valve and seal. Discard the seal.

To install:

5. Install a new seal on the fuel pressure connection.
6. Position the fuel pressure connection in the fuel rail and tighten securely. For 5.7L (VIN 8) engines, tighten the valve to 88 inch lbs. (10 Nm) for 1985–88 vehicles, or to 115 inch lbs. (13 Nm) for 1989–91 vehicles.
7. Tighten the fuel filler cap.
8. Connect the negative battery cable. With the engine **OFF**, turn the ignition to the **ON** position and check for fuel leaks.

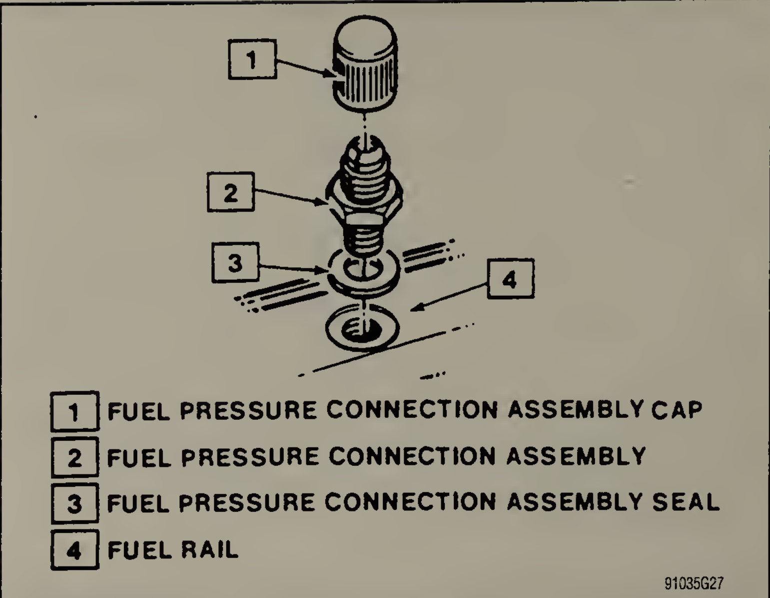


Fig. 47 Exploded view of the fuel pressure connection assembly—5.7L (VIN 8) engine

Cold Start Tube and Valve Assembly

REMOVAL & INSTALLATION

5.7L (VIN 8) Engines

1985–88 VEHICLES

➧ See Figure 48

1. Disconnect the negative battery cable.
2. Properly relieve the fuel system pressure, as outlined earlier in this section.
3. Remove the intake plenum, as outlined in Section 3 of this manual.
4. Disconnect the brake booster line.
5. Remove the tube and body assembly at the fitting on the fuel rail.
6. Detach the electrical connector from the cold start valve.
7. Disconnect the PCV hose.
8. Unfasten the cold start valve retaining bolt, then remove the valve from the fuel rail and intake manifold.
9. If necessary, disassemble as follows:
   a. Raise the tab on the tube body to clear the electrical connector and unscrew the coid start valve.

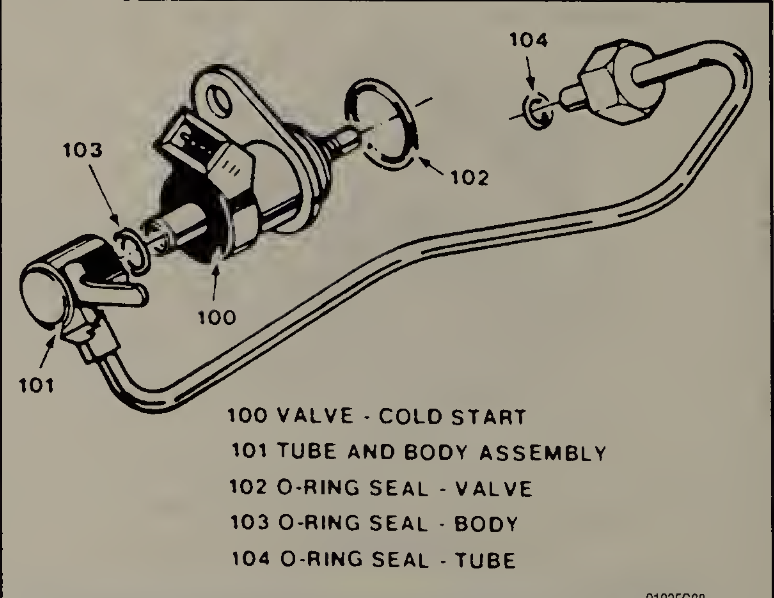


Fig. 48 The cold start valve is used on 1985–88 vehicles with the 5.7L (VIN 8) engine

b. Remove and discard the O-ring seals from the tube and body assembly, cold start valve and fuel rail fitting.

To install:

10. If disassembled, perform the following:
a. Lightly lubricate new O-ring seals with clean engine oil and install onto the end of the cold start valve, inside the body of the tube and body assembly, and up against the collar to the tube and body assembly.
b. Install the cold start valve onto the tube and body assembly. Screw the valve in until it bottoms, then back off until the hole in the mounting lug on the valve will be aligned properly with the hole in the fuel rail when mounted.
c. Bend the tang over the valve to lock it in place.
d. Clean the areas around the vale and connection.

11. Position the cold start valve into the intake manifold. Install the retaining bolt and tighten to 20 ft. lbs. (27 Nm).
12. Connect the PCV hose.
13. Install the tube and body to the fitting on the fuel rail. Tighten the nut on the fitting to 20 ft. lbs. (27 Nm).
14. Connect the brake booster line, then attach the electrical connector to the cold start valve.
15. Connect the negative battery cable, then with the engine **OFF**, turn the ignition to the **ON** position and check for fuel leaks. Disconnect the negative battery cable.
16. Install the intake plenum, then connect the negative battery cable.

FUEL TANK

Tank Assembly

REMOVAL & INSTALLATION

See Figures 49, 50 and 51

Ensure an approved dry chemical (Class B) fire extinguisher is near the work area. For safety, additional vehicle supports should be added to the end of the vehicle opposite the work area to keep the vehicle stable on the lift.

1. Disconnect the negative battery cable and properly relieve fuel system pressure.
2. Drain the fuel tank into an approved container using a hand-operated fuel pump.
3. Remove the 4 screws attaching the fuel door bezel, then remove the bezel and the filler cap.
4. Lift the filler neck housing and disconnect the drain hose from the nipple.
5. Reinstall the filler cap to prevent dirt from entering and remove the filler neck housing.

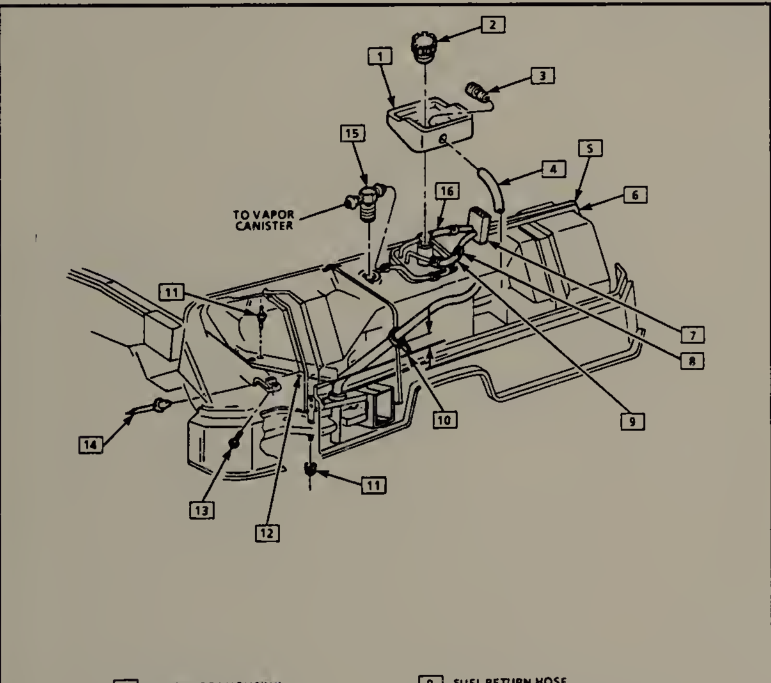


Fig. 49 Typical fuel tank replacement

6. Unplug the fuel sender electrical connector at the tank.
7. Thoroughly clean the surrounding areas to prevent fuel system contamination, then disconnect the fuel hoses from the sender assembly.
8. Remove the license plate and all rear lamps to provide access, then remove the carriage bolts securing the fascia to the impact bar.
9. Raise and support the vehicle safely.
10. Remove the spare tire and tire carrier from the frame.
11. With the aid of an assistant, remove the mufflers as an assembly from the converter.
12. Remove the canister splash shield, if equipped, and both rear inner fender braces at the frame.
13. Remove both rear wheel house liner panels.
14. Remove the antenna ground strap and clip at the antenna base and frame.
15. Disconnect the fuel vapor pipes from the canister or the bottom of the tank, then remove the canister.
16. Remove both fuel tank cables from the stabilizer shaft supports.
17. Remove the 2 bottom fascia-to-energy absorbing pad attaching screws.
18. Remove the marker lamps and spare tire light.
19. Remove the 4 nuts attaching each side of the fascia to the horizontal body retainer. Then remove the 5 nuts securing each side of the outer body retainer to the fascia.
20. Remove 6 side impact bar bolts and loosen the front 2 bolts, 1 on each side. With the aid of an assistant, support the impact bar, and remove the front bar bolts. Remove the impact bar and fuel tank assembly, then separate the fuel tank.
21. If the tank is being replaced, transfer the cables, vapor connections and hoses, fuel sender assembly, and/or fuel connector, as required and applicable.

To install:

22. Install the fuel tank to the impact bar assembly and tighten the strap bolts to 11 ft. lbs. (15 Nm) and the strap nuts to 40 inch lbs. (4.5 Nm). Install

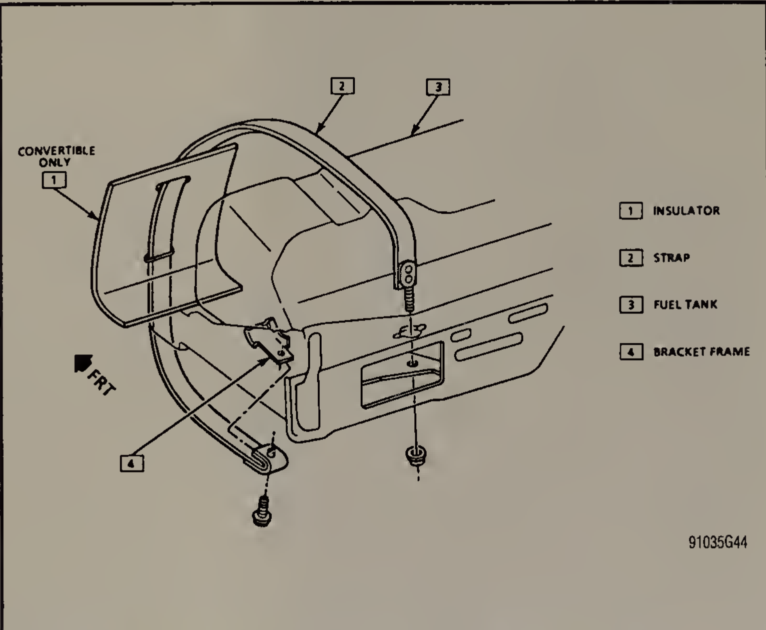


Fig. 50 View of the fuel tank insulator used on convertibles

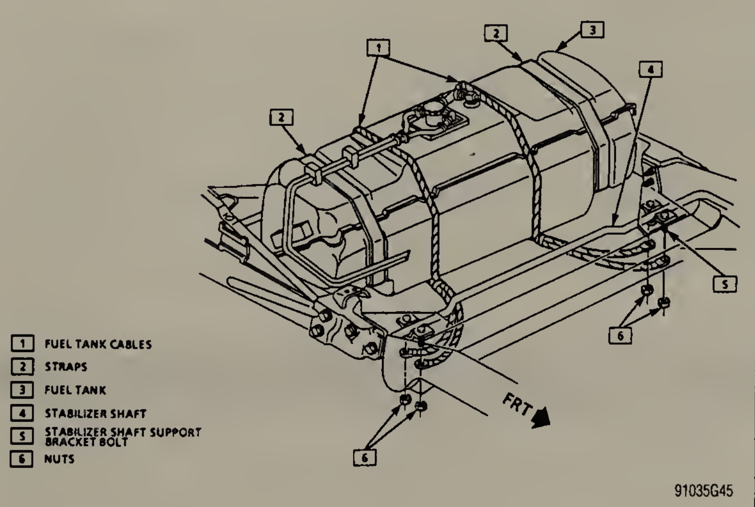


Fig. 51 Fuel tank cable routing

the impact bar assembly to the vehicle and tighten the 8 bolts to 37 ft. lbs. (50 Nm).

23. Install rear and side fascia to the body retainer using the attaching nuts. Tighten the nuts to 53 inch lbs. (6 Nm).
24. Install the marker lights and the spare tire light sockets.
25. Attach screws to the edge of the fascia and impact bar.
26. Attach the fuel tank cables to the stabilizer shaft supports. Tighten the cable attaching nuts to 18 ft. lbs. (25 Nm).
27. Install the 2 carriage bolts securing the fascia to the impact bar, then install the antenna ground strap and clip.
28. Install both inner fender panels, then the braces to the frame.
29. Connect the vapor hoses to the canister or the bottom of the tank, then install the canister and, if equipped, the canister splash shield.
30. With the aid of an assistant, install the muffler assembly to the rear of the converter.
31. Install the spare tire and carrier to the frame.
32. Lower the vehicle and install all rear lamps.
33. Install the license plate.
34. Connect all lines and electrical connections to the fuel sender assembly.
35. Refill the fuel tank, tighten the fuel filler cap and connect the negative battery cable.
36. Turn the ignition **ON** for 2 seconds, **OFF** for 10 seconds, then **ON** again and inspect the system for leaks.
37. Install the drain hose, seal and fuel filler door bezel.

6

CHASSIS ELECTRICAL

UNDERSTANDING AND TROUBLESHOOTING ELECTRICAL SYSTEMS

Basic Electrical Theory

See Figure 1

For any 12 volt, negative ground, electrical system to operate, the electricity must travel in a complete circuit. This simply means that current (power) from the positive (+) terminal of the battery must eventually return to the negative (ñ) terminal of the battery. Along the way, this current will travel through wires, fuses, switches and components. If, for any reason, the flow of current through the circuit is interrupted, the component fed by that circuit will cease to function properly.

Perhaps the easiest way to visualize a circuit is to think of connecting a light bulb (with two wires attached to it) to the battery—one wire attached to the negative (ñ) terminal of the battery and the other wire to the positive (+) terminal. With the two wires touching the battery terminals, the circuit would be complete and the light bulb would illuminate. Electricity would follow a path from the battery to the bulb and back to the battery. It's easy to see that with longer wires on our light bulb, it could be mounted anywhere. Further, one wire could be fitted with a switch so that the light could be turned on and off.

The normal automotive circuit differs from this simple example in two ways. First, instead of having a return wire from the bulb to the battery, the current travels through the frame of the vehicle. Since the negative (–) battery cable is attached to the frame (made of electrically conductive metal), the frame of the vehicle can serve as a ground wire to complete the circuit. Secondly, most automotive circuits contain multiple components which receive power from a single circuit. This lessens the amount of wire needed to power components on the vehicle.

HOW DOES ELECTRICITY WORK: THE WATER ANALOGY

Electricity is the flow of electrons—the subatomic particles that constitute the outer shell of an atom. Electrons spin in an orbit around the center core of an atom. The center core is comprised of protons (positive charge) and neutrons (neutral charge). Electrons have a negative charge and balance out the positive charge of the protons. When an outside force causes the number of electrons to unbalance the charge of the protons, the electrons will split off the atom and look for another atom to balance out. If this imbalance is kept up, electrons will continue to move and an electrical flow will exist.

Many people have been taught electrical theory using an analogy with water. In a comparison with water flowing through a pipe, the electrons would be the water and the wire is the pipe.

The flow of electricity can be measured much like the flow of water through a pipe. The unit of measurement used is amperes, frequently abbreviated as amps (a). You can compare amperage to the volume of water flowing through a pipe. When connected to a circuit, an ammeter will measure the actual amount of current flowing through the circuit. When relatively few electrons flow through a circuit, the amperage is low. When many electrons flow, the amperage is high.

Water pressure is measured in units such as pounds per square inch (psi); The electrical pressure is measured in units called volts (v). When a voltmeter is connected to a circuit, it is measuring the electrical pressure.

The actual flow of electricity depends not only on voltage and amperage, but also on the resistance of the circuit. The higher the resistance, the higher the force necessary to push the current through the circuit. The standard unit for measuring resistance is an ohm. Resistance in a circuit varies depending on the amount and type of components used in the circuit. The main factors which determine resistance are:

- Material—some materials have more resistance than others. Those with high resistance are said to be insulators. Rubber materials (or rubber-like plastics) are some of the most common insulators used in vehicles as they have a very high resistance to electricity. Very low resistance materials are said to be conductors. Copper wire is among the best conductors. Silver is actually a superior conductor to copper and is used in some relay contacts, but its high cost prohibits its use as common wiring. Most automotive wiring is made of copper.
- Size—the larger the wire size being used, the less resistance the wire will have. This is why components which use large amounts of electricity usually have large wires supplying current to them.
- Length—for a given thickness of wire, the longer the wire, the greater the resistance. The shorter the wire, the less the resistance. When determining the proper wire for a circuit, both size and length must be considered to design a circuit that can handle the current needs of the component.
- Temperature—with many materials, the higher the temperature, the greater the resistance (positive temperature coefficient). Some materials exhibit the opposite trait of lower resistance with higher temperatures (negative temperature coefficient). These principles are used in many of the sensors on the engine.

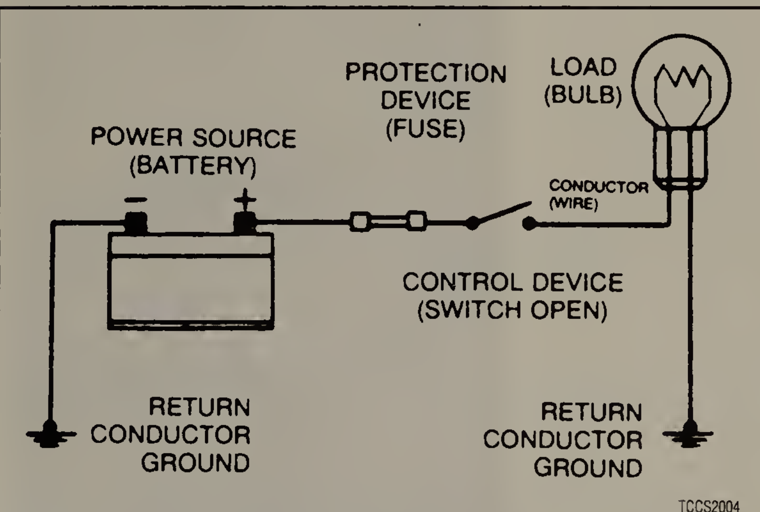


Fig. 1 This example illustrates a simple circuit. When the switch is closed, power from the positive (+) battery terminal flows through the fuse and the switch, and then to the light bulb. The light illuminates and the circuit is completed through the ground wire back to the negative (ñ) battery terminal. In reality, the two ground points shown in the illustration are attached to the metal frame of the vehicle, which completes the circuit back to the battery

OHM'S LAW

There is a direct relationship between current, voltage and resistance. The relationship between current, voltage and resistance can be summed up by a statement known as Ohm's law.

Voltage (E) is equal to amperage (I) times resistance (R): E=I x R

Other forms of the formula are R=E/I and I=E/R

In each of these formulas, E is the voltage in volts, I is the current in amps and R is the resistance in ohms. The basic point to remember is that as the resistance of a circuit goes up, the amount of current that flows in the circuit will go down, if voltage remains the same.

The amount of work that the electricity can perform is expressed as power. The unit of power is the watt (w). The relationship between power, voltage and current is expressed as:

Power (w) is equal to amperage (I) times voltage (E): W=I x E

This is only true for direct current (DC) circuits; The alternating current formula is a tad different, but since the electrical circuits in most vehicles are DC type, we need not get into AC circuit theory.

Electrical Components

POWER SOURCE

Power is supplied to the vehicle by two devices: The battery and the alternator. The battery supplies electrical power during starting or during periods when the current demand of the vehicleís electrical system exceeds the output capacity of the alternator. The alternator supplies electrical current when the engine is running. Just not does the alternator supply the current needs of the vehicle, but it recharges the battery.

The Battery

In most modern vehicles, the battery is a lead/acid electrochemical device consisting of six 2 volt subsections (cells) connected in series, so that the unit is capable of producing approximately 12 volts of electrical pressure. Each subsection consists of a series of positive and negative plates held a short distance apart in a solution of sulfuric acid and water.

The two types of plates are of dissimilar metals. This sets up a chemical reaction, and it is this reaction which produces current flow from the battery when its positive and negative terminals are connected to an electrical load. The power removed from the battery is replaced by the alternator, restoring the battery to its original chemical state.

The Alternator

On some vehicles there isn't an alternator, but a generator. The difference is that an alternator supplies alternating current which is then changed to direct current for use on the vehicle, while a generator produces direct current. Alternators tend to be more efficient and that is why they are used.

Alternators and generators are devices that consist of coils of wires wound together making big electromagnets. One group of coils spins within another set and the interaction of the magnetic fields causes a current to flow. This current is then drawn off the coils and fed into the vehicles electrical system.

GROUND

Two types of grounds are used in automotive electric circuits. Direct ground components are grounded to the frame through their mounting points. All other components use some sort of ground wire which is attached to the frame or chassis of the vehicle. The electrical current runs through the chassis of the vehicle and returns to the battery through the ground (–) cable; if you look, you'll see that the battery ground cable connects between the battery and the frame or chassis of the vehicle.

➡It should be noted that a good percentage of electrical problems can be traced to bad grounds.

PROTECTIVE DEVICES

➧ See Figure 2

It is possible for large surges of current to pass through the electrical system of your vehicle. If this surge of current were to reach the load in the circuit, the surge could burn it out or severely damage it. It can also overload the wiring, causing the harness to get hot and melt the insulation. To prevent this, fuses, circuit breakers and/or fusible links are connected into the supply wires of the electrical system. These items are nothing more than a built-in weak spot in the system. When an abnormal amount of current flows through the system, these protective devices work as follows to protect the circuit:

- Fuse—when an excessive electrical current passes through a fuse, the fuse "blows" (the conductor melts) and opens the circuit, preventing the passage of current.
- Circuit Breaker—a circuit breaker is basically a self-repairing fuse. It will open the circuit in the same fashion as a fuse, but when the surge subsides, the circuit breaker can be reset and does not need replacement.
- Fusible Link—a fusible link (fuse link or main link) is a short length of special, high temperature insulated wire that acts as a fuse. When an excessive electrical current passes through a fusible link, the thin gauge wire inside the link melts, creating an intentional open to protect the circuit. To repair the circuit, the link must be replaced. Some newer type fusible links are housed in plug-in modules, which are simply replaced like a fuse, while older type fusible links must be cut and spliced if they melt. Since this link is very early in the electrical path, it's the first place to look if nothing on the vehicle works, yet the battery seems to be charged and is properly connected.

⁂ CAUTION

Always replace fuses, circuit breakers and fusible links with identically rated components. Under no circumstances should a component of higher or lower amperage rating be substituted.

SWITCHES & RELAYS

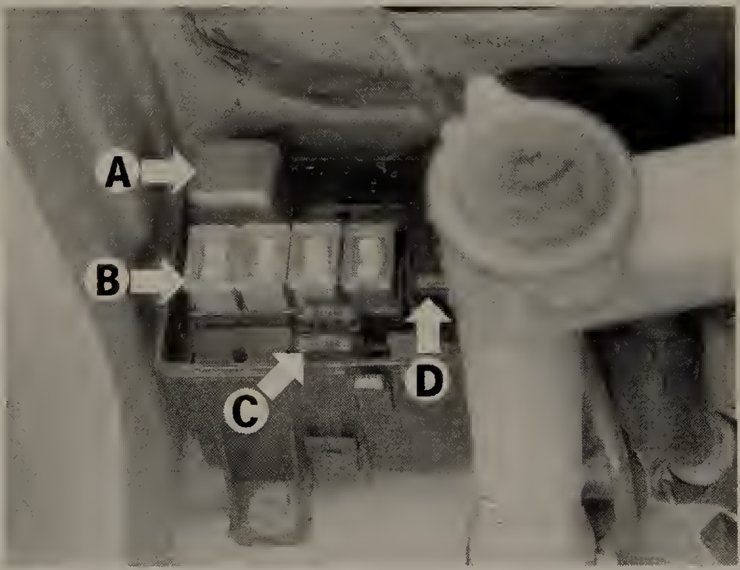
➧ See Figures 3 and 4

Switches are used in electrical circuits to control the passage of current. The most common use is to open and close circuits between the battery and the various electric devices in the system. Switches are rated according to the amount of amperage they can handle. If a sufficient amperage rated switch is not used in a circuit, the switch could overload and cause damage.

Some electrical components which require a large amount of current to operate use a special switch called a relay. Since these circuits carry a large amount of current, the thickness of the wire in the circuit is also greater. If this large wire were connected from the load to the control switch, the switch would have to carry the high amperage load and the fairing or dash would be twice as large to accommodate the increased size of the wiring harness. To prevent these problems, a relay is used.

TCCA6P01

Fig. 2 Most vehicles use one or more fuse panels. This one is located on the driver's side kick panel



A. Relay
B. Fusible link
C. Fuse
D. Flasher

TCCA6P02

Fig. 3 The underhood fuse and relay panel usually contains fuses, relays, flashers and fusible links

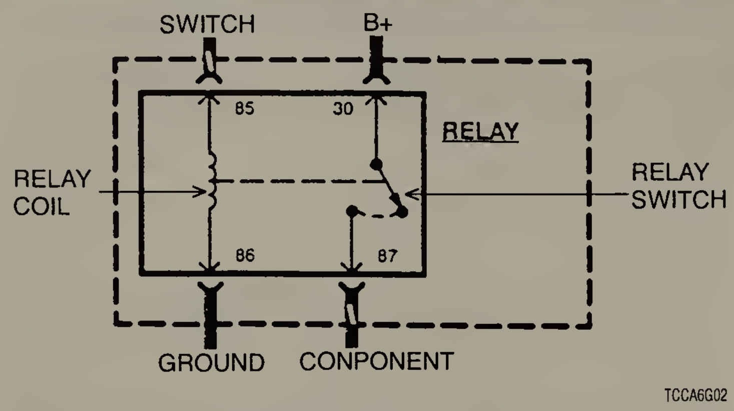


Fig. 4 Relays are composed of a coil and a switch. These two components are linked together so that when one operates, the other operates at the same time. The large wires in the circuit are connected from the battery to one side of the relay switch (B+) and from the opposite side of the relay switch to the load (component). Smaller wires are connected from the relay coil to the control switch for the circuit and from the opposite side of the relay coil to ground

Relays are composed of a coil and a set of contacts. When the coil has a current passed though it, a magnetic field is formed and this field causes the contacts to move together, completing the circuit. Most relays are normally open, preventing current from passing through the circuit, but they can take any electrical form depending on the job they are intended to do. Relays can be considered "remote control switches." They allow a smaller current to operate devices that require higher amperages. When a small current operates the coil, a larger current is allowed to pass by the contacts. Some common circuits which may use relays are the horn, headlights, starter, electric fuel pump and other high draw circuits.

LOAD

Every electrical circuit must include a "load" (something to use the electricity coming from the source). Without this load, the battery would attempt to deliver its entire power supply from one pole to another. This is called a "short circuit." All this electricity would take a short cut to ground and cause a great amount of damage to other components in the circuit by developing a tremendous amount of heat. This condition could develop sufficient heat to melt the insulation on all the surrounding wires and reduce a multiple wire cable to a lump of plastic and copper.

WIRING & HARNESSES

The average vehicle contains meters and meters of wiring, with hundreds of individual connections. To protect the many wires from damage and to keep them from becoming a confusing tangle, they are organized into bundles, enclosed in plastic or taped together and called wiring harnesses. Different harnesses serve different parts of the vehicle. Individual wires are color coded to help trace them through a harness where sections are hidden from view.

Automotive wiring or circuit conductors can be either single strand wire, multi-strand wire or printed circuitry. Single strand wire has a solid metal core and is usually used inside such components as alternators, motors, relays and other devices. Multi-strand wire has a core made of many small strands of wire twisted together into a single conductor. Most of the wiring in an automotive electrical system is made up of multi-strand wire, either as a single conductor or grouped together in a harness. All wiring is color coded on the insulator, either as a solid color or as a colored wire with an identification stripe. A printed circuit is a thin film of copper or other conductor that is printed on an insulator backing. Occasionally, a printed circuit is sandwiched between two sheets of plastic for more protection and flexibility. A complete printed circuit, consisting of conductors, insulating material and connectors for lamps or other components is called a printed circuit board. Printed circuitry is used in place of individual wires or harnesses in places where space is limited, such as behind instrument panels.

Since automotive electrical systems are very sensitive to changes in resistance, the selection of properly sized wires is critical when systems are repaired. A loose or corroded connection or a replacement wire that is too small for the circuit will add extra resistance and an additional voltage drop to the circuit.

The wire gauge number is an expression of the cross-section area of the conductor. Vehicles from countries that use the metric system will typically describe the wire size as its cross-sectional area in square millimeters. In this method, the larger the wire, the greater the number. Another common system for expressing wire size is the American Wire Gauge (AWG) system. As gauge number increases, area decreases and the wire becomes smaller. An 18 gauge wire is smaller than a 4 gauge wire. A wire with a higher gauge number will carry less current than a wire with a lower gauge number. Gauge wire size refers to the size of the strands of the conductor, not the size of the complete wire with insulator. It is possible, therefore, to have two wires of the same gauge with different diameters because one may have thicker insulation than the other.

It is essential to understand how a circuit works before trying to figure out why it doesn't. An electrical schematic shows the electrical current paths when a circuit is operating properly. Schematics break the entire electrical system down into individual circuits. In a schematic, usually no attempt is made to represent wiring and components as they physically appear on the vehicle; switches and other components are shown as simply as possible. Face views of harness connectors show the cavity or terminal locations in all multi-pin connectors to help locate test points.

CONNECTORS

See Figures 5 and 6

Three types of connectors are commonly used in automotive applications—weatherproof, molded and hard shell.

- Weatherproof—these connectors are most commonly used where the connector is exposed to the elements. Terminals are protected against moisture and dirt by sealing rings which provide a weathertight seal. All repairs require the use of a special terminal and the tool required to service it. Unlike standard blade type terminals, these weatherproof terminals cannot be straightened once they are bent. Make certain that the connectors are properly seated and all of the sealing rings are in place when connecting leads.
- Molded—these connectors require complete replacement of the connector if found to be defective. This means splicing a new connector assembly into the harness. All splices should be soldered to insure proper contact. Use care when probing the connections or replacing terminals in them, as it is possible to create a short circuit between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking and NEVER probe through weatherproof seals.
- Hard Shell—unlike molded connectors, the terminal contacts in hard-shell connectors can be replaced. Replacement usually involves the use of a special terminal removal tool that depresses the locking tangs (barbs) on the connector terminal and allows the connector to be removed from the rear of the shell. The connector shell should be replaced if it shows any evidence of burning, melting, cracks, or breaks. Replace individual terminals that are burnt, corroded, distorted or loose.

Test Equipment

Pinpointing the exact cause of trouble in an electrical circuit is most times accomplished by the use of special test equipment. The following describes different types of commonly used test equipment and briefly explains how to use them in diagnosis. In addition to the information covered below, the tool manufacturer's instructions booklet (provided with the tester) should be read and clearly understood before attempting any test procedures.

JUMPER WIRES

CAUTION

Never use jumper wires made from a thinner gauge wire than the circuit being tested. If the jumper wire is of too small a gauge, it may overheat and possibly melt. Never use jumpers to bypass high resistance loads in a circuit. Bypassing resistances, in effect, creates a short circuit. This may, in turn, cause damage and fire. Jumper wires should only be used to bypass lengths of wire or to simulate switches.

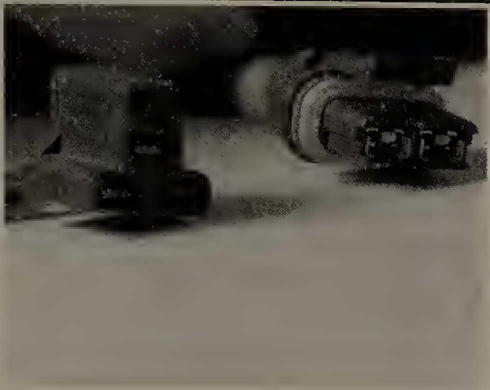

TCCA6P03

Fig. 5 Hard shell (left) and weatherproof (right) connectors have replaceable terminals


TCCA6P04

Fig. 6 Weatherproof connectors are most commonly used in the engine compartment or where the connector is exposed to the elements

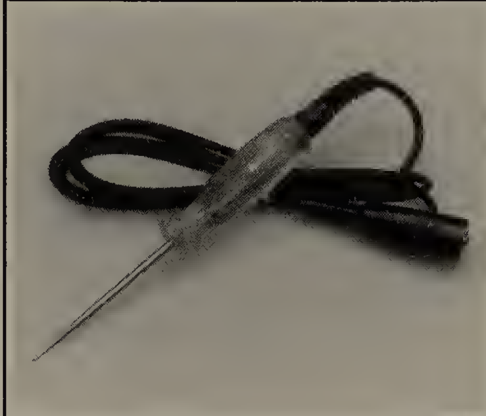

TCCS2006

Fig. 7 A 12 volt test light is used to detect the presence of voltage in a circuit

Jumper wires are simple, yet extremely valuable, pieces of test equipment. They are basically test wires which are used to bypass sections of a circuit. Although jumper wires can be purchased, they are usually fabricated from lengths of standard automotive wire and whatever type of connector (alligator clip, spade connector or pin connector) that is required for the particular application being tested. In cramped, hard-to-reach areas, it is advisable to have insulated boots over the jumper wire terminals in order to prevent accidental grounding. It is also advisable to include a standard automotive fuse in any jumper wire. This is commonly referred to as a "fused jumper". By inserting an in-line fuse holder between a set of test leads, a fused jumper wire can be used for bypassing open circuits. Use a 5 amp fuse to provide protection against voltage spikes.

Jumper wires are used primarily to locate open electrical circuits, on either the ground (–) side of the circuit or on the power (+) side. If an electrical component fails to operate, connect the jumper wire between the component and a good ground. If the component operates only with the jumper installed, the ground circuit is open. If the ground circuit is good, but the component does not operate, the circuit between the power feed and component may be open. By moving the jumper wire successively back from the component toward the power source, you can isolate the area of the circuit where the open is located. When the component stops functioning, or the power is cut off, the open is in the segment of wire between the jumper and the point previously tested.

You can sometimes connect the jumper wire directly from the battery to the "hot" terminal of the component, but first make sure the component uses 12 volts in operation. Some electrical components, such as fuel injectors or sensors, are designed to operate on about 4 to 5 volts, and running 12 volts directly to these components will cause damage.

TEST LIGHTS

▶ See Figure 7

The test light is used to check circuits and components while electrical current is flowing through them. It is used for voltage and ground tests. To use a 12 volt test light, connect the ground clip to a good ground and probe wherever necessary with the pick. The test light will illuminate when voltage is detected. This does not necessarily mean that 12 volts (or any particular amount of voltage) is present, it only means that some voltage is present. It is advisable before using the test light to touch its ground clip and probe across the battery posts or terminals to make sure the light is operating properly.

⁂ WARNING

Do not use a test light to probe electronic ignition, spark plug or coil wires. Never use a pick-type test light to probe wiring on computer controlled systems unless specifically instructed to do so. Any wire insulation that is pierced by the test light probe should be taped and sealed with silicone after testing.

Like the jumper wire, the 12 volt test light is used to isolate opens in circuits. But, whereas the jumper wire is used to bypass the open to operate the load, the 12 volt test light is used to locate the presence of voltage in a circuit. If the test light illuminates, there is power up to that point in the circuit; if the test light does not illuminate, there is an open circuit (no power). Move the test light in successive steps back toward the power source until the light in the handle illuminates. The open is between the probe and a point which was previously probed.

The self-powered test light is similar in design to the 12 volt test light, but contains a 1.5 volt penlight battery in the handle. It is most often used in place of a multimeter to check for open or short circuits when power is isolated from the circuit (continuity test).

The battery in a self-powered test light does not provide much current. A weak battery may not provide enough power to illuminate the test light even when a complete circuit is made (especially if there is high resistance in the circuit). Always make sure that the test battery is strong. To check the battery, briefly touch the ground clip to the probe; if the light glows brightly, the battery is strong enough for testing.

➡A self-powered test light should not be used on any computer controlled system or component. The small amount of electricity transmitted by the test light is enough to damage many electronic automotive components.

MULTIMETERS

Multimeters are an extremely useful tool for troubleshooting electrical problems. They can be purchased in either analog or digital form and have a price range to suit any budget. A multimeter is a voltmeter, ammeter and ohmmeter (along with other features) combined into one instrument. It is often used when testing solid state circuits because of its high input impedance (usually 10 megaohms or more). A brief description of the multimeter main test functions follows:

- Voltmeter—the voltmeter is used to measure voltage at any point in a circuit, or to measure the voltage drop across any part of a circuit. Voltmeters usually have various scales and a selector switch to allow the reading of different voltage ranges. The voltmeter has a positive and a negative lead. To avoid damage to the meter, always connect the negative lead to the negative (–) side of the circuit (to ground or nearest the ground side of the circuit) and connect the positive lead to the positive (+) side of the circuit (to the power source or the nearest power source). Note that the negative voltmeter lead will always be black and that the positive voltmeter will always be some color other than black (usually red).
- Ohmmeter—the ohmmeter is designed to read resistance (measured in ohms) in a circuit or component. Most ohmmeters will have a selector switch which permits the measurement of different ranges of resistance (usually the selector switch allows the multiplication of the meter reading by 10, 100, 1,000 and 10,000). Some ohmmeters are "auto-ranging" which means the meter itself will determine which scale to use. Since the meters are powered by an internal battery, the ohmmeter can be used like a self-powered test light. When the ohmmeter is connected, current from the ohmmeter flows through the circuit or component being tested. Since the ohmmeter's internal resistance and voltage are known values, the amount of current flow through the meter depends on the resistance of the circuit or component being tested. The ohmmeter can also be used to perform a continuity test for suspected open circuits. In using the meter for making continuity checks, do not be concerned with the actual resistance readings. Zero resistance, or any ohm reading, indicates continuity in the circuit. Infinite resistance indicates an opening in the circuit. A high resistance

reading where there should be none indicates a problem in the circuit. Checks for short circuits are made in the same manner as checks for open circuits, except that the circuit must be isolated from both power and normal ground. Infinite resistance indicates no continuity, while zero resistance indicates a dead short.

⁂ WARNING

Never use an ohmmeter to check the resistance of a component or wire while there is voltage applied to the circuit.

- Ammeter—an ammeter measures the amount of current flowing through a circuit in units called amperes or amps. At normal operating voltage, most circuits have a characteristic amount of amperes, called "current draw" which can be measured using an ammeter. By referring to a specified current draw rating, then measuring the amperes and comparing the two values, one can determine what is happening within the circuit to aid in diagnosis. An open circuit, for example, will not allow any current to flow, so the ammeter reading will be zero. A damaged component or circuit will have an increased current draw, so the reading will be high. The ammeter is always connected in series with the circuit being tested. All of the current that normally flows through the circuit must also flow through the ammeter; if there is any other path for the current to follow, the ammeter reading will not be accurate. The ammeter itself has very little resistance to current flow and, therefore, will not affect the circuit, but it will measure current draw only when the circuit is closed and electricity is flowing. Excessive current draw can blow fuses and drain the battery, while a reduced current draw can cause motors to run slowly, lights to dim and other components to not operate properly.

Troubleshooting Electrical Systems

When diagnosing a specific problem, organized troubleshooting is a must. The complexity of a modern automotive vehicle demands that you approach any problem in a logical, organized manner. There are certain troubleshooting techniques, however, which are standard:

- Establish when the problem occurs. Does the problem appear only under certain conditions? Were there any noises, odors or other unusual symptoms? Isolate the problem area. To do this, make some simple tests and observations, then eliminate the systems that are working properly. Check for obvious problems, such as broken wires and loose or dirty connections. Always check the obvious before assuming something complicated is the cause.
- Test for problems systematically to determine the cause once the problem area is isolated. Are all the components functioning properly? Is there power going to electrical switches and motors. Performing careful, systematic checks will often turn up most causes on the first inspection, without wasting time checking components that have little or no relationship to the problem.
- Test all repairs after the work is done to make sure that the problem is fixed. Some causes can be traced to more than one component, so a careful verification of repair work is important in order to pick up additional malfunctions that may cause a problem to reappear or a different problem to arise. A blown fuse, for example, is a simple problem that may require more than another fuse to repair. If you don't look for a problem that caused a fuse to blow, a shorted wire (for example) may go undetected.

Experience has shown that most problems tend to be the result of a fairly simple and obvious cause, such as loose or corroded connectors, bad grounds or damaged wire insulation which causes a short. This makes careful visual inspection of components during testing essential to quick and accurate troubleshooting.

Testing

OPEN CIRCUITS

➧ See Figure 8

This test already assumes the existence of an open in the circuit and it is used to help locate the open portion.

1. Isolate the circuit from power and ground.
2. Connect the self-powered test light or ohmmeter ground clip to the ground side of the circuit and probe sections of the circuit sequentially.
3. If the light is out or there is infinite resistance, the open is between the probe and the circuit ground.
4. If the light is on or the meter shows continuity, the open is between the probe and the end of the circuit toward the power source.

SHORT CIRCUITS

➡Never use a self-powered test light to perform checks for opens or shorts when power is applied to the circuit under test. The test light can be damaged by outside power.

1. Isolate the circuit from power and ground.
2. Connect the self-powered test light or ohmmeter ground clip to a good ground and probe any easy-to-reach point in the circuit.
3. If the light comes on or there is continuity, there is a short somewhere in the circuit.
4. To isolate the short, probe a test point at either end of the isolated circuit (the light should be on or the meter should indicate continuity).
5. Leave the test light probe engaged and sequentially open connectors or switches, remove parts, etc. until the light goes out or continuity is broken.
6. When the light goes out, the short is between the last two circuit components which were opened.

VOLTAGE

This test determines voltage available from the battery and should be the first step in any electrical troubleshooting procedure after visual inspection. Many electrical problems, especially on computer controlled systems, can be caused by a low state of charge in the battery. Excessive corrosion at the battery cable terminals can cause poor contact that will prevent proper charging and full battery current flow.

1. Set the voltmeter selector switch to the 20V position.
2. Connect the multimeter negative lead to the battery's negative (–) post or terminal and the positive lead to the battery's positive (+) post or terminal.
3. Turn the ignition switch **ON** to provide a load.
4. A well charged battery should register over 12 volts. If the meter reads below 11.5 volts, the battery power may be insufficient to operate the electrical system properly.

VOLTAGE DROP

➧ See Figure 9

When current flows through a load, the voltage beyond the load drops. This voltage drop is due to the resistance created by the load and also by small resistances created by corrosion at the connectors and damaged insulation on the wires. The maximum allowable voltage drop under load is critical, especially if there is more than one load in the circuit, since all voltage drops are cumulative.

1. Set the voltmeter selector switch to the 20 volt position.
2. Connect the multimeter negative lead to a good ground.
3. Operate the circuit and check the voltage prior to the first component (load).
4. There should be little or no voltage drop in the circuit prior to the first component. If a voltage drop exists, the wire or connectors in the circuit are suspect.
5. While operating the first component in the circuit, probe the ground side of the component with the positive meter lead and observe the voltage readings. A small voltage drop should be noticed. This voltage drop is caused by the resistance of the component.
6. Repeat the test for each component (load) down the circuit.
7. If a large voltage drop is noticed, the preceding component, wire or connector is suspect.

RESISTANCE

➧ See Figures 10 and 11

⁂ WARNING

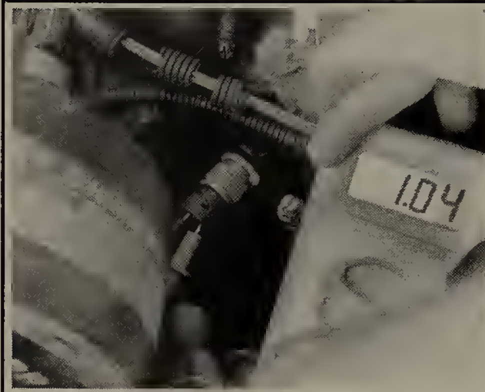
Never use an ohmmeter with power applied to the circuit. The ohmmeter is designed to operate on its own power supply. The normal 12 volt electrical system voltage could damage the meter!


TCCA6P10

Fig. 8 The infinite reading on this multimeter indicates that the circuit is open

TCCA6P07

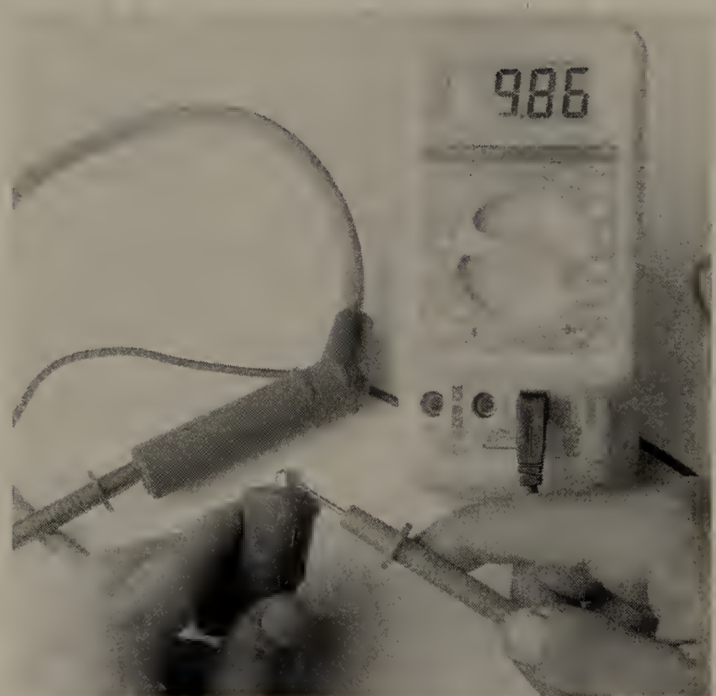
Fig. 9 This voltage drop test revealed high resistance (low voltage) in the circuit



TCCA6P08

Fig. 10 Checking the resistance of a coolant temperature sensor with an ohmmeter. Reading is 1.04 kilohms

1. Isolate the circuit from the vehicle's power source.
2. Ensure that the ignition key is **OFF** when disconnecting any components or the battery.
3. Where necessary, also isolate at least one side of the circuit to be checked, in order to avoid reading parallel resistances. Parallel circuit resistances will always give a lower reading than the actual resistance of either of the branches.
4. Connect the meter leads to both sides of the circuit (wire or component) and read the actual measured ohms on the meter scale. Make sure the selector switch is set to the proper ohm scale for the circuit being tested, to avoid misreading the ohmmeter test value.



TCCA6P09

Fig. 11 Spark plug wires can be checked for excessive resistance using an ohmmeter

Wire and Connector Repair

Almost anyone can replace damaged wires, as long as the proper tools and parts are available. Wire and terminals are available to fit almost any need. Even the specialized weatherproof, molded and hard shell connectors are now available from aftermarket suppliers.

Be sure the ends of all the wires are fitted with the proper terminal hardware and connectors. Wrapping a wire around a stud is never a permanent solution and will only cause trouble later. Replace wires one at a time to avoid confusion. Always route wires exactly the same as the factory.

➡If connector repair is necessary, only attempt it if you have the proper tools. Weatherproof and hard shell connectors require special tools to release the pins inside the connector. Attempting to repair these connectors with conventional hand tools will damage them.

BATTERY CABLES

Disconnecting the Cables

When working on any electrical component on the vehicle, it is always a good idea to disconnect the negative (–) battery cable. This will prevent potential damage to many sensitive electrical components such as the Engine Control Module (ECM), radio, alternator, etc.

➡Any time you disengage the battery cables, it is recommended that you disconnect the negative (–) battery cable first. This will prevent your accidentally grounding the positive (+) terminal to the body of the vehicle when disconnecting it, thereby preventing damage to the above mentioned components.

Before you disconnect the cable(s), first turn the ignition to the **OFF** position. This will prevent a draw on the battery which could cause arcing (electricity trying to ground itself to the body of a vehicle, just like a spark plug jumping the gap) and, of course, damaging some components such as the alternator diodes.

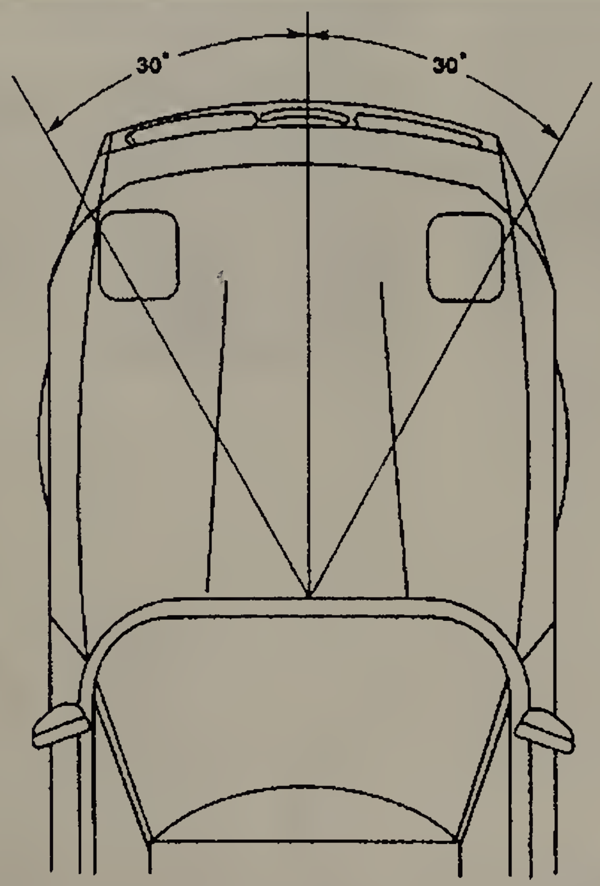
When the battery cable(s) are reconnected (negative cable last), be sure to check that your lights, windshield wipers and other electrically operated safety components are all working correctly. If your vehicle contains an Electronically Tuned Radio (ETR), donít forget to also reset your radio stations. Ditto for the clock.

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) SYSTEM

General Information

➧ See Figure 12

All 1990–96 vehicles are equipped with an airbag system. Vehicles through 1993 were equipped with a driverís side airbag only, but a passenger side airbag became standard in 1994. The Supplemental Inflatable Restraint (SIR) system helps supplement the protection offered by the seat belts by deploying an air bag from the center of the steering wheel and from the top of the right side of the instrument panel. The air bag deploys when the vehicle is involved in a frontal crash of sufficient force up to 30 degrees off the centerline of the vehicle. To further absorb the crash energy, there is a knee bolster located beneath the instrument panel and the steering column is collapsible.



91036G01

Fig. 12 SIR system deployment window

SYSTEM OPERATION

The main portions of the SIR system are the deployment loops and the Diagnostic Energy Reserve Module (DERM). The main function of the deployment loops is to supply current through the inflator module(s), which will cause deployment of the air bag(s) in the event of a frontal crash of sufficient force. The arming sensor, SIR coil assembly (driver side only), passenger inflator module jumper (passenger side only), inflator module(s), passenger compartment discriminating sensor and forward discriminating sensor make up the deployment loops.

The DERM has two functions. One to supply the deployment loops with a 36 volt reserve to ensure sufficient energy is available to deploy the airbag(s) if the battery voltage feed to the arming sensor is lost during a frontal crash. Another function is SIR electrical system diagnostics.

The arming sensor switches power to the inflator module(s) on the high side (power side) of the deployment loops. Either of the discriminating sensors can supply ground to the inflator module(s) on the low side (ground side) of the loop. The inflator module(s) are only supplied sufficient current to deploy when the arming sensor and at least one of the two discriminating sensors are closed simultaneously.

SYSTEM COMPONENTS

Diagnostic Energy Reserve Module (DERM)

The DERM is designed to perform the following functions in the SIR system:

- Energy Reserve—Maintains a 36 volt energy reserve(s) to provide deployment energy when the vehicle voltage is low or lost in a frontal impact
- Malfunction Detection—Performs diagnostic monitoring of the SIR system electrical components
- Malfunction Recording—Provides diagnostic trouble code information
- Frontal Crash Recording—Records the SIR system status during a frontal crash

Warning Lamp

The "INFL REST" or "AIR BAG" warning lamp is used to do the following:

- Verify lamp and DERM operation by flashing seven to nine times when the ignition key is first turned ON
- Warn the driver of SIR electrical system faults which could potentially affect the operation of the SIR system
- Provide diagnostic information by flashing the fault codes when the diagnostic mode is enabled

Arming Sensor

The arming sensor is a protective switch located in the power feed side of the deployment loop. It is calibrated to close at low level velocity changes (lower than the discriminating sensors). This assures that the inflator module is connected directly to the volt output of the DERM or battery voltage feed when either of the discriminating sensors close.

Discriminating Sensors

The discriminating sensors are wired in parallel on the ground side of the deployment loop. These sensors are calibrated to close with velocity changes which are severe enough to warrant deployment.

SIR Coil Assembly

See Figure 13

The SIR coil assembly consists of two current carrying coils. They are attached to the steering column and allow rotation of the steering wheel while maintaining continuous contact of the deployment loop to the inflator module.

Passenger Inflator Module Jumper

The passenger inflator module jumper consists of two current carrying wires attached to the passenger inflator module pigtail and also to the SIR wiring harness behind the instrument panel compartment door assembly.

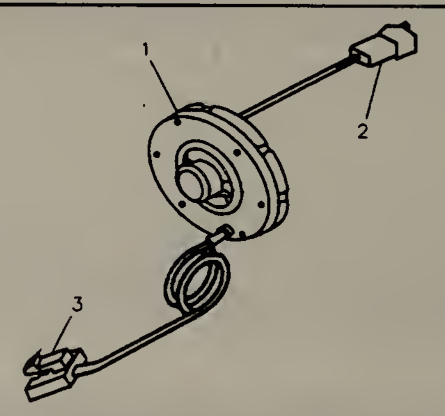
Inflator Modules

See Figure 14

Each inflator module consists of an inflatable bag and an inflator (a canister of gas–generating material with an initiating device). When the vehicle is in a frontal crash of sufficient force, current flows through the deployment loops. Current flowing through the initiator ignites the material in the inflator module. The gas produced from this reaction rapidly inflates the air bag.

SERVICE PRECAUTIONS

The DERM can maintain sufficient voltage to cause a deployment for up to 10 minutes after the ignition switch is turned OFF or the battery is disconnected. **Always disable the system when performing service procedures ON OR NEAR the system and it's components.**



1 SIR COIL ASSEMBLY
2 INFLATOR MODULE CONNECTOR
3 STEERING COLUMN CONNECTOR

91036G02

Fig. 13 The SIR coil attaches to the inflator module and steering column

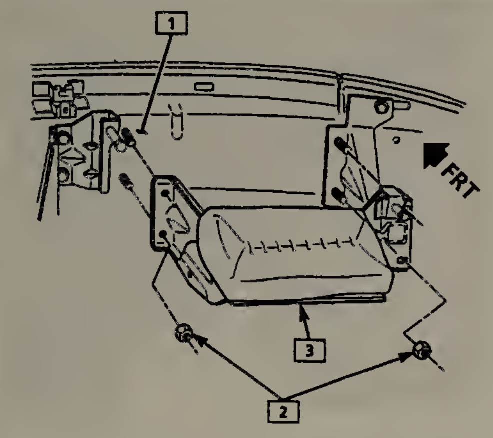


Fig. 14 Passenger inflator module mounting–a passenger side airbag is found on 1994–96 vehicles

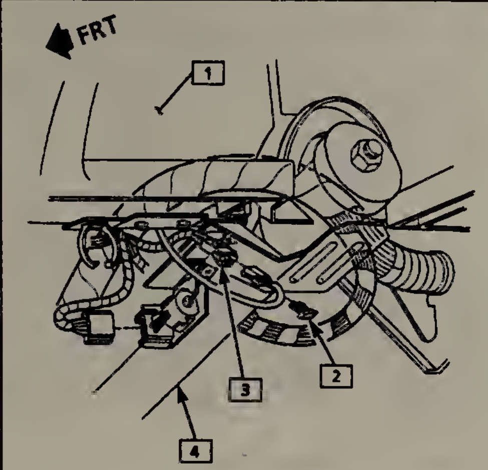


Fig. 15 Location of the driver's side yellow 2-way SIR connector

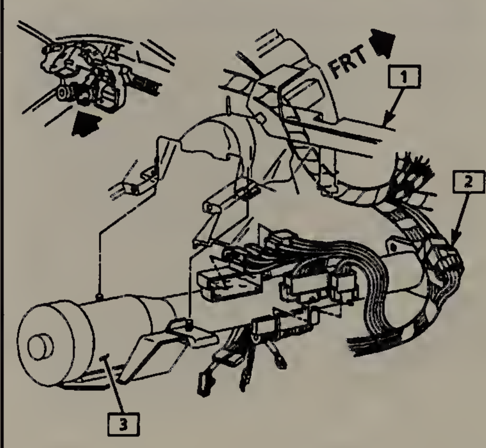


Fig. 16 Location of the passenger yellow 2-way SIR connector

CAUTION

The disarming and arming procedures must be followed in the order listed to temporarily disable the SIR system. Failure to do so could result in possible air bag deployment, personal injury or otherwise unneeded SIR system repairs.

DISARMING THE SYSTEM

1990 Vehicles

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition key to the **LOCK** position and remove the key.
3. Remove the left side lower trim panel, remove the Connector Position Assurance (CPA) device then unplug the yellow 2-way SIR harness wire connector at the base of the steering column.
4. Install a suitable load tool, such as Load Tool J 37808, or equivalent by connecting the "Base of Column" lead of the tool to the DERM-to-SIR coil connector.

1991–96 Vehicles

See Figures 15 and 16

With the fuse removed and the ignition switch ON, the air bag warning lamp will be on. This is normal and does not indicate a SIR system malfunction.

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition key to the **LOCK** position and remove the key.
3. Remove the AIR BAG fuse from the fuse block.
4. Remove the left side lower trim panel, then unplug the Connector Position Assurance (CPA) device and the yellow 2-way SIR harness wire connector at the base of the steering column. On 1994–96 vehicles, which are equipped with dual air bags, there are 2 yellow SIR connectors to unplug.

ARMING THE SYSTEM

1990 Vehicles

1. Turn the ignition switch to the **LOCK** position.
2. Disconnect and remove the load tool.
3. Attach the yellow 2-way SIR connector at the base of the steering column, then install the Connector Position Assurance (CPA).
4. If removed, install the left side lower trim panel.
5. Turn the ignition switch to the **RUN** position, and make sure the "INFL REST" indicator comes on for about 5 seconds, and then goes out and stays out for the next minute and a half. If it does not operate as described, have the system repaired by a qualified technician.

1991–96 Vehicles

1. Turn the ignition switch to the **LOCK** position.
2. Engage the yellow 2-way connector and the CPA device at the base of the steering column. On 1994–96 vehicles, make sure to attach both yellow connectors, then install the CPA device.
3. Install the left side lower trim panel, then install the SIR fuse to the fuse block.
4. Insert the key, then turn the ignition switch to the **RUN** position.
5. Make sure that the SIR dash "AIR BAG" indicator light flashes 7 times and then turns OFF. If it does not operate as described, have the system repaired by a qualified technician.

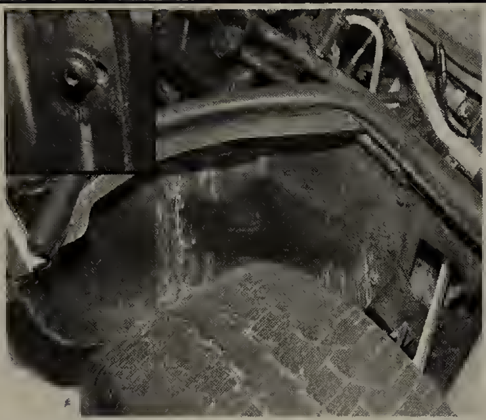
HEATING AND AIR CONDITIONING

Blower Motor

REMOVAL & INSTALLATION

See Figures 17 thru 23

1. Disconnect the negative battery cable.
2. Remove the front wheel house rear panel and seal.
3. Detach the blower motor electrical connector(s).
4. Remove the blower motor cooling tube.
5. Unfasten the necessary retainers, then remove the blower motor and fan from the evaporator case.
6. Installation is the reverse of the removal procedure.

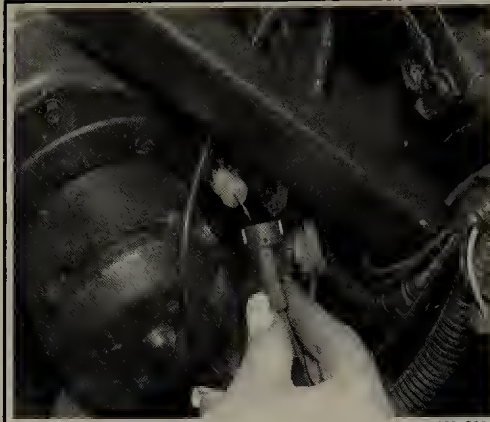


91036P04

Fig. 17 You must unfasten the inner fender well Torx® retaining bolts

91036P05

Fig. 18 Unplug the blower motor electrical connector

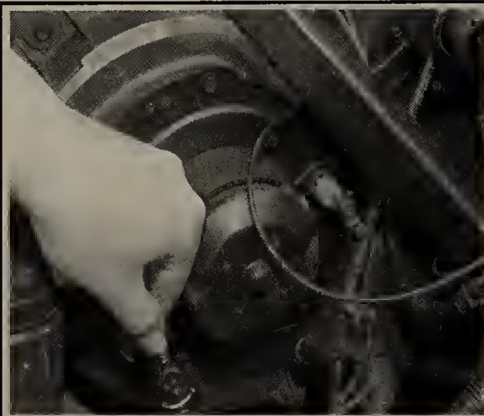


91036P06

Fig. 19 Make sure you detach all of the necessary connectors

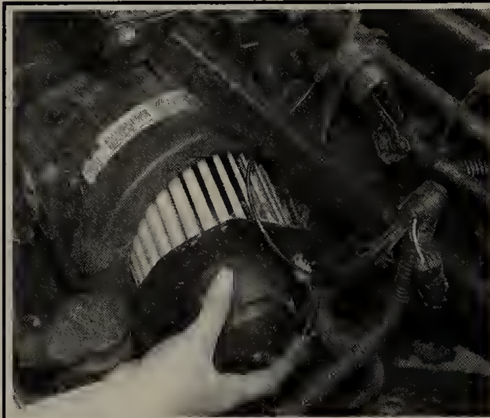
91036P07

Fig. 20 Disconnect the cooling tube from the blower motor



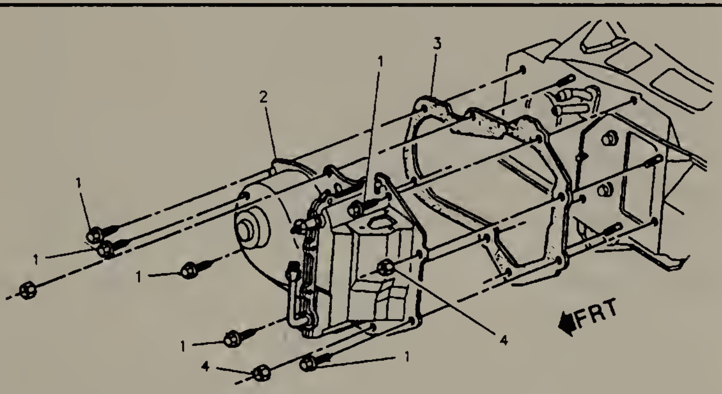
91036P08

Fig. 21 Unfasten the blower motor retaining bolts . . .



91036P09

Fig. 22 . . . then pull the blower motor from the mounting case



1 BLOWER MOTOR EVAPORATOR MODULE BOLT
2 AIR CONDITIONING EVAPORATOR AND BLOWER MOTOR MODULE
3 AIR CONDITIONING EVAPORATOR AND BLOWER MOTOR MODULE GASKET
4 BLOWER MOTOR AND EVAPORATOR MODULE NUT

91036G07

Fig. 23 Exploded view of the blower motor and evaporator case—1996 vehicle shown, other years similar

Heater Core

REMOVAL & INSTALLATION

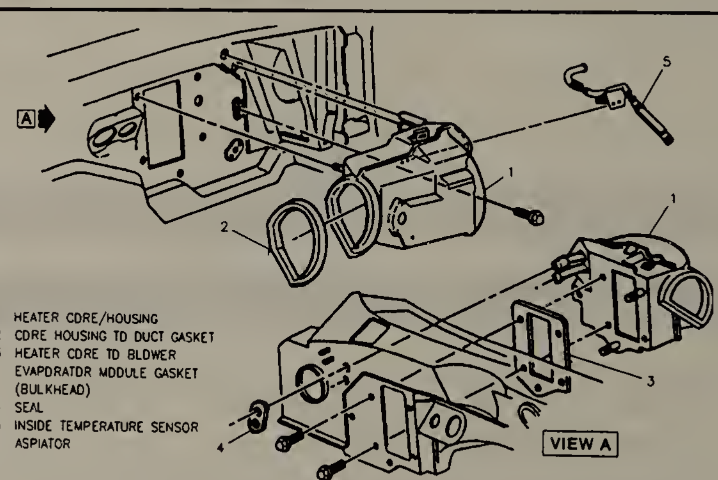
⁂ CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

1984–88 Vehicles

➧ **See Figure 24**

1. Disconnect the negative battery cable. Drain the cooling system into a suitable container.
2. Remove the instrument cluster bezel including the tilt wheel lever and instrument panel pad.
3. Remove the A/C distributor duct and disconnect the flex hose.
4. Remove the right side hush panel.
5. Remove the side window defroster flex hose.



1 HEATER CORE/HOUSING
2 CORE HOUSING TO DUCT GASKET
3 HEATER CORE TO BLOWER EVAPORATOR MODULE GASKET (BULKHEAD)
4 SEAL
5 INSIDE TEMPERATURE SENSOR ASPIATOR

91036G08

Fig. 24 Exploded view of a typical heater core assembly

6. Remove the side window defroster to heater cover screws and disconnect the extension.
7. Remove the temperature control cable and bracket assembly at heater cover including disconnecting heater door control shaft.

➡Make sure the ignition switch is OFF prior to disconnecting the ECM.

8. Remove the ECM (Electric Control Module) and disconnect the electrical connectors.
9. Remove the tubular support brace from the door pillar to aluminum, instrument panel reinforcement brace.
10. Remove heater core cover attaching screws.
11. Remove heater pipe and heater water control bracket attaching screws.
12. Remove heater hose at heater core pipes.
13. Remove the heater core.
14. Installation is the reverse of the removal procedure. Fill the cooling system with the proper type and amount of coolant.

1989–96 Vehicles

➧ See Figure 24

1. Properly disable the SIR air bag system, then disconnect the negative battery cable.
2. Remove the instrument panel upper trim pad as follows:
   a. Remove the lower right trim panel.
   b. Remove the fuse box cover and side trim panel.
   c. Remove the glove compartment.
   d. Remove the right outer air outlet and center air outlet.
   e. Remove the console trim plate and accessory trim plate.
   f. Remove the windshield defroster grill.
   g. Remove the left outer air outlet.
   h. Unfasten the dash pad retaining bolts/screws, then remove the pad by pulling rearward and upward.
3. Drain the engine coolant into a suitable container. Disconnect the in-vehicle temperature sensor aspirator hose.
4. Unplug the in-vehicle temperature sensor electrical connector.
5. Remove the floor heat deflector attaching screws, right side knee bolster brace and the floor heat deflector.
6. Disconnect the relays from the multi-use relay bracket.
7. Loosen the nuts attaching the wiring harness retainer to the radio receiver, then slide the wiring harness retainer from the receiver.
8. Remove the harnesses from the wiring harness retainer, then remove the wiring harness retainer.
9. Remove the carrier nuts from the right side pillar, the multi-use relay bracket and the passenger knee bolster brace attachments.
10. Unclip the side window defroster duct clip, then remove the duct hose from the knee bolster brace.
11. Pull the carrier back, then remove the passenger knee bolster brace. Detach the electrical connectors from the radio receiver.
12. Remove the multi-use relay bracket and unplug the cruise control module electrical connector.
13. Remove the screws attaching the side window defroster duct to the rear of the heater case. Remove the fuse block from the carrier.
14. Disconnect the vacuum hose from the actuator, then remove the vacuum line retainer tape from the heater. Remove the harness from the retainer clip, mounted on the bottom of the rear heater case.
15. Disconnect the side window defroster duct (center) extension, in the heater case. Remove the rear heater case attaching screws, then the rear heater case half.
16. Remove the high fill reservoir. Disconnect the heater hoses from the heater core. Remove the heater core from the case.

To install:

17. Install the heater core into the case. Connect the heater hoses to the heater core. Install the high fill reservoir, then the rear heater case.
18. Install the side window defroster duct extension. Install the harnesses to the retainer clip on the bottom rear of the heater case.
19. Install the vacuum line and tape onto the retainer. Connect the vacuum hose to the actuator. Install the fuse block to the carrier.
20. Install the side window defroster duct screws to the rear of the heater case. Attach the radio receiver and cruise control module electrical connectors.
21. Install the multi-use relay bracket, the knee bolster brace and attachments. Install the carrier to pillar attachment, then the wiring harness retainer, harness retainer to the radio receiver and the relays to the multi-use relay bracket.
22. Install the floor heat deflector, the right side knee bolster brace and then the floor heat deflector screws. Attach the in-vehicle temperature sensor electrical connectors and the aspirator hose.
23. Install the upper instrument pad assembly in the reverse order of removal. Connect the negative battery cable and enable the SIR system. Properly fill the engine cooling system and check for leaks.

Air Conditioning Components

REMOVAL & INSTALLATION

Repair or service of air conditioning components is not covered by this manual, because of the risk of personal injury or death, and because of the legal ramifications of servicing these components without the proper EPA certification and experience. Cost, personal injury or death, environmental damage, and legal considerations (such as the fact that it is a federal crime to vent refrigerant into the atmosphere), dictate that the A/C components on your vehicle should be serviced only by a Motor Vehicle Air Conditioning (MVAC) trained, and EPA certified automotive technician.

➡If your vehicleís A/C system uses R-12 refrigerant and is in need of recharging, the A/C system can be converted over to R-134a refrigerant (less environmentally harmful and expensive). Refer to Section 1 for additional information on R-12 to R-134a conversions, and for additional considerations dealing with your vehicleís A/C system.

Temperature Control Cable

REMOVAL & INSTALLATION

➧ See Figures 25 and 26

1. Disconnect the negative battery cable.
2. Remove the heater and A/C control head, as outlined later in this section.
3. Remove the hush or trim panel, as necessary.
4. Unfasten the screw and/or retaining clip(s) securing the cable, then remove the temperature control cable from the vehicle.

To install:

5. Properly route the temperature control cable to the control head.
6. Install the retaining clip(s) and/or screw.
7. Instlal the hush panel.
8. Install the control head, as outlined later in this section.
9. Adjust the cable, as follows:

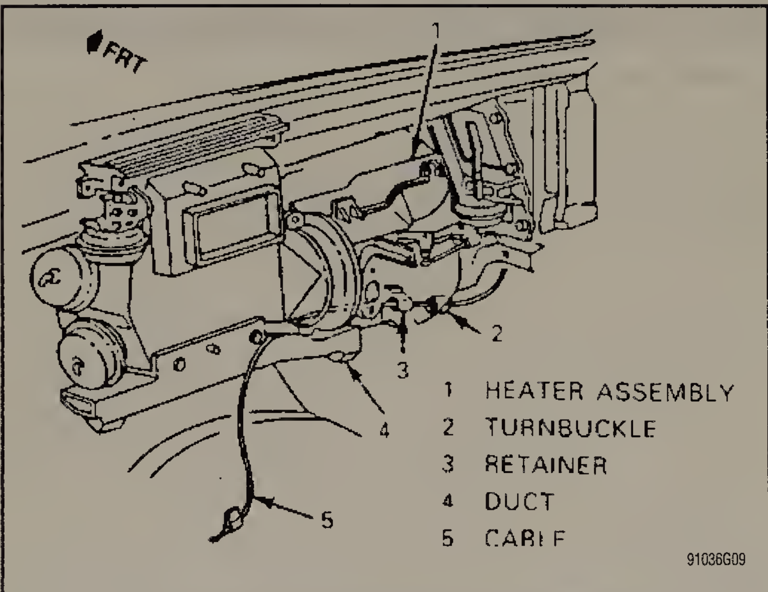


Fig. 25 Temperature control cable routing—1989 vehicle shown

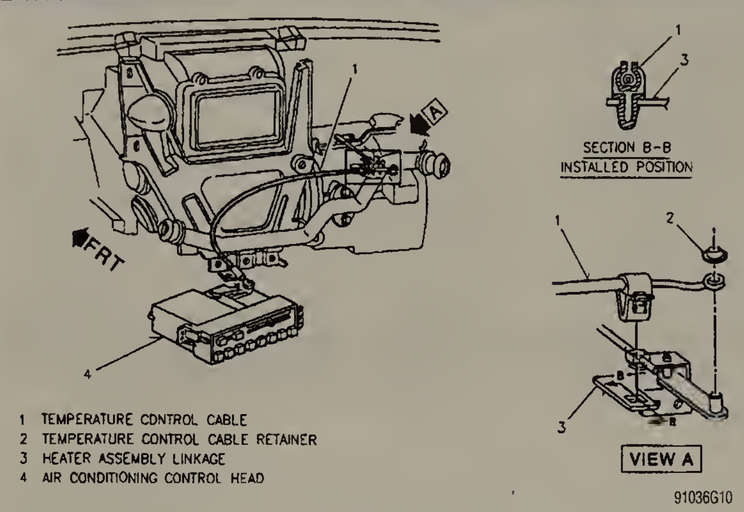


Fig. 26 Exploded view of the temperature control cable—1996 vehicle shown

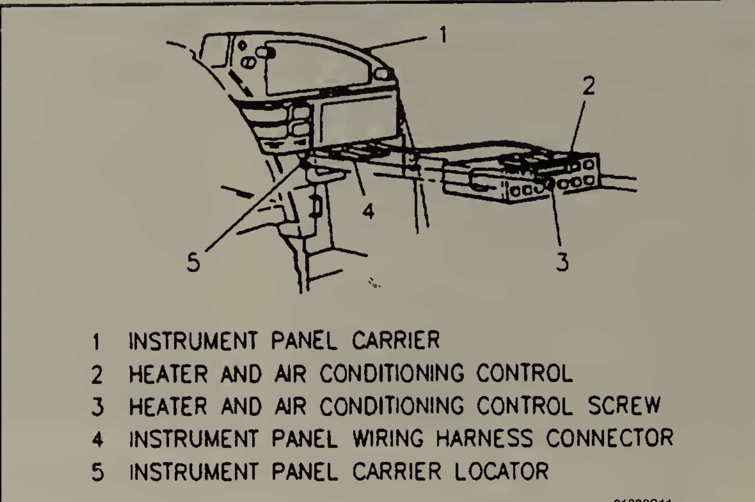


Fig. 27 Exploded view of the heater and A/C control panel—1996 vehicle with manual controlled system shown

a. With the cable properly connected at each end and the control panel installed, quickly move the temperature control lever from full cold to full hot 2 times.

b. A distinct thump or click should be heard from the temperature door as the lever is rapidly moved to its extreme hot and cold positions.

c. The lever must stay in the full cold position without any spring back.

10. Connect the negative battery cable.

Control Panel

REMOVAL & INSTALLATION

➧ **See Figures 27 and 28**

1. Disconnect the negative battery cable.
2. For 1984–88 vehicles, perform the following:
   a. Remove the cluster bezel, including the tilt wheel lever.
   b. Remove the center bezel from above the console.
3. For 1989–96 vehicles, remove the instrument panel trim plate.
4. Unfasten the control panel-to-carrier attaching screws.
5. Rotate the control panel for access to the electrical connectors, control cable and vacuum hoses (if equipped), then unplug and remove the control panel from the vehicle.
6. Installation is the reverse of the removal procedure. Tighten the heater and A/C control screws to 35 inch lbs. (4 Nm).

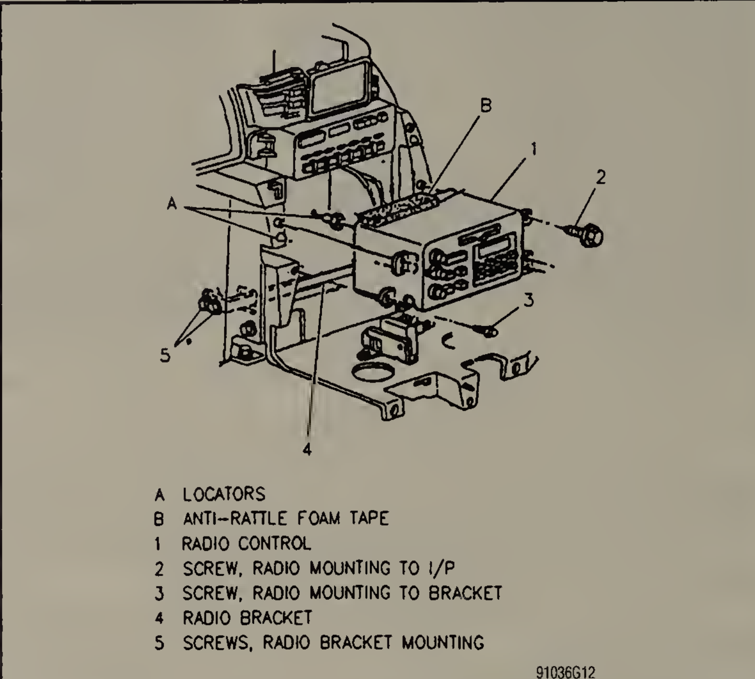


Fig. 28 View of the electronic automatic heater and A/C control panel mounting—1996 vehicle shown

CRUISE CONTROL

General Information

➧ **See Figures 29, 30 and 31**

Cruise control is a speed control system that maintains a desired vehicle speed under normal driving conditions. However, steep grades up or down may cause variations in the selected speeds. The electronic cruise control system has the capability to cruise, coast, resume speed, accelerate, "tap-up" and "tap-down".

The main parts of the cruise control system are the functional control switches, cruise control module servo, vacuum tank, switch assembly, vacuum hoses, wiring and cruise control servo cable.

The cruise control system works a mechanical linkage to the throttle by way of a vacuum motor which is inside a server. This is a diaphragm moved by vacuum applied to one side. A solenoid driven valve connects the vacuum motor to a vacuum tank. Another solenoid vents the vacuum. The cruise control module controls the servo and the throttle by pulsing these solenoid valves on and off.

One input to the cruise control module is the vehicle speed, which is sent to the computer control module (ECM or PCM, as applicable) by the Vehicle Speed Sensor (VSS). The cruise control module assembly contains a low speed limit which will prevent system engagement below 25 mph (40 km/h).

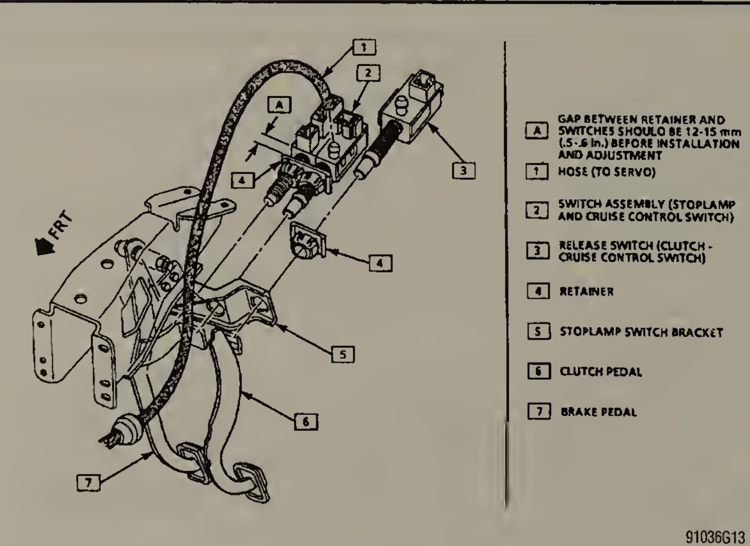


Fig. 29 Cruise control release switch locations—manual transmission shown, automatic similar

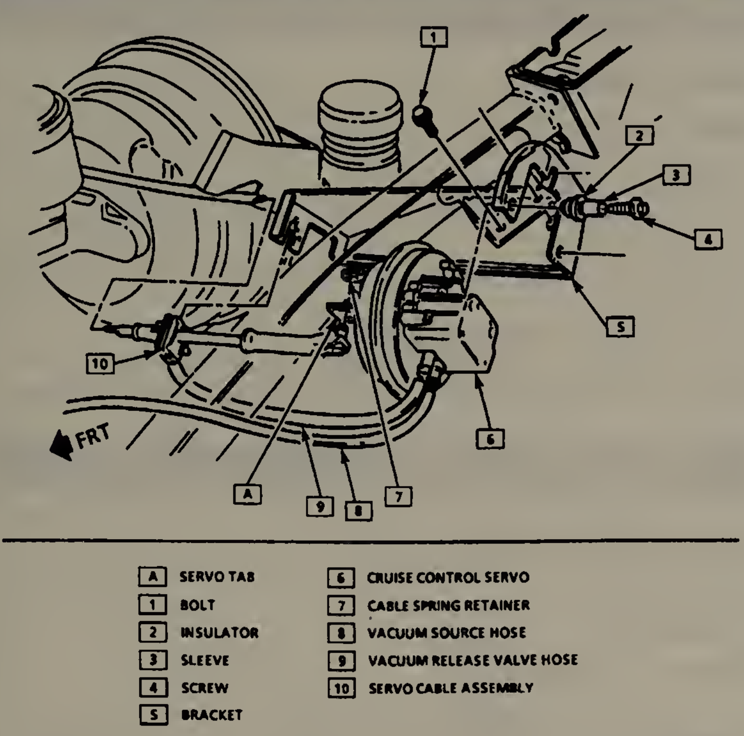


Fig. 30 Cruise control servo mounting

Other inputs to the module are the switches. The module is controlled by the functional switches in the turn signal/headlamp switch and windshield wiper lever. The release switches are mounted on the brake/clutch/accelerator pedal bracket. When the brake or clutch pedal is depressed, the cruise control system is electrically disengaged and the throttle is returned to the idle position.

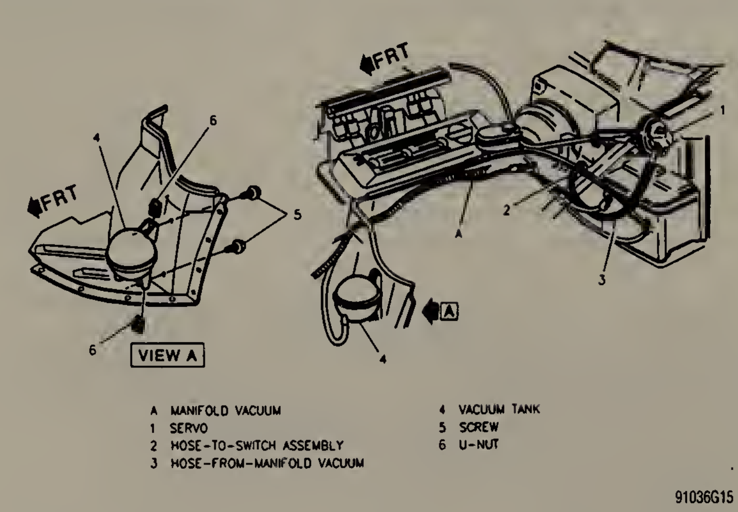


Fig. 31 Cruise control vacuum hose routing

CRUISE CONTROL TROUBLESHOOTING

Problem	*Possible Cause*
Will not hold proper speed	Incorrect cable adjustment Binding throttle linkage Leaking vacuum servo diaphragm Leaking vacuum tank Faulty vacuum or vent valve Faulty stepper motor Faulty transducer Faulty speed sensor Faulty cruise control module
Cruise intermittently cuts out	Clutch or brake switch adjustment too tight Short or open in the cruise control circuit Faulty transducer Faulty cruise control module
Vehicle surges	Kinked speedometer cable or casing Binding throttle linkage Faulty speed sensor Faulty cruise control module
Cruise control inoperative	Blown fuse Short or open in the cruise control circuit Faulty brake or clutch switch Leaking vacuum circuit Faulty cruise control switch Faulty stepper motor Faulty transducer Faulty speed sensor Faulty cruise control module

Note: Use this chart as a guide. Not all systems will use the components listed.

TCCA6C01

ENTERTAINMENT SYSTEMS

Radio

REMOVAL & INSTALLATION

Radio Control Assembly

▶ See Figure 32

1. Disconenct the negative battery cable.
2. Remvoe the shift lever knob.
3. Remove the console trim plate.
4. Remvoe the center air duct.
5. Remove the instrument panel accessory trim plate.
6. Unfasten the upper right corner console right hand trim pad-to-carrier screw.
7. Unfasten the bolts/screws securing the radio control assembly. Pull the radio partially for access to the electrical connectors, then unplug the connectors and remove the radio control assembly from the vehicle.
8. Installation is the reverse of the removal procedure.

Remote Radio Receiver

1984–92 VEHICLES

▶ See Figure 33

1. Disconnect the negative battery cable.
2. Remove the instrument panel fuse cover.
3. Remove the instrument panel side trim panel.
4. Remve the instrument panel right hand lower trim panel from the upper trim pad.
5. Unplug the wire harness connector from the pad.
6. Detach the electrical connectors and antenna lead from the radio receiver.
7. Remove the receiver from the multi-use bracket by loosening the nuts and sliding forward.
8. Remove the radio receiver from the instrument panel wiring harness bracket.

To install:

9. Position the receiver to the wiring harness bracket.
10. Secure the receiver to the relay bracket by aligning the studs with the locator holes, then tightening the nuts.
11. The remainder of installation is the reverse of the removal procedure.

1993–96 VEHICLES

▶ See Figure 34

1. Disconnect the negative battery cable.
2. Open the right rear floor stowage compartment door.
3. Remove the tray.
4. Remove the receiver by pulling firmly on the receiver to separate the hook and loop fastener.
5. Detach the antenna cable extension and electrical connectors.
6. Installation is the reverse of the removal procedure. When installing the receiver, make sure to push firmly to properly engage the hook and loop fastener.

Speakers

REMOVAL & INSTALLATION

Front Speakers

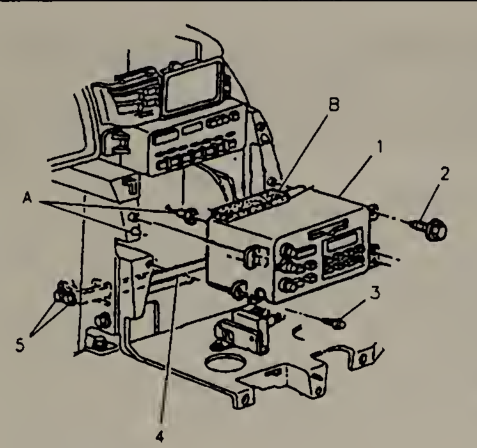
▶ See Figures 35 and 36

➡The front speaker covers are integral with the door sill panel. The speakers can only be accessed by removing the sill panel. Do not pry on the speaker covers to remove them from the sill panel. Access to the cover on the left side of the vehicle is gained by removing the seat cushion and parking brake control cover. On later models vehicles, the speaker and enclosure assembly are integral and removed as an assembly.

1. Disconnect the negative battery cable.
2. Remove the door sill front trim panel and speaker cover, as follows:
   a. If removing the left side, remove the seat cushion and parking brake lever cover.
   b. Remove the sill rear trim plate.
   c. Remove the door sill front trim panel.
3. Unfasten the speaker mounting screws.
4. Pull the speaker partially up, then detach the electrical connector.
5. Remove the speaker from the vehicle.

To install:

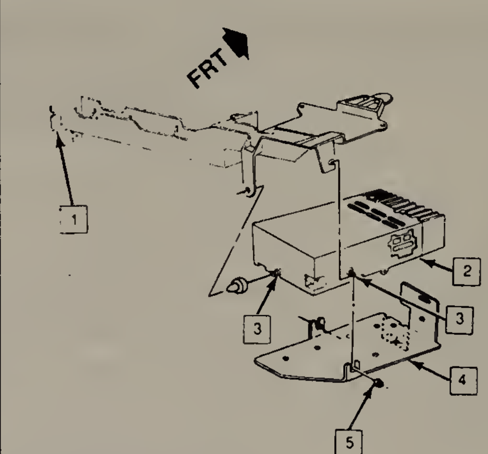
6. Attach the electrical connector to the speaker.
7. Position the speaker in its mounting position and secure with the retaining screws.
8. Install the door sill front trim panel, as follows:
   a. Install the door sili front trim panel.



A LOCATORS
B ANTI-RATTLE FOAM TAPE
1 RADIO CONTROL
2 SCREW, RADIO MOUNTING TO I/P
3 SCREW, RADIO MOUNTING TO BRACKET
4 RADIO BRACKET
5 SCREWS, RADIO BRACKET MOUNTING

91036G16

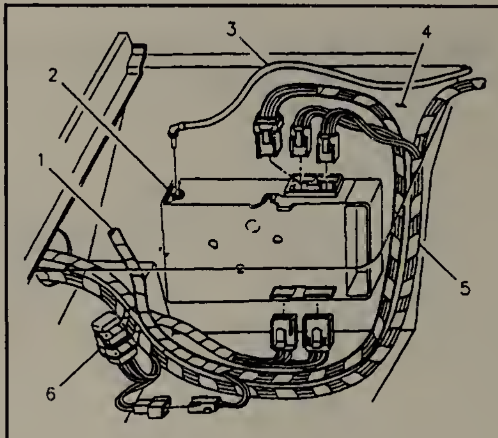
Fig. 32 Exploded view of the radio control assembly



1 BRACKET, MULTI-USE RELAY
2 RECEIVER, RADIO
3 STUD, RADIO RECEIVER
4 BRACKET, INSTRUMENT PANEL WIRING HARNESS
5 NUT, RADIO RECEIVER

91036G17

Fig. 33 Remote radio receiver mounting—1990 vehicle shown



1 FRONT BODY HARNESS
2 RADIO RECEIVER
3 ANTENNA EXTENSION CABLE
4 RIGHT REAR STORAGE COMPARTMENT
5 SPEAKER HARNESS
6 AMPLIFIER RELAY

91036G18

Fig. 34 On 1993–96 vehicles, the receiver is mounted in the right rear floor stowage compartment

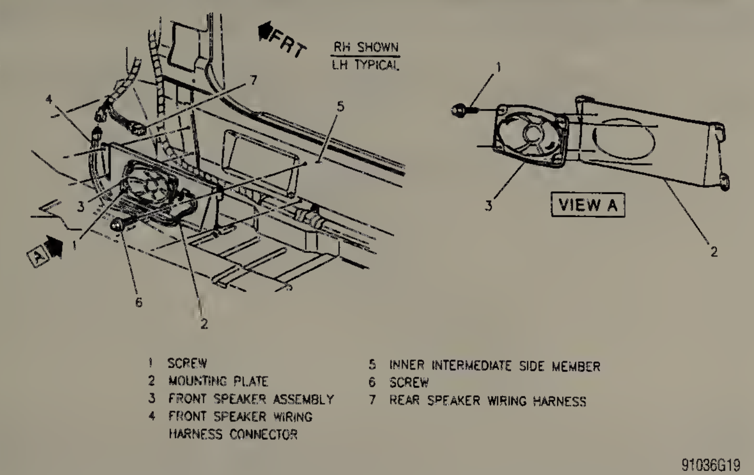


Fig. 35 Exploded view of the standard front speaker mounting

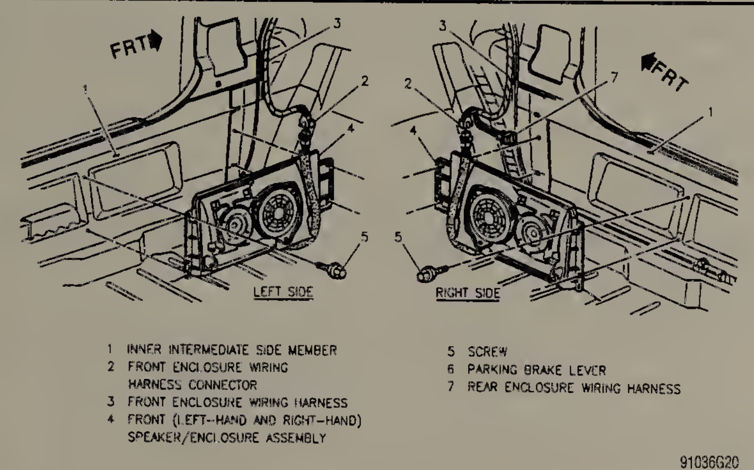


Fig. 36 Exploded view of the optional front speaker mounting

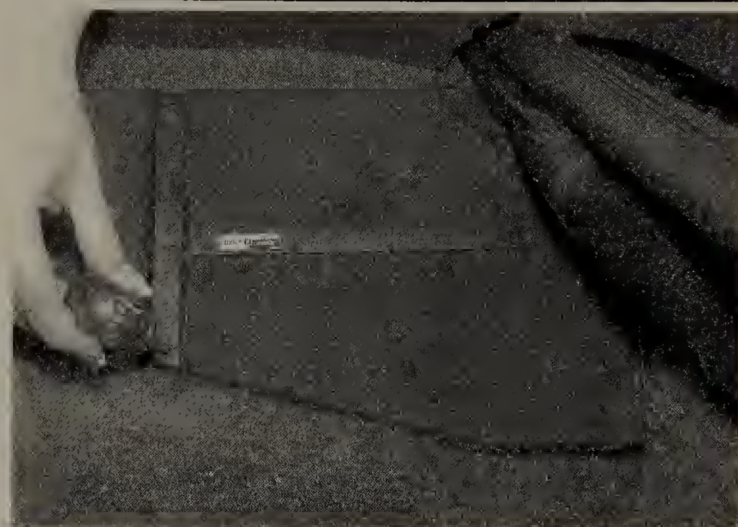
b. Instlal the sill rear trim plate.
c. If removed, install the parking brake lever cover and left seat cushion.

Rear Speakers

See Figures 37, 38, 39 and 40

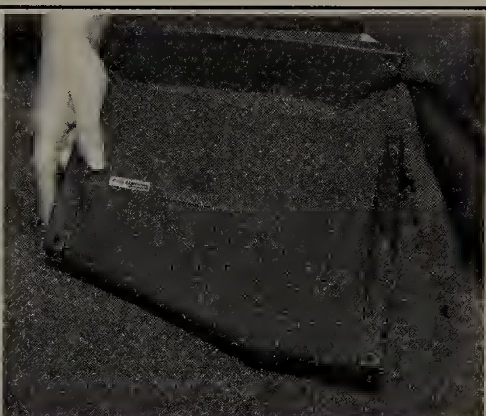
On later models vehicles, the speaker and enclosure assembly are integral and removed as an assembly.

1. Disconnect the negative battery cable.
2. Unfasten the speaker grill retaining screws, then remove the grille.
3. Unfasten the speaker retaining screws, then pull the speaker partially up and detach the electrical connector.
4. Remove the speaker from the vehicle.
5. Installation is the reverse of the removal procedure.



91036P42

Fig. 37 To remove the rear speakers, unfasten the speaker grille retaining screws



91036P43

Fig. 38 Lift the speaker grille off to get to the speaker underneath

91036P44

Fig. 39 The speaker is usually secured with 3 or 4 retaining screws

91036P45

Fig. 40 After the screws are loosened or removed, as applicable, carefully lift the speaker up, detach the connector and remove it from the vehicle

WINDSHIELD WIPERS AND WASHERS

Windshield Wiper Arm

REMOVAL & INSTALLATION

See Figures 41 and 42

1. With the wipers on, turn the ignition **OFF** when the wiper is at the mid-wipe position. At the tip of the blade assembly, mark the windshield with a crayon to aid in reassembly.
2. Lift the wiper arm assembly from the windshield and pull the retaining latch out.
3. Lift the wiper arm assembly from the transmission driveshaft.
4. Disconnect the washer nozzle hose from the end of the wiper arm.
5. If necessary, remove the blade, as outlined later in this section.

To install:

6. Connect the washer hose to the end of the wiper arm.
7. Position the wiper arm assembly on the transmission driveshaft.
8. Push the retaining latch in to lock the wiper arm in position, then carefully lower the wiper arm and blade onto the windshield.

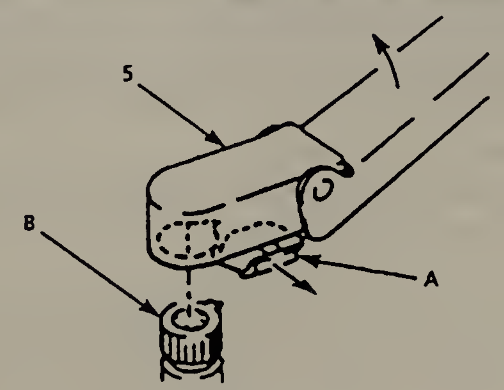


Fig. 41 Removal of the wiper arm assembly

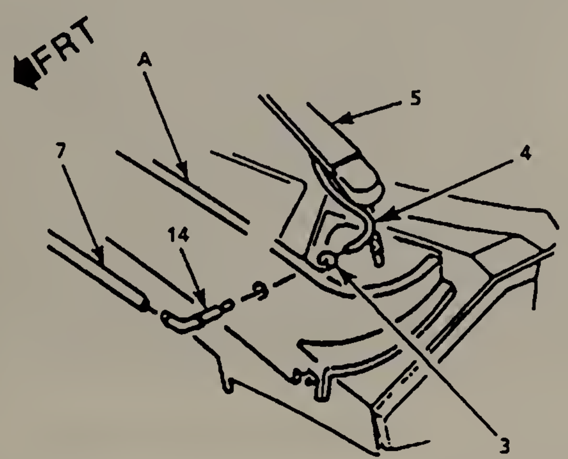


Fig. 42 Don't forget to disconnect the washer fluid hose from the arm assembly

Windshield Wiper Motor

REMOVAL & INSTALLATION

➧ See Figure 43

1. Disconnect the negative battery cable.
2. Unplug the motor park switch and the circuit board electrical connectors at the motor.
3. Remove the left wiper arm and the left side plenum screen.
4. Remove the wiper transmission nuts and sockets.
5. For the VIN J engine, remove the crank nut and crank arm.

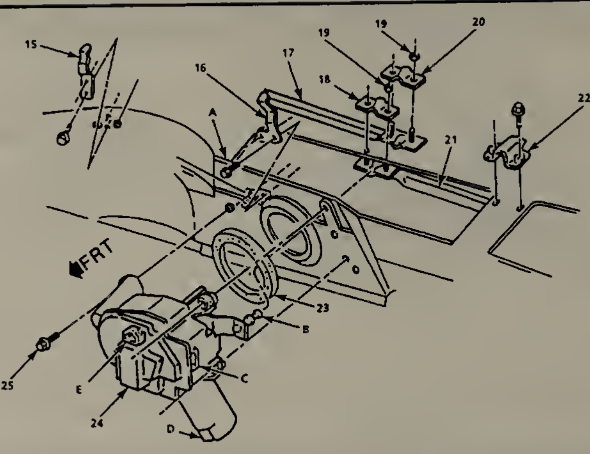


Fig. 43 Exploded view of a typical wiper motor and transmission assembly

6. If equipped, disconnect the vacuum booster supply hose at the plenum.
7. Remove the wiper motor mounting bolts.
8. Unplug any remaining motor electrical connectors while removing wiper motor assembly.

To install:

9. Attach the wiper motor electrical connector.
10. Install the wiper motor and gasket by guiding the crank arm through the hole in the plenum panel and positioning it over the transmission.

➡If installing a replacement motor on the VIN J engine, it may be necessary to file the motor shaft so the crank arm can slip over the shaft.

11. Install the motor mounting bolts and tighten to 27 inch lbs. (3 Nm).
12. For the VIN J engine, install the crank arm nut and tighten to 30 ft. lbs. (42 Nm).
13. If applicable, connect the vacuum hose.
14. Install the transmission link sockets and nuts. Tighten the nuts to 27 inch lbs. (3 Nm).
15. Install the left plenum screen and the left wiper arm, then connect the motor upper electrical connectors.
16. Connect the negative battery cable and check motor operation.

Windshield Washer Motor

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Detach the water motor electrical connector.
3. Place a suitable drain pan under the vehicle. Drain the washer reservoir.
4. Remove the washer pump from the reservoir using suitable pliers.
5. Disconnect the washer hose from the pump.

To install:

6. Connect the washer hose to the pump.
7. Place the washer pump into the reservoir using a pair of pliers. Make sure the pump is pushed in all the way into the reservoir seal.
8. Attach the washer motor electrical connector.
9. Refill the windshield washer reservoir.
10. Connect the negative battery cable, then check for proper washer motor operation.

INSTRUMENTS AND SWITCHES

⁂ WARNING

Many solid state electrical components utilized in these vehicles can be damaged by Electrostatic Discharge (ESD). Some of these vehicles will display a label informing you that they will be damaged by ESD and some will not have labels, but they may be damaged also. To avoid the possible damage to any of these components, follow the steps outlines in Handling Electrostatic Discharge (ESD) sensitive parts in this section.

Handling Electrostatic Discharge (ESD) Sensitive Parts

See Figure 44

1. Body movement produces an electrostatic charge. To discharge personal static electricity, touch a ground point (metal) on the vehicle. This should be performed any time you:
   - slide across the vehicle seat
   - sit down or get up
   - do any walking
2. Do not touch any exposed terminals on components or connectors with your fingers or any tools.
3. Never use jumper wires, ground a terminal on a component, use test equipment on any component or terminal unless instructed to in a diagnosis or testing procedure. When using test equipment, always connect the ground lead first.
4. If installing a new components, never remove the replacement component from its protective packaging until you are ready to install it.
5. Always touch the component package to ground before opening it.
6. Solid state components may also be damaged if they are dropped, bumped, laid near any components that operated electrically such as a TV, radio, or an oscilloscope.

Fig. 44 Electrostatic Discharge (ESD) label

Instrument Cluster

REMOVAL & INSTALLATION

See Figure 45

1. Remove the knee bolster and the lower trim panel.
2. If equipped, disable the SIR system.
3. Disconnect the negative battery cable.
4. Remove the steering column support bolts and carefully lower the steering column.
5. Remove the cluster bezel screws and the bezel.
6. If necessary for lens replacement, remove the lens screws and separate the lens from the cluster.
7. Remove the cluster mounting bolts/screws, unplug the electrical connectors and remove the cluster.

To install:

8. If removed, install the lens to the cluster.
9. Position the cluster and engage the electrical connectors.
10. Secure the cluster using the retainers and tighten to 16 inch lbs. (1.8 Nm).
11. Install the bezel and tighten the screws to 29 inch lbs. (3.3 Nm).
12. Raise the steering column and tighten the supporting bolts to 20 ft. lbs. (27 Nm).
13. Connect the negative battery cable and enable the SIR system, if equipped.
14. Install the knee bolster and the lower trim panel.

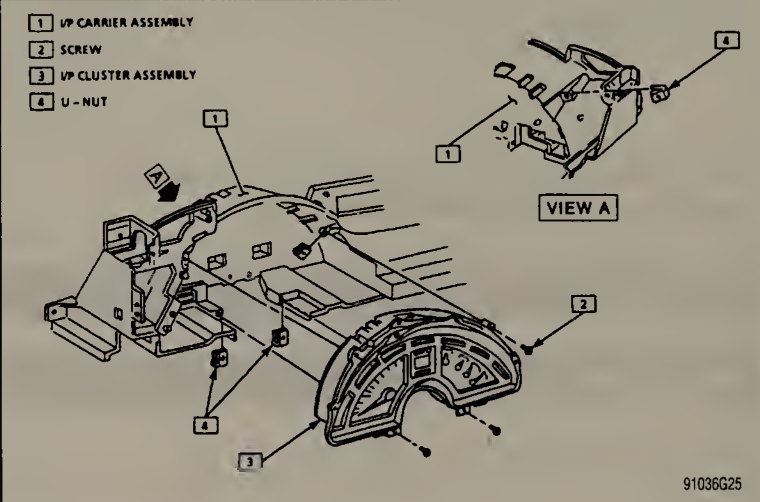


Fig. 45 Typical instrument cluster mounting

Gauges

REMOVAL & INSTALLATION

The gauges are an integral part of the instrument cluster assembly. If one of the gauges is faulty, the entire cluster must be replaced.

Headlight Switch

REMOVAL & INSTALLATION

1984–90 Vehicles

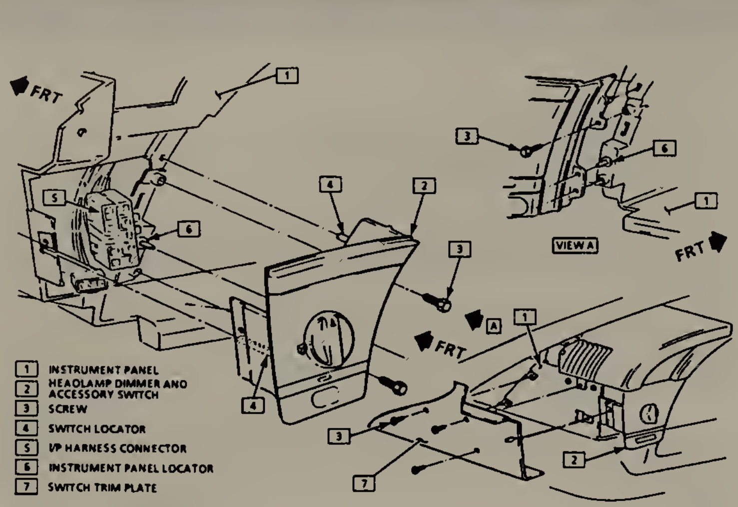
See Figure 46

1. Disconnect the negative battery cable.
2. Remove the instrument cluster, as outlined earlier in this section.
3. Unfasten the screws on the right side of the switch.
4. Remove the switch trim plate screws.
5. Pull the switch partially away from the dash, unplug the connectors, then remove the switch from the vehicle.
6. Installation is the reverse of the removal procedure.

1991–96 Vehicles

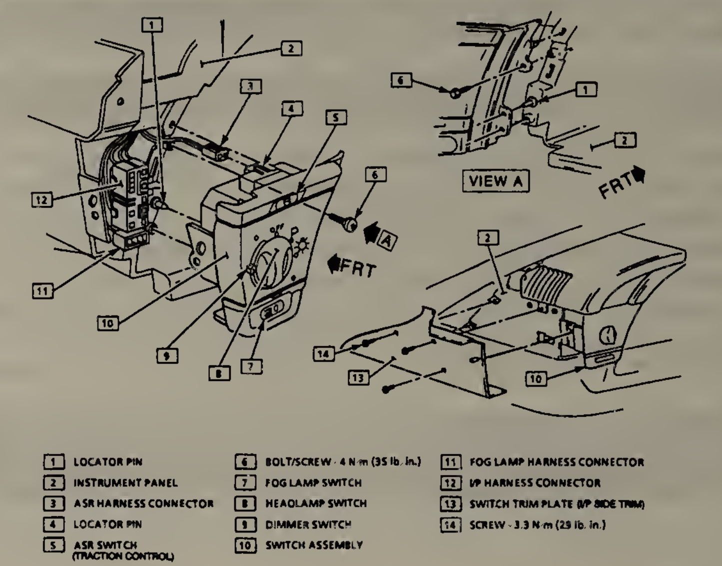
See Figure 47

1. Disconnect the negative battery cable.
2. Remove the cluster trim plate screws.
3. Reposition the trim plate in order to get to the screws on the right side of the switch.
4. Remove the screws from the right side of the switch.
5. Remove the switch trim plate, screws and trim plate.
6. Pull the switch partially away from the dash, unplug the connectors, then remove the switch from the vehicle.
7. Installation is the reverse of the removal procedure.



91036G26

Fig. 46 Exploded view of the headlight, dimmer and accessory switch mounting—1990 vehicle shown



91036G27

Fig. 47 Exploded view of the headlight and accessory switch—1996 vehicle shown

LIGHTING

Headlights

REMOVAL & INSTALLATION

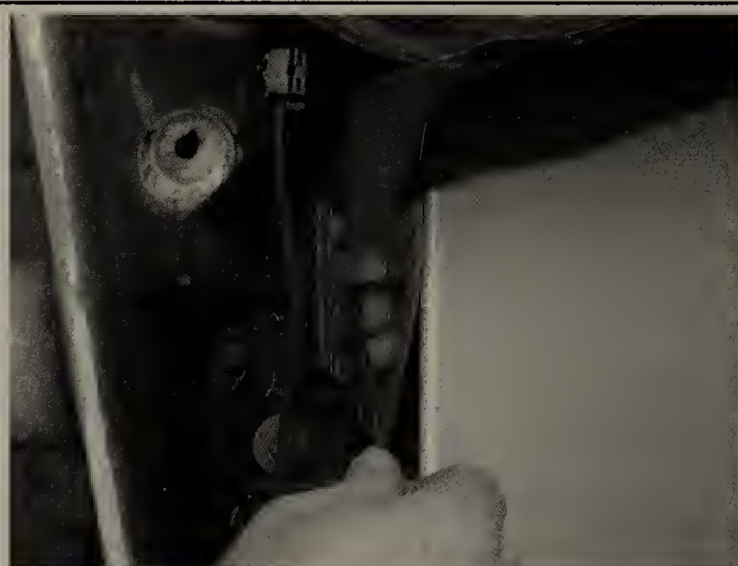
1984–88 Vehicles

See Figures 48 thru 55

1. Open the hood, then turn the headlights on.
2. Detach the headlight motor wire on the outer side of the headlight.
3. Turn the headlights off (the disconnected light should stay open).
4. Unfasten the 4 screws at the bezel. There are 2 at the front and 2 at the sides.
5. Remove the bezel.
6. Remove the retaining spring by carefully using a hooked end tool, such as a cotter pin removal tool to move it to the side.
7. Remove the headlight from the aiming pins by rotating the headlight toward the center of the car.
8. Unfasten the 4 retaining ring screws, then remove the ring.
9. Remove the headlight pump from the mounting bracket, unplugging the socket as you pull it away.

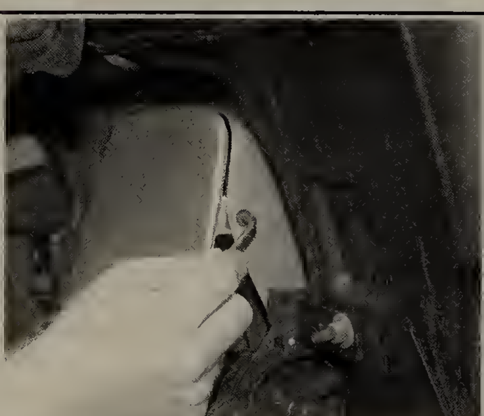
To install:

10. Install the headlight bulb, making sure it is plugged in properly.
11. Position the retaining ring and secure with the 4 screws.
12. Position the headlight into the aiming pins. Move the retaining spring back into place.
13. Install the bezel and secure with the retainers.
14. Turn the headlights on, then connect the headlight motor wire.
15. Turn the headlights off. Both should lower.



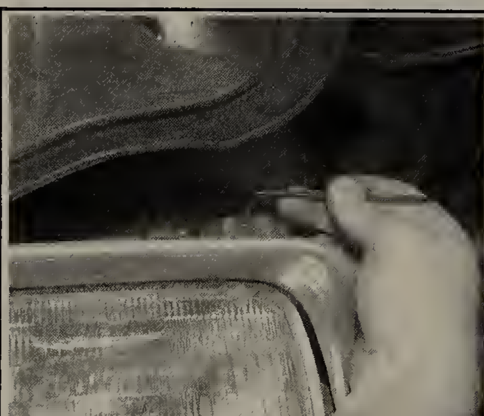
91036P23

Fig. 48 With the hood in the raised position, unfasten the Torx® screws from the outer side of the headlight bezel/trim piece



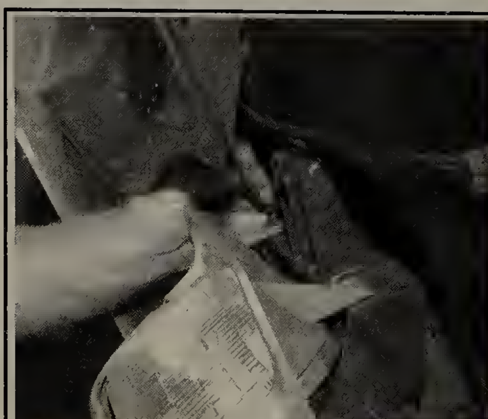
91036P24

Fig. 49 You must then remove the screws from the inner side of the bezel/trim piece



91036P25

Fig. 50 Remove the first of the top bezel/retaining ring screws . . .



91036P26

Fig. 51 . . . then remove the remaining Torx® screw

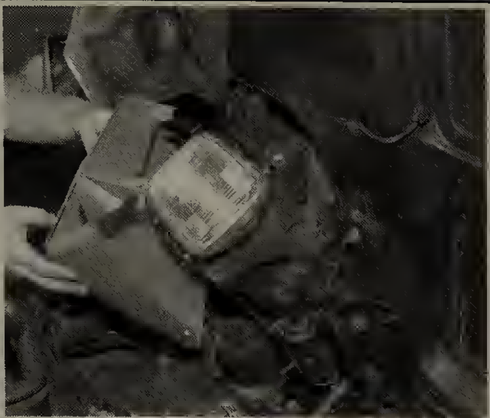
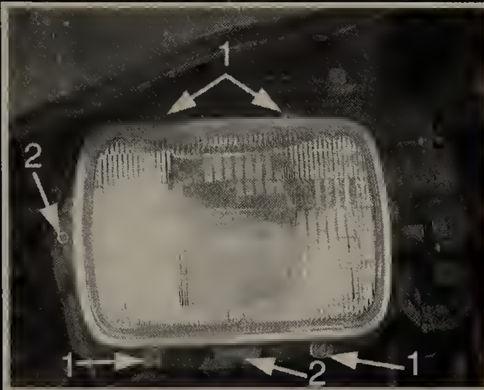

91036P27

Fig. 52 Lift the bezel/trim piece away from the headlight assembly



91036P28

Fig. 53 With the hood closed, you can see the 4 headlight retaining ring screws (1) and 2 aiming screws (2)

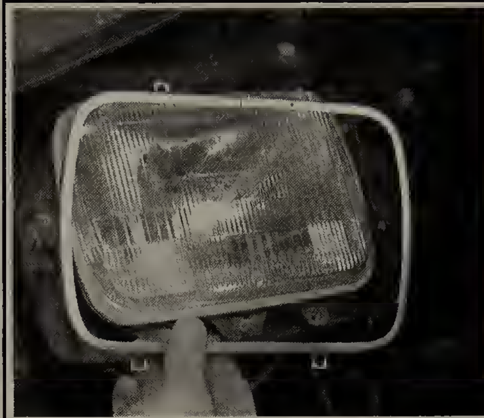

91036P29

Fig. 54 Remove ONLY the 4 retaining ring screws, do NOT touch the aiming screws


91036P30

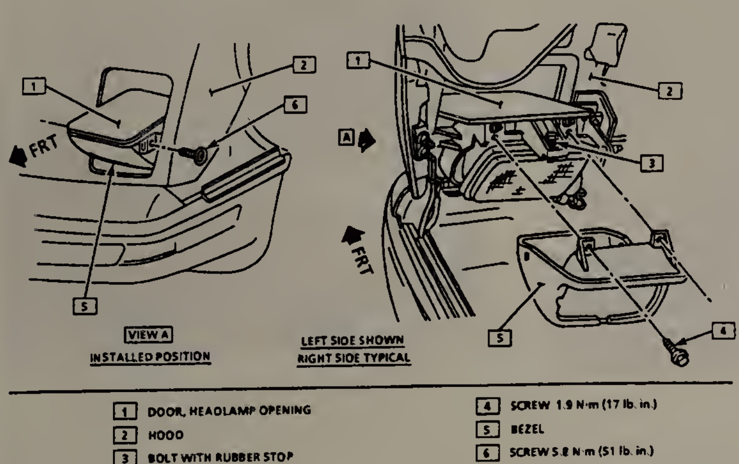
Fig. 55 Remove the headlight away from the mounting bracket, unplugging the socket as you pull it away

16. Close the hood. Check the aim of the headlights, and adjust if necessary.

1989–96 Vehicles

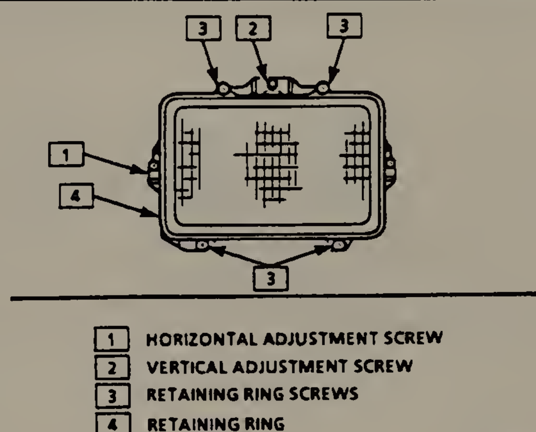
➧ See Figures 56, 57 and 58

1. Open the hood.
2. Open the headlight door halfway. This can be done either by turning the headlight switch on, then back to the parking lamp on position, or by the manual headlamp control knob (which is located on the inboard side of the headlight door).



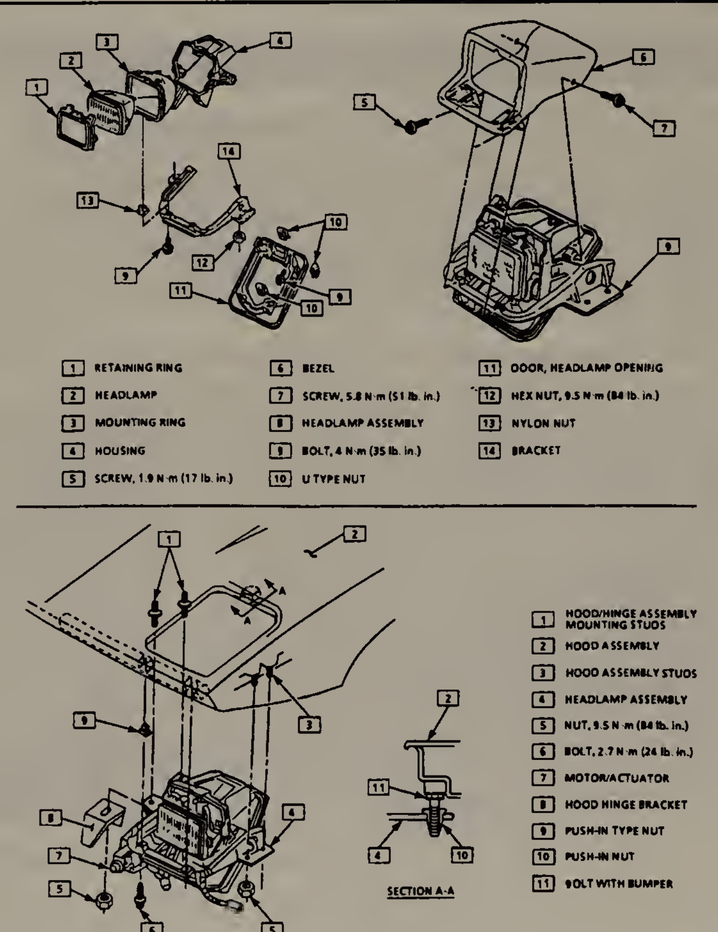
91036G28

Fig. 56 View of the headlight bezel mounting



91036G29

Fig. 57 Exploded view of the headlight assembly



91036G30

Fig. 58 Location of the headlight mounting and aiming screws

➡Before removing the screws from the side of the headlight bezel, place your hand under the bezel to support and prevent damage to it.

3. Remove the screws from the front of the headlight bezel.
4. Remove the Phillips head screws from each side of the headlight bezel.
5. Remove the bezel by pulling it straight out from the engine side of the hood.
6. Unfasten the screws from the headlight retaining ring.
7. Remove the headlamp from the assembly, unplugging the electrical connector as you are pulling it away.

To install:

8. Attach the headlight electrical connector.
9. Position the retaining ring and install the screws securing the ring to the headlight.
10. Position the bezel in place on the headlight assembly.
11. Install the screws on each side of the bezel and tighten to 51 inch lbs. (5.8 Nm).
12. Install the screws on the front of the bezel and tighten to 17 inch lbs. (1.9 Nm).
13. Cycle the headlamps, then close the hood. Check the headlight aim, and adjust if necessary.

MANUAL OPERATION

The headlight doors can be opened automatically by turning the headlights switch to the on position, then turn the switch back 1 click to the parking lights on position and the headlight doors will stay open.

If necessary, then headlight doors may be opened manually. To open the headlight doors manually, raise the hood and turn the headlight manual control knob (located next to the headlight door) in the direction of the arrow, until the door is fully opened.

AIMING

The headlights must be properly aimed to provide the best, safest road illumination. The lights should be checked for proper aim and adjusted as necessary. Certain state and local authorities have requirements for headlight aiming; these should be checked before adjustment is made.

***** CAUTION**

About once a year, when the headlights are replaced or any time front end work is performed on your vehicle, the headlight should be accurately aimed by a reputable repair shop using the proper equipment. Headlights not properly aimed can make it virtually impossible to see and may blind other drivers on the road, possibly causing an accident. Note that the following procedure is a temporary fix, until you can take your vehicle to a repair shop for a proper adjustment.

Headlight adjustment may be temporarily made using a wall, as described below, or on the rear of another vehicle. When adjusted, the lights should not glare in oncoming car or truck windshields, nor should they illuminate the passenger compartment of vehicles driving in front of you. These adjustments are rough and should always be fine-tuned by a repair shop which is equipped with headlight aiming tools. Improper adjustments may be both dangerous and illegal.

For most of the vehicles covered by this manual, horizontal and vertical aiming of each sealed beam unit is provided by two adjusting screws which move the retaining ring and adjusting plate against the tension of a coil spring. There is no adjustment for focus; this is done during headlight manufacturing.

➡Because the composite headlight assembly is bolted into position, no adjustment should be necessary or possible. Some applications, however, may be bolted to an adjuster plate or may be retained by adjusting screws. If so, follow this procedure when adjusting the lights, BUT always have the adjustment checked by a reputable shop.

Before removing the headlight bulb or disturbing the headlamp in any way, note the current settings in order to ease headlight adjustment upon reassembly. If the high or low beam setting of the old lamp still works, this can be done using the wall of a garage or a building:

1. Park the vehicle on a level surface, with the fuel tank about ½ full and with the vehicle empty of all extra cargo (unless normally carried). The vehicle should be facing a wall which is no less than 6 feet (1.8m) high and 12 feet (3.7m) wide. The front of the vehicle should be about 25 feet from the wall.
2. If aiming is to be performed outdoors, it is advisable to wait until dusk in order to properly see the headlight beams on the wall. If done in a garage, darken the area around the wall as much as possible by closing shades or hanging cloth over the windows.
3. Turn the headlights on and mark the wall at the center of each light's low beam, then switch on the brights and mark the center of each light's high beam. A short length of masking tape which is visible from the front of the vehicle may be used. Although marking all four positions is advisable, marking one position from each light should be sufficient.
4. If neither beam on one side is working, and if another like-sized vehicle is available, park the second one in the exact spot where the vehicle was and mark the beams using the same-side light. Then switch the vehicles so the one to be aimed is back in the original spot. It must be parked no closer to or farther away from the wall than the second vehicle.
5. Perform any necessary repairs, but make sure the vehicle is not moved, or is returned to the exact spot from which the lights were marked. Turn the headlights on and adjust the beams to match the marks on the wall.
6. Have the headlight adjustment checked as soon as possible by a reputable repair shop.

Signal and Marker Lights

REMOVAL & INSTALLATION

Front Turn Signal and Parking Lights

▶ See Figures 59, 60 and 61

1. Use your thumb to depress the side tab, rotate the socket and bulb assembly in the direction shown, then withdraw the bulb and socket from the lamp housing.
2. Gently twist the light bulb to align the nubs on the bulb with the channels in the socket, then pull it straight out of the socket.

To install:

3. Before installing the light bulb into the socket, ensure that all electrical contact surfaces are free of corrosion or dirt.
4. Line up the nubs of the light bulb with the channels socket, then insert the light bulb into the socket until it is fully seated. Twist the bulb to lock it into place.
5. To ensure that the replacement bulb functions properly, activate the applicable switch to illuminate the bulb which was just replaced. If the replacement light bulb does not illuminate, either it too is faulty or there is a problem in the bulb circuit or switch. Correct as necessary.
6. Install the socket and bulb assembly into the lens housing. Rotate as shown to lock the bulb and socket in the installed position.

Side Marker Light

▶ See Figures 62 and 63

Twist the socket to unlock the it from the housing, then carefully withdraw the bulb and socket from the lens housing. The bulb is replaced by pulling it straight out.

91036P10

Fig. 59 You must depress the side tab, then rotate the socket and bulb assembly in the direction shown on the socket

91036P11

Fig. 60 It may be necessary to pull up on the hood bumper to get enough clearance to remove the bulb and socket

91036P12

Fig. 61 Turn the bulb to align the nubs on the bulb with the channels in the socket, then carefully pull the bulb from the socket

Rear Turn Signal, Brake and Parking Lights

1984–89 VEHICLES

➧ See Figures 64, 65 and 66

1. If removing an inner bulb, remove the license plate. For outer bulb replacement, reach from under the vehicle.
2. Remove the socket from the lens by releasing the locking tab and twisting.
3. Remove the bulb from the socket and replace.
4. Installation is the reverse of the removal procedure.

1990 VEHICLES—EXCEPT ZR-1

1. Disconnect the negative battery cable.
2. Remove the rear bumper fascia.
3. Remove the bulb and socket from the taillamp assembly.
4. Remove the bulb from the socket.
5. Installation is the reverse of the removal procedure.

1990 ZR-1 AND 1992–96 VEHICLES

➧ See Figure 67

1. Disconnect the negative battery cable.
2. Unfasten the lens retaining screws, then remove the lens cover.
3. Remove the bulb from the socket.
4. Installation is the reverse of the removal procedure.

Rear Side Marker Lights

➧ See Figures 68 and 69

To remove the rear side marker light, reach up from underneath the vehicle, depress the tab and rotate the bulb and socket. Pull the bulb and socket down, turn the bulb to align the nubs with the channels in the socket, then pull the bulb out of the socket

High-mount Brake Light

LIFT WINDOW MOUNTED

➧ See Figures 70, 71, 72, 73 and 74

1. Open the hatch, then unfasten the center high mount light 2 Torx® retaining screws
2. For access to the underside of the lamp, lift the light assembly up. It may be slightly difficult to lift due to the water proofing sealant used
3. Remove the retaining screws located on the under side of the 3rd brake light
4. Lift the cover for access to the bulbs. It may be necessary to pry around the edges to remove the cover, but if your have to, very careful.
5. Remove the bulbs, but be careful not to bend or break the pins.
6. Installation is the reverse of the removal procedure.

REAR FASCIA MOUNTED

➧ See Figure 75

1. Remove the license plate and bracket for access to the high mount brake light connector.
2. Detach the wire connector from the bottom of the light assembly.
3. Unfasten the screws mounting the lamp assembly to the rear fascia.
4. Remove the lamp assembly by lowering the assembly and removing it through the license plate opening.
5. Installation is the reverse of the removal procedure.

91036P13

Fig. 62 To remove the side marker light bulb, twist the socket to unlock it, then pull it from the housing

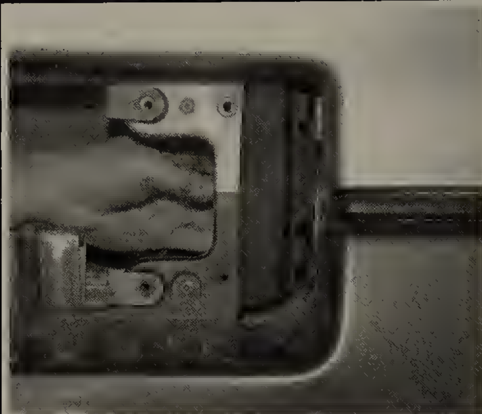
91036P14

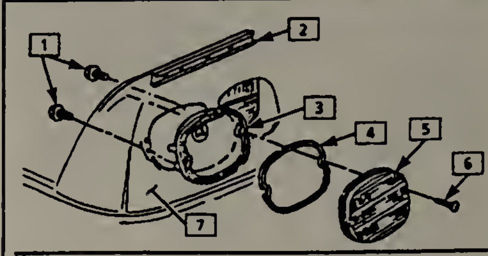
Fig. 63 Then, simply pull the bulb straight out of the socket

91036P31

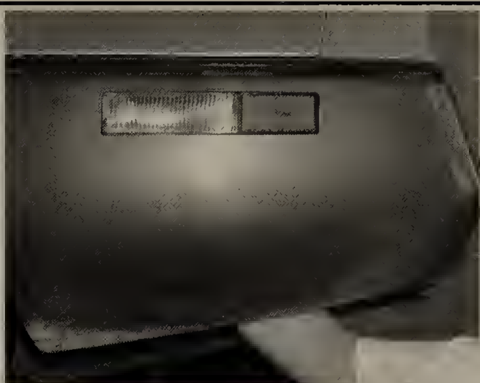
Fig. 64 To remove the inner rear brake light, you must reach behind the license place and under the vehicle to access the bulb and socket


91036P32
Fig. 65 Once the bulb and socket are pulled from the rear of the lens, grasp it from behind the license plate opening


91036P33
Fig. 66 Then, pull it out of the side and replace the bulb



91036G31
Fig. 67 Exploded view of the rear tail, stop and turn signal assembly—1990 ZR-1 and all 1992–96 vehicles

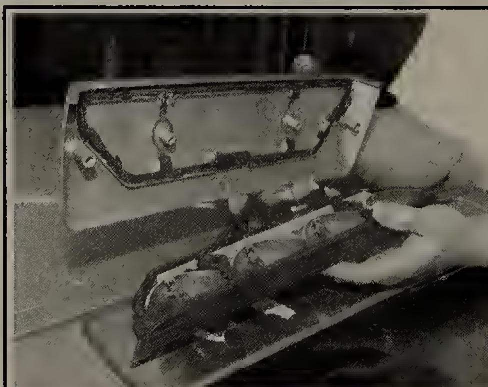

91036P35
Fig. 68 To remove the rear side marker light, reach up from underneath the vehicle, depress the tab and rotate the bulb and socket


91036P36
Fig. 69 Pull the bulb and socket down, turn the bulb to align the nubs with the channels in the socket, then pull the bulb out of the socket


91036P37
Fig. 70 Open the hatch, then unfasten the center high mount light 2 Torx® retaining screws


91036P38
Fig. 71 Lift the light assembly up for access to the underside. It may be slightly difficult to lift due to the water proofing sealant used


91036P39
Fig. 72 Remove the retaining screws located on the under side of the 3rd brake light


91036P40
Fig. 73 Lift the cover for access to the bulbs. If you have to pry around the edges to remove it, be very careful

Dome Light

➧ See Figure 76

1. Remove the bulb from its retaining clip contacts. If the bulb has tapered ends, gently depress the spring clip/metal contact and disengage the light bulb, then pull it free of the two metal contacts.

To install:

2. Before installing the light bulb into the metal contacts, ensure that all electrical conducting surfaces are free of corrosion or dirt.
3. Position the bulb between the two metal contacts. If the contacts have small holes, be sure that the tapered ends of the bulb are situated in them.
4. To ensure that the replacement bulb functions properly, activate the applicable switch to illuminate the bulb which was just replaced. If the replacement light bulb does not illuminate, either it is faulty or there is a problem in the bulb circuit or switch. Correct as necessary.
5. Install the cover lens until its retaining tabs are properly engaged.

Fig. 74 When removing or installing bulbs, be careful not to bend the pins

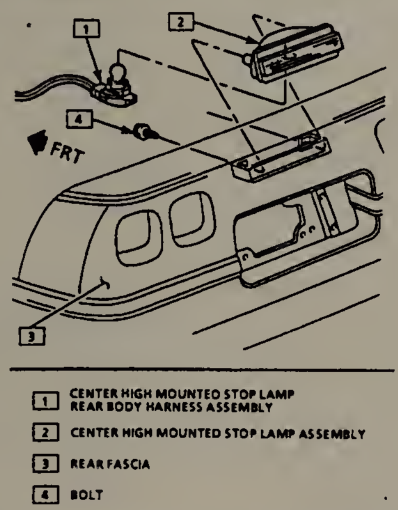


Fig. 75 Exploded view of the rear fascia mounted high mount brake light assembly

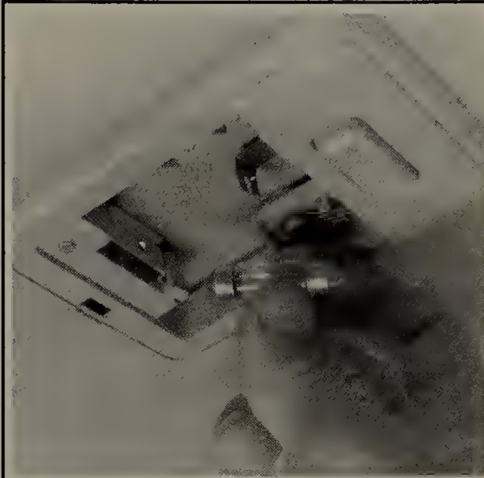


Fig. 76 Disengage the spring clip which retains one tapered end of this dome light bulb, then withdraw the bulb

License Plate Lights

See Figures 77, 78, 79 and 80

1. Disconnect the negative battery cable.
2. Unfasten the license plate light lamp screws.
3. Pull the lamp assembly down, rotate the socket ¼ turn to unlock it, then pull it from the housing.
4. Pull the bulb straight out of the socket to replace it.
5. Installation is the reverse of the removal procedure.

Reverse Lights

See Figures 81 and 82

To remove the reverse light bulb, reach behind the license plate mounting and pull the reverse light bulb and socket out. Then, carefully pull the bulb straight out of the socket

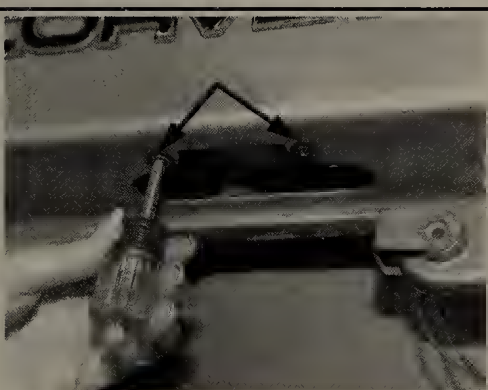


Fig. 77 Use a stubby screwdriver to unfasten the 2 license plate lamp retaining screws

Fig. 78 After removing the retainers, pull the license plate lamp down

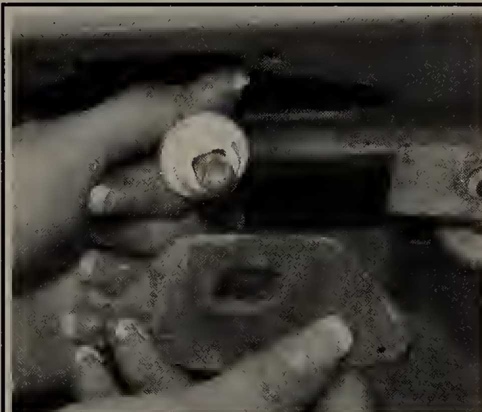


Fig. 79 Rotate the socket ¼ turn to unlock it, then pull it out of the lens

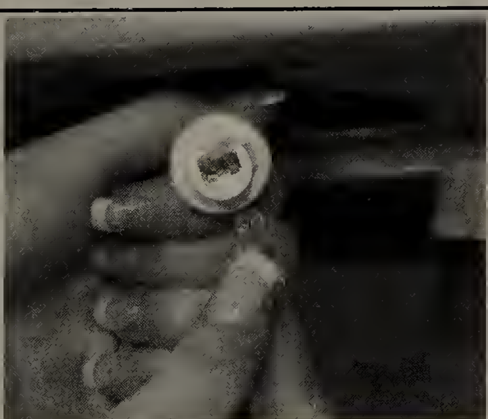


Fig. 80 The bulb can be pulled straight out of the socket for replacement

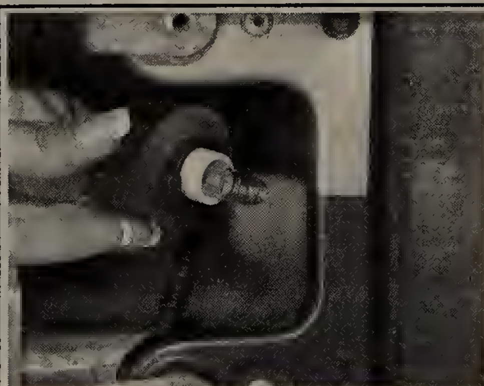


Fig. 81 Reach behind the license plate mounting and pull the reverse light bulb and socket out

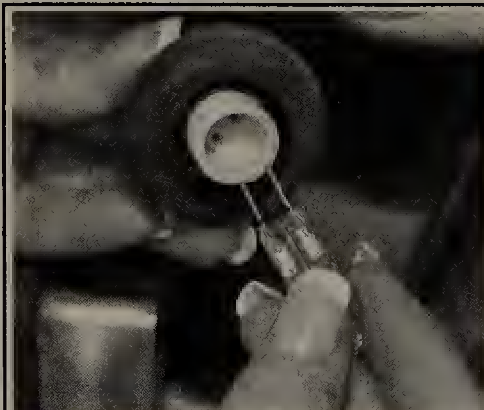


Fig. 82 Then, carefully pull the bulb straight out of the socket

Exterior Lamps	Trade No.
Backup Lamp	1156
Center High-Mounted Stoplamp (CHMSL)	1156
Cornering Lamps (Front and Rear)	1156
Fog Lamps	896
Front Parking/Turn Signal Lamps	2057NA
Headlamps, Glass	H6054
Headlamps, Plastic	HP6054
License Plate Lamp	24
Rear Tail/Stop/Turn Signal Lamps	2057
Sidemarker Lamps (Front and Rear)	24
Underhood Lamps	211-2

Interior Lamps	Trade No.
Console Compartment	564
Cargo Courtesy - Coupe	906
Cargo Courtesy - Convertible	562
Door, Courtesy	212
Door, Handle Flood	73
Inside Rearview Mirror Courtesy/Map	168
Inside Rearview Mirror Console Flood	74
I/P Courtesy	562
Vanity Mirror Lamp	74

91036C01

Fuses

See Figure 83

The main fuse block on these vehicles is located on the right side of the dash, behind an access panel. These also may be a convenience center which can be found under the hood.

Each fuse block uses miniature fuses which are designed for increased circuit protection and greater reliability. The compact fuse is a blade terminal design which allows easy pull–out/push–in removal and replacement.

Although the fuses are interchangeable, the amperage values are not. The values are usually molded in bold, color coded, easy to read numbers on the fuse body. Use only fuses of equal replacement valve.

REPLACEMENT

1. Remove the fuse block access panel or cover.
2. Locate the fuse for the circuit in question.

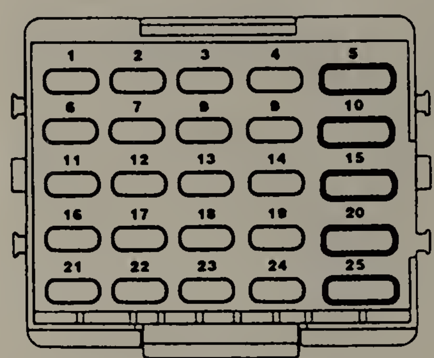
When replacing the fuse, DO NOT use one with a higher amperage rating.

3. Check the fuse by pulling it from the fuse block and observing the element. If it is broken, install a replacement fuse of the same amperage rating. If the fuse blows again, check the circuit for a short to ground or faulty device in the circuit protected by the fuse.
4. Continuity can also be checked with the fuse installed in the fuse block with the use of a test light connected across the 2 test points on the end of the fuse. If the test light lights, replace the fuse. Check the circuit for a short to ground or faulty device in the circuit protected by the fuse.

Fusible Links

In addition to circuit breakers and fuses, the wiring harness incorporates fusible links to protect the wiring. Links are used rather than a fuse, in wiring circuits that are not normally fused, such as the ignition circuit. The fusible links are color coded red in the charging and load circuits to match the color

FUSE CHART



FUSE	AMPS	USAGE
1.	15	Courtesy Lights, Antenna, Bose • Speakers, A/C
2.	25	A/C, DRL, CCM, O_2 Sensor (ZR1)
3.	10	CCM, LTPWS, Van. Mirrors
4.	5	Instrument Cluster, DIC Warning Lights
5.	30	Circuit Breaker-- Hatch Release
6.	15	Parking Lights, Fog Lamps, DRL, IP Lights
7.	5	HVAC, DIC, Radio, Power Seats
8.	20	Electronic Fuel Injectors
9.	10	HVAC, Cooling Fans, DRL, Ignition (ZR1)
10.	35	Circuit Breaker-- Rear Defogger
11.	10	CCM, Tone Generator, Dome Lights
12.	10	Heated Mirrors, A/C
13.	10	Electronic Fuel Injectors
14.	15	Turn Signals, Back Up Lights
15.	30	Circuit Breaker-- Power Windows
16.	10	Anti-lock Brakes
17.	10	Radio
18.	10	Instrument Cluster, S.I.R., ECM, ABS, Selective Ride
19.	3	Cruise Control, Power Mirror
20.	30	Circuit Breaker-- Power Seats, Locks
21.	20	Stop/Hazard Lamp
22.	25	Wipers, Radio
23.	3	ECM
24.	10	Primary Fuel Pump
25.		Not Used

★ Electronic-AC (C68) has an under-hood fuse connector near the blower motor with a 5-AMP fuse for the blower motor.

★ ZR1 has an under-hood fuse connector near the left-hand wheel house with a 10-AMP fuse for the vacuum pump.

91036G33

Fig. 83 Typical fuse identification

coding of the circuits they protect. Each link is four gauges smaller than the cable it protects, and is marked on the insulation with the gauge size because the insulation makes it appear heavier than it really is. The engine compartment wiring harness has several fusible links. The same size wire with a special Hypalon insulation must be used when replacing a fusible link.

➡For more details, see the information on fusible links at the beginning of this section.

The links are located in the following areas:

1. A molded splice at the starter solenoid **Bat** terminal, a 14 gauge red wire.
2. A 16 gauge red fusible link at the junction block to protect the unfused wiring of 12 gauge or larger wire. This link stops at the bulkhead connector.
3. The alternator warning light and field circuitry is protected by a 20 gauge red wire fusible link used in the battery feed–to–voltage regulator number 3 terminal. The link is installed as a molded splice in the circuit at the junction block.
4. The ammeter circuit is protected by two 20 gauge fusible links installed as molded splices in the circuit at the junction block and battery to starter circuit.

Circuit Breakers

Circuit breakers differ from fuses in that they are reusable. Circuit breakers open when the flow of current exceeds specified value and will close after a few seconds when current flow returns to normal. Some of the circuits protected by circuit breakers include electric windows and power accessories. Circuit breakers are used in these applications due to the fact that they must operate at times under prolonged high current flow due to demand, even though there is not malfunction in the circuit.

There are 2 types of circuit breakers. The first type opens when high current flow is detected. A few seconds after the excessive current flow has been removed, the circuit breaker will close. If the high current flow is experienced again, the circuit will open again.

The second type is referred to as the Positive Temperature Coefficient (PTC) circuit breaker. When excessive current flow passes through the PTC circuit breaker, the circuit is not opened, but its resistance increases. As the device heats up with the increase in current flow, the resistance increases to the point where the circuit is effectively open. Unlike other circuit breakers, the PTC circuit breaker will not reset until circuit is opened, removing voltage from the terminals. Once the voltage is removed, the circuit breaker will not reset until the circuit is opened, remove voltage from the terminals. Once the voltage is removed, the circuit breaker will re-close within a few seconds.

Various circuit breakers are located under the instrument panel. In order to gain access to these components, it may be necessary to first remove the under dash padding. Most of the circuit breakers are located in the convenience center or the fuse panel. Replace the circuit breaker by unplugging the old one and plugging in the new one. Confirm proper circuit operation.

Flashers

REPLACEMENT

Hazard Lamp Flasher

▸ See Figure 84

The hazard lamp flasher is located under the right side of the instrument panel behind the SIR module. To replace the hazard flasher:

1. Disconnect the negative battery cable.
2. Remove the fuse box cover and right side instrument panel trim panel.
3. Unfasten the bolts/screws from the side of the lower trim panel.
4. Remove the right side instrument panel air outlet assembly.
5. Remove the lower trim panel-to-instrument panel retaining nuts.
6. Partially remove the lower trim panel and detach the courtesy lamp connector.
7. Remove the trim panel. Pull it out from over the floor air outlet.
8. Unclip the flasher from the rear of the multi-use bracket.
9. Detach the electrical connector, then remove the flasher.
10. Installation is the reverse of the removal procedure.

Turn Signal Flasher

▸ See Figure 85

The turn signal flasher is located on the left hand multi-use relay bracket to the left of the steering column. To replace the turn signal flasher:

1. Disconnect the negative battery cable.
2. Remove the retainer securing the lower trim panel to the stud on the steering column.
3. Unfasten the screws holding the trim panel to the knee bolster.
4. Remove the screws mounting the trim panel to the instrument panel.
5. Remove the Data Link Connector (DLC) assembly mounting screw.
6. Unplug the courtesy lamp electrical connector.
7. Remove the left side lower trim panel.
8. Unclip the flasher, detach the electrical connector, then remove the flasher from the vehicle.
9. Installation is the reverse of the removal procedure.

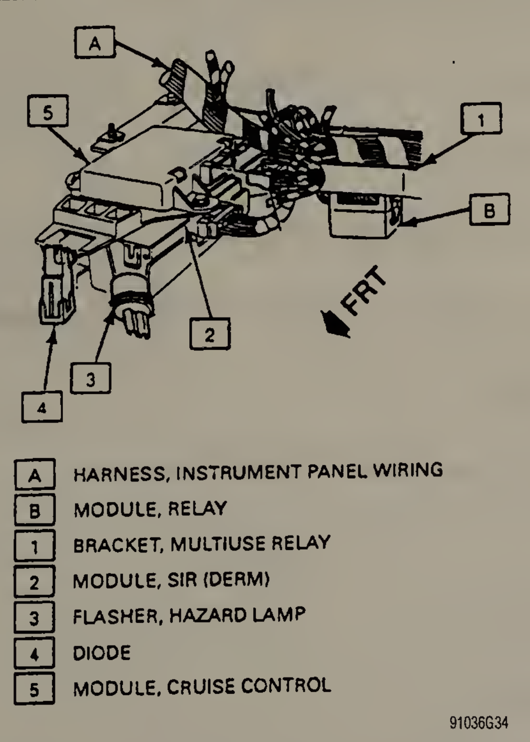


Fig. 84 Location of the hazard lamp flasher

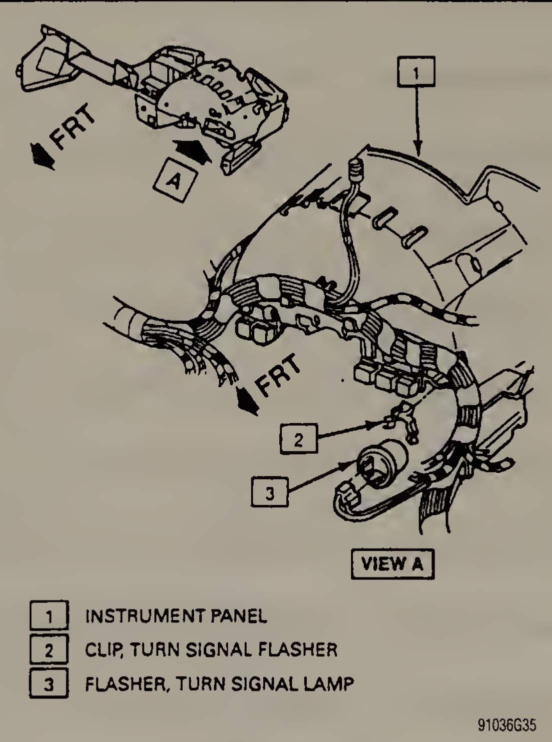


Fig. 85 Location of the turn signal flasher mounting

WIRING DIAGRAMS

INDEX OF WIRING DIAGRAMS

91036W01

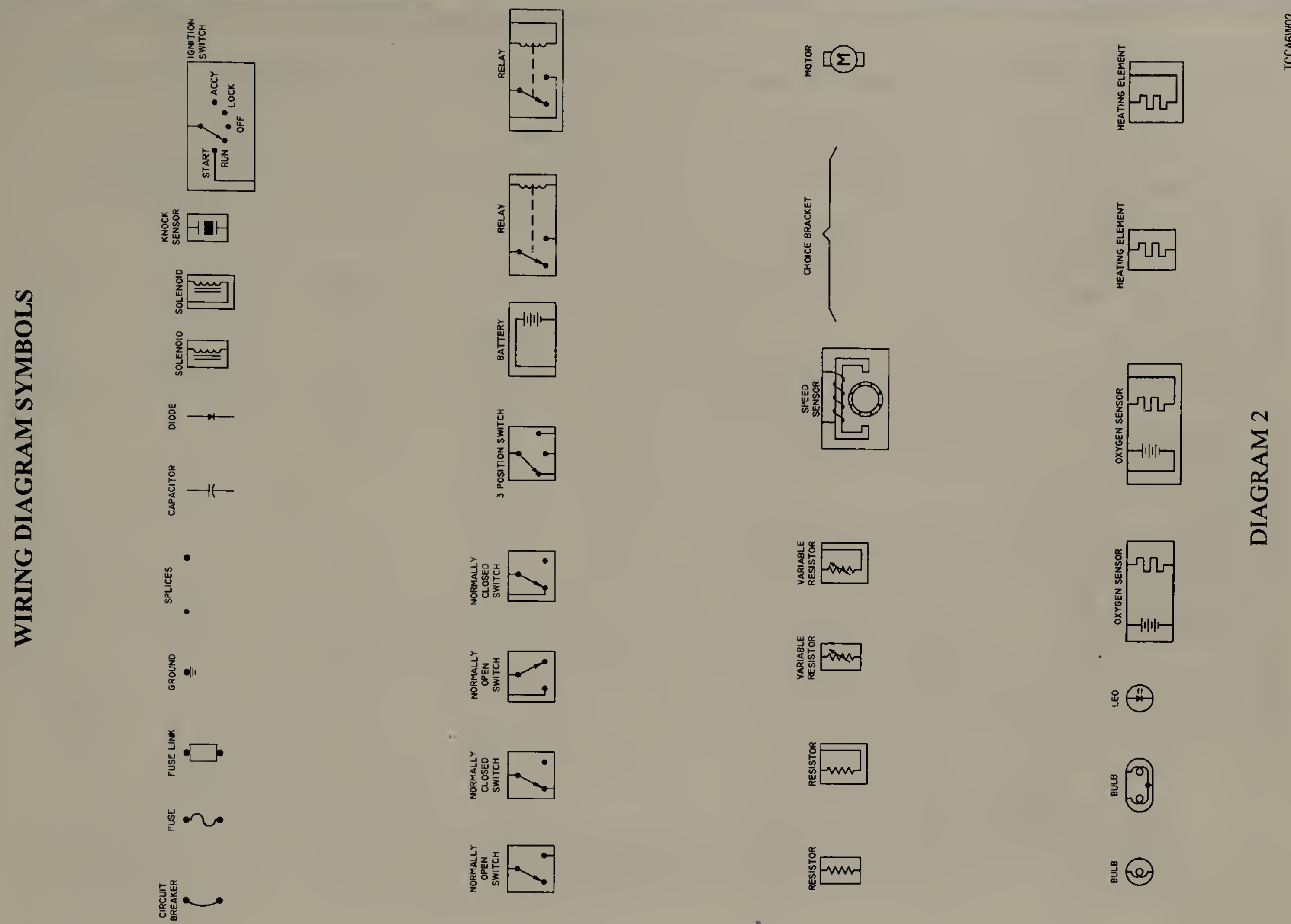
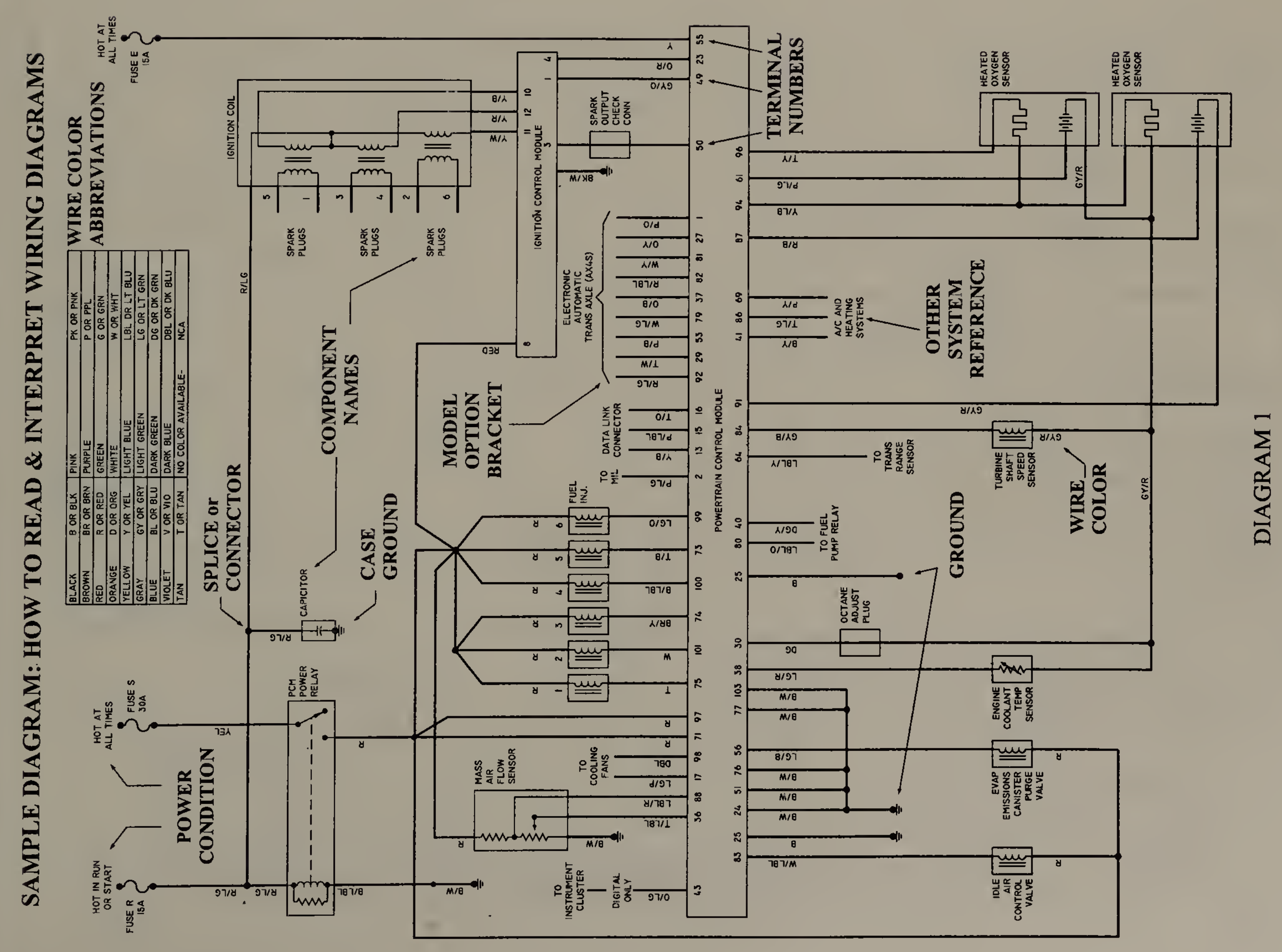


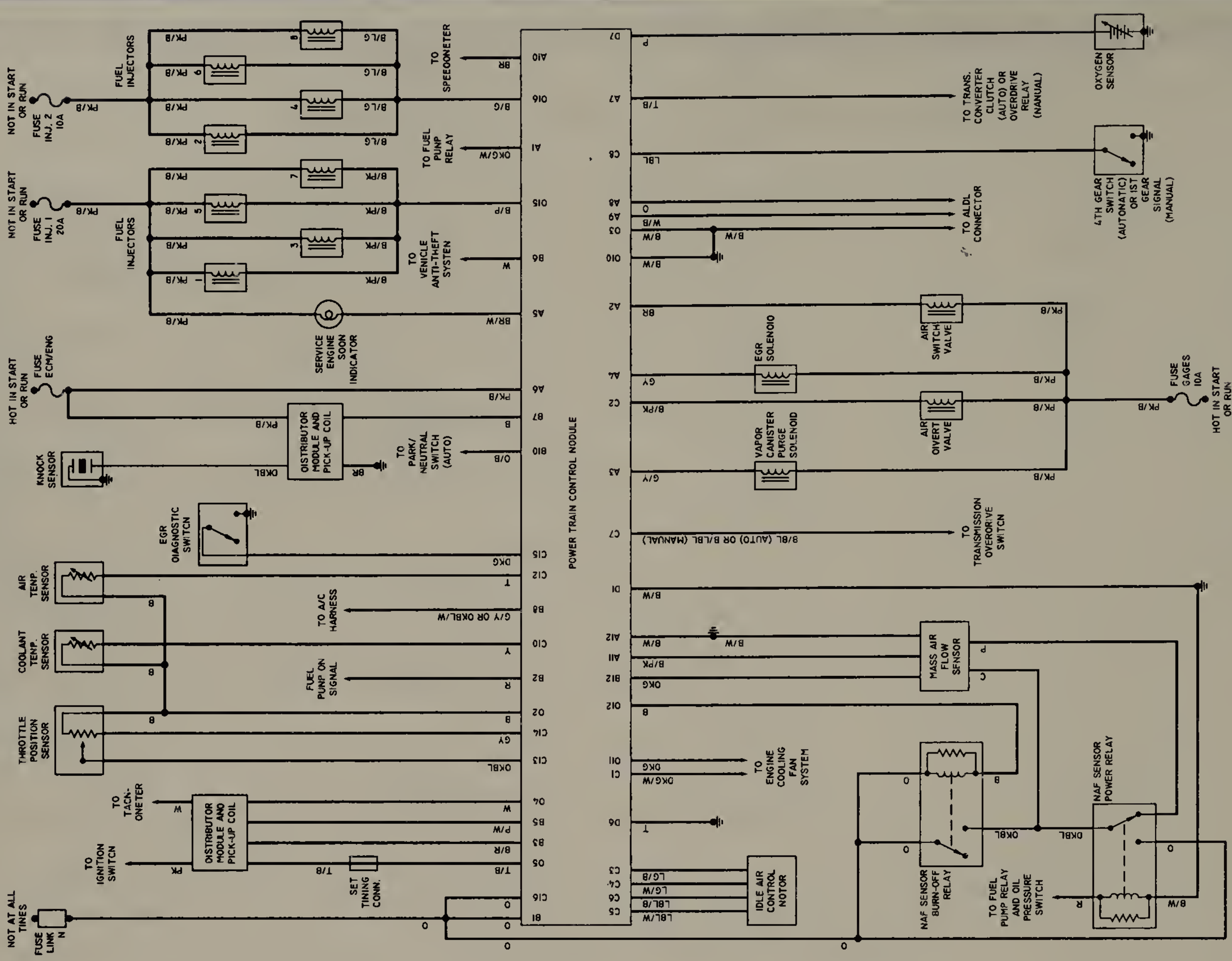
DIAGRAM 2



WIRE COLOR ABBREVIATIONS

BLACK	B OR BLK	PINK	PK OR PNK
BROWN	BR OR BRN	PURPLE	P OR PPL
RED	R OR RED	GREEN	G OR GRN
ORANGE	D OR ORG	WHITE	W OR WHT
YELLOW	Y OR YEL	LIGHT BLUE	LBL OR LT BLU
GRAY	GY OR GRY	LIGHT GREEN	LG OR LT GRN
BLUE	BL OR BLU	DARK GREEN	DG OR DK GRN
VIOLET	V OR VIO	DARK BLUE	DBL OR DK BLU
TAN	T OR TAN	NO COLOR AVAILABLE-	NCA

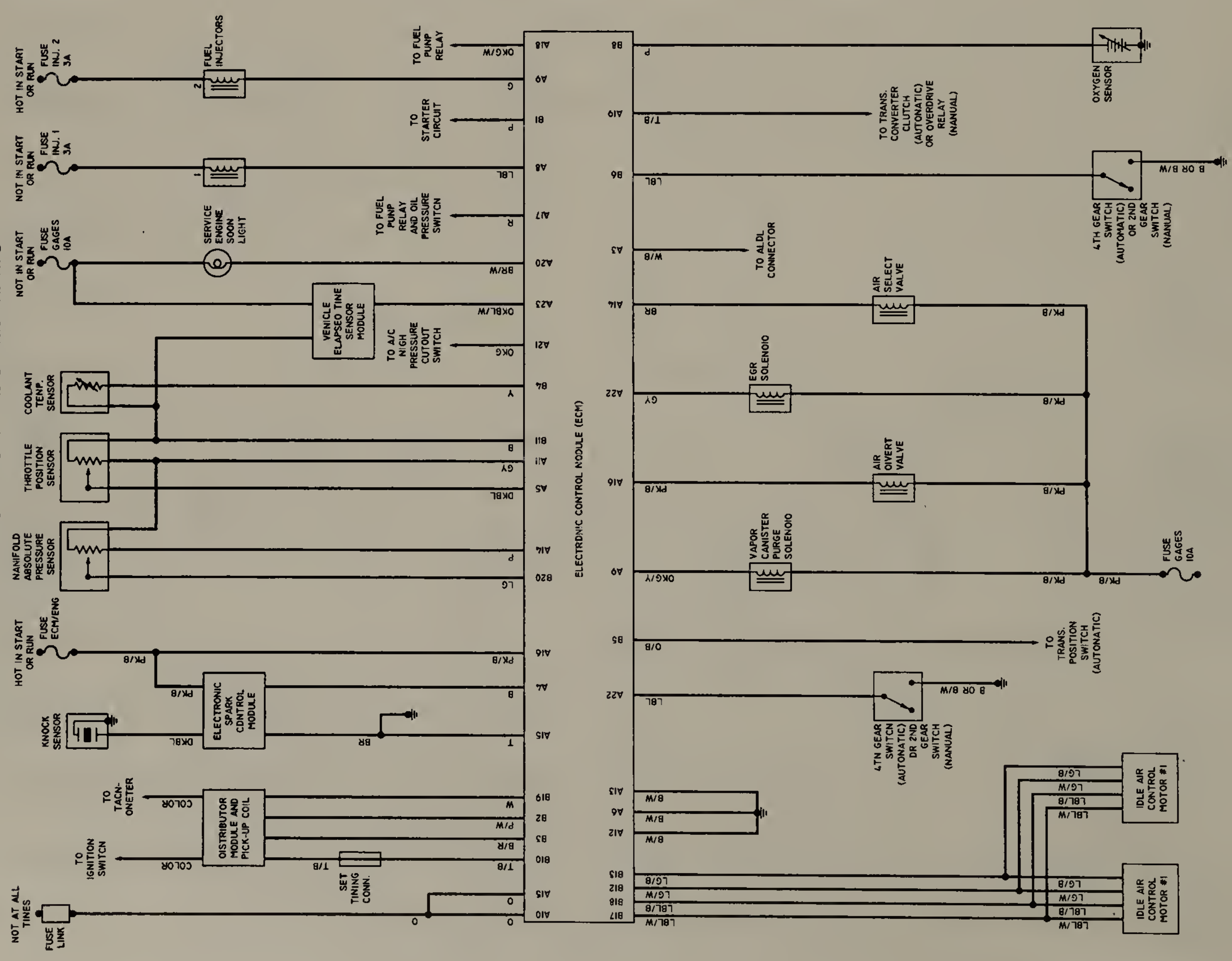
DIAGRAM 1



1985-1989 5.7L TPI VIN 8 ENGINE SCHEMATIC

DIAGRAM 4

91036E02

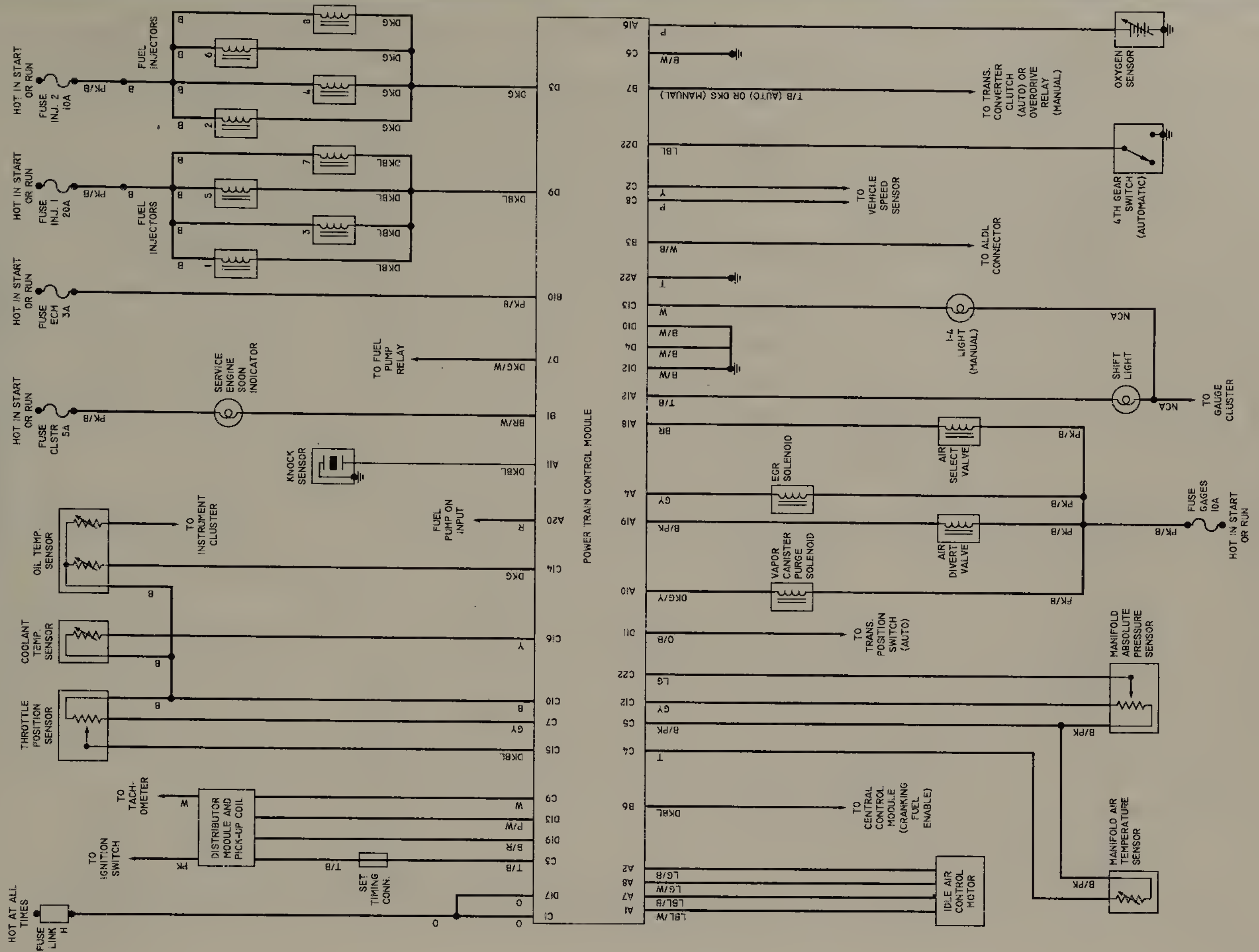


1984 5.7L TBI VIN 8 ENGINE SCHEMATIC

DIAGRAM 3

91036E01

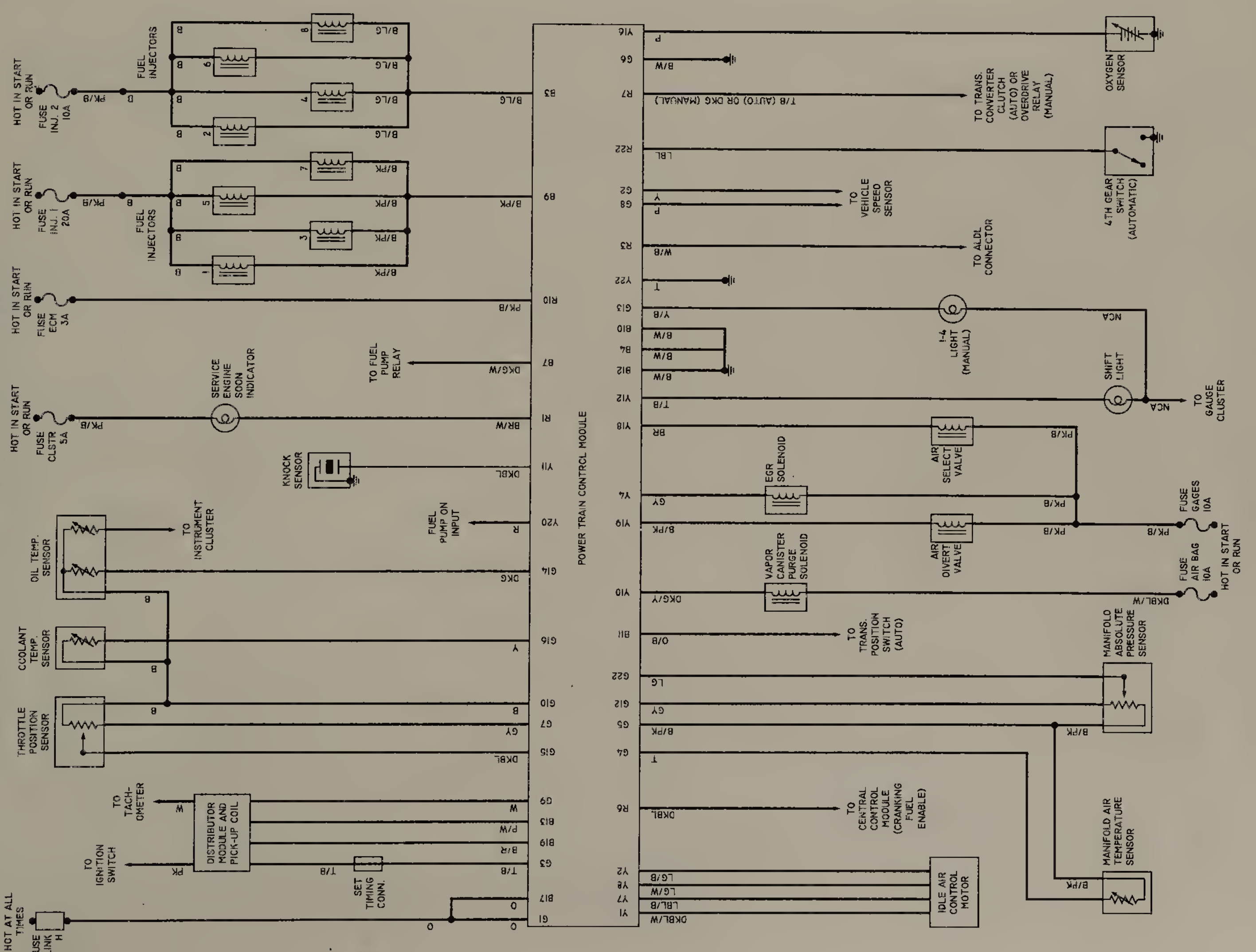
1991 5.7L TPI VIN 8 ENGINE SCHEMATIC



91036E04

DIAGRAM 6

1990 5.7L TPI VIN 8 ENGINE SCHEMATIC



91036E03

DIAGRAM 5

1992-95 5.7L MFI VIN P ENGINE SCHEMATIC

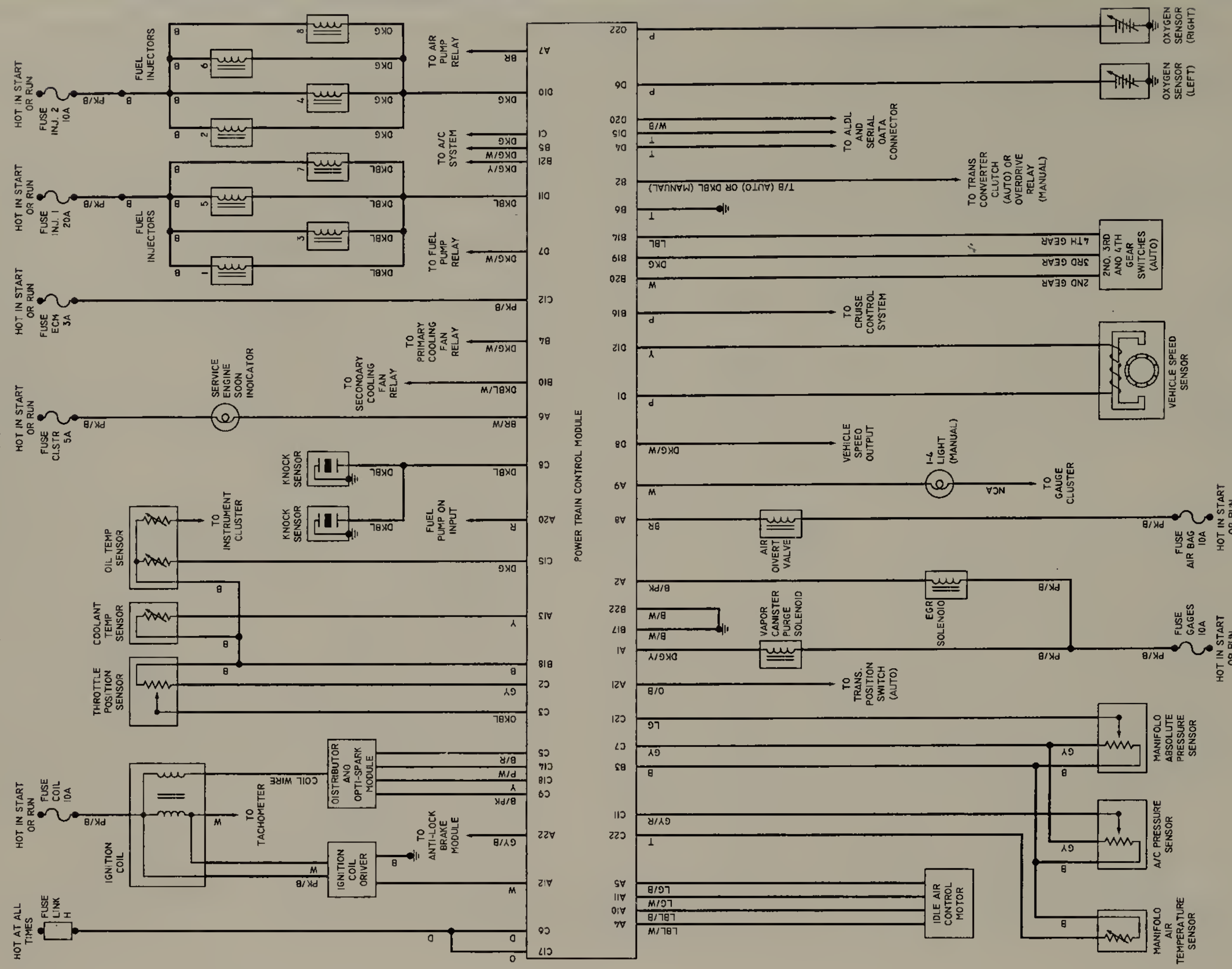


DIAGRAM 8

91036E06

1990-1995 5.7L MFI VIN J ENGINE SCHEMATIC

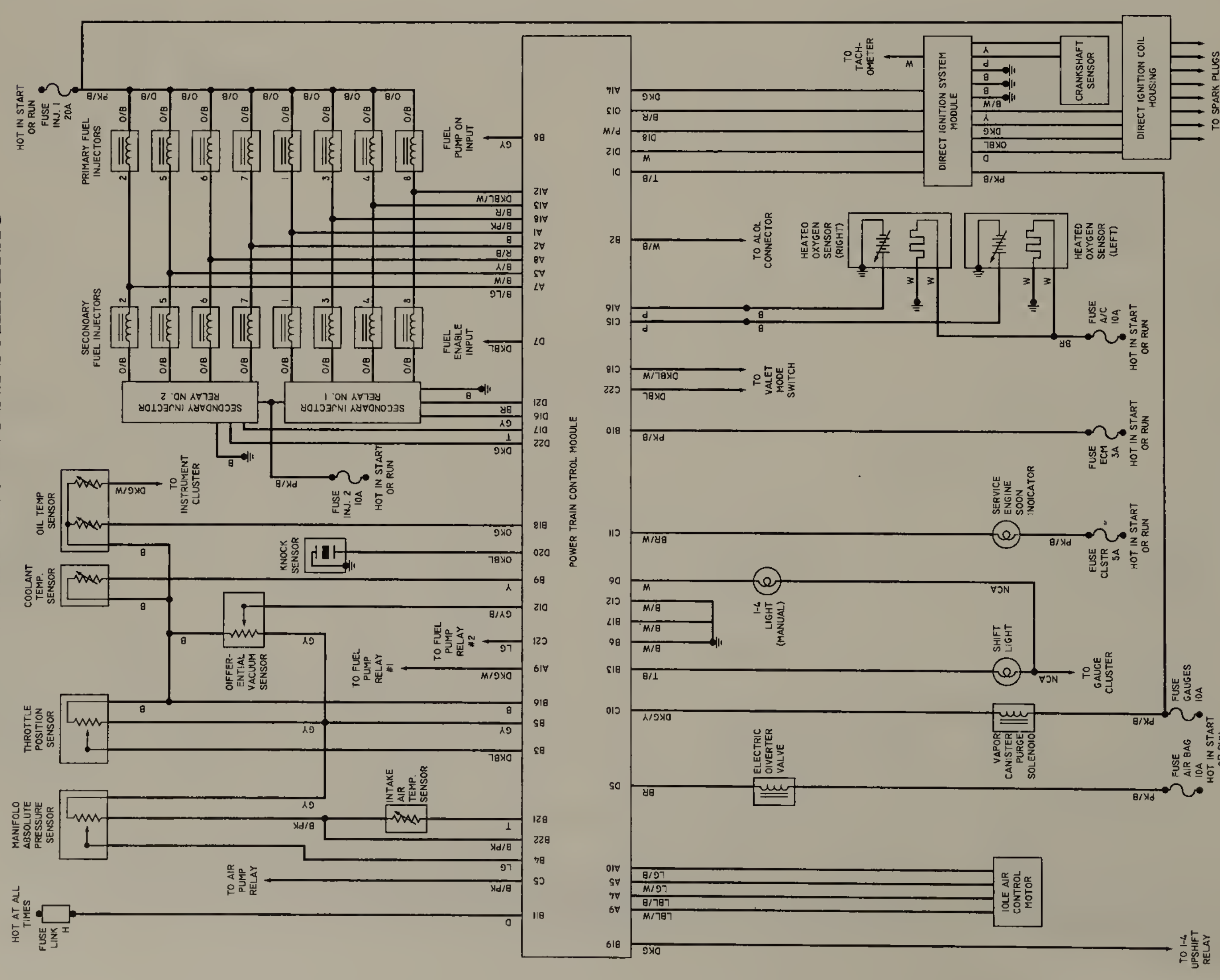
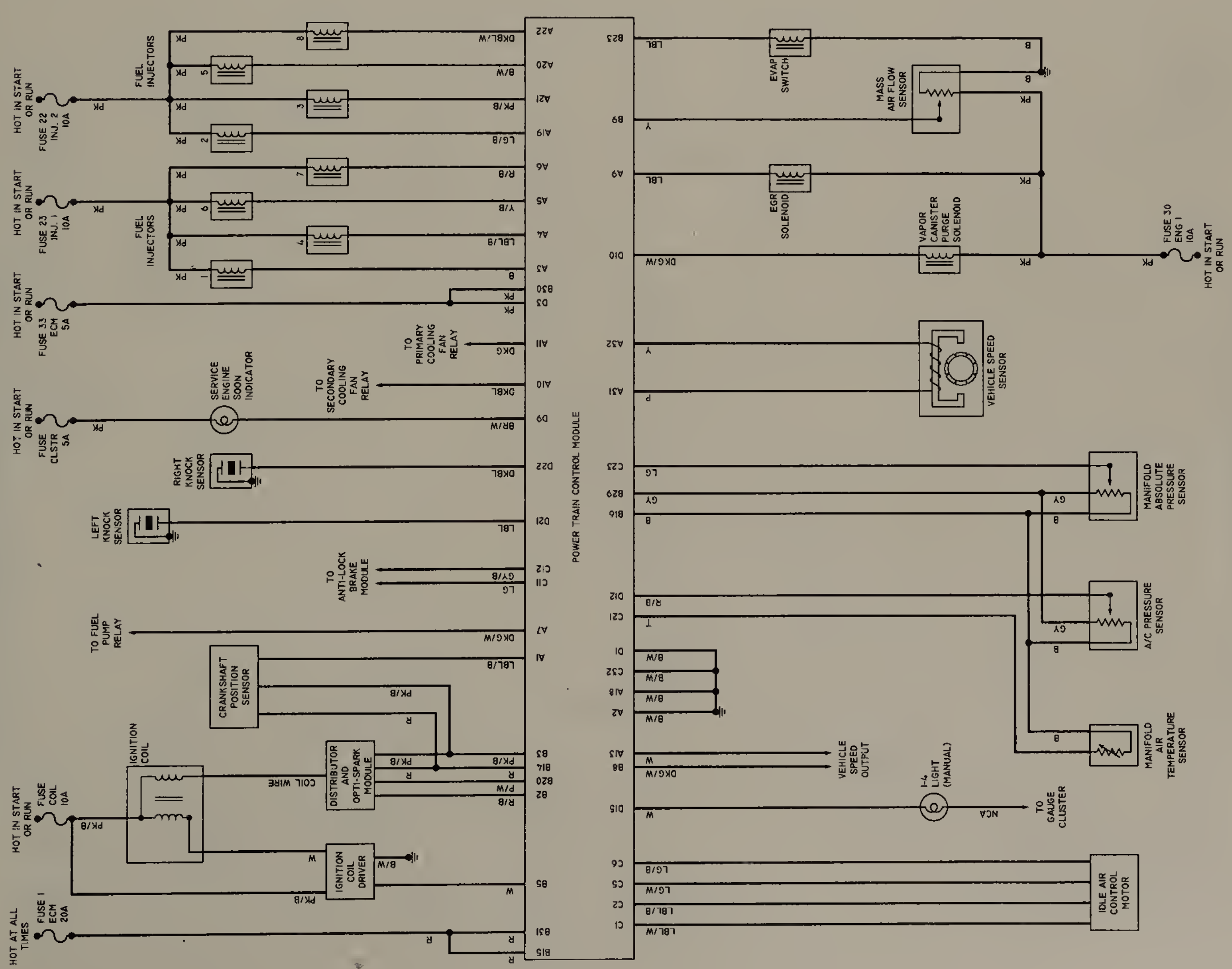


DIAGRAM 7

91036E05

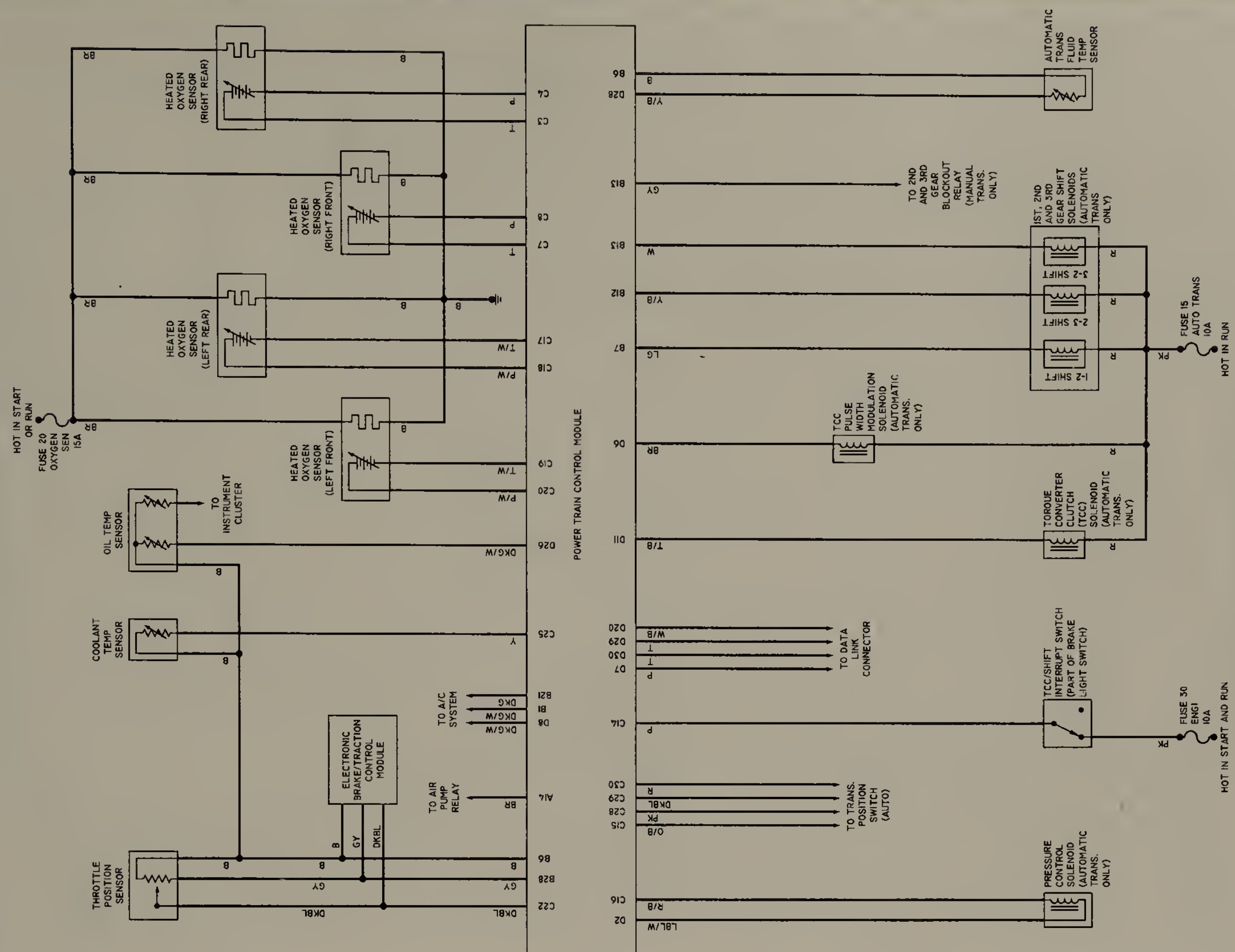
1996 5.7L MFI ENGINE SCHEMATIC (PAGE 1 OF 2)



91036E07

DIAGRAM 9

1996 5.7L MFI ENGINE SCHEMATIC (PAGE 2 OF 2)



91036E08

DIAGRAM 10

1986-88 CORVETTE CHASSIS SCHEMATIC

MULTI-PORT FUEL INJECTION: V8 VIN 8

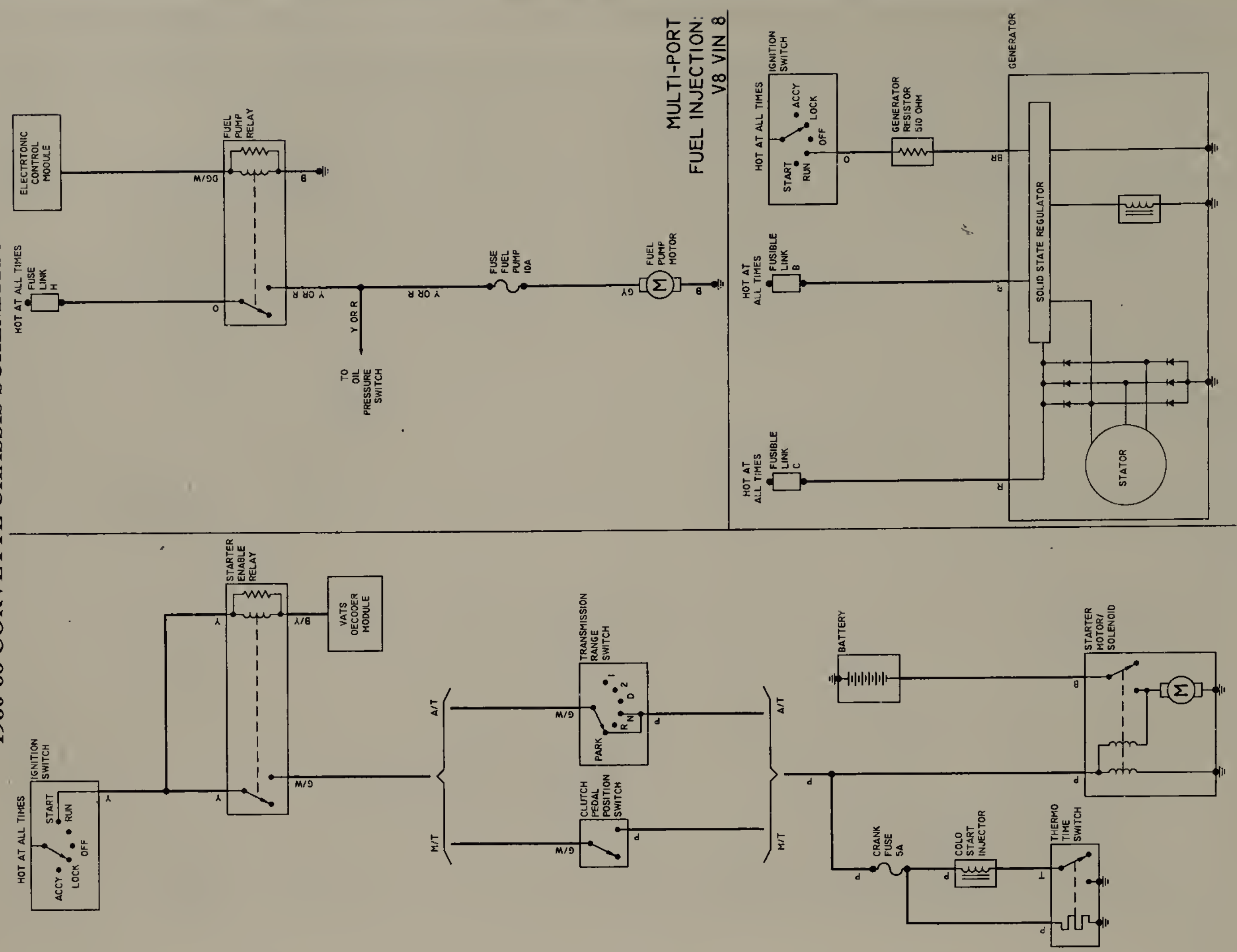


DIAGRAM 12

91036B14

1984-85 CORVETTE CHASSIS SCHEMATIC

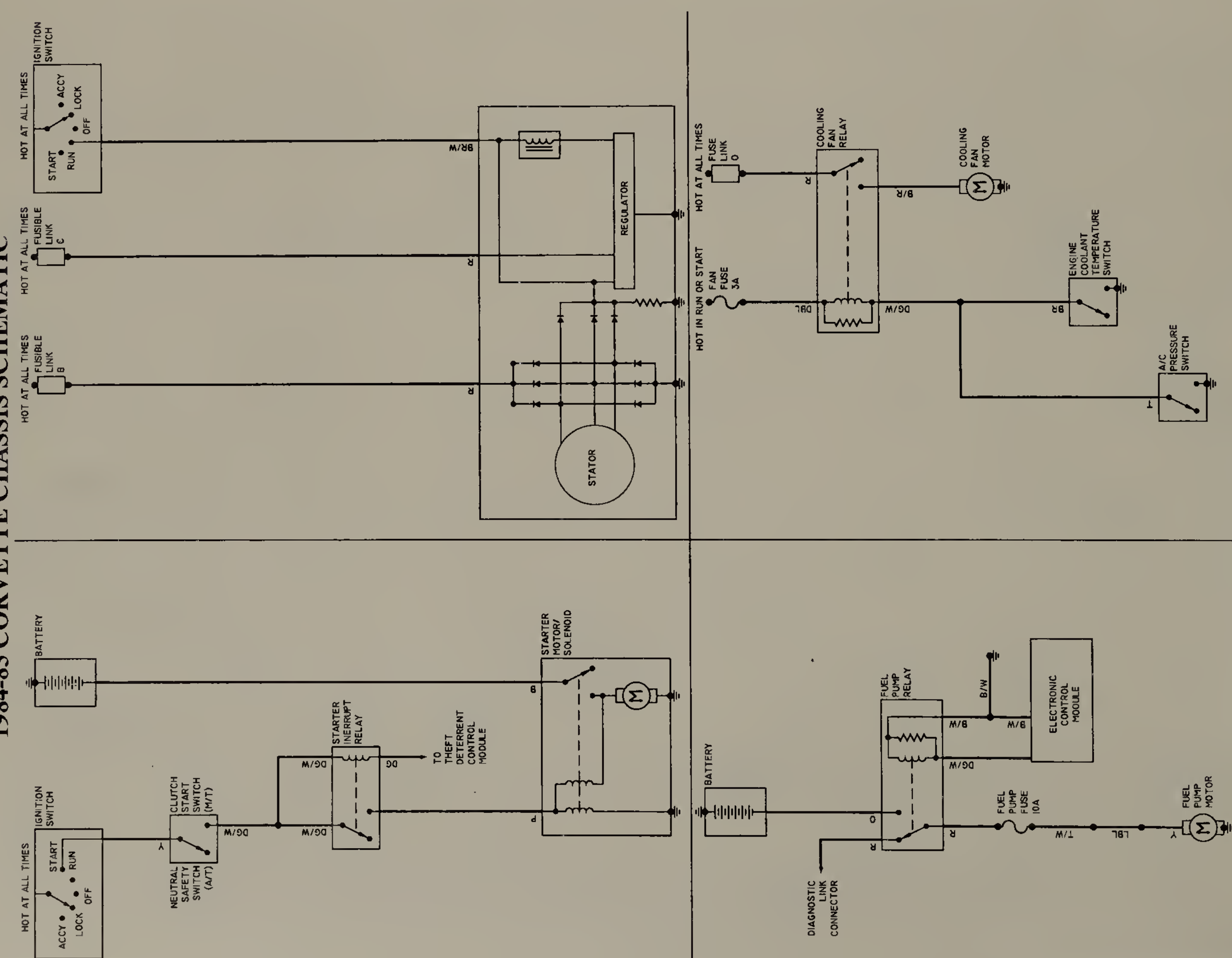


DIAGRAM 11

91036B10

1984-89 CORVETTE CHASSIS SCHEMATIC

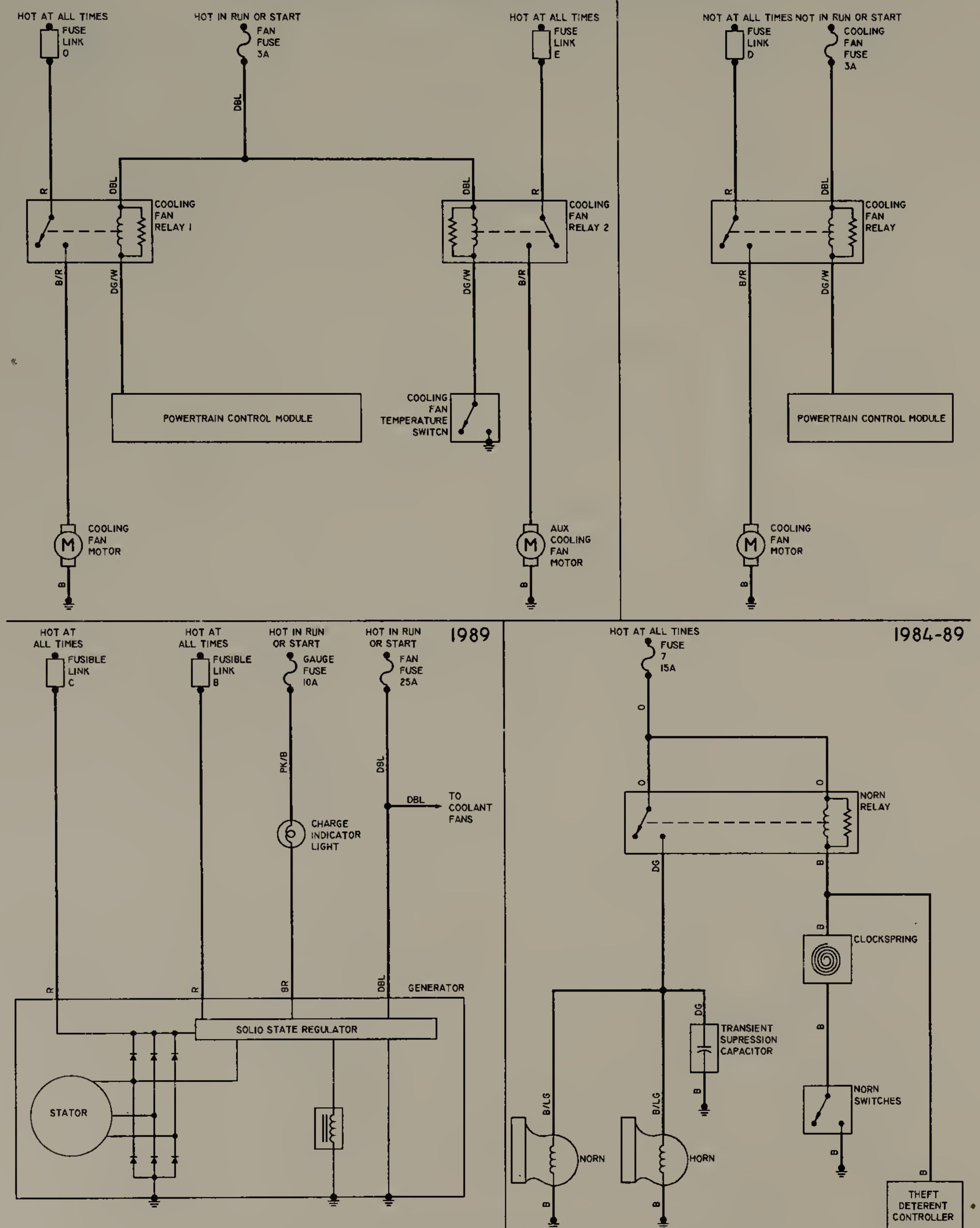


DIAGRAM 13

91036B15

1989-92 CORVETTE CHASSIS SCHEMATIC

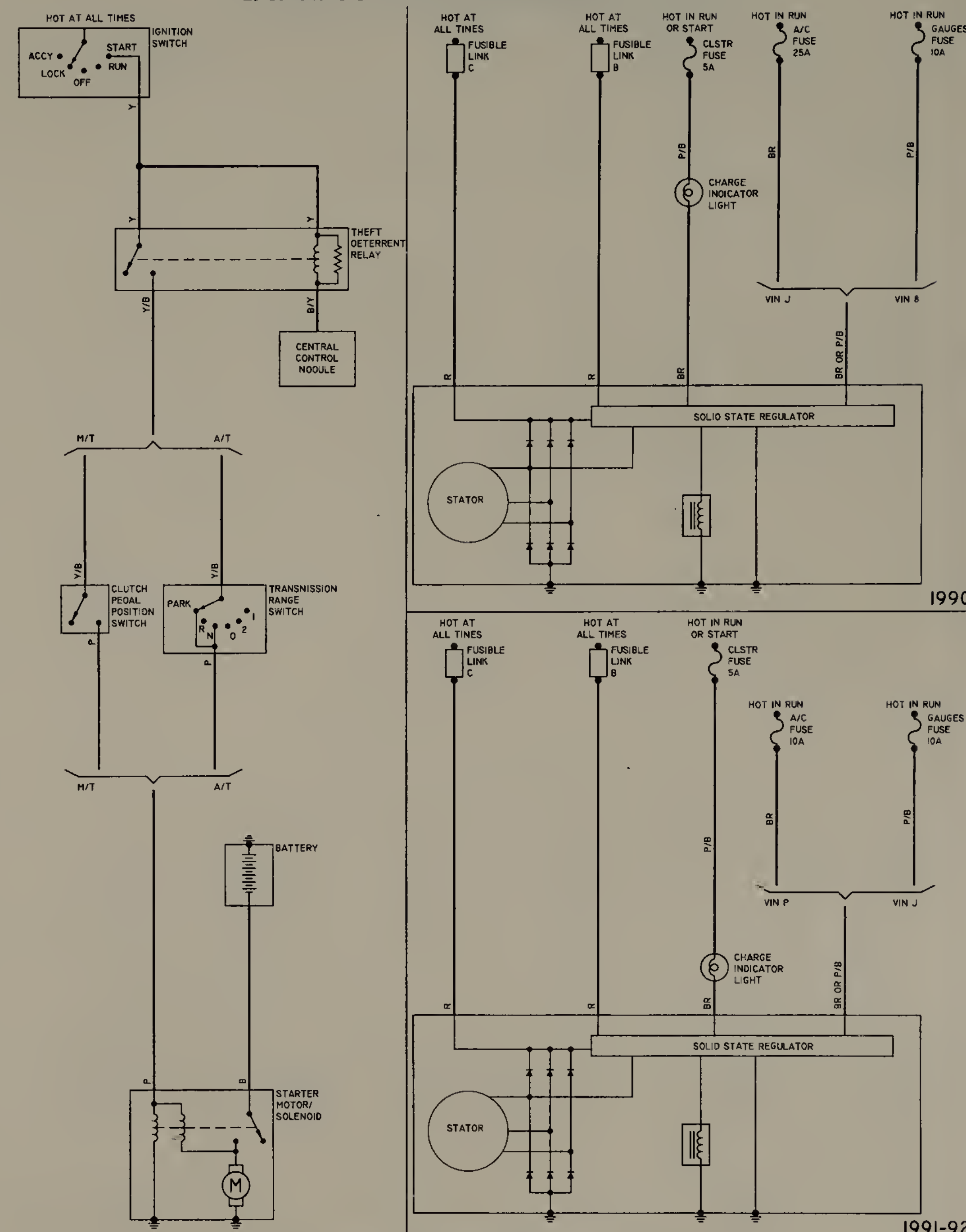


DIAGRAM 14

91036B09

1984-88 CORVETTE CHASSIS SCHEMATIC

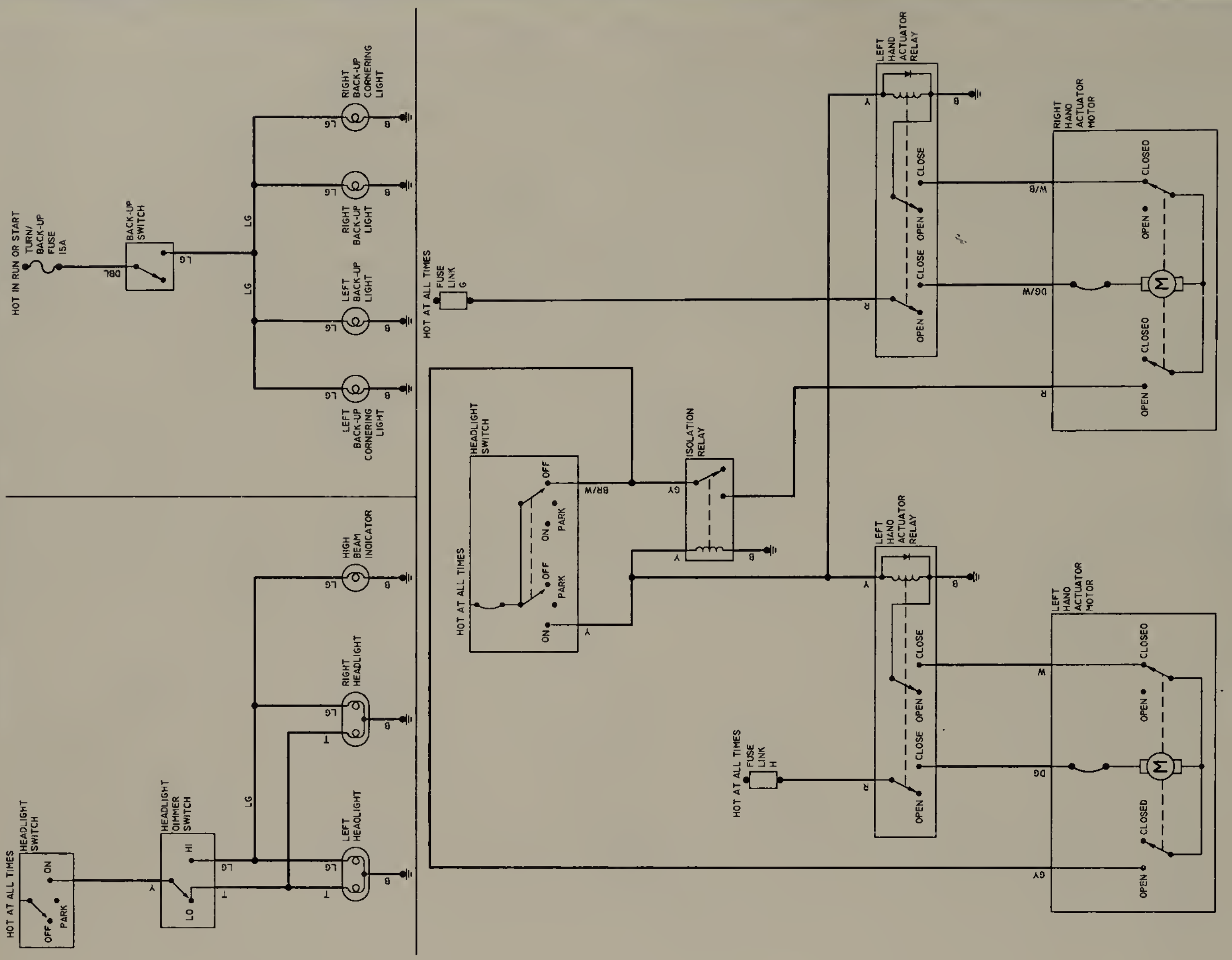


DIAGRAM 16

91036B11

1993-96 CORVETTE CHASSIS SCHEMATIC

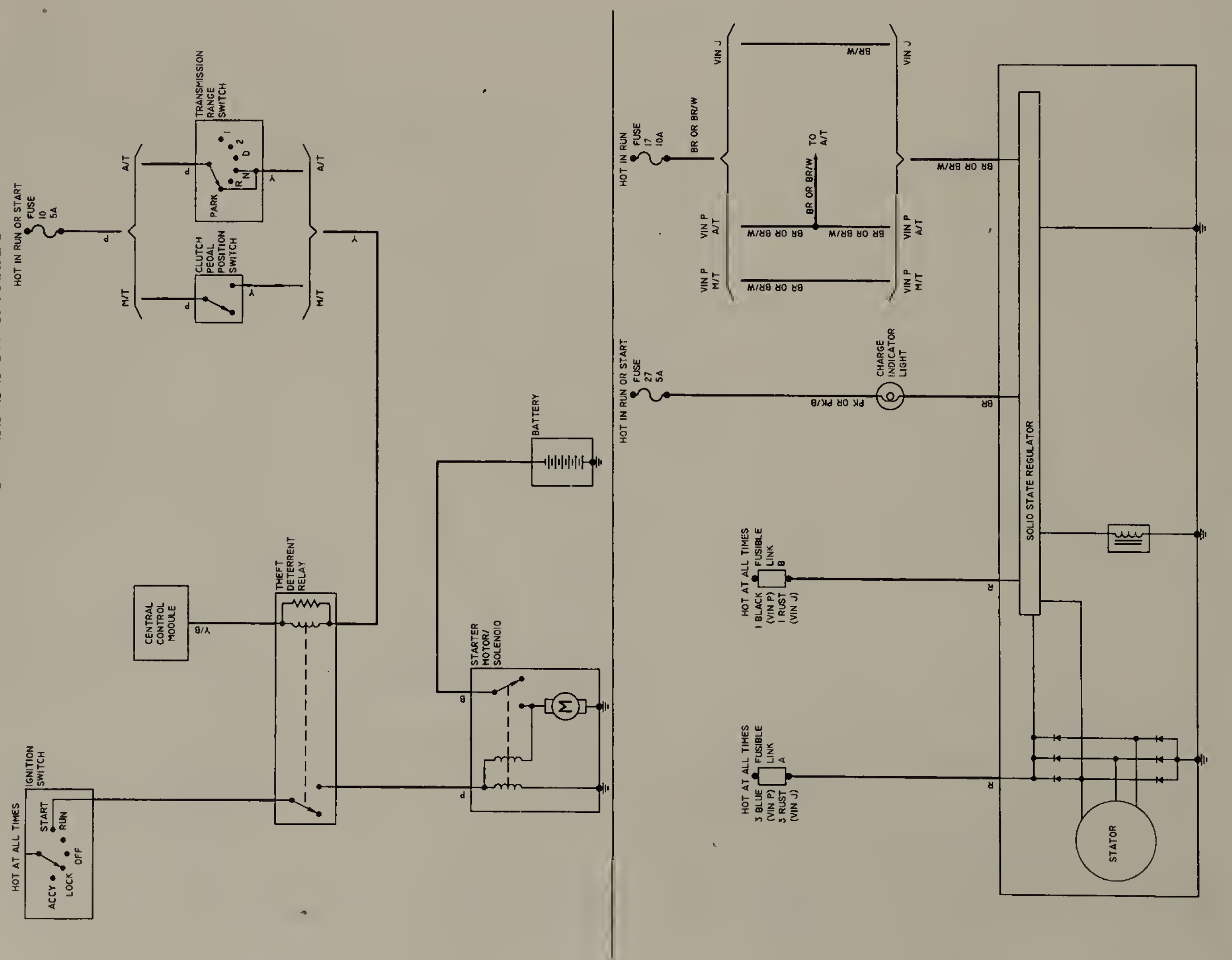


DIAGRAM 15

91036B01

1984-85 CORVETTE CHASSIS SCHEMATIC

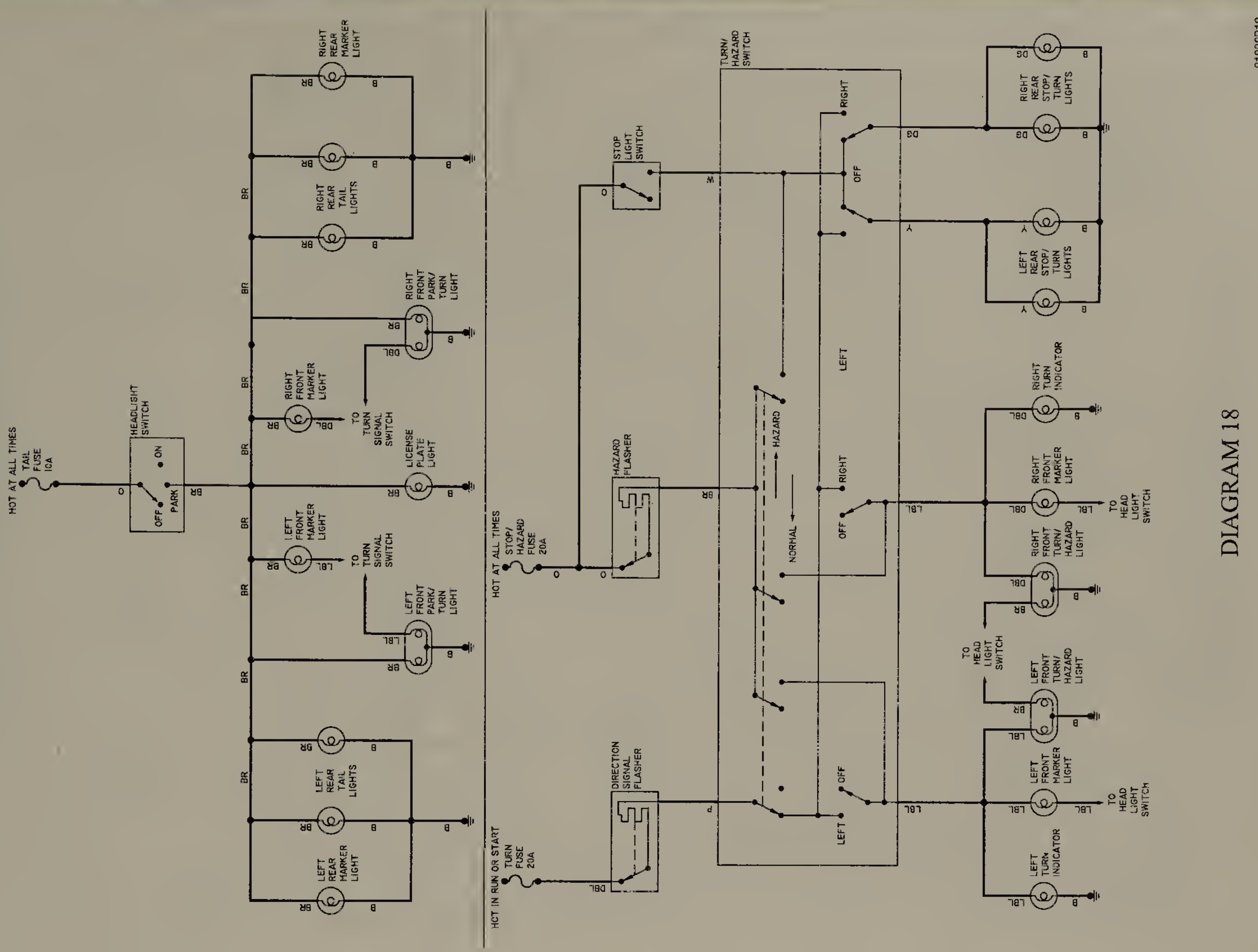


DIAGRAM 18

1989 CORVETTE CHASSIS SCHEMATIC

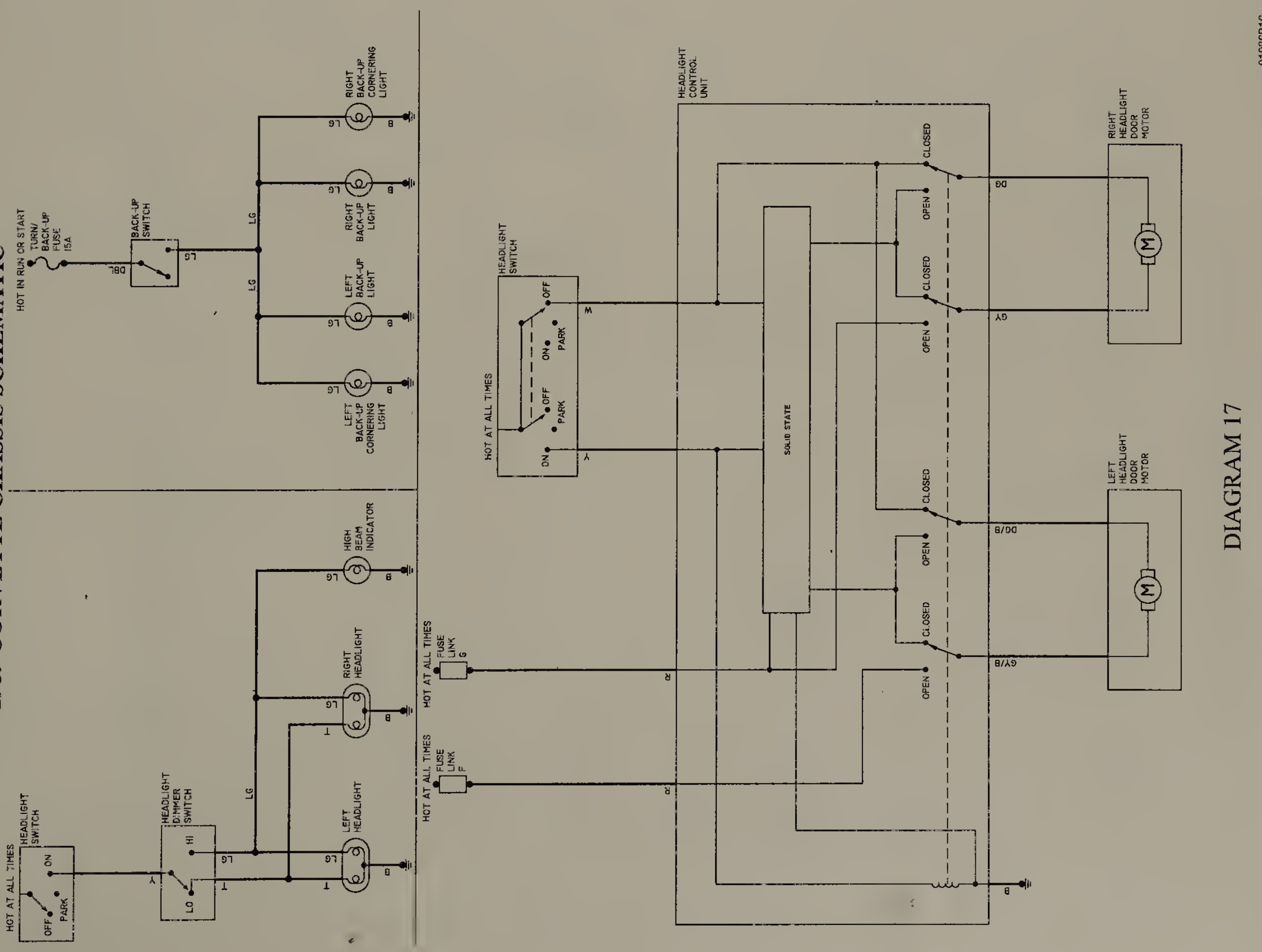
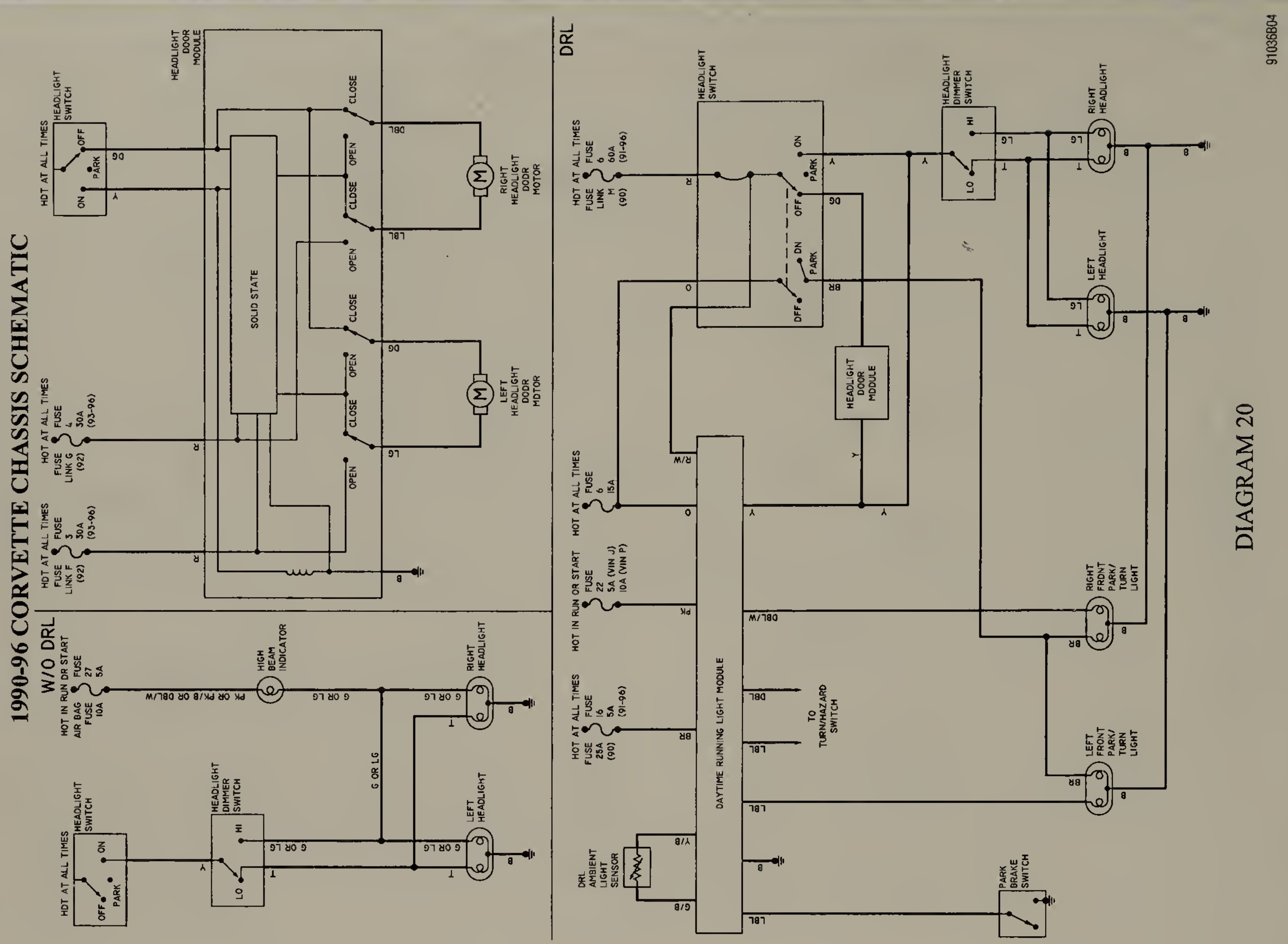
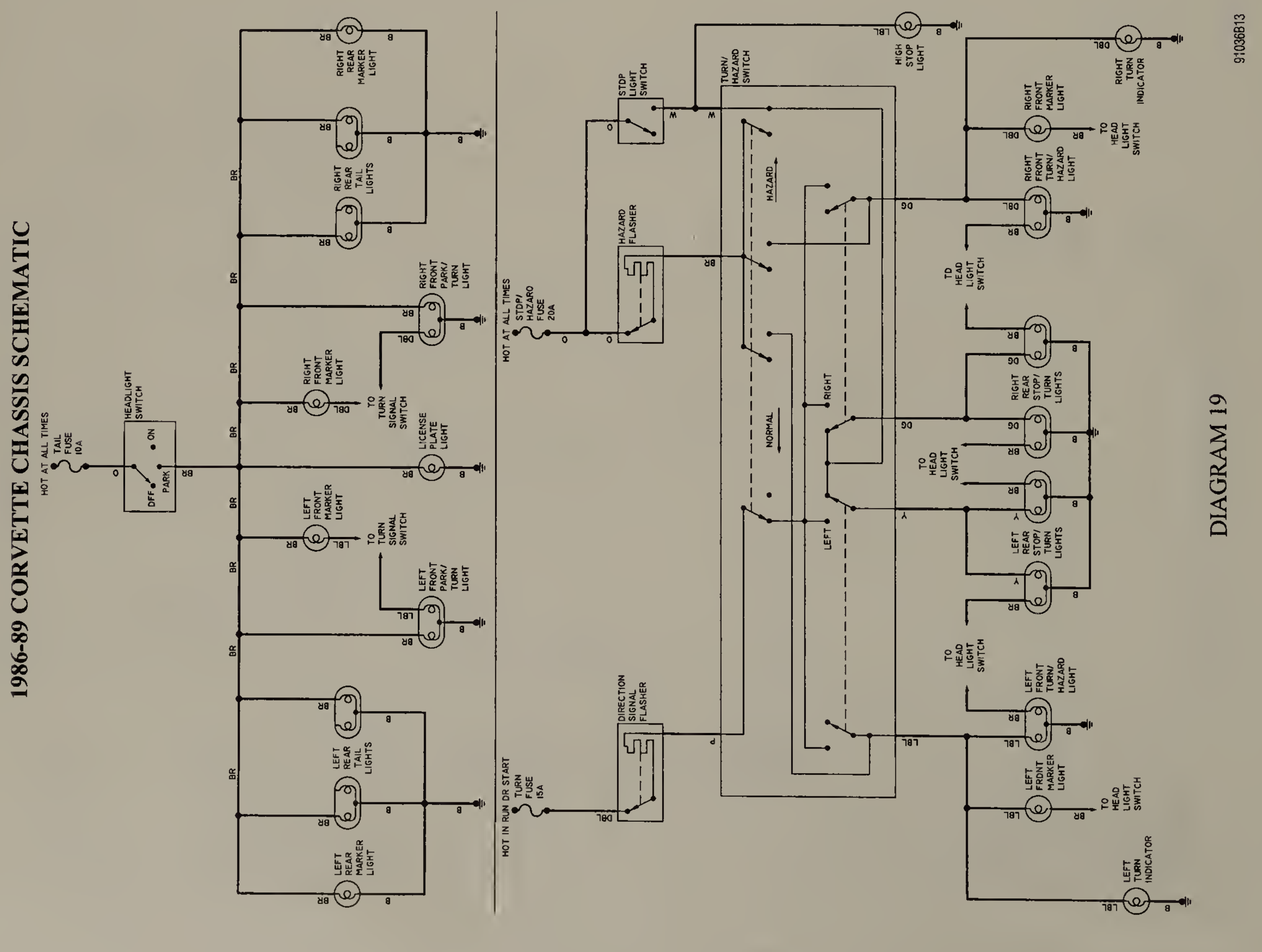
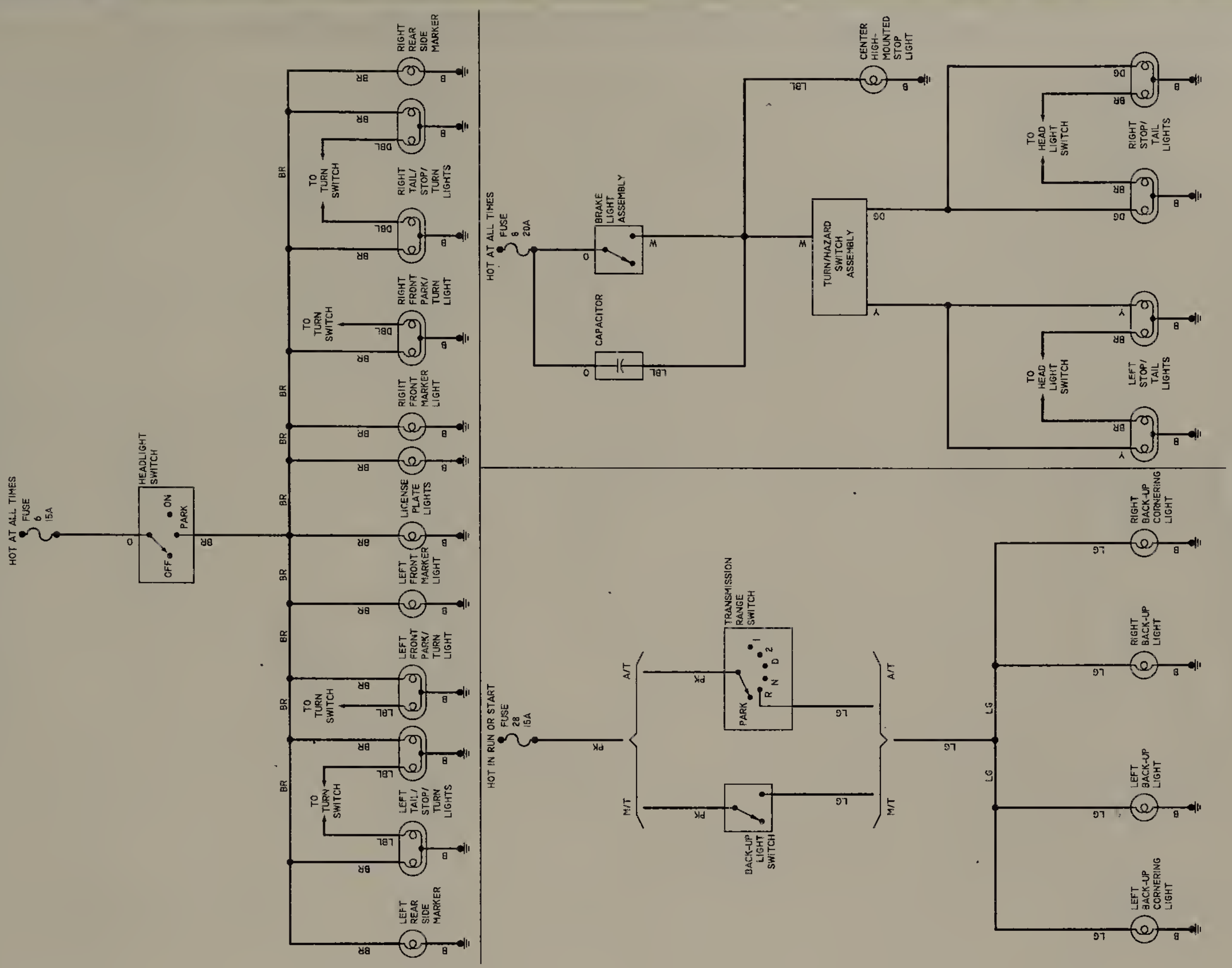


DIAGRAM 17


1990-96 CORVETTE CHASSIS SCHEMATIC
W/O DRL
DRL
HEADLIGHT SWITCH
HEADLIGHT DOOR MODULE
SOLID STATE
RIGHT HEADLIGHT DOOR MOTOR
LEFT HEADLIGHT DOOR MOTOR
HIGH BEAM INDICATOR
HEADLIGHT DIMMER SWITCH
RIGHT HEADLIGHT
LEFT HEADLIGHT
DAYTIME RUNNING LIGHT MODULE
DRL AMBIENT LIGHT SENSOR
TO TURN/HAZARD SWITCH
RIGHT FRONT PARK/TURN LIGHT
LEFT FRONT PARK/TURN LIGHT
PARK BRAKE SWITCH
DIAGRAM 20
91036B04


1986-89 CORVETTE CHASSIS SCHEMATIC
HOT AT ALL TIMES
TAIL FUSE 10A
HEADLIGHT SWITCH
RIGHT REAR MARKER LIGHT
RIGHT REAR TAIL LIGHTS
RIGHT FRONT PARK/TURN LIGHT
RIGHT FRONT MARKER LIGHT
LICENSE PLATE LIGHT
LEFT FRONT MARKER LIGHT
LEFT FRONT PARK/TURN LIGHT
LEFT REAR TAIL LIGHTS
LEFT REAR MARKER LIGHT
STOP/HAZARD FUSE 20A
TURN FUSE 15A
STOP LIGHT SWITCH
HAZARD FLASHER
DIRECTION SIGNAL FLASHER
TURN/HAZARD SWITCH
HIGH STOP LIGHT
RIGHT TURN INDICATOR
LEFT TURN INDICATOR
DIAGRAM 19
91036B13

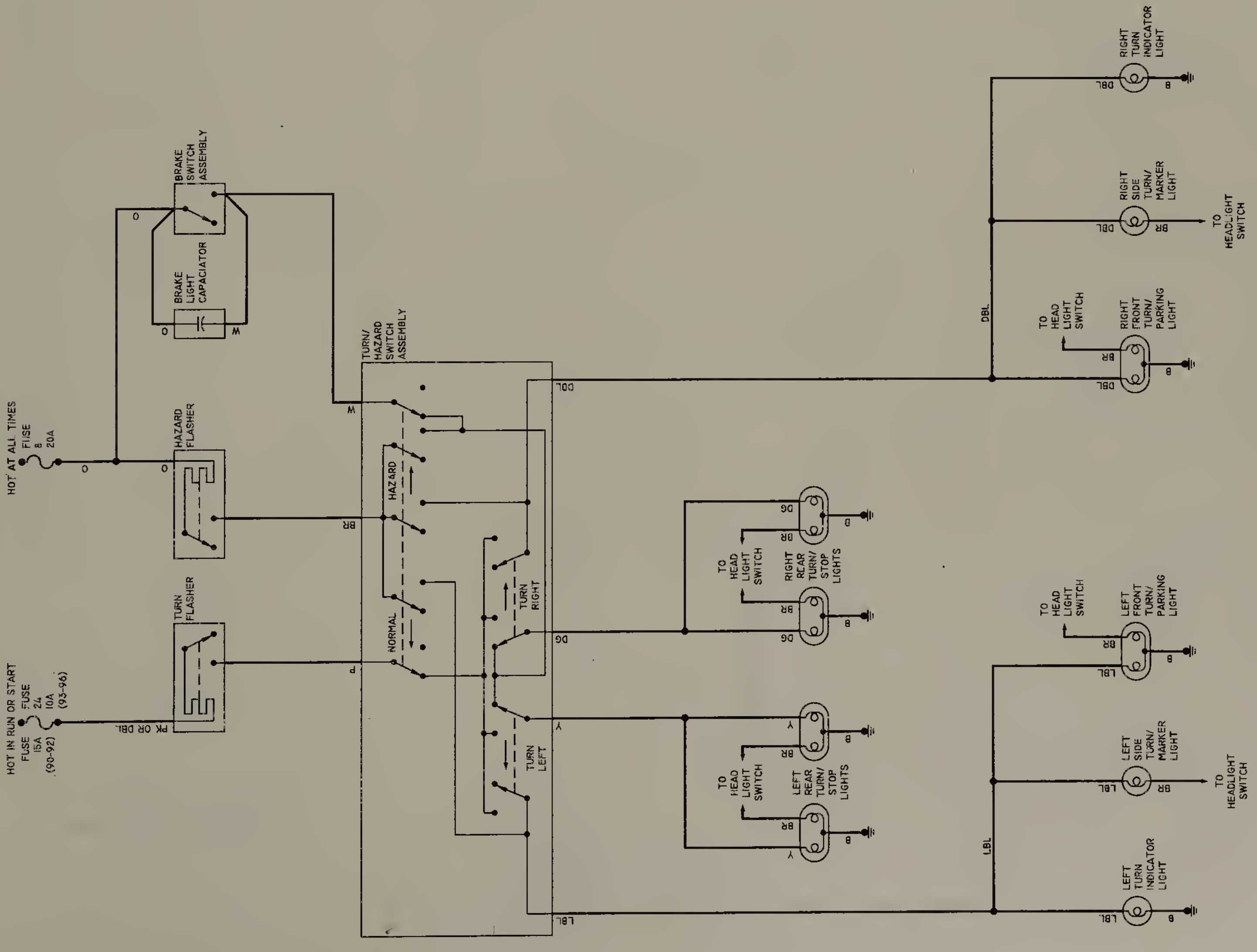
1990-96 CORVETTE CHASSIS SCHEMATIC



91036B06

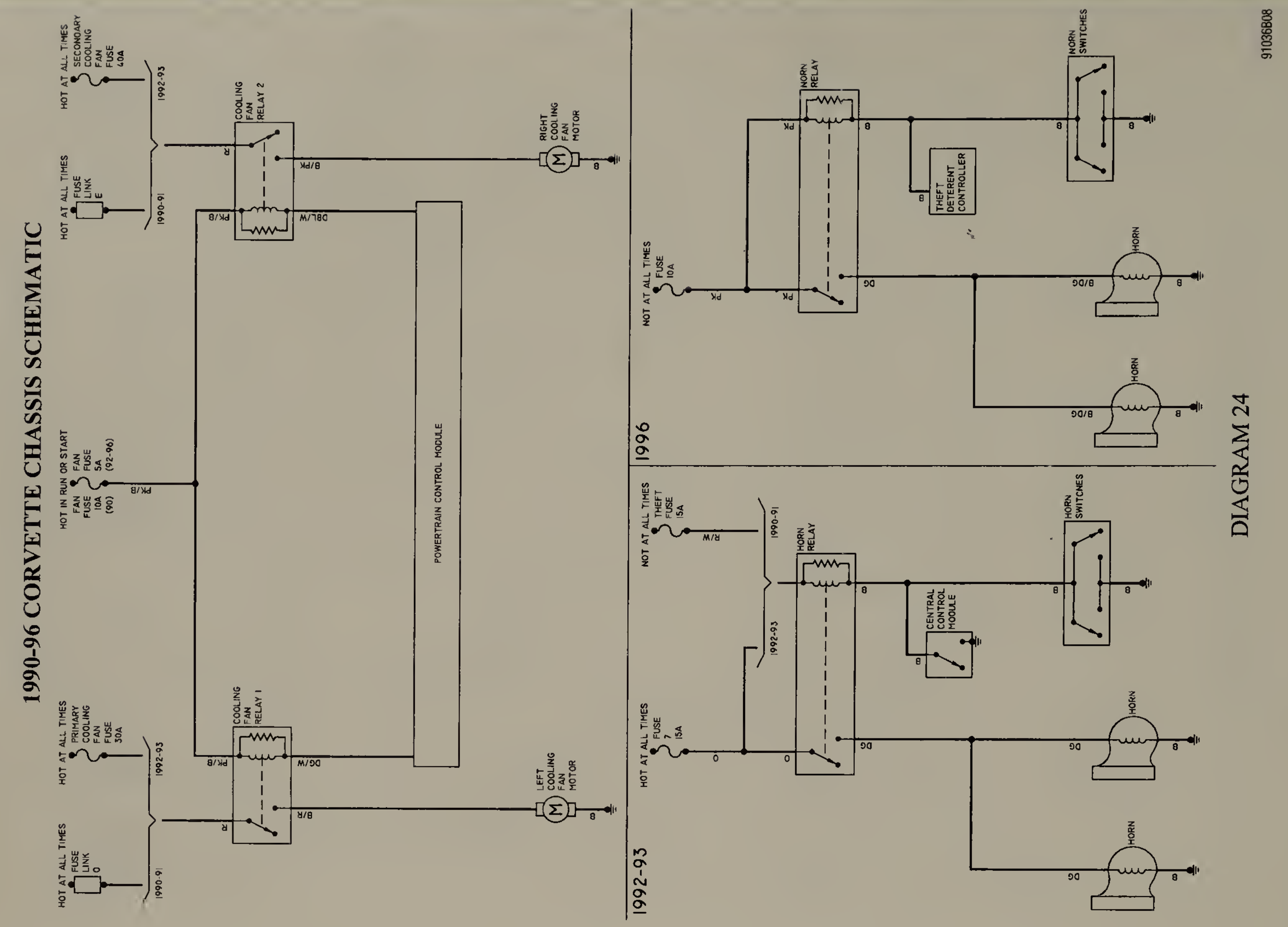
DIAGRAM 22

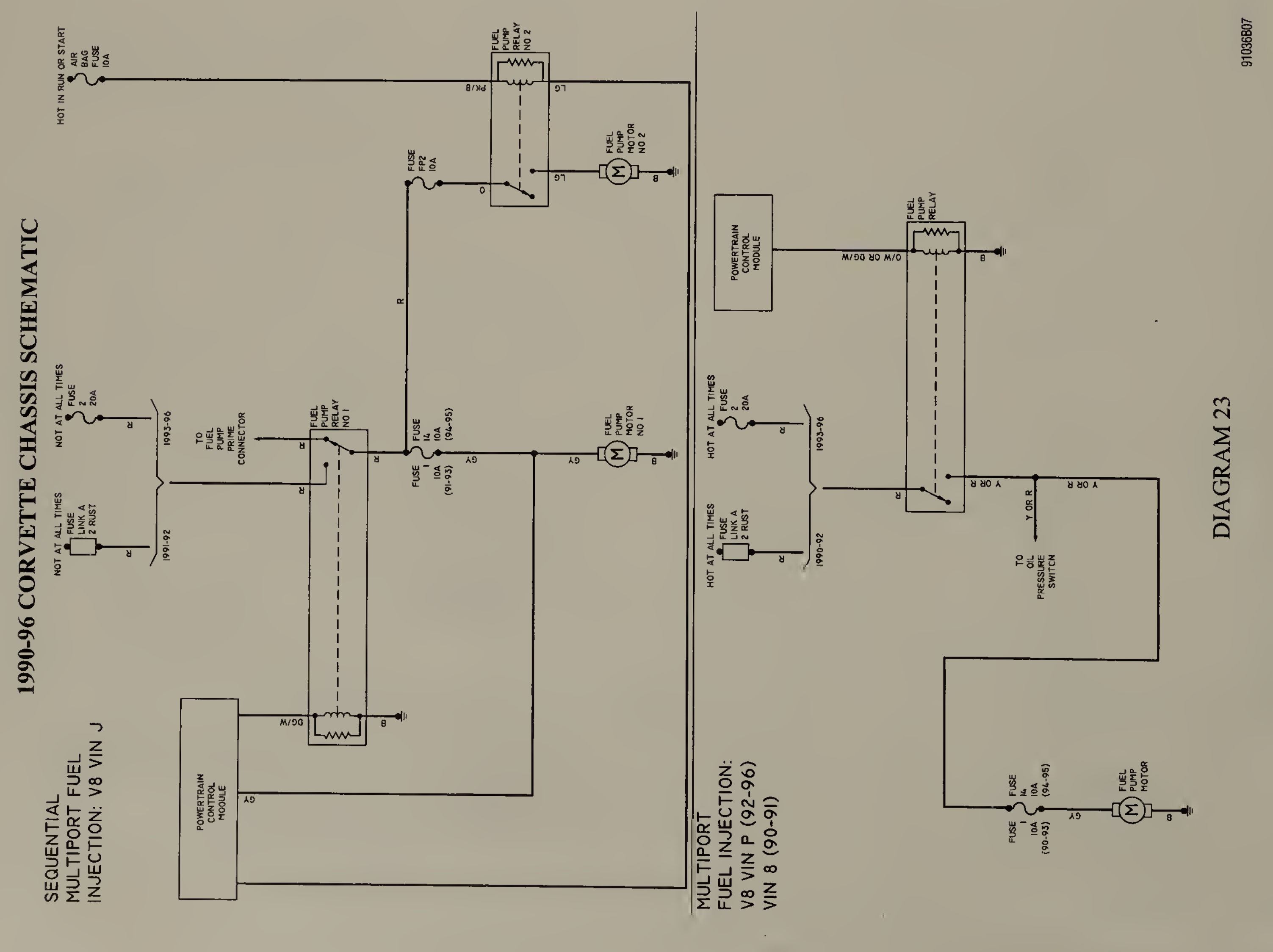
1990-96 CORVETTE CHASSIS SCHEMATIC



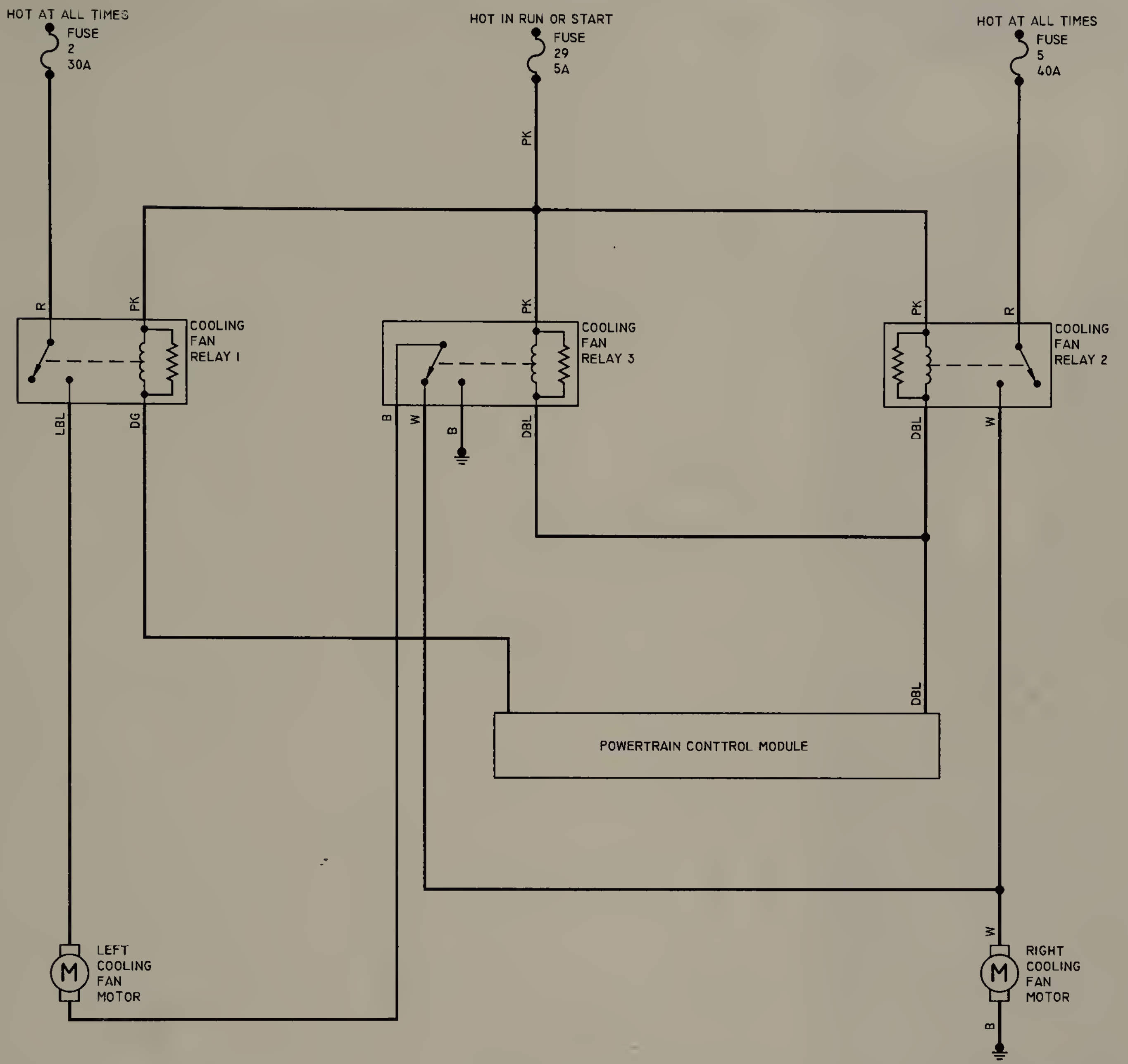
91036B05

DIAGRAM 21


1990-96 CORVETTE CHASSIS SCHEMATIC
POWERTRAIN CONTROL MODULE
1992-93
1996
DIAGRAM 24
91036B08


1990-96 CORVETTE CHASSIS SCHEMATIC
SEQUENTIAL MULTIPORT FUEL INJECTION: V8 VIN J
MULTIPORT FUEL INJECTION: V8 VIN P (92-96) VIN 8 (90-91)
POWERTRAIN CONTROL MODULE
DIAGRAM 23
91036B07

1994-95 CORVETTE CHASSIS SCHEMATIC



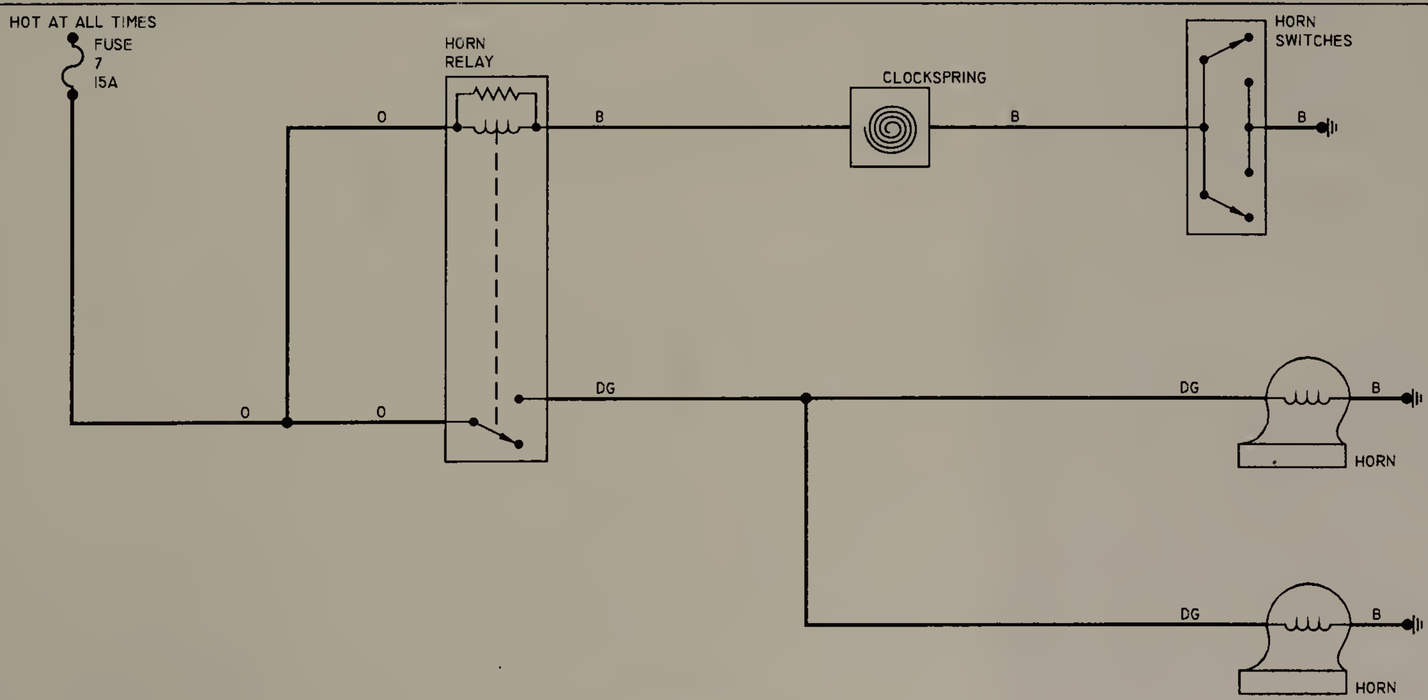


DIAGRAM 25

91036B02

1984-96 CORVETTE CHASSIS SCHEMATIC

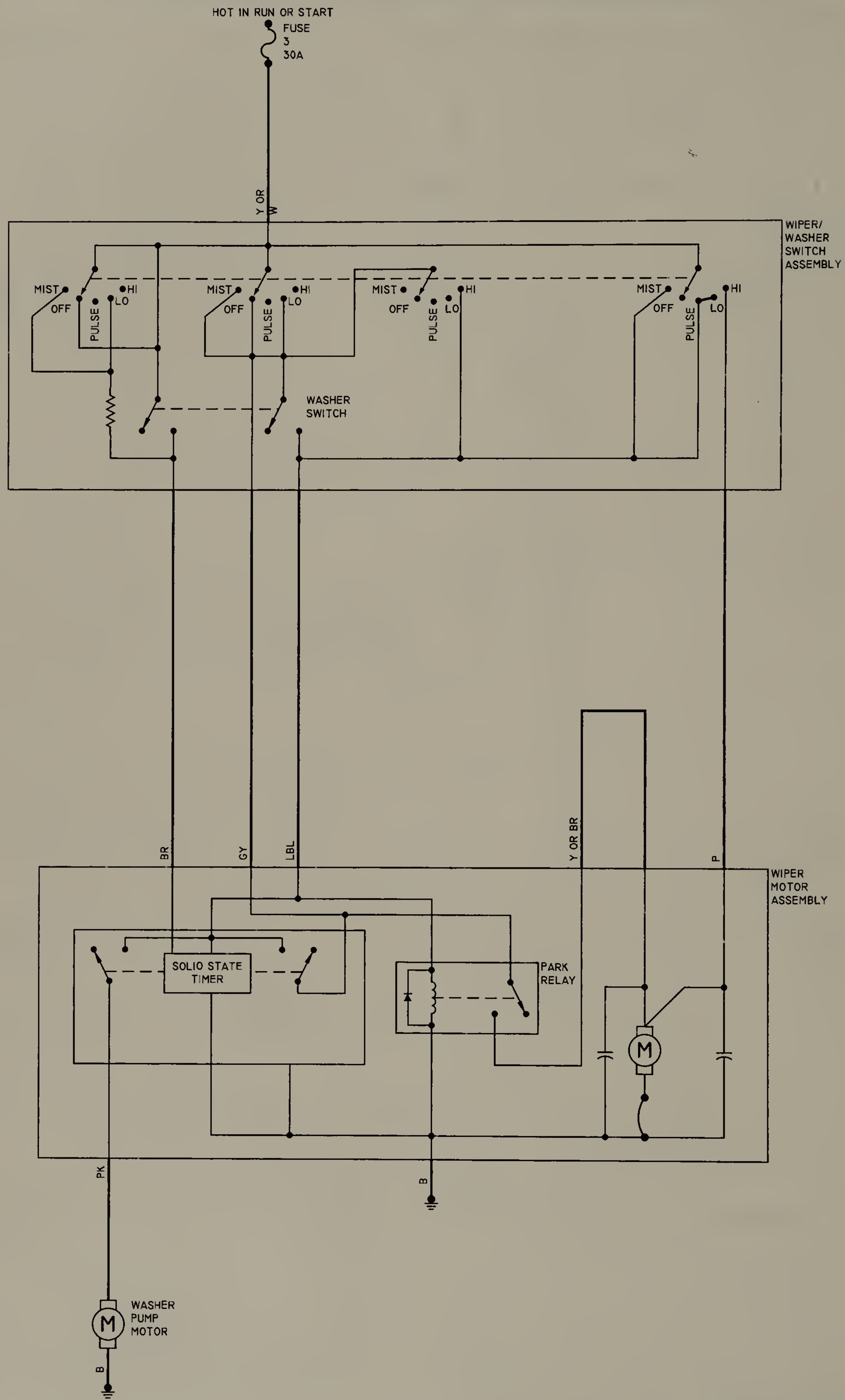


DIAGRAM 26

91036B03

7

DRIVE TRAIN

MANUAL TRANSMISSION

Understanding the Manual Transmission

Because of the way an internal combustion engine breathes, it can produce torque (or twisting force) only within a narrow speed range. Most overhead valve pushrod engines must turn at about 2500 rpm to produce their peak torque. Often by 4500 rpm, they are producing so little torque that continued increases in engine speed produce no power increases.The torque peak on overhead camshaft engines is, generally, much higher, but much narrower.The manual transmission and clutch are employed to vary the relationship between engine RPM and the speed of the wheels so that adequate power can be produced under all circumstances. The clutch allows engine torque to be applied to the transmission input shaft gradually, due to mechanical slippage. The vehicle can, consequently, be started smoothly from a full stop.The transmission changes the ratio between the rotating speeds of the engine and the wheels by the use of gears. 4-speed or 5-speed transmissions are most common. The lower gears allow full engine power to be applied to the rear wheels during acceleration at low speeds.The clutch driveplate is a thin disc, the center of which is splined to the transmission input shaft. Both sides of the disc are covered with a layer of material which is similar to brake lining and which is capable of allowing slippage without roughness or excessive noise.The clutch cover is bolted to the engine flywheel and incorporates a diaphragm spring which provides the pressure to engage the clutch. The cover also houses the pressure plate. When the clutch pedal is released, the driven disc is sandwiched between the pressure plate and the smooth surface of the flywheel, thus forcing the disc to turn at the same speed as the engine crankshaft.The transmission contains a mainshaft which passes all the way through the transmission, from the clutch to the driveshaft. This shaft is separated at one point, so that front and rear portions can turn at different speeds.Power is transmitted by a countershaft in the lower gears and reverse. The gears of the countershaft mesh with gears on the mainshaft, allowing power to be carried from one to the other. Countershaft gears are often integral with that shaft, while several of the mainshaft gears can either rotate independently of the shaft or be locked to it. Shifting from one gear to the next causes one of the gears to be freed from rotating with the shaft and locks another to it. Gears are locked and unlocked by internal dog clutches which slide between the center of the gear and the shaft. The forward gears usually employ synchronizers; friction members which smoothly bring gear and shaft to the same speed before the toothed dog clutches are engaged.

Adjustments

1984–88 VEHICLES

Linkage

➧ See Figure 1

1. Disconnect the negative battery cable.
2. Remove the left seat from the vehicle. If your vehicle is equipped with power seats, make sure to detach the electrical wiring.
3. Remove the shift knob.
4. Remove the console cover and the glove compartment lock.
5. Remove the left side panel from the console.
6. Remove the shifter cover.
7. Loosen the shifter rod adjusting nuts.
8. With the transmission and shifter in Neutral, install the alignment in the shifter, as shown in the accompanying figure.
9. Equalize the swivels on all three shift levers. Hand tighten the forward and rear adjusting nuts at the same time with equal force. Do this for all three shifter rods, and then tighten the forward and rear adjusting nuts at the same time to specifications.
10. After the adjustment is complete, install the components previously removed.

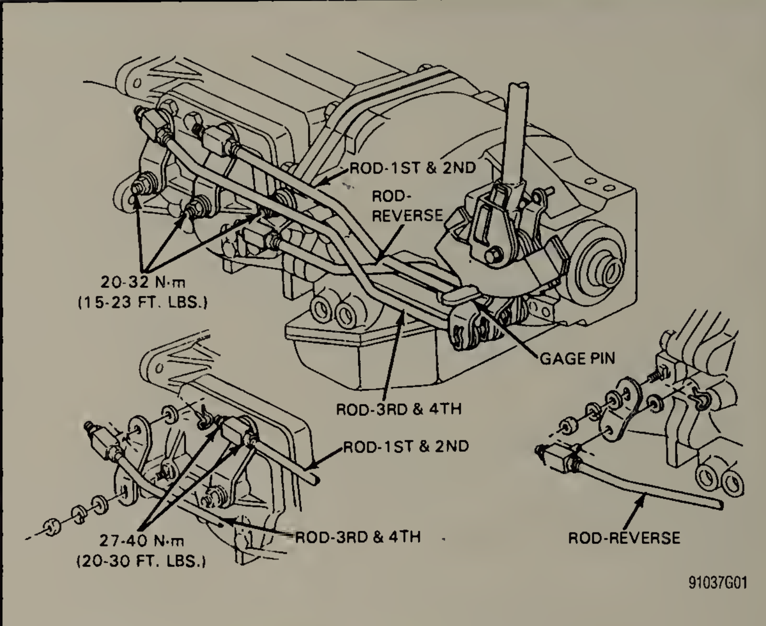


Fig. 1 Shift linkage adjustment—1984–88 vehicles

TV Cable

➧ See Figure 2

To adjust the Throttle Valve (TV) cable, refer to the accompanying figure.

Park Lock Cable

➧ See Figure 3

To adjust the Park Lock cable, refer to the accompanying figure.

1989–96 VEHICLES

On these vehicles, no adjustments are necessary or possible.

Back-up Light Switch

REMOVAL & INSTALLATION

➧ See Figures 4, 5 and 6

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Detach the electrical connector from the switch.
4. Remove the back-up lamp switch from the transmission case.

To install:

5. Apply a suitable pipe sealant with Teflon® to the threads of the switch.
6. Install the switch and tighten to 35 ft. lbs. (47 Nm).
7. Attach the switch electrical connector.
8. Carefully lower the vehicle, then connect the negative battery cable.

Extension Housing (Output Shaft) Seal

REMOVAL & INSTALLATION

➧ See Figures 7, 8 and 9

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.

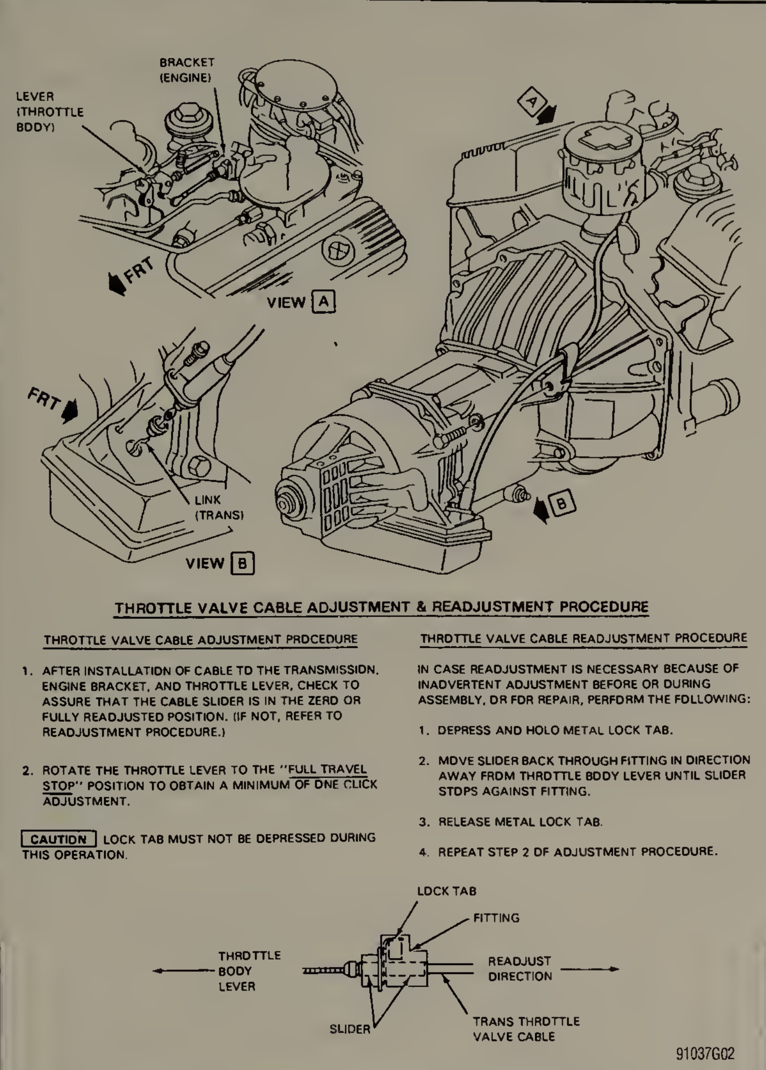


Fig. 2 TV cable adjustment procedure—1984–88 vehicles

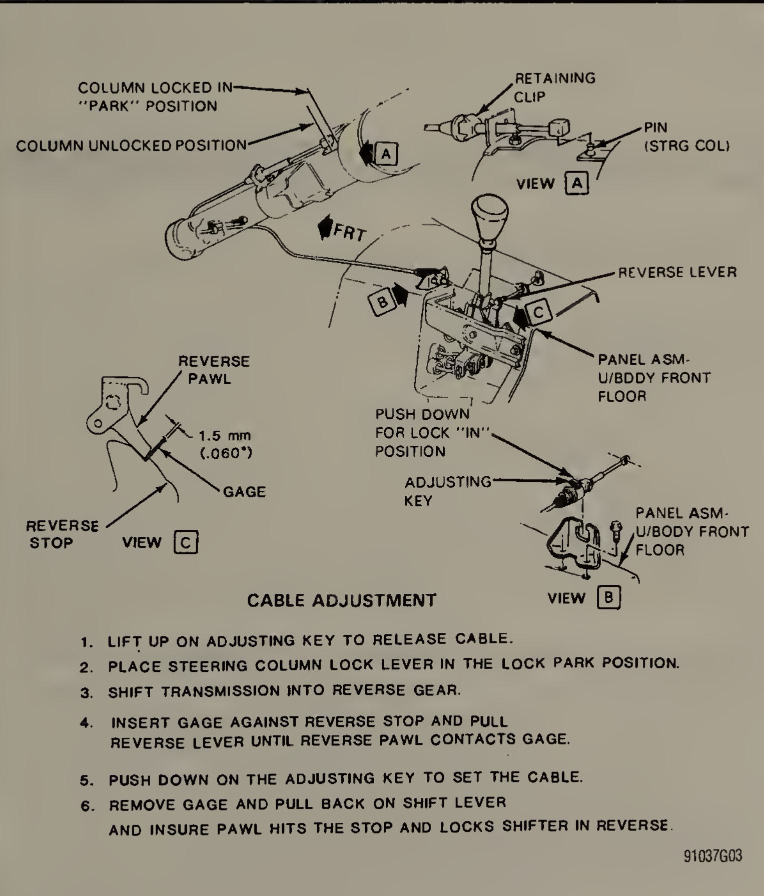


Fig. 3 Park lock cable adjustment—1984–88 vehicles

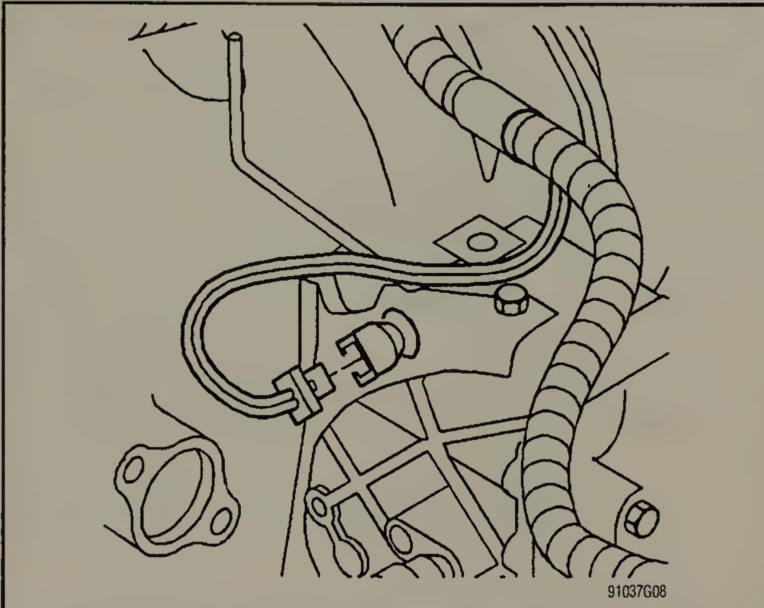


Fig. 4 Unplug the electrical connector from the back-up light switch—1996 vehicle shown

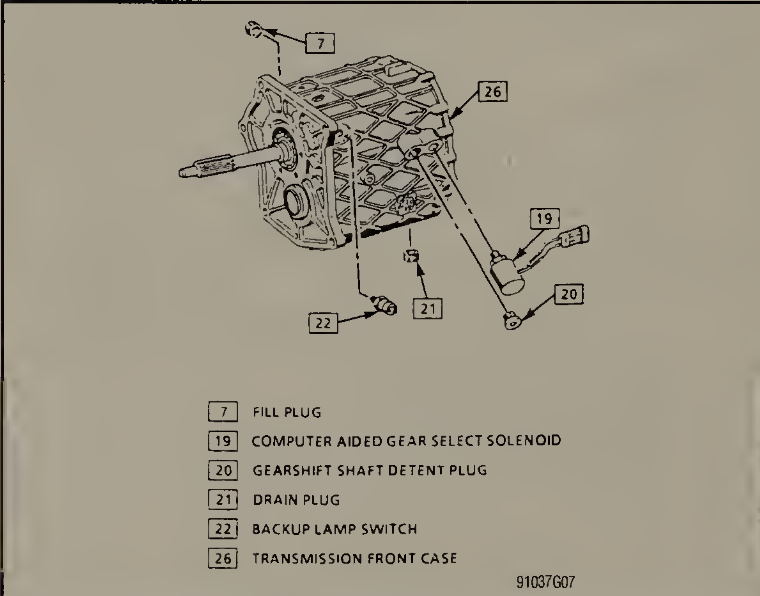


Fig. 5 Exploded view of the back-up lamp switch location—1992 vehicle shown

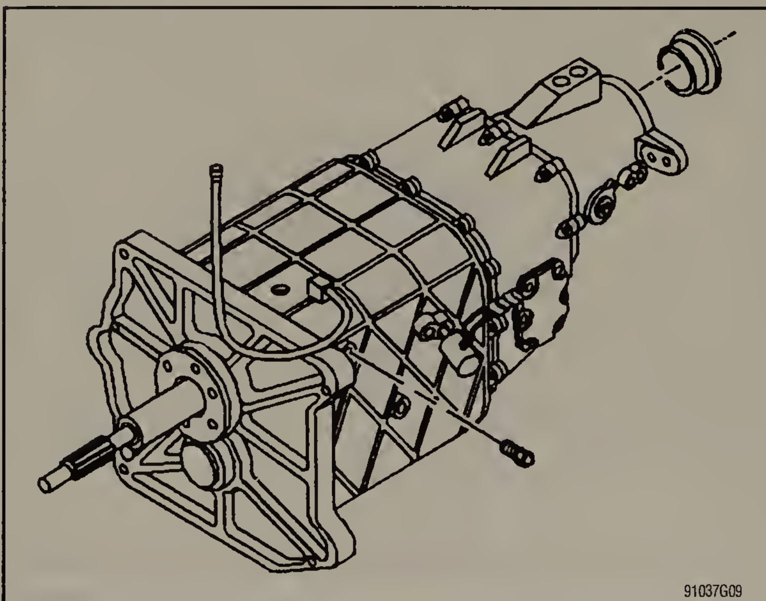
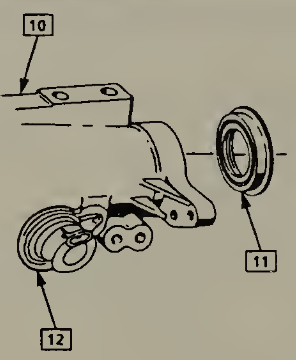


Fig. 6 The back-up light switch is mounted in the transmission case—1996 vehicle shown



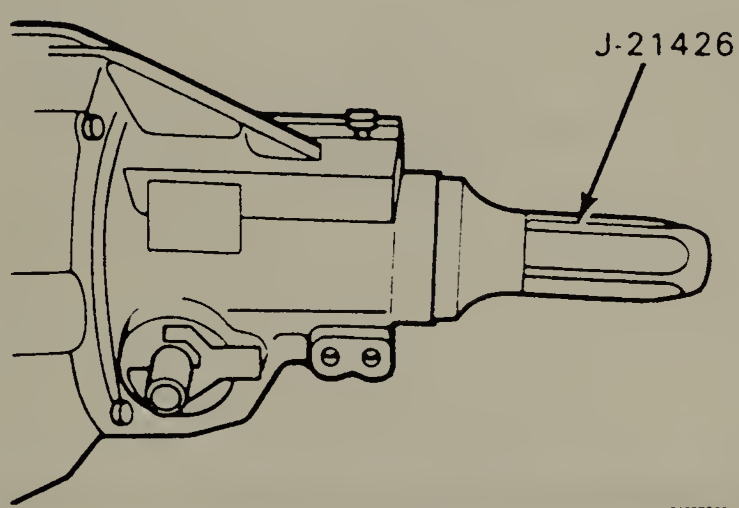
10 EXTENSION HOUSING

11 EXTENSION HOUSING REAR OIL SEAL

12 SPEED SENSOR

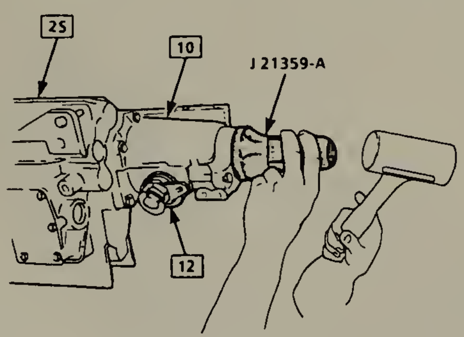
91037G10

Fig. 7 Exploded view of the extension housing oil seal, removed from the vehicle—1992 vehicle shown



91037G06

Fig. 8 Use the proper tool to install the output shaft seal—1984–88 vehicles



10 EXTENSION HOUSING

12 SPEED SENSOR

25 TRANSMISSION REAR CASE

91037G11

Fig. 9 You will need the seal drive and a mallet to install the extension housing seal

3. If equipped, disconnect the TV cable from the left TBI unit.
4. Remove the distributor cap, and position it aside.
5. Raise and safely support the vehicle.
6. If equipped with a convertible, remove the upper and lower underbody braces.

➡You will probably need an assistant to help you remove the exhaust system.

7. Remove the complete exhaust system as an assembly, as follows:
   a. Disconnect the AIR pipe from the converter.
   b. Unfasten the AIR pipe clamps from the exhaust manifold.
   c. Detach the Oxygen sensor electrical connector.
   d. Unfasten the bolts securing the mufflers to the hangers.
   e. Remove the hanger bracket from the converter.
   f. Detach the exhaust pipes from the exhaust manifolds, then carefully remove the exhaust system and place it in a safe place.
8. Support the transmission assembly with a suitable jack.
9. Remove the bolts securing the driveline support beam at the axle and transmission. Remove the driveline support beam from the vehicle, as outlined in later in this section.
10. Matchmark the position of the shaft to the companion flange and disconnect the rear universal joint by removing the trunnion bearing straps. Make sure to tape the bearing cups to avoid dropping and/or losing the bearing rollers.
11. There may be some fluid leakage from the transmission output shaft housing, so place a suitable catch pan underneath, then slide the slip yolk from the transmission and remove the shaft.
12. Carefully pry the old seal out using a suitable seal removal tool, working around the perimeter of the seal, removing it a little at a time, until the seal can be removed.

To install:

13. Coat the lip of a new seal with automatic transmission fluid.
14. Using a suitable seal installation tool, as shown in the accompanying figure, place a new seal on the tool and install the seal.
15. Install the propeller shaft. Make sure to align the shaft with the matchmarks made during removal, remove the tape over the trunnion bearing caps and connect the exposed caps to the companion flange. Tighten the strap retaining bolts to 12.5 ft. lbs. (17 Nm).
16. The remainder of installation is the reverse of the removal procedure.
17. Refer to the procedure located later in this section for driveline support beam installation and tightening specifications.
18. Check the transmission fluid level add if necessary. Keep in mind that the transmission should be level when checking the fluid level. Tighten the fill plug to 26 ft. lbs. (35 Nm).

Manual Transmission Assembly

REMOVAL & INSTALLATION

1984–88 Vehicles

➧ See Figures 10 and 11

1. Disconnect the negative battery cable.
2. Remove the air cleaner assembly.
3. If equipped, disconnect the TV cable from the left TBI unit.
4. Remove the distributor cap, and position it aside.
5. Raise and safely support the vehicle.
6. If equipped with a convertible, remove the upper and lower underbody braces.

➡You will probably need an assistant to help you remove the exhaust system.

7. Remove the complete exhaust system as an assembly, as follows:
   a. Disconnect the AIR pipe from the converter.
   b. Unfasten the AIR pipe clamps from the exhaust manifold.
   c. Detach the Oxygen sensor electrical connector.
   d. Unfasten the bolts securing the mufflers to the hangers.
   e. Remove the hanger bracket from the converter.
   f. Detach the exhaust pipes from the exhaust manifolds, then carefully remove the exhaust system and place it in a safe place.
8. Support the transmission assembly with a suitable jack.

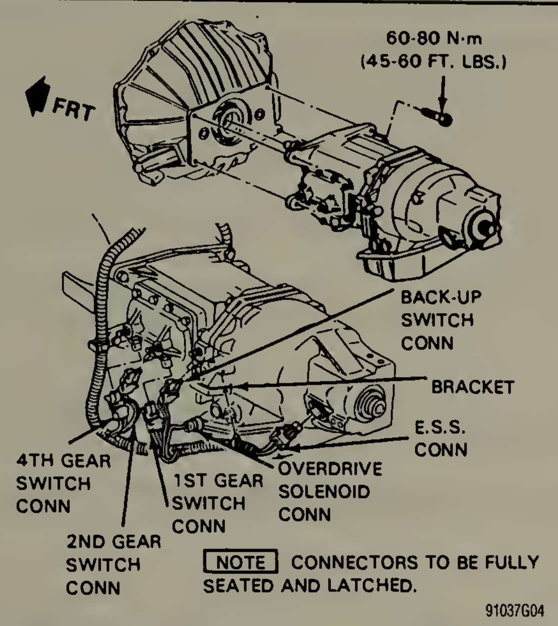


Fig. 10 View of the transmission components—1984 vehicle shown

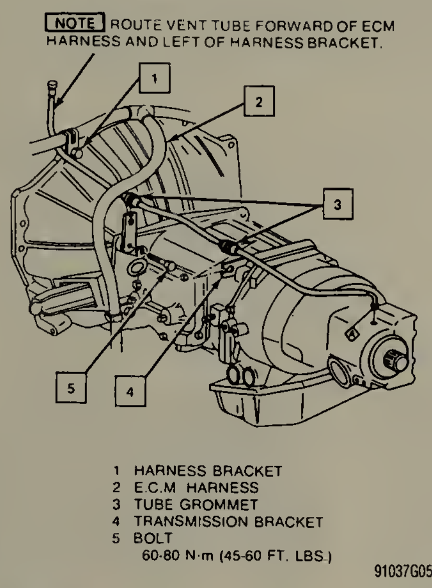


Fig. 11 Exploded view of the transmission attachment—1987 vehicle shown

9. Unfasten the bolts securing the driveline support beam to the axle and transmission. Remove the driveline beam from the vehicle.
10. Matchmark the position of the propeller shaft to the axle companion flange. Remove the trunnion bearing straps and disengage the rear universal joint from the axle. Slide the propeller shaft slip yoke out from the overdrive unit and remove the shaft from the vehicle.
11. Disconnect the cooler lines and the TV cable, if equipped, from the overdrive unit.
12. Detach the shift linkage from the side cover.
13. Detach the electrical connectors from the side cover switches, backup light switch, overdrive unit and speedometer sensor.
14. While supporting the engine with a suitable fixture, carefully lower the transmission.
15. Unfasten the bolts attaching the transmission to the bellhousing. Slide the transmission rearward to disengage the input shaft from the clutch. Remove the transmission from the vehicle.
16. Inspect the clutch components and replace components as necessary, as outlined later in this section.

To install:

17. Installation is the reverse of the removal procedure. Make sure to tighten all components securely and attach all connectors properly. Please note the following important steps:
    a. Clean and repack the clutch release bearing.
    b. Tighten the transmission attaching bolts to 45–60 ft. lbs. (60–80 Nm) and the oil cooler line fittings to 8–12 ft. lbs. (11–16 Nm).
    c. If equipped, adjust the TV cable, as outlined earlier in this section.
    d. Install and align the driveline support beam installation as follows:
    • To insure proper alignment of the driveline, you must maintain a clearance of 1.52–2.02 in. (39–51mm) between the top of the beam to the under body and a clearance of 0.85–1.35 in. (22–34mm) from the right (passenger) side of the beam to the side wall.
    • Take the previous measurements directly above and to the right of the propeller shaft yoke.
    • Refer to the driveshaft procedure, located later in this section, for additional installation information and tightening specifications.
18. Refill the transmission with the proper type and amount of fluid as outlined in Section 1 of this manual.

1989–92 Vehicles

See Figure 12

1. Disconnect the negative battery cable.
2. Remove the center air outlet.
3. Remove the console and accessory trim plates.
4. Remove the control lever button.
5. Remove the shift lever knob assembly.
6. Remove the center console trim plate.
7. Remove the shift lever snapring.
8. Remove the shifter retainer nuts.
9. Raise and safely support the vehicle.
10. Remove the complete exhaust assembly.
11. Remove the driveshaft.
12. Support the transmission with a suitable jack.
13. Remove the driveline support beam.
14. Disengage the electrical connectors from the speed sensor, backup lamp switch and shift solenoid.
15. Remove the transmission to clutch housing attaching bolts.
16. Remove the transmission assembly from the vehicle.
17. Installation is the reverse of the removal procedure. Please note the following tightening specifications:
    • Transmission-to-clutch housing bolts: 37 ft. lbs. (50 Nm), making sure to torque the bolts using the proper crisscross sequence, starting at the top right bolt.
    • Driveline support beam-to-differential bolts: to 60 ft. lbs. (80 Nm).
    • Driveline support beam-to-transmission bolts: to 37 ft. lbs. (50 Nm).
18. Check transmission oil level and add if necessary.

➡In a horizontal position, the transmission should be filled to the point of overflow.

19. Connect the negative battery cable.

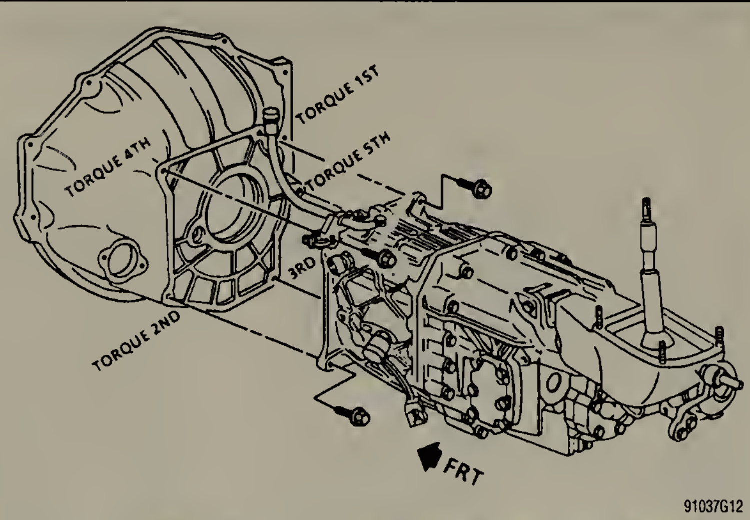


Fig. 12 Exploded view of the manual transmission—1992 vehicle shown

1993–96 Vehicles

➧ See Figures 13 and 14

1. Disconnect the negative battery cable.
2. Remove the shifter button, retainer, shift knob, set screw and reverse inhibitor.
3. Remove the rear trim plate screws and the screw located underneath the cup holder mat.
4. Disengage the instrument panel harness connectors from the lighter and rear compartment lid release switch, then unclip the accessory plug harness.
5. Pry the locking tabs on the underside of the boot from the shaft groove, then remove the console trim plate and boot from the shaft.
6. Raise and support the vehicle safely.
7. Remove the complete exhaust assembly.
8. Remove the bolts retaining the driveline torque beam, then slide the beam outboard to gain access to the driveshaft.
9. Remove the parking brake cable clip, then remove the bolts retaining the support bracket.
10. To maintain drive train balance, matchmark the relationship between the driveshaft and the differential carrier yoke, then remove the bolts attaching the driveshaft to the yoke.
11. Slide the driveline torque beam rearward until it make contact with the rear exhaust hanger.
12. Support the transmission using an adjustable transmission jack.
13. Disengage the electrical connectors from the speed sensor, back-up lamp switch and the computer aided shift solenoid.
14. Remove the transmission to clutch housing attaching bolts.
15. Carefully lower the transmission and remove the transmission assembly from the vehicle.

To install:

16. Install transmission assembly into the vehicle.
17. Install and tighten the transmission to clutch housing bolts to 37 ft. lbs. (50 Nm). Be sure to tighten the bolts using the proper crisscross sequence, starting at the top right bolt.
18. Engage the wiring harness connectors to the speed sensor, back-up lamp switch and shift solenoid.
19. Slide the driveline torque beam forward and onto the transmission extension housing.
20. Install the driveshaft, aligning the matchmarks made on the shaft and yoke during removal. Tighten the shaft-to-yoke retaining bolts to 18 ft. lbs. (24 Nm).
21. Install the bolts retaining the support bracket and tighten to 18 ft. lbs. (25 Nm).
22. Check transmission oil level and add if necessary.

➡In a horizontal position, the transmission should be filled to the point of overflow.

23. Install the parking brake cable clip.
24. Align the torque beam and install the retaining bolts. Tighten the beam-to-differential carrier bolt to 60 ft. lbs. (80 Nm) and the beam-to-transmission bolt to 37 ft. lbs. (50 Nm).
25. Install the complete exhaust system assembly.
26. Lower the vehicle.
27. Install the console trim plate and boot assembly.
28. Connect the negative battery cable.

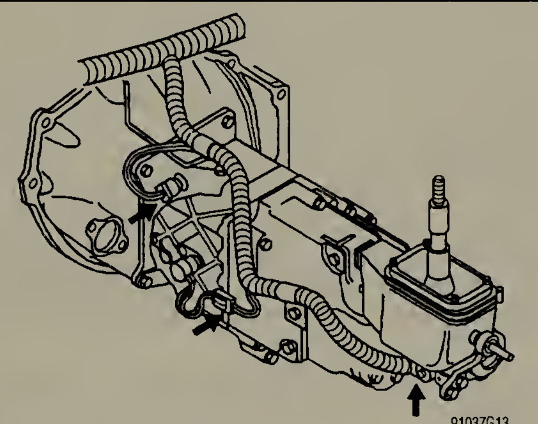


Fig. 13 Location of the electrical connectors you need to unplug for transmission removal—1996 vehicle shown

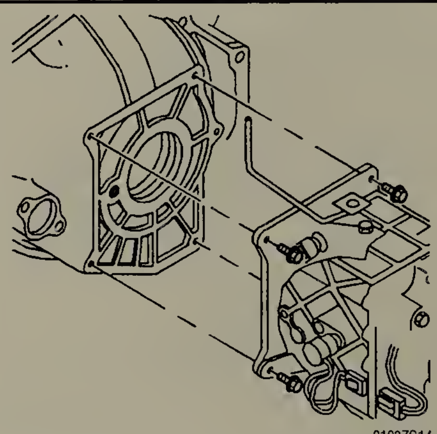


Fig. 14 Exploded view of the transmission attachment—1996 vehicle shown

CLUTCH

Understanding the Clutch

The purpose of the clutch is to disconnect and connect engine power at the transmission. A vehicle at rest requires a lot of engine torque to get all that weight moving. An internal combustion engine does not develop a high starting torque (unlike steam engines) so it must be allowed to operate without any load until it builds up enough torque to move the vehicle. To a point, torque increases with engine rpm. The clutch allows the engine to build up torque by physically disconnecting the engine from the transmission, relieving the engine of any load or resistance.The transfer of engine power to the transmission (the load) must be smooth and gradual; if it weren't, drive line components would wear out or break quickly. This gradual power transfer is made possible by gradually releasing the clutch pedal. The clutch disc and pressure plate are the connecting link between the engine and transmission. When the clutch pedal is released, the disc and plate contact each other (the clutch is engaged) physically joining the engine and transmission. When the pedal is pushed in, the disc and plate separate (the clutch is disengaged) disconnecting the engine from the transmission.Most clutch assemblies consists of the flywheel, the clutch disc, the clutch pressure plate, the throw out bearing and fork, the actuating linkage and the pedal. The flywheel and clutch pressure plate (driving members) are connected to the engine crankshaft and rotate with it. The clutch disc is located between the flywheel and pressure plate, and is splined to the transmission shaft. A driving member is one that is attached to the engine and transfers engine power to a driven member (clutch disc) on the transmission shaft. A driving member (pressure plate) rotates (drives) a driven member (clutch disc) on contact and, in so doing, turns the transmission shaft.There is a circular diaphragm spring within the pressure plate cover (transmission side). In a relaxed state (when the clutch pedal is fully released) this spring is convex; that is, it is dished outward toward the transmission. Pushing in the clutch pedal actuates the attached linkage. Connected to the other end of this is the throw out fork, which hold the throw out bearing. When the clutch pedal is depressed, the clutch linkage pushes the fork and bearing forward to contact the diaphragm spring of the pressure plate. The outer edges of the spring are secured to the pressure plate and are pivoted on rings so that when the center of the spring is compressed by the throw out bearing, the outer edges bow outward and, by so doing, pull the pressure plate in the same direction – away from the clutch disc. This action separates the disc from the plate, disengaging the clutch and allowing the transmission to be shifted into another gear. A coil type clutch return spring attached to the clutch pedal arm permits full release of the pedal. Releasing the pedal pulls the throw out bearing away from the diaphragm spring resulting in a reversal of spring position. As bearing pressure is gradually released from the spring center, the outer edges of the spring bow outward, pushing the pressure plate into closer contact with the clutch disc. As the disc and plate move closer together, friction between the two increases and slippage is reduced until, when full spring pressure is applied (by fully releasing the pedal) the speed of the disc and plate are the same. This stops all slipping, creating a direct connection between the plate and disc which results in the transfer of power from the engine to the transmission. The clutch disc is now rotating with the pressure plate at engine speed and, because it is splined to the transmission shaft, the shaft now turns at the same engine speed.The clutch is operating properly if:

1. It will stall the engine when released with the vehicle held stationary.2. The shift lever can be moved freely between 1st and reverse gears when the vehicle is stationary and the clutch disengaged.

Driven Disc and Pressure Plate

✱✱ CAUTION

The clutch driven disc may contain asbestos, which has been determined to be a cancer causing agent. Never clean clutch surfaces with compressed air! Avoid inhaling any dust from any clutch surface! When cleaning clutch surfaces, use a commercially available brake cleaning fluid.

REMOVAL & INSTALLATION

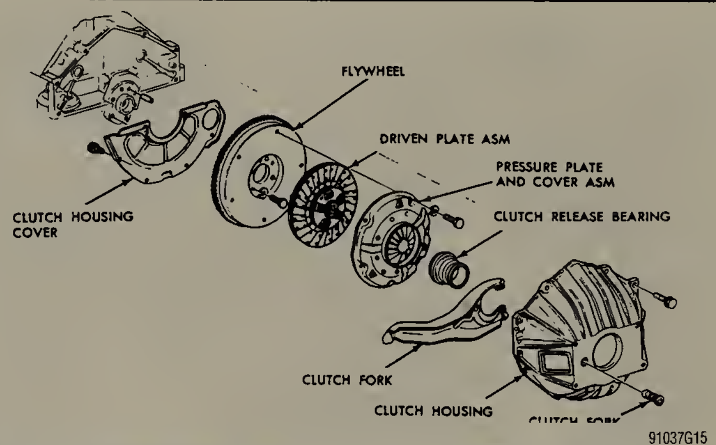
1984–88 Vehicles

➧ See Figures 15 thru 24

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Support the engine assembly, then remove the transmission, as outlined earlier in this section.
4. Remove the slave cylinder attaching bolts.
5. Remove the flywheel housing.
6. Slide the clutch fork from the ball stud then remove the fork from the dust boot. The ball stud is threaded into the clutch housing and is easily replaced, if necessary.
7. Install a suitable clutch pilot tool to support the clutch assembly during removal. Look for the "X" mark or white painted letter on the clutch cover and the "X" mark on the flywheel. If you don't see any marks, matchmark the flywheel and clutch cover for proper alignment during installation.
8. Loosen the clutch-to-flywheel attaching bolts evenly, 1 turn at a time, until the spring pressure is released, then remove the bolts and remove the clutch and pressure plate assembly.
9. Inspect flywheel, clutch plate and disc for heat stress, cracks or worn parts and replace as necessary.

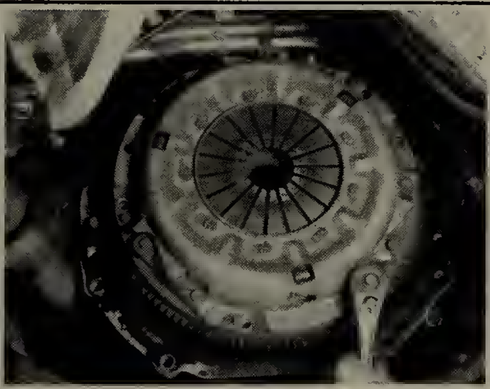
To install:

10. Clean the pressure plate and flywheel face. They must be free of any oil, grease, metal deposits or burned spots.



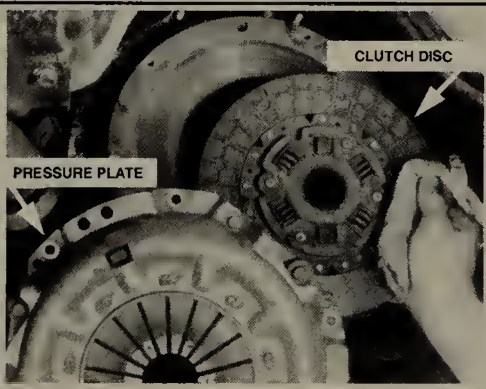
91037G15

Fig. 15 Exploded view of the clutch pressure plate and related components—1984–88 vehicles



TCCS7116

Fig. 16 Loosen and remove the clutch and pressure plate bolts evenly, a little at a time . . .

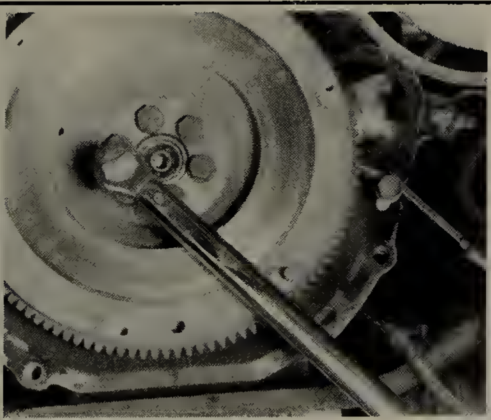


TCCS7118

Fig. 17 . . . then carefully removing the clutch and pressure plate assembly from the flywheel

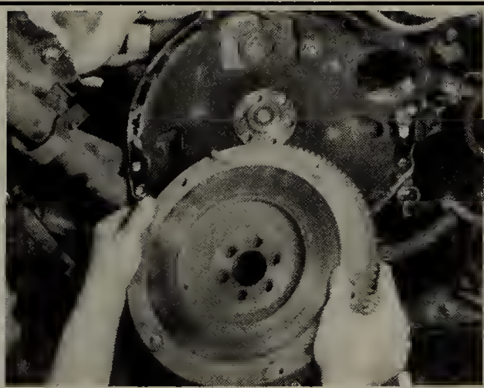
TCCS7125

Fig. 18 Check across the flywheel surface, it should be flat



TCCS7121

Fig. 19 If necessary, lock the flywheel in place and remove the retaining bolts . . .



TCCS7122

Fig. 20 . . . then remove the flywheel from the crankshaft in order replace it or have it machined

TCCS7127

Fig. 21 Install a clutch alignment arbor, to align the clutch assembly during installation

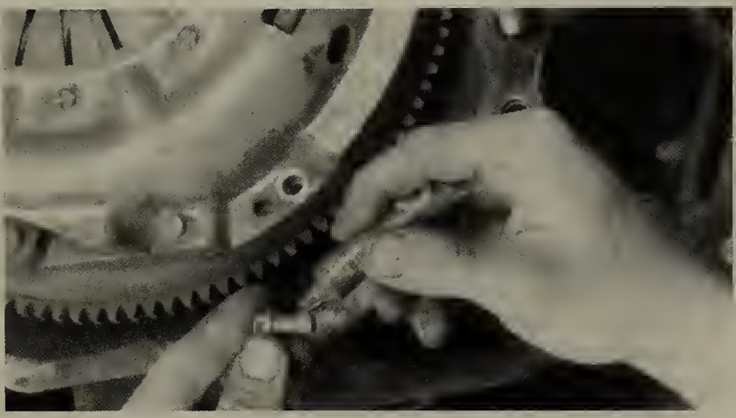

TCCS7131

Fig. 22 You may want to use a threadlocking compound on the clutch assembly bolts

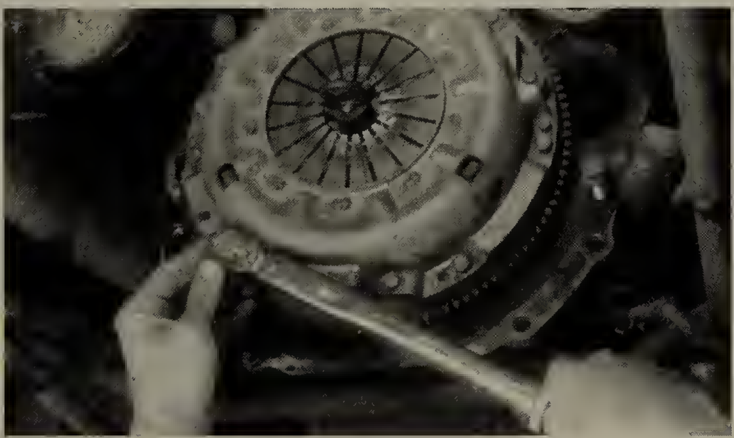
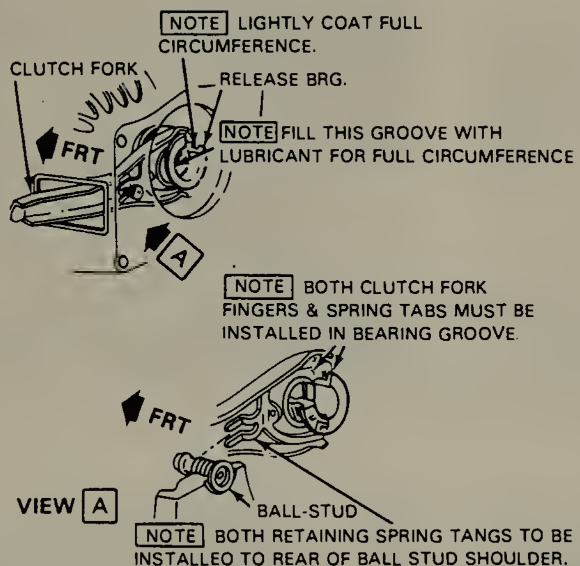

TCCS7133

Fig. 23 Be sure to use a torque wrench to tighten all bolts



91037G16

Fig. 24 Use a suitable graphite grease to lubricate the areas shown on the release bearing

11. Place the clutch disc and pressure place their approximate installed position and support them with a suitable universal alignment tool or a drive gear. The driven disc is installed with damper springs to the transmission. The flywheel side should be marked.
12. Turn the clutch assembly until the "X" mark (or other matchmark) on the cover lines up with the mark on the flywheel. Then, align the cover bolt holes to the nearest flywheel holes.
13. Install a bolt in every hole, then tighten them down evenly and gradually until tight, to avoid distorting the clutch.
14. Remove the pilot tool.
15. Unhook the clutch fork and lubricate the ball socket and fork fingers at the release bearing end with a suitable high melting point grease (such as a graphite grease), then reinstall the fork on the ball stud.
16. Lubricate the recess on the inside of the release bearing collar and the clutch fork groove with a light coating of graphite grease.
17. Install the clutch fork and dust boot into the clutch housing, then install the release bearing to the fork.
18. Install the flywheel housing.
19. Install the transmission, as outlined earlier in this section.
20. Install the slave cylinder, and secure with the attaching bolts.
21. Lubricate the clutch fork pushrod ends, then connect the pushrod.
22. Adjust the shift linkage, as outlined earlier in this section.

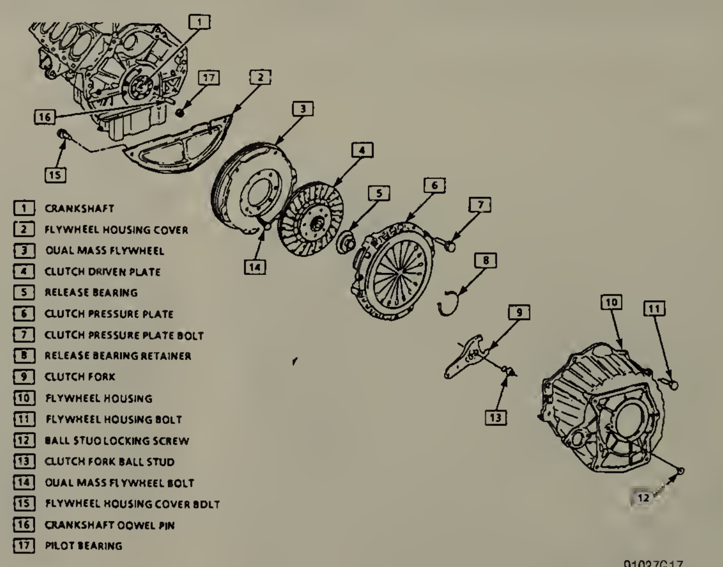
1989–96 Vehicles

See Figures 25, 26, 27 and 28

1. Disconnect the negative battery cable, then raise and support the vehicle safely.
2. Remove the complete exhaust system.
3. Remove the transmission assembly.
4. Except for the VIN J and 1993–96 VIN P engines, remove the starter assembly.
5. Except for the VIN J engine, disconnect the ground wire attached to the left clutch housing stud.
6. Remove the nuts attaching the clutch slave cylinder to the housing and support the cylinder to the side. Do not allow the cylinder to hang freely.
7. For the VIN J engine, remove the nut retaining the left converter shield to the housing.
8. Remove the clutch housing cover.
9. Remove the bolts retaining the housing to the engine block, if applicable on the 5.7L (VIN J) engine, the right side converter heat shield.
10. Remove the housing by aligning the fork onto the 2 flats of the release bearing and push the fork away from the bearing with a twisting motion. Remove the clutch housing, for 5.7L (VIN P and 5) engine with magnesium housings, the aluminum spacers.

➡Excessive clutch wear may require removal of the ball stud locking screw and loosening of the ball stud to disengage the fork and housing.

11. Mark the alignment of the clutch cover and flywheel for installation purposes.
12. Loosen the clutch cover bolts evenly, 1 turn at a time until spring pressure is released. Failure to properly release spring pressure may result in damage to the clutch cover assembly and the flywheel.
13. Remove the clutch plate and disc assembly.
14. If necessary, remove the clutch release bearing as follows:
    a. Remove the clutch release bearing retainer.
    b. Remove the clutch release bearing.



91037G17

Fig. 25 Exploded view of the clutch system components—1995 5.7L (VIN J) engine shown, other engine similar

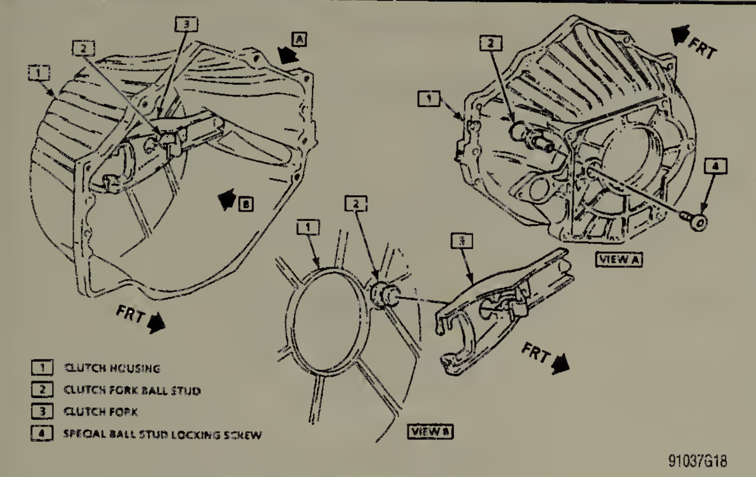


Fig. 26 Clutch fork and ball attachment

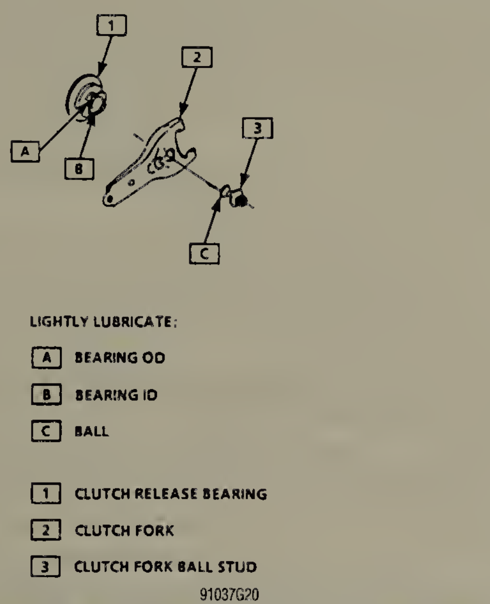


Fig. 27 The clutch release bearing must be lubricated at the points shown before installation

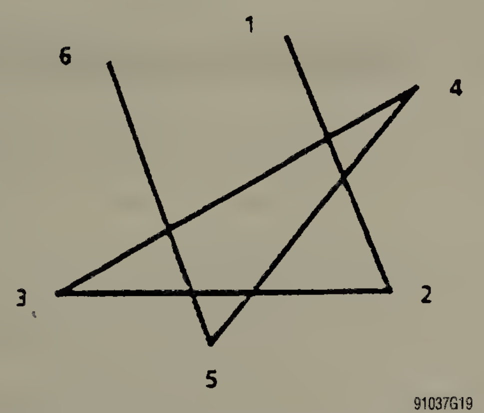


Fig. 28 The clutch pressure plate bolts must be tightened in the proper sequence

To install:

➡Before installation, lightly lubricate the release bearing as shown in the accompanying figure.

15. If removed, install the clutch release bearing and secure with the retainer. The retainer must be installed with the tangs facing away from the engine.
16. Inspect flywheel, clutch plate and disc for heat stress, cracks or worn parts and replace as necessary.
17. Install the clutch assembly using a suitable universal clutch disc alignment tool.
18. Be sure the marks made earlier are in alignment, then install the cover assembly-to-flywheel bolts. Tighten the bolts in the proper sequence, 1 turn at a time, until spring pressure is properly attained and the bolts are tightened to 30 ft. lbs. (41 Nm).
19. Position the clutch housing to the engine block and engage the fork onto the release bearing. If equipped, be sure the aluminum spacer is in position.
20. Verify the housing is properly positioned on the 2 engine dowel pins, for the 5.7L (VIN J) engine, that the right converter heat shield is installed.
21. Tighten the clutch housing bolts to 37 ft. lbs. (50 Nm) and the ball stud to 33 ft. lbs. (45 Nm). Tighten the ball stud locking screw to 11 ft. lbs. (15 Nm) for VIN P and 5 engines or to 16 ft. lbs. (22 Nm) for VIN J engine, as applicable.
22. If equipped, install the ground harness connection to the housing.
23. Install the housing cover and tighten the bolts to 80 inch lbs. (9 Nm).
24. For the VIN J engine, install the left heat shield and tighten the retaining nut to 12 inch lbs. (1.4 Nm).
25. Install the clutch slave cylinder and tighten the retaining nuts to 19 ft. lbs. (25 Nm).
26. Install the transmission assembly.
27. Install the exhaust system and lower the vehicle.
28. Connect the negative battery cable and check clutch for proper operation.

Master Cylinder

REMOVAL & INSTALLATION

➧ See Figure 29

1. Disconnectg the negative battery cable.
2. For 1989–96 vehicles, disconnect the positive battery cable, then remove the battery from the vehicle.
3. If necessary, remove the ECM from its mounting bracket for access to the master cylinder.
4. Use a clean turkey baster or a suitable syringe to siphon as much fluid as possible from the master cylinder reservoir. Discard the fluid in the proper manner.
5. Remove the hush panel from under the dash.
6. Remove the pushrod retaining clip (if equipped), then disengage the pushrod from the clutch pedal.
7. Disconnect and plug the hydraulic line from the master cylinder.
8. Unfasten the master cylinder mounting bolts from the front of the dash, then remove the master cylinder from the vehicle.

To install:

9. Position the master cylinder to the front of the dash and secure with the mounting bolts. Tighten the bolts to 15–22 ft. lbs. (20–30 Nm) for 1984–88 vehicles or to 12 ft. lbs. (17 Nm) for 1989–96 vehicle.

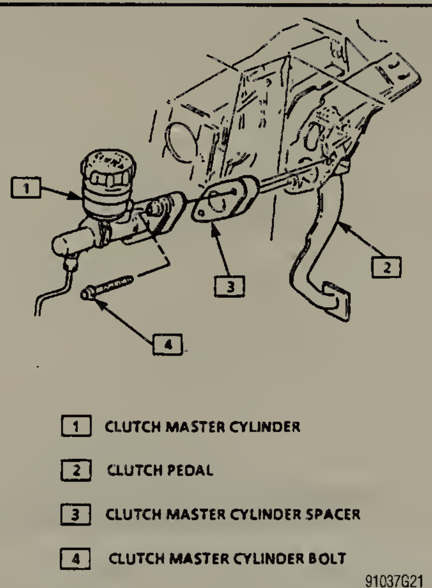


Fig. 29 Exploded view of the master cylinder mounting

10. Unplug and connect the hydraulic line to the master cylinder. Tighten the hydraulic line fitting, if equipped, to 13 ft. lbs. (18 Nm).
11. Attach the pushrod to the clutch pedal and secure with the retaining clip, if equipped.
12. Install the hush panel.
13. If removed, install the battery, then connect the positive battery cable.
14. Fill the master cylinder with the proper type of DOT 3 brake fluid from a fresh, sealed container.
15. Raise and safely support the vehicle, then bleed the system at the slave cylinder, as outlined later in this section.
16. Carefully lower the vehicle, then connect the negative battery cable.

Slave Cylinder

REMOVAL & INSTALLATION

1984–88 Vehicles

See Figure 30

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Disconnect and plug the hydraulic lines from the slave cylinder.
4. Unfasten the slave cylinder-to-clutch housing mounting bolts.
5. Remove the pushrod and slave cylinder from the vehicle.

To install:

6. Unplug and connect the fluid line to the slave cylinder.
7. Bleed the clutch hydraulic system, as outlined later in this section.
8. Lubricate the end of the slave cylinder with a suitable rubber lubricant.

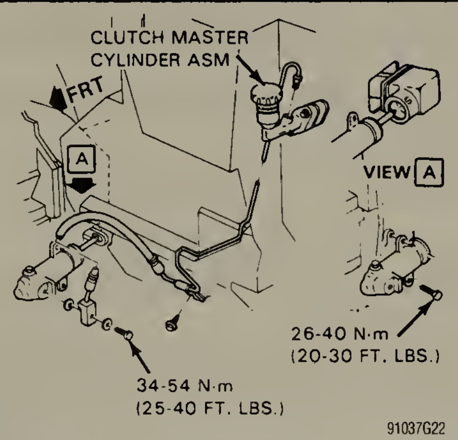


Fig. 30 Exploded view of the clutch slave cylinder and related components—1984–88 vehicles

9. Position the slave cylinder to the clutch housing and secure with the mounting bolts. Tighten the bolts to 25–40 ft. lbs. (34–54 Nm).
10. Carefully lower the vehicle.

1989–96 Vehicles

See Figure 31

On later model vehicles, the slave cylinder is referred to as the actuator cylinder.

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle.
3. Unfasten the clutch actuator cylinder retaining nuts.
4. Note the position of the hydraulic line, then detach the line from the retaining clip.
5. Remove the pushrod and clutch actuator cylinder from the clutch housing.

WARNING

Do not let the clutch actuator cylinder to hang by its fluid hose.

6. Disconnect and plug the fluid line fitting from the actuator cylinder.

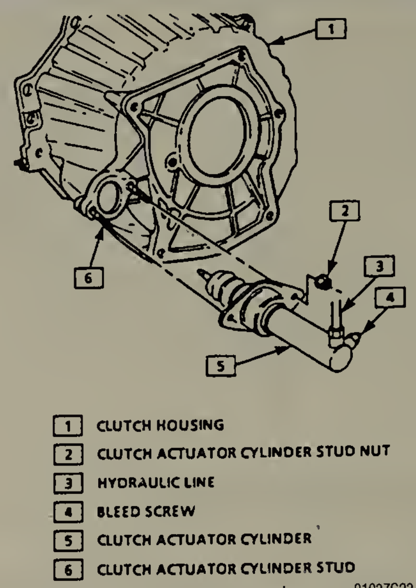


Fig. 31 Exploded view of the clutch actuator (slave) cylinder—1989–96 vehicles

To install:

7. Unplug and connect the fluid line to the actuator cylinder. Tighten the line fitting to 13 ft. lbs. (18 Nm).
8. Instlal the pushrod and clutch actuator cylinder. Secure with the mounting bolts and tighten to 18 ft. lbs. (25 Nm).
9. Place the hydraulic line into the retaining clip.
10. Carefully lower the vehicle, then bleed the clutch hydraulic system, as outlined later in this section.

HYDRAULIC SYSTEM BLEEDING

The bleeding procedure must be performed whenever any component of the hydraulic clutch system is disconnected, or the level of fluid has been allowed to fall low enough or air to be drawn into the master cylinder.

This procedure will require the use of an assistant.

1984–88 Vehicles

1. Fill the master cylinder reservoir with the DOT 3 or equivalent fluid from a fresh, sealed container.

WARNING

NEVER fill the master cylinder with fluid that has already been bled from a system, as it may be aerated, contain too much moisture, or be contaminated.

2. Raise and safely support the vehicle.
3. Unfasten the slave cylinder attaching bolts.
4. Hold the slave cylinder at a 45° angle with the bleeder at the highest point. Have an assistant fully depress the clutch pedal, then open the bleeder.
5. Close the bleeder valve and release the clutch pedal.
6. Repeat Steps 4 and 5 until all air is evacuated from the system. Check and refill the master cylinder as necessary to prevent air from drawn through the master cylinder.

1989–90 Vehicles

1. Raise and support vehicle.
2. Remove the slave/actuator cylinder attaching stud nuts.
3. Remove the pushrod and slave/actuator cylinder from the clutch housing and the hydraulic line from the retaining clip.
4. Disconnect the hydraulic hose fitting from the slave/actuator cylinder.
5. Remove the bleed screw dust cap.
6. Remove the factory bleed screw from the slave/actuator cylinder using a fluted screw extractor. Install a new bleed screw.

7. Connect hydraulic hose fitting to the actuator, then install the clutch slave/actuator cylinder and nuts.
8. Install the hydraulic line into the retaining clip. Torque stud nuts to 19 ft. lbs. (25 Nm).
9. Lower vehicle.
10. Remove the ECM from the mounting bracket to gain access to the clutch master cylinder for filling.
11. Fill the master cylinder reservoir with the proper grade and type brake fluid.
12. To remove some of the air from the system prior to bleeding, proceed as follows:
   a. Remove master cylinder cap and moisture barrier. Reinstall the cap.
   b. Lightly stroke the clutch pedal to release the air in the system through the master cylinder.
   c. Remove the master cylinder cap and reinstall moisture barrier.
   d. Reinstall the cap.
13. Raise and support vehicle.
14. Fully depress the clutch pedal and open the bleeder screw. Close the bleed screw and release the clutch pedal.
15. Repeat Step 13 until all the air is expelled from the system.
16. Check the fluid reservoir and replenish, as required.
17. Tighten the bleeder screw until the screw breaks, requires for body clearance. Screw should break at approximately 10–14 ft. lbs. (14–19 Nm).
18. Install dust cap on the bleeder screw.
19. Lower the vehicle and install the ECM.

1991–96 Models

1. Disconnect the negative battery cable and remove the ECM from the mounting bracket to access the master cylinder for filling. Fill the master cylinder reservoir with the proper grade and type of fresh brake fluid or hydraulic clutch fluid.
2. Prior to bleeding the actuator, most of the air can be removed as follows:
   a. Remove the master cylinder cap and moisture barrier.
   b. Install the master cylinder cover.
   c. Lightly stroke the clutch pedal to release trapped air through the master cylinder.
   d. Remove the master cylinder cap and install the moisture barrier.
   e. Install the master cylinder cap.
3. Raise and support the vehicle safely.
4. Remove the actuator cylinder attaching stud nuts.
5. Remove the pushrod and actuator cylinder from the clutch housing and the hydraulic line from the retaining clip.
6. Lower cylinder slightly for access and disconnect the hydraulic hose fitting from the actuator cylinder.
7. Remove the bleed screw dust cap.
8. Position a drain pan or attach a clear plastic hose.
9. Support the slave cylinder in a horizontal position, with the bleeder screw vertical.
10. Fully depress the clutch pedal and open the bleeder screw.
11. Close the bleed screw and release the clutch pedal.
12. Repeat Steps 11 and 12 until all the air is expelled from the system. Check the fluid reservoir and replenish, as required during the procedure. Be sure the reservoir is kept sufficiently full to prevent air from being drawn into the system.
13. Tighten the bleeder screw and install the dust cover.
14. Install the hydraulic line into the retaining clip, position the actuator cylinder and tighten the stud nuts to 19 ft. lbs. (25 Nm).
15. Lower the vehicle.
16. Install the ECM and connect the negative battery cable.

AUTOMATIC TRANSMISSION

Understanding the Automatic Transmission

The automatic transmission allows engine torque and power to be transmitted to the rear wheels within a narrow range of engine operating speeds. It will allow the engine to turn fast enough to produce plenty of power and torque at very low speeds, while keeping it at a sensible rpm at high vehicle speeds (and it does this job without driver assistance). The transmission uses a light fluid as the medium for the transmission of power. This fluid also works in the operation of various hydraulic control circuits and as a lubricant. Because the transmission fluid performs all of these functions, trouble within the unit can easily travel from one part to another. For this reason, and because of the complexity and unusual operating principles of the transmission, a very sound understanding of the basic principles of operation will simplify troubleshooting.

TORQUE CONVERTER

See Figures 32

The torque converter replaces the conventional clutch. It has three functions:
1. It allows the engine to idle with the vehicle at a standstill, even with the transmission in gear.
2. It allows the transmission to shift from range-to-range smoothly, without requiring that the driver close the throttle during the shift.
3. It multiplies engine torque to an increasing extent as vehicle speed drops and throttle opening is increased. This has the effect of making the transmission more responsive and reduces the amount of shifting required.

The torque converter is a metal case which is shaped like a sphere that has been flattened on opposite sides. It is bolted to the rear end of the engine's crankshaft. Generally, the entire metal case rotates at engine speed and serves as the engine's flywheel.The case contains three sets of blades. One set is attached directly to the case. This set forms the torus or pump. Another set is directly connected to the output shaft, and forms the turbine. The third set is mounted on a hub which, in turn, is mounted on a stationary shaft through a one-way clutch. This third set is known as the stator.A pump, which is driven by the converter hub at engine speed, keeps the torque converter full of transmission fluid at all times. Fluid flows continuously through the unit to provide cooling.Under low speed acceleration, the torque converter functions as follows:

The torus is turning faster than the turbine. It picks up fluid at the center of the converter and, through centrifugal force, slings it outward. Since the outer edge of the converter moves faster than the portions at the center, the fluid picks up speed.The fluid then enters the outer edge of the turbine blades. It then travels back toward the center of the converter case along the turbine blades. In impinging upon the turbine blades, the fluid loses the energy picked up in the torus.If the fluid was now returned directly into the torus, both halves of the converter would have to turn at approximately the same speed at all times, and torque input and output would both be the same.In flowing through the torus and turbine, the fluid picks up two types of flow, or flow in two separate directions. It flows through the turbine blades, and it spins with the engine. The stator, whose blades are stationary when the vehicle is being accelerated at low speeds, converts one type of flow into another. Instead of allowing the fluid to flow straight back into the torus, the stator's curved blades turn the fluid almost 90° toward the direction of rotation of the engine. Thus the fluid does not flow as fast toward the torus, but is already spinning when the torus picks it up. This has the effect of allowing the torus to turn much faster than the turbine. This difference in speed may be compared to the difference in speed between the smaller and larger gears in any gear train. The result is that engine power output is higher, and engine torque is multiplied.As the speed of the turbine increases, the fluid spins faster and faster in the direction of engine rotation. As a result,

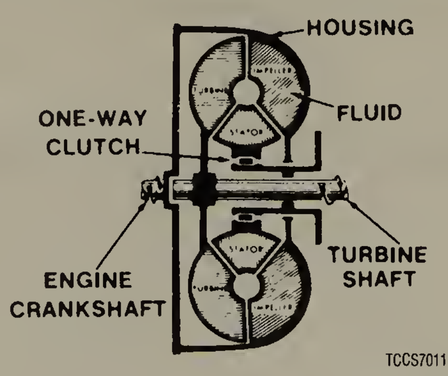


Fig. 32 The torque converter housing is rotated by the engine's crankshaft, and turns the impeller—The impeller then spins the turbine, which gives motion to the turbine shaft, driving the gears

the ability of the stator to redirect the fluid flow is reduced. Under cruising conditions, the stator is eventually forced to rotate on its one-way clutch in the direction of engine rotation. Under these conditions, the torque converter begins to behave almost like a solid shaft, with the torus and turbine speeds being almost equal.

PLANETARY GEARBOX

See Figures 33, 34, 35

The ability of the torque converter to multiply engine torque is limited. Also, the unit tends to be more efficient when the turbine is rotating at relatively high speeds. Therefore, a planetary gearbox is used to carry the power output of the turbine to the driveshaft.

Planetary gears function very similarly to conventional transmission gears. However, their construction is different in that three elements make up one gear system, and, in that all three elements are different from one another. The three elements are: an outer gear that is shaped like a hoop, with teeth cut into the inner surface; a sun gear, mounted on a shaft and located at the very center of the outer gear; and a set of three planet gears, held by pins in a ring-like planet carrier, meshing with both the sun gear and the outer gear. Either the outer gear or the sun gear may be held stationary, providing more than one possible torque multiplication factor for each set of gears. Also, if all three gears are forced to rotate at the same speed, the gearset forms, in effect, a solid shaft.

Most automatics use the planetary gears to provide various reductions ratios. Bands and clutches are used to hold various portions of the gearsets to the transmission case or to the shaft on which they are mounted. Shifting is accomplished, then, by changing the portion of each planetary gearset which is held to the transmission case or to the shaft.

SERVOS AND ACCUMULATORS

See Figure 36

The servos are hydraulic pistons and cylinders. They resemble the hydraulic actuators used on many other machines, such as bulldozers. Hydraulic fluid enters the cylinder, under pressure, and forces the piston to move to engage the band or clutches.

The accumulators are used to cushion the engagement of the servos. The transmission fluid must pass through the accumulator on the way to the servo. The accumulator housing contains a thin piston which is sprung away from the discharge passage of the accumulator. When fluid passes through the accumulator on the way to the servo, it must move the piston against spring pressure, and this action smoothes out the action of the servo.

HYDRAULIC CONTROL SYSTEM

The hydraulic pressure used to operate the servos comes from the main transmission oil pump. This fluid is channeled to the various servos through the shift valves. There is generally a manual shift valve which is operated by the transmission selector lever and an automatic shift valve for each automatic upshift the transmission provides.

➡Many new transmissions are electronically controlled. On these models, electrical solenoids are used to better control the hydraulic fluid. Usually, the solenoids are regulated by an electronic control module.

There are two pressures which affect the operation of these valves. One is the governor pressure which is effected by vehicle speed. The other is the modulator pressure which is effected by intake manifold vacuum or throttle position. Governor pressure rises with an increase in vehicle speed, and modulator pressure rises as the throttle is opened wider. By responding to these two pressures, the shift valves cause the upshift points to be delayed with increased throttle opening to make the best use of the engine's power output.Most transmissions also make use of an auxiliary circuit for downshifting. This circuit may be actuated by the throttle linkage the vacuum line which actuates the modulator, by a cable or by a solenoid. It applies pressure to a special downshift surface on the shift valve or valves.The transmission modulator also governs the line pressure, used to actuate the servos. In this way, the clutches and bands will be actuated with a force matching the torque output of the engine.

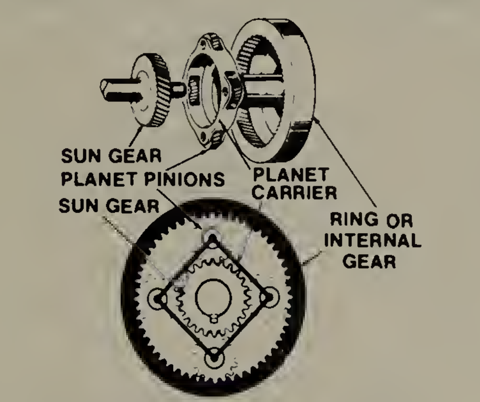


Fig. 33 Planetary gears work in a similar fashion to manual transmission gears, but are composed of three parts

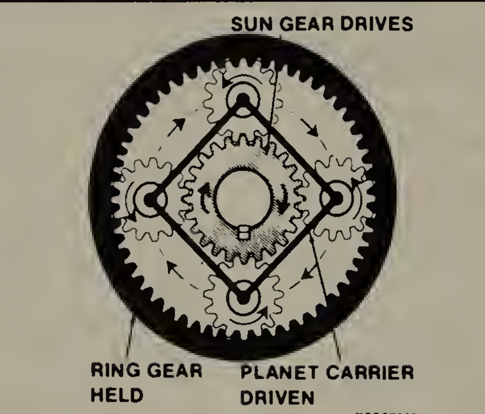


Fig. 34 Planetary gears in the maximum reduction (low) range. The ring gear is held and a lower gear ratio is obtained

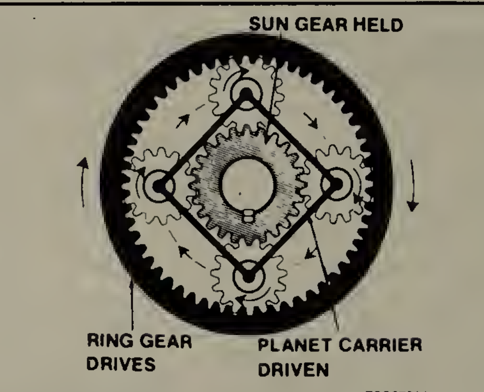


Fig. 35 Planetary gears in the minimum reduction (drive) range. The ring gear is allowed to revolve, providing a higher gear ratio

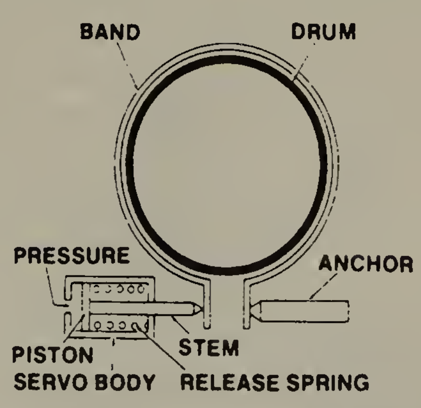


Fig. 36 Servos, operated by pressure, are used to apply or release the bands, to either hold the ring gear or allow it to rotate

Park/Neutral Safety Switch

The park/neutral and back-up lamp switch is one unit mounted to the side of the shifter assembly. The park/neutral portion of the switch allows electrical current to travel to the ignition system when the shift selector is in Park or Neutral only. The vehicle will not start when the selector is in any other gear. The back-up portion operates the rear back-up lamps when the selector is in the reverse gear.

REMOVAL & INSTALLATION

See Figure 37

1. Disconnect the negative battery cable.
2. For 1984–92 vehicles, remove the shifter knob, then remove the console assembly, as outlined in Section 10 to this manual.
3. For 1993–96 vehicles, remove the console trim plate.
4. Unfasten the switch mounting nuts, then remove the switch.
5. Remove the gage pin.

To install:

After switch adjustment, make sure that the car will only start in Park or Neutral. If the engine starts in any other position, the switch must be readjusted.

6. To install using a new switch, perform the following:
   a. Place the shift control lever in Neutral.
   b. Insert the carrier tang on the switch into the slot on the shifter.
   c. Install the mounting nuts and tighten to 26 inch lbs. (3 Nm).

If the holes do not align with the shift control, make sure the shift control lever is in Neutral. Do not rotate the switch as it is pinned in the Neutral position. If the switch has been rotated and the pin broken, the switch can be adjusted using the old switch procedure.

   d. Move the shift control lever out of the Neutral position, in order to shear the plastic pin.
7. If installing an old switch, perform the following:
   a. Place the shift control lever in Neutral.
   b. Align the carrier tang on the switch with the tang slot on the shift control.
   c. Loosely assembly the mounting nuts to the case.
   d. Rotate the switch to align the service adjustment hole with the carrier pin hole.
   e. Insert a 0.94 in. (2.34mm) gage pin in the service adjustment hold and rotate the switch until the pin drops in to a depth of 0.59 in. (15mm).
   f. Tighten the nuts to 26 inch lbs. (3 Nm).
8. Install the gage pin.
9. Install the console and shifter knob or console trim plate as applicable.
10. Connect the negative battery cable, then make sure that the car only starts in Park or Neutral. If the engine starts in any other position, you must readjust the switch.

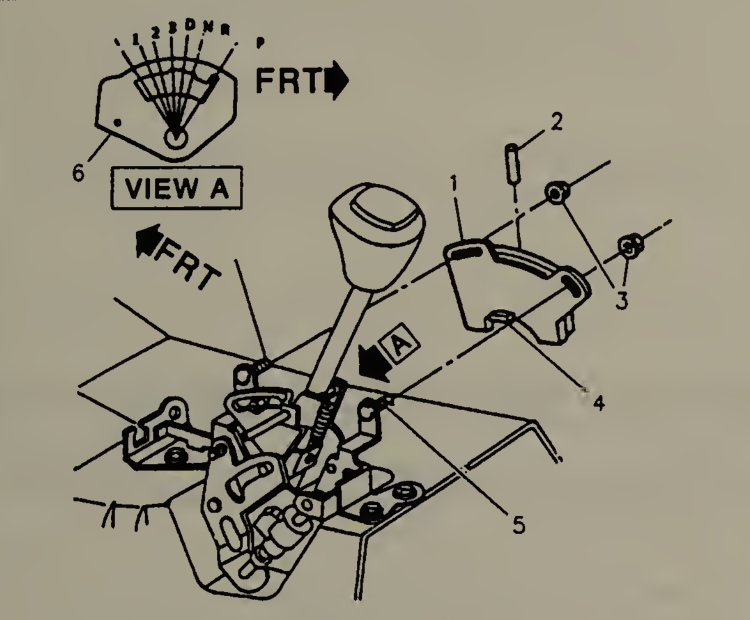


Fig. 37 Exploded view of the park/neutral position switch

Extension Housing Seal

REMOVAL & INSTALLATION

See Figure 38

1. Disconnect the negative battery cable, then raise and safely support the vehicle.
2. For convertibles, remove the upper and lower underbody braces.
3. Remove the complete exhaust system.
4. Support the transmission assembly with a suitable jack.
5. Remove the bolts securing the driveline support beam at the axle and transmission. Remove the driveline support beam from the vehicle, as outlined in later in this section.
6. Matchmark the position of the shaft to the companion flange and disconnect the rear universal joint by removing the trunnion bearing straps. Make sure to tape the bearing cups to avoid dropping and/or losing the bearing rollers.
7. There may be some fluid leakage from the transmission output shaft housing, so place a suitable catch pan underneath, then slide the slip yolk from the transmission and remove the shaft.
8. Carefully pry the old seal out using a suitable seal removal tool, working around the perimeter of the seal, removing it a little at a time, until the seal can be removed.

To install:

9. Coat the lip of a new seal with automatic transmission fluid.
10. Using a suitable seal installation tool, as shown in the accompanying figure, place a new seal on the tool and install the seal.
11. Install the propeller shaft. Make sure to align the shaft with the matchmarks made during removal, remove the tape over the trunnion bearing caps and connect the exposed caps to the companion flange. Tighten the strap retaining bolts to 12.5 ft. lbs. (17 Nm).
12. The remainder of installation is the reverse of the removal procedure.
13. Refer to the procedure located later in this section for driveline support beam installation and tightening specifications.
14. Check the transmission fluid level add if necessary. Keep in mind that the transmission should be level when checking the fluid level.

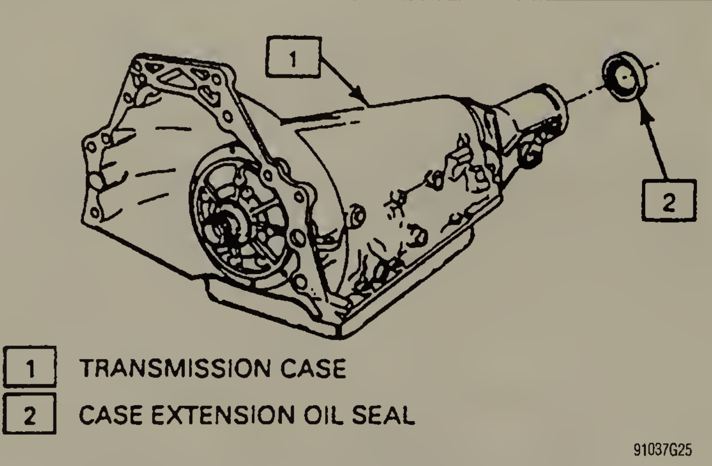


Fig. 38 Location of the case extension oil seal—1995 vehicle shown, other similar

Automatic Transmission Assembly

REMOVAL & INSTALLATION

See Figures 39, 40 and 41

The engine must be supported before removing the transmission assembly in order to prevent the vapor blow pipe located across the rear of the engine from contacting the dash panel.

1. Disconnect the negative battery cable and remove the transmission fluid level indicator.

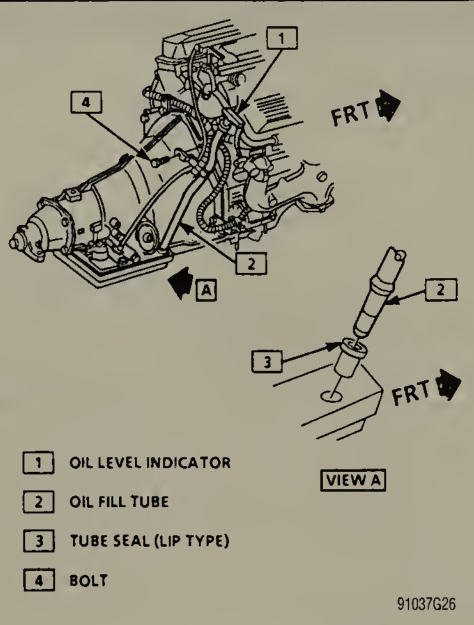


Fig. 39 You must remove the transmission fluid level dipstick

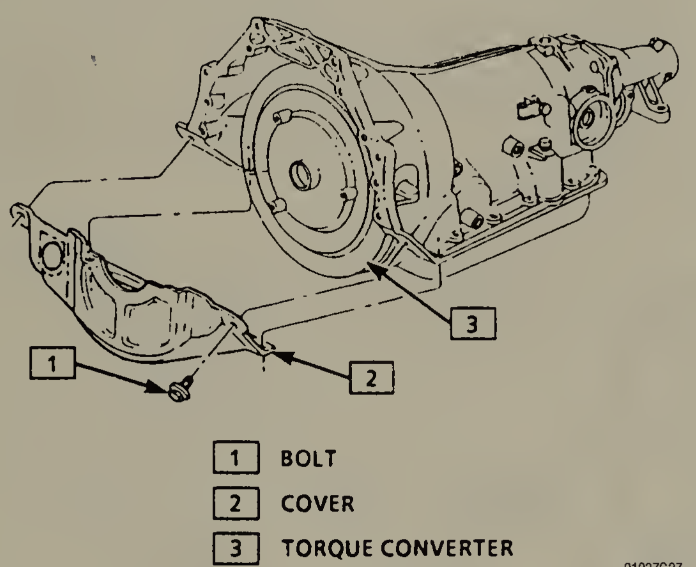


Fig. 40 Unfasten the retainers and remove the torque converter cover . . .

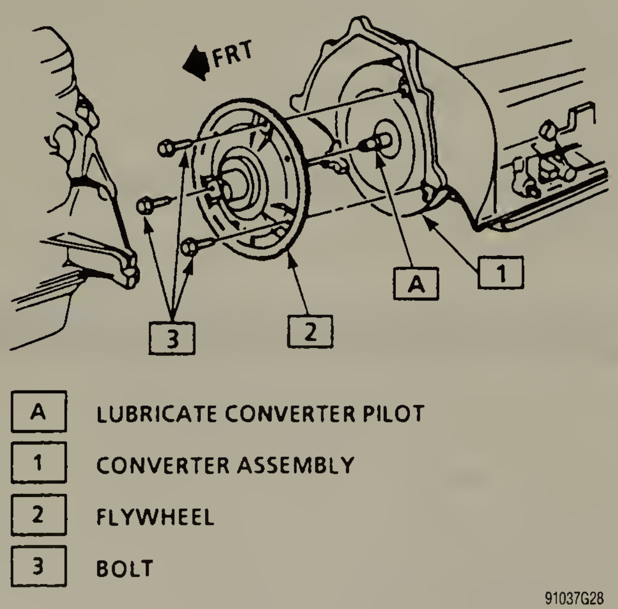


Fig. 41 . . . then remove the converter-to-flywheel bolts

2. Disconnect the TV cable at the throttle lever or the adjuster assembly.
3. Remove the transmission fluid level indicator.
4. Raise and support the vehicle safely.
5. If equipped, remove the upper and lower underbody braces.
6. Remove the complete exhaust system.
7. Support the transmission with a suitable jack.
8. Remove the driveline support beam.
9. Matchmark and remove the driveshaft.
10. Disengage the speedometer electrical connector, then disconnect the shift control cable and the remaining electrical leads from the transmission.
11. Remove the torque converter cover and mark the relationship of the converter to the flywheel, then remove the converter-to-flywheel bolts.
12. Disconnect the oil cooler pipes at the transmission. Plug the openings to prevent system contamination or excessive fluid loss.
13. Disconnect the TV cable at the transmission.
14. Remove the transmission-to-engine mounting bolts and fasten the torque converter to the transmission using a converter restraining tool or a length of wire.
15. Carefully move the transmission rearward, downward and out from under the vehicle. If interference is encountered with cables, cooler lines, etc., remove the component(s) before finally lowering the transmission.

To install:

16. Flush the transmission oil cooler lines using J-35944 or an equivalent transmission cooler and line flushing tool.
17. Install a converter restraint tool to hold the torque converter in place.
18. Support the transmission with a suitable jack, then raise the transmission into position and remove the torque converter holding tool.
19. Install and tighten the transmission to engine bolts to 35 ft. lbs. (47 Nm).
20. Connect the TV cable to the transmission.
21. Remove the plugs, then connect the oil cooler pipes to the transmission.
22. Align the marks made during removal and start the torque converter to flywheel bolts by hand. Tighten the bolts to 46 ft. lbs. (62 Nm).
23. Install converter cover and tighten screws to 89 inch lbs. (10 Nm).
24. Engage the electrical connectors to the transmission.
25. Connect the shift control cable.
26. Engage the speedometer electrical connector.
27. Align the marks made earlier and install the driveshaft, then the driveline support beam.
28. Install the exhaust system, if equipped, the underbody braces.
29. Lower the vehicle and install the oil level indicator.
30. Connect the TV cable to the throttle lever or to the adjuster assembly.
31. Connect the negative battery cable.
32. Check and add the proper type and amount of transmission fluid.
33. Because the driveline support beam was removed, check clearance between the air intake duct and the throttle body. If the air duct becomes dislodged from the throttle body, a driveability problem could occur.

ADJUSTMENTS

Shift Linkage/Control Cable

See Figures 42 and 43

1. Disconnect the negative battery cable.
2. Place the control lever in the **N** position.
3. Raise and support the vehicle safely.
4. Loosen the cable attachment at the shift lever.
5. Rotate the shift lever clockwise to **P** detent and then back to **N**.
6. Tighten the cable attachment to 15 ft. lbs. (20 Nm).

The lever must be held out of the P position when tightening the nut.

7. Lower the vehicle.
8. Check the cable adjustment by rotating the control lever through the detents.
9. Connect the battery negative cable.

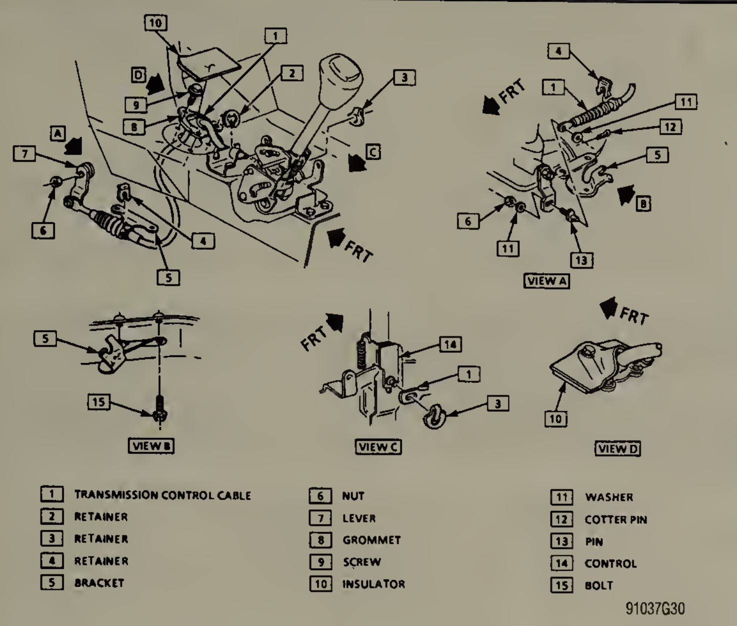


Fig. 42 Typical shift control cable attachment

91037P02

Fig. 43 The control cable is mounted to the side of the transmission, just above the transmission fluid pan

TV Cable

1984–91 VEHICLES

➧ See Figure 44

To adjust the Throttle Valve (TV) cable on these vehicles, please refer to the accompanying figure.

1992–96 VEHICLES

Beginning in 1992, the Acceleration Slip Regulation (ASR) system was added to all Corvettes. This required a cable adjuster assembly which has the ability to extend cables slightly, according to commands from the control module. This extension allows the throttle close regardless of accelerator pedal position. The adjuster does not have the ability to apply throttle, it can only release it.

The cable adjuster assembly must be adjusted each time the throttle and/or TV cables are disconnect. On some models, the TV cable is also attached to a servo. The cable may be adjusted BEFORE cable adjuster assembly adjustment.

1. Make sure the TV cable is installed into servo bracket.
2. Pull servo assembly end of cable toward servo without moving the throttle lever.
3. If 1 out of the 5 holes in the servo assembly tab aligns with the cable pin, push pin through hole and connect pin to tab with retainer.
4. If the tab holes does not align with the pin, move the cable away from the servo assembly until the next closest tab hole aligns and connect the pin to the tab with the retainer.

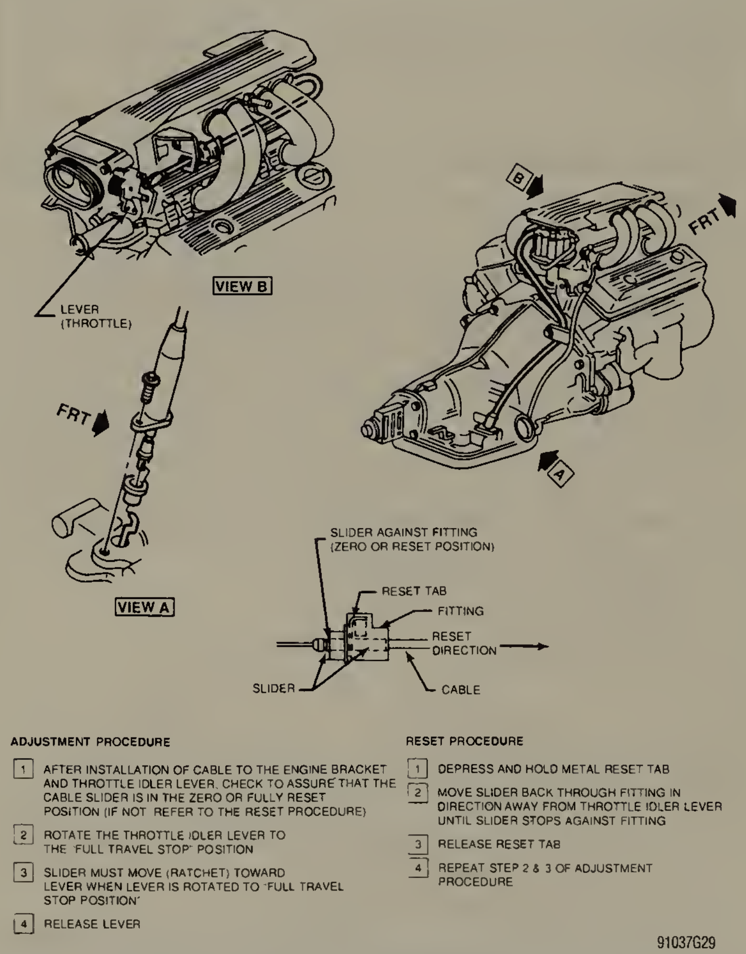


Fig. 44 Throttle Valve (TV) cable adjustment procedure—1984–91 vehicles

DRIVELINE

Driveshaft and U-Joints

REMOVAL & INSTALLATION

➧ See Figure 45

➡The driveshaft is also referred to as the propeller shaft.

1. Raise and support the vehicle safely.
2. If equipped, remove the upper and lower underbody braces.
3. Remove the complete exhaust system as an assembly.
4. Support the transmission, then remove the bolts, washers and nuts attaching the driveline support beam at the axle and/or transmission to gain necessary clearance.
5. Mark relationship of shaft to the pinion yoke and disconnect the rear universal joint by removing trunnion bearing straps. Tape bearing cups to trunnion to prevent dropping and loss of roller bearings.
6. Place a suitable drain pan under the transmission for oil leakage, slide the slip yoke from the transmission and remove the driveshaft from the vehicle.

To install:

7. Slide the driveshaft slip yoke into the transmission extension.
8. Align the marks made during removal and install the rear of the driveshaft to the pinion yoke. If no marks were made or the driveshaft is being replaced, align the black paint dot on the driveshaft as close to 180 degrees opposite the yellow paint dot on the axle pinion yoke.
9. Install the propeller shaft retainers and bolts. Tighten the bolts to 18 ft. lbs. (24 Nm).
10. If removed, install and align driveline support beam as follows:

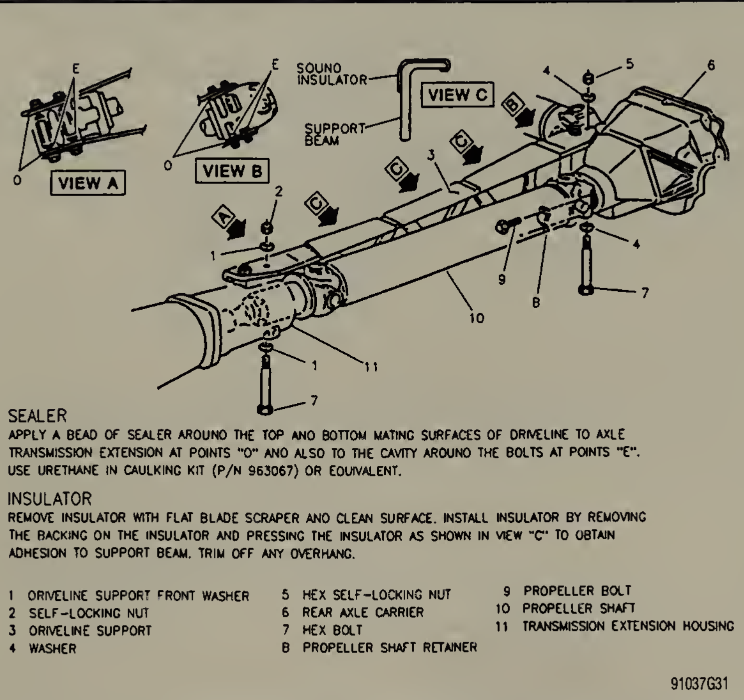


Fig. 45 View of the propeller shaft (driveshaft) and driveline support mounting

a. To ensure proper alignment of the driveline, a clearance of 1.53–2.00 in. (39–51mm) must be maintained between the top of the beam to the underbody and a clearance of 0.86–1.34 in. (22–34mm) from the passenger side of the beam to the side wall.

b. Take the measurements directly above and to the right of the driveshaft yoke.

c. Apply sealer to the support sealing surfaces at the transmission extension, the differential carrier and the driveline support.

d. Install the washers, bolts and nuts then tighten the bolts at the carrier to 60 ft. lbs. (80 Nm) and the transmission bolts to 37 ft. lbs. (50 Nm).

e. Remove the transmission support.

11. Install the exhaust system assembly.
12. If equipped, install the upper and lower underbody braces.
13. Lower the vehicle.

U-JOINT REPLACEMENT

See Figures 46, 47 and 48

1. For reassembly, make a mark indicating the front of the propeller shaft on the transmission end of the shaft and yoke.
2. Remove the driveshaft from the vehicle.
3. Remove the snaprings. If a snapring does not readily come out, tap the end of the bearing cap lightly to relieve pressure against the ring.
4. Place the driveshaft horizontally in line with the base plate of a press, but do not clamp the tube.
5. Support the lower ear of the universal joint with a 1⅛ inch socket.
6. Press the lower bearing cap out from the yoke using a pusher on the upper bearing cup.
7. Rotate the driveshaft, then remove the opposite bearing cup.
8. Remove the universal joint from the yoke.

To install:

9. Install one bearing cap partially into 1 side of the yoke, then turn this side to the bottom.
10. Install the joint into the yoke so the trunnion seats freely in the bearing cap.
11. Install the opposite bearing cap partially into the yoke, verifying the trunnions are straight and true in the bearing caps.
12. Press against the opposite bearing caps; while working the joint in order to verify that the joint is not binding and turns freely. If the joint begins to bind, there is probably 1 or more needle bearings out of place and tipped under the trunnion.
13. When 1 bearing cap snapring retainer groove clears the inside of the yoke, stop pressing and install a snapring into place.
14. Continue to press the opposite side until a snapring can be inserted. If difficulty is encountered, strike the yoke firmly with a hammer to slightly spring the yoke ears.
15. Assemble the other half of the joint in the same manner.
16. Install the driveshaft (propeller shaft), as outlined earlier in this section.

Driveline Support

REMOVAL & INSTALLATION

See Figure 45

1. Raise and safely support the vehicle.
2. If equipped, remove the upper and lower underbody braces.
3. Remove the complete exhaust system from the vehicle.
4. Remove the parking brake front cable guide from the driveline support.
5. Support the transmission with a suitable jack.
6. Unfasten the driveline support nuts, bolts and washers.
7. Slide the driveline support toward the right side of the vehicle.
8. Remove the propeller shaft (driveshaft), as outlined earlier in this section.
9. Carefully position the transmission toward the left side of the vehicle.

➡Be careful when removing the driveline support near the parking brake cable not to scrape or cut the cable. If precautions are not taken, system and/or vehicle damage may result.

10. Remove the driveline support by moving forward, then maneuvering down and around the differential carrier and transmission.

To install:

➡After installing the driveline support, check the air intake duct-to-throttle body mating surface. If the air duct becomes dislodged from the throttle body, a driveability problem may occur.

11. Apply a suitable sealant to the mating surfaces of the transmission housing, differential carrier and driveline support.

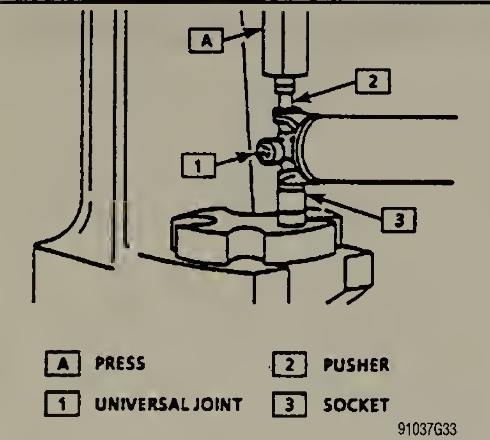


Fig. 46 Use a suitable press to drive out the bearing cap

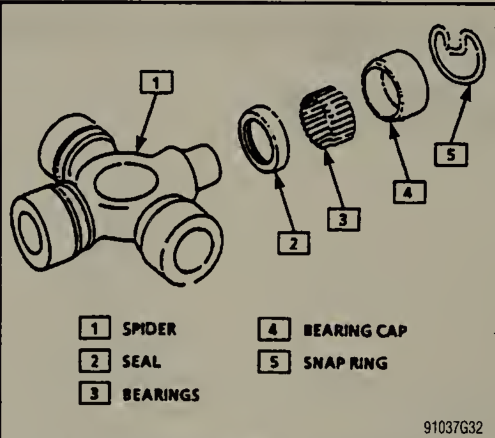


Fig. 47 Exploded view of a universal joint assembly

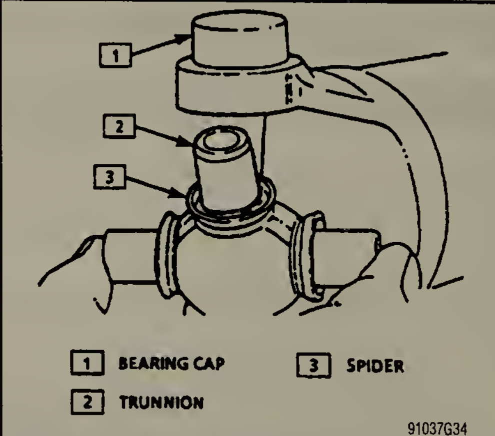


Fig. 48 View of the partially inserted bearing cap

12. Install the insulator. Refer to the accompanying figure for details.
13. Maneuver the driveline support up and around the transmission and rear axle, then slide it toward the right side of the vehicle.
14. Install the propeller shaft (driveshaft) as outlined in this section.
15. Place the driveline support into position, making sure to align the bolt holes. Align the driveline components. To ensure proper driveline alignment, a clearance of 1.53–2.00 in. (39–51mm) must be maintained between the top of the support to the underbody and a clearance of 0.86–1.34 ft. lbs. (22–34mm) from the right side (passenger side of the vehicle) of the support to the side wall. Take these measurements directly above an to the right of the propeller shaft front yoke.
16. Install the driveline support washers, bolts and nuts. Tighten the driveline support bolts at the differential carrier to 59 ft. lbs. (80 Nm) and the driveline support bolts to the transmission to 37 ft. lbs. (50 Nm).
17. Remove the transmission support.
18. Install the parking brake front cable guide to the driveline support.
19. Install the complete exhaust system.
20. If equipped, install the upper and lower underbody braces.
21. Carefully lower the vehicle.

REAR AXLE

Axle Shaft, Bearing and Seal

REMOVAL & INSTALLATION

➧ See Figures 49 and 50

1. Raise and support the vehicle safely, making sure the rear suspension hangs freely.

➡Do not support the vehicle by means of the differential or the transverse leaf springs.

2. Remove the rear transverse leaf spring from the knuckle as follows:
   a. Remove 1 rear wheel assembly.
   b. Install tool J–33432 or equivalent transverse leaf compressor, onto the rear transverse spring and compress the spring.
   c. Remove the cotter pin, nut, rubber grommets and bolt attaching the spring to the knuckle.
   d. Carefully release and remove spring compressor.
3. Remove the cotter pin, nut and washer from the tie rod outer socket at knuckle. Using a suitable linkage puller, disconnect the outer tie rod from the knuckle.
4. Disconnect the spindle rod bracket at the differential carrier.
5. Remove the axle shaft universal joint straps at the both the spindle and yoke shaft ends.
6. Remove the shaft by supporting the shaft and pushing out on the knuckle assembly.
7. If necessary, remove rear axle yoke, oil seal and bearing as follows:
   a. If equipped, remove the upper and lower underbody braces.
   b. Remove the exhaust assembly.
   c. Support the rear differential, then remove the differential carrier outer support bolts.
   d. Remove the carrier cover and drain the gear oil into a suitable container.
   e. Remove the snapring from the axle shaft yoke and remove the yoke.
   f. If only replacing the seal, pry the axle shaft yoke seal out using a suitable tool. Be careful not to damage the yoke shaft bearing assembly.
   g. If the seal cannot be removed in this manner or the bearing assembly is to be replaced as well, remove the differential assembly.
   h. Using tools J–34171 for the 7.875 inch axle (automatic transmission) or J–35509 for the 8.5 inch axle (manual transmission), and driver handle J–8592 or equivalents, and a hammer, remove the seal and bearing assembly. Discard the seal and bearing.

To install:

8. If removed, install a new rear axle shaft bearing and seal as follows:
   a. If installing a new bearing, clean the seal bore using a standard metal cleaning solvent.
   b. Install a new rear axle bearing assembly. Use tools J–34172 for the 7.875 inch axle (automatic transmission) or J–35510 for the 8.5 inch axle (manual transmission) with driver handle J–8592 or equivalents, and a hammer.
   c. Lubricate bearings with a suitable hypoid lubricant.
   d. Apply a light coat of hypoid lubricant on the lip of the axle shaft seal.
   e. Install axle shaft seal using tools J–26938 for 7.875 in. axle or J–35511 for 8.5 in. axle and driver J–8592 or equivalents.
   f. If removed, install the differential assembly.
   g. Install the axle yoke shaft and snapring into the differential carrier.
   h. If a new yoke shaft is installed, yoke shaft end play should be checked and adjusted, if necessary by using snaprings of varying thickness. Endplay should be 0.0005–0.0085 inch (0.013–0.216mm).

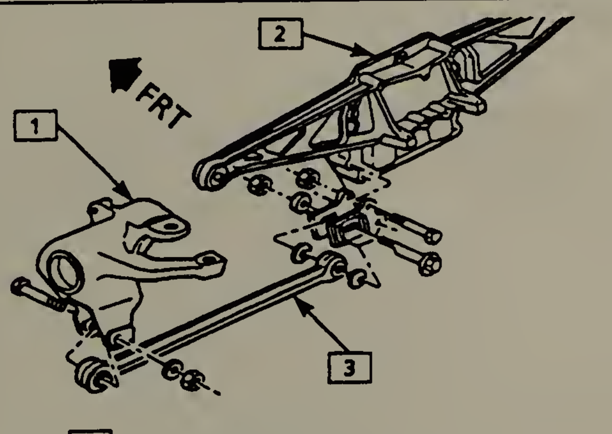


Fig. 49 Exploded view of the spindle support rod

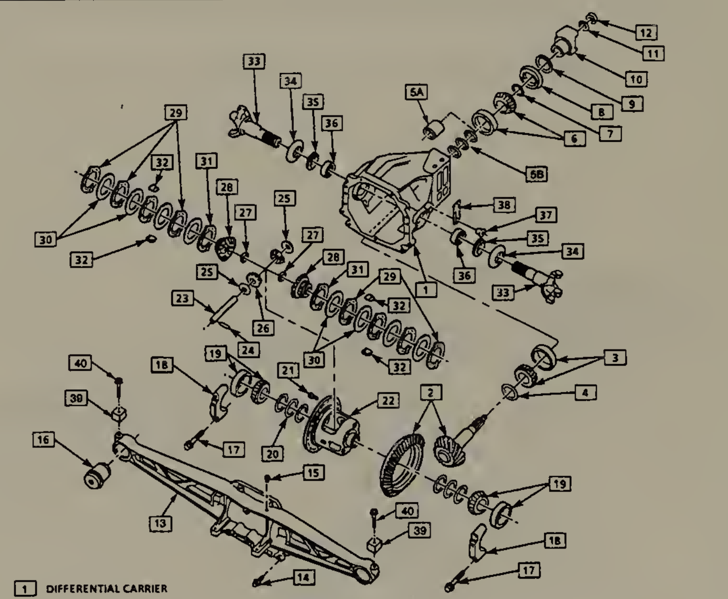


Fig. 50 Exploded view of the rear axle components—1996 vehicle shown, others similar

i. Apply a continuous ¼ inch bead of sealant to the mating surfaces, then install the differential carrier cover, with gasket, to the carrier. Tighten the bolts to specification using the proper torque sequence.

j. Install the carrier outer support retaining bolts and tighten to 60 ft. lbs. (80 Nm).

k. Remove the differential support and install the exhaust assembly or connect the crossover pipe, as applicable.

l. If applicable, install the underbody upper and lower braces.

9. Install the axle assembly shaft into the differential and spindle yoke.
10. Install the shaft U-joint retainers and tighten the bolts to 26 ft. lbs. (35 Nm).
11. Connect the spindle rod bracket to the differential carrier and tighten the spindle rod bracket bolts to 60 ft. lbs. (80 Nm).
12. Install the tie rod outer axle socket to the knuckle. Install the washer and nut, tighten the end nut to 33 ft. lbs. (45 Nm), then replace the cotter pin.
13. Using a suitable compression tool, connect the leaf spring to the knuckle and install the bolt, grommets and nut. Tighten the nut and align the slot in the nut with the hole in the bolt, then insert a new cotter pin.
14. Lower the vehicle.

Pinion Seal

REMOVAL & INSTALLATION

See Figure 51

1. Raise and safely support the vehicle.
2. If equipped, remove the upper and lower underbody braces.
3. Remove the exhaust assembly.
4. Remove the driveline support beam and driveshaft.
5. Remove the pinion yoke nut using a suitable tool to hold the yoke, then remove the yoke from the carrier.
6. Inspect the yoke seal area for wear, replace the yoke if necessary.
7. Carefully pry the pinion yoke seal from the differential housing using a small suitable tool. Be careful not to damage the pinion threads.

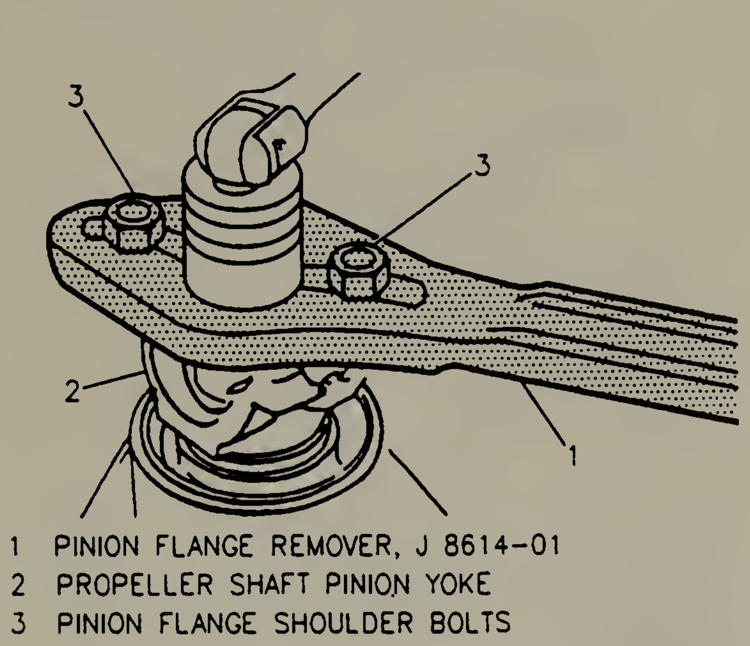


Fig. 51 Removal and installation of the pinion nut and washer

To install:

8. Clean the seal bore of the differential carrier.
9. Use J-34163 for the 7.875 inch axle (automatic transmission), J-35503 for the 8.5 inch axle (manual transmission), or an equivalent pinion seal installation tool, to install the new seal into the carrier bore.
10. Install the pinion yoke and tighten the nut while using a suitable tool to hold the pinion yoke. Tighten the pinion nut to 200 ft. lbs. (271 Nm) for an automatic transmission or 250 ft. lbs. (339 Nm) for a manual transmission.
11. Install the driveshaft and the driveline support beam.
12. Install the exhaust assembly or crossover pipe, as applicable.
13. If equipped, install the upper and lower underbody braces.
14. Check and fill the differential, as necessary.
15. Lower the vehicle.

Differential Assembly

REMOVAL & INSTALLATION

See Figures 52 and 53

1. Disconnect the negative battery cable.
2. Remove the rear axle assembly.
3. Remove the differential cover and drain the gear oil into a suitable container, then mount the assembly in a suitable support.
4. Remove the snaprings from each axle shaft yoke in the differential carrier. Mark each snapring to indicate which side it was removed from. The snaprings come in several different sizes.
5. Remove the axle shaft yokes.
6. Remove the differential bearing caps, noting the matched letters stamped on the caps and carrier.
7. Mount the carrier housing spreader tools J-24385-01 and J-24385-20 or equivalents, to the carrier housing and install a dial indicator set.

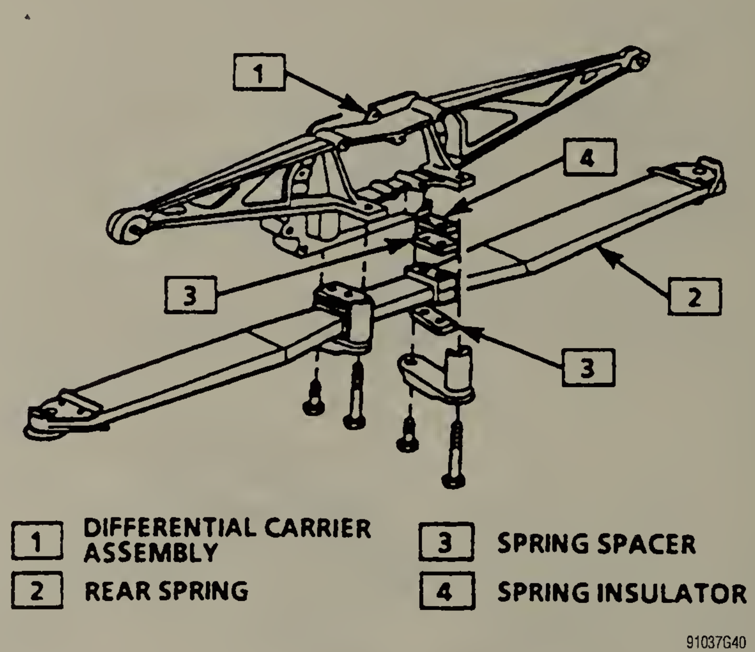


Fig. 52 Rear spring-to-differential carrier mounting

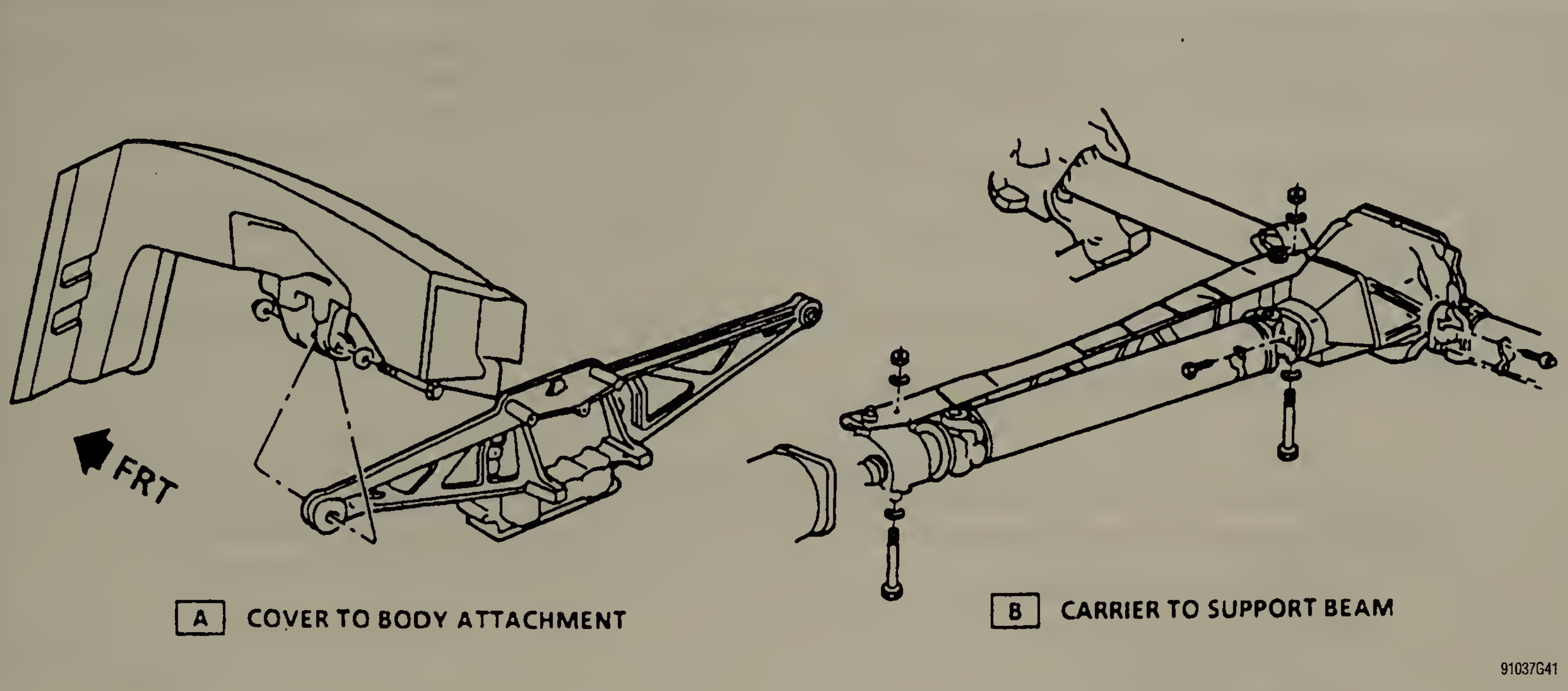


Fig. 53 Location of the differential carrier cover attachments

8. Measure the carrier spread using the dial indicator mounted to the assembly.
9. Spread the case, but do not exceed 0.010 inch (0.25mm) of spread.
10. Use 2 prybars to carefully pry the carrier assembly from the case. Be sure to avoid damage to any machined surfaces and tag the bearing cups to indicate from which side they were removed.
11. Remove the spreader after the assembly has been removed.

To install:

12. With the spreader mounted to carrier, spread the carrier, but not exceeding 0.010 in. (0.25mm) of spread then remove the dial set.
13. Lubricate and assemble the bearing cups to the differential bearing.
14. Install the differential assembly into the carrier and seat the differential assembly into the cross bore of the carrier. If necessary, use a rawhide or heavy duty plastic hammer to seat the differential.
15. Install the bearing caps and bolts, make sure the letters stamped on the caps and carrier assembly coincide in both direction and letter.
16. Tighten the cap bolts to 45 ft. lbs. (60 Nm) for the 7.875 inch axle (automatic transmission) or to 63 ft. lbs. (85 Nm) for the 8.5 inch axle (manual transmission).
17. Measure the ring gear backlash at 3 equally spaced points:
    a. Backlash tolerance is 0.006–0.009 in. (0.15–0.23mm) and cannot vary more than 0.0010–0.0015 in. (0.03–0.04mm).
    b. High backlash is corrected by moving some shims from the opposite side of the case to the ring gear side, thus moving the ring gear closer to the pinion.
    c. Low backlash is corrected by moving shims from the ring gear side of the case to the opposite side, thus moving the ring gear away from the pinion.
18. Install axle shaft yokes and snaprings, ensuring snaprings are installed on the side from which they were removed.
19. Apply a continuous ¼ inch bead of 1052914 or equivalent sealant, to the mating surfaces and install the carrier cover with gasket onto the carrier. Tighten the bolts to specification, following the proper sequence.
20. Install the rear axle housing assembly into vehicle.
21. Lower the vehicle and connect the negative battery cable.

Rear Axle Housing

REMOVAL & INSTALLATION

See Figure 50

1. Raise and support the vehicle safely.
2. Remove the spare tire, then remove tire cover by disengaging the support hooks.
3. If equipped, remove the upper and lower underbody braces.
4. Remove the exhaust assembly.
5. Remove the transverse leaf springs from vehicle.
6. If necessary, remove exhaust hangers.
7. Remove the spindle support rod, bolts and mounting bracket from the carrier.
8. Remove both tie rod ends from knuckles.
9. Remove the axle universal joint straps from differential yokes.
10. Support the axle shaft and push the wheel and tire assembly outward to disengage joints from differential yokes.
11. Scribe alignment marks on driveshaft and pinion yoke for installation purposes.
12. Remove the driveshaft U-joint straps from the pinion flange and push the driveshaft forward into the transmission, then support the shaft from the driveline support beam.
13. Support the rear axle assembly using a transmission jack, then install a jackstand or other support under the transmission.
14. Remove the carrier cover attaching bolts from the frame brackets.
15. Remove the driveline support beam attaching bolts from the rear axle rear axle housing.
16. Carefully lower the rear axle assembly from the vehicle.

To install:

17. Raise the rear axle assembly into position on the vehicle.
18. Apply 9636067 or equivalent sealant to the driveline support and the differential carrier, then install the driveline support bolts at the front of the carrier cover.

19. To ensure proper alignment of the driveline, a clearance of 1.53–2.00 in. (39–51mm) must be maintained between the top of the beam to the underbody and a clearance of 0.86–1.34 in. (22–34mm) from the passenger side of the beam to the side wall. Take the measurements directly above and to the right of the driveshaft yoke and adjust if necessary, then tighten the bolts to 60 ft. lbs. (80 Nm).
20. Install the differential carrier cover-to-frame bracket bolts and tighten to 89 ft. lbs. (120 Nm).
21. Align the marks on driveshaft and yoke, and install the driveshaft. Tighten the U-joint strap bolts to 18 ft. lbs. (24 Nm).
22. Install wheel axle shaft joints into the yokes.
23. Install axle shaft U-joint retainers onto the yoke shafts, then tighten the retainers to 26 ft. lbs. (35 Nm).
24. Install tie rod ends into knuckle. Install the washers and nuts, then tighten the tie rod nut to 33 ft. lbs. (45 Nm) to align slot in nut with hole in stud. Install a new cotter pin.
25. Install the spindle support rod mounting bracket onto the carrier and tighten the bolts to 60 ft. lbs. (80 Nm).
26. Install the transverse leaf spring.
27. If removed, install the exhaust system hangers and nuts, tighten the nuts to 13 ft. lbs. (17 Nm).
28. Install the exhaust system assembly or crossover pipe, as applicable.
29. If equipped, install the upper and lower underbody braces.
30. Install the spare tire cover and spare tire.
31. Fill the rear axle with a suitable lubricant.
32. Adjust the rear suspension, as necessary, then lower the vehicle.

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Manual Transmission			
Back-up light switch 35 ft. lbs. (47 Nm)	35		47
Extension housing (output shaft) seal			
Strap retaining bolts	12.5		17
Transmission fluid fill plug	26		35
Manual transmission assembly			
1984-92 vehicles			
Transmission attaching bolts	45-60		60-80
Oil cooler line fittings	8-12		11-16
1993-96 vehicles			
Transmission-to-clutch housing bolts	37		50
Driveshaft -to-yoke retaining bolts	18		25
Support bracket bolts	18		25
Torque beam-to-differential carrier bolt	60		80
Torque beam-to-transmission bolt	37		50
Clutch			
Driven disc and Pressure Plate			
1989-96 vehicles			
Clutch housing bolts	37		50
Ball stud nut	33		45
Ball stud locking screw			
VIN P & 5 engines	11		15
VIN J engines	16		22
Housing cover bolts		80	9
Left heat shield nut		12	1.4
Master Cylinder			
1984-88 vehicles	15-22		20-30
1989-96 vehicles	12		17
Slave Cylinder			
1984-88 vehicles	25-40		34-54
1989-96 vehicles			
Line fittings	13		18
Mounting bolts	18		25
Bleeder Screws			
1989-90 vehicles (tighten until screw breaks for clearance)	10-14		14-19
Automatic Transmission			
Park/Neutral Safety switch nuts		26	3
Extension housing seal			
Strap retaining bolts	12.5		17
Automatic transmission assembly			
Transmission-to-engine bolts	35		47
Torque converter-to-flywheel bolts	46		62
Converter cover screws		89	10
Shift linkage/control cable retainer	15		20

91037C01

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Driveline			
Driveshaft & U-Joints			
Propeller shaft retaining bolts	18		24
Differential carrier bolts at the carrier	60		80
Transmission bolts	37		50
Driveline Support			
Driveline support bolts at the differential carrier	59		80
Driveline support-to-transmission bolts	37		50
Axle Shaft, Bearing & Seal			
Carrier outer support retaining bolts 60 ft. lbs. (80 Nm)	60		80
Driveshaft U-joint retainer bolts 26 ft. lbs. (35 Nm)	26		35
Spindle rod bracket bolts 60 ft. lbs. (80 Nm)	60		80
Tie rod outer axle socket-to-knuckle end nut 33 ft. lbs. (45 Nm)	33		45
Rear Axle			
Differential Assembly			
Bearing cap bolts			
7.875 inch rear axle (automatic transmission)	45		60
8.5 inch axle (manual transmission)	63		85
Rear Axle Housing			
Driveshaft yoke bolts	60		80
Differential carrier cover-to-frame bracket bolts	89		120
U-joint strap bolts	18		24
Axle shaft U-joint-to-yoke shaft retainers	26		35
Tie rod end-to-knuckle nuts	33		45
Spindle support rod mounting bracket-to-carrier bolt	60		80
Exhaust system hangers and nuts	13		17

91037C02

BASIC DRIVESHAFT PROBLEMS

Problem	Cause	Solution
Shudder as car accelerates from stop or low speed	• Loose U-joint • Defective center bearing	• Replace U-joint • Replace center bearing
Loud clunk in driveshaft when shifting gears	• Worn U-joints	• Replace U-joints
Roughness or vibration at any speed	• Out-of-balance, bent or dented driveshaft • Worn U-joints • U-joint clamp bolts loose	• Balance or replace driveshaft • Replace U-joints • Tighten U-joint clamp bolts
Squeaking noise at low speeds	• Lack of U-joint lubrication	• Lubricate U-joint; if problem persists, replace U-joint
Knock or clicking noise	• U-joint or driveshaft hitting frame tunnel • Worn CV joint	• Correct overloaded condition • Replace CV joint

86747G59

Troubleshooting Basic Clutch Problems

Problem	Cause
Excessive clutch noise	Throwout bearing noises are more audible at the lower end of pedal travel. The usual causes are: · Riding the clutch · Too little pedal free-play · Lack of bearing lubrication A bad clutch shaft pilot bearing will make a high pitched squeal, when the clutch is disengaged and the transmission is in gear or within the first 2" of pedal travel. The bearing must be replaced. Noise from the clutch linkage is a clicking or snapping that can be heard or felt as the pedal is moved completely up or down. This usually requires lubrication. Transmitted engine noises are amplified by the clutch housing and heard in the passenger compartment. They are usually the result of insufficient pedal free-play and can be changed by manipulating the clutch pedal.
Clutch slips (the car does not move as it should when the clutch is engaged)	This is usually most noticeable when pulling away from a standing start. A severe test is to start the engine, apply the brakes, shift into high gear and SLOWLY release the clutch pedal. A healthy clutch will stall the engine. If it slips it may be due to: · A worn pressure plate or clutch plate · Oil soaked clutch plate · Insufficient pedal free-play
Clutch drags or fails to release	The clutch disc and some transmission gears spin briefly after clutch disengagement. Under normal conditions in average temperatures, 3 seconds is maximum spin-time. Failure to release properly can be caused by: · Too light transmission lubricant or low lubricant level · Improperly adjusted clutch linkage
Low clutch life	Low clutch life is usually a result of poor driving habits or heavy duty use. Riding the clutch, pulling heavy loads, holding the car on a grade with the clutch instead of the brakes and rapid clutch engagement all contribute to low clutch life.

86747G58

8

SUSPENSION AND STEERING

WHEELS

Wheel Assembly

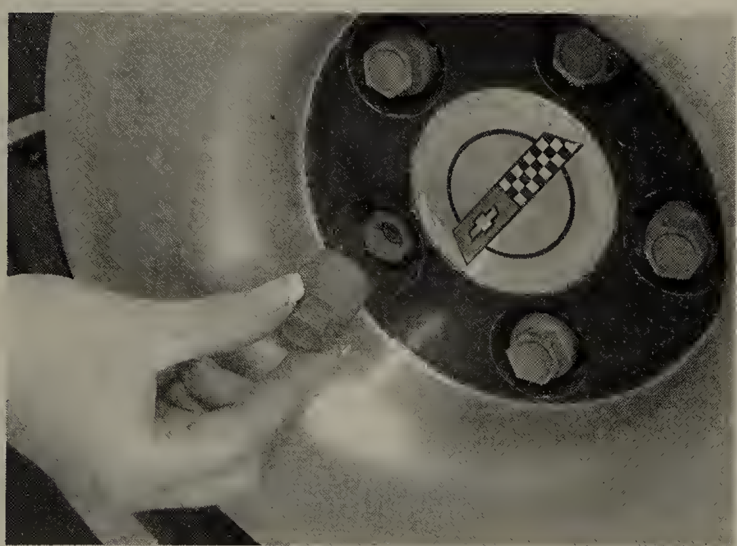
REMOVAL & INSTALLATION

See Figures 1, 2, 3 and 4

1. Park the vehicle on a level surface.
2. Remove the jack, tire iron and, if necessary, the spare tire from their storage compartments.
3. Check the ownerís manual or refer to Section 1 of this manual for the jacking points on your vehicle. Then, place the jack in the proper position.
4. If equipped with lug nut trim caps, remove them by either unscrewing or pulling them off the lug nuts, as appropriate. Consult the ownerís manual, if necessary.
5. Apply the parking brake and block the diagonally opposite wheel with a wheel chock or two.

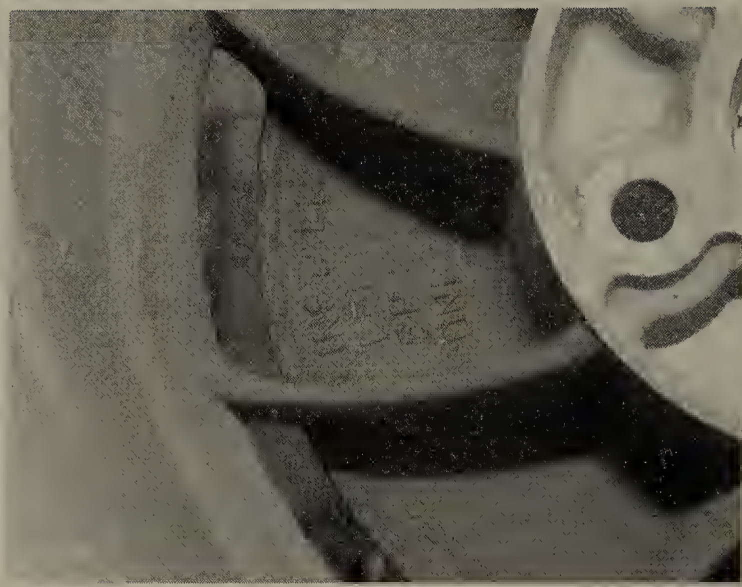
91038P03

Fig. 1 Use a ratchet with an extension and a 19mm socket to loosen . . .



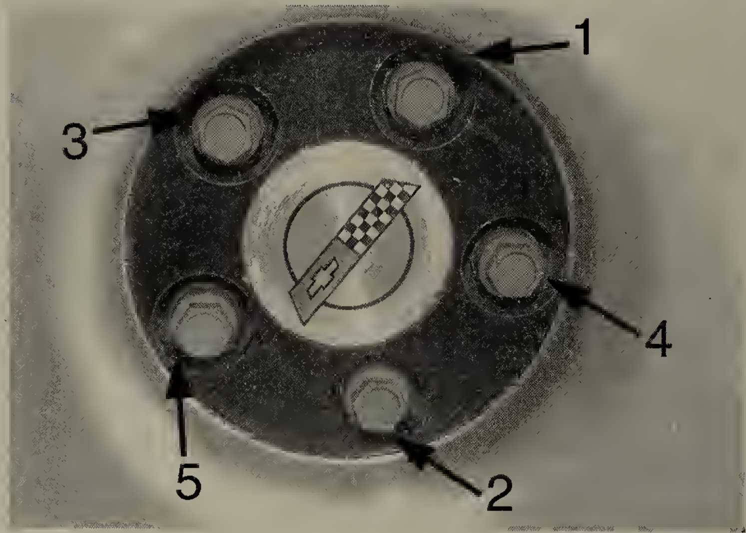
91038P04

Fig. 2 . . . then remove the wheel lug nut covers



91038P53

Fig. 3 On Corvettes, the wheels have markings designating which side they should be installed on



91038P05

Fig. 4 The lug nuts should be tightened in a star pattern, in the sequence shown

➡Wheel chocks may be purchased at your local auto parts store, or a block of wood cut into wedges may be used. If possible, keep one or two of the chocks in your tire storage compartment, in case any of the tires has to be removed on the side of the road.

6. If equipped with an automatic transmission, place the selector lever in **P** or Park; with a manual transmission, place the shifter in Reverse.
7. With the tires still on the ground, use the tire iron/wrench to break the lug nuts loose.

➡If a nut is stuck, never use heat to loosen it or damage to the wheel and bearings may occur. If the nuts are seized, one or two heavy hammer blows directly on the end of the bolt usually loosens the rust. Be careful, as continued pounding will likely damage the brake drum or rotor.

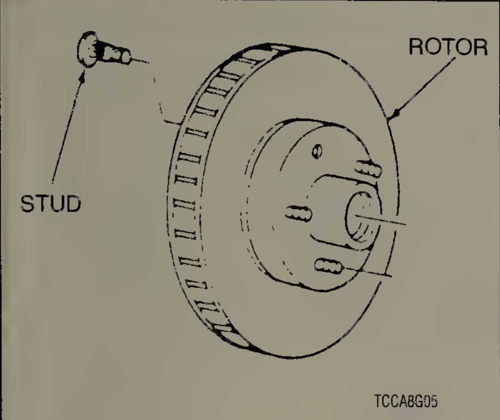


Fig. 5 View of the rotor and stud assembly

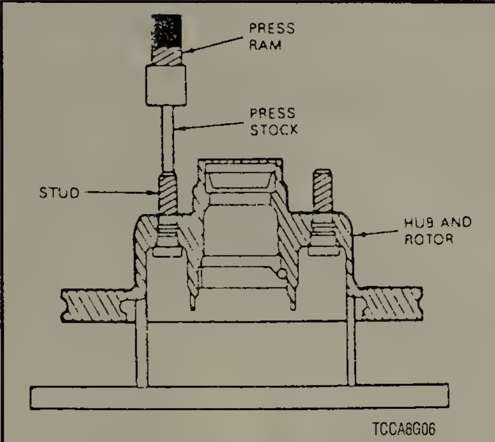


Fig. 6 Pressing the stud from the rotor

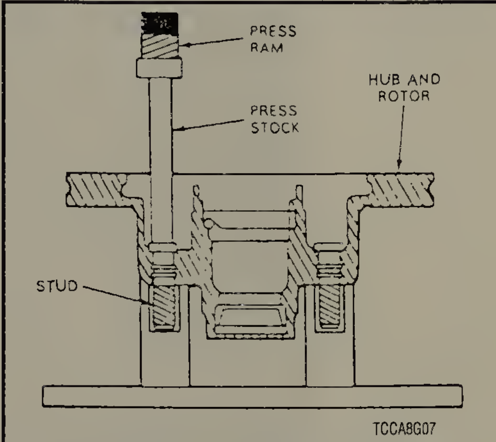


Fig. 7 Use a press to install the stud into the rotor

8. Using the jack, raise the vehicle until the tire is clear of the ground. Support the vehicle safely using jackstands.
9. Remove the lug nuts, then remove the tire and wheel assembly.

To install:

10. Make sure the wheel and hub mating surfaces, as well as the wheel lug studs, are clean and free of all foreign material. Always remove rust from the wheel mounting surface and the brake rotor or drum. Failure to do so may cause the lug nuts to loosen in service.
11. Install the tire and wheel assembly and hand-tighten the lug nuts.
12. Using the tire wrench, tighten all the lug nuts, in a crisscross pattern, until they are snug.
13. Raise the vehicle and withdraw the jackstand, then lower the vehicle.

**** WARNING**

Do not overtighten the lug nuts, as this may cause the wheel studs to stretch or the brake disc (rotor) to warp.

14. Using a torque wrench, tighten the lug nuts in a crisscross pattern to 100 ft. lbs. (136 Nm).
15. If equipped, install the lug nut trim caps by pushing them or screwing them on, as applicable.
16. Remove the jack from under the vehicle, and place the jack and tire iron/wrench in their storage compartments. Remove the wheel chock(s).
17. If you have removed a flat or damaged tire, place it in the storage compartment of the vehicle and take it to your local repair station to have it fixed or replaced as soon as possible.

INSPECTION

Inspect the tires for lacerations, puncture marks, nails and other sharp objects. Repair or replace as necessary. Also check the tires for treadwear and air pressure as outlined in Check the wheel assemblies for dents, cracks, rust and metal fatigue. Repair or replace as necessary.

Wheel Lug Studs

REPLACEMENT

See Figures 5, 6 and 7

1. Raise and support the appropriate end of the vehicle safely using jackstands, then remove the wheel.
2. Remove the brake pads and caliper. Support the caliper aside using wire or a coat hanger. For details, please refer to Section 9 of this manual.
3. Remove the outer wheel bearing and lift off the rotor. For details on wheel bearing removal, installation and adjustment, please refer to Section 1 of this manual.
4. Properly support the rotor using press bars, then drive the stud out using an arbor press.

➡If a press is not available, CAREFULLY drive the old stud out using a blunt drift. MAKE SURE the rotor is properly and evenly supported or it may be damaged.

To install:

5. Clean the stud hole with a wire brush and start the new stud with a hammer and drift pin. Do not use any lubricant or thread sealer.
6. Finish installing the stud with the press.

➡If a press is not available, start the lug stud through the bore in the hub, then position about 4 flat washers over the stud and thread the lug nut. Hold the hub/rotor while tightening the lug nut, and the stud should be drawn into position. MAKE SURE THE STUD IS FULLY SEATED, then remove the lug nut and washers.

7. Install the rotor and adjust the wheel bearings.
8. Install the brake caliper and pads.
9. Install the wheel, then remove the jackstands and carefully lower the vehicle.
10. Tighten the lug nuts to the proper torque.

FRONT SUSPENSION

Transverse Spring

REMOVAL & INSTALLATION

See Figures 8 and 9

➡This procedure requires the use of special tools to properly compress the spring for removal. Do NOT attempt this procedure without the proper tools!

1. Raise and support the vehicle safely. Position the supports so the front suspension hangs freely.
2. Remove both front tire and wheel assemblies.

➡Do not use corrosive cleaning agents, engine degreasers or solvents near the fiberglass front spring, or extensive damage could occur to the spring assembly.

3. For 1988–96 vehicles, perform the following:
   a. Unfasten the retaining nuts and bolts, then disconnect both shock absorbers from the lower control arms.
   b. Remove the nuts and bolts, then disconnect the stabilizer shaft links from both lower control arms.
4. If equipped with ABS, detach the wheel speed sensor electrical connectors, then remove the speed sensor wire from the bracket.
5. Remove the spring protectors.
6. Compress the front leaf springs using tool J-33432 and adapters J-33432-88 or a suitable equivalent tool, then compress the spring.

FRONT SUSPENSION COMPONENT LOCATIONS

1. Power steering gear
2. Stabilizer shaft
3. Upper control arm
4. Upper ball joint
5. Tie rod end
6. Shock absorber
7. Lower ball joint
8. Lower control arm
9. Front transverse spring

91038P01

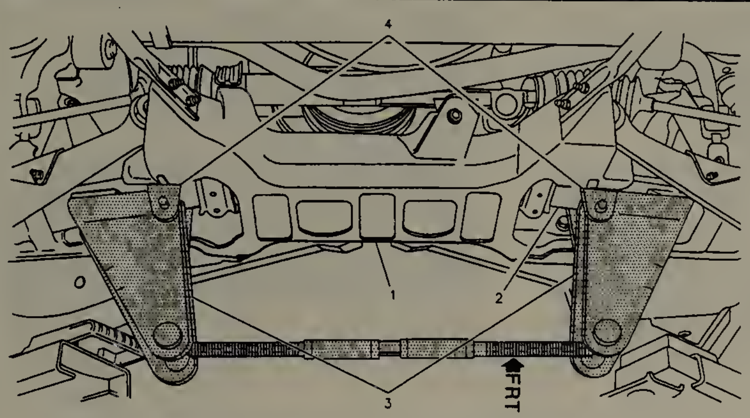


Fig. 8 You must install special tools to safely compress and remove the transverse spring

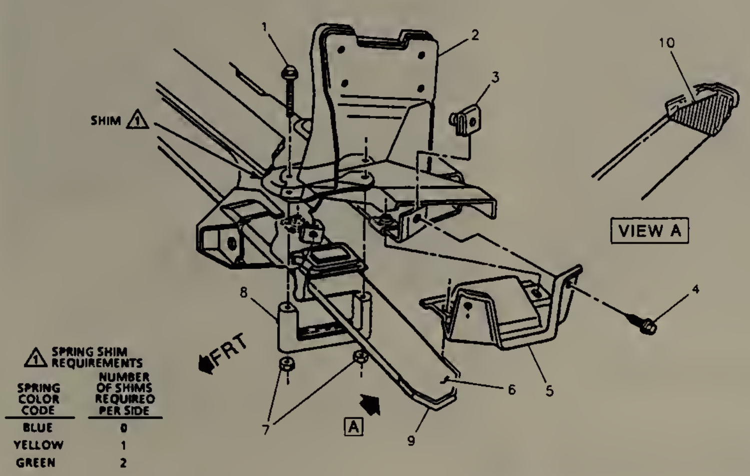


Fig. 9 Exploded view of the front transverse spring installation and shim location

7. Disconnect the lower control arms from the steering knuckles by separating the ball joints from the knuckle bores.
8. Remove the spring retainer nuts and retainers, then carefully release the spring compression and remove the tools.
9. With the aid of an assistant, pull both lower control arms downward to release the spring ends from the lower control arms.
10. Remove the spring and retainer shims from the vehicle. Use care not to scratch or damage the spring and note the number, types (color) and positions of the shims.

To install:

11. Lubricate the spring pads with an appropriate lubricant.
12. Carefully install the retainer shims and the spring. Be careful not to scratch the spring and be sure to use the correct number and type of shims.
13. With the aid of an assistant, pull both lower control arms downward while seating the spring ends into the lower control arms.
14. Using the J–33432 and J–33432–88 or equivalents, compress the spring.
15. Install the retainers and hand-tighten the retainer nuts. Install both lower control arm ball joints into the steering knuckles. The ball joints must be positioned so the cotter pins can be inserted from the rear to the front of the vehicle.
16. Install both lower control arm ball stud washers and nuts. Tighten the hex nut to 50 ft. lbs. (68 Nm), then insert a new cotter pin. If necessary tighten the nut additionally in order to insert the pin, but do not exceed a total torque of 88 ft. lbs. (120 Nm) and do not back off the original torque.
17. Install the cotter pins from the rear to the front of the vehicle.
18. Release and remove the spring compression tools.
19. Install both spring protectors and tighten the bolts to 18 ft. lbs. (25 Nm).
20. Install the wheel speed sensor connector, cable and/or bracket, as applicable.
21. If removed, install the stabilizer shaft links, bolts and nuts to the lower control arm. Make sure the link bolts are properly positioning, then hand-tighten the nuts.
22. If removed, connect both shock absorbers to the lower control arms and tighten the lower mounting nuts to 19 ft. lbs. (26 Nm).
23. Use jackstands to hold the suspension at proper trim height, then tighten the spring retainer nuts to 46 ft. lbs. (63 Nm) and the stabilizer shaft link nuts to 33 ft. lbs. (45 Nm).
24. Remove the jackstand supports, then install the tire and wheel assemblies.
25. Lower the vehicle, then have the front end alignment checked and adjusted, as necessary.

Shock Absorbers

REMOVAL & INSTALLATION

Without Selective Ride Control

➧ See Figures 10 thru 19

1. Raise and support the vehicle safely.
2. Remove the tire and wheel assemblies.
3. Disconnect the shock absorber from the lower control arm and the shock tower. If necessary, remove the front wheelhouse lower center panel to access the upper mount nut.
4. Remove the insulator and retainers from the shock absorber and the shock absorber from the vehicle.
5. Installation is the reverse of the removal procedure. Tighten the upper and lower mount nuts to 19 ft. lbs. (26 Nm).

Fig. 10 Unclip the wiring harness retainer for access to the trim panel retainers

Fig. 11 Unfasten the trim panel retainers, then lift the panel up and out of the vehicle for access to the upper shock nut

Fig. 12 Use a wire brush to clean off the upper shock mounting nut threads and stud

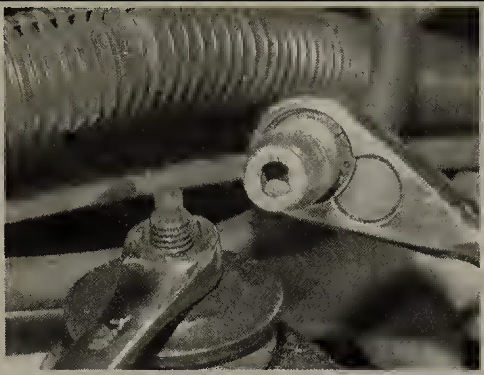

91038P33

Fig. 13 There is a special socket available to place on the shock stud to prevent it from turning while removing the nut

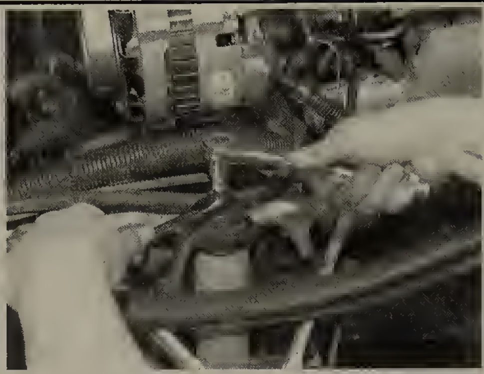
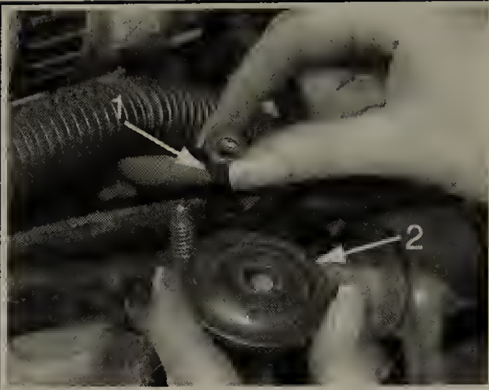

91038P32

Fig. 14 Use a wrench to loosen the shock upper nut while holding the ratchet and socket over the shock stud



91038P35

Fig. 15 Remove the upper shock mounting nut (1) and insulator retainer (2) . . .

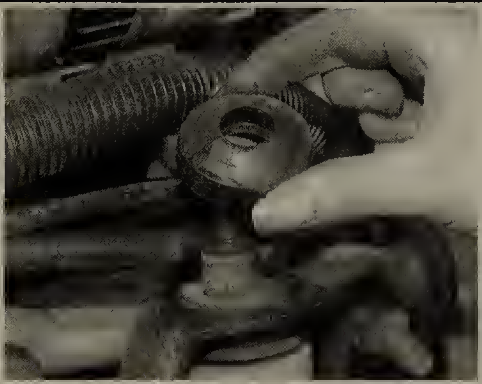

91038P36

Fig. 16 . . . then remove the upper shock insulator


91038P37

Fig. 17 Remove the 2 shock lower mounting bolts . . .

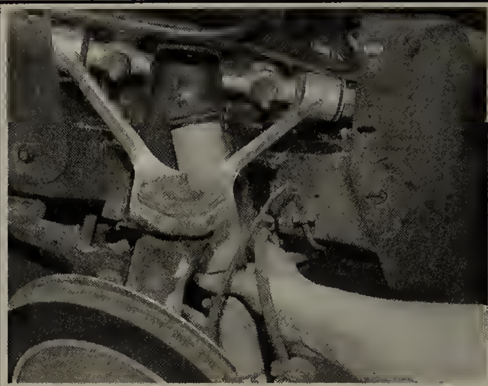
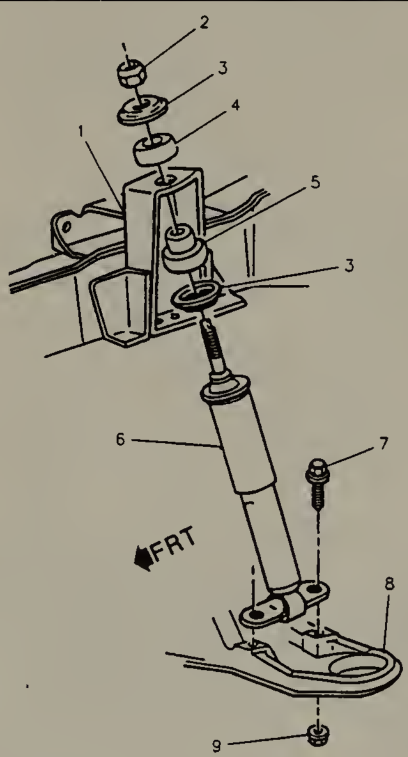

91038P38

Fig. 18 . . . then remove the shock absorber assembly from the vehicle



1 SHOCK ABSORBER TOWER
2 HEX PREVAILING TORQUE NUT
3 SHOCK ABSORBER INSULATOR RETAINER
4 SHOCK ABSORBER UPPER INSULATOR
5 SHOCK ABSORBER LOWER INSULATOR
6 SHOCK ABSORBER
7 HEX FLANGE HEAD BOLT

91038G05

Fig. 19 Exploded view of the shock absorber mounting

With Selective Ride Control

1992–95 VEHICLES

➧ See Figures 20, 21 and 22

➡Although the basic principles remained the same, in 1996 the name of the system changed from Selective Ride Control to Real Time Damping.

1. Disconnect the negative battery cable.
2. Raise and safely support vehicle, then remove the tire and wheel assemblies.


91038P39

Fig. 20 Place a jack or stand under the control arm for support

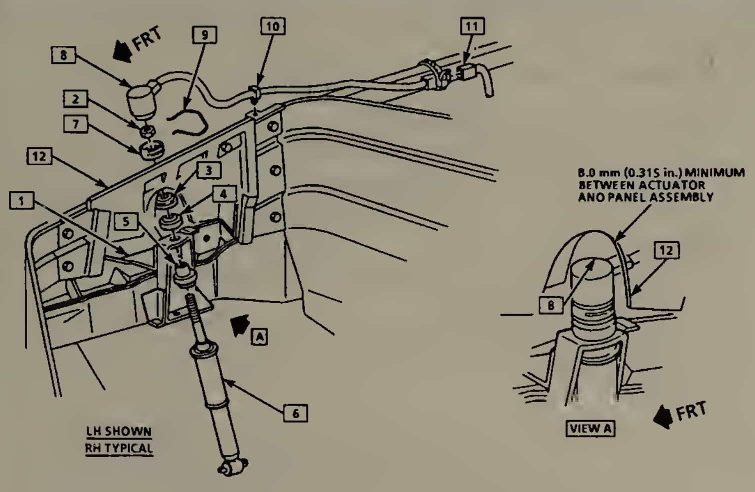


Fig. 21 Exploded view of the front selective ride control shock absorber

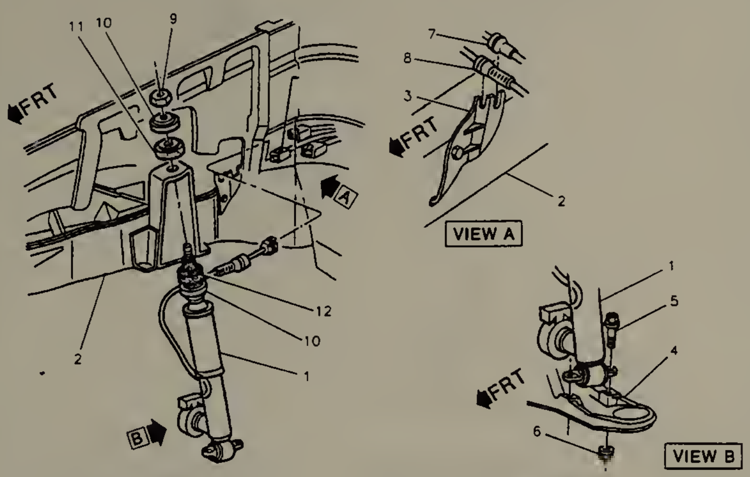


Fig. 22 Exploded view of the real time damping shock absorber, used on 1996 vehicles

3. Safely support the lower control arm with a jackstand.
4. For 1992–95 vehicles, remove the actuator retaining clip, then remove the actuator from the cup retainer. Note the position of the actuator electrical leads for installation purposes.
5. For 1996 vehicles, detach the shock absorber solenoid electrical connector, then remove the solenoid harness from the support bracket.

➡Do not let the shock absorber hang by the wiring harness after removing the retainers.

6. Remove the shock absorber upper mounting nut(s).
7. If equipped, remove the cup retainer, then remove the upper insulator retainer and insulator.
8. Remove the shock absorber lower mounting bolts, nuts, then compress the shock absorber and remove it from the vehicle. If necessary, remove the lower insulator from the shock.

To install:

9. If removed, install the lower insulator to the shock absorber, compress the shock and install into the vehicle.
10. Install the shock absorber lower mounting nuts and bolts, then tighten the bolts to 19 ft. lbs. (26 Nm).
11. Install the upper insulator and retainer, then install the cup assembly retainer.
    a. Install the upper mounting nut and tighten to 31 ft. lbs. (42 Nm) for 1992–95 vehicles. For 1996 vehicles, install the nut but do not tighten it at this time. On 1992–95 vehicles, the selector gear should be at least 0.178 inch (4.5mm) above the top of the cup assembly retainer.
    b. For 1992–95 vehicles, perform the following:
    c. Install and properly seat the actuator retaining clip onto the cup assembly retainer. Make sure the ends of the actuator clip protrude outward from the retainer.
    d. Install the actuator onto the cup assembly retainer with the electrical leads in the same position as noted earlier. Verify that there is at least 0.315 inch (8mm) of clearance between the front wheelhouse lower center panel and the actuator electrical leads.

➡Very little effort is required to snap the actuator onto the retainer, do not force it into position.

12. For 1996 vehicles, attach the solenoid electrical connector, then secure the solenoid harness in the bracket. Tighten the upper mounting nut to 19 ft. lbs. (26 Nm).
13. Install the tire and wheel assembly, then remove the jackstand.
14. Lower the vehicle and connect the negative battery cable.

TESTING

See Figure 23

The purpose of the shock absorber is simply to limit the motion of the spring during compression and rebound cycles. If the vehicle is not equipped with these motion dampers, the up and down motion would multiply until the vehicle was alternately trying to leap off the ground and to pound itself into the pavement.

Contrary to popular rumor, the shocks do not affect the ride height of the vehicle. This is controlled by other suspension components such as springs and tires. Worn shock absorbers can affect handling; if the front of the vehicle is rising or falling excessively, the ìfootprintî of the tires changes on the pavement and steering is affected.

The simplest test of the shock absorber is simply push down on one corner of the unladen vehicle and release it. Observe the motion of the body as it is released. In most cases, it will come up beyond it original rest position, dip back below it and settle quickly to rest. This shows that the damper is controlling the spring action. Any tendency to excessive pitch (up-and-down) motion or failure to return to rest within 2-3 cycles is a sign of poor function within the shock absorber. Oil-filled shocks may have a light film of oil around the seal, resulting from normal breathing and air exchange. This should NOT be taken as

Fig. 23 When fluid is seeping out of the shock absorber, it's time to replace it

a sign of failure, but any sign of thick or running oil definitely indicates failure. Gas filled shocks may also show some film at the shaft; if the gas has leaked out, the shock will have almost no resistance to motion.

While each shock absorber can be replaced individually, it is recommended that they be changed as a pair (both front or both rear) to maintain equal response on both sides of the vehicle. Chances are quite good that if one has failed, its mate is weak also.

Upper Ball Joints

INSPECTION

See Figures 24 and 25

➡Anytime the ball joint is separated from the knuckle, it should be checked for looseness. If it is loose or can be twisted in the socket by hand, the ball joint must be replaced.

1. Raise and safely support the vehicle with jackstands under the left and right lower control arms, as far outboard and nearest to the ball joint as possible.
2. Make sure the vehicle is stable and does not rock on the stands.
3. Position a dial indicator against the wheel rim.
4. Grasp the front tire and push in on the bottom while pulling out at the top. Read the dial indicator, then reverse the push-pull procedure.
5. Horizontal deflection on the dial indicator must not exceed 0.125 in. (3.18mm).
6. The ball joint must be replaced if deflection is greater than indicated.

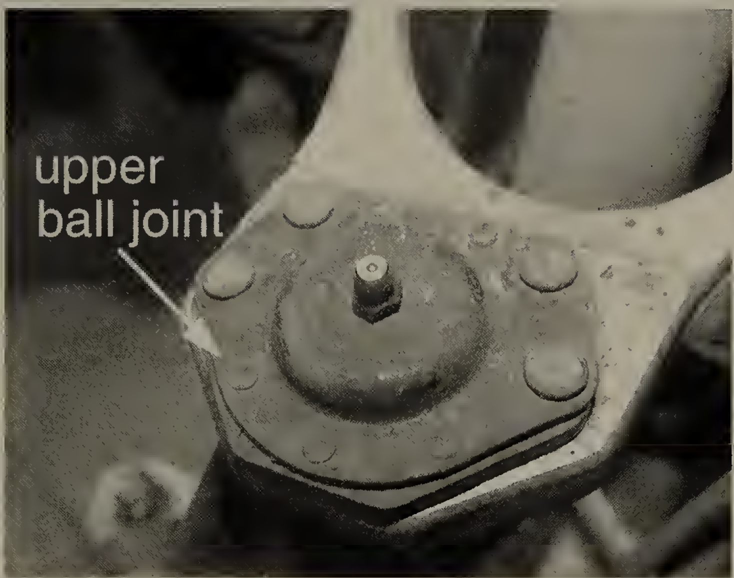


Fig. 24 The upper ball joint is mounted in the upper control arm

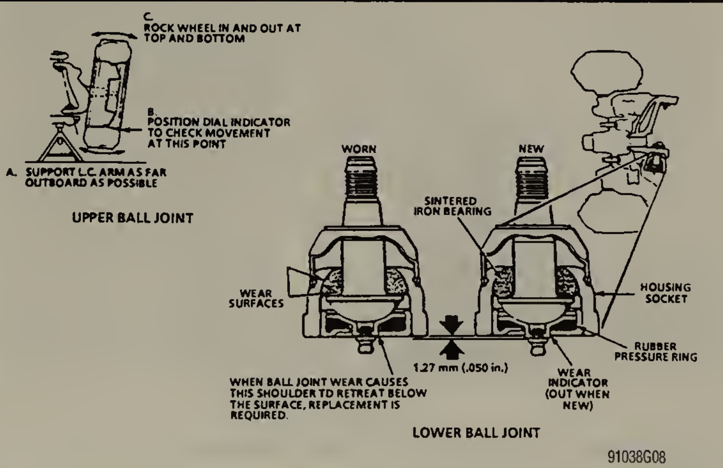


Fig. 25 Upper and lower ball joint inspection

REMOVAL & INSTALLATION

See Figures 26 and 27

1. Raise and support the vehicle safely.
2. Safely support the lower control arm with a jackstand.
3. Remove the tire and wheel assemblies.
4. Using J-33436 or equivalent ball joint removal tool, separate the ball joint from the knuckle.
5. Remove the upper ball joint from the control arm as follows:
   a. Center punch the rivet.
   b. Drill a pilot hole, then drill the rivet head.
   c. Punch out the rivet.

To install:

6. Install a new ball joint into the upper control arm and position so the cotter pin can be installed from the rear to the front of the vehicle.
7. Install and tighten the mounting nuts to 13 ft. lbs. (18 Nm).
8. Position the ball stud into the steering knuckle, then install the upper ball joint stud washer and nut. Tighten the upper control arm ball stud nut to 33 ft. lbs. (45 Nm). Tighten the nut additionally as necessary to insert the cotter pin but do not exceed 63 ft. lbs. (85 Nm).
9. Install a new cotter pin from the rear to the front of the vehicle.

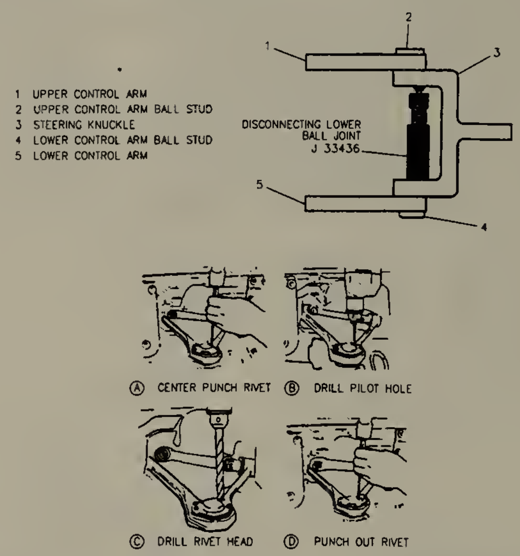


Fig. 26 The upper ball joint is secured in the upper control arm by rivets

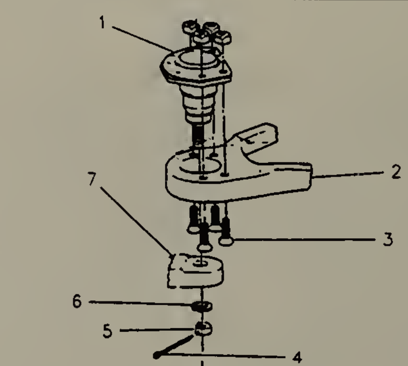
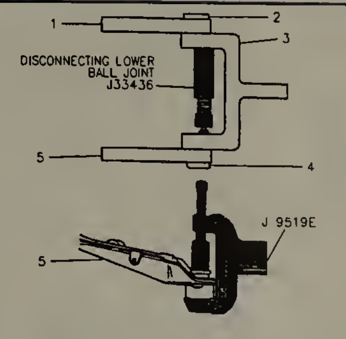


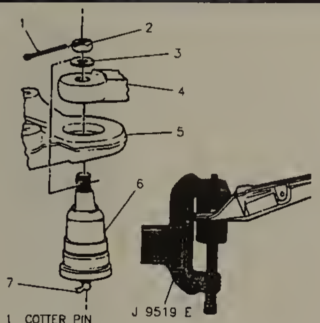
Fig. 27 Replacement upper ball joints are secured with nuts and bolts



1 UPPER CONTROL ARM
2 UPPER CONTROL ARM BALL STUD
3 STEERING KNUCKLE
4 LOWER CONTROL ARM BALL STUD
5 LOWER CONTROL ARM

91038G11

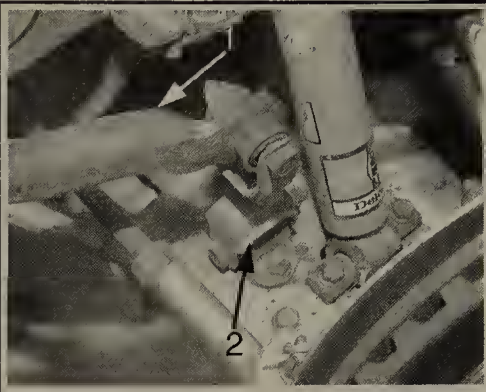
Fig. 28 You must use the proper tools to remove the lower ball joint



1 COTTER PIN
2 HEX SLOTTED NUT
3 LOWER CONTROL ARM BALL STUD MUST BE REPLACED WASHER
4 STEERING KNUCKLE
5 LOWER CONTROL ARM
6 LOWER CONTROL ARM BALL STUD
7 INSTALL ZERK FITTING AS SHOWN

91038G12

Fig. 29 Installation of the lower ball joint



91038P42

Fig. 30 View of the front stabilizer shaft (1) and link (2)

10. Remove the jackstand and lubricate the ball joint.
11. Install the tire and wheel assembly, then lower the vehicle.

Lower Ball Joints

INSPECTION

➧ See Figure 25

1. With the weight of the vehicle properly loading the ball joints, check the wear indicators on the bottom of the lower ball joints.
2. The wear indicator (lower grease fitting shoulder) should protrude 0.050 in. (1.27mm) when new.
3. When the wear indicator shoulder retreats below the surface, the ball joint must be replaced.

REMOVAL & INSTALLATION

➧ See Figures 28 and 29

1. Raise and support the vehicle safely.
2. Safely support the lower control arm with a jackstand.
3. Remove the tire and wheel assembly.
4. Using J–33436 or equivalent ball joint removal tool, separate the ball joint from the knuckle.
5. Press the upper ball joint from the control arm using tool J–9519–E or an equivalent removal tool.

To install:

6. Position the ball stud so the cotter pin may be installed from the rear to the front of the vehicle and press into the control arm using J–9519–E or equivalent.
7. Position the ball joint into the steering knuckle, then install the washer and nut. Tighten the lower control arm ball stud nut to 50 ft. lbs. (68 Nm). Tighten the ball stud nut additionally, as necessary to insert a cotter pin, but do not exceed 88 ft. lbs. (120 Nm) to align the cotter pin holes.
8. Install a new cotter pin from the rear to the front of the vehicle.
9. Remove the jackstand and lubricate the ball joint.
10. Install the tire and wheel assembly, then lower the vehicle.

Stabilizer Shaft

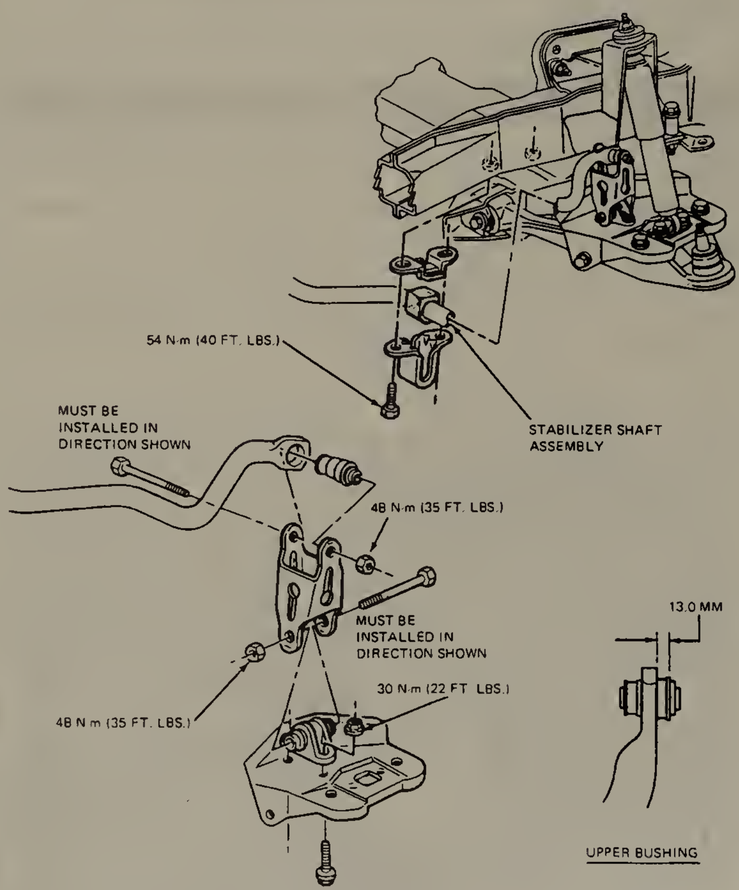
REMOVAL & INSTALLATION

➧ See Figures 30, 31 and 32

1. Raise and support vehicle safely, then remove the tire and wheel assemblies.
2. Support the lower control arms using jackstands.
3. Remove the stabilizer shaft insulator clamp bolts and brackets from the frame.
4. Remove the stabilizer shaft-to-links attaching bolts. Note the bolt positioning for installation purposes.
5. Remove the stabilizer shaft from the vehicle.
6. If necessary, remove the link upper or lower insulators, using a suitable universal steering linkage puller and a suitable spacer to provide contact with the insulator flange.

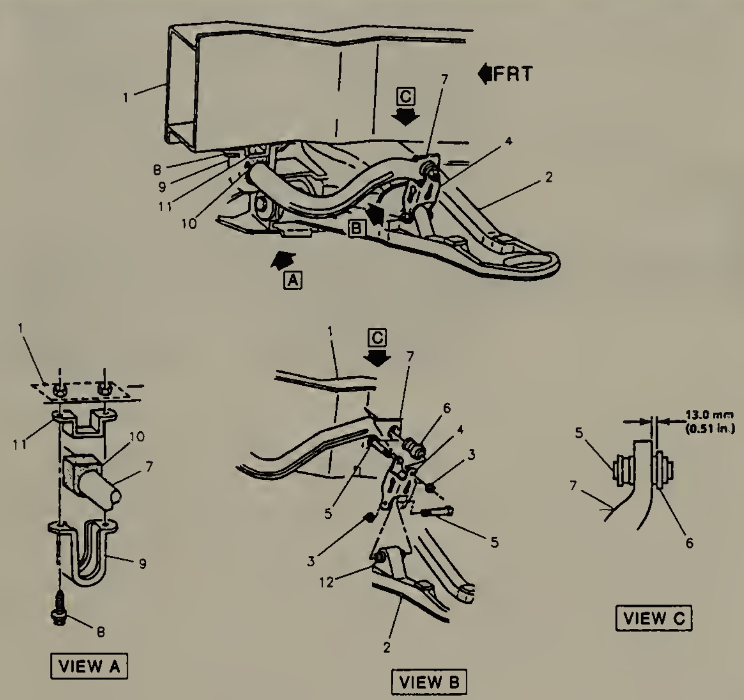
To install:

7. If removed, install the stabilizer shaft link upper or lower insulators using the puller and a spacer. The upper insulators must be installed to the dimension shown in the accompanying figure.
8. The remainder of installation is the reverse of the removal procedure.
9. Install the shaft link bolts and nuts facing the same positions as they were removed. With the suspension held at the proper trim height, tighten the stabilizer shaft link nuts to 35 ft. lbs. (48 Nm) and the insulator clamp bolts to 40 ft. lbs. (54 Nm).



91038G13

Fig. 31 Exploded view of the stabilizer shaft assembly—1984–87 vehicles



1 DRIVETRAIN AND SUSPENSION FRAME
2 LOWER CONTROL ARM
3 HEX NUT
4 STABILIZER SHAFT LINK
5 HEX BOLT
6 STABILIZER SHAFT LINK UPPER INSULATOR
7 STABILIZER SHAFT
8 BOLT
9 STABILIZER SHAFT INSULATOR CLAMP
10 STABILIZER SHAFT INSULATOR
11 STABILIZER SHAFT BRACKET
12 STABILIZER SHAFT LINK LOWER INSULATOR

91038G14

Fig. 32 Exploded view of the stabilizer shaft and insulators—1988–96 vehicles

Upper Control Arm

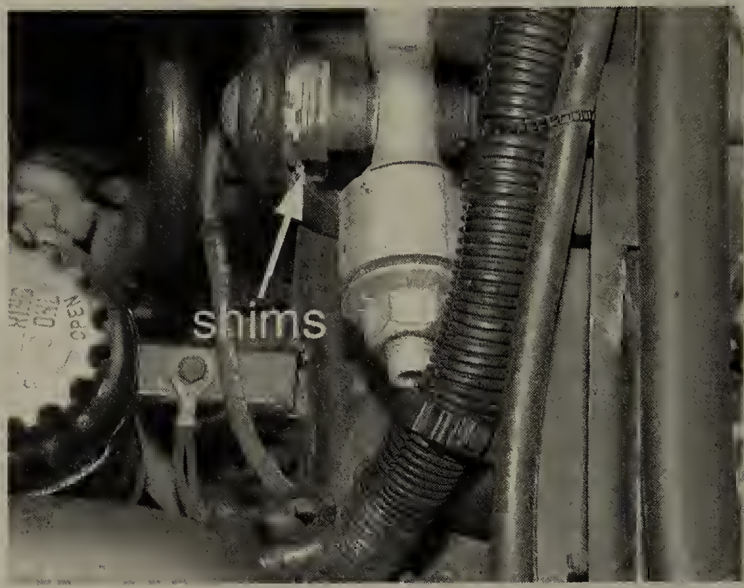
REMOVAL & INSTALLATION

➧ **See Figures 33, 34 and 35**

1. Disconnect the negative battery cable, then raise and support the vehicle safely.
2. Remove the tire and wheel assembly.

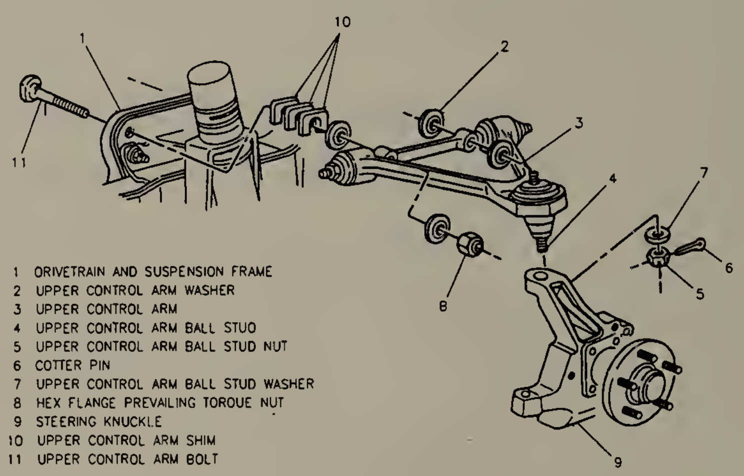
91038P40

Fig. 33 View of the upper control arm (1) and ball joint (2)



91038P41

Fig. 34 Note the position of any upper control arm shims



91038G15

Fig. 35 Exploded view of the upper control arm—1996 vehicle shown, other years similar

3. For 1988–96 vehicles, remove the front wheelhouse panel seal and lower center panel.
4. If equipped, remove the shock absorber actuator wire connector.
5. Support the lower control arm with a jackstand.
6. If equipped, disengage the speed sensor electrical connector and remove the cable from the bracket.
7. Use tool J–33436 or equivalent and disconnect the upper ball joint from the knuckle.
8. Remove the upper control arm attaching bolts, shims and nuts. Note the number and position of the shims for reinstallation purposes. Remove the control arm.

To install:

9. Position the bolts through the frame, then install the upper control arm and shims. Place the shims in the locations noted during removal. Install and tighten the control arm nuts as follows:
   a. 1984–86 vehicles: 63 ft. lbs. (85 Nm)
   b. 1987 vehicles: 48 ft. lbs. (65 Nm)
   c. 1988–96 vehicles: 37 ft. lbs. (50 Nm)
10. Position the ball stud into the steering knuckle, then install the upper ball joint stud washer and nut. Tighten the upper control arm ball stud nut to 33 ft. lbs. (45 Nm). Tighten the nut additionally as necessary to insert the cotter pin but do not exceed 63 ft. lbs. (85 Nm).
11. Install a new cotter pin from the rear to the front of the vehicle.
12. If equipped, connect the ABS speed sensor bracket, cable and/or electrical connection, as applicable.
13. If equipped, engage the shock absorber electrical actuator connection.

14. Remove the jackstand and install the front wheelhouse lower center panel and seal, if removed.
15. Install the tire and wheel assembly.
16. Lower the vehicle and connect the negative battery cable.
17. Have the front end alignment checked and adjusted, as necessary.

Lower Control Arm

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable, then raise and support the vehicle safely.
2. Remove the tire and wheel assembly, then remove both spring protectors.
3. Using tool J–33432 and adapters J–33432–88 or equivalent, compress the spring.
4. Support the lower control arm with a jackstand.
5. Disconnect the shock absorber from the lower control arm, then disconnect the front stabilizer shaft link from the lower control arm.
6. If equipped, disengage the speed sensor electrical connector and remove the cable from the bracket.
7. Using tool J–33436 or equivalent, disconnect the lower ball joint from the knuckle.
8. Remove the engine support bracket.
9. Remove nuts, washers and bolts attaching the lower control arm to the frame.
10. Remove the jackstand and the lower control arm.

To install:

11. Install the lower control arm, bolts, washers and nuts.
12. Support the lower control arm with a jackstand.
13. Install the engine support bracket.
14. Position the ball joint into the steering knuckle, then install the washer and nut. Tighten the lower control arm ball stud nut to 50 ft. lbs. (68 Nm). Tighten the ball stud nut additionally, as necessary to insert a cotter pin, but do not exceed 88 ft. lbs. (120 Nm) to align the cotter pin holes.
15. Install a new cotter pin from the rear to the front of the vehicle.
16. If equipped, connect the ABS speed sensor bracket, cable and/or electrical connection, as applicable.
17. Connect the stabilizer shaft link to the lower control arm but hand-tighten the nuts only.
18. Remove the spring compression tool and adapters.
19. Hold the suspension at the proper trim height using jackstands and tighten the stabilizer link nuts to 35 ft. lbs. (48 Nm) and the lower control arm bolts to 96 ft. lbs. (130 Nm) for 1984–87 vehicles or to 82 ft. lbs. (112 Nm) for 1988–96 vehicles.
20. Connect the shock absorber to the lower control arm and tighten the nuts to 19 ft. lbs. (26 Nm).
21. Remove the jackstands and install both spring protectors. Tighten the bolts to 18 ft. lbs. (25 Nm).
22. Install the tire and wheel assembly.
23. Lower the vehicle and connect the negative battery cable.

Knuckle and Spindle

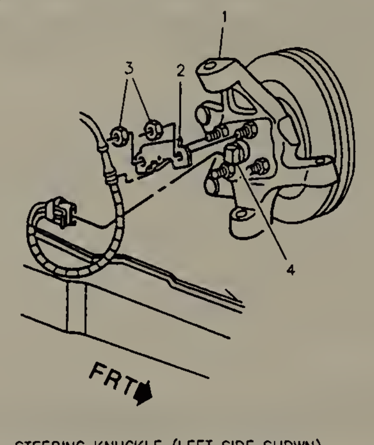
REMOVAL & INSTALLATION

See Figures 36, 37 and 38

1. Disconnect the negative battery cable, then raise and support the vehicle safely.
2. Remove the tire and wheel assembly.
3. Remove the brake caliper and rotor. Support the caliper from the suspension to prevent damage to the brake line.
4. If equipped, disengage the ABS speed sensor electrical connection and remove the cable bracket.
5. Remove the wheel hub/speed sensor assembly.
6. For 1984–86 vehicles, remove the splash shield.
7. Support the lower control arm with a jackstand.
8. Separate the upper and lower ball joints from the steering knuckle using J–33436 or equivalent ball joint remover tool.
9. Remove the tie rod ball stud from the steering knuckle using, J–6627–A or equivalent steering linkage puller.
10. Remove the knuckle from the vehicle.

To install:

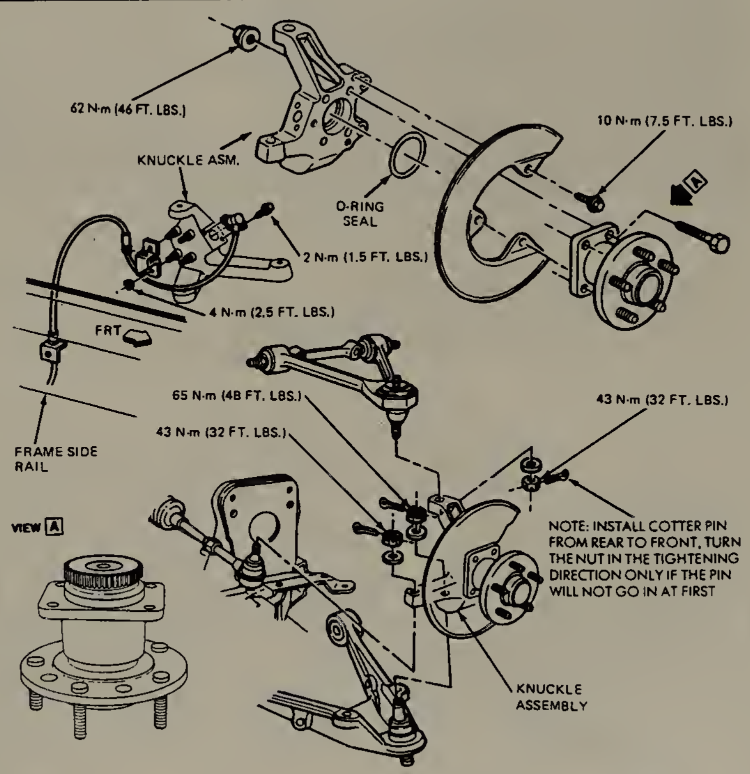
11. Position the knuckle and install the tie rod ball stud. Tighten the hex nut to 35 ft. lbs. (47 Nm), then insert a new cotter pin from the rear to the front of the vehicle. If necessary tighten the nut additionally in order to insert the pin, but do not exceed a total torque of 52 ft. lbs. (70 Nm) and do not back off the original torque.
12. Install the upper and lower ball joints to the steering knuckle. Make sure the studs are positioned so cotter pins may be installed from the rear to the front of the vehicle, then install the washers and nuts.
13. Tighten the upper control arm ball stud nut to 33 ft. lbs. (45 Nm). Tighten the nut additionally as necessary to insert the cotter pin but do not exceed 63 ft. lbs. (85 Nm).
14. Tighten the lower control arm ball stud nut to 50 ft. lbs. (68 Nm). Tighten the ball stud nut additionally, as necessary to insert a cotter pin, but do not exceed 88 ft. lbs. (120 Nm) to align the cotter pin holes.



1 STEERING KNUCKLE (LEFT SIDE SHOWN)
2 WHEEL SPEED SENSOR CABLE BRACKET
3 WHEEL SPEED SENSOR CABLE BRACKET RETAINING NUTS
4 WHEEL SPEED SENSOR

91038G19

Fig. 36 View of the wheel speed sensor and electrical harness—1996 vehicle shown



91038G17

Fig. 37 Exploded view of the steering knuckle, wheel hub and bearing assembly—1984–86 vehicles

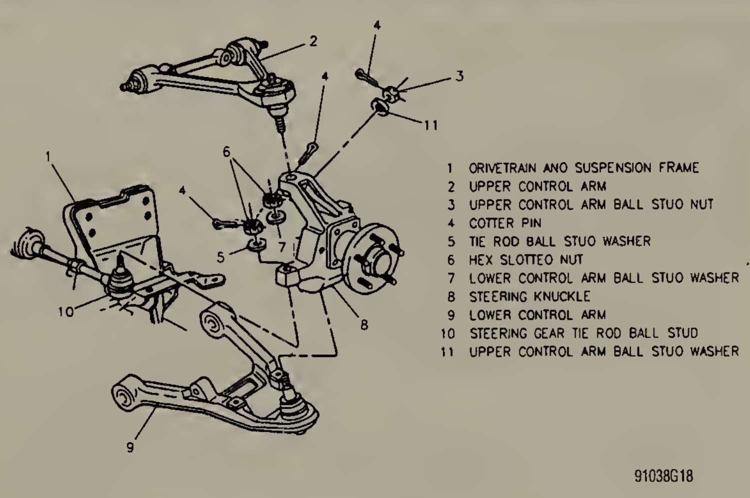


Fig. 38 Exploded view of the steering knuckle assembly—1996 vehicle shown

15. Remove the jackstand.
16. Install the wheel hub or the wheel hub/speed sensor assembly, as applicable.
17. If equipped, install the ABS speed sensor bracket and engage the electrical connection.
18. For 1984–86 vehicles, install the splash shield.
19. Install the rotor and caliper.
20. Install the tire and wheel assembly.
21. Lower the vehicle and connect the negative battery cable.

Front Hub and Bearing

REMOVAL & INSTALLATION

See Figures 37 and 39

1. Disconnect the negative battery cable, then raise and support the vehicle safely.
2. Remove the tire and wheel assembly.
3. Remove the caliper and support it aside, then remove the rotor.
4. If equipped, disengage the ABS speed sensor electrical connector, then remove the ABS speed sensor cable bracket.
5. Remove the wheel hub/bearing/speed sensor assembly.

To install:

6. Install the hub/bearing/speed sensor assembly onto the vehicle. Make sure the speed sensor cable connection is facing rearward.
7. Tighten the assembly mounting nuts to 46 ft. lbs. (62 Nm).
8. If equipped, engage the ABS electrical connector and install the cable bracket.
9. Install the brake rotor and caliper.
10. Install the tire and wheel assembly, then lower the vehicle.
11. Connect the negative battery cable. The bearings do not require adjustment.

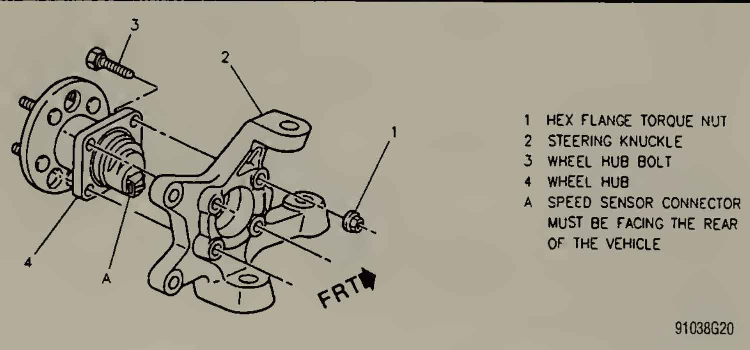


Fig. 39 Front wheel hub and bearing/speed sensor mounting—1996 vehicle shown

Wheel Alignment

If the tires are worn unevenly, if the vehicle is not stable on the highway or if the handling seems uneven in spirited driving, the wheel alignment should be checked. If an alignment problem is suspected, first check for improper tire inflation and other possible causes. These can be worn suspension or steering components, accident damage or even unmatched tires. If any worn or damaged components are found, they must be replaced before the wheels can be properly aligned. Wheel alignment requires very expensive equipment and involves minute adjustments which must be accurate; it should only be performed by a trained technician. Take your vehicle to a properly equipped shop.

Following is a description of the alignment angles which are adjustable on most vehicles and how they affect vehicle handling. Although these angles can apply to both the front and rear wheels, usually only the front suspension is adjustable.

CASTER

See Figure 40

Looking at a vehicle from the side, caster angle describes the steering axis rather than a wheel angle. The steering knuckle is attached to a control arm or strut at the top and a control arm at the bottom. The wheel pivots around the line between these points to steer the vehicle. When the upper point is tilted back, this is described as positive caster. Having a positive caster tends to make the wheels self-centering, increasing directional stability. Excessive positive caster makes the wheels hard to steer, while an uneven caster will cause a pull to one side. Overloading the vehicle or sagging rear springs will affect caster, as will raising the rear of the vehicle. If the rear of the vehicle is lower than normal, the caster becomes more positive.

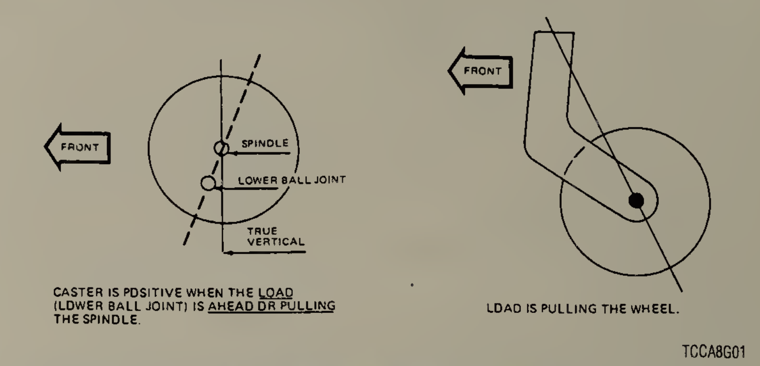


Fig. 40 Caster affects straight-line stability. Caster wheels used on shopping carts, for example, employ positive caster

CAMBER

See Figure 41

Looking from the front of the vehicle, camber is the inward or outward tilt of the top of wheels. When the tops of the wheels are tilted in, this is negative

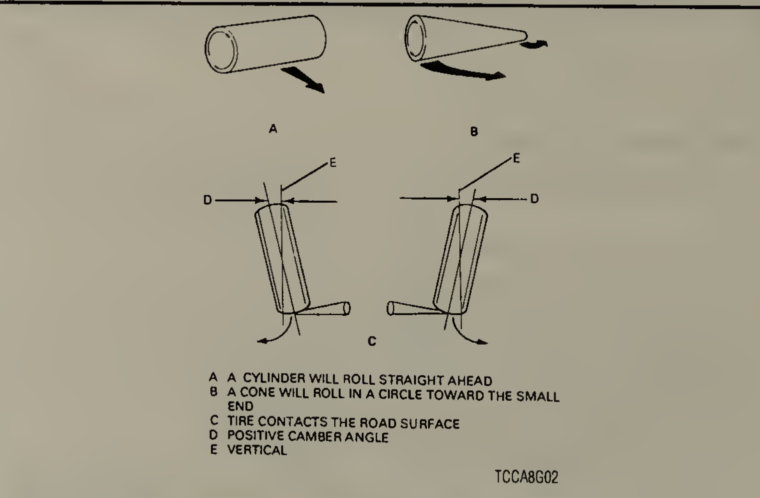


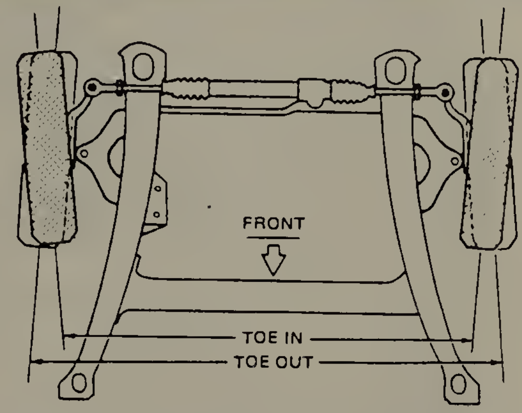
Fig. 41 Camber influences tire contact with the road

camber; if they are tilted out, it is positive. In a turn, a slight amount of negative camber helps maximize contact of the tire with the road. However, too much negative camber compromises straight-line stability, increases bump steer and torque steer.

TOE

➧ See Figure 42

Looking down at the wheels from above the vehicle, toe angle is the distance between the front of the wheels, relative to the distance between the back of the wheels. If the wheels are closer at the front, they are said to be toed-in or to have negative toe. A small amount of negative toe enhances directional stability and provides a smoother ride on the highway.



TCCA8G03

Fig. 42 With toe-in, the distance between the wheels is closer at the front than at the rear

REAR SUSPENSION

Transverse Spring

REMOVAL & INSTALLATION

➧ See Figures 43 thru 48

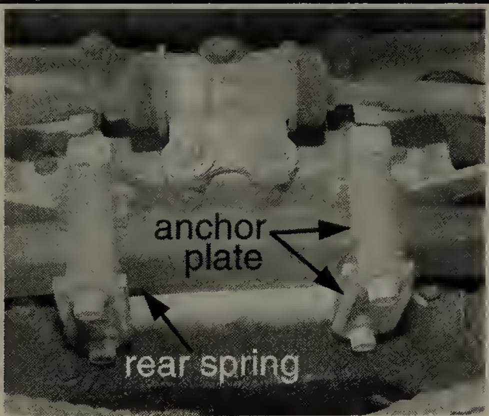
1. Raise and support the vehicle safely.
2. Remove 1 wheel and tire assembly from the vehicle.

➡Do not use corrosive cleaning agents, engine degreasers or solvents near the fiberglass rear spring or extensive damage could occur to the spring assembly.

3. For 1990–96 vehicles, install tool J–33432 or equivalent spring compressor, onto the rear transverse spring, then compress the spring.
4. Remove the cotter pins, retaining nuts, insulators and spring bolts attaching the spring to the knuckles.
5. For 1990–96 vehicles, carefully release and remove the spring compression tool.
6. Remove the rear spring anchor plate bolts, then the anchor plate, spacers and insulator from the vehicle. Note the spacer positioning for installation purposes.
7. Remove the transverse spring from the vehicle.

To install:

8. Position the spring in the vehicle. Take care not to scratch the spring during installation.

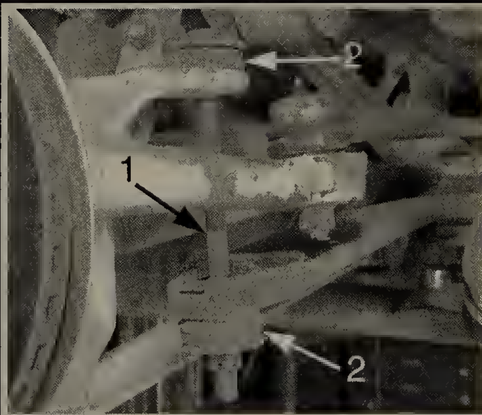


91038P23

Fig. 43 View of the center of the rear spring, including the anchor plate

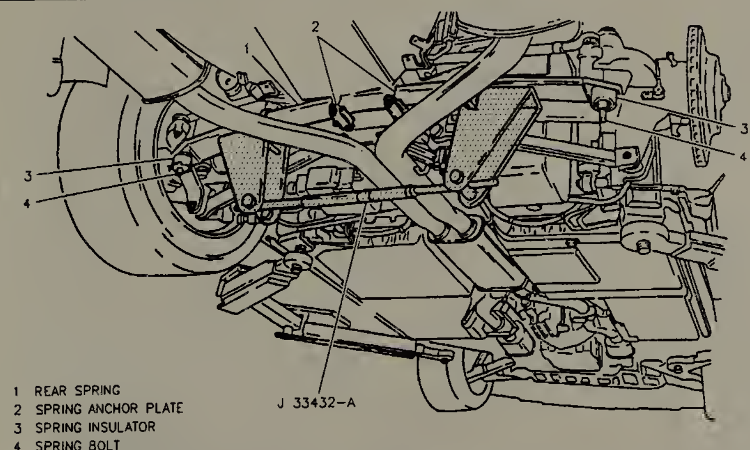
91038P24

Fig. 44 View of the stabilizer bar (1), axle tie rod (2) and rear spring (3)



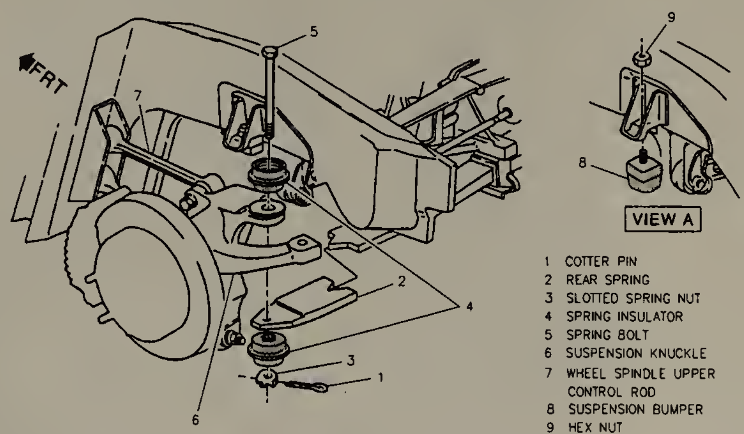
91038P26

Fig. 45 View of the spring bolt (1) and insulators (2)



91038G23

Fig. 46 Removal of the rear transverse spring requires the use of a spring compressor on 1990–96 vehicles

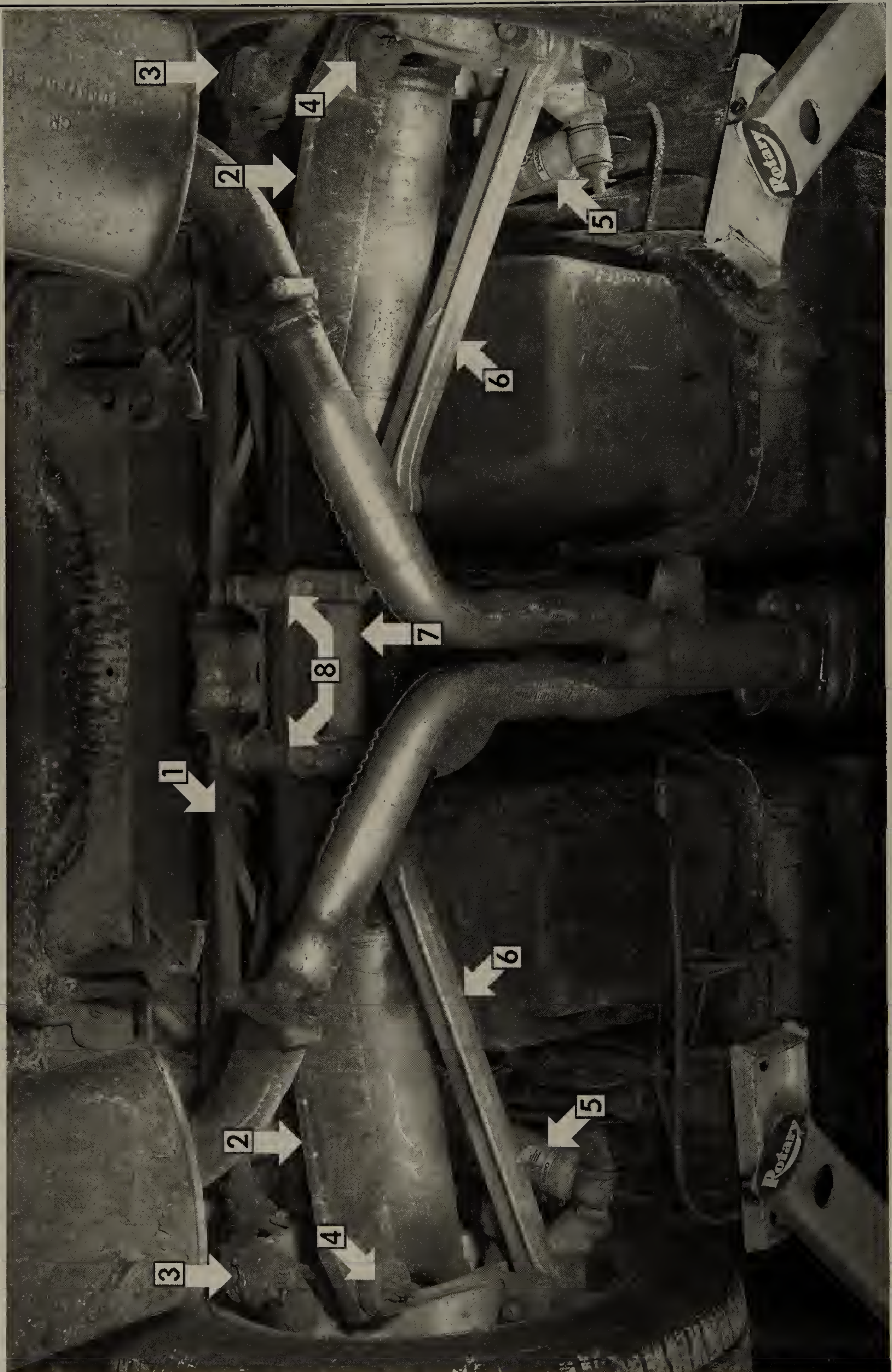


91038G24

Fig. 47 Exploded view of the rear transverse spring insulators and suspension bumper

REAR SUSPENSION COMPONENT LOCATIONS

1. Tie rod
2. Rear spring
3. Tie rod end
4. Spring insulators
5. Shock absorber
6. Support rod
7. Differential carrier
8. Anchor plate



91038P02

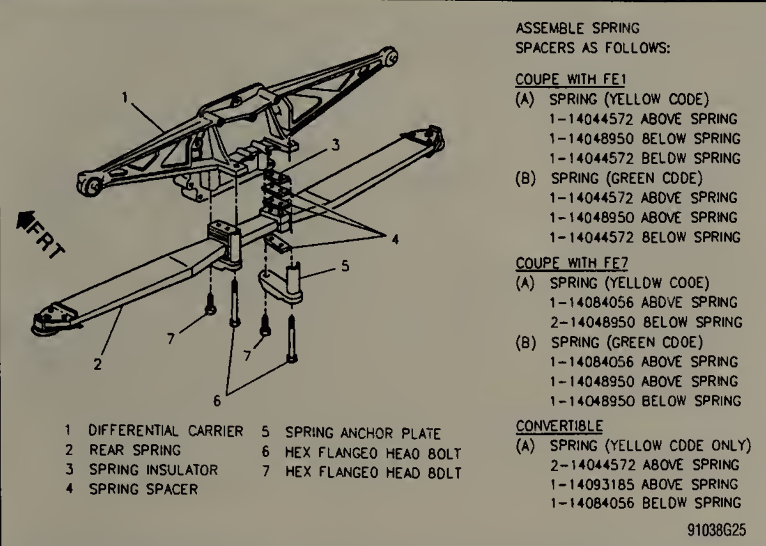


Fig. 48 Exploded view of the transverse spring, differential carrier and related components—1996 vehicle shown, others similar

9. Position the spacers as noted during removal, then install the insulators and anchor plates onto the differential carrier.
10. Install the anchor plate bolts and tighten to 37 ft. lbs. (50 Nm).
11. For 1990–96 vehicles, install the spring compression tool and compress the spring.
12. Position the spring to the knuckles and install the spring bolts, insulators and nuts. Tighten the nuts until slot in nut aligns with hole in bolt and install a new cotter pin.
13. If used, carefully release and remove the spring compression tool.
14. Install the tire and wheel assembly.
15. Remove the jackstands and lower the vehicle.

Shock Absorbers

REMOVAL & INSTALLATION

1984–87 Vehicles

➧ See Figures 49 and 50

1. Raise and safely support the vehicle.
2. Using a back-up wrench on the mounting stud nut, unfasten the retainer, then disconnect the shock absorber from the knuckle.
3. Remove the upper shock absorber mounting nut and bolt, then remove the shock absorber from the vehicle.

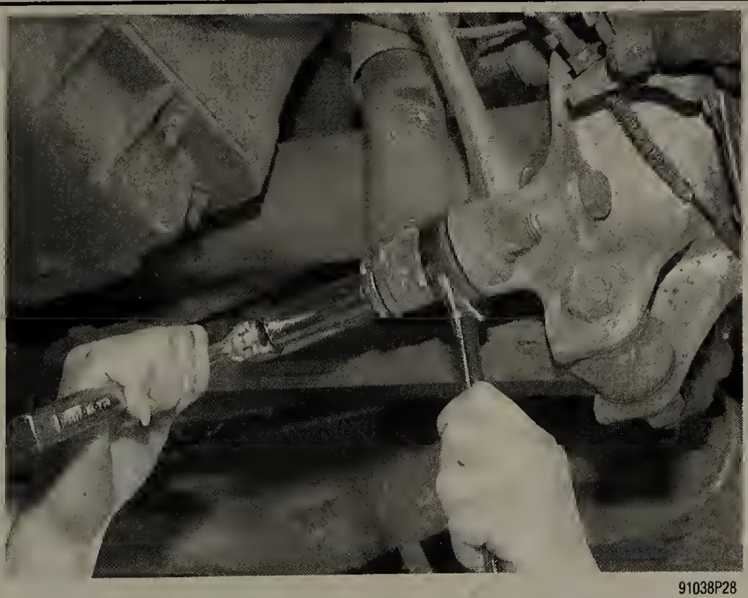


Fig. 49 While holding the nut stationary with a wrench, loosen the lower shock mounting bolt

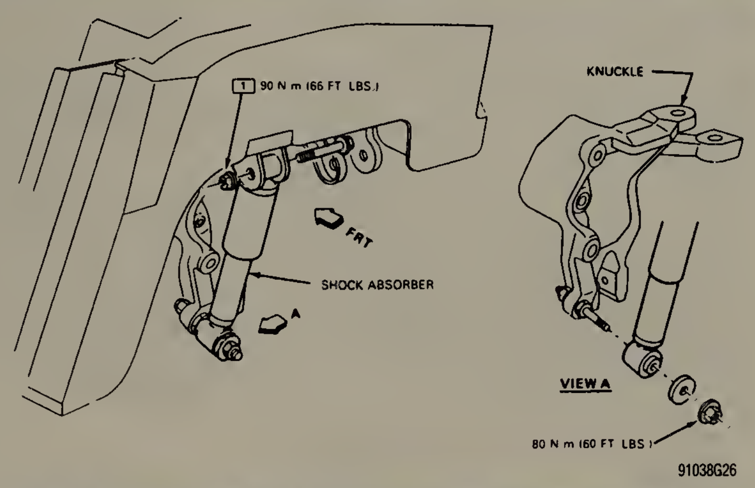


Fig. 50 Exploded view of the shock absorber attachment—1984–87 vehicles

To install:

4. Position the shock absorber to the body bracket. Install the attaching nut and bolt and tighten to 66 ft. lbs. (90 Nm).
5. Position the shock absorber to the knuckle. Install the retaining washer and nut, then, with a back-up wrench on the mounting stud nut, tighten it to 60 ft. lbs. (80 Nm).
6. Carefully lower the vehicle.

1988–96 Vehicles

WITHOUT SELECTIVE RIDE CONTROL

➧ See Figure 51

1. Raise and support the vehicle safely. Support the knuckle with a jackstand.
2. Remove the shock absorber lower mounting nut and washer.
3. Remove the shock absorber upper bracket mounting bolt.
4. Disconnect the shock absorber from the lower mounting stud.
5. If necessary, remove the shock absorber upper bracket retaining nut and remove the bracket assembly.
6. Installation is the reverse of the removal procedure.
7. Tighten the upper bracket retaining nut, if removed, to 19 ft. lbs. (26 Nm). With the suspension at proper trim height, tighten the upper bracket mounting bolts to 22 ft. lbs. (30 Nm) and the lower mounting nut to 61 ft. lbs. (83 Nm).

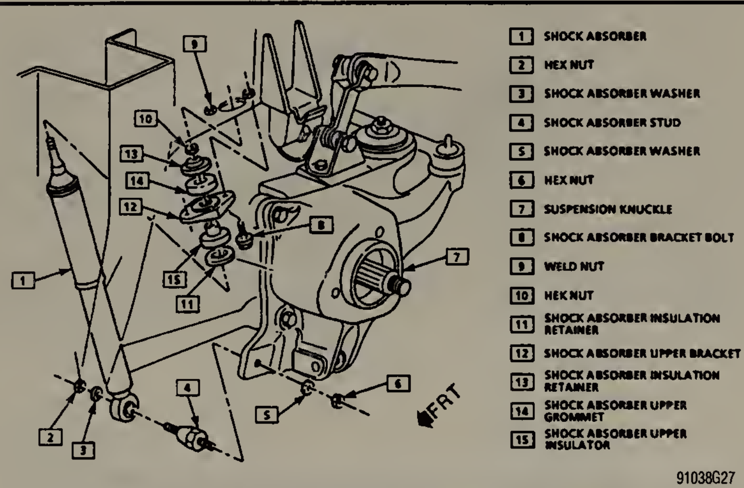


Fig. 51 Exploded view of the shock absorber and mounting bracket—1996 vehicle shown, others similar

WITH SELECTIVE RIDE CONTROL

➧ See Figures 52 and 53

➨Although the basic principles remained the same, in 1996 the name of the system changed from Selective Ride Control to Real Time Damping.

1. Disconnect the negative battery cable.
2. Raise and support the vehicle safely.
3. Support the rear knuckle with a jackstand.

➡Do not let the shock absorber hang by the solenoid harness after removing the fastener.

4. For 1996 vehicles, detach the shock absorber solenoid electrical connector. Remove the solenoid harness retaining straps from the spindle lower control rod.
5. Disconnect the shock absorber lower mounting nut and washer.
6. Remove the shock absorber upper bracket mounting bolt.
7. Disconnect the shock absorber from the mounting stud and support. Do not allow the shock to hang from the actuator harness.
8. For 1992–95 vehicles, remove the actuator retaining clip and remove the actuator from the shock.
9. Remove the shock absorber from the vehicle.

To install:

10. For 1992–95 vehicles, perform the following:
    a. Install and properly seat the actuator retaining clip onto the cup assembly. The ends of the clip should protrude from the cup.
    b. Install the shock absorber electrical actuator into the cup assembly retainer. The actuator should be snapped, not be forced into position.
    c. Verify that a minimum of 0.178 inch (4.5mm) of clearance exists between the selector gear and the top of the cup assembly retainer.
11. Position the shock absorber into the frame and onto the lower mounting stud.
12. Install the shock absorber upper bracket mounting bolt.
13. With the suspension held at the proper trim height. Tighten the upper bracket mounting bolts to 22 ft. lbs. (30 Nm) and the lower mounting nut to 61 ft. lbs. (83 Nm).
14. For 1996 vehicles, attach the solenoid electrical connector and install the solenoid harness retaining straps to the spindle lower control rod.
15. Remove the jackstands and lower the vehicle.
16. Connect the negative battery cable.

TESTING

➧ See Figure 54

The purpose of the shock absorber is simply to limit the motion of the spring during compression and rebound cycles. If the vehicle is not equipped with these motion dampers, the up and down motion would multiply until the vehicle was alternately trying to leap off the ground and to pound itself into the pavement.

Contrary to popular rumor, the shocks do not affect the ride height of the vehicle. This is controlled by other suspension components such as springs and tires. Worn shock absorbers can affect handling; if the front of the vehicle is rising or falling excessively, the "footprint" of the tires changes on the pavement and steering is affected.

The simplest test of the shock absorber is simply push down on one corner of the unladen vehicle and release it. Observe the motion of the body as it is released. In most cases, it will come up beyond it original rest position, dip back below it and settle quickly to rest. This shows that the damper is controlling the spring action. Any tendency to excessive pitch (up-and-down) motion or failure to return to rest within 2-3 cycles is a sign of poor function within the shock absorber. Oil-filled shocks may have a light film of oil around the seal, resulting from normal breathing and air exchange. This should NOT be taken as a sign of failure, but any sign of thick or running oil definitely indicates failure. Gas filled shocks may also show some film at the shaft; if the gas has leaked out, the shock will have almost no resistance to motion.

While each shock absorber can be replaced individually, it is recommended that they be changed as a pair (both front or both rear) to maintain equal response on both sides of the vehicle. Chances are quite good that if one has failed, its mate is weak also.

Control Rods

REMOVAL & INSTALLATION

➧ See Figures 55 thru 59

1. Raise and support the vehicle safely.
2. For 1984–89 vehicles, disconnect the transverse spring from the knuckle, as outlined in this section.
3. Remove the control arm nut, bolt and washers at the knuckle.
4. Remove control arm nut and bolt at the bracket.
5. Remove the control arm from the vehicle.
6. Installation is the reverse of the removal procedure.
7. With the suspension held at the proper trim height, tighten the bracket bolt to 63 ft. lbs. (85 Nm) and the knuckle nut to 140 ft. lbs. (190 Nm).

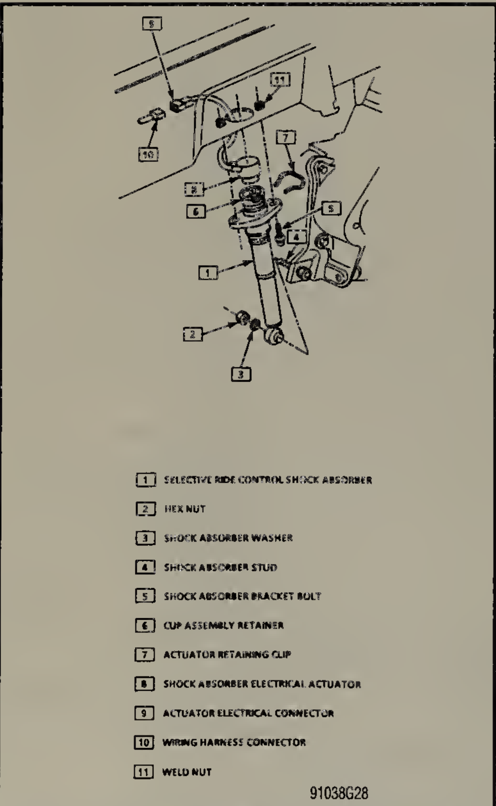


Fig. 52 Exploded view of the rear selective ride control shock absorber—1992–95 vehicles

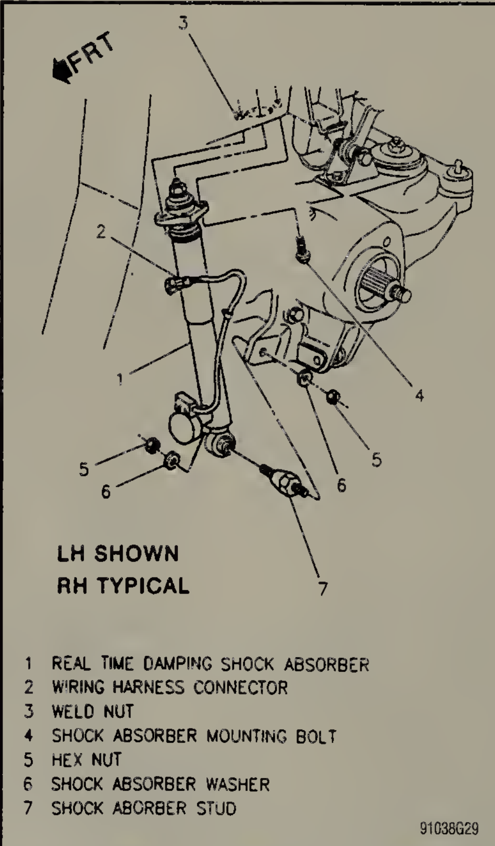


Fig. 53 View of the rear real time damping shock absorber used on 1996 vehicles

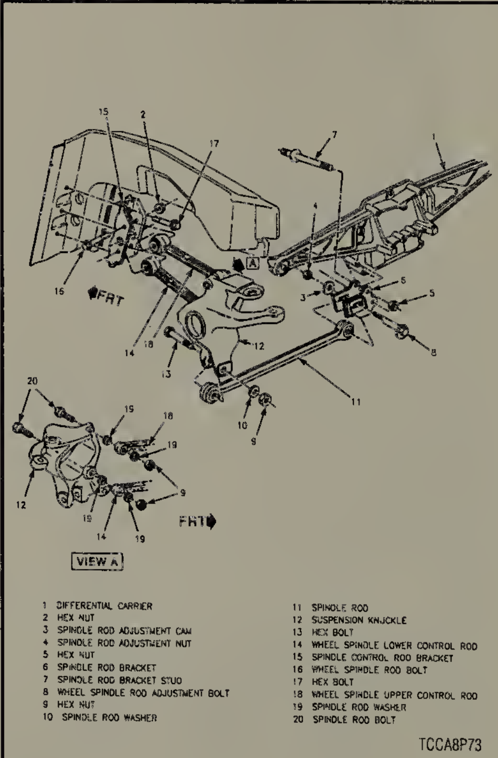
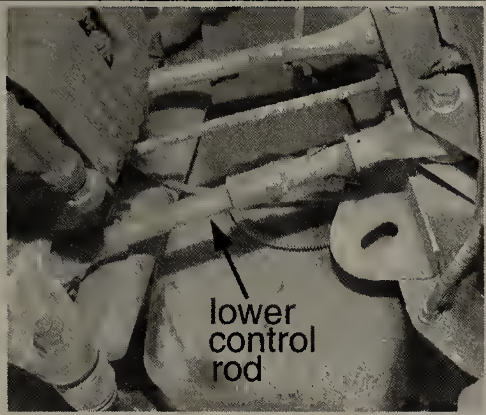


Fig. 54 When fluid is seeping out of the shock absorber, it's time to replace it

91038P18

Fig. 55 Upper control rod mounting

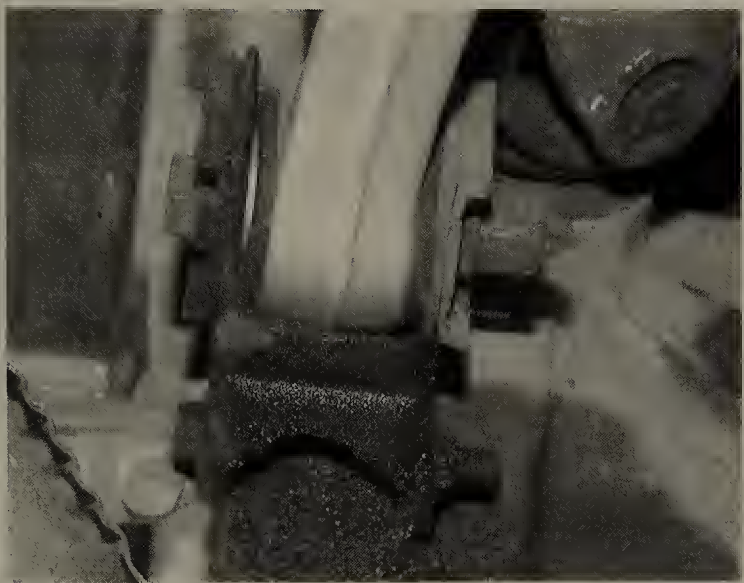


91038P19

Fig. 56 Lower control rod mounting

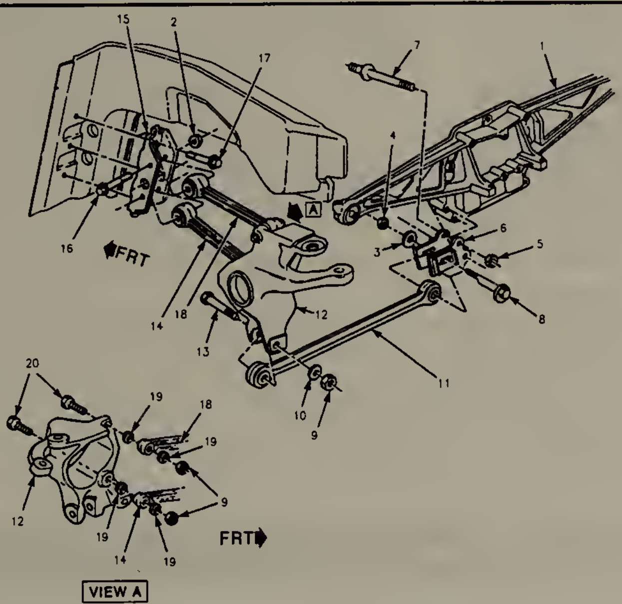
91038P25

Fig. 57 The control rod is secured to the knuckle with a bolt and nut



91038P27

Fig. 58 Control rod-to-bracket mounting



1 DIFFERENTIAL CARRIER
2 HEX NUT
3 SPINDLE ROD ADJUSTMENT CAM
4 SPINDLE ROD ADJUSTMENT NUT
5 HEX NUT
6 SPINDLE ROD BRACKET
7 SPINDLE ROD BRACKET STUD
8 WHEEL SPINDLE ROD ADJUSTMENT BOLT
9 HEX NUT
10 SPINDLE ROD WASHER
11 SPINDLE ROD
12 SUSPENSION KNUCKLE
13 HEX BOLT
14 WHEEL SPINDLE LOWER CONTROL ROD
15 SPINDLE CONTROL ROD BRACKET
16 WHEEL SPINDLE ROD BOLT
17 HEX BOLT
18 WHEEL SPINDLE UPPER CONTROL ROD
19 SPINDLE ROD WASHER
20 SPINDLE ROD BOLT

91038G30

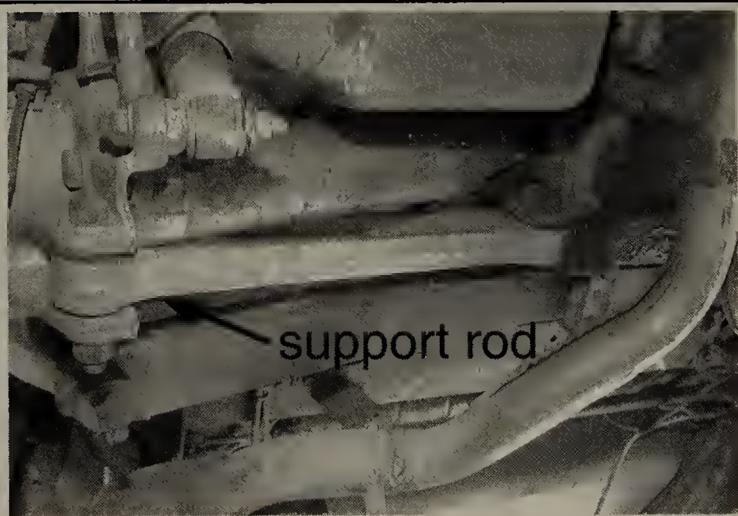
Fig. 59 Exploded view of the upper and lower control rods, spindle rod, and related components—1996 vehicle shown, others similar

Spindle/Support Rod

REMOVAL & INSTALLATION

➧ See Figures 59 and 60

1. Raise and support vehicle safely.
2. Scribe alignment marks on the wheel spindle/support rod adjustment bolt and the spindle/support rod bracket so they can be installed in their original positions.
3. Remove the adjustment bolt, cam and nut, then separate the spindle/support rod from the bracket.
4. Remove the spindle/support bolt, washer and nut at the knuckle, then remove the spindle/support rod from the vehicle.
5. Installation is the reverse of the removal procedure. Be sure to align the marks made during removal.
6. With the suspension held at the proper trim height, tighten the spindle/support rod-to-knuckle nut to 107 ft. lbs. (145 Nm), then tighten the spindle/support rod adjustment nut to 186 ft. lbs. (253 Nm).
7. Check and adjust the rear suspension alignment, as necessary.



91038P20

Fig. 60 Support rod mounting

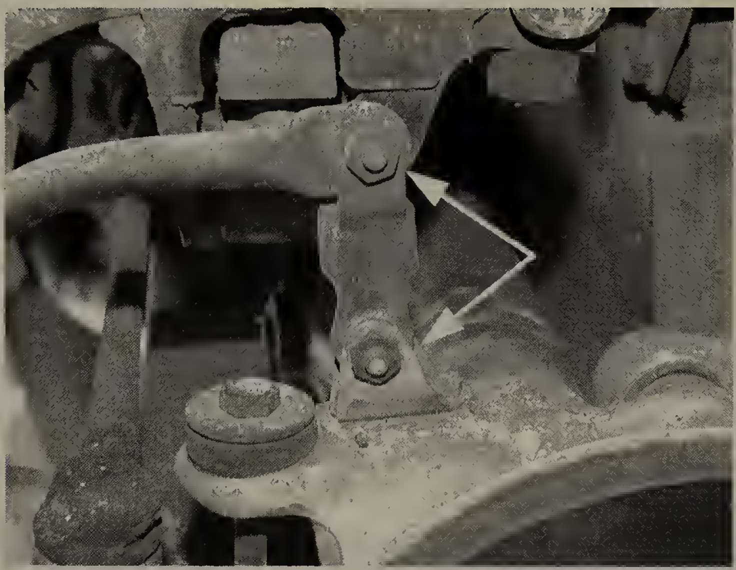
Stabilizer Shaft

REMOVAL & INSTALLATION

1984–88 Vehicles

➧ See Figures 44 and 61

1. Raise and safely support the vehicle.
2. Remove the spare tire and tire carrier.



91038P17

Fig. 61 View of the rear stabilizer (sway) bar-to-link attachment (see arrows)

3. Disconnect the stabilizer bar from the knuckles.
4. Remove the stabilizer bar bushing retainers, bushings and bar from the vehicle.
5. Installation is the reverse of the removal procedure. Tighten the stabilizer bar-to-body retainers to 15–22 ft. lbs. (20–30 Nm).

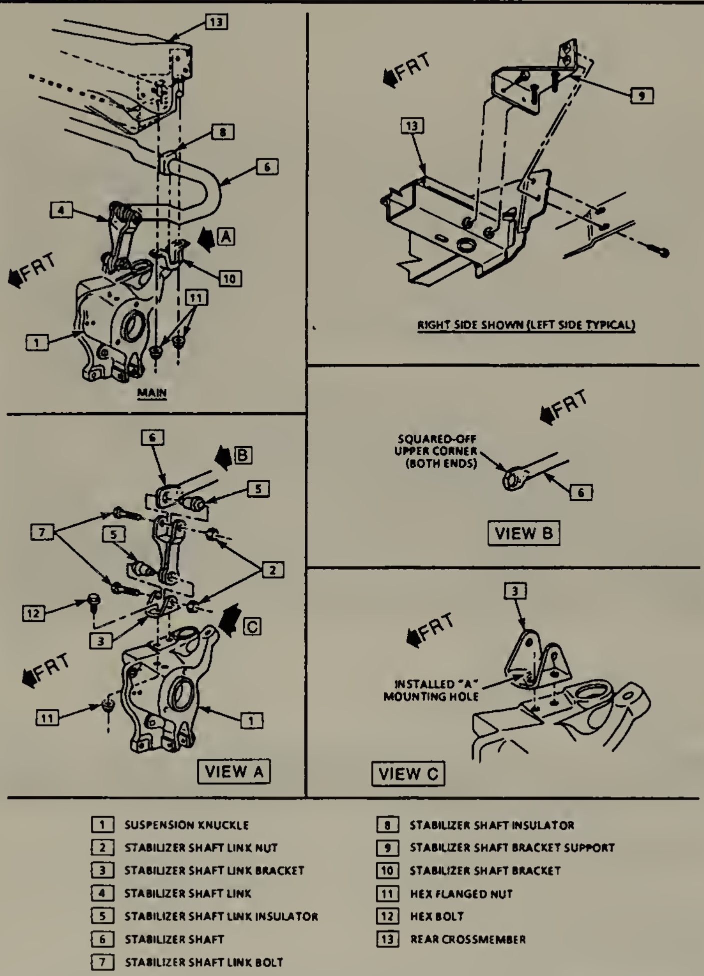
1989 Vehicles

➧ See Figure 62

1. Raise and safely support the vehicle.
2. Remove the tire carrier and spare tire.
3. Unfasten the stabilizer shaft from the link flange at the knuckles.
4. Remove the stabilizer shaft bushing insulators and shaft from the vehicle.

To install:

5. Install the stabilizer shaft insulators.
6. Position the stabilizer shaft ends to the shaft links and insert the insulator, bolt and nut. Make sure the squared off upper corner of the stabilizer shaft is facing up, as shown in the accompanying figure.
7. Install the stabilizer shaft to the frame. With the suspension held at the proper trim height, tighten the bracket nuts to 18 ft. lbs. (25 Nm), and the link bolt nut to 35 ft. lbs. (48 Nm).
8. Install the spare tire and tire carrier.
9. Carefully lower the vehicle.



91038G32

Fig. 62 Exploded view of the rear stabilizer bar used on 1989–96 vehicles

1990–96 Vehicles

➧ See Figure 62

1. Raise and safely support the vehicle.
2. Remove the rear tire and wheel assemblies.
3. Remove the spare tire cover, the spare tire, then jack and the tire carrier.
4. Unfasten the stabilizer shaft link bolts and nuts securing the stabilizer shaft lines to the stabilizer shaft link brackets.
5. Remove the nuts securing the fuel tank safety straps to the stabilizer shaft brackets, then remove the straps.
6. Unfasten the stabilizer shaft bracket nuts, brackets and insulators.
7. Remove the muffler hanger, nuts and disconnect the mufflers from the hangers.
8. Remove the stabilizer shaft from the vehicle.
9. Remove the stabilizer shaft link nuts, bolts and links from the shaft.
10. Remove the stabilizer shaft link insulators from the shaft using a universal steering linkage puller and a suitable spacer to provide contact with the insulator flange.
11. If necessary, remove the stabilizer shaft link insulators, using a universal steering linkage puller and a suitable spacer to provide contact with the insulator flange.

To install:

12. If removed, install the stabilizer shaft link insulators to the link using the puller and spacer. The insulators must be installed in the direction shown in the accompanying figure.
13. Install the stabilizer shaft link insulators to the shaft using the puller and spacer. The insulators must be installed in the direction shown in the accompanying figure.
14. Install the stabilizer shaft links, bolts and nuts to the shaft. The link bolts must be installed with the bolt heads inboard, as shown in the accompanying figure.

➡Do not allow the suspension to move beyond rebound.

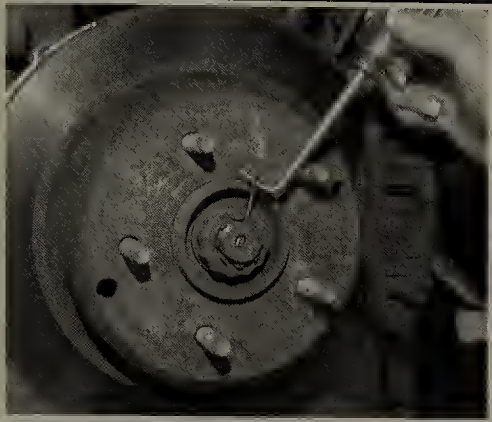
15. Install the stabilizer shaft insulators, brackets and nuts. With the suspension held at the proper trim height, tighten the retainers as follows:
    a. Stabilizer shaft bracket nuts: 18 ft. lbs. (25 Nm)
    b. Stabilizer shaft link nuts at the stabilizer shaft: 39 ft. lbs. (53 Nm)
    c. Stabilizer shaft link nuts at link brackets: 31 ft. lbs. (42 Nm)
16. Remove the jack stands.
17. Connect the fuel tank safely straps to the stabilizer shaft brackets and install the nuts. Tighten the nuts to 18 ft. lbs. (25 Nm).
18. Position the mufflers to the muffler hangers and install the retaining nuts. Tighten the nuts to 40 ft. lbs. (54 Nm).
19. Install the tire carrier, spare tire, spare tire cover and jack.
20. Carefully lower the vehicle.

Hub and Bearings

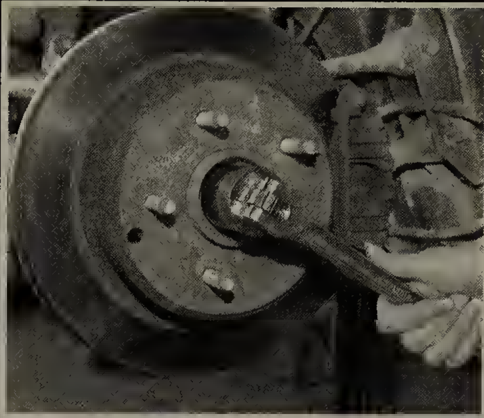
REMOVAL & INSTALLATION

➧ See Figures 63 thru 73

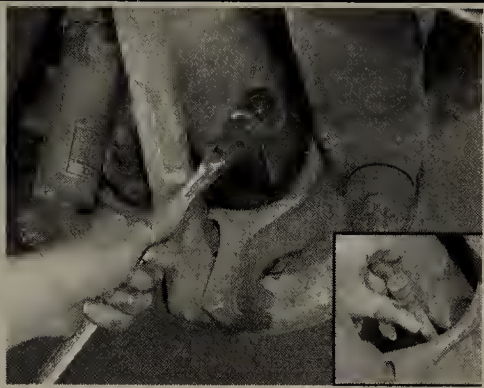
1. Disconnect the negative battery cable. If necessary, remove the wheel center cover for access to the spindle (hub) nut. Raise and safely support the vehicle.
2. Remove the tire and wheel assembly.
3. If equipped with ABS, remove the wheel speed sensor.


91038P06
Fig. 63 Use a suitable tool to pull the cotter pin out of the wheel nut retainer

91038P07
Fig. 64 Discard the cotter pin (1), then remove the wheel nut retainer (2)


91038P08
Fig. 65 With an assistant depressing the brakes, loosen the hub nut

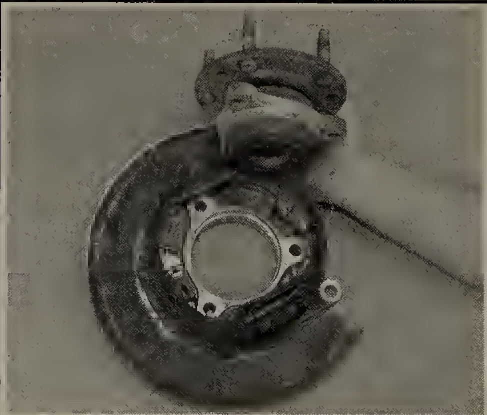
91038P09
Fig. 66 Remove the hub nut (1) and washer (2)


91039P10
Fig. 67 Access to the hub and bearing Torx® bolts is difficult; you may have to turn the driveshaft and/or use an extension


91039P11
Fig. 68 Pull the bolts from the rear of the hub and bearing assembly


91038P12
Fig. 69 Once the 3 bolts are removed, you can pull the hub and bearing, along with the backing plate off the driveshaft


91038P13
Fig. 70 Rear view of the hub and bearing and backing plate assembly


91038P14
Fig. 71 You can pull the hub and bearing away from the backing plate

4. Remove the cotter pin and wheel nut retainer. Discard the cotter pin. With an assistant depressing the brakes, break the spindle (hub) nut looses, then remove the nut and washer.

5. Remove the brake caliper on 1984–87 vehicles and the brake caliper/parking brake assembly on 1988–96 vehicles, then remove the rotor.

6. If necessary on 1984–89 vehicles, disconnect the transverse spring from the knuckle.

7. Remove the wheel hub mounting bolts. Some early model vehicles have Torx® retaining bolts so you will need to use a suitable driver to remove them.

8. On 1984–89 vehicles, remove the hub and bearing from the vehicle, then support the parking brake backing plate.

9. On 1990–96 vehicles, remove the wheel hub and bearing, caliper mounting plate and wheel spindle washer from the vehicle.

To install:

10. Inspect the wheel hub and bearing seal, replace if necessary. Also inspect the wheel spindle washer and replace, if damaged or excessively worn.

11. Install the wheel hub and bearing, caliper mounting plate and the wheel spindle washer. The washer flat should firmly seat against the shoulder of the wheel spindle. The lip of the washer should face the wheel spindle splines prior to hub and bearing installation.

12. Install the wheel hub mounting bolts and tighten to 66 ft. lbs. (90 Nm).

13. Install the washer and spindle nut, and hand-tighten.

14. Install the wheel retainer and a new cotter pin.

15. If removed, connect the transverse spring to the knuckle.

16. Install the brake rotor, then install the caliper and parking brake assembly.

17. With an assistant depressing the brake pedal to prevent the wheel from turning, tighten the spindle nut to 164 ft. lbs. (223 Nm). The vehicle should not rest on the tires or move until the spindle nut is tightened.

18. Install the wheel speed sensor, if equipped, then install the wheel and tire assembly.

19. Lower the vehicle and connect the negative battery cable.

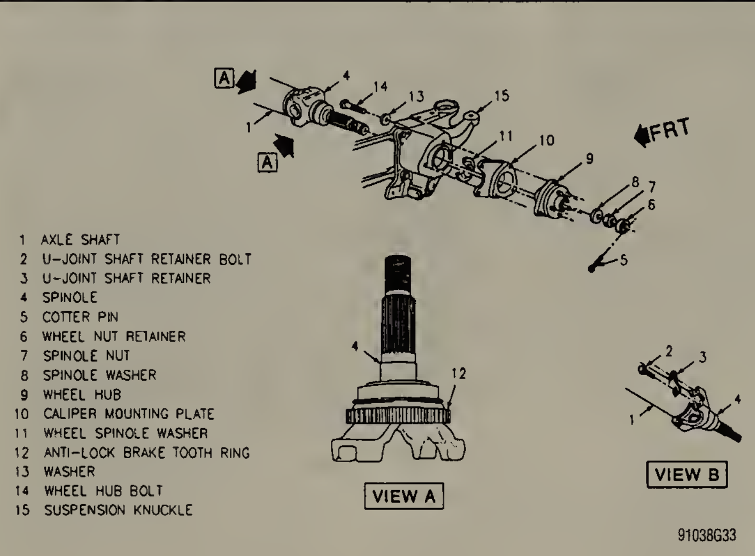


Fig. 72 Exploded view of the wheel hub and bearing and spindle assemblies—1996 vehicle shown

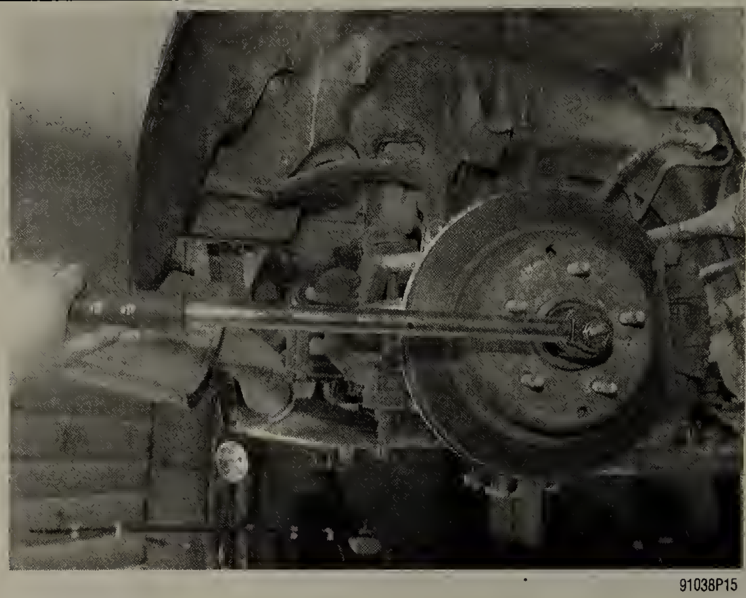


Fig. 73 With an assistant depressing the brake pedal, tighten the hub nut to specifications

STEERING

Steering Wheel

REMOVAL & INSTALLATION

1984–89 Vehicles

➧ See Figures 74 and 75

1. Disconnect the negative battery cable.
2. Squeeze the top and bottom of the horn cap to disengage the locking fingers, then pull back and remove the horn cap.
3. If equipped, carefully pull the horn contact plate from the steering wheel.
4. Disconnect the horn lead wire.
5. Remove the telescope lever screws and the shaft lock knob, then remove the telescope adjusting lever from the slot in the top of the steering wheel.
6. If equipped, remove the steering wheel nut retainer, then unfasten the wheel retaining nut.
7. Note the matchmarks on the steering wheel and shaft for alignment during installation. If you canít see any marks, use a marker or equivalent to make matchmarks.
8. Install a suitable steering wheel puller, then remove the steering wheel from the vehicle.
9. Remove the horn contact spring.

To install:

10. Install the horn contact spring.
11. Align the matchmarks, then position the steering wheel. Secure with the retaining nut and tighten it to 30 ft. lbs. (40 Nm). When tightening, do not force the steering shaft against the steering column "Lock".
12. Install the steering wheel nut retainer.
13. Install the telescope lever assembly through the slot in the top of the steering wheel. Install the shaft lock knob screw and tighten to 30 inch lbs. (2.8 Nm).
14. Position the telescope adjustment lever as far to the right as possible while aligning the screws holes, then install the screws and tighten to 40 inch lbs. (3.3 Nm).
15. Connect the horn electrical lead.
16. For 1984–88 vehicles, perform the following:
   a. Align the contact plate (with the horn lead wire on the bottom) and press it in place.
   b. Align the horn cap with the openings in the contact plate.
   c. Use 2 ¼ in. square spacers as shown in the accompanying figure to press the cap to seat the 2 locking fingers, then withdraw the spacers.
17. For 1989 vehicles, secure the horn cap to the steering wheel.
18. Connect the negative battery cable.

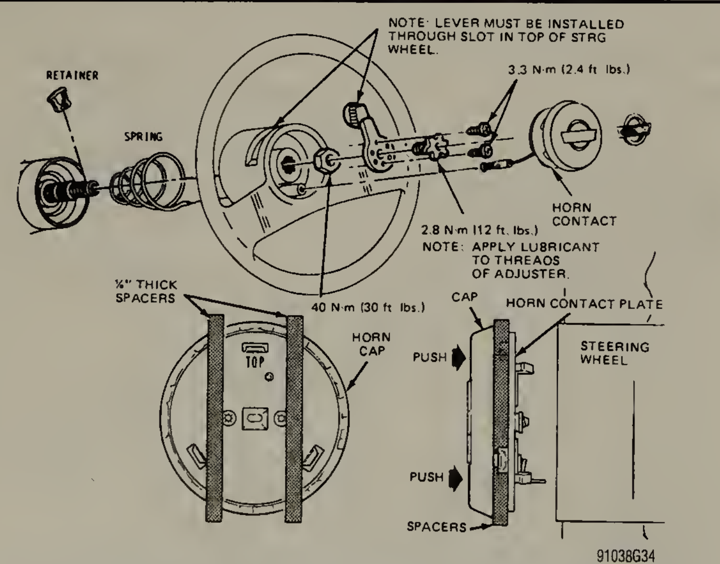


Fig. 74 Exploded view of the steering wheel components—1984–88 vehicles

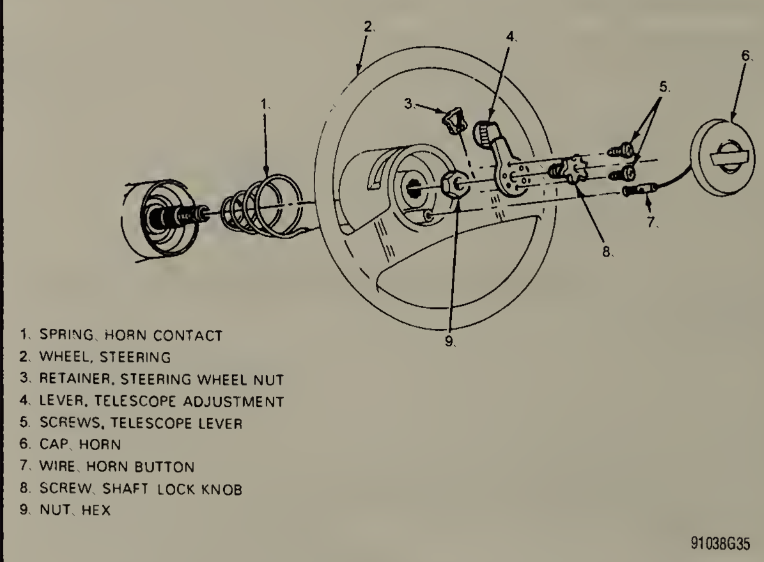


Fig. 75 Steering wheel removal and installation—1989 vehicles

1990–96 Vehicles

➧ **See Figures 76 and 77**

⁂ CAUTION

Some models covered by this manual may be equipped with a Supplemental Inflatable Restraint (SIR) system, which uses an air bag. Whenever working near any of the SIR components, such as the impact sensors, the air bag module, steering column and instrument panel, disable the SIR, as described in Section 6.

PREFERRED METHOD

1. Properly disable the SIR system, as outlined in Section 6 of this manual.
2. Remove the SIR inflator module as follows:
   a. Unfasten the screws from the back of the steering wheel retaining the inflator module to the steering wheel.
   b. Remove the inflator module from the steering wheel.
   c. Detach the CPA and SIR coil electrical connector from the inflator module.

⁂ CAUTION

When carrying a live inflator module, make sure the bag and trim cover and pointed away from you. Never carry the module by the wires or connector on the underside of the module. If the bag accidentally deploys, the bag will deploy with minimal chance of injury. When you place the inflator module on a bench or other surface, always face the bag and trim cover up, away from the surface. Refer to Section 6 for more information about the air bag system.

⁂ WARNING

Make sure to use the proper type of steering wheel puller or side screws. Using the wrong type could easily damage the SIR coil.

3. Unfasten the steering wheel jam nut. Discard the nut and use a new one during installation.
4. Detach the horn electrical connector.
5. Note the matchmarks on the steering wheel and shaft for alignment during installation. If you canít see any marks, use a marker or equivalent to make matchmarks.
6. Install a suitable steering wheel puller and puller screws such as the type shown in the accompanying figure. Remove the steering wheel from the shaft. If the steering wheel does not come off easily, follow the "ALTERNATE METHOD" procedure.

To install:

7. Attach the horn electrical connector.

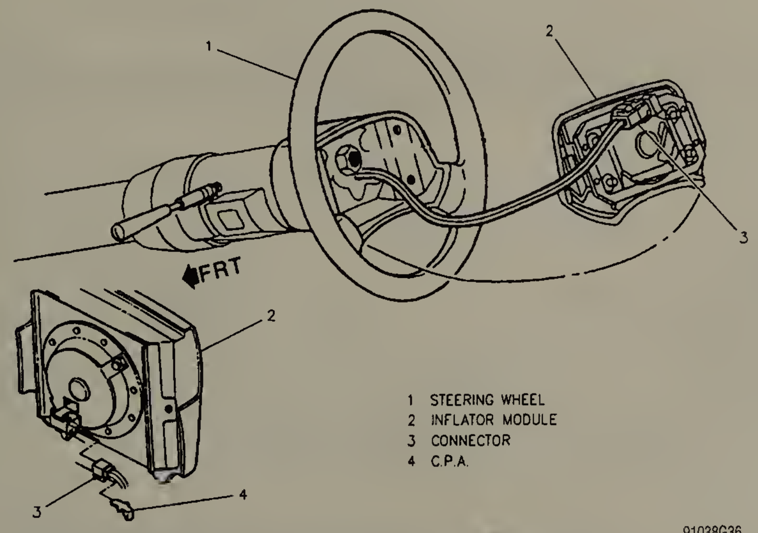


Fig. 76 Exploded view of the SIR inflator module mounting—1990–96 vehicles

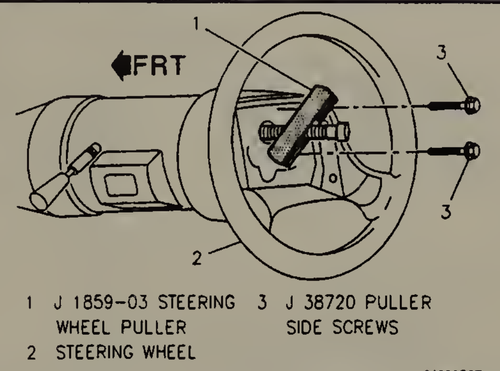


Fig. 77 The proper type of puller and side screws must be used when removing the steering wheel

8. Position the steering wheel on the column, observing the alignment marks (splines).
9. Install a new steering wheel jam nut and tighten to 30 ft. lbs. (41 Nm).
10. Install the inflator module, by performing the following steps:
    a. Make sure the ignition switch is **OFF**.
    b. Attach the SIR coil electrical connector to the inflator module, then install the CPA retaining clip.
    c. Positoin the inflator module to the steering wheel, then install the module retaining screws through the back of the steering wheel to the inflator module. Tighten the retaining screws to 86 inch lbs. (9.7 Nm).
11. Properly enable the SIR system, as outlined in Section 6 of this manual.

ALTERNATE METHOD

1. Remove the inflator module, jam nut and horn connector as outlined under the "PREFERRED METHOD" procedure.
2. Install a suitable steering wheel puller (J 1859-A or equivalent), using J 38720 side screws. Make sure the side screws are fully threaded (up to shoulder) into the puller, then tighten the puller center screw snugly against the steering shaft.
3. Back out each side screw 1 revolution from the fully installed position. Retighten the puller center screw.

➡Tightening the screws more that ¼ turn at a time could damage the steering wheel.

4. Alternately tighten each side screw ¼ turn until you can remove the steering wheel.
5. To install, follow the procedure located under "PREFERRED METHOD".

Turn Signal Switch

REMOVAL & INSTALLATION

1984–88 Vehicles

➧ **See Figure 78**

1. Disconnect the negative battery cable.
2. Remove the steering wheel, as outlined earlier in this section.
3. Remove the steering column/dash trim cover.
4. Remove the C-ring plastic retainer.
5. Install the special lockplate compressor tool (J-23653 and J-23063) over the steering shaft. Place ⁵⁄₁₆ in. nut under each tool leg and reinstall the star screw to prevent the shaft from moving.
6. Compress the lockplate by turning the shaft nut clockwise until the C-ring can be removed.
7. Remove the tool and lift out the lockplate, horn contact carrier, and the upper bearing preload spring.
8. Pull the switch connector out of the mast jacket and tape the upper part to facilitate switch removal.
9. Remove the turn signal lever. Push the flasher in, then unscrew it.
10. Position the turn signal and shifter housing in the Low position. Remove the switch by pulling it straight up while guiding the wiring harness out of the housing.

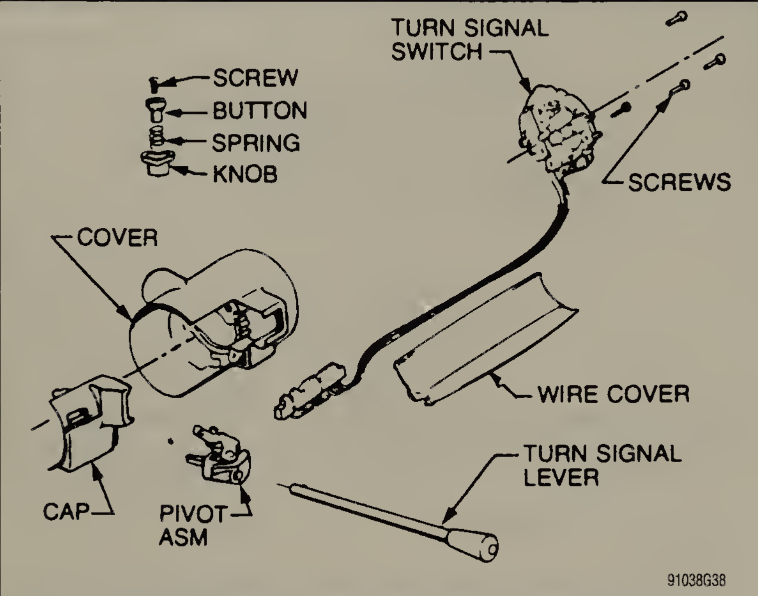


Fig. 78 Exploded view of the turn signal switch and related components—1984–88 vehicles

To install:

11. Install the replacement switch by working the harness connector down through the housing and under the mounting bracket.
12. Install the harness cover and clip the connector to the mast jacket.
13. Install the switch mounting screws, signal lever and the flasher knob.
14. With the turn signal lever in neutral and the flasher knob out, install the upper bearing preload spring, horn contact carrier, and lockplate onto the shaft.
15. Position the tool as in Step 5, and compress the plate far enough to allow the C-ring to be installed.
16. Remove the tool, then install the plastic C-ring retainer.
17. Install the column/dash trim cover and steering wheel.
18. Connect the negative battery cable.

1989–96 Vehicles

See Figures 79, 80, 81, 82 and 83

➡Some of these vehicles may be equipped with a Supplemental Inflatable Restraint (SIR) air bag system, it is imperative that the disarming procedure is followed before repairs, and that the coil centering and rearming procedures are followed after repairs. Although it may be possible to perform this procedure with the steering column installed in the vehicle, but lowered for access, the manufacturer suggests that the column be removed.1

1. For 1990–96 vehicles, properly disable the SIR system. Place the ignition switch to the **LOCK** position in order to prevent uncentering of the coil assembly.
2. Disconnect the negative battery cable.
3. Properly remove and store the inflator module, if equipped with an air bag, then remove the steering wheel. Either remove the column from the vehicle or lower it for access.
4. If equipped with a SIR system, remove the coil assembly retaining ring. Remove the coil assembly and allow it to hang freely from the wiring.

➡The coil assembly will become uncentered if the steering column is separated from the steering gear and allowed to rotate or the center spring of the coil assembly is pushed down, letting the hub rotate while the coil is removed from the steering column. In the event this should occur, follow the recommended procedure for recentering of the coil in order to avoid accidental deployment of the air bag or damage to the internal components of the steering column.

5. Remove the wave washer.
6. Remove the shaft lock retaining ring using tool J–23653–C or equivalent, shaft lock compressor. Discard the old ring.
7. Remove the shaft lock, turn signal canceling cam and upper bearing assembly.
8. Move the multi-function lever to the **RIGHT TURN** position. Remove the column housing cover end cap by pulling toward the vehicle front. Disconnect the electrical harness connector and remove the turn signal lever by pulling toward the driver door.
9. Remove the hazard knob retaining screw and assembly.
10. Remove the turn signal switch arm and screws.
11. Remove the turn signal switch screws.
12. Disconnect the switch harness connector from the bulkhead connector and remove the wiring protector.
13. Remove the horn pad ground wiring assembly from slot "D" of the switch connector.
14. Attach a length of mechanic's wire to the switch harness to aid in reinstallation and gently pull the assembly up through the housing. Leave the wire routed through the column in order to pull the new harness back into position.
15. Remove the switch and harness from the vehicle.

To install:

16. Connect the horn pad ground wiring assembly to slot "D" of the turn signal switch connector.
17. Using the mechanic's wire, pull the switch harness through the column and connect to the bulkhead connector.
18. Install the harness wiring protector.
19. Position the turn signal switch assembly and install the attaching screws. Tighten the screws to 30 inch lbs. (3.4 Nm).
20. Install the switch arm and mounting screws. Tighten the screws to 20 inch lbs. (2.3 Nm).
21. Install the hazard knob assembly and the multi-function lever.
22. Install the inner race, the upper bearing race seat, and the upper bearing spring.
23. Lubricate the friction surfaces using synthetic grease, then install the turn signal canceling cam.
24. Position the shaft lock. Install the a new shaft lock retaining ring using tool J–23653–C or equivalent. Be sure the ring is firmly seated in the groove of the shaft.
25. Install the wave washer.
26. Install the coil assembly, making sure it is properly centered.
27. Position and secure the steering column, as necessary.
28. Install the steering wheel and the inflator module.
29. Connect the negative battery cable and, if equipped, enable the SIR system as outlined in Section 6 of this manual.

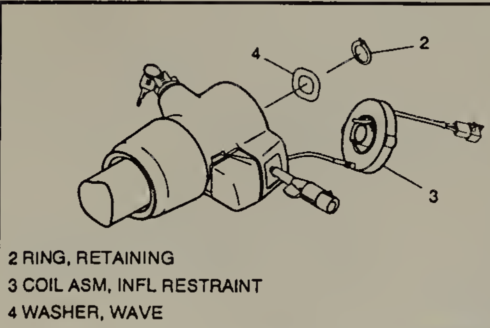


Fig. 79 Exploded view of the SIR coil assembly—1996 vehicle shown, others similar

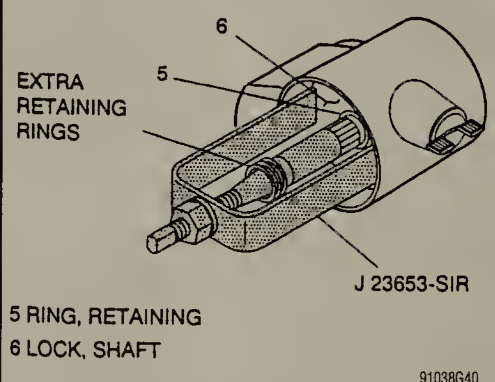


Fig. 80 You must use the proper tool to remove the shaft lock retaining ring

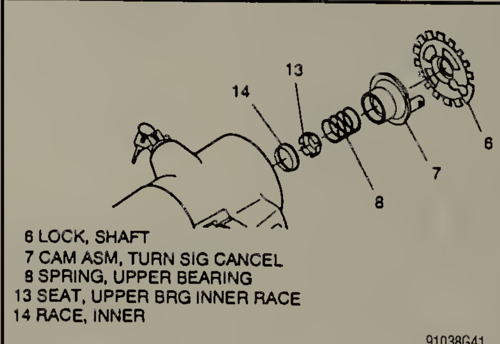


Fig. 81 Exploded view of the upper shaft components—1996 vehicle shown, others similar

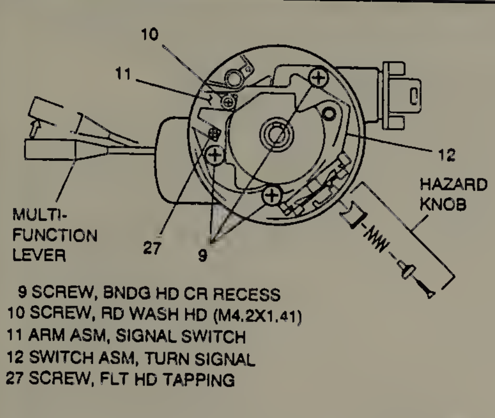


Fig. 82 Turn signal removal preparation

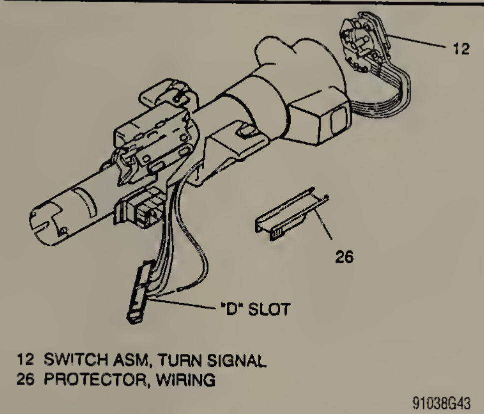


Fig. 83 Exploded view of the turn signal switch

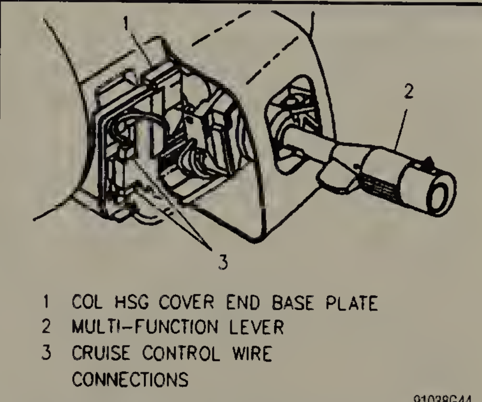


Fig. 84 View of the multi-function lever, which includes the wiper switch

Windshield Wiper Switch

REMOVAL & INSTALLATION

1984–89 Vehicles

➡On 1984–89 vehicles, the windshield wiper switch is located on the driverís side door panel.

1. Disconnect the negative battery cable.
2. Remove the armrest and filler from the door panel.
3. Remove the accessory trim plate.
4. If equipped, remove the retainers, detach the connector, then remove the windshield wiper switch.
5. Installation is the reverse of the removal procedure.

1990–96 Vehicles

See Figure 84

➡On 1990–96 vehicles, the wiper switch is a non-replaceable component of the multi-function turn signal lever. For multi-function lever removal and installation, refer to the following procedure.

1. Disconnect the negative battery cable.
2. Remove the column housing cover end cap by pulling it toward the front of the vehicle.
3. Detach the electrical harness connector and grommet.
4. Pull toward the driver side door to release the detent/multi-function turn signal lever.

To install:

5. Position the multi-function turn signal lever. Align the lever tab into the slot with the lever in the **OFF** position.
6. Attach the electrical harness connector and grommet.
7. Install the column housing cover end cap.

Ignition Switch

REMOVAL & INSTALLATION

See Figures 85 and 86

1. If equipped, disable the SIR system, as outlined in Section 6, then disconnect the negative battery cable.
2. Remove the column to instrument panel trim plates and attaching nuts.
3. Loosen the steering column mounting bolts.
4. Remove the steering column mounting bolts, lower and properly support the column. If access to the switch is not sufficient, remove the column from the vehicle.

➡Be sure the steering column is supported at all times in order to prevent damage to the column.

5. Remove the hex nut and washer head screw securing the dimmer switch to the column.

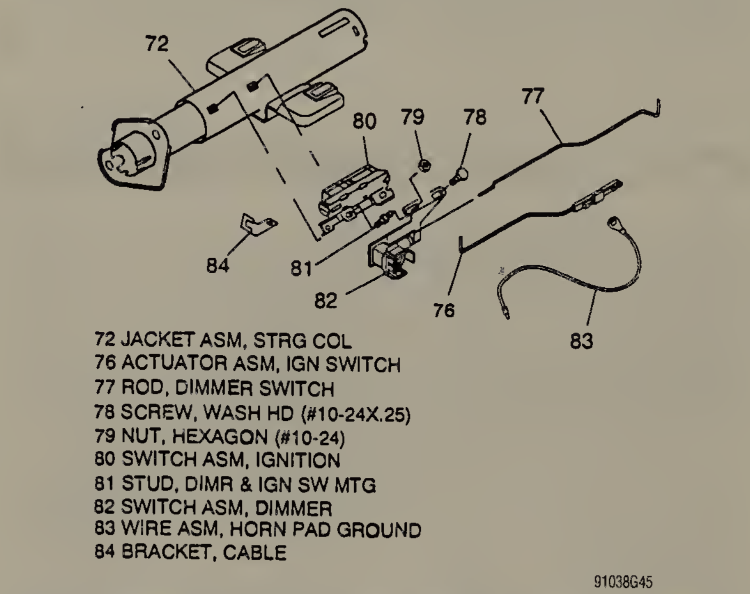


Fig. 85 Exploded view of the ignition and dimmer switches—1996 vehicle shown, others similar

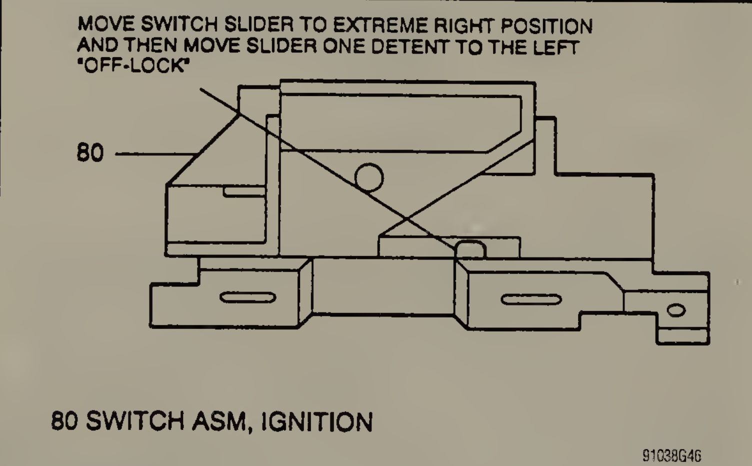


Fig. 86 Ignition switch adjustment

6. If equipped, remove the horn ground strap attached to the dimmer/ignition switch mounting stud.
7. If equipped, remove the cable bracket.
8. Disengage the switch assembly from the actuator rod, unplug the wiring harness connector and remove the dimmer switch assembly.
9. Remove the dimmer and ignition switch mounting stud.
10. Remove the ignition switch from the actuating assembly and disengage the switch wire connector.

To install:

11. Make sure that the key cylinder is in the **OFF-LOCK** position.

➡Install the ignition switch to the jacket with the switch in the "OFF-LOCK" position, as shown in the accompanying figure. New switches will be pinned in the "OFF-LOCK" position. Remove the plastic pin after the switch is assembled to the column. Failure to do this may cause switch damage.

12. Install the switch with the rod in the hole and adjust as necessary. To verify the switch is in the lock position, adjust the ignition switch assembly as follows:
    a. Move the switch slider to the extreme right position.
    b. Move the switch slider one detent to the left **"OFF-LOCK"** position.
    c. Install a $^{3}/_{32}$ in. drill bit in the hole on the switch to limit travel.
13. Install the ignition switch to the actuator assembly. Install the ignition and dimmer switch mounting stud and tighten to 35 inch lbs. (4.0 Nm).
14. Remove the drill bit from the switch.
15. Install the dimmer switch assembly to the actuator rod.
16. If equipped, install the cable bracket and the horn pad ground wire.
17. Install and finger-tighten the washer head screw and the hex nut.
18. Adjust the dimmer switch and tighten the screw and nut to 35 inch lbs. (4.0 Nm).
19. Position the steering column, then engage the ignition and dimmer switch connectors. Secure the column in the vehicle
20. Connect the negative battery cable and enable the SIR system.

Ignition Lock Cylinder

REMOVAL & INSTALLATION

➧ See Figure 87

➡On vehicles equipped with a SIR air bag system, it is imperative that the disarming procedure is followed before repairs, and that the coil centering and rearming procedures are followed after repairs.

1. If equipped, disable the SIR system, then disconnect the negative battery cable.

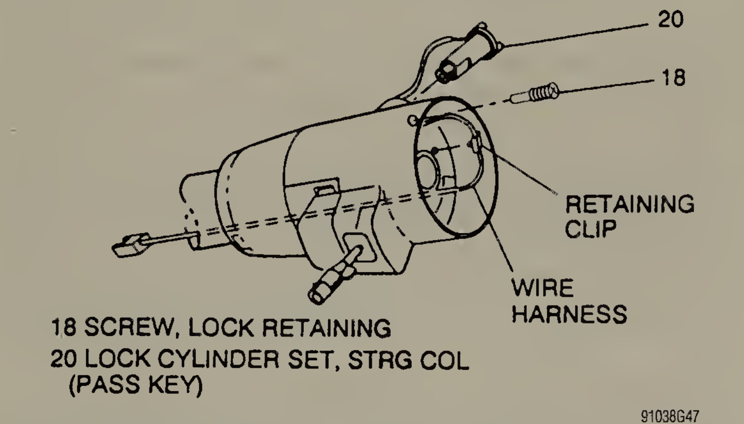


Fig. 87 Exploded view of the lock cylinder mounting—1996 vehicle shown, others similar

2. Remove turn signal switch assembly, but do not disconnect or pull the wire harness through the column. Allow the switch assembly to hang freely from the wires.
3. If necessary, remove the coil assembly as follows:
    a. Disengage the coil terminal connector from the vehicle harness. Remove the yellow connector shroud from the black connector.
    b. Remove wiring protector.
    c. Attach a length of mechanic's wire to the terminal connector to aid in reassembly.
    d. Carefully pull the wire harness through the column, leaving the mechanic's wire in the column for installation purposes.
4. Remove the key from the lock cylinder.
5. Remove the buzzer switch and clip.
6. Reinsert the key into the lock cylinder, making sure the key is in the **LOCK** position.
7. Remove the lock retaining screw.
8. Disengage the Pass Key wire harness connector from the bulkhead connector. If not done already, remove the wiring protector.
9. Attach a piece of string or mechanic's wire to the wire connector to aid in reassembly, disconnect the retaining clip from the housing cover and pull the wire up through the column. Leave the length of string or wire in the column in order to pull the new harness into position.
10. Remove the lock cylinder.

To install:

11. Using the length of string or the mechanic's wire, pull the PASS Key wire harness down through the column into the original position and engage the connector.
12. Install the lock cylinder set. Snap the wire retaining clip into the hole in the housing.
13. Engage the lock cylinder wiring connector to the bulkhead connector.
14. Install the lock cylinder retaining screw and tighten to 22 inch lbs. (2.5 Nm).
15. Remove the key and install the buzzer switch with retaining clip, then insert the key and leave in the **LOCK** position.
16. If removed, pull the turn signal switch wiring connector and/or the coil wiring connector through the steering column, connect the harnesses and install the wiring protector.
17. Install the turn signal switch assembly.
18. Connect the negative battery cable and enable the SIR system, if equipped.

Steering Linkage

REMOVAL & INSTALLATION

Tie Rod Ends

FRONT

➧ See Figures 88 thru 97

1. Raise and safely support the vehicle.
2. Matchmark the installed position of the tie rod end with paint or a marker.

Fig. 88 Make sure you matchmark the installed position of the tie rod end for proper alignment during installation

Fig. 89 Use pliers to hold the inner tie rod end, then loosen the jam nut

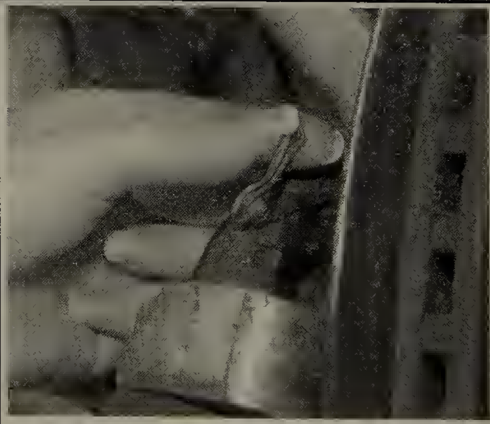


Fig. 90 Remove the cotter pin from the slotted nut

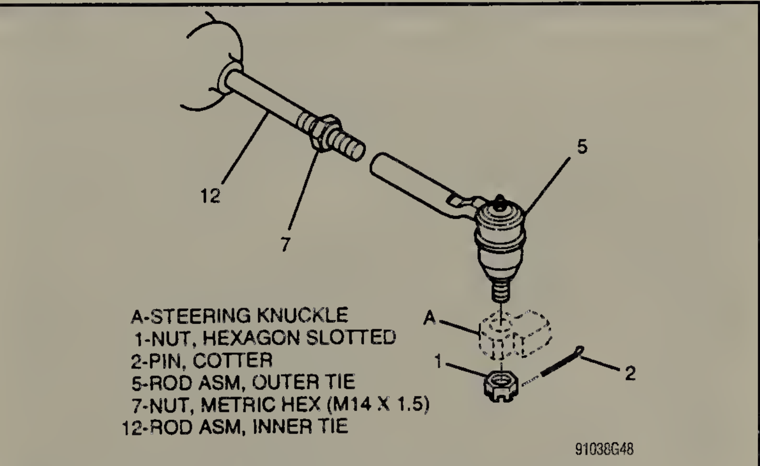


Fig. 97 Exploded view of the outer tie rod end replacement

3. Use a pair of pliers to hold the inner tie rod stationary, then loosen tie rod jam nut.
4. Remove and discard the tie rod cotter pin, then loosen, but do not remove, the hex slotted nut.
5. Use a universal steering linkage puller, such as tool J–24319–01 or equivalent, to separate the tie rod end from the steering knuckle.
6. After the tie rod is separated, remove the hex slotted nut, then remove the tie rod end from the knuckle.
7. Unscrew the outer tie rod end from the steering rack assembly, counting the number of turns necessary to remove the tie rod end.

To install:

8. Install the tie rod to the steering rack assembly, but do not tighten the jam nut. Thread the tie rod end in the same number of turns and/or align it to the marks made during removal.
9. Install the tie rod to the steering knuckle and install the hex slotted nut to the tie rod stud.
10. Tighten the hex nut to 35 ft. lbs. (47 Nm), then insert a new cotter pin. If necessary tighten the nut additionally in order to insert the pin, but do not exceed a total torque of 52 ft. lbs. (70 Nm) and do not back off the original torque.

➡Make sure the rack and pinion boot is not twisted or puckered during installation or adjustment.

11. Adjust the toe by turning the inner tie rod, making sure the rack and pinion boot is not twisted or puckered during toe adjustment.
12. Tighten the jam nut against the tie rod to 50 ft. lbs. (68 Nm).
13. Carefully lower the vehicle. Have the front end alignment checked and adjusted if necessary at a reputable repair shop.

Power Steering Gear

REMOVAL & INSTALLATION

1984–86 Vehicles

➧ See Figure 98

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle, then remove the drivers side wheel and tire assembly.
3. Disconnect the power steering fluid lines from the gear, then plug the lines to prevent excessive leaking and system contamination.
4. Disconnect the outer tie rod ends from both sides, as outlined in this section.
5. Remove the upper and lower mounting bolts from the passenger side of the vehicle.
6. Remove the drivers side mounting bolts.
7. Remove the intermediate shaft lower universal joint from the rack and pinion assembly.
8. Remove the stabilizer bar.
9. Remove the electrical fan assembly.
10. Remvoe the rack and pinion assembly from the vehicle.

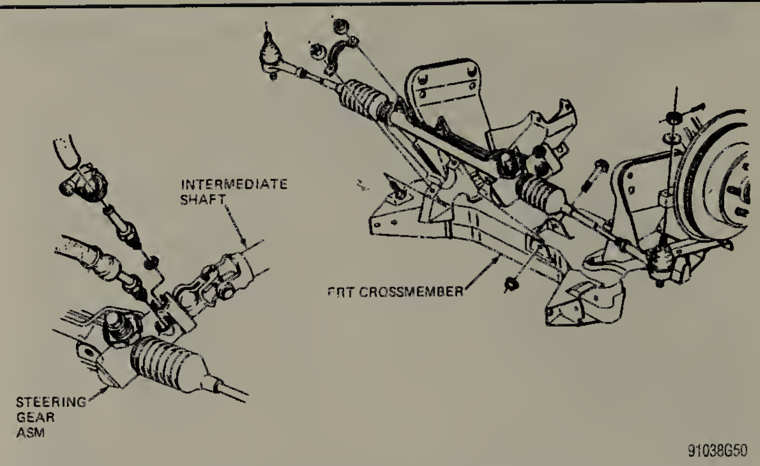


Fig. 98 Power rack and pinion steering gear mounting—1984–86 vehicles

11. Installation is the reverse of the removal procedure.
12. Properly fill and bleed the power steering system.
13. Have the front end alignment checked and adjusted, if necessary.

1987–96 Vehicles

➧ See Figures 99 and 100

1. Position a suitable drain pan under the vehicle to catch power steering fluid.
2. For 1993–96 vehicles equipped with a VIN P or 5 engine, perform the following:
   a. Remove the air intake duct.
   b. Remove the serpentine drive belt.
   c. Remove the drive belt idler pulley.
3. If equipped, unfasten the clamp, then disconnect the outlet hose from the return pipe.
4. Disconnect the inlet hose from the steering gear. Plug the fluid lines to prevent excessive leakage and system contamination.
5. Remove the lower coupling shield.
6. Remove the intermediate shaft pinch bolt from the steering gear.
7. Raise and safely support the vehicle.
8. Remove the tire and wheel assemblies.
9. Separate both tie rod ends from the knuckles using a suitable puller.
10. For 1993–96 vehicles, remove the power steering cooler assembly.
11. Remove the stabilizer shaft, as outlined earlier in this section.
12. Unfasten the rack mounting through bolt and nut.

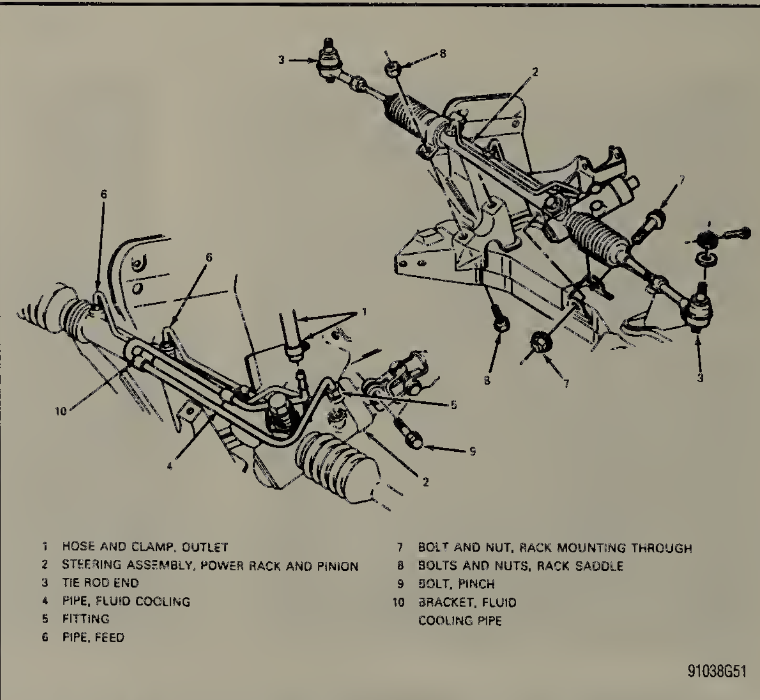


Fig. 99 Power rack and pinion steering gear—1987–89 vehicles

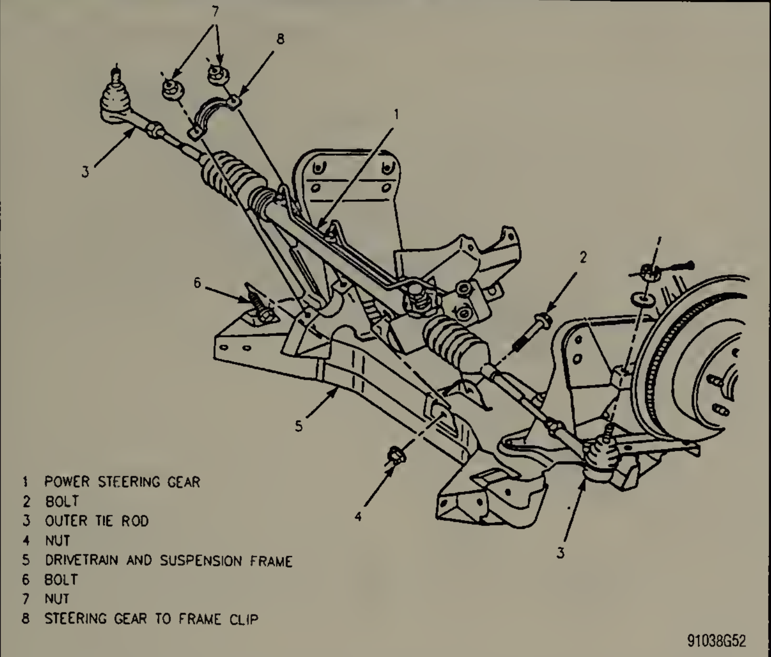


Fig. 100 Power steering gear mounting—1996 vehicle shown

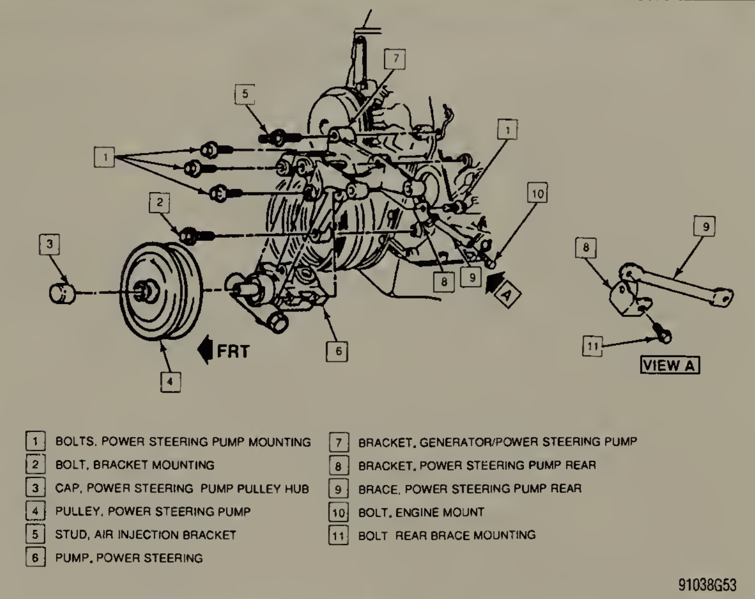


Fig. 101 Exploded view of the power steering pump and related components—1990 shown, others similar

13. Remove the rack saddle (clamp) mounting bolts and nuts.
14. Remove the power rack and pinion assembly.
15. If necessary, remove the outer tie rods and rack and pinion boots from the steering gear.
16. If necessary, remove the return pipe and brackets from the housing.

To install:

17. Install the return pipe and brackets to the housing.
18. Install the power rack and pinion assembly.
19. Fasten the intermediate shaft pinch bolt at the gear assembly and tighten to 44 ft. lbs. (60 Nm).
20. Install the rack saddle (clamp) mounting nuts and bolts and tighten the nuts to 18 ft. lbs. (25 Nm).
21. Install the rack mounting through bolt and nut, then tighten the nut to 30 ft. lbs. (40 Nm).
22. Install the stabilizer shaft, as outlined in this section.
23. For 1993–96 vehicles, install the power steering cooler assembly.
24. Connect both tie rod ends to the knuckle, then tighten the slotted nuts to 33 ft. lbs. (45 Nm).
25. Install the tire and wheel assemblies, then carefully lower the vehicle.
26. Connect the outlet hose and clamp, if equipped, to the return pipe. Tighten the clamp to 22 inch lbs. (2.5 Nm) or the fitting to 21 ft. lbs. (28 Nm).
27. Attach the inlet hose assembly to the steering gear. Tighten the inlet pipe fitting to 20 ft. lbs. (28 Nm).
28. Install the intermediate shaft pinch bolt to the gear and tighten to 44 ft. lbs. (60 Nm).
29. Properly fill and bleed the power steering system.
30. Have the front end alignment checked and adjusted, if necessary.

Power Steering Pump

REMOVAL & INSTALLATION

VIN 8 Engines

See Figures 101 and 102

1. Disconnect the negative battery cable and place a drain pan under the vehicle to catch fluid.
2. Remove the serpentine drive belt.

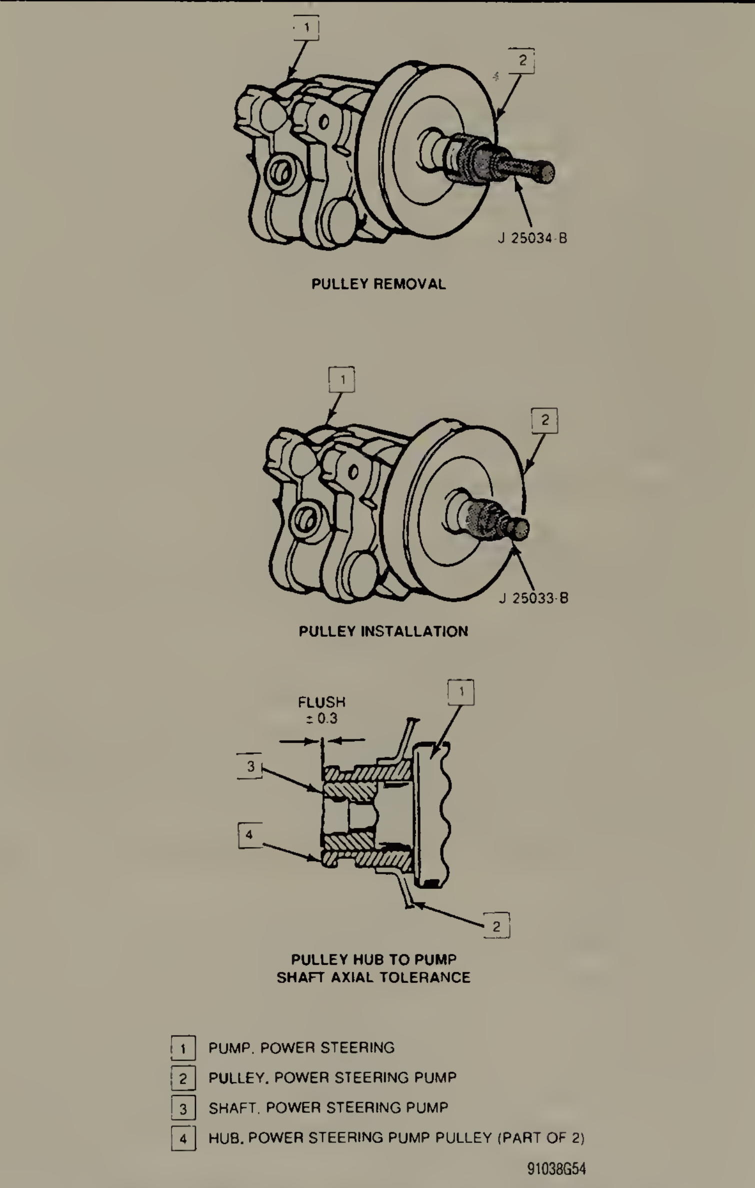


Fig. 102 Power steering pump pulley removal and installation

3. Remove the power steering pump pulley as follows:
   a. If equipped with an automatic transmission, remove the water pump damper.
   b. Unfasten the bolts securing the power steering reservoir bracket to the drivetrain and front suspension frame.
   c. Reposition the reservoir bracket with the reservoir and hoses for pulley clearance.
   d. Remove the power steering pump pulley hub cap, then remove the pulley using a suitable removal tool.
4. Disconnect and plug the power steering gear inlet hose from the pump. Disconnect and plug the reservoir hose from the power steering pump.
5. Unfasten the bolt securing the pump rear bracket to the rear brace.
6. Remove the engine mount bolt and power steering pump rear brace.
7. Remove the power steering pump mounting bolts.
8. Remove the power steering pump and rear bracket.
9. If alternator/power steering pump bracket removal is necessary, perform the following:
   a. Remove the alternator assembly, as outlined in Section 2 of this manual.
   b. Remove the AIR pump and bracket.
   c. Remove the bolts securing the alternator/power steering pump bracket to the engine, then remove the bracket.

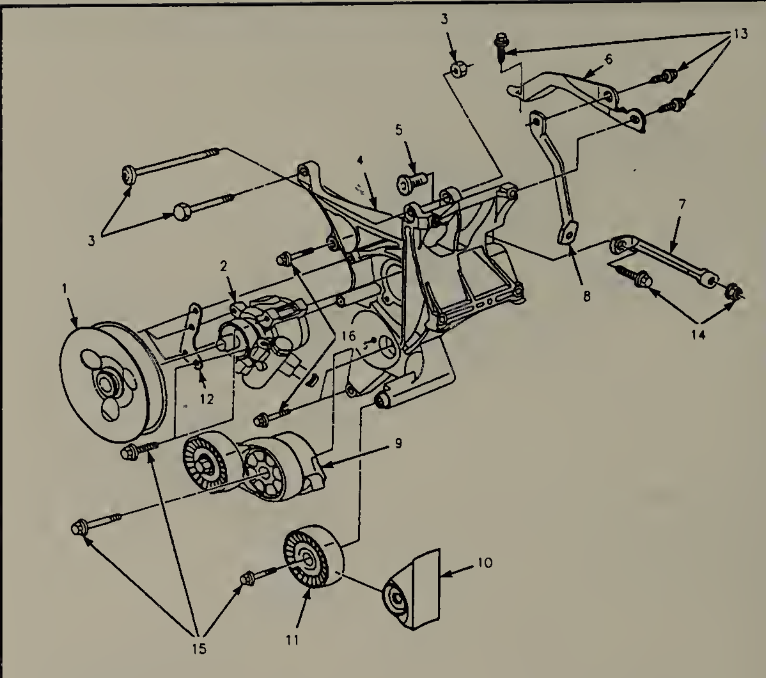
To install:

10. If removed, install the alternator/power steering pump bracket as follows:
   a. Position the bracket to the engine and secure with the retaining bolts. Tighten the bolts to 24 ft. lbs. (33 Nm).
   b. Install the AIR pump bracket and pump.
   c. Install the alternator.
11. Install the power steering pump, rear bracket and bolts to the alternator/power steering pump bracket.
12. Instlal the power steering pump rear brace and engine mount bolt.
13. Install the bolt holding the rear bracket to the rear brace.
14. Tighten the bolts to the following specifications:
   a. Power steering pump mounting bolts: 18 ft. lbs. (25 Nm)
   b. Power steering pump rear bracket-to-rear brace bolt: 24 ft. lbs. (33 Nm)
   c. Engine mount bolts: 41 ft. lbs. (56 Nm)
   d. Power steering pump rear bracket-to-power steering pump bolt: 18 ft. lbs. (25 Nm)
15. Connect the power steering reservoir hose and clamp to the power steering pump.
16. Attach the power steering gear inlet hose and tighten the fitting to 21 ft. lbs. (28 Nm).
17. Install the power steering pump pulley as follows:
   a. Install the pulley using a suitable installation tool such as J 25033-B or equivalent. The pulley must be installed onto the pump shaft to the specifications shown in the accompanying figure.
   b. Install the hub cap on the pulley.
   c. Position the reservoir bracket with the reservoir and hoses.
   d. Install the bolts retaining the reservoir assembly bracket to the drivetrain and front suspension frame. Tighten the bolts to 89 inch lbs. (10 Nm).
   e. If equipped with an automatic transmission, install the water pump damper.
18. Install the serpentine drive belt.
19. Connect the negative battery cable, then properly fill and bleed the power steering system.

VIN P and 5 Engines

➧ See Figure 103

1. Disconnect the negative battery cable and place a drain pan under the vehicle to catch fluid.
2. Remove the air intake duct, then remove the serpentine drive belt.
3. Remove the steering pump pulley hub cap, then remove the pulley using J–25034–B or an equivalent puller tool.
4. For 1993–96 vehicles, remove the serpentine drive belt idler pulley.
5. Disconnect the gear inlet hose assembly from the pump. For 1993–96 vehicles, remove the pump inlet pipe mounting bolts, then disconnect the pipe assembly from the pump.



1 PUMP PULLEY
2 POWER STEERING PUMP
3 GENERATOR MOUNTING BOLTS AND NUT
4 GENERATOR/ A/C COMPRESSOR AND POWER STEERING PUMP BRACKET
5 GENERATOR MOUNTING BRACKET SPACER
6 REAR INNER SUPPORT BRACE
7 REAR SUPPORT BRACE
8 OUTER SUPPORT BRACE
9 TENSIONER
10 IDLER SHIELD
11 IDLER PULLEY
12 POWER STEERING BRACKET
13 REAR INNER SUPPORT BRACE BOLTS
14 REAR SUPPORT BRACE BOLT/NUT
15 BOLTS
16 BRACKET MOUNTING BOLTS

91038G55

Fig. 103 Exploded view of the power steering pump and brackets—5.7L (VIN P & 5) engines

6. For 1992 vehicles. disconnect the reservoir hose and clamp from the pump.
7. Remove the power steering pump mounting bolts.
8. Remove the power steering pump and front bracket.

To install:

9. Install the power steering pump and front bracket with the mounting bolts. Tighten the bolts to 18 ft. lbs. (25 Nm).
10. For 1992 vehicles, connect the power steering pump reservoir hose and clamp to the pump. Tighten the clamp to 22 inch lbs. (2.5 Nm).
11. For 1993–96 vehicles, install the pump inlet pipe to the pump, then install the mounting bolts and tighten to 24 ft. lbs. (33 Nm).
12. Connect the power steering gear inlet hose assembly to the power steering pump and tighten the fitting to 21 ft. lbs. (28 Nm).
13. For 1993–96 vehicles, install the serpentine drive belt idler pulley.
14. Using J–25033–B, or an equivalent installation tool, install the power steering pump pulley so the front of the pulley hub is flush with the front of the pump shaft.
15. Install the hub cap to the pulley.
16. Install the serpentine drive belt, then install the intake air duct.
17. Connect the negative battery cable and remove the drain pan.
18. Refill the power steering reservoir and properly bleed the system.

VIN J Engines

➧ See Figures 104 and 105

1. Disconnect the negative battery cable and remove the air intake duct.
2. Drain the engine cooling system into a suitable container.
3. Drain and appropriately discard the power steering fluid.
4. Remove the serpentine drive belt.
5. Remove the left coolant outlet cover and hose.

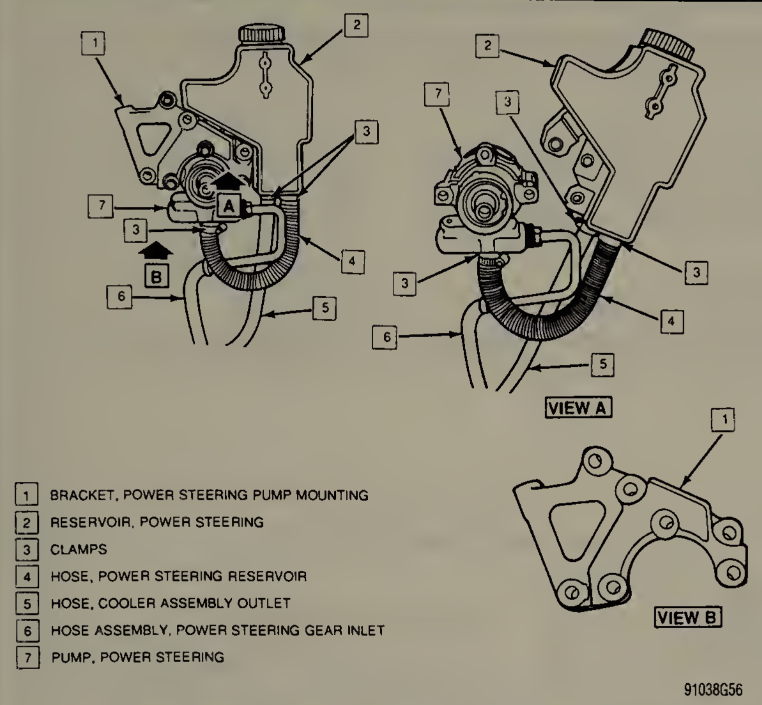


Fig. 104 Power steering pump, reservoir and mounting bracket—5.7L (VIN J) engine

6. Disconnect the vacuum hose retainer from the pump reservoir, then remove the vacuum hose(s) and set aside.
7. For 1990–92 vehicles:
   a. Remove the power steering pump bracket-to-cylinder head bolts.
   b. Remove the pump bracket to air conditioning compressor bolt.
   c. Remove the cooler assembly outlet hose from the reservoir.
   d. Disconnect the power steering gear inlet pipe from the power steering pump, then remove the power steering pump assembly from the vehicle.
   e. As necessary, remove the pump pulley using tool J–25034–B or equivalent puller. Remove the reservoir hose from the pump. Remove the power steering pump-to-mounting bracket bolts and remove the pump and/or reservoir from the bracket.
8. For 1993–96 vehicles:
   a. Remove the bolts retaining the compressor hose clip to the crossmember.
   b. Remove the pulley hub cap and separate the pulley from the pump using J–25034–B or an equivalent puller.
   c. Remove the crankcase vent inlet pipe from the power steering pump bracket.
   d. Remove the crankcase vent inlet hose from the throttle body extension.
   e. Remove the compressor-to-power steering pump bracket bolt.
   f. Remove the gear inlet pipe from the pump, then remove the outlet hose from the cooler assembly.
   g. Remove the power steering pump bracket-to-cylinder head bolts, then remove the pump from the vehicle.
   h. As necessary, remove the fluid reservoir hose from the assembly, remove the pump-to-mounting bracket bolts and remove the pump and/or reservoir from the mounting bracket.

To install:

9. If replacing the pump, do not use a pump with the letter **R** on the back of the pump housing.
10. If removed, install the reservoir and/or pump to the bracket. Apply Loctite® 565 or equivalent, to the pump-to-bracket mounting bolts and install. Tighten the bolts to 19 ft. lbs. (26 Nm).
11. If removed, connect the pump reservoir hose to the pump and tighten the clamp screw to 22 inch lbs. (2.5 Nm).
12. For 1993–96 vehicles:
   a. Install the pump assembly to the vehicle. Coat the bolt threads with Loctite® 565 or equivalent, then install the bolts and tighten 19 ft. lbs. (26 Nm).

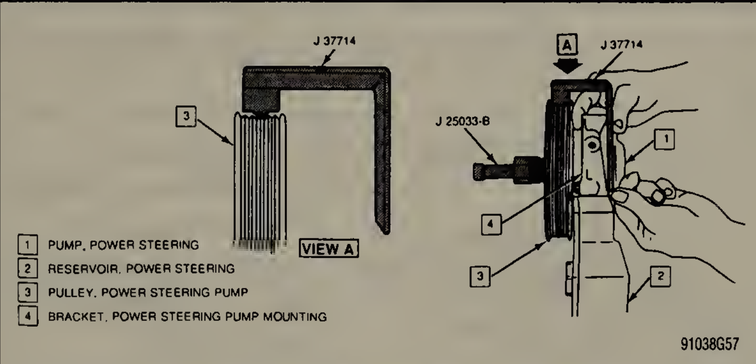


Fig. 105 Installation of the power steering pump pulley—5.7L (VIN J) engine

   b. Connect the outlet hose to the cooler assembly. Tighten the clamp screw to 22 inch lbs. (2.5 Nm).
   c. Connect the power steering gear inlet pipe to the pump, then tighten the fitting to 21 ft. lbs. (28 Nm).
   d. Install the compressor-to-power steering pump bracket bolt and tighten to 19 ft. lbs. (26 Nm).
   e. Install the crankcase vent inlet hose to the throttle body extension and to the power steering pump bracket.
   f. Install the pump pulley using J–25033–B or equivalent installation tool, then install the hub cap.
   g. Install the bolt retaining the compressor hose clip to the crossmember.
13. For 1990–92 vehicles:
   a. If removed, install the power steering pump pulley using a suitable installation tool.
   b. Position the pump assembly onto the engine.
   c. Connect the gear inlet pipe to the pump and tighten the fitting to 21 ft. lbs. (28 Nm).
   d. Install the cooler assembly outlet hose to the reservoir and tighten the hose clamp screw to 22 inch lbs. (2.5 Nm).
   e. Install the A/C compressor to power steering pump bracket bolt and tighten to 19 ft. lbs. (26 Nm).
   f. Apply a coat of Loctite® 565 to the pump bracket-to-cylinder head bolts, install and tighten the bolts to 19 ft. lbs. (26 Nm).
14. Install the vacuum hose(s) and connect the retainer to the power steering pump reservoir. Tighten the screws to 13 inch lbs. (1.5 Nm).
15. Install the left coolant outlet cover and hose.
16. Install the serpentine drive belt.
17. Install the air intake duct and connect the negative battery cable.
18. Refill the power steering reservoir.
19. Properly fill the engine cooling system.
20. Bleed the power steering system.

BLEEDING

See Figure 106

1. With the engine **OFF** and wheels off the ground, turn the steering wheel all the way to the left. Add power steering fluid to the **COLD** mark on the fluid level indicator.
2. Bleed the system by turning the wheels from side-to-side without reaching the stop at either end. It may be necessary to turn the wheel from side-to-side several times. Be sure to keep the fluid full.
3. Start the engine. With engine idling, recheck the fluid level. If necessary add fluid to bring the fluid up to the **COLD** mark.
4. Return the wheels to the center position. Lower the front wheels to the ground and continue to run for 2–3 minutes.
5. Road test the vehicle to make sure the steering functions normally and without noise.
6. Check for fluid leakage. Check to make sure the fluid level is at the **HOT** mark after system is stabilized at its normal operating temperature.

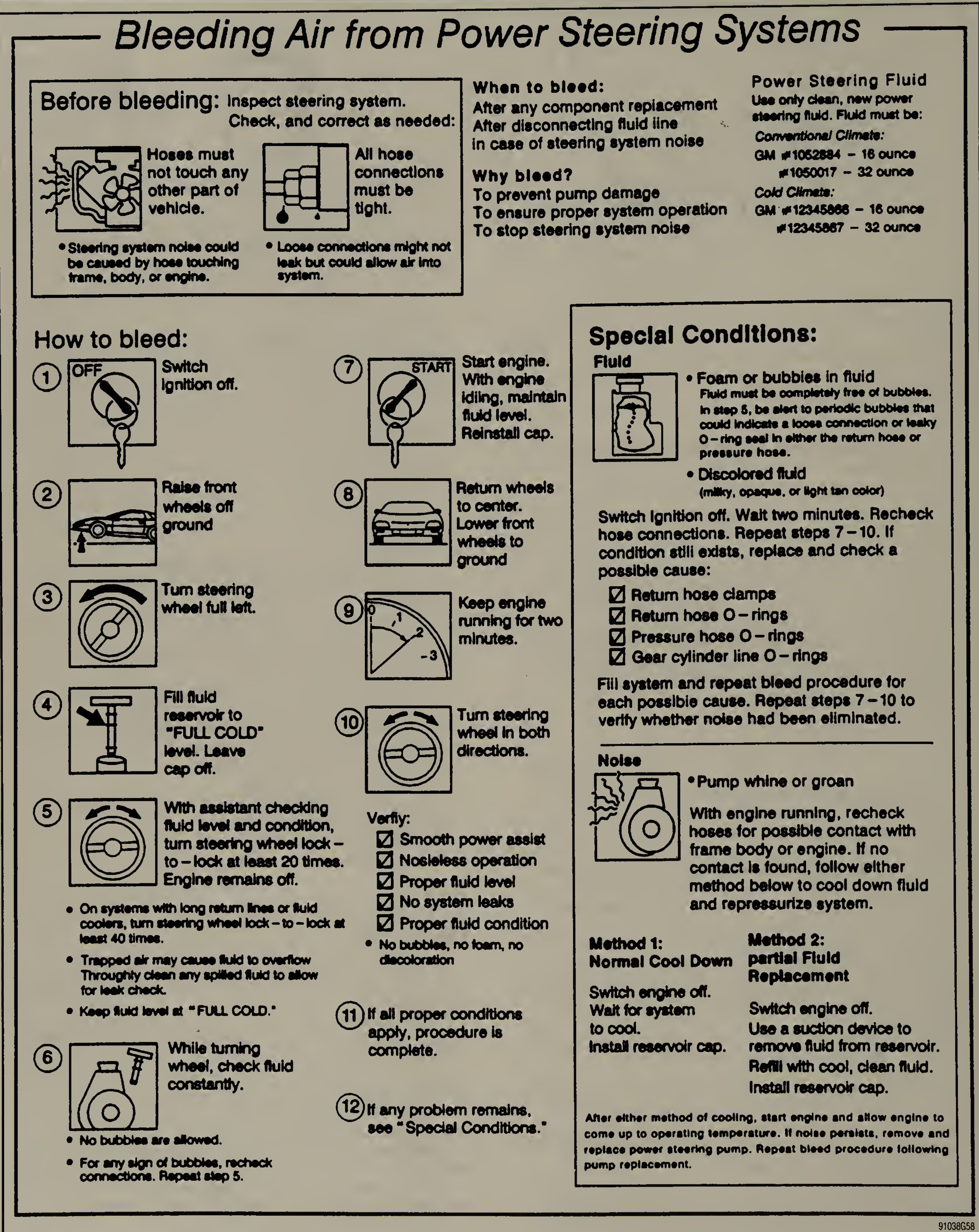


Fig. 106 Bleeding the power steering system

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Wheels			
Lug nuts	100		136
Front Suspension			
Transverse spring			
Lower control arm ball stud nuts			
minumum	50		68
maximum	88		120
Spring protector bolts	18		25
Shock absorber-to-lower control arms lower mounting nuts	19		26
Spring retainer nuts (at proper trim height)	46		63
Stabilizer shaft link nuts (at proper trim height)	33		45
Shock Absorber			
Without selective ride control			
Upper and lower shock mounting nuts	19		26
With selective ride control			
Lower shock absorber mounting nuts and bolts	19		26
Upper mounting nut			
1992-95 vehicles	31		42
1996 vehicles	19		26
Upper Ball Joints			
Ball joint nuts	13		18
Upper control arm ball stud hex nut			
minimum	33		45
maximum (to insert cotter pin)	63		85
Lower Ball Joints			
Lower control arm ball stud nut			
minimum	50		68
maximum (to insert cotter pin)	88		120
Stabilizer Shaft			
Stabilizer shaft link nuts to 35 ft. lbs. (48 Nm)	35		48
Insulator clamp bolts to 40 ft. lbs. (54 Nm)	40		54
Upper Control Arm nuts			
1984-86 vehicles	63		85
1987 vehicles	48		65
1988-96 vehicles	37		50
Lower Control Arm bolts			
1984-87 vehicles	96		130
1988-96 vehicles	82		112
Knuckle and Spindle			
Tie rod ball stud hex nut			
minimum	35		47
maximum (to insert cotter pin)	52		70
Front hub and bearing nuts	46		62
Rear Suspension			
Transverse spring anchor plate bolts	37		50
Shock Absorber			
1984-87 vehicles			
Shock absorber-to-body bracket nut and bolt	66		90
Shock absorber-to-knuckle washer and nut	60		80

91038C01

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Rear Suspension cont.			
Shock Absorber			
1988-96 vehicles			
Upper bracket retaining nut	19		26
Upper bracket mounting bolts	22		30
Lower mounting nut	61		83
Control Rods			
Bracket bolt	63		85
Knuckle nut	140		190
Spindle Support Rod			
Spindle/support rod-to-knuckle nut	107		145
Spindle/support rod adjustment nut	186		253
Stabilizer Shaft			
1984-88 vehicles			
Stabilizer bar-to-body retainers	15-22		20-30
1989 vehicles			
Bracket nuts	18		25
Link bolt nut	35		48
1990-96 vehicles			
Stabilizer shaft bracket nuts	18		25
Stabilizer shaft link-to-stabilizer shaft nuts	39		53
Stabilizer shaft link-to-link bracket nuts	31		42
Fuel tank-to-stabilizer shaft bracket nuts	18		25
Mufflers-to-muffler hangers nuts	40		54
Hub and Bearing			
Wheel hub mounting bolts	66		90
Spindle nut	164		223
Steering			
Steering Wheel			
1984-89 vehicles			
Steering wheel retaining nut	30		41
Telescope lever shaft lock knob screw		30	2.8
Telescope adjustment lever screws		40	3.3
1990-96 vehicles			
Steering wheel jam nut	30		41
SIR inflator module retaining screws		86	9.7
Turn signal switch			
1990-96 vehicles			
Turn signal switch assembly screws		30	3.4
Switch arm mounting screws		20	2.3
Ignition switch			
Ignition and dimmer switch mounting stud		35	4
Dimmer switch screw and nut		35	4
Lock cylinder retaining screw		22	2.5
Front Tie Rod Ends			
Hex nut			
minimum	35		47
maximum (to insert cotter pin)	52		70

91038C02

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Steering cont.			
Front Tie Rod Ends			
Jam nut	50		68
Rear Tie Rod Ends			
Axle rod-to-differential carrier bolts	55		74
Axle tie rod nuts	37		50
Tie rod jam nuts	49		67
Power Steering Gear			
1987-96 vehicles			
Intermediate shaft-to-gear pinch bolt	44		60
Rack saddle (clamp) mounting nuts	18		25
Rack mounting through bolt and nut	30		40
Outlet hose clamp		22	2.5
Outlet hose fitting	21		28
Inlet hose fitting	20		27
Intermediate shaft pinch bolt	44		60
Power Steering Pump			
VIN 8 engines			
Power steering pump mounting bolts	18		25
Power steering pump rear bracket-to-rear brace bolt	24		33
Engine mount bolts	41		56
Power steering pump rear bracket-to-power steering pump bolt	18		25
Power steering reservoir assembly bracket bolts		89	10
VIN P & 5 engines			
Power steering pump and front bracket mounting bolts	18		25
VIN J engines			
Pump reservoir hose clamp screw		22	2.5
1993-96 vehicles			
Pump retaining bolts	19		25
Outlet hose-to-cooler clamp screw		22	2.5
Power steering gear inlet pipe fitting	21		28
A/C Compressor-to-pump bracket bolts	19		26
1990-92 vehicles			
Gear inlet pipe fitting	21		27
Cooler assembly outlet hose clamp screw		22	2.5
A/C compressor-to-pump bracket bolt	19		26
Pump bracket -to-cylinder head bolts	19		26
Power steering pump reservoir screws		13	1.5

91038C03

9

BRAKES

BRAKE OPERATING SYSTEM

Basic Operating Principles

Hydraulic systems are used to actuate the brakes of all modern automobiles. The system transports the power required to force the frictional surfaces of the braking system together from the pedal to the individual brake units at each wheel. A hydraulic system is used for two reasons.First, fluid under pressure can be carried to all parts of an automobile by small pipes and flexible hoses without taking up a significant amount of room or posing routing problems.Second, a great mechanical advantage can be given to the brake pedal end of the system, and the foot pressure required to actuate the brakes can be reduced by making the surface area of the master cylinder pistons smaller than that of any of the pistons in the wheel cylinders or calipers.The master cylinder consists of a fluid reservoir along with a double cylinder and piston assembly. Double type master cylinders are designed to separate the front and rear braking systems hydraulically in case of a leak. The master cylinder coverts mechanical motion from the pedal into hydraulic pressure within the lines. This pressure is translated back into mechanical motion at the wheels by the caliper.Steel lines carry the brake fluid to a point on the vehicle's frame near each of the vehicle's wheels. The fluid is then carried to the calipers by flexible tubes in order to allow for suspension and steering movements.In disc brake systems, the cylinders are part of the calipers. At least one cylinder in each caliper is used to force the brake pads against the disc.All pistons employ some type of seal, usually made of rubber, to minimize fluid leakage. A rubber dust boot seals the outer end of the cylinder against dust and dirt. The boot fits around the outer end of the piston on disc brake calipers.The hydraulic system operates as follows: When at rest, the entire system, from the piston(s) in the master cylinder to those in the calipers, is full of brake fluid. Upon application of the brake pedal, fluid trapped in front of the master cylinder piston(s) is forced through the lines to the cylinders. Here, it forces the pistons inward toward the disc, in the case of disc brakes.

Upon release of the brake pedal, a spring located inside the master cylinder immediately returns the master cylinder pistons to the normal position. The pistons contain check valves and the master cylinder has compensating ports drilled in it. These are uncovered as the pistons reach their normal position. The piston check valves allow fluid to flow toward the calipers as the pistons withdraw. Then, as the return springs force the brake pads or shoes into the released position, the excess fluid reservoir through the compensating ports. It is during the time the pedal is in the released position that any fluid that has leaked out of the system will be replaced through the compensating ports.

Dual circuit master cylinders employ two pistons, located one behind the other, in the same cylinder. The primary piston is actuated directly by mechanical linkage from the brake pedal through the power booster. The secondary piston is actuated by fluid trapped between the two pistons. If a leak develops in front of the secondary piston, it moves forward until it bottoms against the front of the master cylinder, and the fluid trapped between the pistons will operate the rear brakes. If the rear brakes develop a leak, the primary piston will move forward until direct contact with the secondary piston takes place, and it will force the secondary piston to actuate the front brakes. In either case, the brake pedal moves farther when the brakes are applied, and less braking power is available.

All dual circuit systems use a switch to warn the driver when only half of the brake system is operational. This switch is usually located in a valve body which is mounted on the firewall or the frame below the master cylinder. A hydraulic piston receives pressure from both circuits, each circuit's pressure being applied to one end of the piston. When the pressures are in balance, the piston remains stationary. When one circuit has a leak, however, the greater pressure in that circuit during application of the brakes will push the piston to one side, closing the switch and activating the brake warning light.In disc brake systems, this valve body also contains a metering valve and, in some cases, a proportioning valve. The metering valve keeps pressure from traveling to the disc brakes on the front wheels until the brake pads rear wheels have contacted the rotors, ensuring that the front brakes will never be used alone. The proportioning valve controls the pressure to the rear brakes to lessen the chance of rear wheel lock-up during very hard braking.Warning lights may be tested by depressing the brake pedal and holding it while opening one of the bleeder screws. If this does not cause the light to go on, substitute a new lamp, make continuity checks, and, finally, replace the switch as necessary.The hydraulic system may be checked for leaks by applying pressure to the pedal gradually and steadily. If the pedal sinks very slowly to the floor, the system has a leak. This is not to be confused with a springy or spongy feel due to the compression of air within the lines. If the system leaks, there will be a gradual change in the position of the pedal with a constant pressure.Check for leaks along all lines and at wheel cylinders. If no external leaks are apparent, the problem is inside the master cylinder.

DISC BRAKES

Instead of the traditional expanding brakes that press outward against a circular drum, disc brake systems utilize a disc (rotor) with brake pads positioned on either side of it. An easily-seen analogy is the hand brake arrangement on a bicycle. The pads squeeze onto the rim of the bike wheel, slowing its motion. Automobile disc brakes use the identical principle but apply the braking effort to a separate disc instead of the wheel.The disc (rotor) is a casting, usually equipped with cooling fins between the two braking surfaces. This enables air to circulate between the braking surfaces making them less sensitive to heat buildup and more resistant to fade. Dirt and water do not drastically affect braking action since contaminants are thrown off by the centrifugal action of the rotor or scraped off the by the pads. Also, the equal clamping action of the two brake pads tends to ensure uniform, straight line stops. Disc brakes are inherently self-adjusting. There are three general types of disc brake:

1. A fixed caliper.
2. A floating caliper.
3. A sliding caliper.

The fixed caliper design uses two pistons mounted on either side of the rotor (in each side of the caliper). The caliper is mounted rigidly and does not move.The sliding and floating designs are quite similar. In fact, these two types are often lumped together. In both designs, the pad on the inside of the rotor is moved into contact with the rotor by hydraulic force. The caliper, which is not held in a fixed position, moves slightly, bringing the outside pad into contact with the rotor. There are various methods of attaching floating calipers. Some pivot at the bottom or top, and some slide on mounting bolts. In any event, the end result is the same.

Stoplamp Switch

REMOVAL & INSTALLATION

1984–92 Vehicles

➧ See Figure 1

1. Disconnect the negative battery cable.
2. Remove any necessary instrument panel sound insulators.

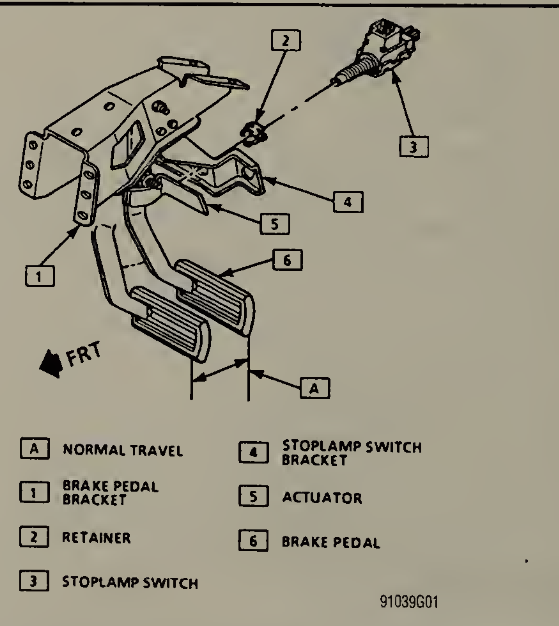


Fig. 1 Exploded view of the stoplamp switch—1984–92 vehicles

3. Remove the retaining clip, then unscrew and remove the stoplamp switch from the brake pedal.
4. Installation is the reverse of the removal procedure. Adjust the switch, as outlined later in this section.

1993–96 Vehicles

See Figure 2

➡On these vehicles, the stoplamp and cruise control switch is one unit.

1. Disconnect the negative battery cable.
2. Remove the instrument panel sound insulator.
3. Detach the electrical and vacuum connectors from the switch.
4. Remove the stoplamp/cruise control switch.

To install:

5. Install and adjust the stoplamp/cruise control switch.
6. Attach the electrical and vacuum connectors.
7. Connect the negative battery cable.

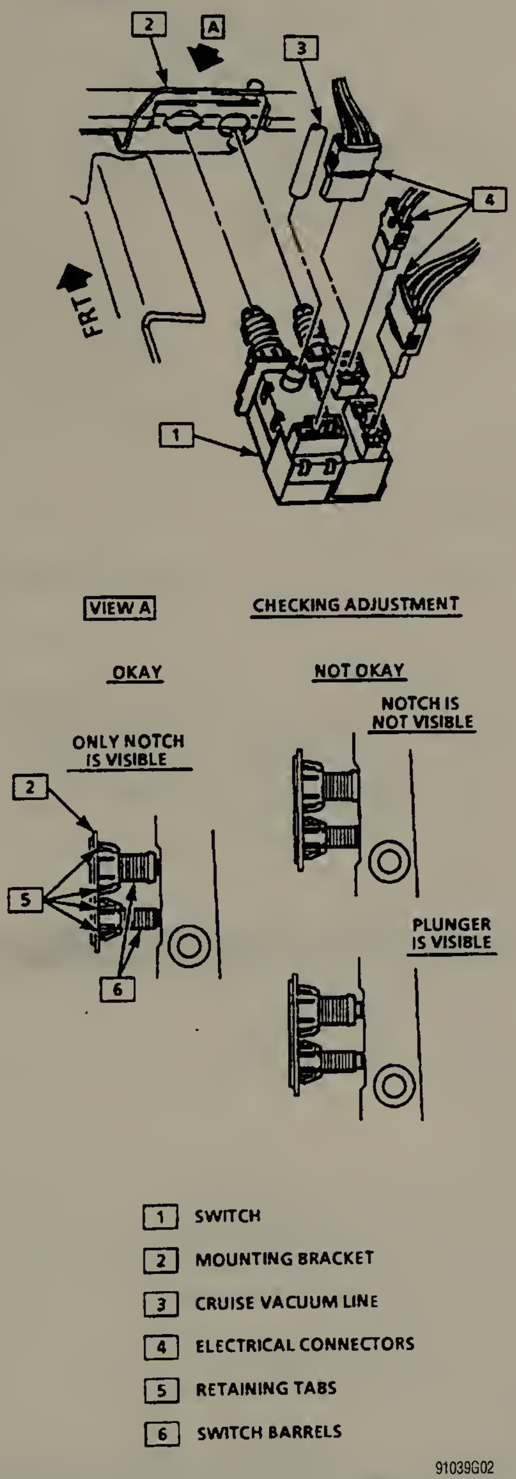


Fig. 2 Stoplamp/cruise control switch mounting and adjustment—1993–96 vehicles

ADJUSTMENT

See Figures 1 and 2

➡The stoplamp switch must be adjusted for proper operation of the ABS and ASR systems.

The design of the switch allows for automatic adjustment when the brake pedal is manually return to its mechanical stop, as follows:

1. With the brake pedal depressed, insert the stoplamp switch into the retainer until the switch body seats on the retainer. Make sure you can hear the clicks as the threaded part of the switch is pushed through the retainer toward the brake pedal.

➡Do not use excessive force when adjusting the stoplamp switch, as this will cause damage to the power booster.

2. Pull the brake pedal fully rearward against the pedal stop, using a force of about 42 lbs. (187 N), until you no longer hear the click sounds. The switch will be moved in the retainer providing proper adjustment.
3. Release the brake pedal, then repeat Step 2, to make sure no clicking sounds remain.

Master Cylinder

REMOVAL & INSTALLATION

See Figures 3 thru 9

1. Disconnect the negative battery cable.
2. Unplug the electrical connector from the warning switch and, if equipped, the fluid level warning switch assemblies.
3. Disconnect the hydraulic brake lines at the master cylinder. Plug the openings to prevent fluid contamination or loss.
4. If equipped, disconnect the master cylinder prime pipe from the reservoir.
5. Remove the retaining nuts holding the cylinder to the brake booster assembly.
6. If necessary for removal, reposition the battery cable and cruise control cable.
7. Remove the master cylinder assembly from the brake booster.

To install:

8. Position the master cylinder assembly to the power booster.
9. If removed, clip the battery and cruise control cables into position.
10. Install the master cylinder retaining nuts and tighten to 15–25 ft. lbs. (20–34 Nm) for 1984–87 vehicles or to 13 ft. lbs. (18 Nm) for 1988–96 vehicles.
11. Remove the plugs, then connect the hydraulic brake lines to the master cylinder and tighten the fittings to 13 ft. lbs. (18 Nm).

Fig. 3 Unplug the electrical connector from the fluid level sensor

91039P51

Fig. 4 With a rag underneath to soak up any drips, use a flare nut wrench to loosen the brake lines

91039P52

Fig. 5 Pull the brake lines from the side of the master cylinder, then plug the holes to avoid contaminating the system

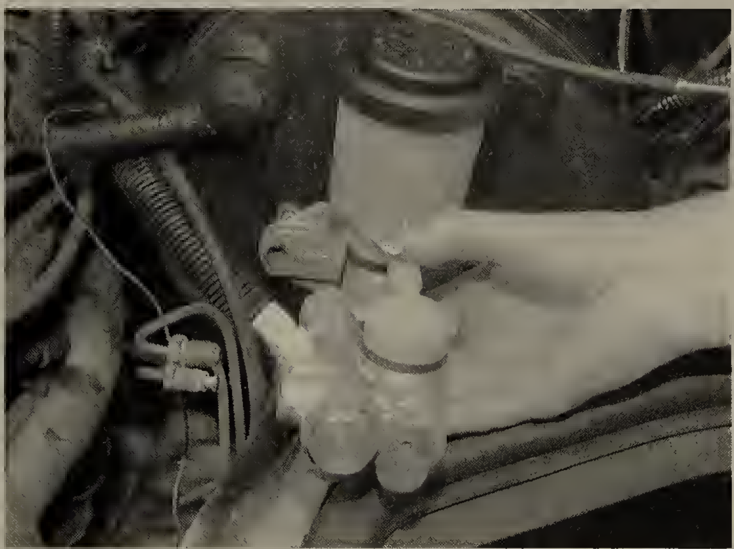
91039P53

Fig. 6 The brake master cylinder is secured to the power booster with 2 retaining nuts

12. If equipped, connect the master cylinder prime pipe.
13. Engage the electrical connections to the warning switch assemblies.

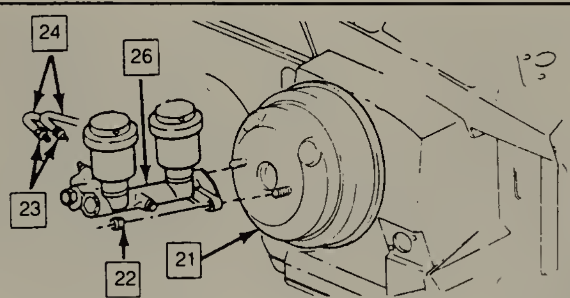
WARNING

Clean, high quality brake fluid is essential to the safe and proper operation of the brake system. You should always buy the highest quality brake fluid that is available. If the brake fluid becomes contaminated, drain and flush the system, then refill the master cylinder with new fluid. Never reuse any brake fluid. Any brake fluid that is removed from the system should be discarded.



91039P54

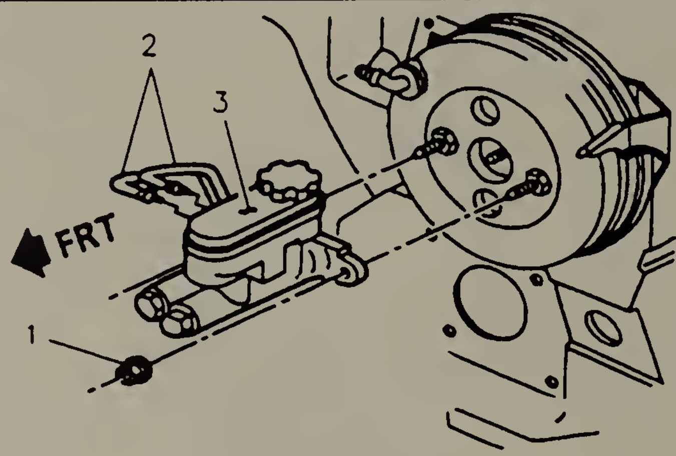
Fig. 7 Unfasten the retaining nuts, then pull the master cylinder off the power booster studs



21 BOOSTER ASSEMBLY, POWER
22 NUT
23 NUTS, TUBE
24 PIPES, BRAKE
26 MASTER CYLINDER, COMPOSITE

91039G03

Fig. 8 The master cylinder on 1984–91 vehicles has 2 fluid reservoirs . . .



1 NUT
2 BRAKE PIPES
3 MASTER CYLINDER

91039G04

Fig. 9 . . . while the master cylinder on 1992–96 vehicles has a single reservoir

14. Fill the master cylinder and properly bleed the hydraulic brake system.
15. Connect the negative battery cable.

Power Brake Booster

REMOVAL & INSTALLATION

1984–89 Vehicles

See Figure 10

1. Unbolt the master cylinder from the power booster and position it aside. You do not have to disconnect the fluid lines, unless necessary for access.
2. Disconnect the vacuum hose from the check valve.
3. Remove the pushrod end of the valve assembly from the brake pedal by removing the retaining clip.
4. Unfasten the nuts from the tie rods.
5. Remove the power booster assembly from the cowl.

To install:

6. Position the power booster assembly to the cowl.
7. Install the retaining nuts on the tie rods and tighten to 15 ft. lbs. (20 Nm).
8. Connect the pushrod end of the valve assembly to the brake pedal and install the retaining clip.

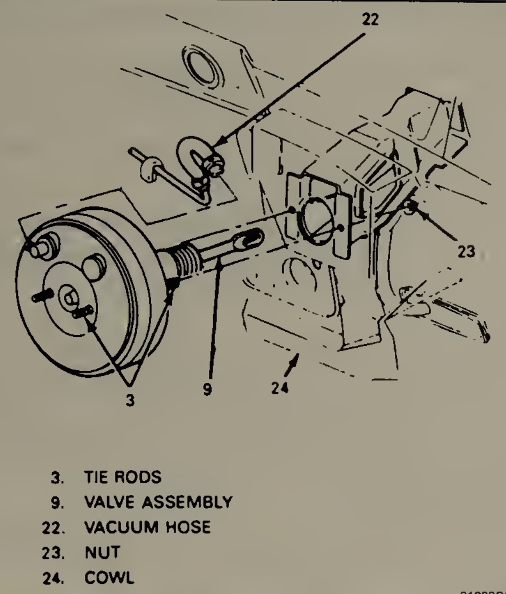


Fig. 10 Exploded view of power booster assembly—1984–89 vehicles

9. Attach the vacuum hose to the vacuum check valve.
10. Install the master cylinder to the power booster and tighten the retaining nuts.
11. If the brake lines were disconnected, bleed the brake system as outlined later in this section.

1990–96 Vehicles

See Figures 11 and 12

1. Disconnect the negative battery cable.
2. Remove the ECM, then remove the ECM housing bracket attaching bolt.
3. Remove the cruise control cable from the cruise control servo and the servo mounting bracket.
4. Disengage the pressure differential sensor electrical connector and the vacuum hose.
5. Disengage the master cylinder warning switch electrical connector, then remove the nuts attaching the master cylinder to the power booster assembly.
6. Reposition the master cylinder assembly, cruise control cable and the battery cable aside. Be careful not to damage the hydraulic lines.
7. Remove the power booster vacuum check valve from the power booster assembly.
8. Remove the instrument panel left sound insulator.
9. Remove the input pushrod assembly retaining ring and washer from the brake pedal.
10. For the VIN P engine, remove the nuts and washers from the tie rods.
11. Remove the power booster assembly attaching nuts and washers, then remove the power booster with seals and the ECM bracket attached, while disengaging the input pushrod assembly.

To install:

12. Install the seals, ECM bracket and power booster assembly to the brake pedal bracket. Have an assistant engage the pushrod assembly onto the brake pedal while installing the booster.
13. Install the booster assembly retaining nuts and tighten to 15 ft. lbs. (21 Nm).
14. Install the washer and retaining clip to the brake pedal, then install the left sound insulator.
15. Connect the vacuum check valve to the power booster assembly.
16. Position the master cylinder, cruise control cable bracket and the battery cable clip, then install the retaining nuts and tighten to 13 ft. lbs. (18 Nm).
17. Engage the master cylinder warning switch electrical connector.
18. Engage the pressure differential sensor electrical connection and vacuum hose.
19. Connect the cruise control cable to the servo and the mounting bracket.
20. Install the ECM housing bracket bolt and tighten to 18 ft. lbs. (25 Nm).
21. Install the ECM.
22. Connect the negative battery cable.

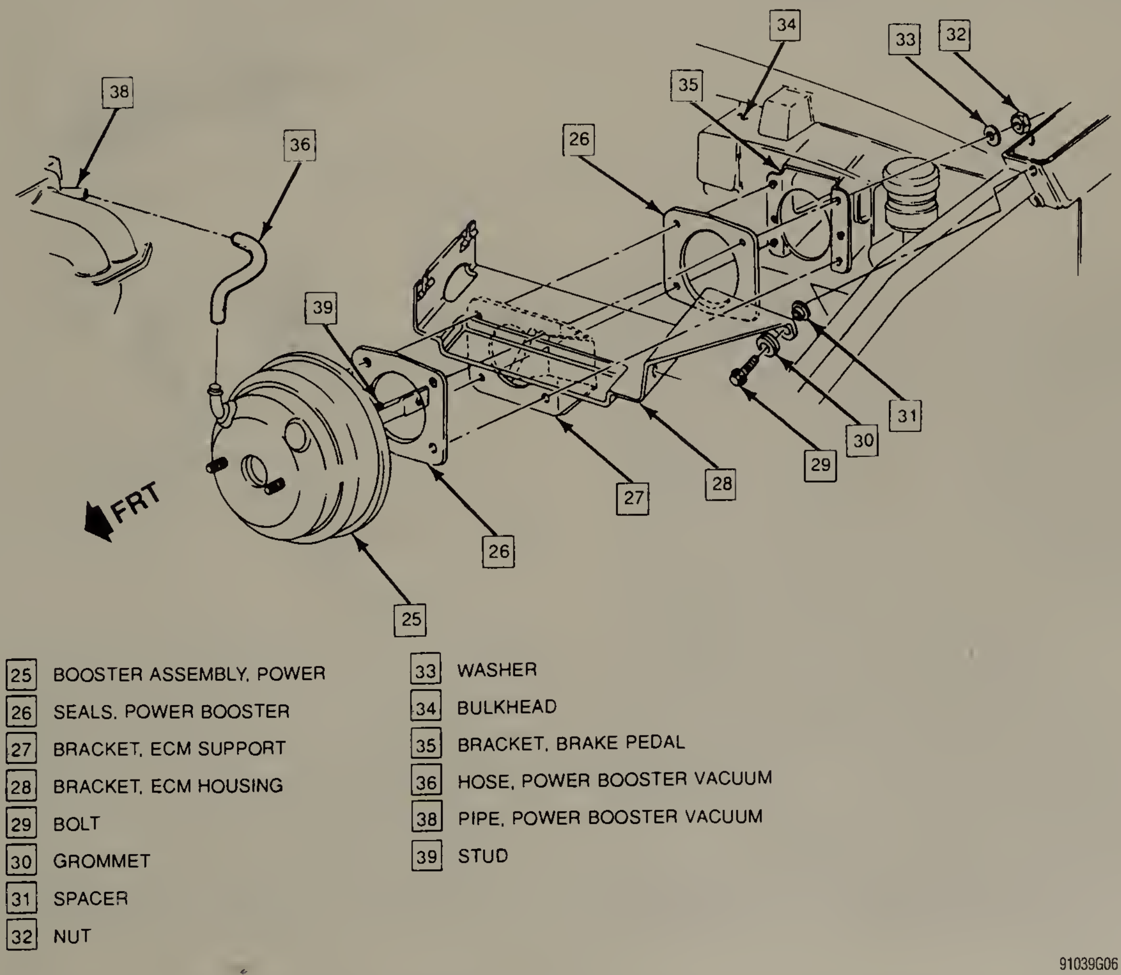


Fig. 11 Exploded view of the brake power booster—1990 vehicle shown

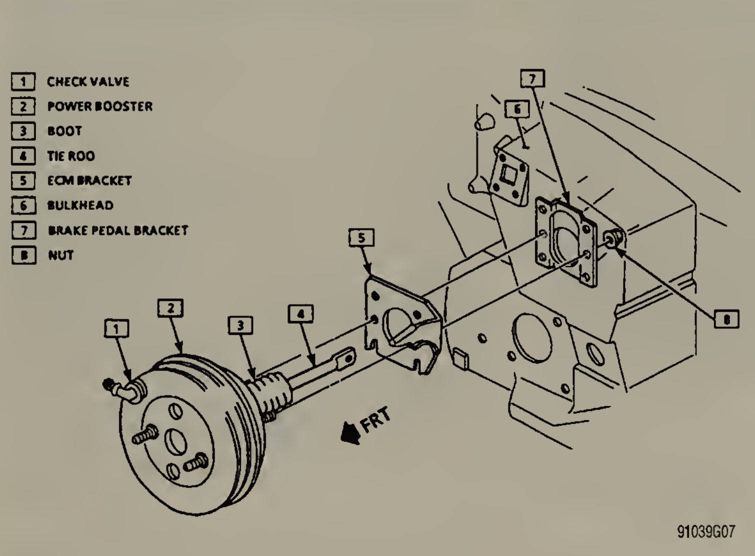


Fig. 12 Power booster assembly mounting—1996 vehicle shown

Proportioning Valve

REMOVAL & INSTALLATION

See Figures 13 and 14

1. Disconnect the negative battery cable.
2. Remove the master cylinder assembly from the vehicle.
3. Remove the warning switch assembly from the master cylinder.
4. Remove the end plug and O-ring from the master cylinder.
5. For 1984–91 vehicles, remove the proportioning valve with the ground spring attached.
6. For 1992–96 vehicles, remove the electrical bias spring, then remove the proportioning valve assembly along with the O-ring and spacer.

➡If necessary, gently tap the cylinder body against a piece of wood to dislodge the proportioning valve assembly.

7. Do not disassemble the proportioning valve, it is serviced only as an assembly. Also, do not clean the proportioning valve with any solution as the internal components are lubricated with a special grease.

To install:

8. Lubricate the valve and cylinder bore with clean brake fluid, then install the valve into the master cylinder and bottom it into the bore. On 1984–91 vehicles, the proportioning valve should be installed with the open end first. On 1992–96 vehicles, the valve should be installed with the capped end first.
9. Install a new O-ring over the end plug, then install the spring followed by the end plug.
10. Tighten the proportioning valve end plug to 18 ft. lbs. (25 Nm).
11. Install the warning switch assembly, hand-tighten only.
12. Install the master cylinder assembly to the vehicle.
13. Connect the negative battery cable and properly bleed the hydraulic brake system.

Brake Hoses and Pipes

Metal lines and rubber brake hoses should be checked frequently for leaks and external damage. Metal lines are particularly prone to crushing and kinking under the vehicle. Any such deformation can restrict the proper flow of fluid and therefore impair braking at the wheels. Rubber hoses should be checked for cracking or scraping; such damage can create a weak spot in the hose and it could fail under pressure.

Any time the lines are removed or disconnected, extreme cleanliness must be observed. Clean all joints and connections before disassembly (use a stiff bristle brush and clean brake fluid); be sure to plug the lines and ports as soon as

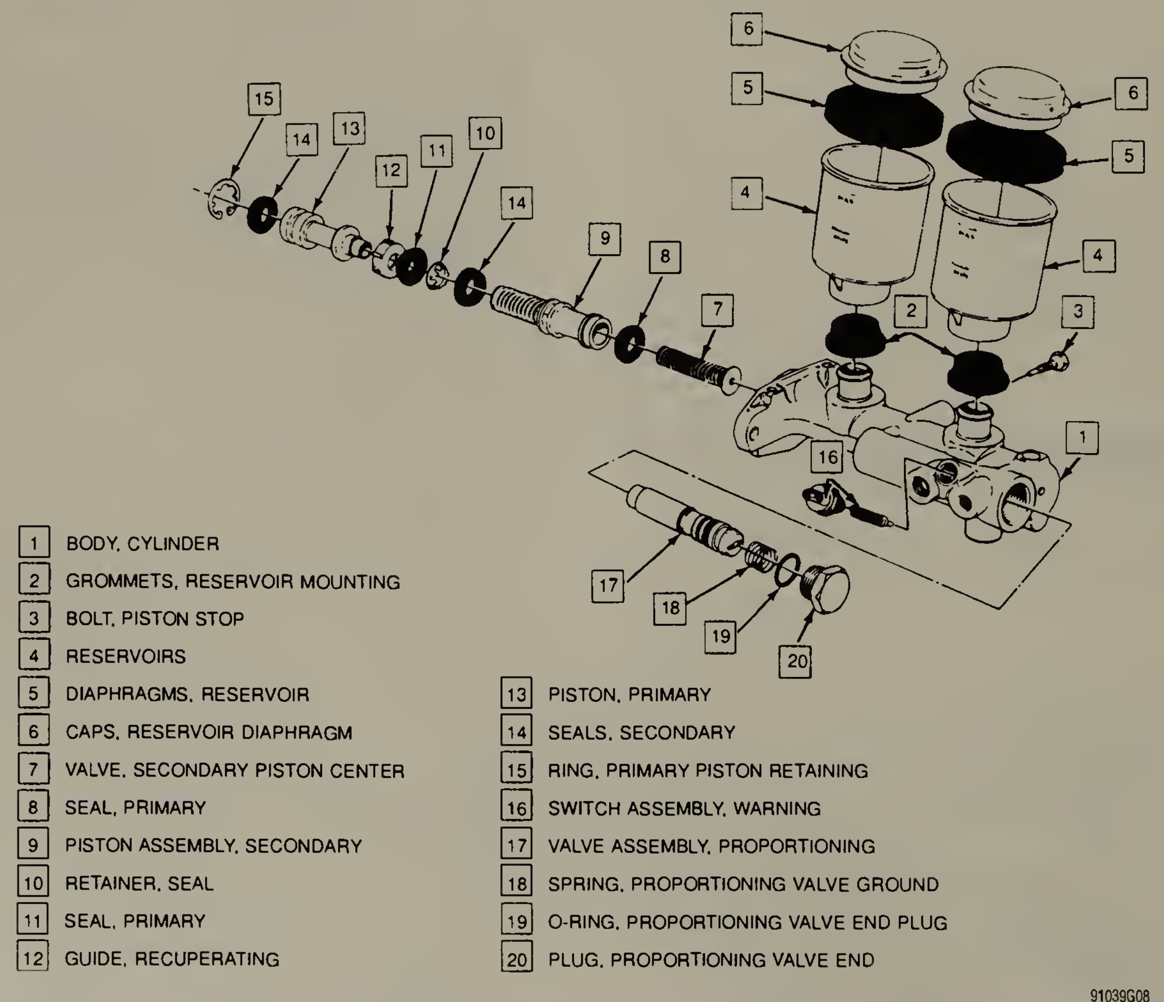
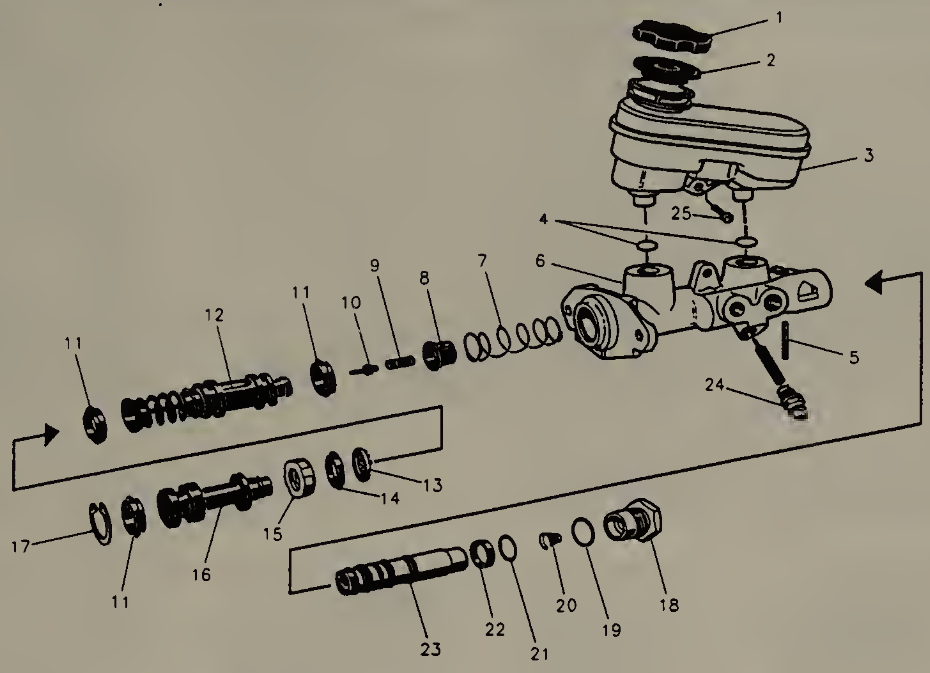


Fig. 13 Exploded view of the master cylinder components, including the proportioning valve—1984–91 vehicles



1 RESERVOIR CAP
2 RESERVOIR CAP DIAPHRAGM
3 RESERVOIR BODY
4 RESERVOIR 'O' RING
5 SECONDARY PISTON STOP PIN
6 CYLINDER BOOY
7 SECONOARY RETURN SPRING
8 SECONOARY SPRING RETAINER
9 CENTER VALVE SPRING
10 CENTER VALVE PLUNGER
11 'L' TYPE CUP SEAL
12 SECONDARY PISTON ASSEMBLY
13 PRIMARY CUP RETAINING RING
14 RECUPERATING TYPE CUP SEAL
15 RECUPERATING GUIOE
16 PRIMARY PISTON
17 RETAINING RING
18 ENG PLUG
19 ENO PLUG 'O' RING
20 ELECTRICAL BIAS SPRING
21 PROPORTIONING VALVE O-RING
22 PROPORTIONING VALVE SPACER
23 PROPORTIONING VALVE/PRESSURE OIFFERENTIAL ASSEMBLY
24 PRESSURE DIFFERENTIAL WARNING SWITCH ASSEMBLY
25 RESERVOIR RETAINER SCREW

91039G09

Fig. 14 Location of the proportioning valve and related components—1992–96 vehicles

they are opened. New lines and hoses should be flushed clean with brake fluid before installation to remove any contamination.

REMOVAL & INSTALLATION

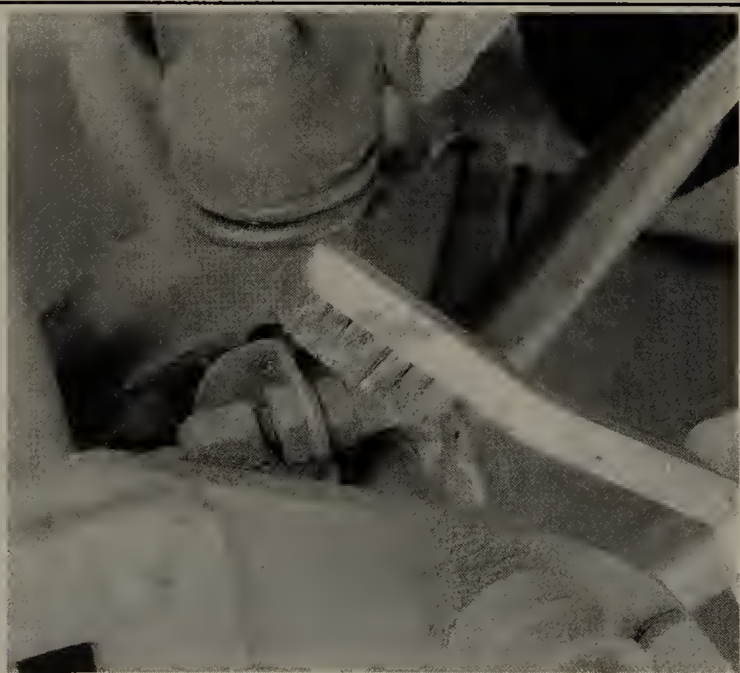
See Figures 15 thru 23

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle on jackstands.
3. Remove any wheel and tire assemblies necessary for access to the particular line you are removing.
4. Thoroughly clean the surrounding area at the joints to be disconnected.
5. Place a suitable catch pan under the joint to be disconnected.
6. Using two wrenches (one to hold the joint and one to turn the fitting), disconnect the hose or line to be replaced.
7. Disconnect the other end of the line or hose, moving the drain pan if necessary. Always use a back-up wrench to avoid damaging the fitting.
8. Disconnect any retaining clips or brackets holding the line and remove the line from the vehicle.

➡If the brake system is to remain open for more time than it takes to swap lines, tape or plug each remaining clip and port to keep contaminants out and fluid in.

To install:

9. Install the new line or hose, starting with the end farthest from the master cylinder. Connect the other end, then confirm that both fittings are correctly



TCCA9P09

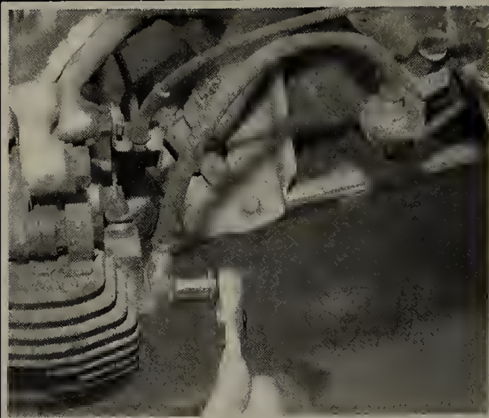
Fig. 15 Use a brush to clean the fittings of any debris

TCCA9P10

Fig. 16 Use two wrenches to loosen the fitting. If available, use flare nut type wrenches

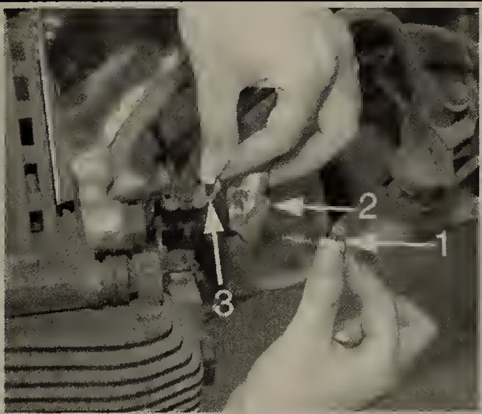
91039P44

Fig. 17 When possible, use a flare nut wrench to loosen brake lines



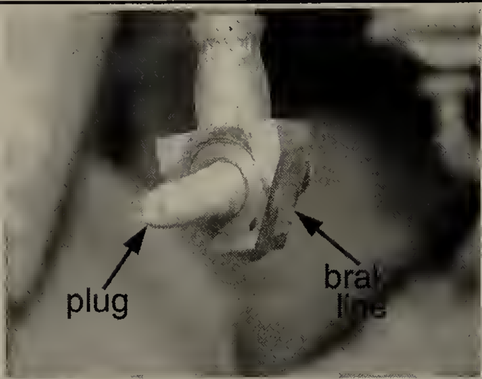
91039P41

Fig. 18 Loosen the bolt securing the brake line to the caliper



91039P42

Fig. 19 Remove the bolt (1), brake line (2) and washer from the caliper



91039P43

Fig. 20 You should always plug open brake lines to avoid getting contaminants in the brake system

91039P45

Fig. 21 Remove any routing clips retaining the brake line that is being removed

threaded and turn smoothly using finger pressure. Make sure the new line will not rub against any other part. Brake lines must be at least 1/2 in. (13mm) from the steering column and other moving parts. Any protective shielding or insulators must be reinstalled in the original location.

** WARNING

Make sure the hose is NOT kinked or touching any part of the frame or suspension after installation. These conditions may cause the hose to fail prematurely.

10. Using two wrenches as before, tighten each fitting.
11. Install any retaining clips or brackets on the lines.
12. If removed, install the wheel and tire assemblies, then carefully lower the vehicle to the ground.
13. Refill the brake master cylinder reservoir with clean, fresh brake fluid, meeting DOT 3 specifications. Properly bleed the brake system.
14. Connect the negative battery cable.

Bleeding Brake System

When any part of the hydraulic system has been disconnected for repair or replacement, air may get into the lines and cause spongy pedal action (because air can be compressed and brake fluid cannot). To correct this condition, it is necessary to bleed the hydraulic system so to be sure all air is purged. If air is

TCCA9P11

Fig. 22 Any gaskets/crush washers should be replaced with new ones during installation

TCCA9P12

Fig. 23 Tape or plug the line to prevent contamination

introduced into the system at the master cylinder, it may be necessary to bled the entire system. If the disconnection of a fitting or pipe is the cause for air presence in the system, then only the caliper(s) served by that component need to be bled. Do not move the vehicle until a firm brake pedal is obtained. Air in the system can cause the loss of brake operation.

When bleeding the brake system, bleed one brake cylinder at a time, observing the sequence given in the following procedures. ALWAYS Keep the master cylinder reservoir filled with brake fluid during the bleeding operation. Never use brake fluid that has been drained from the hydraulic system, no matter how clean it is.

WARNING

Clean, high quality brake fluid is essential to the safe and proper operation of the brake system. You should always buy the highest quality brake fluid that is available. If the brake fluid becomes contaminated, drain and flush the system, then refill the master cylinder with new fluid. Never reuse any brake fluid. Any brake fluid that is removed from the system should be discarded.

MANUAL BLEEDING

1984–87 Vehicles

See Figures 24 and 25

1. Fill the master cylinder with the proper type of brake fluid and keep at least one half full during the bleeding procedure.
2. For 1984–86 vehicles, bleed the brakes in the following sequence: left rear, right rear, left front, right front.
3. For 1987 vehicles, bleed the brakes in the following sequence: right front, right rear, left rear, left front.
4. With the proper sized box wrench over the bleeder valve, attach a bleeder tube to the valve and allow the tube to hang submerged in brake fluid in a clear glass jar.
5. Open the bleeder valve and have an assistant fully depress the brake pedal.
6. Close the bleeder valve and release the brake pedal.
7. Repeast the 2 previous steps until all air is evacuated. Check and refill the master cylinder reservoir as necessary to prevent air from being drawn through the master cylinder.
8. Releat the bleeding procedure at all wheels if the entire system is to be bled.
9. Check the brake pedal for sponginess and, if any is found, repeat the entire bleeding procedure until a firm pedal is achieved.

Fig. 25 With a hose over the end of the bleeder valve, and the other end submerged in clean brake fluid, open the valve to bleed the system

1988–96 Vehicles

See Figure 26

1. Fill the master cylinder reservoir with brake fluid and keep it at least ½ full of fluid at all times during the bleeding operation.
2. Deplete the brake vacuum reserve by applying and releasing the brakes several times while the engine is **OFF**.
3. On 1992–94 vehicles and 1995 vehicles equipped with the VIN J engine, if the entire system must be bled, the master cylinder prime pipe must first be bled at the hydraulic modulator located in the left rear storage compartment.
   a. Open the left rear storage compartment, then remove the sound insulator pad.
   b. Remove the cap from the modulator bleed screw, then position a box wrench and a short piece of clear tube over the screw.
   c. Position a container and rags to protect the vehicle interior from the brake fluid. Open the bleed screw and allow fluid to flow until all air is removed.
   d. Tighten the bleed screw to 106 inch lbs. (12 Nm) and remove the tubing. Wipe the screw off and make sure it has properly sealed.
   e. Install the sound insulator pad, making sure it covers the entire modulator valve or excessive noise may be heard when the system is operating. Close the rear compartment.

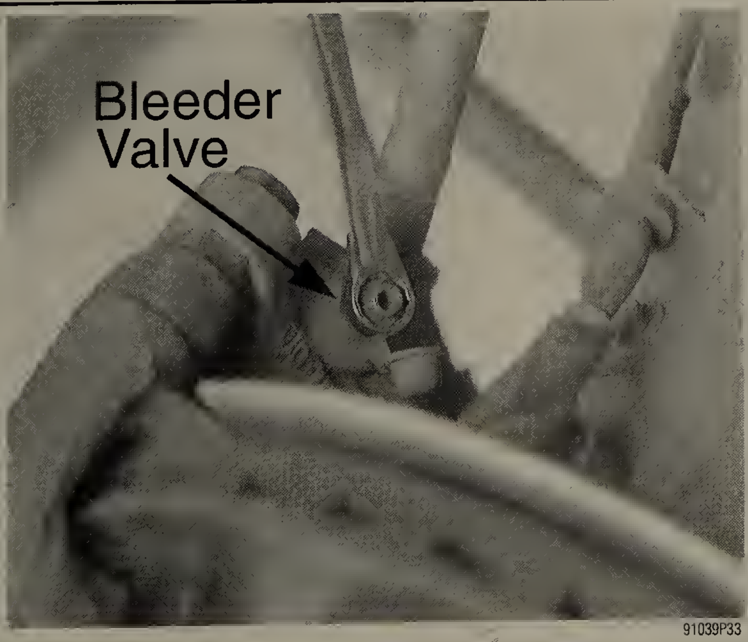


Fig. 24 Location of the rear brake bleeder valve

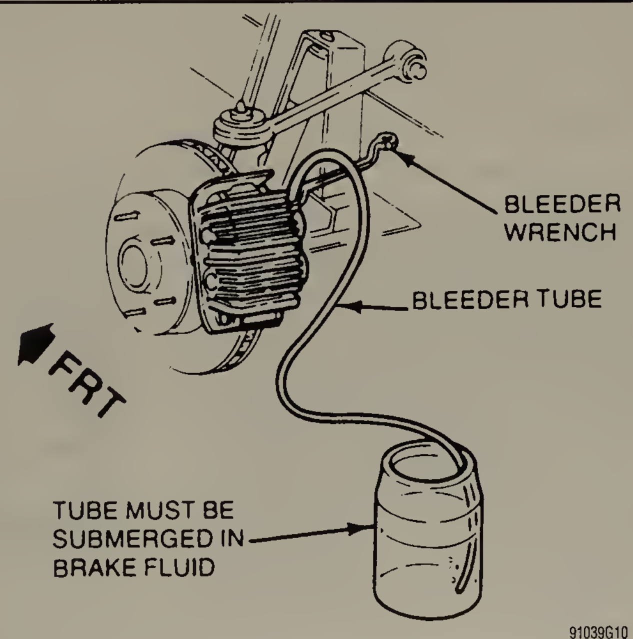


Fig. 26 Proper set-up for bleeding the individual calipers

4. If the master cylinder is known or suspected to have air in the bore, bleed the unit before bleeding the calipers, in the following manner:
   a. Disconnect the forward (blind end) brake line connection at the master cylinder.
   b. Allow brake fluid to fill the master cylinder piston bore until it begins to flow from the forward pipe connector port at the master cylinder.
   c. Connect the forward brake line to the master cylinder and tighten.
   d. Have an assistant depress the brake pedal slowly 1 time and hold. Loosen the forward brake line connection at the master cylinder to purge air from the bore. Tighten the connection to 13 ft. lbs. (18 Nm), and have the assistant release the pedal slowly. Wait 15 seconds and repeat the sequence, including the 15 second pause, until all air is removed from the bore. Make sure brake fluid does not contact any painted surface.
   e. Repeat the procedure at the rear master cylinder brake line connection.
   f. If it is known that the calipers do not contain any air, it will not be necessary to bleed them.
5. If it is necessary to bleed all of the calipers, follow the proper sequence:
   a. 1988–91 vehicles: right front, right rear, left rear, left front.
   b. 1992–96 vehicles: right rear, left rear, right front, left front.
6. After all air is removed from the master cylinder, bleed the individual calipers as follows:
   a. Place a suitable sized box wrench over the bleeder valve.
   b. Attach a clear tube over the bleeder valve and allow the tube to hang, submerged in a clear container partially filled with brake fluid.
   c. Have an assistant depress the brake pedal slowly 1 time and hold. Loosen the bleeder valve to purge the air from the cylinder. Tighten the bleeder screw to 80 inch lbs. (9 Nm), and have the assistant slowly release the pedal. Wait 15 seconds and repeat the sequence, including the 15 second pause, until all air is removed.
   d. It may be necessary to repeat the sequence 10 or more times to remove all of the air.

➡Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the bore in a way that makes it difficult to bleed the system.

7. Check the brake pedal for sponginess and the brake warning light for an indication of unbalanced pressure. Repeat the bleeding procedure to correct either of these conditions.
8. On 1995–96 vehicles, if the proper pedal height and feel is not achieved after the bleeding is completed, you must perform the Auto Bleed procedure, located under the ABS section of this manual. This procedure requires the use of a Tech 1®, or equivalent scan tool.

PRESSURE BLEEDING

The pressure bleeding equipment you use must be of the diaphragm type, which means it must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminants from entering the hydraulic system. Make sure you are using the proper master cylinder bleeder adapters to avoid damaging master cylinder reservoirs.

1984–87 Vehicles

1. Install the proper bleeding adapter(s) to the master cylinder reservoirs, Tool J-35690, or equivalent.
2. Make sure the pressure tank is at least ⅓ full of the proper type of brake fluid. The bleeder ball must be re-bled each time fluid is added.
3. Charge the bleeder ball to between 20–25 psi (140–175 kPa).
4. When you are ready to start the bleeding procedure, connect the hose to the master cylinder bleeder adapter, and open the tank valve.
5. For 1984–86 vehicles, bleed the brakes in the following sequence: left rear, right rear, left front, right front.
6. For 1987 vehicles, bleed the brakes in the following sequence: right front, right rear, left rear, left front.

➡Have an assistant stroke the brake pedal while pressure bleeding.

7. With the proper size wrench over the bleeder valve, attach the bleeder tube. The discharge end must hang submerged in a clean container partially filled with brake fluid.
8. Open the bleeder valve at least ¾ turn and allow the flow to continue until no air can be seen in the fluid.
9. Close the bleeder valve, making sure it seals.
10. Repeat the 3 previous steps for the remaining bleeder valves.
11. Check the brake pedal for sponginess and, if any is found, repeat the entire bleeding procedure until a firm pedal is achieved.
12. Properly dispose of all of the brake fluid that was removed from the system.
13. Disconnect the bleeder equipment from the brake bleeder adapter. Remove the adapter, then if any fluid was spilled, make sure to wipe all areas so they are clean and dry.
14. Fill the master cylinder reservoirs to the proper level, then install the master cylinder diaphragm and cover.

1988–96 Vehicles

➧ See Figures 27 and 28

1. On 1992–94 vehicles and 1995 vehicles equipped with the VIN J engine, if the entire system must be bled, the master cylinder prime pipe must first be bled at the hydraulic modulator located in the left rear storage compartment.
   a. Fill the master cylinder to the proper level.
   b. Open the left rear storage compartment, then remove the sound insulator pad.
   c. Remove the cap from the modulator bleed screw, then position a box wrench and a short piece of clear tube over the screw.
   d. Position a container and rags to protect the vehicle interior from the brake fluid.
   e. Remove the master cylinder cap and install a suitable compact pressure bleeding adapter, such as tool J 35589, or equivalent.
   f. Charge the bleeder to 20–25 psi (140–172 kPa).
   g. Connect a hose to the adapter.
   h. Open the valve on the brake bleeder tank.
   i. Open the modulator valve bleed screw ¾ turn and allow the flow continue until no air is seen in the fluid.
   j. Tighten the bleed screw to 106 inch lbs. (12 Nm) and remove the tubing. Wipe the screw off and make sure it has properly sealed.
   k. Install the sound insulator pad, making sure it covers the entire modulator valve or excessive noise may be heard when the system is operating. Close the rear compartment.
   l. Fill the master cylinder to the proper level and install the cap.

➡To bleed the hydraulic system, perform the following procedure.

2. Remove the master cylinder reservoir cap, then connect the proper bleeder adapter(s) to the master cylinder reservoirs.
3. Charge the bleeder to 20–25 psi (140–172 kPa).

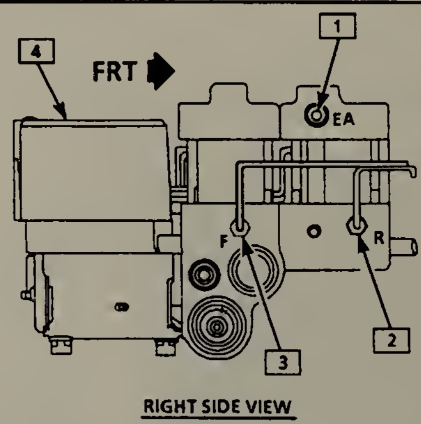


Fig. 27 Location of the prime pipe bleed screw—1995 VIN J engine shown

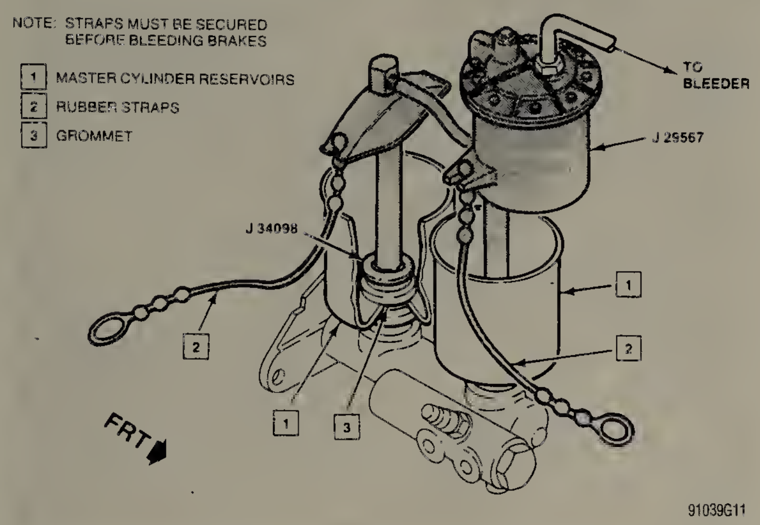


Fig. 28 View of the pressure bleeding adapters installed on the master cylinder—1988-91 vehicles shown

4. Connect the hose to the bleeder adapter tank, and open the valve on top of the tank. Depress the bleed-off valve until a few drops of brake fluid appear. Refer to the accompanying figure for installation details.
5. Raise and safely support the vehicle.
6. If it is necessary to bleed all of the calipers, follow the proper sequence:
   a. 1988-91 vehicles: right front, right rear, left rear, left front.
   b. 1992-96 vehicles: right rear, left rear, right front, left front.
7. Place a proper size box end wrench over the bleeder screw. Attach a clear tube over the screw and let the tube hang submerged in a clear container partially filled with brake fluid.
8. Open the bleeder screws at least ¾ turn and let the flow continue, until you can see no air in the fluid. Have an assistant stroke the brake pedal while pressure bleeding.
9. Close the bleeder screws, and tighten to 80 inch lbs. (9 Nm), making sure they seal.
10. Repeat the 3 previous steps until all of the calipers have been bled.
11. Carefully lower the vehicle.
12. Check the brake pedal for sponginess and the "BRAKE" warning lamp for any indication of unbalanced pressure. If either of these 2 conditions exist, repeat the entire bleeding procedure.
13. Properly dispose of all of the brake fluid that was removed from the system.
14. Disconnect the bleeder equipment from the brake bleeder adapter. Remove the adapter, then if any fluid was spilled, make sure to wipe all areas so they are clean and dry.
15. Check the brake pedal for sponginess and the brake warning light for an indication of unbalanced` pressure. Repeat the bleeding procedure to correct either of these conditions.
16. On 1995-96 vehicles, if the proper pedal height and feel is not achieved after the bleeding is completed, you must perform the Auto Bleed procedure, located under the ABS section of this manual. This procedure requires the use of a Tech 1®, or equivalent scan tool.

DISC BRAKES

⁂ CAUTION

Older brake pads or shoes may contain asbestos, which has been determined to be cancer causing agent. Never clean the brake surfaces with compressed air! Avoid inhaling any dust from any brake surface! When cleaning brake surfaces, use a commercially available brake cleaning fluid.

Brake Pads

REMOVAL & INSTALLATION

Front

➧ **See Figures 29 thru 35**

1. Disconnect the negative battery cable and use a clean turkey baster, or equivalent siphon to remove ⅔ of the brake fluid from the master cylinder reservoir. Install the reservoir cap.
2. Raise and safely support the vehicle.
3. Mark the relationship between the wheel to the axle flange.
4. Remove the tire and wheel assembly. Install 2 lug nuts to hold the brake rotor in place.
5. Use a large C-clamp or pair of pliers to compress the caliper piston into its bore. Make sure one end of the C-clamp rests on the inlet fitting bolt head at the other rests against the outboard shoe, then tighten the C-clamp to push the piston into the bore. There are also special tools available to compress the caliper piston.
6. For 1984-87 vehicles, perform the following:
   a. Hold the guide pin bolt in place with a wrench, then loosen the top caliper self-locking bolt.
   b. Remove the bolt, then rotate the caliper housing down for access to the brake pads.
   c. Discard the self-locking bolt and replace with a new one during installation.
7. For 1988-96 vehicles, perform the following:
   a. Remove the circlip and retainer pin.
   b. Remove the caliper housing from the rotor and caliper mounting bracket.
   c. Suspend the caliper housing from the upper control arm using a piece of wire, such as a clothes hanger.

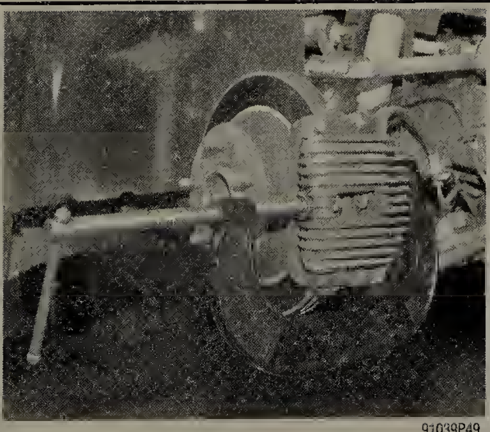

91039P49

Fig. 29 Use a large C-clamp to compress the caliper piston into its bore


91039P36

Fig. 30 While holding the guide pin bolt stationary with a wrench, loosen the top caliper self-locking bolt


91039P37

Fig. 31 Remove the bolt, then rotate the caliper down to access the brake pads

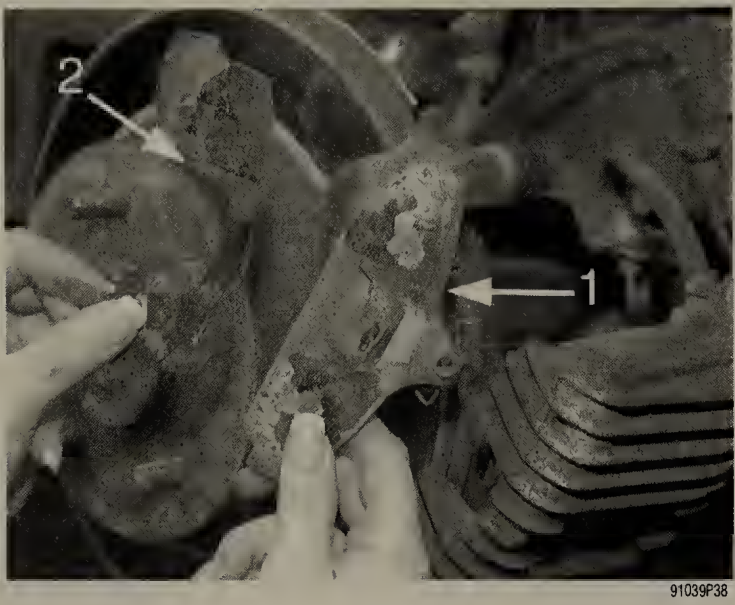


Fig. 32 Remove the outboard brake pad (1) and shim (2) . . .

Fig. 33 . . . then remove the inboard brake pad from the caliper

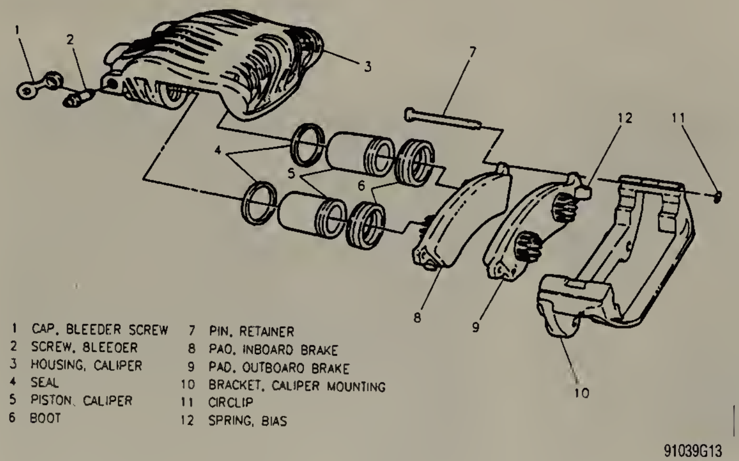


Fig. 34 Exploded view of the inboard and outboard brake pads—1996 vehicle shown

Fig. 35 Another way to push the piston in the caliper bore is to use this type of caliper piston compressor tool

8. Remove the outboard and inboard brake pads. Clean all dirt and residue from the pad abutments on the mounting bracket and from the inside of the housing outer legs.
9. Check to make sure the guide pins move freely in the bracket. Replace the guide pins or boots if they are corroded or damaged.

To install:

10. For 1984–87 vehicles, install new inboard and outlet pads on the mounting bracket. The pad with the insulator is installed outboard and the pad with the wear sensor is installed inboard. The wear sensor must be in the trailing position with forward wheel rotation. If not, use the other inboard pad in the replacement set.
11. For 1988–96 vehicles, install the brake pads, pressing them firmly in place until they are flush and fully seated in the caliper housing and pistons. The outboard brake pad with the insulator is installed in the caliper housing, and the inboard brake pad with the wear sensor is pressed into the caliper piston.
12. For 1984–87 vehicles, perform the following:
    a. Rotate the caliper back into its original position. Check the shoe springs; if they protrude through the inspection hole, rotate the caliper back down and readjust.
    b. Install a new self-locking bolt and tighten to 22–25 ft. lbs. (30–34 Nm).
13. For 1988–96 vehicles, perform the following:
    a. Position the housing over the rotor and into the caliper mounting bracket. Make sure the guiding surfaces on the brake pads are seated correctly in the mounting bracket.
    b. Install a new retaining pin and circlip. Press the housing down into the mounting bracket to compress the bias springs. Slide the retainer pin into position and install the circlip.
14. Remove the lug nuts from the rotor, then install the wheel and tire assembly and hand-tighten the lug nuts.
15. Carefully lower the vehicle, then tighten the lug nuts to 100 ft. lbs. (136 Nm).
16. Remove the reservoir cap and fill the master cylinder reservoir with the proper type and amount of fluid.
17. Depress the brake pedal firmly about 3 times to proper seat the pads. Check the fluid level and add if necessary.

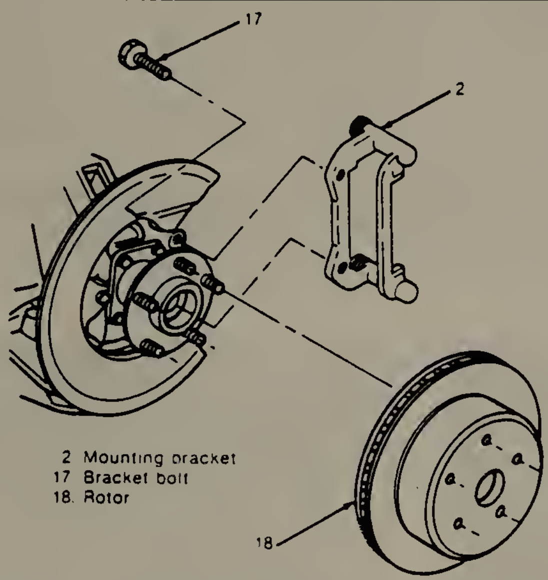
Rear

➧ See Figures 36, 37, 38 and 39

1. Disconnect the negative battery cable and remove ⅔ of the brake fluid from the master cylinder reservoirs.
2. Raise and support the vehicle safely.
3. Mark the relationship between the wheel to the axle flange.
4. Remove the tire and wheel assembly. Install 2 lug nuts to hold the brake rotor in place.


91039P04

Fig. 36 Remove the bolt, then rotate the caliper down for access to the pads

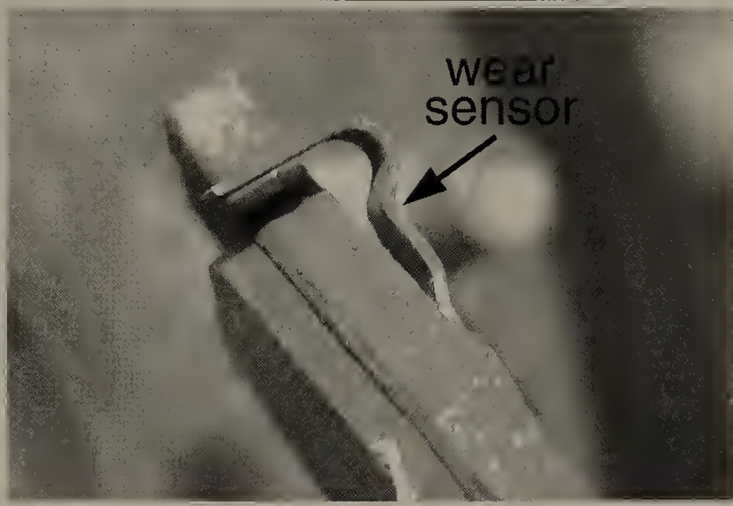


91039G14

Fig. 37 Allow the caliper to rotate down in order to replace the brake pads—1996 vehicle shown

91039P05

Fig. 38 Remove the inboard (1) and outboard (2) pads from the caliper



91039P32

Fig. 39 The inboard rear brake pad usually has a wear sensor to let you know your brakes are getting low

5. Use a C-clamp to depress the caliper pistons into the caliper bores to provide clearance between the pads and the rotor. Make sure 1 end of the clamp rests on the inlet fitting bolt while the other end rests on the outboard pad.
6. Remove the caliper upper guide pin bolt and discard, then rotate the caliper on the lower guide pin to access the pad linings. Be careful not to strain the cable conduit or the hoses.
7. Remove the inboard and outboard pads from the caliper.

To install:

8. Install the outboard pad with the insulator to the caliper housing and the inboard pad with the wear sensor nearest the caliper pistons. The wear sensor must be in the trailing position during forward wheel rotation. Press the pads firmly until they are they are fully seated.
9. Rotate the caliper housing into position, then install a new upper guide pin bolt and tighten 26 ft. lbs. (35 Nm).
10. Remove the wheel nuts securing the rotor to the hub and install the tire and wheel assembly.
11. Lower the vehicle and fill the master cylinder to the proper level with clean brake fluid.
12. Connect the negative battery cable, start the engine and pump the brake pedal slowly and firmly 3 times to seat the shoe and lining assemblies.

INSPECTION

You should check the brake pads every 6,000 miles (9,600km), and any time the wheels are removed. Inspect both ends of the outer brake pad by looking in at each end of the caliper. These are the points at which the highest rate of wear normally occurs. Also, check the thickness on the inner brake pad to make sure it is not wearing prematurely. Some inboard pads have a thermal layer against the steel backing surface which is integrally molded with the pad. Do not confuse this extra layer with uneven inboard/outboard brake pad wear.

Look down through inspection hole in the top of the caliper to view the inner brake pad. Replace the pads whenever the thickness of any pad is worn within 0.030 in. (0.76mm) of the steel backing surface. For riveted brake pads, they must be replaced if the pad is worn to 0.030 (0.76mm) of any rivet head. The disc brake pads MUST be replaced in axle sets, for example, if you replace the driver's side front brake pads, you must also replace the passenger's side front brake pads. This will prevent uneven wear and other brake system problems.

Brake Caliper

REMOVAL & INSTALLATION

Front

➧ See Figures 40 thru 46

1. Disconnect the negative battery cable and use a clean turkey baster, or equivalent siphon to remove ⅔ of the brake fluid from the master cylinder reservoir.

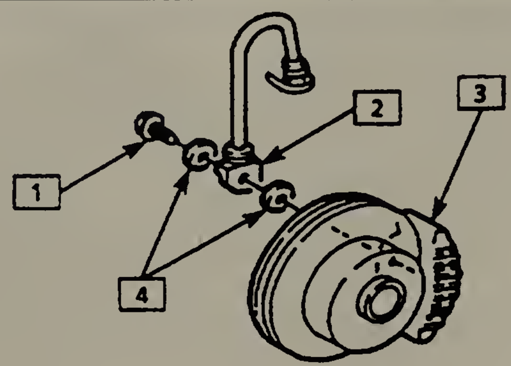


Fig. 40 If you are replacing or overhauling the caliper, remove the fluid inlet fitting and line from the caliper

2. Raise and support the vehicle safely.
3. Mark the relationship between the wheel and axle flange, then remove the tire and wheel assembly.
4. Install 2 lug nuts to hold the brake rotor in place.
5. Use a large C-clamp or pair of pliers to depress the caliper pistons into the caliper bores in order to provide clearance between the pads and the rotor.
6. If the caliper is being completely removed from the vehicle for replacement or overhaul, disconnect the brake line fitting at the caliper by removing the bolt, 2 gaskets and then the brake hose inlet fitting. Plug all openings to prevent fluid contamination or loss.

➡Do not allow the fluid to come into contact with the front transverse spring as damage to the spring may occur.

7. For 1984–87 vehicles, there are two methods you can use to remove the caliper, depending upon whether you want to remove the caliper housing and mounting bracket separately, or as an assembly. Read both options, and pick the one that's suitable for you:
   a. Method 1: Hold the guide pin bolt in place with a wrench, then loosen the top caliper self-locking bolt. Do the same with the bottom guide pin bolt and self-locking bolt, then remove the caliper housing, or if the brake line is still attached, support the caliper from the control arm with a suitable hook or length of mechanic's wire. If necessary, unfasten the bracket mounting bolts and washers, then remove the bracket from the rotor.
   b. Method 2: Unfasten the 2 bracket mounting bolts and washers, then remove the bracket and caliper housing as a single assembly.
   c. Discard the bracket mounting bolts, then clean the old bolt adhesive from the mounting bracket threads.
8. For 1988–96 vehicles, perform the following:
   a. Remove the circlip and the retainer pin, then the caliper housing from the rotor and the caliper mounting bracket. Remove the caliper from the vehicle or if the brake line is still attached, support the caliper from the control arm with a suitable hook or length of mechanic's wire.
   b. If necessary, unfasten the 2 mounting bolts and washers and remove the caliper mounting bracket. Discard the mounting bolts, then clean all of the old bolt adhesive from the bolt hole threads.

To install:

9. For 1988–96 vehicles, perform the following:
   a. If removed, position the caliper mounting bracket to the knuckle. Install the washers and mounting bolts and tighten the bolts to 137 ft. lbs. (185 Nm) for 1988–89 vehicles, or to 151–181 ft. lbs. (205–245 Nm) for 1990–96 vehicles.
   b. Install the caliper over the brake rotor and into the caliper mounting bracket. Make sure the shoe lining guiding surfaces are correctly seated in the bracket.

Fig. 41 If the caliper is being completely removed, you must disconnect the brake line (1) and remove the bracket mounting bolts (2)

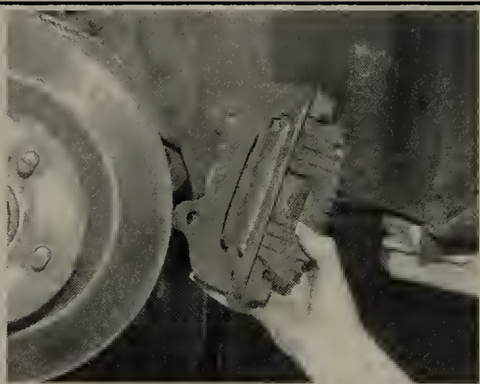


Fig. 42 Then, you can remove the entire caliper and brake assembly from the vehicle

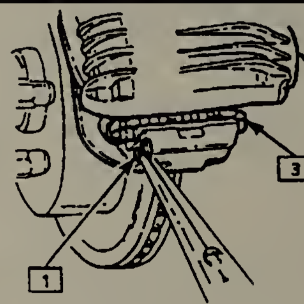


Fig. 43 Use a pair of needle-nose pliers to remove the circlip . . .

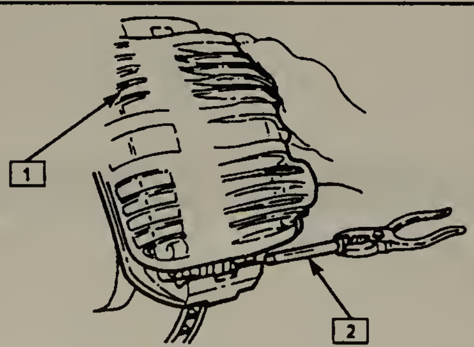


Fig. 44 . . . then remove the retainer pin

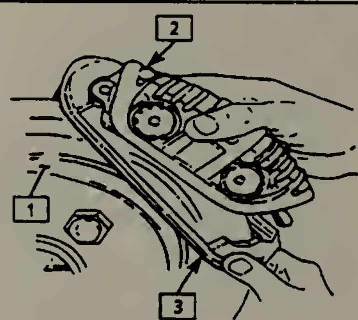
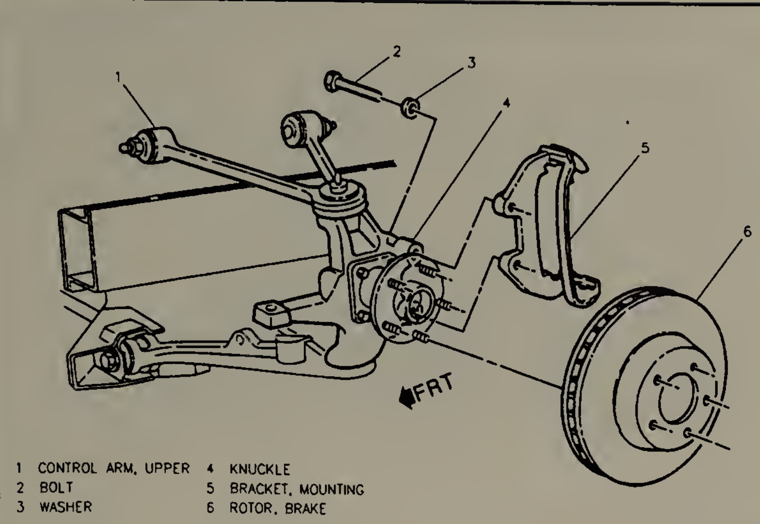


Fig. 45 Lift the caliper housing off of the mounting bracket



91039G19

Fig. 46 If necessary, remove and discard the retaining bolts, remove the washers, then remove the mounting bracket—1996 vehicle shown

➡There are 2 sets of retainer pins in most repair kits. One set is for base calipers and the other is for heavy duty calipers. Make certain the correct retainer pins are installed.

c. Compress the bias springs by applying pressure to the mounting bracket, then install the new retainer pin and circlip.

10. For 1984–87 vehicles, perform the following, as applicable:

a. If the caliper housing and mounting bracket were removed as an unit, install the assembly, washers and 2 new bracket bolts. Tighten the bracket bolts to 133 ft. lbs. (180 Nm). Recheck the torque on both bolts.

b. If they were removed separately, install the mounting bracket, if removed, with the washers and 2 new bolts and tighten to 133 ft. lbs. (180 Nm). Recheck the torque on both bolts. Install the caliper housing, using 2 new self-locking bolts and tighten to 22–25 ft. lbs. (30–34 Nm).

11. If removed, connect the brake hose inlet fitting, 2 new gaskets and the inlet fitting bolt. Tighten the bolt to 30 ft. lbs. (40 Nm).

12. If the inlet fitting was removed, properly bleed the hydraulic brake system.

13. Remove the wheel nuts retaining the rotor, align the marks made earlier and install the tire and wheel assembly.

14. Lower the vehicle and check the brake fluid; add as necessary.

➡The new bracket mounting bolts come with an adhesive on the threads. You must allow the adhesive to cure for 2 hours after installation before moving the vehicle.

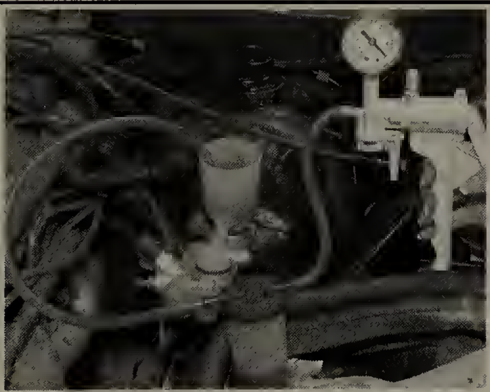
15. Connect the negative battery cable, start the engine and pump the brake pedal slowly and firmly 3 times to seat the shoe and lining assemblies.

Rear

1984–87 VEHICLES

➧ See Figures 47 thru 60

1. Disconnect the negative battery cable. Use a turkey baster or a suitable tool to siphon ⅔ of the fluid from the master cylinder reservoir. Install the reservoir cap.
2. Raise and support the vehicle safely.
3. Mark the relationship between the wheel and axle flange, then remove the tire and wheel assembly.
4. Install 2 lug nuts to hold the brake rotor in place.
5. Use a large C-clamp or pair of pliers to depress the caliper pistons into the caliper bores in order to provide clearance between the pads and the rotor.
6. If the caliper is being completely removed from the vehicle for replacement or overhaul, disconnect the brake line fitting at the caliper by removing the bolt, 2 gaskets and then the brake hose inlet fitting. Plug all openings to prevent fluid contamination or loss.



91039P01

Fig. 47 Use a Mighty-Vac® or a turkey baster to siphon ⅔ of the brake fluid from the master cylinder reservoir

91039P02

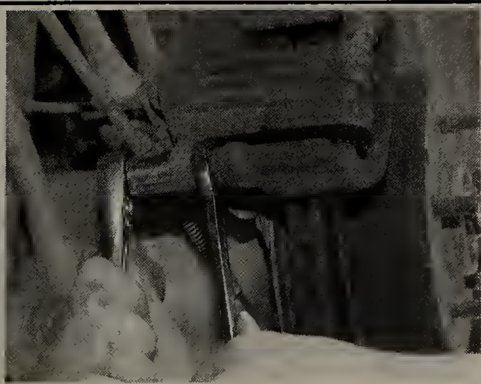
Fig. 48 Position a C-clamp so one end rests on the inlet fitting bolt head and the other end against the outboard shoe. Tighten until the piston is bottomed out in the bore

91039P03

Fig. 49 Hold the guide pin stationary with one wrench, then loosen the top caliper self-locking bolt

91039P06

Fig. 50 Remove the caliper guide pin



91039P08

Fig. 51 Use a wrench to hold the bottom guide pin secure while loosening the locking bolt

91039P09

Fig. 52 Pull the caliper (1) away from the mounting bracket (2)

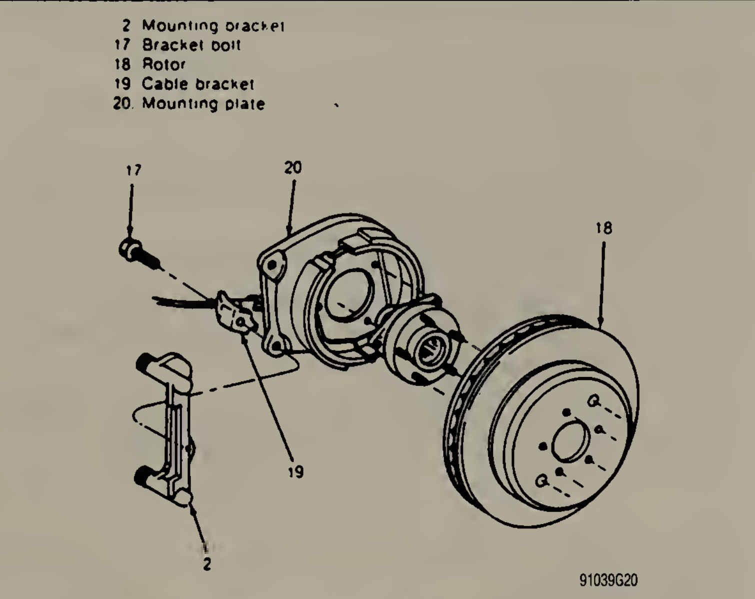


Fig. 53 Exploded view of the rear caliper mounting bracket—1987 vehicle shown

7. Hold the guide pin stationary with one wrench, then loosen the top caliper self-locking bolt. Remove the caliper guide pin.
8. Hold the bottom guide pin in place with a wrench, then loosen and remove the locking bolt.
9. Remove the caliper housing from the mounting bracket.
10. If necessary, unfasten the bolts and washers, then remove the mounting bracket. Discard the mounting bolts and replace with new ones during installation.
11. An alternate method is to remove the entire caliper and bracket assembly as follows:
    a. Loosen the lower caliper mounting bracket bolt.
    b. Remove the lower bolt, then position the parking brake cable and bracket aside.
12. Remove the upper caliper mounting bracket bolt from the rear of the bracket, then lift the caliper and bracket assembly off the rotor.
13. If you are not removing the assembly for replacement or overhaul, suspend the caliper using a suitable piece of wire or hook. Never allow the caliper to hang by it's fluid line!

To install:

14. Installation is the reverse of the removal procedure. Please note the following points:
    a. Lightly lubricate the guide pins before installation.
    b. Tighten the new caliper mounting bracket bolts to 44 ft. lbs. (60 Nm).
    c. Tighten the new caliper housing self-locking bolts to 22–25 ft. lbs. (30–34 Nm).
15. Remove the wheel nuts securing the rotor to the hub and install the tire and wheel assembly.
16. Lower the vehicle and fill the master cylinder to the proper level with clean brake fluid.
17. Connect the negative battery cable, start the engine and pump the brake pedal slowly and firmly 3 times to seat the shoe and lining assemblies.

1988–96 VEHICLES

➧ See Figures 61, 62, 63 and 64

1. Disengage the parking brake automatic adjuster as follows:
    a. Remove the drivers seat cushion.
    b. Remove the parking brake lever cover and screws.
    c. Using a suitable offset tool, disengage and hold the drive pawl from the drive sector.
    d. Insert a nail or drift through the hole in the anchor plate to retain the drive pawl in the disengaged position.
    e. Move the parking brake lever until it aligns with the lock pawl.
    f. Depress the button on the lever and move the lever to the down position.

Fig. 54 If necessary, you can remove the entire assembly by loosening the lower caliper bracket bolt

Fig. 55 Remove the lower bolt and position the parking brake cable and bracket aside

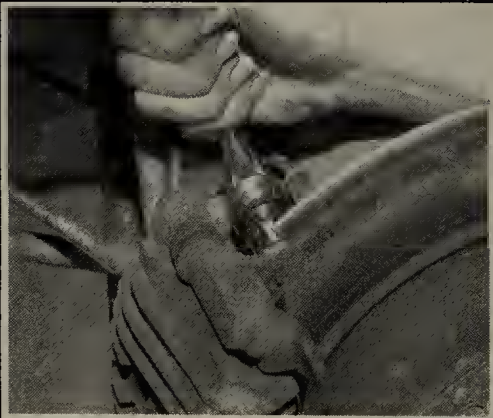


Fig. 56 Loosen the upper caliper bracket mounting bolt . . .

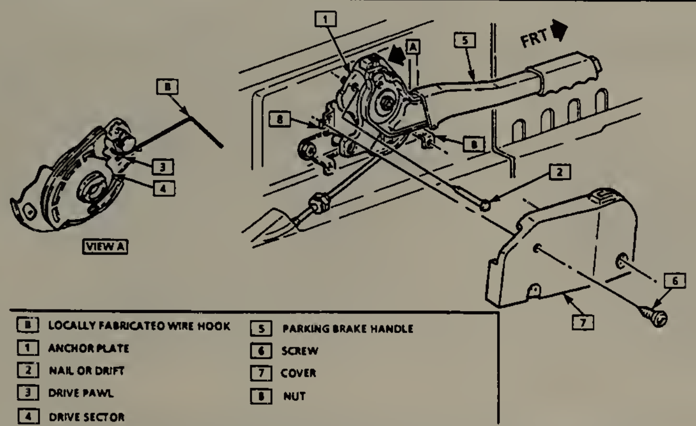
Fig. 57 . . . then pull the bolt out of the rear of the bracket

Fig. 58 Lift the caliper and mounting bracket assembly off the rotor

Fig. 59 Hang the caliper from the suspension with a piece of mechanic's wire. NEVER let the caliper hang by the brake line!

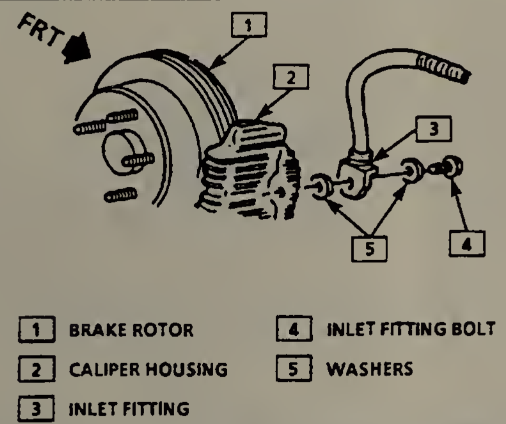
91039P07

Fig. 60 Apply some silicone grease to the guide pin before reinstalling it



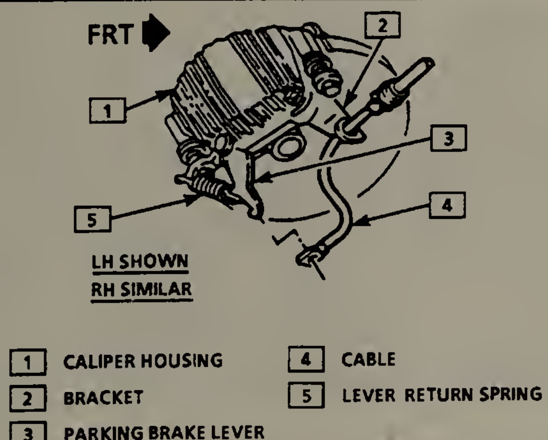
91039G21

Fig. 61 Before beginning caliper removal, you must disable the parking brake automatic adjuster—1996 vehicle shown



91039G22

Fig. 62 Disconnect and plug the fluid line fitting if the caliper is being overhauled or replaced



91039G23

Fig. 63 View of the parking brake cable lever and spring

g. Make sure the anchor plate is against the stud on the parking brake lever, if not as specified, repeat the procedure.

2. Raise and support the vehicle safely.
3. Mark the relationship between the wheel and axle flange, then remove the tire and wheel assembly.
4. Install 2 lug nuts to hold the brake rotor in place.
5. If the caliper is being completely removed from the vehicle for service or replacement, disconnect the brake line fitting at the caliper by removing the bolt, 2 gaskets and the brake hose inlet fitting. Plug all openings to prevent fluid contamination or loss.

➡Do not remove the lever return spring unless the parking brake cable automatic adjuster has been properly disabled.

6. Remove the lever return spring. Discard the spring if the coils are opened.
7. Disconnect the brake cable from the lever and bracket.
8. Remove the 2 guide pins bolts and discard.
9. Remove the caliper housing from the brake rotor and caliper mounting bracket.

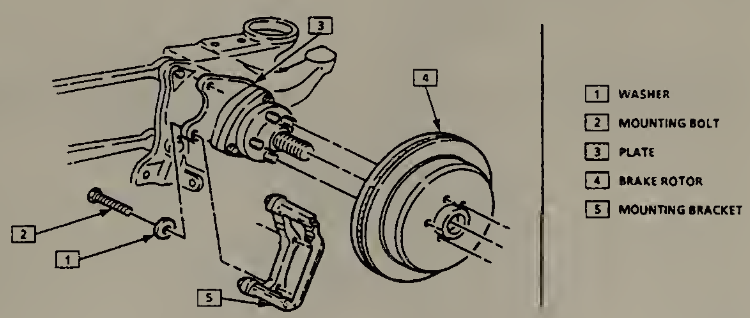
➡The caliper mounting brake should only be removed if it is damaged, or if the rotor must be removed.

10. If necessary, unfasten the 2 mounting bolts and washers and remove the caliper mounting bracket. Discard the mounting bolts, then clean all of the old bolt adhesive from the bolt hole threads.

To install:

➡The new bracket mounting bolts come with an adhesive on the threads. You must allow the adhesive to cure for 2 hours after installation before moving the vehicle.

11. If removed, position the caliper mounting bracket to the knuckle. Install the washers and mounting bolts and tighten the bolts to 137 ft. lbs. (185 Nm) for 1988–89 vehicles, or to 151–181 ft. lbs. (205–245 Nm) for 1990–96 vehicles.
12. Inspect the guide pins for free movement and replace the pins or boots if damaged or corroded.
13. Install the caliper over the brake rotor and into the mounting bracket.
14. Install 2 new guide pin bolts. Tighten the upper bolt to 26 ft. lbs. (35 Nm) and the lower bolt to 16 ft. lbs. (22 Nm).
15. Install the cable to the bracket and parking brake lever, then install the lever return spring.
16. If removed, connect the brake line fitting, 2 new gaskets and the inlet fitting bolt. Tighten the bolt to 30 ft. lbs. (40 Nm).
17. If the inlet fitting was removed, properly bleed the hydraulic brake system.
18. Enable the parking brake automatic adjuster in the reverse order of the disable procedure and make sure the levers are against the stops on the caliper housing.
19. Remove the 2 nuts securing the rotor to the hub, align the marks made earlier and install the tire and wheel assembly.
20. Lower the vehicle and check the brake fluid level.
21. Connect the negative battery cable, start the engine and pump the brake pedal slowly and firmly 3 times to seat the shoe and lining assemblies.



91039G24

Fig. 64 Exploded view of the rear caliper mounting bracket—1996 vehicle shown

OVERHAUL

➧ See Figures 65 thru 72

➡Some vehicles may be equipped dual piston calipers. The procedure to overhaul the caliper is essentially the same with the exception of multiple pistons, O-rings and dust boots.

1. Remove the caliper from the vehicle and place on a clean workbench.

⁂ CAUTION

NEVER place your fingers in front of the pistons in an attempt to catch or protect the pistons when applying compressed air. This could result in personal injury!

➡**Depending upon the vehicle, there are two different ways to remove the piston from the caliper. Refer to the brake pad replacement procedure to make sure you have the correct procedure for your vehicle.**

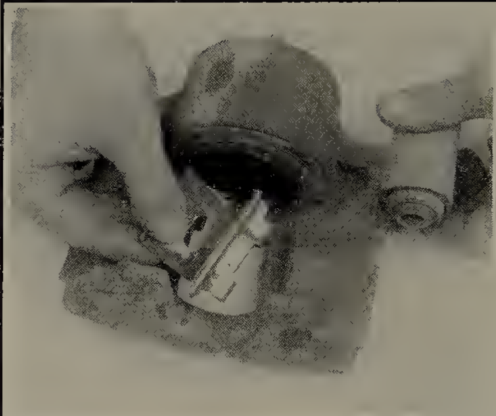
2. The first method is as follows:
   a. Stuff a shop towel or a block of wood into the caliper to catch the piston.
   b. Remove the caliper piston using compressed air applied into the caliper inlet hole. Inspect the piston for scoring, nicks, corrosion and/or worn or damaged chrome plating. The piston must be replaced if any of these conditions are found.
3. For the second method, you must rotate the piston to retract it from the caliper.
4. If equipped, remove the anti-rattle clip.
5. Use a prytool to remove the caliper boot, being careful not to scratch the housing bore.

TCCA9P01

Fig. 65 For some types of calipers, use compressed air to drive the piston out of the caliper, but make sure to keep your fingers clear

TCCA9P02

Fig. 66 Withdraw the piston from the caliper bore

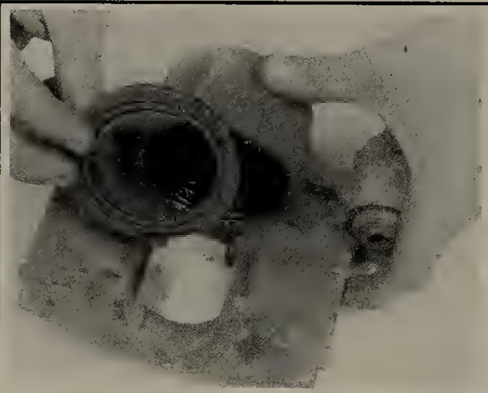


TCCA9P03

Fig. 67 On some vehicles, you must remove the anti-rattle clip

TCCA9P04

Fig. 68 Use a prytool to carefully pry around the edge of the boot . . .



TCCA9P05

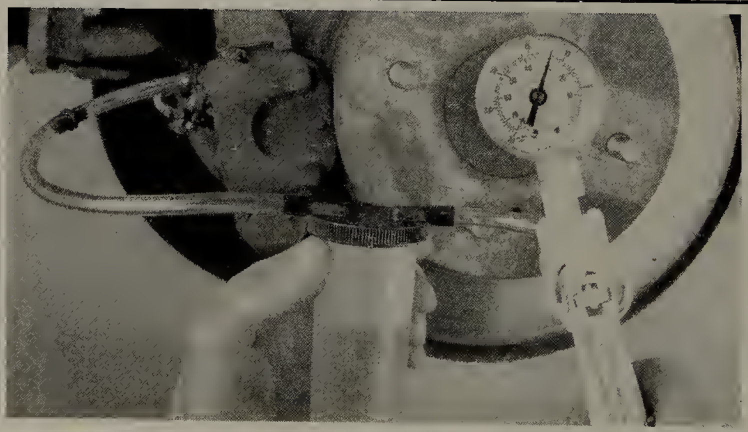
Fig. 69 . . . then remove the boot from the caliper housing, taking care not to score or damage the bore

TCCA9P06

Fig. 70 Use extreme caution when removing the piston seal; DO NOT scratch the caliper bore

TCCA9P07

Fig. 71 Use the proper size driving tool and a mallet to properly seal the boots in the caliper housing



TCCA9P08

Fig. 72 There are tools, such as this Mighty-Vac, available to assist in proper brake system bleeding

6. Remove the piston seals from the groove in the caliper bore.
7. Carefully loosen the brake bleeder valve cap and valve from the caliper housing.
8. Inspect the caliper bores, pistons and mounting threads for scoring or excessive wear.
9. Use crocus cloth to polish out light corrosion from the piston and bore.
10. Clean all parts with denatured alcohol and dry with compressed air.

To assemble:

11. Lubricate and install the bleeder valve and cap.
12. Install the new seals into the caliper bore grooves, making sure they are not twisted.
13. Lubricate the piston bore.
14. Install the pistons and boots into the bores of the calipers and push to the bottom of the bores.
15. Use a suitable driving tool to seat the boots in the housing.
16. Install the caliper in the vehicle.
17. Install the wheel and tire assembly, then carefully lower the vehicle.
18. Properly bleed the brake system.

Brake Disc (Rotor)

REMOVAL & INSTALLATION

See Figures 73 and 74

1. Disconnect battery negative cable.
2. Unbolt the caliper assembly, but do not disconnect the fluid line. Suspend the caliper assembly using a length of mechanic's wire. For more details, refer to the appropriate caliper removal procedure for you vehicle, located earlier in this section.
3. Remove the rotor from the vehicle by pulling it straight off the lug studs.
4. Installation is the reverse of removal.

INSPECTION

See Figure 75

1. Check the rotor surface for wear, scoring, grooves or rust pitting. Rotor damage can be corrected by refacing, consult your local garage or machine shop. Light scoring of the rotor surface which does not exceed 0.060 in. (1.5mm) is generally not detrimental to brake operation and may be caused by normal use. If the damage exceeds the minimum thickness, which is stamped on the rotor, replace the rotor.

Thickness Variation Check

Check rotor thickness variation by measuring the rotor thickness at 4 or more points around the circumference of the rotor. Use a micrometer calibrated in ten-thousandths of an inch. Make all of your measurements at the same distance in from the edge of the rotor. A rotor that varies in thickness by more that 0.0005 in. (0.013mm) may cause your brake pedal to pulsate and/or front end vibration when the brakes are applied. A rotor not meeting these specifications must be refinished or replaced.

Lateral Runout Check

The best way to check lateral runout is with the wheels still installed on the vehicle. This ensures a much more accurate reading. If the proper equipment is not available to do this, the next best reading can be made with the wheels removed, but the caliper installed, as follows:

1. If the wheels are removed, re-install the lug nuts to hold the rotor in place. Tighten the lug nuts to 100 ft. lbs. (136 Nm).
2. Attach a dial indicator to the steering knuckle so that the indicator button contacts the rotor surface about ½ in. from the outer edge.
3. Set the dial indicator to zero.
4. Turn the wheel one complete revolution and check the runout indicated on the dial. The total indicated runout must not exceed 0.003 in. (0.08mm).

Sometimes, excessive lateral runout can be improved by indexing the rotor on the hub one or two bolt positions from the original position. If this doesn't work, check the hub and bearing for excessive lateral runout or looseness. If those specifications exceed 0.0015 in. (0.040mm), replace the hub and bearing. If the lateral runout is within specifications, refinish or replace the rotor, as necessary.

Whenever the rotor is separated from the wheel bearing flange, thoroughly clean the any rust or other debris from the wheel bearing flange and rotor mating surfaces. If you don't do this, the lateral runout and brake pulsation may be increased.

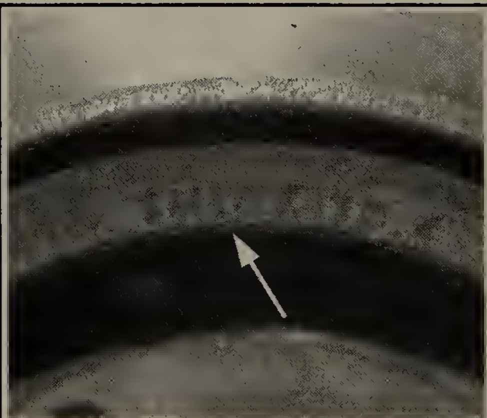
5. If the lateral runout exceeds the specification in Step 4, refinish or replace the rotor.

91039P16

Fig. 73 Remove the rotor by lifting it straight off the lug studs–rear rotor shown

91039P48

Fig. 74 Install the rotor by positioning it over the lug studs, and pushing it into place—front rotor shown



91039P17

Fig. 75 The rotor has a "Minimum Thickness" specification stamped into it

PARKING BRAKE

Cable(s)

REMOVAL & INSTALLATION

See Figures 76 and 77

Front Cable

1. Remove the driver's seat cushion and frame assembly.
2. Properly disable the parking brake automatic adjuster.
3. Raise the vehicle and support it safely.
4. Disconnect the front cable from the front cable connector.
5. Disconnect the front cable from the front cable return spring.
6. Disconnect the left rear cable from the parking brake front cable assembly connector.
7. Remove the front cable attaching clip bolt and clip.
8. Lower the vehicle and remove the front cable from the automatic adjuster.
9. Remove the front cable attaching nut and washer.
10. Remove the front cable from the vehicle.

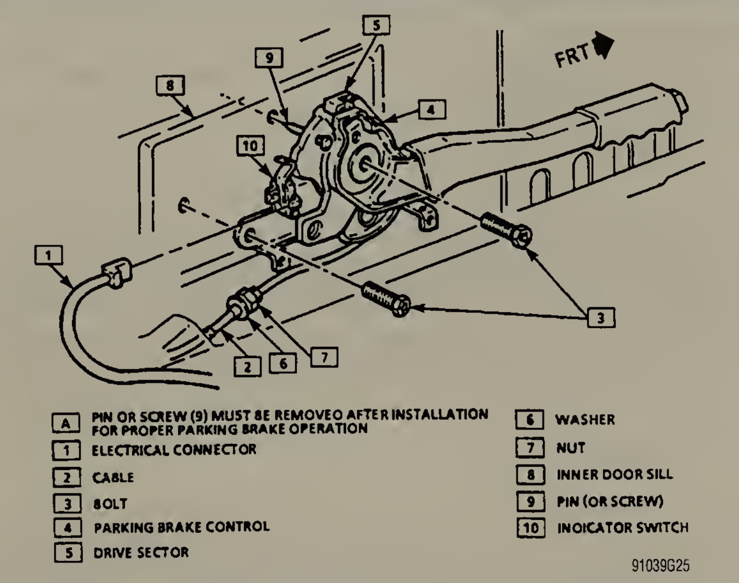


Fig. 76 Parking brake handle and cable attachment—1996 vehicle shown

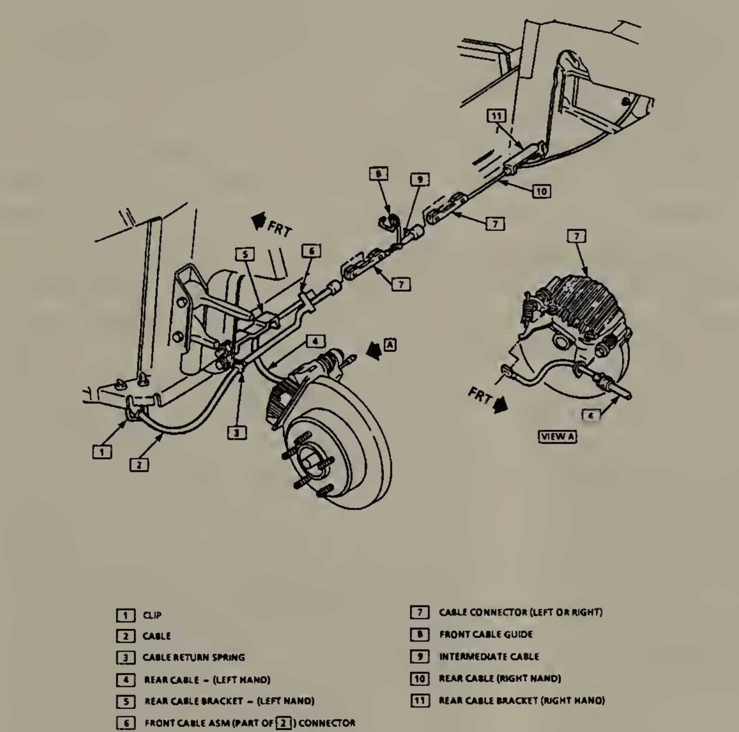


Fig. 77 View of the parking brake cables—1996 vehicle shown

To install:

11. Install the front cable to the vehicle, then attach the front cable washer and nut. Tighten the nut 24 ft. lbs. (33 Nm).
12. Connect the front cable to the automatic adjuster.
13. Raise and support the vehicle safely.
14. Install the front cable clip and bolt. Tighten the bolt to 8 ft. lbs. (11 Nm).
15. Connect the parking brake left rear cable to the front cable assembly connector.
16. Connect the parking brake front cable to the front cable return spring and then to the parking brake cable connector.
17. Lower the vehicle.
18. Properly enable the automatic brake adjuster.
19. Install the driver's seat cushion and frame assembly.

Intermediate Cable

1. Disable the parking brake automatic adjuster.
2. Raise the vehicle and support it safely.
3. Disconnect the parking brake intermediate cable from the cable connectors and front cable guide.
4. Installation is the reverse of the removal procedure.

Rear Cable

LEFT

1. Disable the automatic parking brake adjuster.
2. Raise and support the vehicle safely, then remove the tire and wheel assembly.
3. Remove the front cable from the front cable return spring.
4. Disconnect the left rear cable from the front cable assembly connector.
5. Disconnect the cable from the left rear cable bracket.
6. Disconnect the left rear cable from the caliper mounting bracket and lever.

To install:

7. Install the left rear cable to the caliper lever and mounting bracket. Be sure the boot on the end of the cable is attached to the conduit end fitting.
8. Installation is the reverse of the removal procedure.
9. Be sure to properly enable the parking brake automatic adjuster.

RIGHT

1. Disable the parking brake automatic adjuster.
2. Raise the vehicle and support it safely, then remove the tire and wheel assembly.
3. Disconnect the right rear cable from the intermediate cable.
4. Disconnect the right rear cable from the right rear cable bracket.
5. Disconnect the right rear cable from the caliper mounting bracket and lever.

To install:

6. Install the right rear cable to the caliper lever and mounting bracket. Be sure the boot on the end of the cable is attached to the conduit end fitting.
7. Installation is the reverse of the removal procedure.
8. Be sure to properly enable the parking brake automatic adjuster.

ADJUSTMENT

1984–87 Vehicles

See Figure 78

1. Raise and safely support the vehicle.
2. Remove the rear wheel and tire assemblies, then install 2 lug nuts on each wheel to retain the rotors.
3. Use a large C-clamp or pair of pliers to compress the caliper piston into its bore.
4. Loosen the parking brake cable so there is not tension on the parking brake shoes.
5. Rotate the disc so that the hole in the disc/drum face will align with the star adjuster.
6. To perform the adjustment, insert a suitable flat-bladed tool through the hole in the disc face and perform the following:

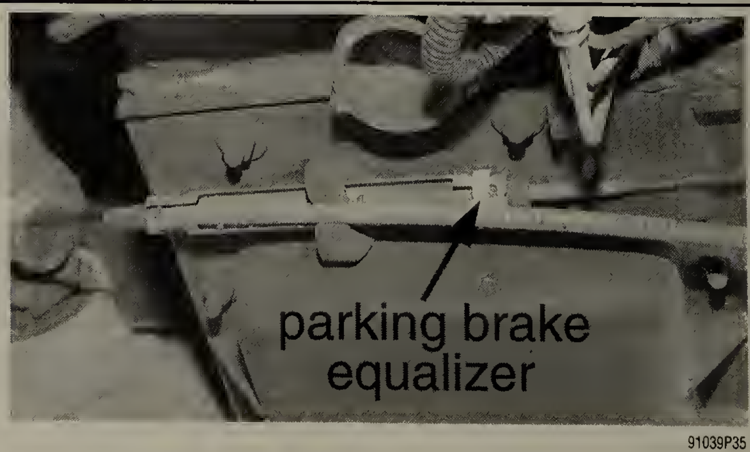


Fig. 78 The parking brake equalizer is located under the vehicle, near the rear wheels

a. For the driver's side, move the handle of the tool towards the ceiling to adjust the shoes out and towards the floor to adjust the shoes in.

b. For the passenger's side, move the handle of the tool toward the floor to adjust the shoes out and towards the ceiling to adjust them in.

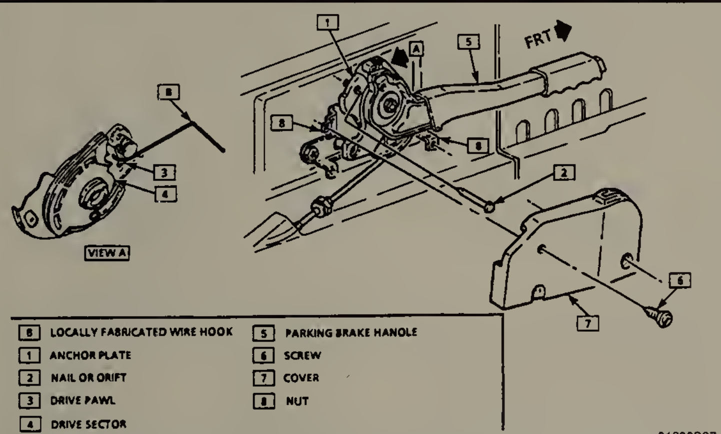
7. Adjust one side at a time until there is no rotation of the disc/drum. Then, back the star adjuster off about 5–7 notches. Then, go back to the opposite side and perform the same procedure.
8. Remove the lug nuts, then install the wheel and tire assemblies.
9. Apply the parking brake lever 2 notches.
10. Adjust the cable at the equalizer so that the wheel has a drag.
11. Release the parking brake lever and check the wheel for free rotation.
12. If the adjustment is correct, there will be no drag on the wheel.

1988–96 Vehicles

See Figure 79

The parking brake lever/cable adjustment is automatic. The adjuster must be disabled to create the necessary cable slack for certain service procedures. Following these procedures, make sure the adjuster is properly enabled to assure correct parking brake operation.

1. To disable the automatic parking brake adjuster, proceed as follows:
   a. Remove the drivers seat cushion.
   b. Remove the parking brake lever cover and screws.
   c. Using a suitable offset tool, disengage and hold the drive pawl from the drive sector.
   d. Insert a nail or drift through the hole in the anchor plate to retain the drive pawl in the disengaged position.
   e. Move the parking brake lever until it aligns with the lock pawl.
   f. Depress the button on the lever and move the lever to the down position.
   g. Verify the anchor plate is against the stud on the parking brake lever, if not as specified, repeat the procedure.
2. To enable the automatic parking brake adjuster, proceed as follows:
   a. Remove the nail or drift pin from the anchor plate.



91039G27

Fig. 79 Disabling the parking brake automatic adjuster—1988–96 vehicles

b. Apply and release the parking brake 3 times.

c. Pull up on the parking brake lever. Proper adjustment will result in the lever moving 3–5 ratchet clicks with a force of 61 lbs. (270 N).

d. Release the parking brake, there should be no rear brake drag and no gap between the caliper housings and caliper parking brake levers. It may be necessary to remove the tire and wheel assemblies to see the caliper housings and levers.

e. If removed, install the wheel and tire assembly.

f. Install the parking brake lever cover and screws.

g. Install the driver's seat cushion.

Brake Shoes

REMOVAL & INSTALLATION

See Figures 80 thru 92

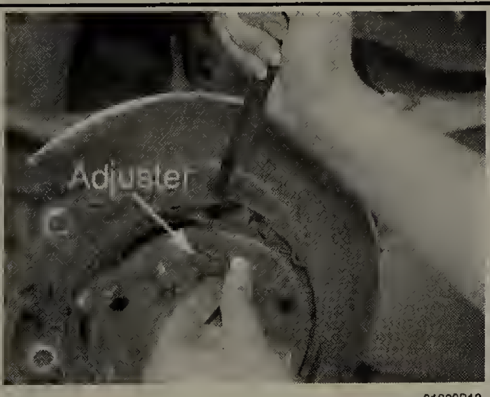
1. Raise and safely support the vehicle.
2. Remove the wheel and tire assembly.
3. Unbolt the caliper and suspend it, out of the way, with a piece of wire. Do NOT disconnect the fluid line!
4. Remove the rotor by pulling it off the lug studs.
5. Spread the brake shoes apart using a suitable tool, then remove the adjuster assembly.
6. Remove the adjuster return spring by unhooking it.
7. Disengage the hold-down springs and pins by pushing down on the spring, and then sliding the pin until it can be removed through the hole at the end of the slot.
8. Remove the pins and springs from the shoes.
9. Pull the shoe and linings apart enough to clear the hub and bearing, then remove the linings with the shoe return spring still engaged.
10. Disassemble the adjuster, as shown in the accompanying figure and check the threads for wear.
11. Clean and inspect the wear bracket and wear shims for burrs and/or damage. If either one is unserviceable, the mounting plate assembly must be replaced. If just slightly distorted, you can very carefully tap the wear shims back into place.
12. Check the rubber boot around the lever stud and replace if damaged.
13. Inspect the springs for wear or damage, and replace as necessary.

To install:

14. Clean all components, EXCEPT the shoe and lining assemblies, with denatured alcohol. Lubricate the wear bracket and shims with a thin coating of silicone grease.

➡Installation of the parking brake shoes can be tricky, so we provide the factory procedure, and an alternate procedure. Read through both procedures, then decide which procedure may work the best for you. If the first procedure you use doesn't work, try the other one.

15. To install the parking brake shoe assemblies using the "factory procedure", perform the following:
    a. Fit the shoe and linings to the mounting plate. The primary and sec-



91039P18

Fig. 80 Use a suitable tool to spread the brake shoes, then remove the adjuster assembly


91039P19

Fig. 81 Unhook and remove the adjuster return spring

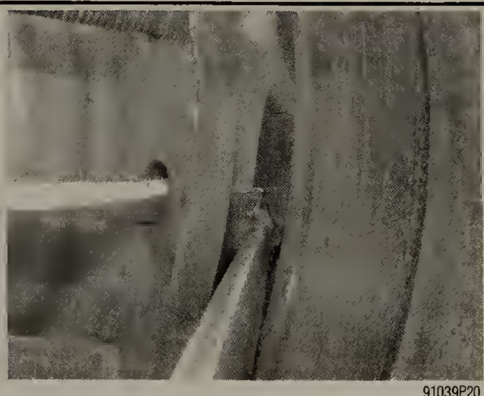

91039P20

Fig. 82 Use a screwdriver to depress the hold-down spring, then slide the pin until it can be removed

ondary shoes are identical. Make sure the operating lever and strut assembly is position on the wear shims, not down in the hole.

b. Use a suitable pair of pliers to install the shoe return spring.

c. Install the pins and hold-down springs by fitting to the spring to extend the pin head through the hole in the backing plate, then down into the slot.

16. To install the parking brake shoe assemblies using the "alternate procedure", perform the following:

a. Position the hold-down pin in the slot with a rubber band wrapped around it as shown in the accompanying figure.

b. Carefully position the shoe and lining assembly over the hold-down pin, being careful not to dislodge the pin.

17. Position the hold-down spring over the pin, and while holding the spring in place with a screwdriver, use needle-nose pliers to turn the pin to the installation position.

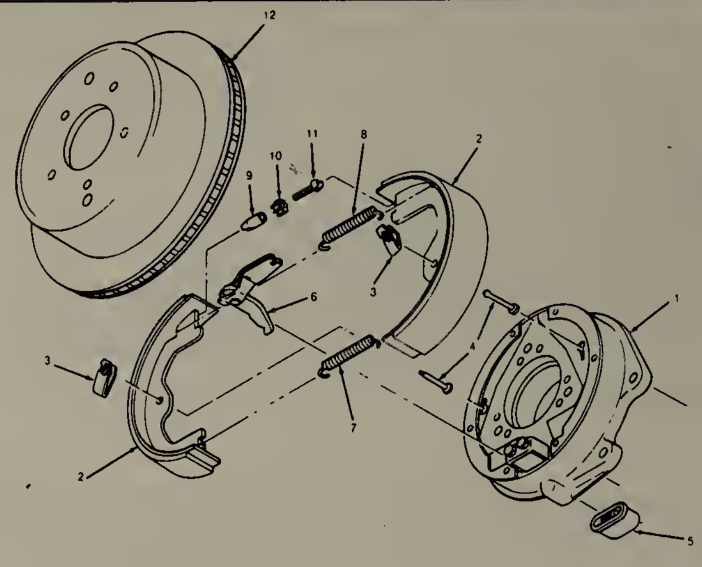
18. Use a suitable tool to install the adjuster return spring.

91039P21

Fig. 83 Pull the shoe and lining out slightly, then remove the hold-down spring

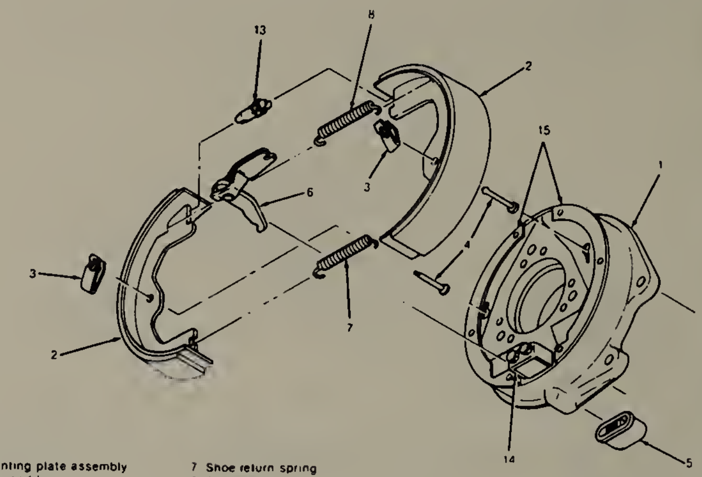
91039P22

Fig. 84 Pull the shoe and linings apart enough to clear the hub and bearing, then remove the linings with the shoe return spring still engaged



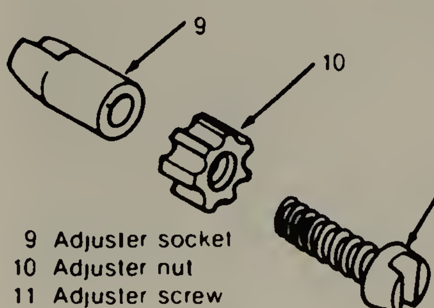
91039G28

Fig. 85 Exploded view of the parking brake components (1 of 2)



91039G29

Fig. 86 Exploded view of the parking brake components (2 of 2)

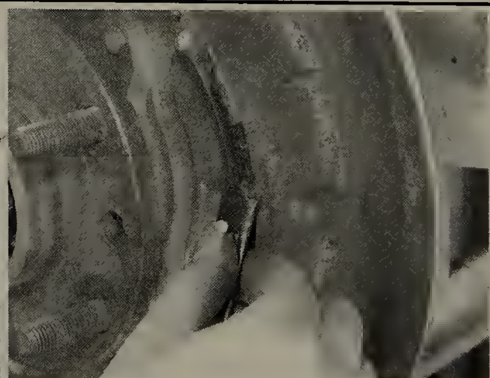


91039G30

Fig. 87 Disassembled view of the adjuster

91039P24

Fig. 88 If the wear shims become slightly distorted, they can usually be carefully tapped back into place



91039P23

Fig. 89 Apply a small amount of a suitable silicone grease to the parking brake shoe wear shim contact areas

91039P25

Fig. 90 Place a rubber band around the hold-down pin to secure it in place before installing the shoes and linings

91039P26

Fig. 91 Carefully place the shoe and lining assembly over the hold-down pins, being careful not to knock them out of the mounting holes

91039P27

Fig. 92 Place the hold-down spring over the pin, and while holding the spring in place with a screwdriver, use needle-nose pliers to turn the pin to the secured position

19. Install the adjuster assembly, making sure the star wheel is positioned properly with the star wheel toward the front of the vehicle.
20. Install the rotor and caliper, then adjust the shoe and linings as outlined earlier in this section.
21. If not already done, install the tire and wheel assemblies, then carefully lower the vehicle.

ADJUSTMENT

For shoe and lining adjustment, refer to the procedure located under Parking Brake Cable.

ANTI-LOCK BRAKE SYSTEM

General Information

The purpose of the Anti-lock Braking System (ABS), used on 1986–96 vehicles, is to maintain vehicle steerability, directional stability and the best deceleration possible under severe braking conditions on most road surfaces. The ABS monitors the speed of each vehicle wheel (treating the rear wheels as a pair) during a braking maneuver. The control module processes these values to produce command controls to prevent the braked wheels from locking. This provides the driver with the best and most vehicle control. There are 3 different types of anti-lock brake systems used on these vehicles however, the all operate in basically the same manner.

BASIC KNOWLEDGE REQUIRED

Before using this section, it is important that you have a basic knowledge ot the following items. Without this basic knowledge, it will be difficult to use the diagnostic procedures contained in this section.

Basic Electrical Circuits—You should understand the basic theory of electricity and know the meaning of voltage, current (amps) and resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

Use Of Circuit Testing Tools—You should know how to use a test light and how to use jumper wires to bypass components to test circuits. You should be familiar with the J 39200 digital multimeter. You should be able to measure voltage, resistance and current and be familiar with the meter controls and how to use them correctly.

PRECAUTIONS

➡Failure to observe the following precautions may result in system damage.

- Before performing electric arc welding on the vehicle, disconnect the Electronic Brake Control Module (EBCM) and the hydraulic modulator connectors.
- When performing painting work on the vehicle, do not expose the Electronic Brake Control Module (EBCM) to temperatures in excess of 185°F (85°C) tor longer than 2 hrs. The system may be exposed to temperatures up to 200°F (95°C) for less than 15 min.
- Never disconnect or connect the Electronic Brake Control Module (EBCM) or hydraulic modulator connectors with the ignition switch **ON**.
- Never disassemble any component of the Anti-Lock Brake System (ABS) which is designated non-serviceable; the component must be replaced as an assembly.
- When filling the master cylinder, always use Delco Supreme 11 brake tluid or equivalent, which meets DOT-3 specifications; petroleum base tluid will destroy the rubber parts.

Diagnosis and Testing

ONBOARD DIAGNOSTICS

The ABS contains sophisticated onboard diagnostics that, when accessed with a Tech 1® or equivalent "Scan" tool, are designed to identify the source ot any system fault as specitically as possible, including whether or not the tault is intermittent. There are over 50 diagnostic fault codes to assist the service technician with diagnosis. The last diagnostic tault code to occur is specifically identitied, and specific ABS data is stored at the time of this fault, also, the first five codes set. Additionally, using the scan tool, each input and output can be monitored, thus enabling fault contirmation and repair verification. Manual control of components and automated functional tests are also available when using a scan tool. Details of many of these functions are contained in the following sections.

ENHANCED DIAGNOSTICS

Enhanced Diagnostic Information, found in the CODE HISTORY function ot the scan tool is designed to provide the service technician with specific fault occurrence information. For each ot the first five (5) and the very last diagnostic fault codes stored, data is stored to identify the specific fault code number, the number of failure occurrences, and the number ot drive cycles since the failure first and last occurred (a drive cycle occurs when the ignition is turned **ON** and the vehicle is driven faster than 10 mph). However, if a tault is present, the drive cycle counter will increment by turning the ignition **ON** and **LOCK**. These first five (5) diagnostic fault codes are also stored in the order of occurrence. The order in which the first 5 faults occurred can be useful in determining if a previous fault is linked to the most recent faults, such as an intermittent wheel speed sensor which later becomes completely open.

During difficult diagnosis situations, this information can be used to identify fault occurrence trends. Does the fault occur more frequently now than it did during the last time when it only failed 1 out ot 35 drive cycles? Did the fault only occur once over a large number of drive cycles, indicating unusual condition present when the fault occurred? Does the fault occur infrequently over a large number of drive cycles, indicating special diagnosis techniques may be required to identify the source ot the fault?

If a fault occurred 1 out of 20 drive cycles, the fault is intermittent and has not reoccurred for 19 drive cycles. This fault may be difficult or impossible to duplicate and may have been caused by a severe vehicle impact (large pot hole, speed bump at high speed, etc.) that momentarily opened an electrical connector or caused unusual vehicle suspension movement. Problem resolution is unlikely, and the problem may never reoccur. If the fault occurred 3 out of 15 drive cycles, the odds of finding the cause are still not good, but you know how often it occurs and you can determine whether or not the fault is becoming more frequent based on an additional or past occurrences if the source of the problem can not or could not be found. If the fault occurred 10 out of 20 drive cycles, the odds of finding the cause are much better, as the fault may be easily reproduced.

By using the additional fault data, you can also determine if a failure is randomly intermittent or if it has not reoccurred for long periods of time due to weather changes or a prior repair. Say a diagnostic fault code occurred 10 of 20 drive cycles but has not reoccurred for 10 drive cycles. This means the failure occurred 10 of 10 drive cycles but has not reoccurred since. A significant environmental change or a repair may have occurred 10 drive cycles ago. A repair may not be necessary if a recent repair can be confirmed. If no repair was made, the service can focus on diagnosis techniques used to locate difficult to recreate problems.

INTERMITTENT FAILURES

As with most electronic systems, intermittent failures may be difficult to accurately diagnose. The following is a method to try to isolate an intermittent failure especially wheel speed circuitry failures.

If an ABS fault occurs, the ABS warning light indicator will be ON during the ignition cycle in which the fault was detected. If it is an intermittent problem which seems to have corrected itself (ABS warning light OFF), a history trouble code will be stored. Also stored will be the history data of the code at the time the fault occurred. The scan tool must be used to read ABS history data.

INTERMITTENTS & POOR CONNECTIONS

Most intermittents are caused by faulty electrical connections or wiring, although occasionally a sticking relay or solenoid can be a problem. Some items to check are:

1. Poor mating of connector halves, or terminals not fully seated in the connector body (backed out).
2. Dirt or corrosion on the terminals. The terminals must be clean and free of any foreign material which could impede proper terminal contact.
3. Damaged connector body, exposing the terminals to moisture and dirt, as well as not maintaining proper terminal orientation with the component or mating connector.
4. Improperly formed or damaged terminals. All connector terminals in problem circuits should be checked carefully to ensure good contact tension. Use a corresponding mating terminal to check for proper tension. Refer to Checking Terminal Contact in this section for the specific procedure.
5. The J-35616-A Connector Test Adapter Kit must be used whenever a diagnostic procedure requests checking or probing a terminal. Using the adapter will ensure that no damage to the terminal will occur, as well as giving an idea of whether contact tension is sufficient. If contact tension seems incorrect, refer to Checking Terminal Contact in this section for specifics.
6. Poor terminal-to-wire connection. Checking this requires removing the terminal from the connector body. Some conditions which fall under this description are poor crimps, poor solder joints, crimping over wire insulation rather than the wire itself, corrosion in the wire-to-terminal contact area, etc.
7. Wire insulation which is rubbed through, causing an intermittent short as the bare area touches other wiring or parts of the vehicle.
8. Wiring broken inside the insulation. This condition could cause a continuity check to show a good circuit, but if only 1 or 2 strands of a multi-strand-type wire are intact, resistance could be far too high.

Checking Terminal Contact

When diagnosing an electrical system that uses Metri-Pack 150/280/480/630 series terminals (refer to Terminal Repair Kit J-38125-A instruction manual J-38125-4 for terminal identification), it is important to check terminal contact between a connector and component, or between in-line connectors, before replacing a suspect component.

Frequently, a diagnostic chart leads to a step that reads Check for poor connection. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination is caused by the connector halves being improperly connected, a missing or damaged connector seal, or damage to the connector itself, exposing the terminals to moisture and dirt. Contamination, usually in underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or an intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter, improperly joining the connector halves or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Follow the procedure below to check terminal contact:

1. Separate the connector halves. Refer to Terminal Repair Kit J-38125-A instruction manual J-38125-4, if available.
2. Inspect the connector halves for contamination. Contamination will result in a white or green buildup within the connector body or between terminals, causing high terminal resistance, intermittent contact or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal from the Terminal Repair Kit J-38125-A, check the retention force of the female terminal in question by inserting and removing the male terminal to the female terminal in the connector body. Good terminal contact will require a certain amount of force to separate the terminals.
4. Using an equivalent female terminal from the Terminal Repair Kit J-38125-A, compare the retention force of this terminal to the female terminal in question by joining and separating the male terminal to the female terminal in question. If the retention force is significantly different between the two female terminals, replace the female terminal in question, using a terminal from Terminal Repair Kit J-38125-A.

DISPLAYING CODES

Flash Code Diagnosis

1986–91 VEHICLES

See Figure 93

➡The flash code diagnosis can only be used on 1986–91 vehicles to read ABS codes except for codes 41, 45, 55, 61, and 61. Those codes can only be read with the use of a Tech 1® or equivalent scan tool, as outlined later in this section.

On these vehicles, you can "flash" the ABS trouble codes through the SERVICE ABS indicator light on the dash panel as follows:

TROUBLE CODE	DESCRIPTION
21	RIGHT FRONT WHEEL SPEED SENSOR FAULT
22	RIGHT FRONT TOOTHED WHEEL FREQUENCY ERROR
25	LEFT FRONT WHEEL SPEED SENSOR FAULT
26	LEFT FRONT TOOTHED WHEEL FREQUENCY ERROR
31	RIGHT REAR WHEEL SPEED SENSOR FAULT
32	RIGHT REAR TOOTHED WHEEL FREQUENCY ERROR
35	LEFT REAR WHEEL SPEED SENSOR FAULT
36	LEFT REAR TOOTHED WHEEL FREQUENCY ERROR
41	RIGHT FRONT SOLENOID VALVE FAULT
45	LEFT FRONT SOLENOID VALVE FAULT
55	REAR WHEELS SOLENOID VALVE FAULT
61	PUMP MOTOR OR MOTOR RELAY FAULT
63	SOLENOID VALVE RELAY FAULT
71	ELECTRONIC BRAKE CONTROL MODULE FAULT
72	SERIAL DATA LINE FAULT
75	LATERAL ACCELEROMETER FAULT (SHORT OR OPEN)
76	LATERAL ACCELEROMETER FAULT (SIGNAL OUT OF RANGE)

91039G44

Fig. 93 View of the ALDL connector terminal identification—1986–91 vehicles

1. Ground terminal "H" of the ALDL connector, then turn the ignition to the **ON** position. The flash code diagnostics will stay enabled as long as the terminal is grounded, serial data line communication has not been initialized and the vehicle speed is less than 4 mph.

2. About 3 seconds after the ALDL terminal "H" is grounded, the EBCM will start flashing the SERVICE ABS indicator if current codes, except 41, 45, 55, 61 and 63 are set. Current codes 41, 45, 55, 61 and 63 can only be read through the ALDL using a Tech 1® or equivalent scan tool. The EBCM will not allow flash code diagnostics is any of these codes are set as current. If these codes are present as history codes only, you can read them with flash code diagnosis.

3. The flash sequence will begin with code 12 to signal the beginning of the trouble code display. Code 12 will flash 3 times. Each stored code will then be displayed 3 times. After all of the codes are displayed, the sequence will repeat, starting with code 12.

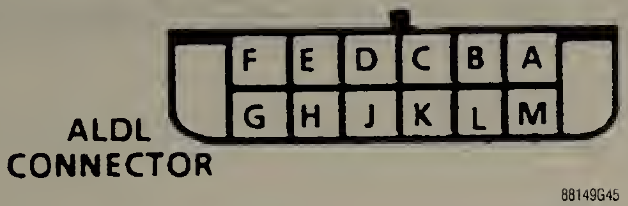


Fig. 94 ABS Diagnostic Trouble Code list—1986–91 vehicles

DTC	DESCRIPTION
21	RF WHEEL SPEED SENSOR CIRCUIT MALFUNCTION
23	RF WHEEL SPEED SENSOR CIRCUIT CONTINUITY MALFUNCTION
25	LF WHEEL SPEED SENSOR CIRCUIT MALFUNCTION
27	LF WHEEL SPEED SENSOR CIRCUIT CONTINUITY MALFUNCTION
28	WHEEL SPEED SENSOR CIRCUIT FREQUENCY ERROR
31	RR WHEEL SPEED SENSOR CIRCUIT MALFUNCTION
33	RR WHEEL SPEED SENSOR CIRCUIT CONTINUITY MALFUNCTION
35	LR WHEEL SPEED SENSOR CIRCUIT MALFUNCTION
37	LR WHEEL SPEED SENSOR CIRCUIT CONTINUITY MALFUNCTION
41	RF VALVE SOLENOID MALFUNCTION
44	PILOT VALVE SOLENOID MALFUNCTION
45	LF VALVE SOLENOID MALFUNCTION
51	RR VALVE SOLENOID MALFUNCTION
55	LR VALVE SOLENOID MALFUNCTION
57	CRUISE CONTROL OUTPUT MONITORING MALFUNCTION
58	EBTCM INTERNAL ADJUSTER ASSEMBLY MALFUNCTION
61	PUMP MOTOR OR PUMP MOTOR RELAY MALFUNCTION (1 OF 2)
62	TACH PULSES MALFUNCTION
63	BPM VALVE RELAY MALFUNCTION (1 OF 2)
64 (LT1)	THROTTLE POSITION SIGNAL MALFUNCTION (VIN P/LT1 ONLY) (1 OF 3)
64 (LT5)	THROTTLE POSITION SIGNAL MALFUNCTION (VIN J/LT5 ONLY) (1 OF 3)
65	ADJUSTER ASSEMBLY CIRCUIT MALFUNCTION (1 OF 2)
66	ADJUSTER ASSEMBLY CONTROL MALFUNCTION
71	EBTCM INTERNAL MALFUNCTION
72	SERIAL DATA LINE MALFUNCTION
73	SPARK RETARD MONITORING MALFUNCTION
74	LOW VOLTAGE
75	LATERAL ACCELEROMETER CIRCUIT MALFUNCTION (1 OF 2)
76	LATERAL ACCELEROMETER SIGNAL OUT OF RANGE (1 OF 2)
83	BRAKE FLUID LEVEL LOW (1 OF 2)

91039G46

Fig. 95 ABS Diagnostic Trouble Code list—1992–94 vehicles and 1995 VIN J vehicles

Tech 1® Diagnosis

➧ See Figures 94, 95 and 96

➡On some vehicles, a Bosch adapter is required for the ALDL connector when using the Tech 1® on the Corvette anti-lock brake system.

Some 1986–91 ABS codes, and all 1992–96 diagnostic fault codes can only be read through the use of a Tech 1® or equivalent bi-directional scan tool. There are no provisions for flash code diagnostics. When using the Tech 1®, or equivalent scan tool, for diagnosis, the ABS is disabled by the EBCM while communicating with the scan tool. The SERVICE ABS indicator light will be on, denoting that only normal power assisted braking is possible.

After completing all diagnostic procedures with the scan tool, disconnect the tool and cycle the ignition **OFF** for at least 10 seconds. This will return the ABS to normal system operation. Refer to Diagnostic Process for more information.

CLEARING CODES

The trouble codes in EBCM memory are erased in one of three ways:

1. Diagnostic request line procedure.
2. Scan tool Clear Codes selection.
3. Ignition cycle default.

These three methods are detailed below. Be sure to verify proper system operation and absence of codes when clearing procedure is completed.

The EBCM will not permit code clearing until all of the codes have been displayed. Also, codes cannot be cleared by unplugging the EBCM, disconnecting the battery cables, or turning the ignition to **LOCK** (except on an ignition cycle default).

Diagnostic Request Line Procedure

➡This method can only be used on 1986–91 vehicles.

To clear the codes using the ALDL diagnostic request line (pin "H"), perform the following:

1. Turn the ignition to the **OFF** position.
2. Attach a jumper to the ALDL connector terminal "H".
3. Attach a jumper to the ALDL connector terminal "A".
4. Connect the jumpers to each other.
5. Turn the ignition switch to the **RUN** position. This will enable flash code diagnostics.

DTC	DESCRIPTION
21	RF Wheel Speed Sensor Circuit Malfunction
23	RF Wheel Speed Sensor Circuit Continuity Malfunction
25	LF Wheel Speed Sensor Circuit Malfunction
27	LF Wheel Speed Sensor Circuit Continuity Malfunction
28	Wheel Speed Sensor Circuit Frequency Malfunction
31	RR Wheel Speed Sensor Circuit Malfunction
33	RR Wheel Speed Sensor Circuit Continuity Malfunction
35	LR Wheel Speed Sensor Circuit Malfunction
37	LR Wheel Speed Sensor Circuit Continuity Malfunction
41	RF Inlet Valve Solenoid Malfunction
42	RF Outlet Valve Solenoid Malfunction
45	LF Inlet Valve Solenoid Malfunction
46	LF Outlet Valve Solenoid Malfunction
47	TCS Prime Valve (ASV) Malfunction
48	TCS Master Cylinder Isolation Valve (USV) Malfunction
51	RR Inlet Valve Solenoid Malfunction
52	RR Outlet Valve Solenoid Malfunction
55	LR Inlet Valve Solenoid Malfunction
56	LR Outlet Valve Solenoid Malfunction
58	EBTCM Internal Adjuster Assembly Malfunction
61	BPM Valve Pump Motor Malfunction (1 of 2)
62	RPM Signal Malfunction
63	BPM Valve Power Supply Malfunction (1 of 2)
64	Throttle Position Signal Malfunction
65	Adjuster Assembly Circuit Malfunction (1 of 2)
66	Adjuster Assembly Control Malfunction
67	Throttle Position Sensor Comparison Malfunction
71	EBTCM Internal Malfunction
72	Serial Data Line Malfunction
73	Spark Retard Monitoring Malfunction
75	Lateral Accelerometer Circuit Malfunction (1 of 3)
76	Lateral Accelerometer Signal Out of Range (1 of 2)
85	Low Voltage

91039G47

Fig. 96 ABS Diagnostic Trouble Code list—1995 VIN P vehicles and 1996 vehicles

6. Disconnect the jumpers for about 1 second, then reconnect for no less than 1 second. Repeat this 4 times with 10 seconds, leaving the jumpers connected after the 4th time.

7. Check the SERVICE ABS indicator on the dash panel. Only code 12 should be flashed. If not, the trouble codes have not been properly cleared. Begin clearing the codes again at Step 1.

8. When the codes are cleared, wait at least 15 seconds before turning the ignition **OFF**.

"Clear Codes" Method

After codes have been viewed completely, scan tool will ask, CLEAR ABS CODES; ANSWER YES. scan tool will then read, HISTORY DATA WILL BE LOST. CLEAR DATA? Answer YES and codes will be cleared.

Ignition Cycle Default

If no diagnostic fault code occurs for 100 drive cycles for 1986–91 vehicles, or 50 cycles for 1992–96 vehicles, (a drive cycle occurs when the ignition is turned **ON** and the vehicle is driven faster than 10 mph), any existing fault codes are cleared from the EBCM memory.

DIAGNOSTIC PROCESS

When servicing the ABS, the following steps should be followed in order. Failure to follow these steps may result in the loss of important diagnostic data and may lead to difficult and time consuming diagnosis procedures.

1. Using the scan tool, read all current and history Diagnostic Trouble Codes (DTCs). Be certain to note which codes are current diagnostic code failures. DO NOT CLEAR CODES unless directed to do so.
2. Using a scan tool, read the CODE HISTORY data. Note the diagnostic fault codes stored and their frequency of failure. Specifically note the last failure that occurred and the conditions present when this failure occurred. This "last failure" should be the starting point for diagnosis and repair.
3. Perform a vehicle preliminary diagnosis inspection. This should include:
   a. Inspection of the compact master cylinder for proper brake fluid level.
   b. Inspection of the ABS hydraulic modulator for any leaks or wiring damage.
   c. Inspection of brake components at all four (4) wheels. Verify no drag exists. Also verify proper brake apply operation.
   d. Inspection for worn or damaged wheel bearings that allow a wheel to "wobble."
   e. Inspection of the wheel speed sensors and their wiring. Verify correct air gap range, solid sensor attachment, undamaged sensor toothed ring, and undamaged wiring, especially at vehicle attachment points.
   f. Verify tires meet legal tread depth requirements.
4. If no codes are present, or mechanical component failure codes are present, perform the automated modulator test using the scan tool to isolate the cause of the problem. If the failure is intermittent and not reproducible, test drive the vehicle while using the automatic snapshot feature of the scan tool.

Perform normal acceleration, stopping, and turning maneuvers. If this does not reproduce the failure, perform an ABS stop, on a low coefficient surface such as gravel, from approximately 30–50 mph while triggering on any ABS code. If the failure is still not reproducible, use the enhanced diagnostic information found in CODE HISTORY to determine whether or not this failure should be further diagnosed.

5. Once all system failures have been corrected, clear the ABS codes.

The scan tool, when plugged into the ALDL connector, becomes part of the vehicle's electronic system. The scan tool can also perform the following functions on components linked by the Serial Data Link (SDL):

- Display ABS data
- Display and clear ABS Diagnostic Trouble Codes (DTCs)
- Control ABS components
- Perform extensive ABS diagnosis
- Provide diagnostic testing for Intermittent ABS conditions.

Each test mode has specific diagnosis capabilities which depend upon various keystrokes. In general, five (5) keys control sequencing: YES, NO, EXIT, UP arrow and DOWN arrow. The FO through F9 keys select operating modes, perform functions within an operating mode, or enter trouble code or model year designations.

In general, most scan tools have six (6) test modes for diagnosing the antilock brake system. The six (6) test modes are as follows:

- **MODE FO: DATA LIST**—In this test mode, the scan tool continuously monitors wheel speed data, brake switch status and other inputs and outputs.
- **MODE F1: CODE HISTORY**—In this mode, fault code history data is displayed. This data includes how many ignition cycles since the fault code occurred, along with other ABS information. The first five (5) and last fault codes set are included in the ABS history data.
- **MODE F2: TROUBLE CODES**—In this test mode, trouble codes stored by the EBCM, both current ignition cycle and history, may be displayed or cleared.
- **MODE F3: ABS SNAPSHOT**—In this test mode, scan tool captures ABS data before and after a fault occurrence or a forced manual trigger.
- **MODE F4: ABS TESTS**—In this test mode, the scan tool performs hydraulic modulator functional tests to assist in problem isolation during troubleshooting. Included here is manual control of the motors which is used prior to bleeding the brake system.

Speed Sensors

REMOVAL & INSTALLATION

Front

1986–90 VEHICLES

See Figure 97

Keep the replacement wheel speed sensor in its packaging until right before installation.

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle, then remove the wheel and tire assembly.
3. Detach the sensor wiring harness connector from the ABS wiring harness connector. Unclip the connectors from the bracket and separate.
4. Remove the sensor wiring harness with the grommets from the remaining brackets. Make sure to note the position of the grommets and harness routing for installation.
5. Unfasten the sensor retaining bolt, then remove the sensor from the knuckle.
6. Clean all sealant from the sensor and sensor opening in the knuckle.
7. Check the front sensor O-ring and spacer for damage and replace as necessary.

To install:

The wheel speed sensors are a tight fit into the knuckle and must be pushed in by hand. Do NOT hammer the sensor into position. There are 4 individual wheel speed sensors that must be installed in the proper locations. Each replacement wheel speed sensor is identified with a white tag, located near neck of the sensor and labeled L or R. You must apply an anti-corrosive sealant to the sensor prior to installation to avoid galvanic corrosion.

8. Properly position the O-ring and spacer, then install the coated sensor into the knuckle.
9. Install the retaining bolt and tighten to 86 inch lbs. (10 Nm).
10. Place the sensor wiring harness with the grommets into the brackets. Make sure to route the wiring and place the grommets as noted during removal.
11. Plug the sensor electrical connector into the ABS wiring harness connector and make sure the connection is tight. Snap the connectors into the bracket.
12. Install the tire and wheel assembly.
13. Carefully lower the vehicle, then perform the ABS system check, as outlined in the accompanying chart.

1991–95 VEHICLES

On these vehicles, the front wheel speed sensor is integral with the wheel hub and bearing. Refer to Section 8 for removal and installation procedures.

Rear

1986–95 VEHICLES

➧ **See Figures 98, 99, 100, 101 and 102**

1. Disconnect the negative battery cable.
2. Raise and safely support the vehicle, then remove the wheel and tire assembly.
3. Detach the sensor wiring harness connector from the ABS wiring harness connector. Unclip the connectors from the bracket and separate.
4. If necessary, remove the bracket and bolt from the knuckle.
5. Remove the sensor wiring harness with the grommets from the remaining brackets. Make sure to note the position of the grommets and harness routing for installation.
6. Unfasten the sensor retaining bolt, then remove the sensor from the knuckle.
7. Clean all sealant from the sensor and sensor opening in the knuckle.

To install:

➡The wheel speed sensors fit tightly into the knuckle and must be pushed in by hand. Do NOT hammer the sensor into position. There are 4 individual wheel speed sensors that must be installed in the proper locations. Each replacement wheel speed sensor is identified with a white tag, located near neck of the sensor and labeled L or R. You must apply an anti-corrosive sealant to the sensor prior to installation to avoid galvanic corrosion.

8. Install the coated sensor into the knuckle, then install the retaining bolt and tighten to 86 inch lbs. (10 Nm).
9. Place the sensor wiring harness with the grommets into the brackets. Make sure to route the wiring and place the grommets as noted during removal.
10. If removed, install the bracket and bolt to the knuckle. Tighten the bolt to 86 inch lbs. (10 Nm).
11. Plug the sensor electrical connector into the ABS wiring harness connector and make sure the connection is tight. Snap the connectors into the bracket.
12. Install the tire and wheel assembly.
13. Carefully lower the vehicle, then perform the ABS system check, as outlined in the accompanying chart.

Modulator Valve

REMOVAL & INSTALLATION

Due to safety reasons, the modulator valve must not be repaired; the complete unit must be replaced. The only exceptions to this are the pump motor relay and the solenoid relay. Both relays can be replaced. No screws on the modulator valve may be loosened. If the screws are loosened, it will not be possible to obtained leak-tight brake circuits.

➡On 1994–96 vehicles, the valve is referred to as the Brake Pressure Modulator (BPM) valve.

When replacing the modulator valve, it is accessed in the rear storage compartment. Make sure to protect the car's interior and exterior to avoid spilling brake fluid. Make sure the completely wipe up the brake fluid from the bottom of the storage compartment when replacing the modulator valve.

1986–91 Vehicles

➧ **See Figures 103, 104, 105, 106 and 107**

1. Disconnect the negative battery cable.
2. Remove the storage tray and insulation.
3. Disconnect and remove the entire ABS wiring harness from the storage compartment, as follows:

⁂ WARNING

To prevent equipment damage, never connect or disconnect the wiring harness connector from the control module with the ignition switch in the ON position.

91039P55

Fig. 97 The front wheel speed sensor is mounted in the front knuckle

91039P28

Fig. 98 The rear wheel speed sensor is mounted on the top of the rear knuckle

91039P29

Fig. 99 Detach the wheel speed sensor connector, and unroute it from all of its retaining clips

91039P56

Fig. 100 View of the rear wheel speed sensor wire harness routing

91039P30

Fig. 101 Unfasten the rear wheel speed sensor mounting bolt . . .

91039P31

Fig. 102 . . . then remove the sensor from the knuckle

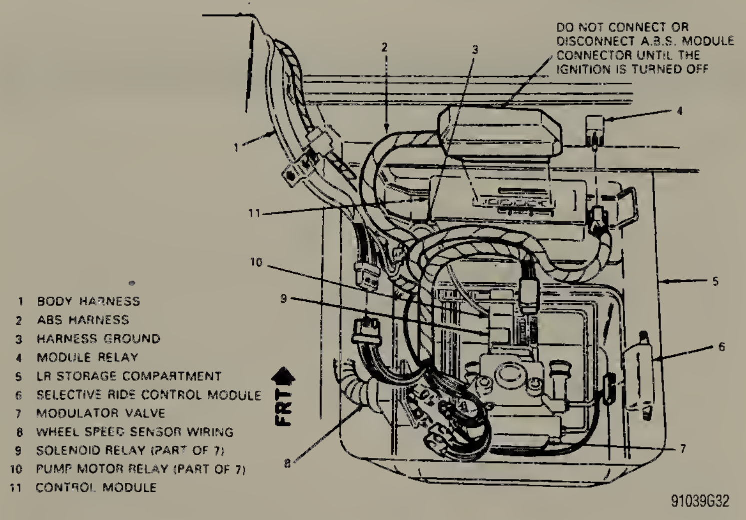


Fig. 103 View of the ABS wiring harness and module relay—1986–91 vehicles with Selective Ride Control (SRC)

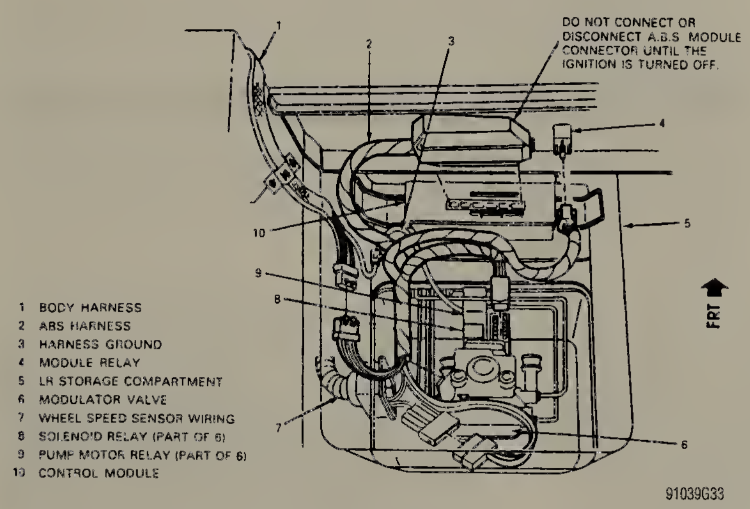


Fig. 104 ABS wiring harness and module relay locations—1986–91 vehicles without Selective Ride Control (SRC)

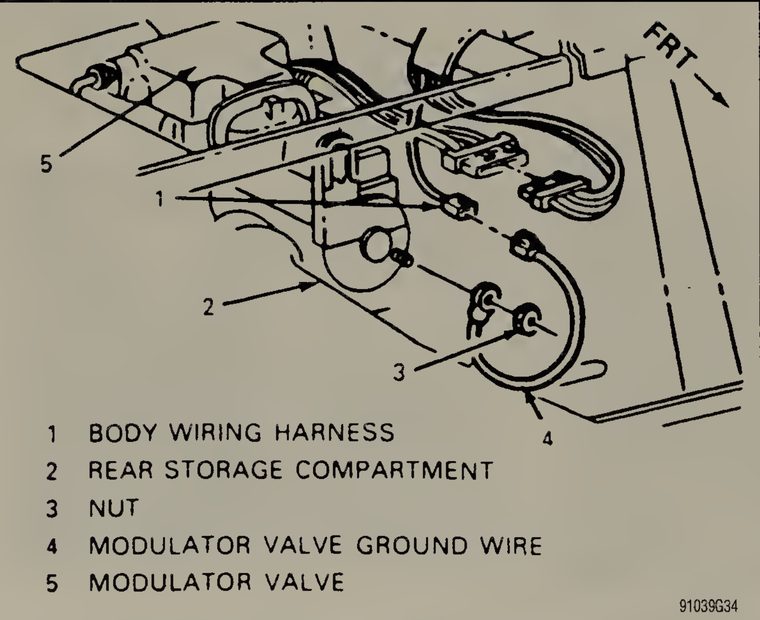


Fig. 105 Location of the modulator valve ground wire

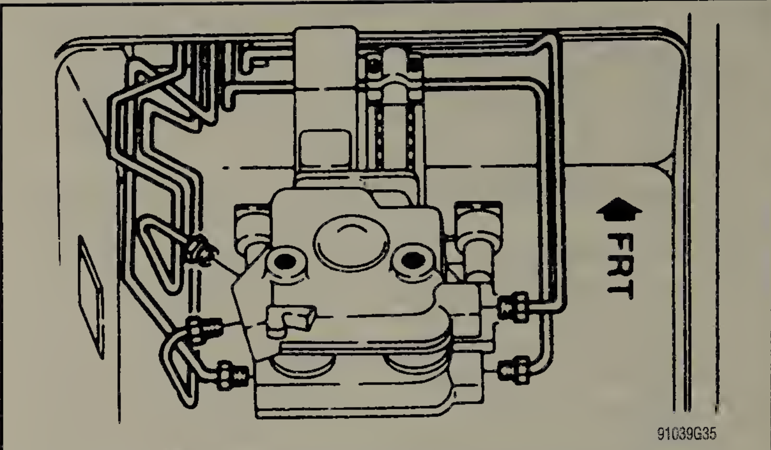


Fig. 106 You MUST note the correct installed position and location of the brake pipes!

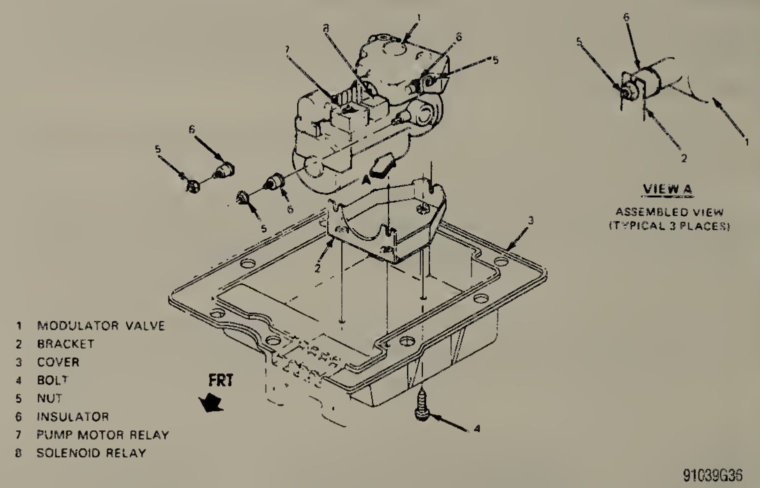


Fig. 107 Exploded view of the modulator valve mounting—1986–91 vehicles

a. Detach the control module wiring harness connector by depressing the spring clip under the neck of the connector, then pulling it out.

b. Remove the 2 screws from the wiring harness retention clip, then remove the retention clip from the wiring harness.

c. Detach the modulator valve wring harness connector.

d. Unplug the battery feed (red) wire connector from the wiring harness connector.

e. Detach the wheel speed sensor connectors from the wiring harness connector.

f. Remove the module relay from the bracket and detach the wiring harness connector.

g. Remove the wiring harness from the vehicle, noting the routing for installation.

4. Detach the modulator valve ground wire from the body wiring harness.

5. Disconnect and plug the brake pipes from the modulator valve, making sure to note their locations for installation.

6. Remove the 3 nuts attaching the modulator valve to the bracket.

➡**When removing the valve from the storage compartment, be careful not to spill any brake fluid.**

7. Remove the modulator valve. Clean any brake fluid from the bottom of the storage compartment.

8. If the valve is being replaced, remove the ground wire and insulators.

To install:

9. If removed, install the ground wire and insulators.

10. Attach the modulator to the bracket and secure with the 3 retaining nuts. Tighten the nuts to 86 inch lbs. (10 Nm).

WARNING

Make sure the brake lines are attached correctly. If the lines are accidentally switched, wheel lockup will occur. The only 2 ways this condition can be detected, is by using the ABS diagnostic tester or by performing an anti-lock stop.

11. Connect the brake pipes to the modulator valve, in the proper locations noted during removal. If a new modulator is being installed, remove the shipping plugs from the valve openings. Tighten the brake pipes to 13 ft. lbs. (18 Nm).
12. Connect the modulator valve ground wire to the body wiring harness.

➡When installing the ABS wiring harness, make sure that all connectors are securely connected. This will prevent system damage and malfunctions.

13. Install the entire ABS wiring harness into the storage compartment, as follows:

➡When installing the wiring harness, make sure that all connectors are securely connected and locked when necessary, Loose connectors can cause ABS malfunctions.

a. Position the wiring harness in the vehicle, using the same routing noted during removal.
b. Attach the module relay connector, then place the relay in the bracket.
c. Connect the wheel speed sensor wiring to the wiring harness connector.
d. Attach the battery feed (red) wire connector to the wiring harness connector.
e. Connect the modulator valve electrical wiring.
f. Position the retention clip to the wiring harness and install the 2 retaining screws.
g. Attach the control module electrical connector, making sure the spring clip locks.

14. Fill the master cylinder reservoirs, then bleed the brake system, as outlined earlier in this section.
15. Install the insulation and storage tray.
16. Connect the negative battery cable, then perform the ABS system check as shown in the accompanying chart.

1992–95 Vehicles

EXCEPT 1995 VIN P ENGINE

See Figures 108, 109 and 110

1. Disconnect the negative battery cable.
2. Remove the rear storage compartment door and frame assembly.
3. Remove the sound insulator pad.
4. If equipped, detach the wire harness with the selective ride control module.
5. Remove the Electronic Brake Control Module (EBCM).
6. Note the installed location of the brake pipes, then disconnect them from the modulator valve. Plug or cap the lines to avoid excessive fluid loss.
7. Raise and safely support the vehicle.
8. Remove the modulator valve bracket-to-underbody cover bolts.
9. Carefully lower the vehicle, then remove the modulator valve.
10. If the modulator valve is being replaced, remove the ground wire and bracket from the valve.
11. If the valve is being replaced, remove the pump motor and solenoid valve relays.

To install:

12. If removed, install the ground wire.
13. Position the modulator valve to the bracket and secure with the mounting bolts. Tighten to 86 inch lbs. (10 Nm).
14. Install the modulator valve.
15. Raise and safely support the vehicle, then install the modulator valve bracket to the underbody cover attaching bolts. Tighten the bolts to 86 inch lbs. (10 Nm).
16. Carefully lower the vehicle.

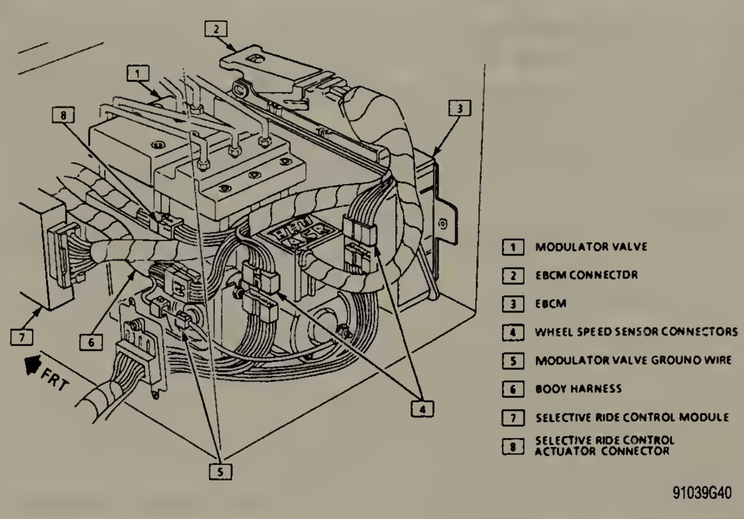


Fig. 108 View of the ABS/ASR wiring harness—1992 vehicle shown

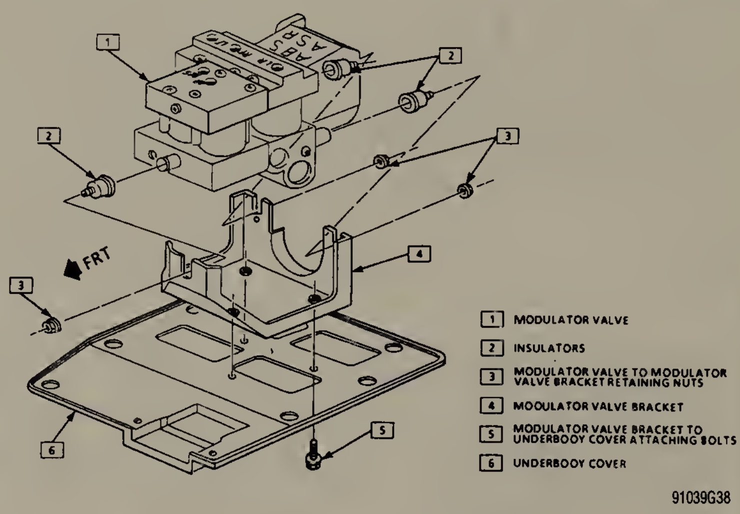


Fig. 109 Exploded view of the modulator valve—1992 vehicle shown, other years similar

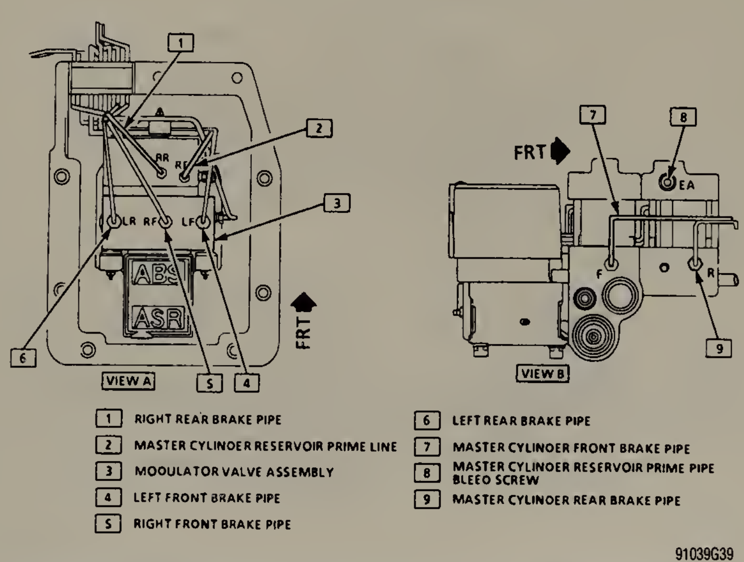


Fig. 110 During installation, connecting the brake lines properly is essential for system operation

⁂ WARNING

Make sure the brake lines are attached correctly. If the lines are accidentally switched, wheel lockup will occur. The only 2 ways this condition can be detected, is by using the ABS diagnostic tester or by performing an anti-lock stop.

17. Connect the brake pipes to the modulator valve, in the proper locations noted during removal. If a new modulator is being installed, remove the shipping plugs from the valve openings. Tighten the brake pipes to 13 ft. lbs. (18 Nm).
18. Install the EBCM.
19. If equipped connect the wiring harness with selective rid control module.
20. Connect the negative battery cable.
21. Fill the master cylinder reservoir, then bleed the master cylinder prime pipe and hydraulic brake system, as outlined earlier in this section.

➡**Always be sure the sound insulator pad covers the whole modulator or excessive noise could result during system operation.**

22. Install the sound insulator pad and rear storage compartment door and frame assembly.

1995 VIN P Engine and 1996 Vehicles

➧ **See Figure 111**

1. Disconnect the negative battery cable.
2. Remove the rear storage compartment door and frame assembly.
3. Remove the sound insulator pad.
4. Detach the wire harness connector.
5. Remove the selective ride control module.

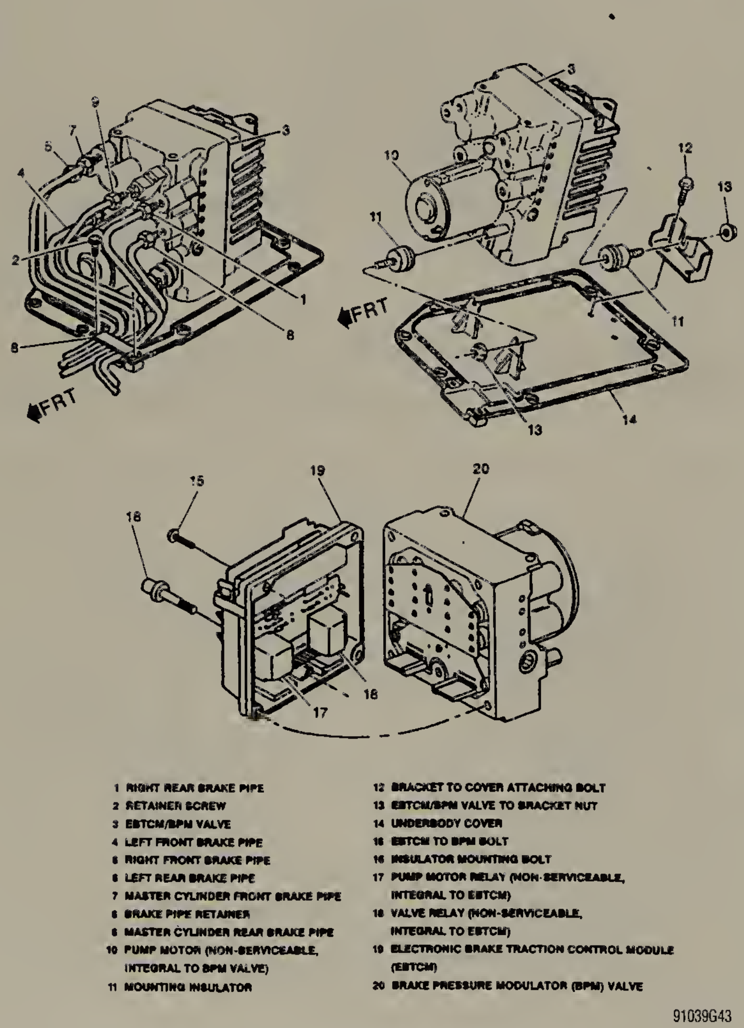


Fig. 111 Exploded view of the BPM/EBTCM valve assembly—1995 VIN P engine and 1996 vehicles

6. Remove the EBTCM bracket.
7. Note the location of the brake lines, then disconnect the lines from the BPM valve. Plug the lines to avoid excessive fluid loss.
8. Remove the BPM valve. Slide the BPM rearward out of the front insulators, leaving them attached to the underbody cover.
9. If the valve is being replaced, transfer the ground wire to the new valve and transfer the EBTCM to the new valve. Tighten the EBTCM-to-BPM bolts to 18 inch lbs. (2 Nm) and the insulator mounting bolt to 11 ft. lbs. (15 Nm).

⁂ WARNING

Be careful not to damage the EBTCM seal.

To install:

10. Install the BPM valve with the EBTCM and bracket attached. Slide the BPM mounting studs into the insulators.
11. Install the EBTCM bracket-to-underbody cover attaching bolts and tighten to 89 inch lbs. (10 Nm). Install the insulator-to-bracket nut to 89 inch lbs. (10 Nm).

⁂ CAUTION

You MUST connect the brake lines properly. Reversing the connection of the lines will cause wheel-lock up and possible personal injury.

12. Unplug the brake lines, then connect to the valve, as noted during removal. Tighten the valve brake pipe fittings to 12 ft. lbs. (16 Nm) using a flare nut wrench to avoid twisting the lines.
13. Install the selective ride control module.
14. Attach the EBTCM electrical connector.

⁂ WARNING

When installing the ABS/TCS wiring harness, make sure that the ignition is OFF, and that all connectors are securely engaged. This will prevent system damage and malfunctions.

15. Connect the negative battery cable. Fill and bleed the hydraulic system, as outlined in this section.
16. Install the sound insulator pad, making sure the pad covers the entire valve to prevent excessive system noise.

Control Module

REMOVAL & INSTALLATION

1986–91 Vehicles

➧ **See Figure 112**

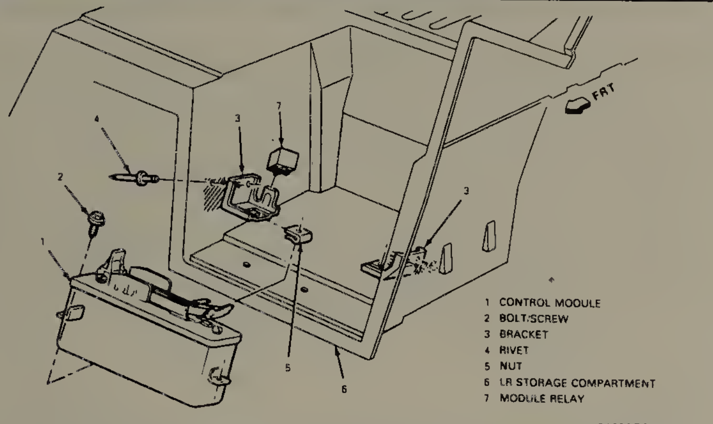
➡**On 1990–91 models, the control module is referred to as the Electronic Brake Control Module (EBCM). On 199 vehicles, the control module is referred to as the Electronic Brake and Traction Control Module (EBTCM).**

1. Disconnect the negative battery cable.

⁂ WARNING

To prevent equipment damage, never connect or disconnect the electrical connector from the control module with the ignition switch in the ON position.

2. From the passenger's compartment, remove the storage tray and insulation, located behind the driver's seat.
3. Detach the electrical connector from the control module connector, by depressing the spring clip located under the neck of the connector.
4. Remove the module relay from the brackets.
5. Unfasten the bolts attaching the control module to the brackets, then remove the control module from the vehicle.



91039G37

Fig. 112 Exploded view of the control module mounting—1986–89 vehicles

To install:

➡**You must install the control module properly so that the wiring harness connector comes in from the proper side.**

6. Position the control module in the brackets, and secure with the retaining bolts. Tighten the bolts to 22 inch lbs. (2.5 Nm).
7. Install the module relay to the bracket.
8. Attach the electrical connector to the control module connector. Make sure the connection is tight and fully seated.
9. Install the insulation and storage tray.
10. Connect the negative battery cable, the perform the ABS system check, as outlined on the accompanying chart.

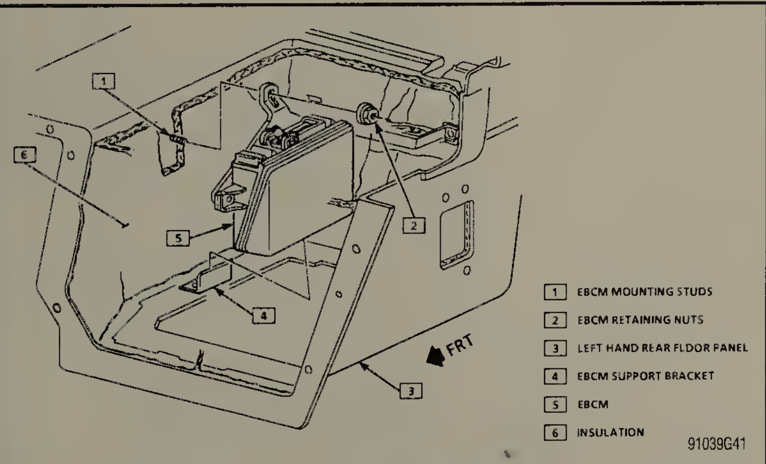
1992–96 Vehicles

▶ See Figure 113

1. Disconnect the negative battery cable.
2. On coupes, open the left rear storage compartment cover.
3. On convertibles, remove the storage compartment frame and covers.
4. Remove the sound insulator pad.

➡**On 1993–96 vehicles, the name was changed to Electronic Brake and Traction Control Module (EBTCM).**

5. Detach the wiring harness connector from the EBCM by pulling the retaining clip up to release front of the connector, then slide the connector towards the front of the vehicle.
6. For 1992–94 vehicles and 1995 VIN J engines, perform the following:
   a. Remove the retaining nut, then remove the EBCM from the vehicle.
7. For 1995 VIN P and 1996 engines, perform the following:
   a. Remove the EBTCM bracket bolts.
   b. Slide the brake and insulator off the EBTCM
   c. Remove the EBTCM. If replacing the module, transfer the bracket to the new module.



91039G41

Fig. 113 Exploded view of the EBCM on 1992–94 vehicles shown

To install:

8. For 1995 VIN P and 1996 engines, perform the following:
   a. Install the EBTCM and bracket.
   b. Install the EBTCM-to-BPM mounting bolts and EBTCM insulator mounting bolts.
   c. Tighten the EBTCM-to-BPM bolts to 18 inch lbs. (2 Nm), the insulator mounting bolt to 11 ft. lbs. (15 Nm), the EBTCM bracket-to-underbody bolts to 89 inch lbs. (10 Nm) and the insulator retaining nut to 8 ft. lbs. (11 Nm).
9. For 1992–94 vehicles and 1995 VIN J engines, position the EBCM and secure with the retaining nut. Tighten the nut to 8 ft. lbs. (11 Nm).
10. Attach the wiring harness connector, making sure the retaining clip locks and the connector is fully seated.

➡**Always be sure the sound insulator pad covers the whole modulator or excessive noise could result during system operation.**

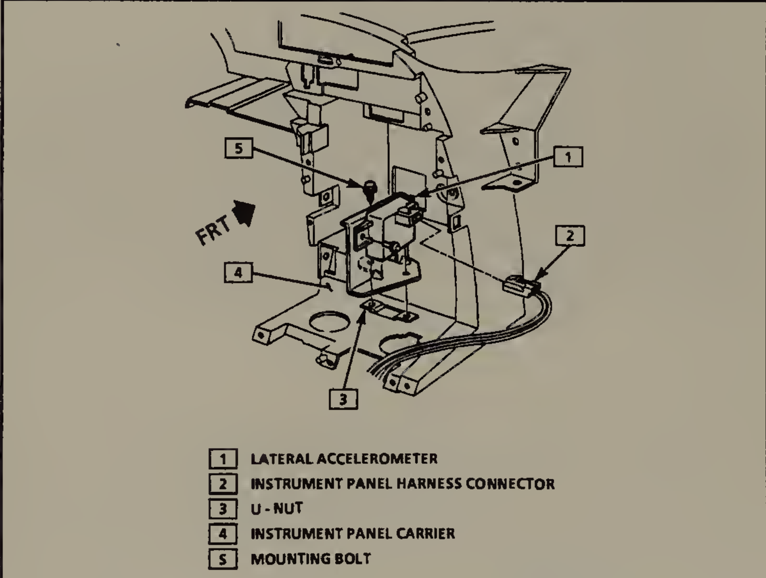
11. Install the sound insulator pad.
12. Install the left storage compartment cover on the coupes or the storage compartment frame and covers on convertibles.
13. Connect the negative battery cable.

Lateral Accelerometer

REMOVAL & INSTALLATION

▶ See Figure 114

1. Disconnect the negative battery cable.
2. Remove the console and accessory trim plates.
3. If necessary, remove the A/C or radio control assembly.
4. Detach the ABS wiring harness connector from the lateral accelerometer.
5. Unfasten the bolts attaching the lateral accelerometer to the instrument panel carrier.
6. Remove the lateral accelerometer from the carrier.
7. Installation is the reverse of the removal procedure. Tighten the mounting bolts to 29 inch lbs. (3.3 Nm).



91039G42

Fig. 114 Exploded view of the lateral accelerometer—1995 vehicle shown, others similar

Bleeding The ABS System

AUTO BLEED PROCEDURE

1995–96 Vehicles

➡**On 1995–96 vehicles, if the proper pedal height and feel is not achieved after the regular bleeding procedure is completed, you must**

perform the Auto Bleed procedure. This procedure requires the use of a Tech 1®, or equivalent scan tool.

The auto bleed procedure is used to provide a complete brake system bleed on 1995–96 vehicles, which are equipped with Bosch 5 ABS. The procedure cycles the system valves and runs the pump to purge air from secondary circuits which are normally closed off during non-ABS/TCS mode operation and bleeding. This procedure is primarily to be used when it is suspected that air has been ingested into the system secondary circuits, or when the Brake Pressure Modulator (BPM) valve has been replaced with a new unit.

In order to perform this procedure, you will need the following:

- Tech 1® or equivalent scan tool with MSC.
- A pressure bleeder capable of producing at least 30 psi with suitable adapters and filled with the proper type of brake fluid from a sealed container.
- A hoist, or jack and stands to safely support the vehicle.
- A suitable bleeder bottle to receive the vented brake fluid. The bottle should be unbreakable plastic, with a clear plastic hose that fits snugly on the bleeder valves. The hose should protrude into the bottle, with its end immersed in brake fluid.
- An assistant to pump the brake pedal during the procedure.
- Proper attire, including safety glasses.

➡The auto bleed procedure may be stopped at any time by pressing the "EXIT" button the scan tool. No further prompts pertaining to the bleeding procedure will be given. After pressing the "EXIT" button, relieve the bleed pressure and disconnect the bleed head from the master cylinder, making sure to follow the bleed equipment manufacturers directions.

1. Raise and safely support the vehicle.
2. Remove all of the wheel and tire assemblies.
3. Check the brake system for leaks or component damage. Make sure to fix all conditions before starting the bleed procedure.
4. Make sure the vehicle's battery is fully charged.
5. Connect the Tech 1® scan tool to the DLC.
6. Turn the ignition switch to the **RUN** position, but do not start the engine.
7. Establish communications with the scan tool and select ABS/TCS system features.
8. Press "F4: Misc. Tests"
9. Select "Automated Bleed Procedure"
10. Bleed the brake system, as outlined earlier in this section.
11. Press the "UP" button. This conducts several tests which determine whether the ABS/TCS system condition is such that the bleed procedure can be performed. If any malfunctions are found, the bleed procedure will be aborted. If DTCs are present, the scan tool will display "DTCs PRESENT", or list the DTCs, depending upon when the codes were set. The codes can be displayed or cleared as necessary in the "F2: Trouble Codes" mode. Make sure to correct any system malfunctions before trying to repeat the bleeding procedure.
12. Connect the pressure bleed equipment, following the manufacturer's directions, then press the "UP" button.
13. Apply bleed pressure, minimum 30 psi. Check for leaks at the master cylinder reservoir bleeder cap and fix, if necessary.
14. Have an assistant pump the brake pedal continuously from this point on, with long, steady strokes. Press "UP" on the scan tool.
15. Open the left rear bleeder screw, use the bleeder bottle. Press "ENTER" when prompted. Press the "UP" button.
16. Close the left rear bleeder screw when prompted on the screen. Press "ENTER" when prompted.
17. The left rear bleed is complete. Press "UP".
18. Repeat the previous 3 steps on the right rear brakes.
19. Open the right front bleeder screw, use the bleeder bottle. Press "ENTER".
20. Have an assistant pump the brake pedal continuously, with long, steady strokes. Press "UP" on the scan tool.
21. Close the right front bleeder screw when prompted on the screen. Press "ENTER" when prompted.
22. The right front bleed is complete. Press "UP".
23. Open the left front bleeder screw, use the bleeder bottle. Press "ENTER".
24. Have an assistant pump the brake pedal continuously, with long, steady strokes. Press "UP" on the scan tool.
25. Close the left front bleeder screw when prompted on the screen. Press "ENTER" when prompted.
26. The left front bleed is complete. Press "UP". At this time, the scan tool performs several tests to recheck system operation. The scan tool does not check bleed success. If any malfunctions occur, relieve the bleed pressure, then disconnect the bleed equipment, as outlined by the manufacturer. If any DTCs are present, the scan tool will show them. The codes can be cleared in the "F2: Trouble Codes" mode. Press "EXIT" to return to the scan tool main menu. Make sure to correct any system malfunctions before trying to repeat the bleeding procedure.
27. If the screen shows "BLEED PROCEDURE COMPLETE", press the up button.
28. Release the bleed pressure, following the tool manufacturers directions, Press the "UP" button.
29. Disconnect the bleed equipment. Immediately clean up any spilled brake fluid, by wiping it up with a cloth, then flushing with water. Do NOT let any water get into the master cylinder. Press "EXIT".
30. DEpress the brake pedal. It should be high and firm. If not, recheck the brake system thoroughly. If the brake system is OK, but excessive pedal travel exists, repeat the auto bleed procedure.
31. Turn the ignition **OFF**.
32. Disconnect the scan tool. Reinstall the wheel and tires, then carefully lower the vehicle.
33. Check the brake fluid level and refill if necessary. Road test the vehicle, making several ABS and traction control stops, in a safe area. The brake pedal should stay high and firm after the road test.

BRAKE SPECIFICATIONS

All measurements in inches unless noted

Year	Model	Master Cylinder Bore	Brake Disc Original Thickness	Brake Disc Minimum Thickness	Brake Disc Maximum Runout	Brake Drum Diameter Original Inside Diameter	Brake Drum Diameter Max. Wear Limit	Brake Drum Diameter Maximum Machine Diameter	Minimum Lining Thickness Front	Minimum Lining Thickness Rear
1984	Corvette	NA	NA	0.724	0.006	NA	NA	NA	0.062	0.061
1985	Corvette	NA	NA	0.724	0.006	NA	NA	NA	0.062	0.061
1986	Corvette	NA	NA	0.724	0.006	NA	NA	NA	0.062	0.061
1987	Corvette	NA	NA	0.724	0.006	NA	NA	NA	0.062	0.061
1988	Corvette	NA	NA	0.724	0.006	NA	NA	NA	0.062	0.062
1989	Corvette	NA	NA	①	0.006	NA	NA	NA	0.062	0.062
1990	Corvette	NA	NA	①	0.006	NA	NA	NA	0.062	0.062
1991	Corvette	NA	NA	①	0.006	NA	NA	NA	0.062	0.062
1992	Corvette	NA	②	③	0.006	NA	NA	NA	0.030	0.030
1993	Corvette	NA	②	③	0.006	NA	NA	NA	0.030	0.030
1994	Corvette	NA	②	③	0.006	NA	NA	NA	0.030	0.030
1995	Corvette	NA	②	③	0.006	NA	NA	NA	0.030	0.030
1996	Corvette	NA	②	③	0.006	NA	NA	NA	0.030	0.030

NA - Not Available

① Heavy duty: 1.039; Std.: 0.724

② Heavy duty: 1.059; Std.: 0.744

③ Heavy duty: 1.110; Std.: 0.795

91039C01

Troubleshooting the Brake System

Problem	Cause	Solution
Low brake pedal (excessive pedal travel required for braking action.)	• Excessive clearance between rear linings and drums caused by inoperative automatic adjusters	• Make 10 to 15 alternate forward and reverse brake stops to adjust brakes. If brake pedal does not come up, repair or replace adjuster parts as necessary
	• Worn rear brakelining	• Inspect and replace lining if worn beyond minimum thickness specification
	• Bent, distorted brakeshoes, front or rear	• Replace brakeshoes in axle sets
	• Air in hydraulic system	• Remove air from system. Refer to Brake Bleeding.
Low brake pedal (pedal may go to floor with steady pressure applied.)	• Fluid leak in hydraulic system	• Fill master cylinder to fill line; have helper apply brakes and check calipers, wheel cylinders, differential valve tubes, hoses and fittings for leaks. Repair or replace as necessary.
	• Air in hydraulic system	• Remove air from system. Refer to Brake Bleeding.
	• Incorrect or non-recommended brake fluid (fluid evaporates at below normal temp).	• Flush hydraulic system with clean brake fluid. Refill with correct-type fluid.
	• Master cylinder piston seals worn, or master cylinder bore is scored, worn or corroded	• Repair or replace master cylinder
Low brake pedal (pedal goes to floor on first application—o.k. on subsequent applications.)	• Disc brake pads sticking on abutment surfaces of anchor plate. Caused by a build-up of dirt, rust, or corrosion on abutment surfaces	• Clean abutment surfaces
Fading brake pedal (pedal height decreases with steady pressure applied.)	• Fluid leak in hydraulic system	• Fill master cylinder reservoirs to fill mark, have helper apply brakes, check calipers, wheel cylinders, differential valve, tubes, hoses, and fittings for fluid leaks. Repair or replace parts as necessary.
	• Master cylinder piston seals worn, or master cylinder bore is scored, worn or corroded	• Repair or replace master cylinder
Decreasing brake pedal travel (pedal travel required for braking action decreases and may be accompanied by a hard pedal.)	• Caliper or wheel cylinder pistons sticking or seized	• Repair or replace the calipers, or wheel cylinders
	• Master cylinder compensator ports blocked (preventing fluid return to reservoirs) or pistons sticking or seized in master cylinder bore	• Repair or replace the master cylinder
	• Power brake unit binding internally	• Test unit according to the following procedure: (a) Shift transmission into neutral and start engine (b) Increase engine speed to 1500 rpm, close throttle and fully depress brake pedal (c) Slow release brake pedal and stop engine (d) Have helper remove vacuum check valve and hose from power unit. Observe for backward movement of brake pedal. (e) If the pedal moves backward, the power unit has an internal bind—replace power unit

TCCA9C01

Troubleshooting the Brake System (cont.)

Problem	Cause	Solution
Spongy brake pedal (pedal has abnormally soft, springy, spongy feel when depressed.)	• Air in hydraulic system	• Remove air from system. Refer to Brake Bleeding.
	• Brakeshoes bent or distorted	• Replace brakeshoes
	• Brakelining not yet seated with drums and rotors	• Burnish brakes
	• Rear drum brakes not properly adjusted	• Adjust brakes
Hard brake pedal (excessive pedal pressure required to stop vehicle. May be accompanied by brake fade.)	• Loose or leaking power brake unit vacuum hose	• Tighten connections or replace leaking hose
	• Incorrect or poor quality brakelining	• Replace with lining in axle sets
	• Bent, broken, distorted brakeshoes	• Replace brakeshoes
	• Calipers binding or dragging on mounting pins. Rear brakeshoes dragging on support plate.	• Replace mounting pins and bushings. Clean rust or burrs from rear brake support plate ledges and lubricate ledges with molydisulfide grease. **NOTE:** If ledges are deeply grooved or scored, do not attempt to sand or grind them smooth—replace support plate.
	• Caliper, wheel cylinder, or master cylinder pistons sticking or seized	• Repair or replace parts as necessary
	• Power brake unit vacuum check valve malfunction	• Test valve according to the following procedure: (a) Start engine, increase engine speed to 1500 rpm, close throttle and immediately stop engine (b) Wait at least 90 seconds then depress brake pedal (c) If brakes are not vacuum assisted for 2 or more applications, check valve is faulty
	• Power brake unit has internal bind	• Test unit according to the following procedure: (a) With engine stopped, apply brakes several times to exhaust all vacuum in system (b) Shift transmission into neutral, depress brake pedal and start engine (c) If pedal height decreases with foot pressure and less pressure is required to hold pedal in applied position, power unit vacuum system is operating normally. Test power unit. If power unit exhibits a bind condition, replace the power unit.
	• Master cylinder compensator ports (at bottom of reservoirs) blocked by dirt, scale, rust, or have small burrs (blocked ports prevent fluid return to reservoirs).	• Repair or replace master cylinder **CAUTION:** Do not attempt to clean blocked ports with wire, pencils, or similar implements. Use compressed air only.
	• Brake hoses, tubes, fittings clogged or restricted	• Use compressed air to check or unclog parts. Replace any damaged parts.
	• Brake fluid contaminated with improper fluids (motor oil, transmission fluid, causing rubber components to swell and stick in bores	• Replace all rubber components, combination valve and hoses. Flush entire brake system with DOT 3 brake fluid or equivalent.
	• Low engine vacuum	• Adjust or repair engine

TCCA9C02

Troubleshooting the Brake System (cont.)

Problem	Cause	Solution
Grabbing brakes (severe reaction to brake pedal pressure.)	• Brakelining(s) contaminated by grease or brake fluid	• Determine and correct cause of contamination and replace brakeshoes in axle sets
	• Parking brake cables incorrectly adjusted or seized	• Adjust cables. Replace seized cables.
	• Incorrect brakelining or lining loose on brakeshoes	• Replace brakeshoes in axle sets
	• Caliper anchor plate bolts loose	• Tighten bolts
	• Rear brakeshoes binding on support plate ledges	• Clean and lubricate ledges. Replace support plate(s) if ledges are deeply grooved. Do not attempt to smooth ledges by grinding.
	• Incorrect or missing power brake reaction disc	• Install correct disc
	• Rear brake support plates loose	• Tighten mounting bolts
Dragging brakes (slow or incomplete release of brakes)	• Brake pedal binding at pivot	• Loosen and lubricate
	• Power brake unit has internal bind	• Inspect for internal bind. Replace unit if internal bind exists.
	• Parking brake cables incorrrectly adjusted or seized	• Adjust cables. Replace seized cables.
	• Rear brakeshoe return springs weak or broken	• Replace return springs. Replace brakeshoe if necessary in axle sets.
	• Automatic adjusters malfunctioning	• Repair or replace adjuster parts as required
	• Caliper, wheel cylinder or master cylinder pistons sticking or seized	• Repair or replace parts as necessary
	• Master cylinder compensating ports blocked (fluid does not return to reservoirs).	• Use compressed air to clear ports. Do not use wire, pencils, or similar objects to open blocked ports.
Vehicle moves to one side when brakes are applied	• Incorrect front tire pressure	• Inflate to recommended cold (reduced load) inflation pressure
	• Worn or damaged wheel bearings	• Replace worn or damaged bearings
	• Brakelining on one side contaminated	• Determine and correct cause of contamination and replace brakelining in axle sets
	• Brakeshoes on one side bent, distorted, or lining loose on shoe	• Replace brakeshoes in axle sets
	• Support plate bent or loose on one side	• Tighten or replace support plate
	• Brakelining not yet seated with drums or rotors	• Burnish brakelining
	• Caliper anchor plate loose on one side	• Tighten anchor plate bolts
	• Caliper piston sticking or seized	• Repair or replace caliper
	• Brakelinings water soaked	• Drive vehicle with brakes lightly applied to dry linings
	• Loose suspension component attaching or mounting bolts	• Tighten suspension bolts. Replace worn suspension components.
	• Brake combination valve failure	• Replace combination valve
Chatter or shudder when brakes are applied (pedal pulsation and roughness may also occur.)	• Brakeshoes distorted, bent, contaminated, or worn	• Replace brakeshoes in axle sets
	• Caliper anchor plate or support plate loose	• Tighten mounting bolts
	• Excessive thickness variation of rotor(s)	• Refinish or replace rotors in axle sets

TCCA9C03

10

BODY AND TRIM

EXTERIOR

Doors

ADJUSTMENT

Door Lock Striker

See Figures 1 and 2

The door lock striker consists of a single metal bolt and washer assembly which threads into a tapped, floating cage plate located in the body lock pillar. With this design, the door is secured in the closed position when the door lock ford-bolt snaps over and engages the striker bolt.

1. To adjust the striker up or down, or in or out, loosen the striker bolt then shift the striker as necessary, then tighten the bolt.
2. To figure out if the striker fore or aft adjustment is necessary, perform the following:
   a. Make sure the door is properly aligned.
   b. Apply modeling clay or body caulking compound to the lock bolt opening.
   c. Close the door only as far as necessary for the striker bolt to form an impression. Do not close the door all of the way, because that will make removing the clay very difficult.
   d. Measure the striker impression as follows: The striker head should be centered fore and aft as shown in the accompanying figure; but, some tolerances are allowed. In this alignment, it is important that the minimum dimensions in the accompanying figure be strictly maintained. The following spacers are available as service parts and can be used individually, or in combination, to achieve the specified alignment:
   - 5⁄64 in. spacer
   - 5⁄32 in. spacer
   - 1⁄4 in. spacer
   - 5⁄16 in. spacer

   If your check indicated a need for spacers, proceed with the following:
3. Use a pencil to matchmark the position of the striker on the body lock pillar.
4. Insert a suitable wrench into the head of the striker bolt, then remove the striker.
5. Installation is the reverse of the removal procedure. Make sure the striker is placed within the pencil mark. Whenever a door has been removed and reinstalled or realigned, the door should not be closed completely until a visual check is made to determine if the lock fork-bolt is properly engaging with the striker.

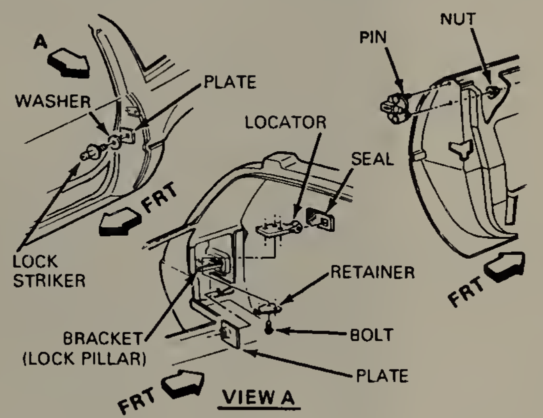


Fig. 1 View of the door lock striker and locator

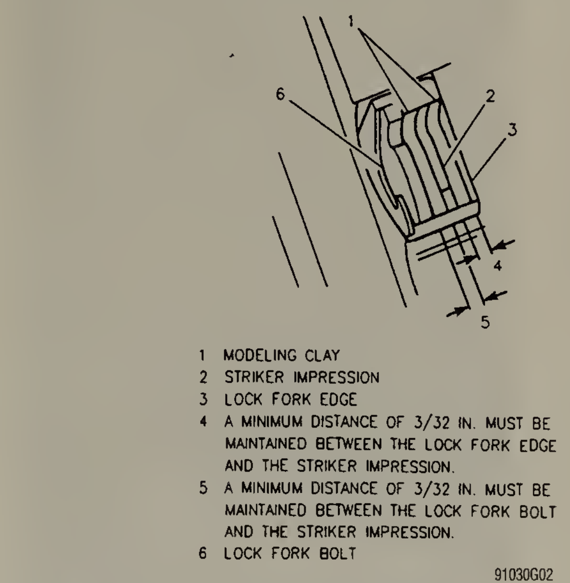


Fig. 2 Checking the striker adjustment

Door

See Figure 3

➡**To adjust the door assembly, you must remove the fender for access to the door hinge.**

1. Remove the front fender as follows:
   a. Raise the hood.
   b. Remove the bolts attaching the lower wheelhouse to the front fender. If you turn the wheels to the right, you will have better access to the lower bolts.
   c. Remove the upper fender bolt and shim.
   d. Remove the lower front rocker panel-to-frame side rail.
   e. Reposition the rocker panel to access the lower fender bolt, then loosen the lower fender bolt.
   f. Remove the front fender and lower shim from the vehicle.
2. Loosen the hinge-to-pillar bolts and hinge-to-door.
3. Adjust the door and check for a proper fit, then tighten the hinge-to-pillar bolts to 26 ft. lbs. (35 Nm).

To install:

4. Install the fender as follows:
   a. Position the fender to the vehicle on the loosely installed lower mounting bolt.
   b. Loosely install the upper fender mounting bolt to the bracket.
   c. Adjust the fender-to-door opening and the fender-to-hood opening with shims, as necessary.
   d. Tighten the fender upper and lower mounting bolts to 15 ft. lbs. (20 Nm) and the wheelhouse-to-fender bolts to 51 inch lbs. (5.75 Nm).
   e. Reposition the rocker panel, then install the bolt to the side rail. Tighten the wheelhouse-to-side rail bolts to 84 inch lbs. (9.5 Nm).
   f. Lower the hood.

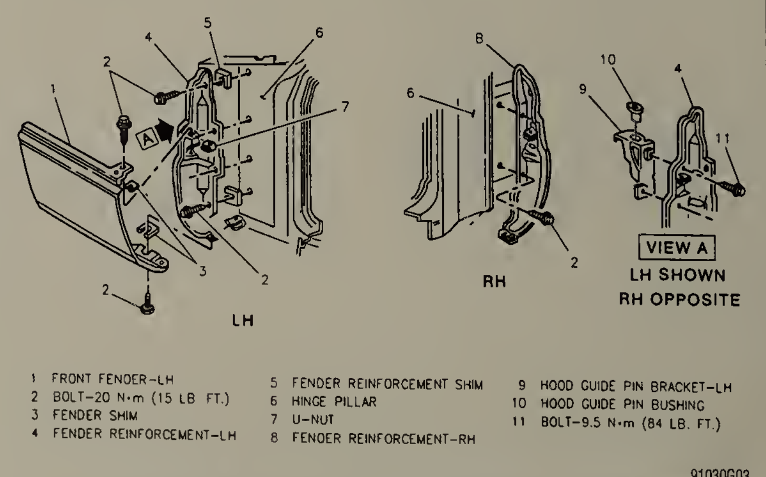


Fig. 3 Exploded view of the front fender mounting—1996 vehicle shown

Hood

REMOVAL & INSTALLATION

1986–89 Vehicles

See Figures 4 thru 10

➡Hood removal will require the use of an assistant.

1. Raise the hood, then disconnect the negative battery cable.
2. Remove the right and left upper wheel house from the hood panel. There are 8 screws on each side.
3. Detach the wiring, then remove the 2 underhood lamps.

91030P01

Fig. 4 Tag and detach any necessary electrical connectors for hood removal

4. Remove the right and left bolt and spring assemblies which are secured by 3 bolts on each side.
5. Detach the head lamp electrical connectors, then remove the headlamps from the vehicle.
6. Unfasten the 2 nuts, then remove the hood emblem.
7. Remove the remaining fasteners and clips.
8. Remove the hood support rod.
9. Use a paint marker or equivalent to matchmark the position of the hinge to the hood, then with the help of an assistant, remove the 2 hinge-to-hood nuts on each side. Carefully remove the hood from the vehicle.
10. If the hinges are removed, make sure to note the number of shims used on each side.
11. For installation of the hood, align the hinges with the marks made during removal, then install the hinge-to-hood retaining nuts.
12. Installation is the reverse of the removal procedure. After completion, make sure the hood is proper aligned.

1990–96 Vehicles

See Figure 11

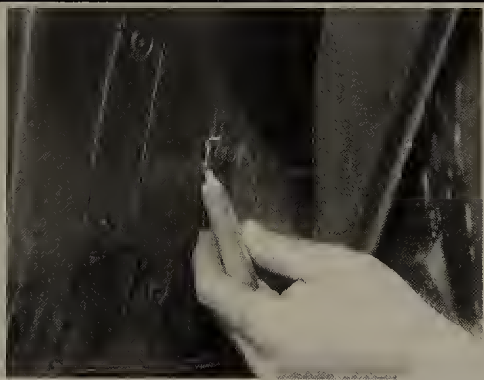
➡You will need an assistant to help you remove the hood. Also, make sure to protect the front of the hood from damage from the hood shifting and hitting the fascia when the hinge nuts are removed.

1. Raise the hood.
2. Detach the electrical connectors from the head lights and underhood lamps.
3. Remove the hood strut.
4. Use a paint marker or equivalent to matchmark the installed positions of the hinges on the hood.
5. With an assistant supporting the hood, remove the nuts securing the hinges to the studs in the hood.

➡The hood must be removed from the hinges while in the lowered position. Trying to remove the hood in the raised position will damage the hood.

91030P02

Fig. 5 Use a paint marker or equivalent to matchmark the lower hinge position



91030P03

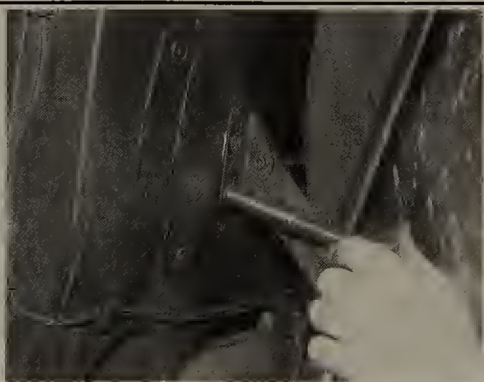
Fig. 6 All the hood hinges should be matchmarked before removal to assure proper alignment during installation

91030P04

Fig. 7 With hood properly supported, remove the necessary retaining nuts and bolts

91030P05

Fig. 8 It may be necessary to use a ratchet with an extension to access some of the retainers



91030P06

Fig. 9 It's very important to have the hood proper supported when removing the retaining bolts

91030P07

Fig. 10 With the help of an assistant, carefully pull the hinge away, then remove the hood from the vehicle

6. Lower the hood then lift straight up to remove it. If the hinges are removed from the front side member, make sure to note the position of the hinge and the number of shims used at each hinge.

7. Transfer the parts as necessary.

To install:

8. With the help of an assistant, position the hood studs to the hinge an align the marks. Install the retaining nuts to secure the hinges to the hood. Tighten the nuts to 20 ft. lbs. (27 Nm).

9. Install the hood strut.

10. Attach the electrical connectors to the head lights and under hood lamps.

11. Lower the hood.

12. Adjust the hood as outlined later in this section.

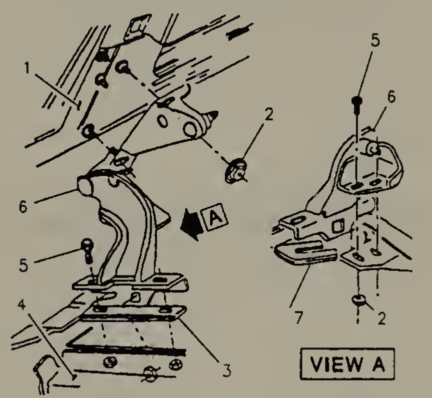


Fig. 11 Exploded view of the hood hinge assembly—1996 vehicles

ALIGNMENT

➧ See Figures 12 and 13

1. Hood adjustment is as follows:
   a. Hood front edge-to-front fascia height adjustment is by shims under the hood hinge.
   b. Hood front edge-to-front fascia gap adjustment is set by loosening the nuts securing the hood to the hood hinge and setting the gap to the front fascia so that it is even across the entire length of the gap.
   c. The hood adjustment rear bumper should be set to a length of 1 in. (26mm) from tip to hood mounting, as shown in the accompanying figure.

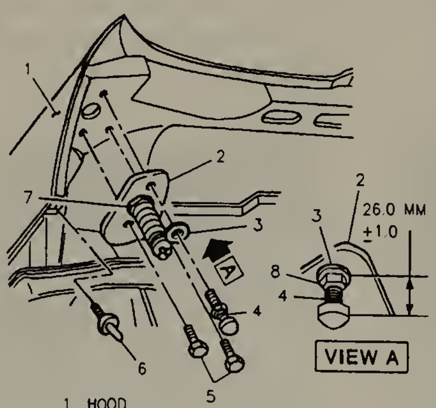


Fig. 12 View of the latch bracket and latch bolts

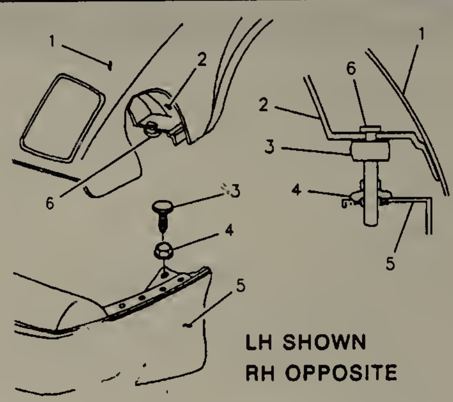


Fig. 13 Exploded view of the hood front bumper

   d. After all adjustments are made the front hood panel adjusting bumpers should be set to a touch condition of 3/64 in. (1mm) interface to the hood rivet.

2. The hood should latch when dropped from an open position, with the front edge of the hood's hood to fender line 6–12 in. (15–30cm) above the roof line.

3. If necessary, adjust the hood latch bolt with the spring to about 2 in. (50mm) from the bracket to the underside of the bolt tip.

4. Vertical hood height is adjusted by loosening the jam nut, then inserting a screwdriver in the slot in the end of the latchbolt, positioning the vertical height of the hood for proper seating and alignment to door edges. Tighten the jam nut to 92 ft. lbs. (125 Nm).

5. If necessary, center the latch bolt in the latch plate by repositioning the bracket and latch bolt assembly. Make sure to pay particular attention to the cross vehicle alignment.

Hatch Lid

REMOVAL & INSTALLATION

➧ See Figures 14 thru 21

➡You will need an assistant to help you remove the glass. The rear hatch window upper hinge and glass are serviced as an assembly.

1. Disconnect the negative battery cable.
2. Open the rear hatch window.

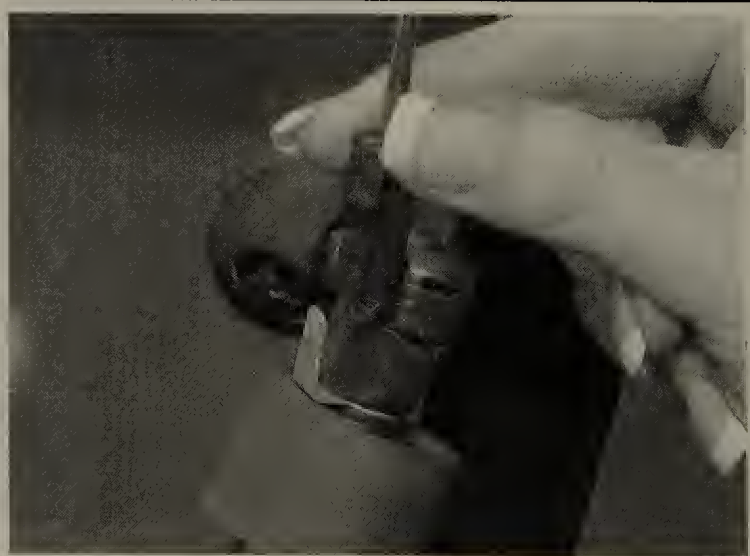


Fig. 14 To remove the hatch lid struts, detach the electrical connector

91030P09

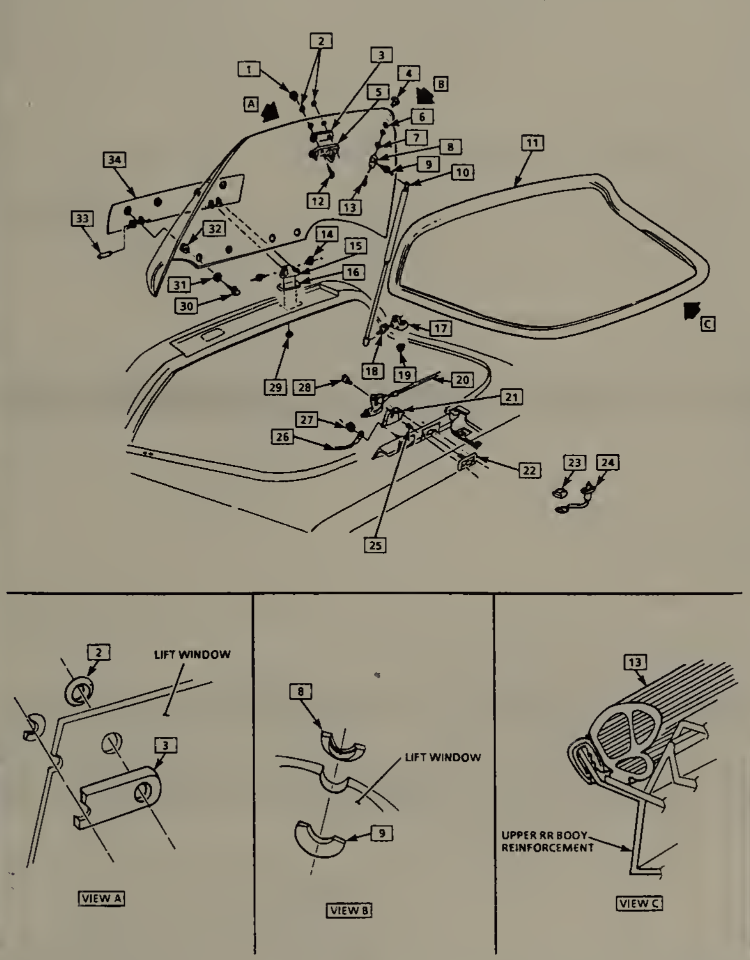
Fig. 15 Use a small flat-bladed tool to carefully pry the retaining clip out

91030P11

Fig. 16 You may find it easier to remove the clip with a pair of needle-nose pliers

91030P10

Fig. 17 Then, pull the strut away from the ball socket on the lid



91030G07

Fig. 18 Exploded view of the rear hatch window and related components—1993 vehicle shown, others similar

1	NUT, CATCH STRIKER	18	STUD, STRUT-BODY SIDE
2	SEAL	19	NUT, HEX
3	SPACER, LATCH STRIKER	20	CABLE/SOLENOID ASM., LATCH RELEASE
4	NUT, STRUT BRACKET	21	LATCH, LIFT WINDOW
5	STRIKER, LATCH	22	RETAINER, LATCH STUD
6	SEAL	23	RELAY, LIFT WINDOW RELEASE
7	SPACER, STRUT BRACKET	24	SWITCH, CARGO LAMP/THEFT DETERRENT
8	BRACKET, STRUT-WINDOW SIDE	25	RIVET
9	STUD, STRUT-WINDOW SIDE	26	GROUND WIRE
10	STRUT	27	NUT, HEX
11	WEATHERSTRIP	28	SCREW
12	BOLT, LATCH STRIKER	29	NUT, HEX
13	BOLT, LIFT WINDOW	30	BOLT, HINGE-WINDOW SIDE
14	BUSHING, HINGE PIN	31	WASHER, HINGE
15	HINGE, BODY SIDE - LOWER	32	SPACER, HINGE
16	SPACER, BODY SIDE	33	PIN, LIFT WINDOW
17	BRACKET, STRUT-BODY SIDE	34	HINGE, WINDOW SIDE - UPPER

91030G08

Fig. 19 Rear hatch window component key list—1993 vehicles

3. Remove the roof panel.
4. For 1984–89 vehicles, remove the interior center roof trim panel.
5. For 1990–92 vehicles, remove the right and left hatch front trim panels.
6. Peel back (both sides at the glass attachment access holes) and reposition the noise control patch.
7. If necessary, detach the ground connector for the electric rear defogger, and or the high-mounted stop lamp connector and retainer.

➡Do not remove the high-mount stoplamp assembly from the upper hinge unless the hatch glass and upper hinge are being replaced.

8. With the hatch properly supported, pry the retaining clip out of the hatch lid struts, then pull the struts away from the ball sockets on the lid.

91030P12

Fig. 20 If necessary, you can unfasten the retainers, remove the trim cover . . .

91030P13

Fig. 21 . . . and access the rear hatch lock assembly

9. With an assistant supporting the hatch window, unfasten the remaining retainers and/or or hinge pins. Carefully remove the hatch from the vehicle and place on a suitable workbench.
10. If replacing the hatch, transfer the striker, assist rod rear brackets, and high-mounted stop lamp to the replacement hatch.
11. Installation is the reverse of the removal procedure.

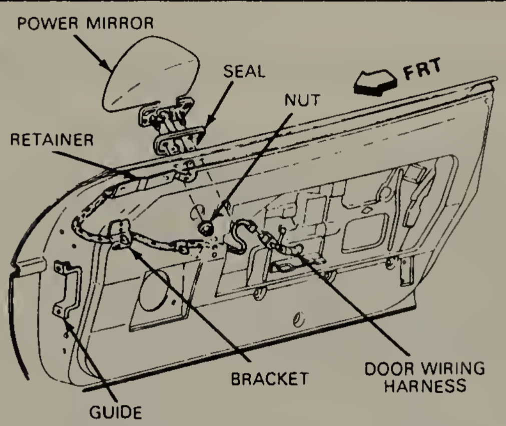
Outside Mirrors

REMOVAL & INSTALLATION

1984–88 Vehicles

See Figure 22

1. Roll the window down, remove the door trim panel and water deflector.
2. Disconnect the negative battery cable.
3. Unfasten the clips holding the electrical wiring to the door.
4. Remove the 2 attaching nuts, then remove the mirror from the vehicle.
5. Installation is the reverse of the removal procedure.



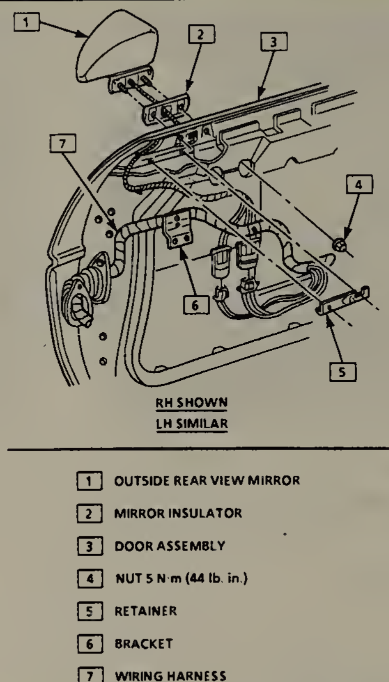
91030G09

Fig. 22 Outside power mirror mounting—1988 vehicle shown

1989–96 Vehicles

See Figure 23

1. Lower the window.
2. Disconnect the negative battery cable.
3. Remove the door trim panel and water deflector.
4. Either remove the accessory mounting plate screws, or partially remove the inner mounting panel for access to the mirror electrical connectors.
5. Remove the mirror wiring harness retainer.
6. Detach the mirror electrical connector.
7. Unfasten the retaining nuts, then remove the mirror from the door. Make sure to note the mirror's wire harness routing. Convertibles are equipped with wind deflectors which are attached to the mirrors. The wind deflectors must be installed.
8. Installation is the reverse of the removal procedure.



91030G10

Fig. 23 Power outside mirror mounting—1993 vehicle shown, others similar

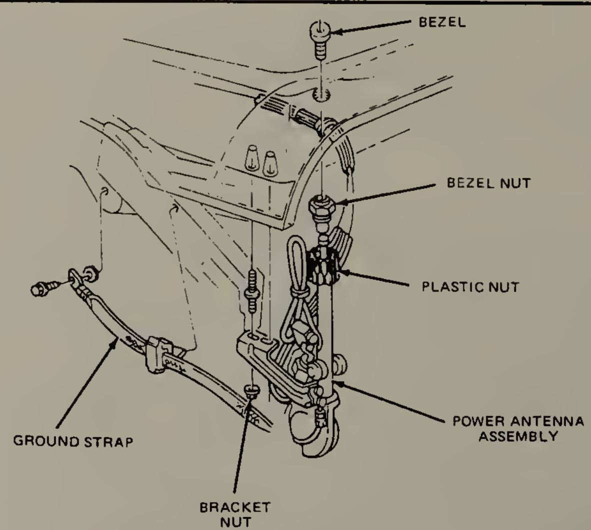
Antenna

REPLACEMENT

1984–88 Vehicles

See Figure 24

1. Disconnect the negative battery cable.
2. Open the hatch, then remove the rear trim panel.
3. Disconnect the power antenna lead from the relay.
4. Remove the left side trim.
5. If equipped, remove the luggage shade.
6. Remove the left side carpet trim, then pull the carpet back.
7. Remove the left side trim panel.
8. Raise and safely support the vehicle.
9. Remove the inner fender screws and brace open for access.



91030G11

Fig. 24 Power antenna removal and installation—1986 vehicle shown

10. Remove the antenna ground strap.
11. Unfasten the plastic nut at the top of the mast.
12. Remove the antenna bracket nuts.
13. Remove the power and antenna leads by pulling them through the body.
14. Remove the antenna from the vehicle. Transfer the bracket and ground strap.
15. Installation is the reverse of the removal procedure.

1989–96 Vehicles

➧ See Figure 25

COUPE

1. Release the hatch, then disconnect the negative battery cable.
2. Remove the hatch rear trim panel.
3. Remove the left rear speaker grille.
4. Reposition the hatch left side trim panel.

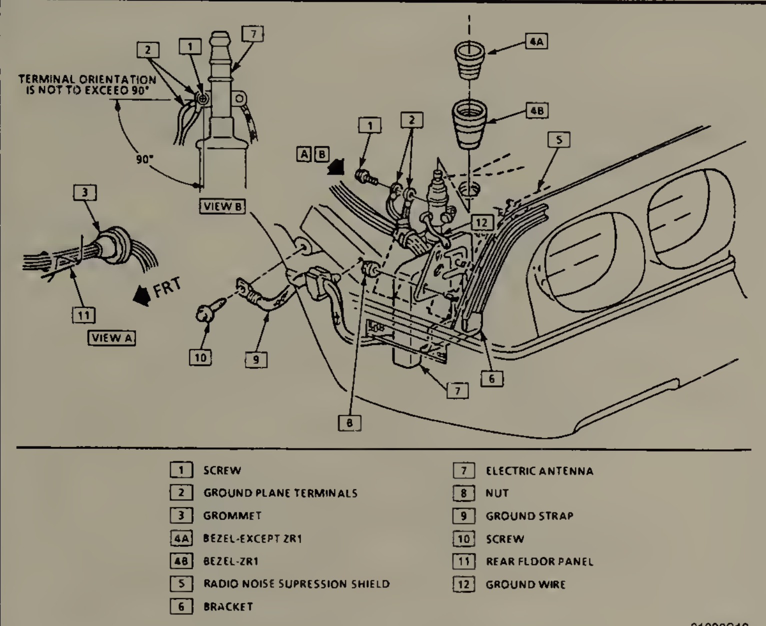


Fig. 25 Exploded view of the power antenna mounting

5. Unfasten the shade latch.
6. Remove the rear carpet retainer and sound insulator.
7. Reposition the carpet in order to get to the antenna lead, then detach the lead.
8. Unplug the connector from the antenna relay.
9. For 1992–96 vehicles, push the rubber grommet, electrical harness and antenna cable through the body hole.
10. Raise and safely support the vehicle.
11. If necessary, unfasten the screws holding the rear wheelhouse for access to the antenna.
12. For 1989–91 vehicles, perform the following:
    a. Remove the retainers securing the antenna and ground wire.
    b. Remove the antenna ground strap.
    c. Remove the grommet from the body hole.
    d. Remove the electrical and antenna leads through the hole in the body.
13. For 1992–96 vehicles, perform the following:
    a. Remove the body ground strap and antenna from bracket.
    b. Remove the antenna from the bezel.
    c. Unfasten the screw securing the ground plane terminals.
    d. Remove the screw fastening the ground strap to the bracket.
14. Remove the antenna from the vehicle.
15. Installation is the reverse of the removal procedure.

CONVERTIBLE

1. Release convertible top stowage lid.
2. Disconnect the negative battery cable.
3. Unfasten the left side carpet retainers, then pull the carpet back.
4. Remove the power antenna relay.
5. Detach the coaxial connector and relay electrical connector.
6. Push the rubber grommet through the hole in the body.
7. For 1992–96 vehicles, pull the electrical and antenna leads through the body hole.
8. Raise and safely support the vehicle.
9. For 1992–96 vehicles, perform the following:
    a. Remove the ground strap from the bracket.
    b. Remove the ground strap from the antenna to the bracket.
    c. Unfasten the screw securing the ground plane terminals.
10. Unfasten the antenna mounting bracket, then remove the antenna assembly from the vehicle.
11. Installation is the reverse of the removal procedure.

INTERIOR

Instrument Panel and Pad

REMOVAL & INSTALLATION

1984–88 Vehicles

➧ See Figure 26

1. Disconnect the negative battery cable.
2. Remove the instrument panel pad, as follows:
    a. Remove the instrument panel cluster bezel.
    b. Remove the steering column tilt lever.
    c. Unfasten the 5 screws securing the instrument panel pad to the carrier.
    d. Remove the 2 screws from the defroster ducts.
    e. Remove the instrument panel pad.
3. Unfasten the 2 left close out panel attaching screws. Detach the courtesy lamp electrical connector, then remove the panel.
4. Remove the right side instrument panel trim and fuse cover.
5. Unfasten the 4 upper dash brace attaching screws, then remove the braces.
6. Remove the right flexible A/C duct hose and duct.
7. Unfasten the 2 screws securing the instrument panel to the side glass defroster hose.
8. Remove the right side trim pad.
9. Unfasten the retainers, then remove the right lower carpeted panel.
10. Remove the radio.
11. Remove the 4 screws from the center cluster and carrier.
12. Tag and detach the electrical connectors from the main cluster. Note that there are metal clips on the back of the connectors.
13. Remove the center cluster.
14. Unfasten the 4 main cluster screws.
15. Remove the console bezel and shift handle. Unplug the bulb connector.
16. Remove the 4 A/C control-to-instrument panel mounting screws, then push the control back through the opening.
17. Unfasten the headlamp switch attaching nut.

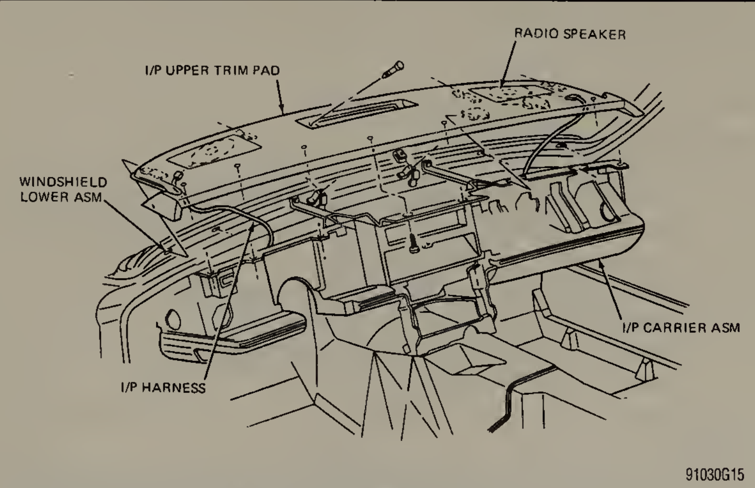


Fig. 26 Exploded view of the instrument panel pad and carrier assembly—1984 vehicle shown, others similar

18. Remove the fog lamp switch.
19. Remove the trim piece at the hood release handle.
20. Remove the steering column trim cover and the 2 column attaching bolts.
21. Unfasten the 2 bolts securing the carrier to the console. Remove the 2 nuts from the upper sides of the console and the 2 bolts from the lower sides. Detach the fuse block from the carrier.
22. Detach the center A/C duct.
23. Disconnect the left side A/C duct, then remove the 2 screws from the carrier-to-defroster duct.
24. Remove the harness-to-carrier screws from the backside of the carrier and from the left defrost hose at the column brace.
25. Carefully remove the remove the instrument panel carrier from the vehicle.
26. Installation is the reverse of the removal procedure. Make sure all electrical connectors are properly attached, and all components installed and tightened securely.

1989 Vehicles

➧ See Figure 26

1. Disconnect the negative battery cable.
2. Remove the steering column tilt lever and the headlamp switch knob.
3. Unfasten the 8 instrument panel courtesy trim plate screws, then remove the trim plate.
4. Remove the instrument panel accessory trim plate.
5. Remove the floor console trim plate and the instrument panel fuse plate.
6. Remove the instrument panel upper pad.
7. Remove the instrument panel gauge cluster.
8. Remove the radio and the HVAC control head assembly.
9. Remove the information center telltale.
10. Unfasten the 4 instrument panel upper brace screws and braces.
11. Disconnect the right duct and flex hose.
12. Remove the 2 right side glass defroster screws and the flexible hose.
13. Unfasten the headlamp switch nut.
14. Detach the fog lamp switch electrical connector.
15. Remove the instrument panel left and right side sound insulators.
16. Remove the hood release handle trim piece.
17. Remove the instrument panel left lower trim pad.
18. Unfasten the 12 instrument panel carrier bolts and nuts.
19. Remove the fuse block from the carrier.
20. Unfasten the 2 left hand side defroster screws and flex hose.
21. Remove the 2 steering column-to-carrier attaching bolts.
22. Unfasten the 2 retainers, then remove the center A/C duct.
23. Remove the multi-use relay bracket.
24. Pull the carrier rearward for access.
25. Remove the left A/C duct.
26. Unfasten the 2 wiring harness retaining screws and 3 clips.
27. Remove the instrument panel left carrier support and 2 nuts.
28. Remove the theft deterrent control, PASS key module and LTPWS module.
29. Carefully remove the instrument panel carrier from the vehicle.
30. Installation is the reverse of the removal procedure. Make sure all electrical connectors are properly attached, and all components installed and tightened securely.

1990–96 Vehicles

➧ See Figures 27 and 28

1. Properly disable the SIR system, as outlined in Section 6 of this manual.
2. If not done already, disconnect the negative battery cable.
3. Remove the driver's side knee bolster.
4. Remove the right side lower trim panel and support.
5. Remove the console and accessory trim plates.
6. Unfasten the console-to-instrument panel bolts/screws.
7. Remove the console side trim panels.
8. Unfasten the retaining bolts/screws holding the instrument panel to the inner knee bolster brackets.
9. Remove the bolts from the stack bracket.
10. Remove the Driver Information Center (DIC), HVAC control panel and radio control assembly.

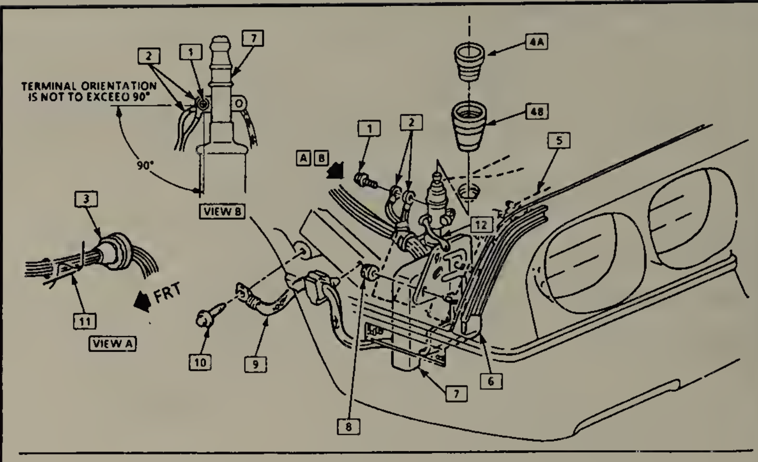


Fig. 27 Exploded view of the instrument panel and related components—1996 vehicle shown

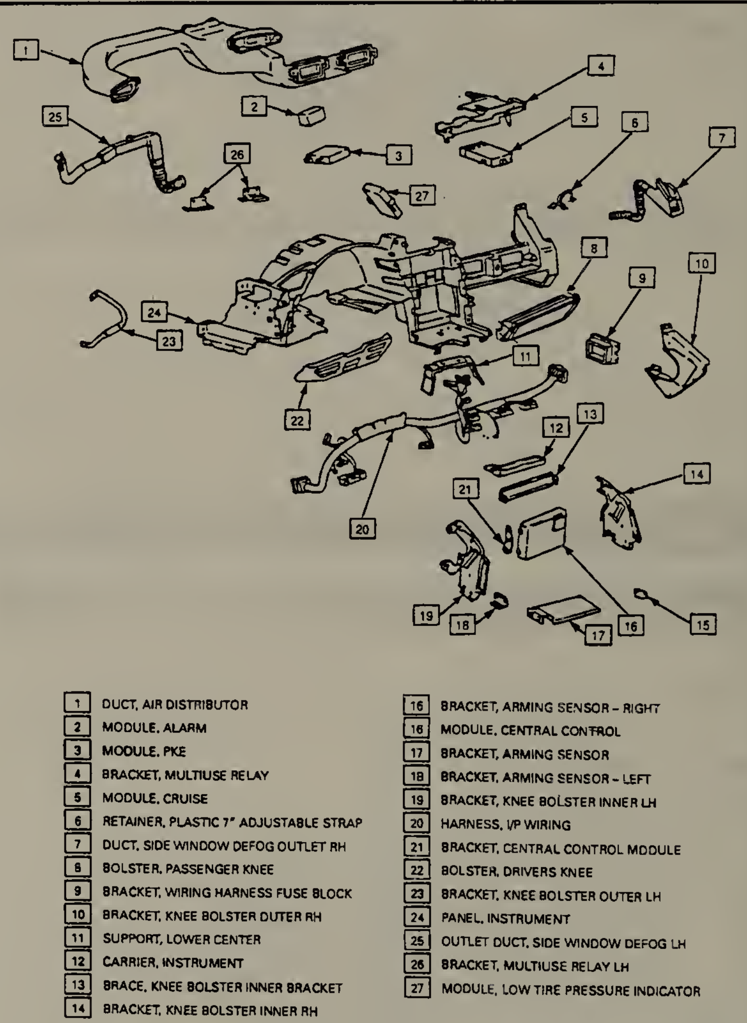


Fig. 28 Instrument panel removal—1996 vehicle shown, others similar

11. Remove the lateral accelerometer.
12. Remove the upper trim pad.
13. Remove the cluster and headlamp switch.
14. Unfasten the wire harness retainers from the instrument panel.
15. Remove the side window defogger outlet ducts.
16. Remove the inside air temperature sensor.
17. Remove the upper instrument panel brace.
18. Unfasten the upper and lower outer instrument panel-to-dash nuts from the studs.

19. Carefully drill out the rivet heads, then remove the fuse box.
20. Remove the multi-use relay brackets.
21. Remove the air distribution duct from the instrument panel.
22. Tag and detach the harness connectors from the instrument panel mounted modules.
23. Remove the instrument panel from the vehicle.
24. Installation is the reverse of the removal procedure. Make sure all electrical connectors are properly attached, and all components mounted securely.

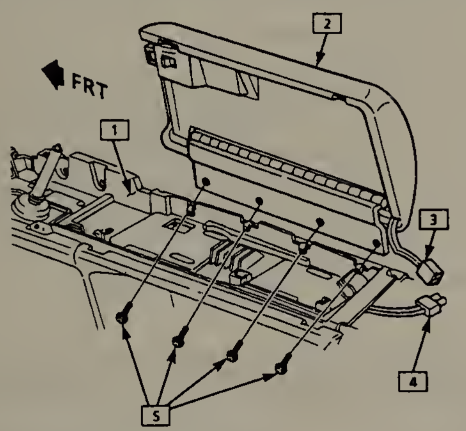
Console

REMOVAL & INSTALLATION

See Figures 29 and 30

The following procedure is a general procedure for console removal. You may have to modify or skip certain steps depending upon your vehicle.

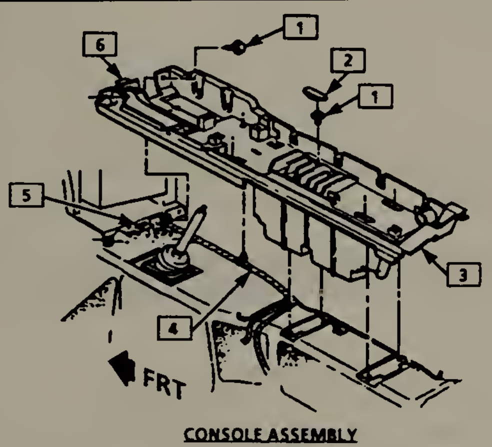
1. Disconnect the negative battery cable.
2. Remove the shift knob, floor compartment door and console trim plate.



1 CONSOLE ASSEMBLY
2 CONSOLE DOOR ASSEMBLY
3 CONSOLE DOOR LAMP CONNECTOR
4 INSTRUMENT PANEL HARNESS CONNECTOR
5 SCREWS

91030G16

Fig. 29 Remove the retainers, unplug the connector, then remove the console door



1 CONSOLE BOLT/SCREW
2 FILLER (CAP)
3 CONSOLE CARRIER ASSEMBLY
4 INSTRUMENT PANEL HARNESS
5 INSTRUMENT PANEL CARRIER LOCATING SLOT
6 CONSOLE LOCATING TAB

91030G17

Fig. 30 Exploded view of a typical console mounting

3. Remove the instrument panel accessory trim plate.
4. Unfasten the retaining bolts, detach the connector, then remove the console door.
5. Remove the seats, as outlined later in this section, in order to get to the lower rear screw(s) on the side trim panels.
6. Remove the console side trim panels.
7. If equipped, remove the switch pack housing with the switches.
8. Remove the console compartment floor protector, bolt covers and bolts.
9. Unfasten the screws mounting the console to the instrument panel and tunnel.
10. Unclip the harness and accessory plug.
11. Tag and detach all necessary electrical connectors.
12. If necessary, remove any remaining retainers.
13. Tilt the rear of the console up, then slide the front tab back out of the instrument panel and remove the console from the vehicle.

To install:

14. Position the console in the vehicle by placing the front tab of the console into the instrument panel slot, making sure to align the screw holes.
15. Attach the electrical connectors as tagged during removal.
16. The remaining of installation is the reverse of the removal procedure. Tighten the console retaining screws to 89 inch lbs. (10 Nm).

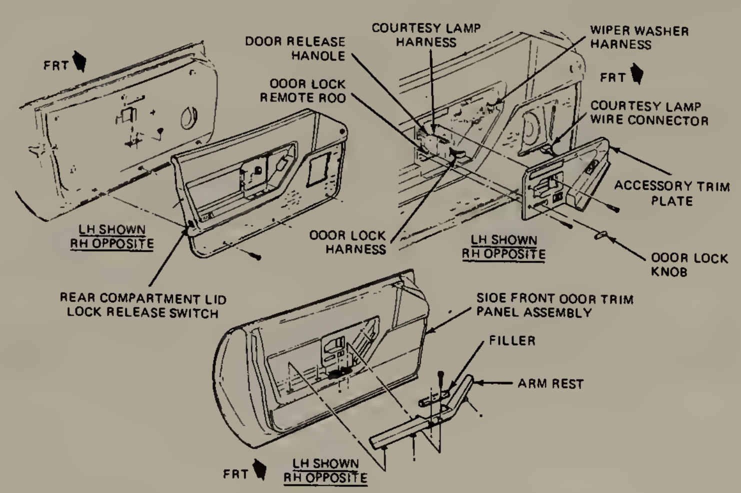
Door Panels

REMOVAL & INSTALLATION

1984–89 Vehicles

See Figure 31

1. Raise the hood, then disconnect the negative battery cable.
2. Unfasten the 2 screws attaching the armrest to the trim panel. Push the armrest inward to remove the plastic hooks on the armrest from the slot on the door trim panel.
3. If equipped, remove the armrest filler.
4. Remove the retaining screws, then remove the speaker grille.
5. If equipped, remove the manual lock knob.
6. Unfasten the accessory trim plate screws. Note there is a hidden screw behind the door release handle.
7. Detach the electrical connectors from the hatch lid release switch, door lock courtesy light and, if removing the driver's side door panel, the wiper switch.
8. Remove the accessory trim plate.
9. Remove the remote control plate and the courtesy lamp.
10. Remove the upper molding an air outlet.
11. Unfasten the door trim panel retaining screws, the pull the panel partially away from the door.
12. Detach the hatch lid release switch electrical connector.
13. Remove the door panel from the vehicle.
14. Installation is the reverse of the removal procedure.



91030G18

Fig. 31 Exploded view of the door trim panel—1984–88 vehicles

1990–96 Vehicles

See Figures 32 and 33

1. Disconnect the negative battery cable.
2. Remove the accessory/inside handle bezel, as follows:
3. Remove the courtesy lamp from the bezel by gently prying down on the top edge, about ½ in. (13mm) inboard of the corners and rotating the lamp downward and out.
   a. Remove the remote control lock knob from the rod by carefully prying it outward.
   b. If removing the right door panel, remove the armrest filler panel by unfastening the screws retaining the armrest filler.
   c. Remove the bezel screws. The right and left side bezels may have different numbers of screws.
   d. Pull the inside handle outward, then reposition the bezel.
   e. Detach the courtesy lamp harness from the wiring harness connector.
   f. Unplug the electrical connector from the door lock switch.
   g. Remove the bezel.
4. If removing the left door panel, remove the armrest filler panel, as follows:
   a. Unfasten the screws from the armrest filler pull cup.
   b. Remove the armrest filler by raising the rear edge and pulling towards the rear to clear the armrest filler clip on the forward edge.
   c. Unplug the wiring harness connectors for the side window switch and outside rearview mirror switch.
5. If removing the right side door panel, you must remove the window switch for access to the trim panel mounting retainer. Carefully pry the switch away from the trim panel, then detach the electrical connector.
6. Unfasten the door trim panel retaining bolts and screws.
7. Detach the rear hatch lid release switch electrical connector by pulling the bottom edge of the trim panel out, then reaching between the panel and the door to disconnect it.

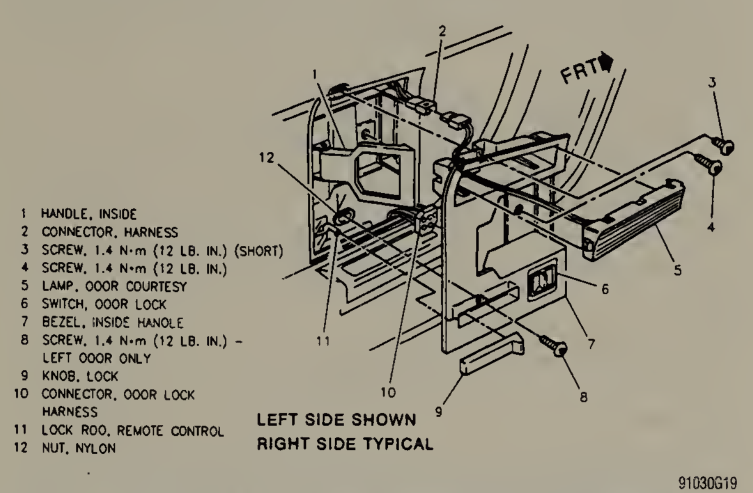


Fig. 32 Exploded view of the inside handle bezel—1996 vehicle shown, others similar

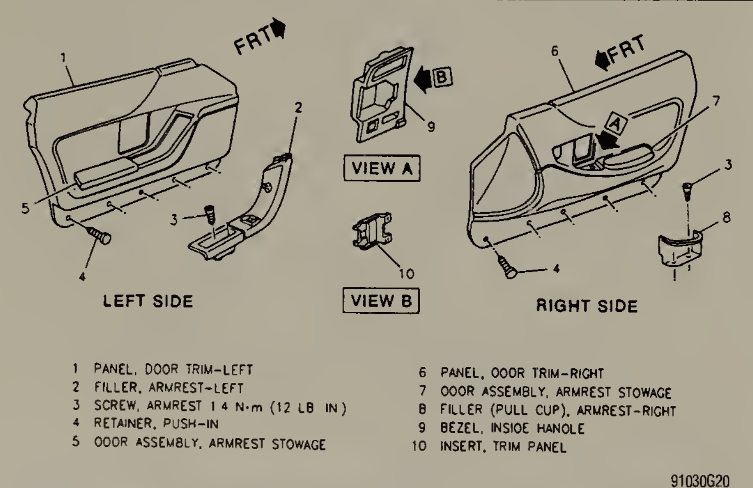


Fig. 33 Right and left side door trim panels—1996 vehicle shown, others similar

8. Remove the door trim panel by pulling the panel out at the bottom, then up out of the door alignment slots.
9. Installation is the reverse of the removal procedure.

Door Locks

REMOVAL & INSTALLATION

1984–88 Vehicles

See Figure 34

1. Disconnect the negative battery cable.
2. Remove the armrest and the speaker grille.
3. Remove the foam insulator.
4. Remove the door trim panel, as outlined earlier in this section.
5. Remove the inner mounting plate as follows:
   a. Disconnect the wire harness rose bud clip.
   b. Unfasten the 8 plate screws and 2 bolts.
   c. Disconnect the actuator rod.
   d. Remove the remote rod by pushing the plate down and pulling out slightly to remove the clip.
   e. Unfasten the screws from the lock mechanism.
   f. Disconnect the lock cylinder rod.
   g. Lower the lock mechanism, pushing the rod and plate assembly back into the door to get to the opening in the door for the lock. With the rod and lever in sight, disconnect the clip and rod, then remove the plate.
6. Unfasten the 2 nuts and backing plate from the handle. Unplug the power door lock connector. If necessary, plate clips on the remote rods to make removal easier.
7. Installation is the reverse of the removal procedure.

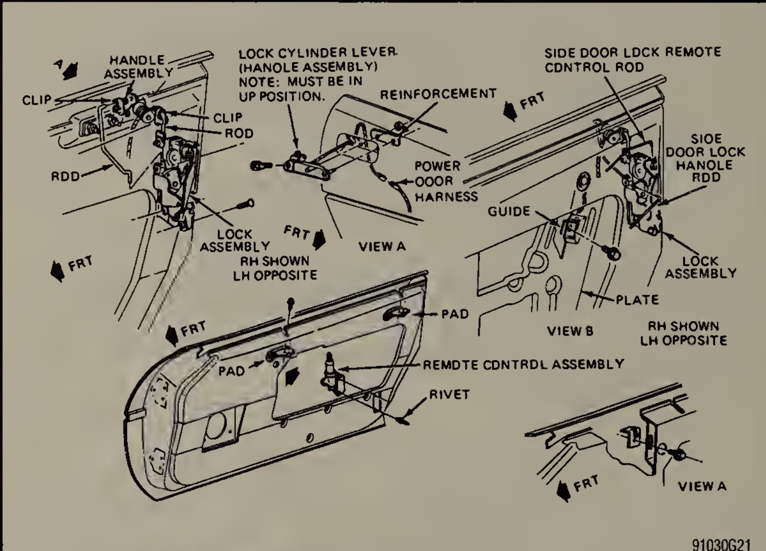
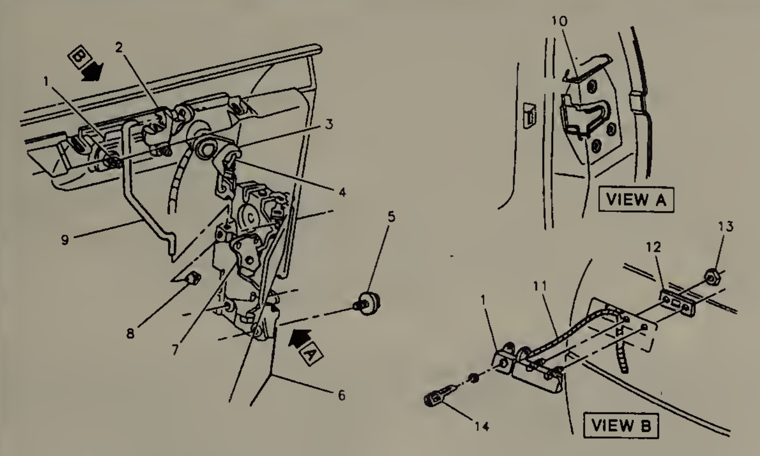


Fig. 34 Exploded view of the door lock and remote control system—1984–88 vehicles

1989–96 Vehicles

See Figure 35

1. Disconnect the negative battery cable.
2. Remove the door trim panel and water separator.
3. For 1989 vehicles, remove the accessory mounting plate, as follows:
   a. Slide the lock remote control rod from the side outside handle rod clip.
   b. Remove the inside handle clip from the inside handle lock, then disconnect the rod.
   c. Remove the inside handle lock rod and lock remote control rod from the inside handle lock rod guides.
   d. Unfasten the accessory mounting plate screws and glass stabilizer guide bolt, then remove the plate.
   e. Remove the wire harness rosebud clips.
   f. Remove the inside handle by drilling out the attaching rivets.



1 OUTSIDE DOOR HANDLE
2 OUTSIDE HANDLE RELEASE ROD CLIP
3 LOCK CYLINDER ROD CLIP
4 LOCK CYLINDER ROD
5 BOLT 7 N·m (63 LB. IN.)
6 DOOR PANEL
7 LOCK
8 INSULATOR/BUMPER, ANTI RATTLE
9 OUTSIDE HANDLE RELEASE ROD
10 DOOR LOCK REINFORCEMENT
11 THEFT DETERRENT WIRE HARNESS
12 BRACKET
13 NUT, 6 N·m (53 LB. IN.)
14 KEY

91030G22

Fig. 35 Exploded view of the door lock assembly—1996 vehicle shown, others similar

4. For 1990–96 vehicles, remove the inner mounting panel, as follows:
   a. Remove the door lock extension plate screw.
   b. Remove the window stabilizer guide bolt.
   c. Unfasten the mounting panel bolts/screws.
   d. Reposition the mounting panel.
   e. Remove the lock rods from the handle, actuator, and anti-rattle clips.
   f. Detach the lock actuator electrical connector.
   g. Remove the inner mounting panel.

Hatch Lock

REMOVAL & INSTALLATION

1984–88 Vehicles

1. Remove the back glass center garnish molding. Loosen the hatch opening side garnish moldings as necessary.
2. Remove the roof panel storage bracket.
3. Unfasten any necessary retainers, then remove the lock.
4. Installation is the reverse of the removal procedure.

1989–96 Vehicles

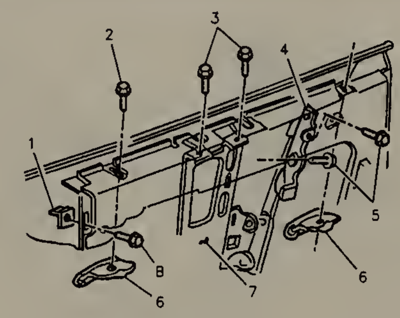
1. Remove the roof panel storage bracket handle.
2. Remove the back glass center garnish molding.
3. Relocate the interior light switches to access the lock assembly.
4. Unfasten the lock assembly retaining nuts, detach the electrical connector, then remove the lock assembly from the vehicle.

Door Glass

REMOVAL & INSTALLATION

See Figures 36 and 37

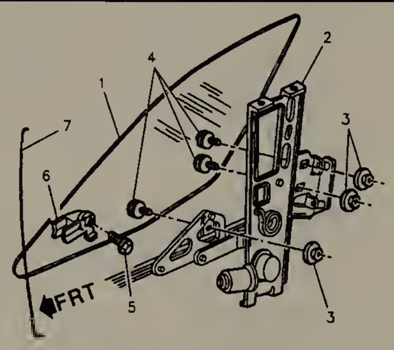
1. Remove the door trim panel and water deflector.
2. Matchmark the installed position of the window pads, then loosen an move the window pads away from the window.
3. Remove the inner mounting panel. For details, refer to the door lock procedure in this section.
4. Connect the window switch, then position the window regulator to access the window nuts and window stop/guide.
5. Detach the window switch electrical connector.
6. Remove the window nuts and window stop/guide. You may need to use a special window retainer nut wrench to remove the nuts.



1 UPPER WINDOW STOP BRACKET
2 BOLT, PAD 9.5 N·m (84 LB. IN.)
3 BOLT, REGULATOR 9.5 N·m (84 LB. IN.)
4 WINDOW STABILIZER GUIDE
5 BOLT, GUIDE 9.5 N·m (84 LB. IN.)
6 WINDOW STABILIZER PAD
7 WINDOW REGULATOR
8 BOLT, BRACKET 8 N·m (70 LB. IN.)

91030G24

Fig. 36 View of the window pads, stop and stabilizer



1 WINDOW-RH
2 MOTOR AND REGULATOR
3 NUT WITH WASHER 7.75 N·m (69 LB. IN.)
4 STUD
5 GUIDE/STOP BOLT 7.75 N·m (69 LB. IN.)
6 GUIDE/STOP
7 GUIDE CHANNEL

91030G23

Fig. 37 Exploded view of the window and regulator—1996 shown, others similar

7. Matchmark the installed position of the upper regulator bolts, then loosen the bolts.

When removing the window from the door, use the openings on the inner edge of the door to clear the studs on the windows.

8. Carefully remove the window from the top of the door and place in a safe place.
9. If replacing the window, transfer the necessary parts to the new window.

To install:

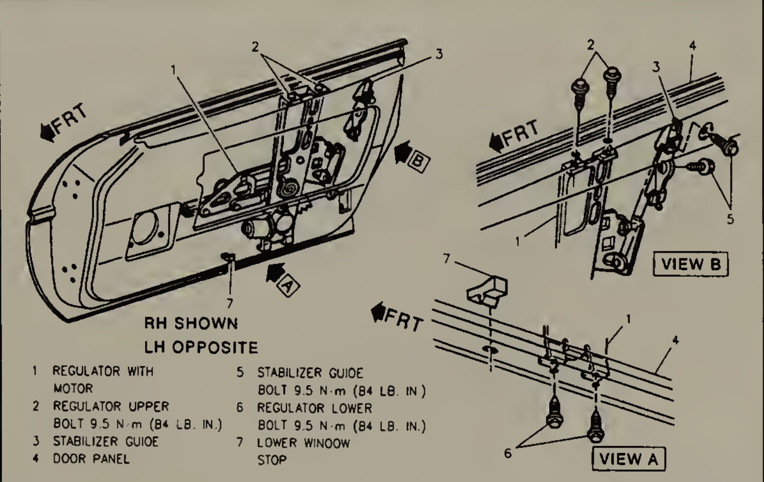
10. Carefully place the window into the door by rotating the window and mounting studs through the openings on the inner edge of the door frame.
11. Install the window regulator nuts to the window studs. Tighten the nuts to 66 inch lbs. (7.5 Nm).
12. Instlal the window stop/guide.
13. Position the window regulator to the marks made during removal, then secure with the retaining bolts. Tighten the bolts to 84 inch lbs. (9.5 Nm).
14. Install the inner mounting panel.
15. Reposition the window pads to their proper locations, and secure with the mounting bolts. Tighten the bolts to 79 inch lbs. (9 Nm).
16. Install the water deflector and door trim panel.

Window Regulator and Motor

REMOVAL & INSTALLATION

See Figure 38

1. Remove the door trim panel and water deflector.
2. Remove the window, as outlined earlier in this section.



91030G25

Fig. 38 Window regulator and motor mounting—1996 shown, others similar

3. Lower the window regulator about ¾ of the way down. Matchmark the location of the upper regulator mounting bolts, then remove the bolts.
4. Detach the window regulator motor electrical connector.
5. Remove the window regulator from the door by rotating the assembly counterclockwise, then tilt the upper rear surface out from the door, rotate clockwise and lift the regulator assembly out.

To install:

6. Position the regulator assembly in the door.
7. Start threading the upper and lower regulator mounting bolts, align the upper bolts with the matchmark made during removal, then tighten the bolts to 84 inch lbs. (9.5 Nm).
8. Attach the regulator motor electrical connector.
9. Install the window, as outlined earlier in this section.
10. Instlal the water deflector and door trim panel.

Windshield and Fixed Glass

REMOVAL & INSTALLATION

If your windshield, or other fixed window, is cracked or chipped, you may decide to replace it with a new one yourself. However, there are two main reasons why replacement windshields and other window glass should be installed only by a professional automotive glass technician: safety and cost.

The most important reason a professional should install automotive glass is for safety. The glass in the vehicle, especially the windshield, is designed with safety in mind in case of a collision. The windshield is specially manufactured from two panes of specially-tempered glass with a thin layer of transparent plastic between them. This construction allows the glass to "give" in the event that a part of your body hits the windshield during the collision, and prevents the glass from shattering, which could cause lacerations, blinding and other harm to passengers of the vehicle. The other fixed windows are designed to be tempered so that if they break during a collision, they shatter in such a way that there are no large pointed glass pieces. The professional automotive glass technician knows how to install the glass in a vehicle so that it will function optimally during a collision. Without the proper experience, knowledge and tools, installing a piece of automotive glass yourself could lead to additional harm if an accident should ever occur.

Cost is also a factor when deciding to install automotive glass yourself. Performing this could cost you much more than a professional may charge for the same job. Since the windshield is designed to break under stress, an often life saving characteristic, windshields tend to break VERY easily when an inexperienced person attempts to install one. Do-it-yourselfers buying two, three or even four windshields from a salvage yard because they have broken them during installation are common stories. Also, since the automotive glass is designed to prevent the outside elements from entering your vehicle, improper installation can lead to water and air leaks. Annoying whining noises at highway speeds from air leaks or inside body panel rusting from water leaks can add to your stress level and subtract from your wallet. After buying two or three windshields, installing them and ending up with a leak that produces a noise while driving and water damage during rainstorms, the cost of having a professional do it correctly the first time may be much more alluring. We here at Chilton, therefore, advise that you have a professional automotive glass technician service any broken glass on your vehicle.

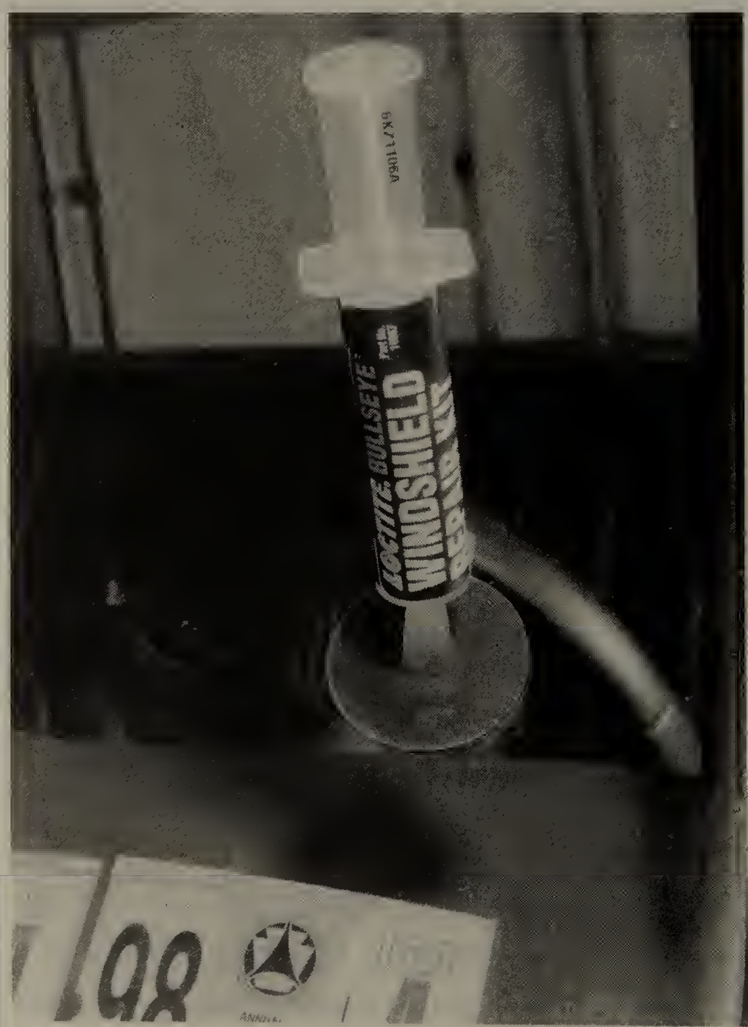
WINDSHIELD CHIP REPAIR

➧ See Figures 39 and 40

➡Check with your state and local authorities on the laws for state safety inspection. Some states or municipalities may not allow chip repair as a viable option for correcting stone damage to your windshield.


TCCA0P00

Fig. 39 Small chips on your windshield can be fixed with an aftermarket repair kit, such as the one from Loctite®



TCCA0P10

Fig. 40 Most kits use a self-stick applicator and syringe to inject the adhesive into the chip or crack

Although severely cracked or damaged windshields must be replaced, there is something that you can do to prolong or even prevent the need for replacement of a chipped windshield. There are many companies which offer windshield chip repair products, such as Loctite's® Bullseye™ windshield repair kit. These kits usually consist of a syringe, pedestal and a sealing adhesive. The syringe is mounted on the pedestal and is used to create a vacuum which pulls the plastic layer against the glass. This helps make the chip transparent. The adhesive is then injected which seals the chip and helps to prevent further stress cracks from developing

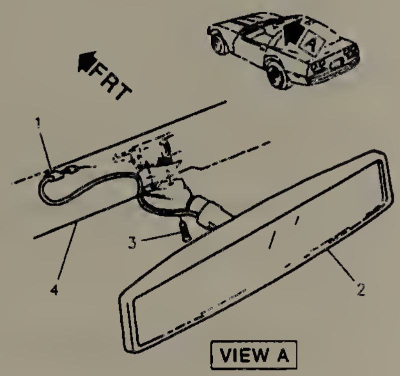
➡Always follow the specific manufacturer's instructions.

Inside Rear View Mirror

REPLACEMENT

➧ See Figure 41

1. Disconnect the negative battery cable.
2. Unfasten the windshield upper garnish molding screws.
3. Remove the mirror retaining screw.
4. If equipped, detach the electrical connector from behind the garnish molding.
5. Remove the mirror.



1 CONNECTOR
2 MIRROR
3 SCREW
4 WINDSHIELD UPPER GARNISH MOLDING

91030G26

Fig. 41 Exploded view of the inside rear view mirror mounting—1996 shown, others similar

Seats

REMOVAL & INSTALLATION

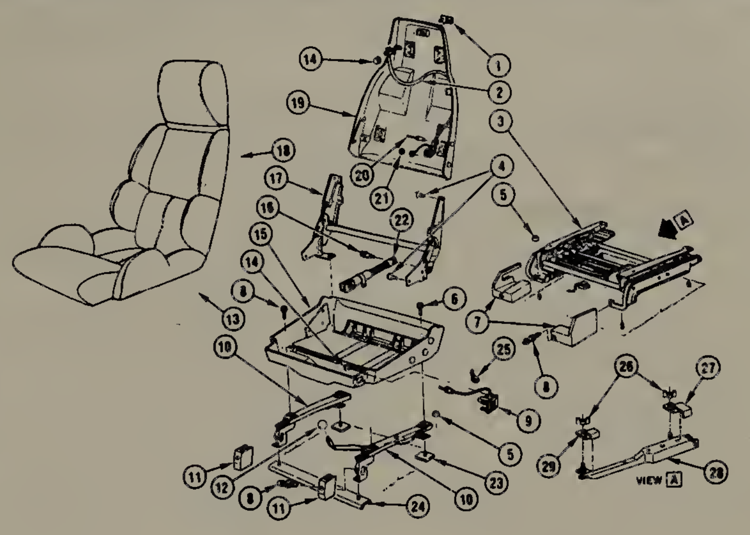
1984–92 Vehicles

➧ See Figure 42

EXCEPT 1984–88 POWER SEATS

1. Move the seat to the full forward position, then fold the seat back forward for access to the support bracket rear bolts or floor pan studs and nuts. Unfasten the bolts/nuts.
2. 1989–92 vehicle's driver side seats, remove the jack wheel wrench handle.
3. Reposition the seat back, then slide the seat rearward.
4. Either move the carpeting away at the edges of the seats, or remove the seat adjuster cover for access to the support front bolts and nuts. You may have to pry the seat adjuster cover retainers out with a suitable prytool.
5. Remove the seat adjuster front nuts.

➡Vehicles with power seats required removing the seat cushion to get to 1 of the 2 electrical connectors The connection under the seat cushion is attached to the seat frame with a push-on type fastener.



1 BEZEL, SEATBACK RELEASE HANDLE
2 RELEASE, SEATBACK
3 ADJUSTER
4 BOLT
5 NUT (W/WASHER)
6 BOLT
7 COVER
8 RETAINER
9 LEVER
10 ADJUSTER
11 COVER
12 KNOB
13 TRIM
14 NUT
15 FRAME, SEAT CUSHION
16 BOLT
17 HINGE
18 TRIM
19 FRAME, SEATBACK
20 RIVET
21 RETAINER
22 ACTUATOR
23 PLATE
24 REINFORCEMENT
25 RETAINER
26 WING NUT
27 RETAINER, WRENCH INTERIOR
28 HANDLE, JACK/WHEEL WRENCH
29 RETAINER, WRENCH OUTER

91030G27

Fig. 42 Exploded view of a manual seat assembly—1989 vehicle shown

6. If equipped, detach the electrical connectors.
7. Remove the seat from the vehicle. If replacing the seat, transfer all necessary components to the new seat.

➡On 1991–92 vehicles, make sure that the power seat wiring harness is protected with a 4 in. section of plastic hose which is split and taped to cover the harness at the gear nut support bracket. This hose protects the harness from shorting with the weight of a person on the seat.

8. Installation is the reverse of the removal procedure.

1984–88 POWER SEATS

The driver's seat is attached to the floor pan with 4 nuts secured to the floor pan. There are electrical connectors from the motor to the switch, and from the switch harness to the body harness.

1. Disconnect the negative battery cable.
2. Remove the seat cushion for access to the adjuster bolts.
3. Remove the seat assembly-to-adjuster bolts, then remove the seat.
4. Remove the front adjuster leg trim covers.
5. Remove the power seat mechanism-to-floor pan stud nuts.
6. Unplug the wire connector from the adjuster and power seat mechanism.
7. Unfasten the cable retainer-to-motor screws, then remove the cable.
8. Remove the vertical adjuster spring, pry off or out of slot with a suitable prytool.
9. Remove the cotter pins from the left side adjuster and split the carriage. You may need to lightly tap with a mallet to disengage the driveshaft at the transmission. The shaft is tubular and is fitted over a mating shaft at the transmission.
10. Remove the driveshaft by prying it out at the left adjuster.
11. Remove the adjuster from the rack and seat mounting.
12. Remove the horizontal adjuster springs.
13. Remove the bolts from the spring retainer.
14. Remove the rack from the adjuster at the carriage assembly.

To install:

15. Align the adjuster in the rack and slide the block to the other slide. Place the plastic side blocks on the mating surface to the rack and gear.
16. Installation is the reverse of the removal procedure, with the following exceptions:

a. Make sure to align the adjusters before replacing them.

b. The adjuster can be moved into position using the motor to access the attaching bolts.

1993–96 Vehicles

See Figures 43, 44 and 45

SEAT WITH ADJUSTERS

1. Move the seat to the full forward position, then fold the seat back forward.
2. If removing the driver's side seat, remove the jack handle and retainers.
3. Remove the nuts rear of the adjuster to the floor studs.

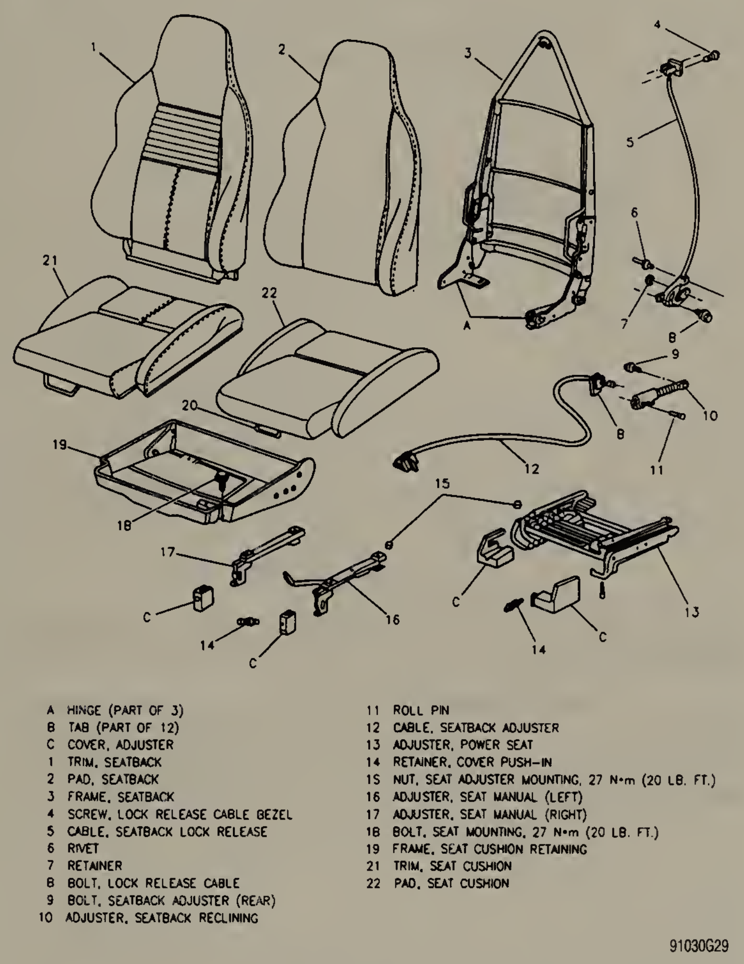


Fig. 43 Exploded view of the base seat assembly, sport seat similar

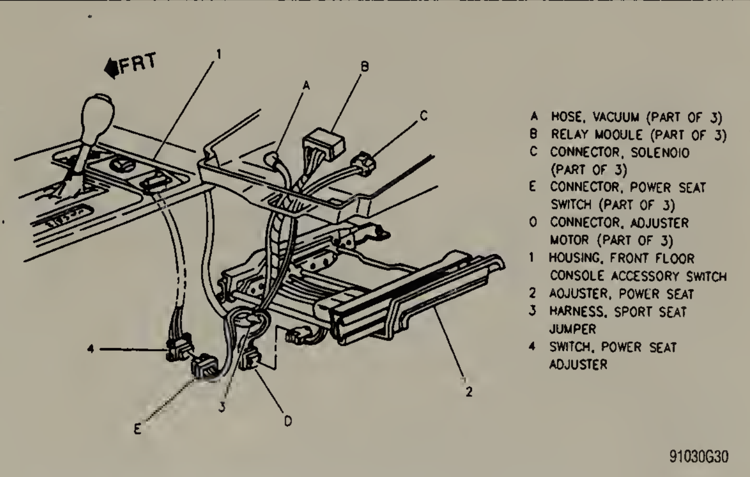


Fig. 44 View of the driver's side sport seat components

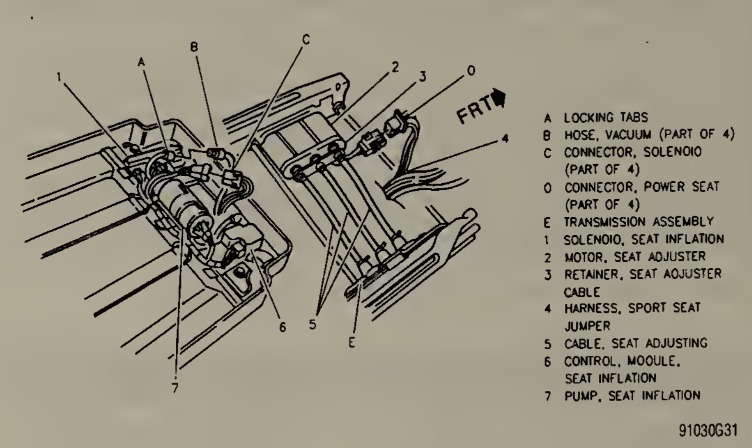


Fig. 45 Passenger's side sport seat components

4. Move the seat rearward.
5. Remove the seat cushion, then detach the electrical connector, if equipped.
6. If equipped with sport seats, perform the following:

Do NOT overbend the locking tabs when disassembling the vacuum hose under the right seat. The tabs will break if they are bent too far, which will require replacing the hose.

a. Disconnect the vacuum hose from the connector (right seat), or from the solenoid (left seat).

b. Detach the solenoid harness connector.

c. If removing the left seat, remove the retainer, strap and relay module.

7. Remove the front adjuster covers by carefully prying out the retainers.
8. Remove the front of the adjusters-to-floor stud nuts.
9. Remove the seat assembly with the adjusters.
10. Installation is the reverse of the removal procedure. Tighten the adjuster nuts to 20 ft. lbs. (27 Nm).

SEAT WITHOUT ADJUSTERS

1. Remove the seat cushion, then detach the electrical connector, if equipped.
2. If equipped with sport seats, perform the following:

Do NOT overbend the locking tabs when disassembling the vacuum hose under the right seat. The tabs will break if they are bent too far, which will require replacing the hose.

a. Disconnect the vacuum hose from the connector (right seat), or from the solenoid (left seat).

b. Detach the electrical connector from the harness (right side) or solenoid (left side).

c. If removing the left seat, remove the retainer, strap and relay module.

3. Remove the seat frame-to-adjuster bolts.
4. Remove the seat assembly.
5. Installation is the reverse of the removal procedure. Tighten the seat-to-adjuster bolts to 20 ft. lbs. (27 Nm).

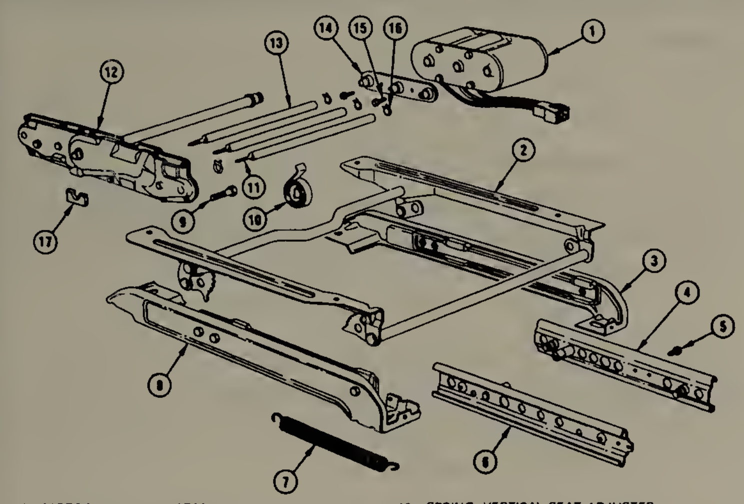
Power Seat Motor

REMOVAL & INSTALLATION

1984–92 Vehicles

See Figure 46

1. Remove the carriage assembly from the seat, as outlined earlier.
2. Line up the access hole in the left side rack and mounting base, then remove the mounting base-to-motor screws.
3. Remove the motor from the vehicle.
4. Installation is the reverse of the removal procedure. Make sure to lubricate all gears and frictional surfaces.



1 MOTOR, SEAT ADJUSTER
2 SUPPORT, UPPER SEAT ADJUSTER
3 BASE, RACK AND MOUNTING SEAT ADJUSTER-LH
4 CARRIAGE, SEAT ADJUSTER-LH
5 SCREW, TAP
6 CARRIAGE, SEAT ADJUSTER-RH
7 SPRING, HORIZONTAL SEAT ADJUSTER
8 BASE, RACK AND MOUNTING SEAT ADJUSTER-RH
9 SCREW
10 SPRING, VERTICAL SEAT ADJUSTER
11 CABLE, SEAT ADJUSTER
12 TRANSMISSION, SEAT ADJUSTER
13 HOUSING, SEAT ADJUSTER CABLE
14 RETAINER, SEAT ADJUSTER HOUSING
15 SCREW
16 CLAMP
17 RETAINER, PINION

91030G28

Fig. 46 Exploded view of the power seat components—1989 vehicle shown

1993–96 Vehicles

➧ See Figure 45

➡If removing the right seat, this procedure will be a lot easier if you have a thin wall, deep well ¼ in. socket. Also, if either of the motors is broken, you will need a variable speed drill.

1. Remove the seat assembly without the adjuster, as outlined earlier in this section.
2. Remove the adjuster.
3. Power up the adjuster motor.
4. If the motor does not work, perform the following:
   a. Separate the retainer with the cables from the motor.
   b. Use a low speed drill, or manually turn the middle drive cable to position the adjuster. Do not force into stop.
5. On the right seat, position the adjuster to align the access hole in the adjuster with the motor mounting rear bolt.
6. On the right seat, remove the motor mounting rear bolt using a thin-walled socket.
7. Move the seat fully rearward.
8. Unfasten the motor mounting bolts. On the right seat, remove the front bolt and on the left seat, remove the front and rear bolts.
9. If reconnected earlier, detach the harness connector.
10. If not already removed, remove the drive cable retainer with the cables from the motor.
11. Remove the motor from the vehicle.
12. Installation is the reverse of the removal procedure.

TORQUE SPECIFICATIONS

Component	ft. lbs.	inch lbs.	Nm
Exterior			
Door			
Hinge-to-pillar bolts	26		35
Fender upper and lower mounting bolts	15-Jan		20
Wheelhouse-to-fender bolts		51	5.7
Wheelhouse-to-side rail bolts		84	9.5
Hood			
Hood hinge retaining nuts	20		27
Jam nut	92		125
Interior			
Console retaining screws		89	10
Window glass and regulator			
Window regulator-to-window stud nuts		66	7.5
Window regulator retaining bolts		84	9.5
Window pad mounting		79	9
Seats			
With adjusters			
Adjuster nuts	20		27
Without adjusters			
Seat-to-adjuster bolts	20		27

91030C01

GLOSSARY

AIR/FUEL RATIO: The ratio of air-to-gasoline by weight in the fuel mixture drawn into the engine.

AIR INJECTION: One method of reducing harmful exhaust emissions by injecting air into each of the exhaust ports of an engine. The fresh air entering the hot exhaust manifold causes any remaining fuel to be burned before it can exit the tailpipe.

ALTERNATOR: A device used for converting mechanical energy into electrical energy.

AMMETER: An instrument, calibrated in amperes, used to measure the flow of an electrical current in a circuit. Ammeters are always connected in series with the circuit being tested.

AMPERE: The rate of flow of electrical current present when one volt of electrical pressure is applied against one ohm of electrical resistance.

ANALOG COMPUTER: Any microprocessor that uses similar (analogous) electrical signals to make its calculations.

ARMATURE: A laminated, soft iron core wrapped by a wire that converts electrical energy to mechanical energy as in a motor or relay. When rotated in a magnetic field, it changes mechanical energy into electrical energy as in a generator.

ATMOSPHERIC PRESSURE: The pressure on the Earth's surface caused by the weight of the air in the atmosphere. At sea level, this pressure is 14.7 psi at 32°F (101 kPa at 0°C).

ATOMIZATION: The breaking down of a liquid into a fine mist that can be suspended in air.

AXIAL PLAY: Movement parallel to a shaft or bearing bore.

BACKFIRE: The sudden combustion of gases in the intake or exhaust system that results in a loud explosion.

BACKLASH: The clearance or play between two parts, such as meshed gears.

BACKPRESSURE: Restrictions in the exhaust system that slow the exit of exhaust gases from the combustion chamber.

BAKELITE: A heat resistant, plastic insulator material commonly used in printed circuit boards and transistorized components.

BALL BEARING: A bearing made up of hardened inner and outer races between which hardened steel balls roll.

BALLAST RESISTOR: A resistor in the primary ignition circuit that lowers voltage after the engine is started to reduce wear on ignition components.

BEARING: A friction reducing, supportive device usually located between a stationary part and a moving part.

BIMETAL TEMPERATURE SENSOR: Any sensor or switch made of two dissimilar types of metal that bend when heated or cooled due to the different expansion rates of the alloys. These types of sensors usually function as an on/off switch.

BLOWBY: Combustion gases, composed of water vapor and unburned fuel, that leak past the piston rings into the crankcase during normal engine operation. These gases are removed by the PCV system to prevent the buildup of harmful acids in the crankcase.

BRAKE PAD: A brake shoe and lining assembly used with disc brakes.

BRAKE SHOE: The backing for the brake lining. The term is, however, usually applied to the assembly of the brake backing and lining.

BUSHING: A liner, usually removable, for a bearing; an anti-friction liner used in place of a bearing.

CALIPER: A hydraulically activated device in a disc brake system, which is mounted straddling the brake rotor (disc). The caliper contains at least one piston and two brake pads. Hydraulic pressure on the piston(s) forces the pads against the rotor.

CAMSHAFT: A shaft in the engine on which are the lobes (cams) which operate the valves. The camshaft is driven by the crankshaft, via a belt, chain or gears, at one half the crankshaft speed.

CAPACITOR: A device which stores an electrical charge.

CARBON MONOXIDE (CO): A colorless, odorless gas given off as a normal byproduct of combustion. It is poisonous and extremely dangerous in confined areas, building up slowly to toxic levels without warning if adequate ventilation is not available.

CARBURETOR: A device, usually mounted on the intake manifold of an engine, which mixes the air and fuel in the proper proportion to allow even combustion.

CATALYTIC CONVERTER: A device installed in the exhaust system, like a muffler, that converts harmful byproducts of combustion into carbon dioxide and water vapor by means of a heat-producing chemical reaction.

CENTRIFUGAL ADVANCE: A mechanical method of advancing the spark timing by using flyweights in the distributor that react to centrifugal force generated by the distributor shaft rotation.

CHECK VALVE: Any one-way valve installed to permit the flow of air, fuel or vacuum in one direction only.

CHOKE: A device, usually a moveable valve, placed in the intake path of a carburetor to restrict the flow of air.

CIRCUIT: Any unbroken path through which an electrical current can flow. Also used to describe fuel flow in some instances.

CIRCUIT BREAKER: A switch which protects an electrical circuit from overload by opening the circuit when the current flow exceeds a predetermined level. Some circuit breakers must be reset manually, while most reset automatically.

COIL (IGNITION): A transformer in the ignition circuit which steps up the voltage provided to the spark plugs.

COMBINATION MANIFOLD: An assembly which includes both the intake and exhaust manifolds in one casting.

COMBINATION VALVE: A device used in some fuel systems that routes fuel vapors to a charcoal storage canister instead of venting them into the atmosphere. The valve relieves fuel tank pressure and allows fresh air into the tank as the fuel level drops to prevent a vapor lock situation.

COMPRESSION RATIO: The comparison of the total volume of the cylinder and combustion chamber with the piston at BDC and the piston at TDC.

CONDENSER: 1. An electrical device which acts to store an electrical charge, preventing voltage surges. 2. A radiator-like device in the air conditioning system in which refrigerant gas condenses into a liquid, giving off heat.

CONDUCTOR: Any material through which an electrical current can be transmitted easily.

CONTINUITY: Continuous or complete circuit. Can be checked with an ohmmeter.

COUNTERSHAFT: An intermediate shaft which is rotated by a mainshaft and transmits, in turn, that rotation to a working part.

CRANKCASE: The lower part of an engine in which the crankshaft and related parts operate.

CRANKSHAFT: The main driving shaft of an engine which receives reciprocating motion from the pistons and converts it to rotary motion.

CYLINDER: In an engine, the round hole in the engine block in which the piston(s) ride.

CYLINDER BLOCK: The main structural member of an engine in which is found the cylinders, crankshaft and other principal parts.

CYLINDER HEAD: The detachable portion of the engine, usually fastened to the top of the cylinder block and containing all or most of the combustion chambers. On overhead valve engines, it contains the valves and their operating parts. On overhead cam engines, it contains the camshaft as well.

DEAD CENTER: The extreme top or bottom of the piston stroke.

DETONATION: An unwanted explosion of the air/fuel mixture in the combustion chamber caused by excess heat and compression, advanced timing, or an overly lean mixture. Also referred to as "ping".

DIAPHRAGM: A thin, flexible wall separating two cavities, such as in a vacuum advance unit.

DIESELING: A condition in which hot spots in the combustion chamber cause the engine to run on after the key is turned off.

DIFFERENTIAL: A geared assembly which allows the transmission of motion between drive axles, giving one axle the ability to turn faster than the other.

DIODE: An electrical device that will allow current to flow in one direction only.

DISC BRAKE: A hydraulic braking assembly consisting of a brake disc, or rotor, mounted on an axle, and a caliper assembly containing, usually two brake pads which are activated by hydraulic pressure. The pads are forced against the sides of the disc, creating friction which slows the vehicle.

DISTRIBUTOR: A mechanically driven device on an engine which is responsible for electrically firing the spark plug at a predetermined point of the piston stroke.

DOWEL PIN: A pin, inserted in mating holes in two different parts allowing those parts to maintain a fixed relationship.

DRUM BRAKE: A braking system which consists of two brake shoes and one or two wheel cylinders, mounted on a fixed backing plate, and a brake drum, mounted on an axle, which revolves around the assembly.

DWELL: The rate, measured in degrees of shaft rotation, at which an electrical circuit cycles on and off.

ELECTRONIC CONTROL UNIT (ECU): Ignition module, module, amplifier or igniter. See Module for definition.

ELECTRONIC IGNITION: A system in which the timing and firing of the spark plugs is controlled by an electronic control unit, usually called a module. These systems have no points or condenser.

END-PLAY: The measured amount of axial movement in a shaft.

ENGINE: A device that converts heat into mechanical energy.

EXHAUST MANIFOLD: A set of cast passages or pipes which conduct exhaust gases from the engine.

FEELER GAUGE: A blade, usually metal, or precisely predetermined thickness, used to measure the clearance between two parts.

FIRING ORDER: The order in which combustion occurs in the cylinders of an engine. Also the order in which spark is distributed to the plugs by the distributor.

FLOODING: The presence of too much fuel in the intake manifold and combustion chamber which prevents the air/fuel mixture from firing, thereby causing a no-start situation.

FLYWHEEL: A disc shaped part bolted to the rear end of the crankshaft. Around the outer perimeter is affixed the ring gear. The starter drive engages the ring gear, turning the flywheel, which rotates the crankshaft, imparting the initial starting motion to the engine.

FOOT POUND (ft. lbs. or sometimes, ft.lb.): The amount of energy or work needed to raise an item weighing one pound, a distance of one foot.

FUSE: A protective device in a circuit which prevents circuit overload by breaking the circuit when a specific amperage is present. The device is constructed around a strip or wire of a lower amperage rating than the circuit it is designed to protect. When an amperage higher than that stamped on the fuse is present in the circuit, the strip or wire melts, opening the circuit.

GEAR RATIO: The ratio between the number of teeth on meshing gears.

GENERATOR: A device which converts mechanical energy into electrical energy.

HEAT RANGE: The measure of a spark plug's ability to dissipate heat from its firing end. The higher the heat range, the hotter the plug fires.

HUB: The center part of a wheel or gear.

HYDROCARBON (HC): Any chemical compound made up of hydrogen and carbon. A major pollutant formed by the engine as a byproduct of combustion.

HYDROMETER: An instrument used to measure the specific gravity of a solution.

INCH POUND (inch lbs.; sometimes in.lb. or in. lbs.): One twelfth of a foot pound.

INDUCTION: A means of transferring electrical energy in the form of a magnetic field. Principle used in the ignition coil to increase voltage.

INJECTOR: A device which receives metered fuel under relatively low pressure and is activated to inject the fuel into the engine under relatively high pressure at a predetermined time.

INPUT SHAFT: The shaft to which torque is applied, usually carrying the driving gear or gears.

INTAKE MANIFOLD: A casting of passages or pipes used to conduct air or a fuel/air mixture to the cylinders.

JOURNAL: The bearing surface within which a shaft operates.

KEY: A small block usually fitted in a notch between a shaft and a hub to prevent slippage of the two parts.

MANIFOLD: A casting of passages or set of pipes which connect the cylinders to an inlet or outlet source.

MANIFOLD VACUUM: Low pressure in an engine intake manifold formed just below the throttle plates. Manifold vacuum is highest at idle and drops under acceleration.

MASTER CYLINDER: The primary fluid pressurizing device in a hydraulic system. In automotive use, it is found in brake and hydraulic clutch systems and is pedal activated, either directly or, in a power brake system, through the power booster.

MODULE: Electronic control unit, amplifier or igniter of solid state or integrated design which controls the current flow in the ignition primary circuit based on input from the pick-up coil. When the module opens the primary circuit, high secondary voltage is induced in the coil.

NEEDLE BEARING: A bearing which consists of a number (usually a large number) of long, thin rollers.

OHM: (Ω) The unit used to measure the resistance of conductor-to-electrical flow. One ohm is the amount of resistance that limits current flow to one ampere in a circuit with one volt of pressure.

OHMMETER: An instrument used for measuring the resistance, in ohms, in an electrical circuit.

OUTPUT SHAFT: The shaft which transmits torque from a device, such as a transmission.

OVERDRIVE: A gear assembly which produces more shaft revolutions than that transmitted to it.

OVERHEAD CAMSHAFT (OHC): An engine configuration in which the camshaft is mounted on top of the cylinder head and operates the valve either directly or by means of rocker arms.

OVERHEAD VALVE (OHV): An engine configuration in which all of the valves are located in the cylinder head and the camshaft is located in the cylinder block. The camshaft operates the valves via lifters and pushrods.

OXIDES OF NITROGEN (NOx): Chemical compounds of nitrogen produced as a byproduct of combustion. They combine with hydrocarbons to produce smog.

OXYGEN SENSOR: Use with the feedback system to sense the presence of oxygen in the exhaust gas and signal the computer which can reference the voltage signal to an air/fuel ratio.

PINION: The smaller of two meshing gears.

PISTON RING: An open-ended ring with fits into a groove on the outer diameter of the piston. Its chief function is to form a seal between the piston and cylinder wall. Most automotive pistons have three rings: two for compression sealing; one for oil sealing.

PRELOAD: A predetermined load placed on a bearing during assembly or by adjustment.

PRIMARY CIRCUIT: the low voltage side of the ignition system which consists of the ignition switch, ballast resistor or resistance wire, bypass, coil, electronic control unit and pick-up coil as well as the connecting wires and harnesses.

PRESS FIT: The mating of two parts under pressure, due to the inner diameter of one being smaller than the outer diameter of the other, or vice versa; an interference fit.

RACE: The surface on the inner or outer ring of a bearing on which the balls, needles or rollers move.

REGULATOR: A device which maintains the amperage and/or voltage levels of a circuit at predetermined values.

RELAY: A switch which automatically opens and/or closes a circuit.

RESISTANCE: The opposition to the flow of current through a circuit or electrical device, and is measured in ohms. Resistance is equal to the voltage divided by the amperage.

RESISTOR: A device, usually made of wire, which offers a preset amount of resistance in an electrical circuit.

RING GEAR: The name given to a ring-shaped gear attached to a differential case, or affixed to a flywheel or as part of a planetary gear set.

ROLLER BEARING: A bearing made up of hardened inner and outer races between which hardened steel rollers move.

ROTOR: 1. The disc-shaped part of a disc brake assembly, upon which the brake pads bear; also called, brake disc. 2. The device mounted atop the distributor shaft, which passes current to the distributor cap tower contacts.

SECONDARY CIRCUIT: The high voltage side of the ignition system, usually above 20,000 volts. The secondary includes the ignition coil, coil wire, distributor cap and rotor, spark plug wires and spark plugs.

SENDING UNIT: A mechanical, electrical, hydraulic or electro-magnetic device which transmits information to a gauge.

SENSOR: Any device designed to measure engine operating conditions or ambient pressures and temperatures. Usually electronic in nature and designed to send a voltage signal to an on-board computer, some sensors may operate as a simple on/off switch or they may provide a variable voltage signal (like a potentiometer) as conditions or measured parameters change.

SHIM: Spacers of precise, predetermined thickness used between parts to establish a proper working relationship.

SLAVE CYLINDER: In automotive use, a device in the hydraulic clutch system which is activated by hydraulic force, disengaging the clutch.

SOLENOID: A coil used to produce a magnetic field, the effect of which is to produce work.

SPARK PLUG: A device screwed into the combustion chamber of a spark ignition engine. The basic construction is a conductive core inside of a ceramic insulator, mounted in an outer conductive base. An electrical charge from the spark plug wire travels along the conductive core and jumps a preset air gap to a grounding point or points at the end of the conductive base. The resultant spark ignites the fuel/air mixture in the combustion chamber.

SPLINES: Ridges machined or cast onto the outer diameter of a shaft or inner diameter of a bore to enable parts to mate without rotation.

TACHOMETER: A device used to measure the rotary speed of an engine, shaft, gear, etc., usually in rotations per minute.

THERMOSTAT: A valve, located in the cooling system of an engine, which is closed when cold and opens gradually in response to engine heating, controlling the temperature of the coolant and rate of coolant flow.

TOP DEAD CENTER (TDC): The point at which the piston reaches the top of its travel on the compression stroke.

TORQUE: The twisting force applied to an object.

TORQUE CONVERTER: A turbine used to transmit power from a driving member to a driven member via hydraulic action, providing changes in drive ratio and torque. In automotive use, it links the driveplate at the rear of the engine to the automatic transmission.

TRANSDUCER: A device used to change a force into an electrical signal.

TRANSISTOR: A semi-conductor component which can be actuated by a small voltage to perform an electrical switching function.

TUNE-UP: A regular maintenance function, usually associated with the replacement and adjustment of parts and components in the electrical and fuel systems of a vehicle for the purpose of attaining optimum performance.

TURBOCHARGER: An exhaust driven pump which compresses intake air and forces it into the combustion chambers at higher than atmospheric pressures. The increased air pressure allows more fuel to be burned and results in increased horsepower being produced.

VACUUM ADVANCE: A device which advances the ignition timing in response to increased engine vacuum.

VACUUM GAUGE: An instrument used to measure the presence of vacuum in a chamber.

VALVE: A device which control the pressure, direction of flow or rate of flow of a liquid or gas.

VALVE CLEARANCE: The measured gap between the end of the valve stem and the rocker arm, cam lobe or follower that activates the valve.

VISCOSITY: The rating of a liquid's internal resistance to flow.

VOLTMETER: An instrument used for measuring electrical force in units called volts. Voltmeters are always connected parallel with the circuit being tested.

WHEEL CYLINDER: Found in the automotive drum brake assembly, it is a device, actuated by hydraulic pressure, which, through internal pistons, pushes the brake shoes outward against the drums.

MASTER INDEX

Pick-Ups and Montero 1983-95
PART NO. 8666/50500

NISSAN

Datsun 210/1200 1973-81
PART NO. 52300

Datsun 200SX/510/610/710/810/Maxima 1973-84
PART NO. 52302

Nissan Maxima 1985-92
PART NO. 8261/52450

Maxima 1993-98
PART NO. 52452

Pick-Ups and Pathfinder 1970-88
PART NO. 8585/52500

Pick-Ups and Pathfinder 1989-95
PART NO. 8145/52502

Sentra/Pulsar/NX 1982-96
PART NO. 8263/52700

Stanza/200SX/240SX 1982-92
PART NO. 8262/52750

240SX/Altima 1993-98
PART NO. 52752

Datsun/Nissan Z and ZX 1970-88
PART NO. 8846/52800

RENAULT

Coupes/Sedans/Wagons 1975-85
PART NO. 58300

SATURN

Coupes/Sedans/Wagons 1991-98
PART NO. 8419/62300

SUBARU

Coupes/Sedan/Wagons 1970-84
PART NO. 8790/64300

Coupes/Sedans/Wagons 1985-96
PART NO. 8259/64302

SUZUKI

Samurai/Sidekick/Tracker 1986-98
PART NO. 66500

TOYOTA

Camry 1983-96
PART NO. 8265/68200

Celica/Supra 1971-85
PART NO. 68250

Celica 1986-93
PART NO. 8413/68252

Celica 1994-98
PART NO. 68254

Corolla 1970-87
PART NO. 8586/68300

Corolla 1988-97
PART NO. 8414/68302

Cressida/Corona/Crown/MkII 1970-82
PART NO. 68350

Cressida/Van 1983-90
PART NO. 68352

Pick-ups/Land Cruiser/4Runner 1970-88
PART NO. 8578/68600

Pick-ups/Land Cruiser/4Runner 1989-98
PART NO. 8163/68602

Previa 1991-97
PART NO. 68640

Tercel 1984-94
PART NO. 8595/68700

VOLKSWAGEN

Air-Cooled 1949-69
PART NO. 70200

Air-Cooled 1970-81
PART NO. 70202

Front Wheel Drive 1974-89
PART NO. 8663/70400

Golf/Jetta/Cabriolet 1990-93
PART NO. 8429/70402

VOLVO

Coupes/Sedans/Wagons 1970-89
PART NO. 8786/72300

Coupes/Sedans/Wagons 1990-98
PART NO. 8428/72302

Collector's Hard-Cover Manuals

Auto Repair Manual 1993-97
PART NO. 7919

Auto Repair Manual 1988-92
PART NO. 7906

Auto Repair Manual 1980-87
PART NO. 7670

Auto Repair Manual 1972-79
PART NO. 6914

Auto Repair Manual 1964-71
PART NO. 5974

Auto Repair Manual 1954-63
PART NO. 5652

Auto Repair Manual 1940-53
PART NO. 5631

Import Car Repair Manual 1993-97
PART NO. 7920

Import Car Repair Manual 1988-92
PART NO.7907

Import Car Repair Manual 1980-87
PART NO. 7672

Truck and Van Repair Manual 1993-97
PART NO. 7921

Truck and Van Repair Manual 1991-95
PART NO. 7911

Truck and Van Repair Manual 1986-90
PART NO. 7902

Truck and Van Repair Manual 1979-86
PART NO. 7655

Truck and Van Repair Manual 1971-78
PART NO. 7012

Truck Repair Manual 1961-71
PART NO. 6198

System-Specific Manuals

Guide to Air Conditioning Repair and Service 1982-85
PART NO. 7580

Guide to Automatic Transmission Repair 1984-89
PART NO. 8054

Guide to Automatic Transmission Repair 1984-89
Domestic cars and trucks
PART NO. 8053

Guide to Automatic Transmission Repair 1980-84
Domestic cars and trucks
PART NO. 7891

Guide to Automatic Transmission Repair 1974-80
Import cars and trucks
PART NO. 7645

Guide to Brakes, Steering, and Suspension 1980-87
PART NO. 7819

Guide to Fuel Injection and Electronic Engine Controls 1984-88
Domestic cars and trucks
PART NO.7766

Guide to Electronic Engine Controls 1978-85
PART NO. 7535

Guide to Engine Repair and Rebuilding
PART NO. 7643

Guide to Vacuum Diagrams 1980-86
Domestic cars and trucks
PART NO. 7821

Total Service Series

ATV Handbook
PART NO. 9123

Auto Detailing
PART NO. 8394

Auto Body Repair
PART NO. 7898

Automatic Transmissions/Transaxles Diagnosis and Repair
PART NO. 8944

Brake System Diagnosis and Repair
PART NO. 8945

Chevrolet Engine Overhaul Manual
PART NO. 8794

Easy Car Care
PART NO. 8042

Engine Code Manual
PART NO. 8851

Ford Engine Overhaul Manual
PART NO. 8793

Fuel Injection Diagnosis and Repair
PART NO. 8946

Motorcycle Handbook
PART NO. 9099

Small Engine Repair (Up to 20 Hp)
PART NO. 8325

Snowmobile Handbook
PART NO. 9124

Multi-Vehicle Spanish Repair Manuals

Auto Repair Manual 1992-96
PART NO. 8947

Import Repair Manual 1992-96
PART NO. 8948

Truck and Van Repair Manual 1992-96
PART NO. 8949

Auto Repair Manual 1987-91
PART NO. 8138

Auto Repair Manual 1980-87
PART NO. 7795

Auto Repair Manual 1976-83
PART NO. 7476

FOR THE TITLES LISTED, PLEASE VISIT YOUR LOCAL CHILTON RETAILER

For a FREE catalog of Chilton's complete line of Automotive Repair Manuals, or to order direct

CALL 800-477-3996

NP/CHILTON'S® •1020 Andrew Drive, Suite 200 • West Chester, PA 19380-4291

CHILTON'S®

Total Car Care®

...For The Do-It-Yourselfer

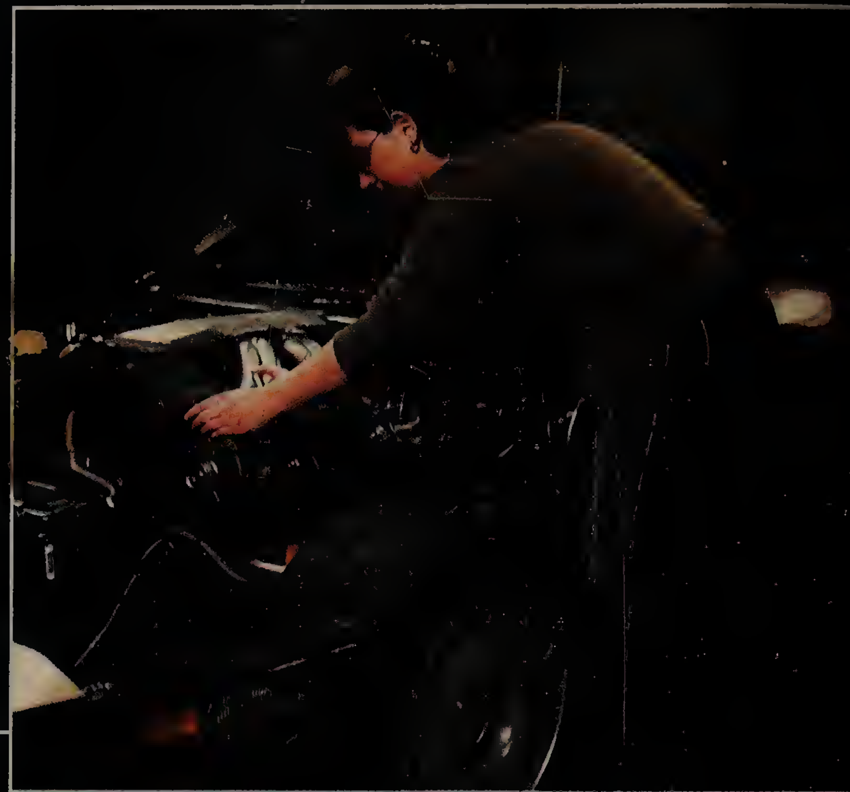
Total Car Care is the most complete, step-by-step automotive repair manual you'll ever use. All repair procedures are supported by detailed specifications, exploded views, and photographs.

Here are just a few of the items in this manual that make your repair jobs easier:

- **Expanded index to quickly locate information**
- **Vacuum diagrams**
- **Wiring diagrams**
- **Diagnostic charts**
- **Troubleshooting charts**
- **A glossary to identify those unfamiliar terms**

From the simplest repair procedure to the most complex, trust Chilton's Total Car Care to give you everything you need to do the job.

Save time and money by doing it yourself, with the confidence only a Chilton Repair Manual can provide.



•General Information •Routine Maintenance & Tune-Up •Engine & Engine Overhaul •Driveability & Emission Controls •Trouble Codes & Diagnostics •Fuel System •Chassis Electrical •Drive Train •Suspension & Steering •Brakes •Body •Glossary

ISBN 0-8019-9103-X
UPC
0 35675 28502 5

ISBN 0-8019-9103-X
EAN
9 780801 991035
90000