INTRODUCTION

VIP

VETTE IMPROVEMENT PROGRAM

In a series of articles to appear in Corvette Fever during 1985, I will be sharing with you some of the things I've learned through racing which directly affect handling, controlabiiity, performance, safety, and ride comfort of a Corvette.

In anticipation of the series, we've recently completed the same series of steps on the two Corvettes shown here: a 1975 Red Station Wagon which is stock except for the customized hatch, and a 1980 black turbo. In this introductory column I will cover some of the general areas we will be getting into.

We will be working toward improving the handling characteristics and drivability. We are going to do things to tighten the car up and soften the ride but every move will be in the direction of improving handling, stability,. controlability and safety. Remarkably enough, most of the changes will also improve the ride comfort.

Corvette owners should know when to change parts and how the change should be made. By the same token, you should know what to look for and the consequence of not changing them in terms of compromise in performance or down stream cost.

The wheel alignment front and rear are very important because proper alignment makes the car more stable, and improper'alignment can cause excessive tire wear. The sequence of work I will recommend will be such that only one alignment will be required.

'75 Wagon

The 1975 red station wagon is a fully reconditioned street car. It is essentially stock and in excellent condition with 45,000 miles.

Steering Box Adjustment

A major aspect of tightening the car involves the steering box. Our experience dictates that regardless of the model from '88 to '82, if it has 30-40,000 miles, it needs a

Above: 1980 turbo charged Vette (engine is shown in top insert).
Below: 1975 stock Vette with station wagon hatch (shown in lower inset).

steering box adjustment. Once the steering box is adjusted you will immediately feel a difference. For example, when backing out of a parking spot or when parallel parking you will have noticeably more control. On the highway you will experience more responsive steering and more stability.

Suspension System

In the '75 the upper and lower ball joints, ail bushings and tire rods were replaced. In the series I will point out some of the different heavy duty parts which can be used on the older cars. For example, there are better strut rods that fit the older cars which some of you might want to install. For high mileage cars, it's probably time to replace these. For those who really want to get something bette, there arq ballbearing idler arms. Ill give part numbers of GM or TRW interchangeable parts.

Sway Bars

In the technical discussions I will describe how different GM sway bars with different rubber and urethane bushing combinations can be used for different driving situation-e sway bars have a slight bend radius at the point of mounting, it is important to use rubber bushings at the frame mounts. The consequences: of replacing them with solid metal bushings will show up in driving. The result can be a significant increase in roll stiffness at the wrong time. As a result of the extent of work done and the different parts used, we had to tune the suspension system in the '75. We're going to explain it to provide the necessary detail to give an understanding of what tuning is so readers can have these things checked out or corrected or new parts put in.

Wheel Bearing Carriers

Again, high mileage necessitated that both the inner and outer bearings be replaced on both of these cars. Today there are excellent bearings and greases available. I know that rear wheel bearings and bearing carriers have caused Vette drivers trouble. In my technical discussions I will address solving this problem.

Drive Shafts and U Joints

Many of you with improved engine performance should give thought to heavier drive train parts. In our racing applications we've put 700 horsepower against them in road racing with wide tires and never failed them. I know that if they held up in our racing application the way we used them, they will not break in a street car. The '75 through '79 Vettes have larger prop shafts than the '68's through '75's. Zora Duntov and other GM engineers were very much aware of competition racing experience. In the technical discussions on drive shafts and U joints I'll explain why the prop shafts became larger and how to use these heavier parts in the older cars.

Idler Arm

The idler arm is critical to steering because it connects to the tie rod which ties the two front wheels, together. In the '75 we installed a high-lity nylon bearing idler arm. By contrast we installed a bailbearing idler arm in the '80 Turbo car. In the Turbo car we had to get better control over the right front wheel. Today the wheel and tire assembly is very heavy and the sticking power of today's tires is as good as the race car tires of 10 years ago. The car and tire combinations of today are approaching capabilities of 1 G cornering forces. That means we are dealing with tires and wheels that have a lot more adhesion and weight than the older 1963 type tires. In 1963 the wheels were 5½" wide and the '65 Vettes had tires 5½ to 6" wide. Those tires were much lighter and didn't stick nearly as well. The idler arm, designed for that early car, has gone essentially unchanged on ail Corvettes through '82. It is marginal to do a really good job and give you control of the front end.

Springs

As the cars got older the GM stock of the older springs was depleted. As time went on the older replacement springs were replaced by later model springs. So today it is quite difficult to get springs for a '75 Corvette. The spring you get for a '75 might be a '79 making it difficult to get the right spring for the weight of your car. In the articles my recommendations will be in considerable detail and explain why I emphasize and explain why we move to softer springs.

Turbo Charged 1980

The black 1980 has just about everything: coil over shocks, a $2,500 radio, custom seats, dual Gale Banks turbo chargers, and nitrous oxide injection. With this kind of horsepower, we had to have excellent controlability along with handling. It had to be very controllable during acceleration, turning and deceleration. Unless the suspension system is modified, when you have 700-800 hp and you dump the throttle with a leaf spring car, the car is going to squat. The only way you can stop that is to change the suspension geometry. In this case we went to a 5 bar suspension which is virtually the same as the '84 Corvette. So this car has 50 to 60% anti-squat. With softer springs, the car gets more body weight into the tire patch.

When watching a drag racing car take off, the car will just sit back a little bit and ail of a sudden you'll see the rear tires go down, flatten out and spread out. You'll see the rear tire actually go down — like trying to dig into the pavement. That is traction. That is exactly what it is doing — transferring weight to the rear wheels. -to the rear end. On the black turbo car we get traction by having 50% to 60% anti-squat.

The cars we build are race cars and road cars that have 50% to 60% anti-squat, whereas the drag car might have a 70% or 80% or 90% anti-squat. With that much anti-squat, if the tire stayed stationary, the car would lift up in the air. Our objective on the turbo was to run as soft a spring as possible in order to get the tire to stay on the road, and let the suspension system do the work of preventing squat. The reason we like the soft spring is simple. The heavier and stiffer the springs, the more bounce you get. If you take a Corvette with F41 gymkhana type springs and go into a turn on a rip-

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ple surface, the car will jitter off the road. You will feel it lose patch — contact with the road. To keep the wheels on the road you must also have the correct shock absorber valving. With the proper springs and shocks, the wheels will follow the road surface and the body will not be jumping up and down pulling the tire away from the road. Manv people don't understand that the velocity of the body moving away from the tire can actually jerk the tire off the road.

A good example of this phenomenon is if you go over a hill and you drop the throttle for an instant to keep from over rewing. To prevent this set the shock absorber rebound control stiffer so that the body will not separate from the wheels. It is just the opposite of what you might logically think. To prevent this most people set the rebound softer on the rear to get the tires to the road surface faster. That's what think. They don't relate the tires to the body. You don't want the body to pull away from the tire because the body gets up over the hill and the body starts getting momentum and it can pull away from the tire and even pull the tire off the ground, If you make the rebound control stiff so the body won't pull away, it won't get up the velocity to jerk it off the ground. When you are going over ripple surface you do the same thing. You make it light on the bump and stiff on the rebound control. Then your body cannot get the velocity to pull it away.

don't seem to make sense. For example, for engine performance you put a big block engine into the car. Result: a heavier engine. The first thing most people do is to put a heavier sway bar in the car, thinking that with a heavier engine the car will stick better when it goes into the turn with a heavier sway bar. It may look good on paper but in my technical article discussing sway bars I'll show you why it doesn't work that way with your Corvette.

Tires

To achieve better controlability on the turbo we replaced the 50 series tires with 60 series for best forward and lateral acceleration as well as slip angle. This gave us a larger aspect ratio (i.e., the distance from wheel rim to the road). This can be achieved two ways: go to a smaller diameter wheel, or you can go to a larger outside diameter tire. I've found that with the Corvette the bigger the diameter, the better the traction. When you decrease the sidewall height too much and make the side wall too rigid, you decrease the slip angle of the car. Then when the car starts to slide or drift, it just breaks away. It doesn't have any forgiveness.

Because of the low mileage on the black car it didn't need any rubber bushings, ball joints, or wheel bearings. However, we did put in good wheel bearings and used grease that could hold up to 200 mph driving and any weather conditions.

Brakes

Because of the power on the turbo, we went further on the brakes than we did on the '75. It has drilled rotors and metallic brake pads. Metallic pads do not work well when they are cold. With drilled rotors they work fine at all temperatures. A characteristic of metallic brake pads is the tendency for the copper to gasify, building up a gas pressure between the pad and the rotor. Drilling the rotor allows the gas to escape the surface thereby allowing the pad and rotor to meet. When operating the car it feels like you just added another power brake booster.

If you drill the front ones and not the rear, put the brakes on and the front end will lock up. Drill the rears and not the front, and the rear will lock up. It is that much more responsive. If in your street Corvette you get on the brakes hard at 70 mph a couple of times in a row, you won't have any brakes. If you get on them at 90 mph, by the time you get down to 20 mph you may not have any brakes. If you're the kind of person who uses brakes hard, they may glaze up and you won't have good brakes. In high powered race car application, with the drilled rotor and metallic pads, you could literally stop this car from 150 mph over and over again and never worry about it.

My real concern is that some people put a lot of power in their cars and they really don't have the security in the brakes. If you got in trouble and you had to stop, the capability of your brakes must match the capability of your car, During the course of these articles I will emphasize safety.

Road Testing

During this article I have used two of my cars as a means of explaining the nature of the recommendations to be covered in each of the next six technical articles. In anticipation and preparation for this series I would like to recommend that you start the Vette Improvement Program by conducting a test drive evaluation of your car. I want you to appreciate the change in the automobile before and after incorporation of the recommended changes. You should test drive your car before and after incorporating each of the changes. I am very confident thar by the completion of the Vette Improvement Program you will have a comprehensive understanding of your Vette controlability and handling qualities.

It may be helpful to get a co-driver and a small note book and conduct the following test drive. While you're waiting for the next issue of Corvette Fever, develop a conscious awareness of just how well or badly your Vette now performs. You don't have to be an engineer to start getting a "feel" for your Corvette.

Start by checking the tires, because tire condition can effect most of the "feelings" you experience in your car. Do they show normal wear. Abnormal wear can be caused by improper balance

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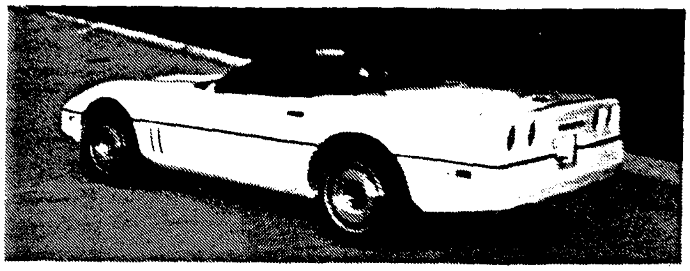

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and alignment. Remember, cars love a good nystery. Tire problems could be caused by bent or worn suspension parts.

For those of you with Goodyear NCT or Goodrich Radial TAs, does your Corvette now seem to dart around and be less forgiving? Remember, quality tires can accentuate any suspension or alignment problem because they stick better.

Many ot you will feel excessive "play" in your steering wheel. If you can move your wheel an inch or so in either direction before your tires seem to get the ressage, the steering box needs adjustment. It takes more than the adjustment of the screw onthetoo of the box to take care of the problem. Next, drive over a one or two inch lip in the pavement or a railroad track at normal speed. Leac with the left tire, then the right. The rattle you immediately felt at the steering wheel when you lead with the right is the idler arm because it can't control the movement of your right wheel and tire. Notice that when you hit the bump straight, the front body shook up and down. If it shook, the cause is related to the way the body is mounted, and we will correct that later.

If the car seems shaky most of the time, better check the ball joints, tie rod ends, and even the A-arm and trailing arm bushinas for wear:, While driving start becoming more aware of the spring and shock relationship. Does your car feel so stiff on rough roads that you actually feel the car lose control by bouncing around on the road surfact? A motor cross kidney belt isn't the answer. Correct spring rates and shock valving are.

Through the VIP series of articles in Corvette Fever, I will show you how to determine problems, what the cause may be, and how to correct for them. The desired results are for you to experience even more satisfaction from improved performance and driving comfort from your Corvette — America's best sports car. ■

VIP

VETTE IMPROVEMENT PROGRAM

STEERING GEAR BOX ADJUSTMENT

"New Car" tightness you can regain

by JOHN GREENWOOD

PART ONE

This is the first in our Vette Improvement Program series of articles to help you make improvements in your Corvette's ride, handling and performance.

If you performed the test drive we suggested in the introductory article (Nov/Dec 84) you are already aware of your Corvette's individual handling and performance mannerisms. In driving you notice little things. Your car pulls one way or another under braking, or the steering gets light under hard accelerations, etc.

You're the same people that noticed your new Corvette lost that "tight" feeling after the first year or so. Many of you have spent a lot of time, money and hours of frustration trying to put that tightness back only to find that many of the products touted for that purpose just don't do the job! I've also had those same experiences. Some ideas sounded so good I tried them twice only to get the same result. That's when I decided that the only way to cut through all the unproven theories would be to test my own ideas on the race track, apply the results to street and/or track driven cars and share this knowledge with as many Corvette owners as possible.

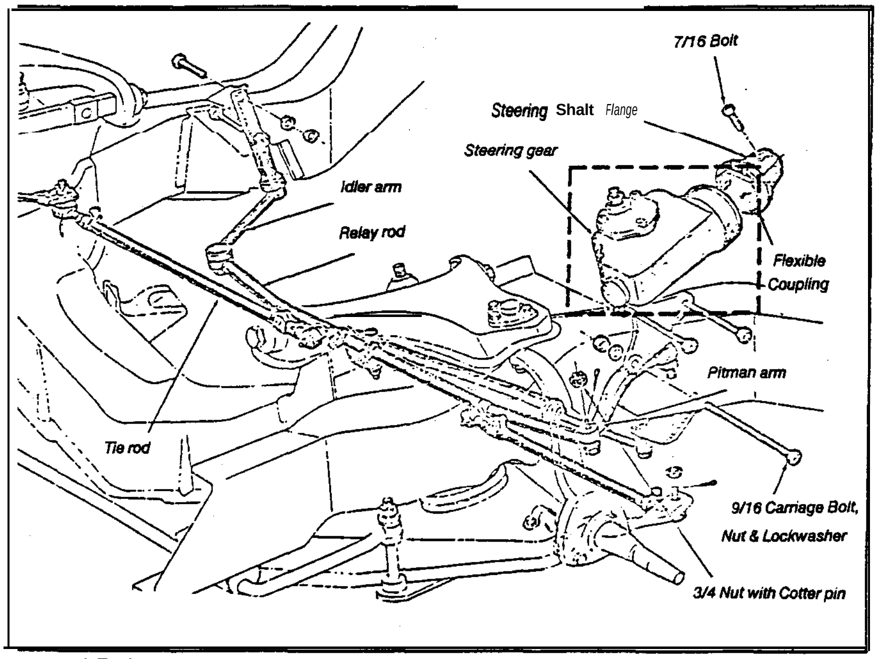

Figure 1: Broken rule indicates steering gear box.

I've chosen *Steering Gear Box Adjustments* as the first subject in these articles because this one, simple, inexpensive improvement can have a most dramatic, positive effect on your car's handling with few part replacements.

Steering Gear Box adjustments were first brought to my attention by a friend and talented Chevrolet engineer, Tom Ryding. We used Tom's adjustments in our race cars. Our first Trans Am Championship win was due in part to more stable control over the car and Tom's adjustment suggestions.

Before getting started

Although we'll be covering some front end components in succeeding articles in this series, to realize the maximum improvement from the steering box adjustment, the suspension parts should be in good working order. The next

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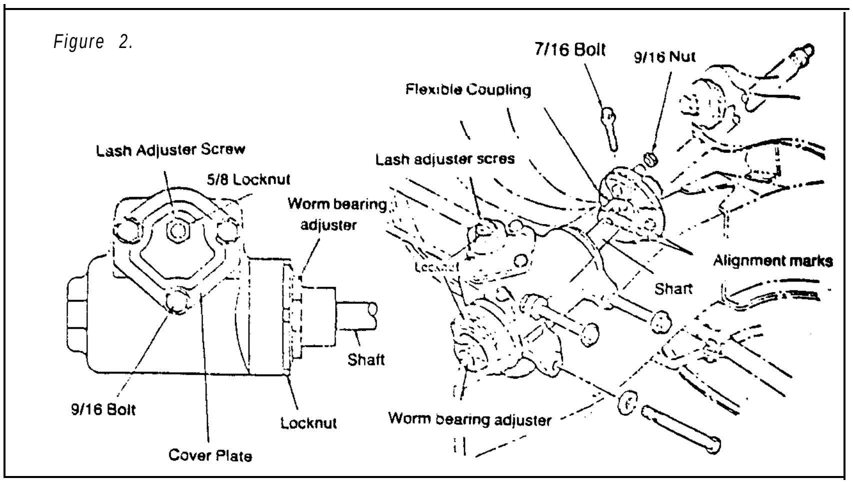
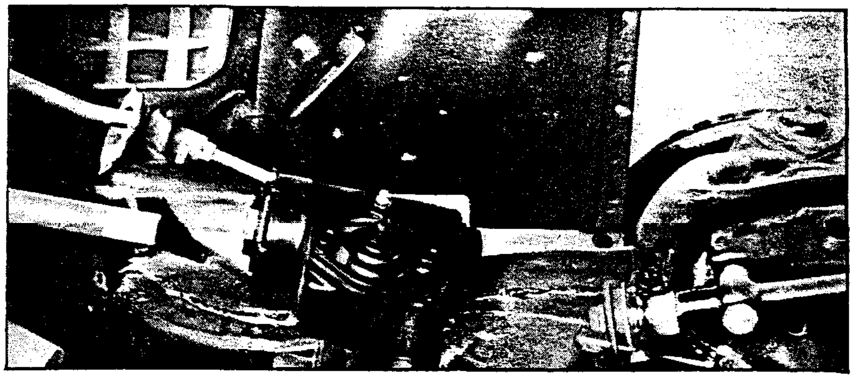


Figure 2.


Steering gear box prior to removal with steering shaft disconnected. (Figure 3)

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several paragraphs contain some helpful hints and suggestions which will make the steering box adjustments more effective and noticeable. First check for obvious wear of suspension linkage and parts. Jack your Corvette up and put it on safety jack stands: then remove the wheels.

After 30,000 miles, inspect and replace, if necessary, the lower ball joints, rear strut rod bushings and idler arm.

The front A-arm bushings and stock sway bar bushings wear more as a function of time than miles and they can last several years. So, unless your Corvette is *4* or 5 years old or more, these parts are probably ok.

Don't rush to change to solid A-arm bushings or sway bar frame mounts that may need replacement. I've tried both with poor results. The lower front A-arms are particularly sensitive to the design of the solid bushings. Loads are great enough on the control arm shafts so that anything shot-t of top quality spherical bearings will prove inadequate. I've seen many autocross and race cars whose nylon, steel or bronze bushings in the lower control arms don't allow free travel. (They bind under load and continually change the roll stiffness, or they become hammered out and loose.)

I've experimented with solid versus rubber A-arm bushings in race competition and the changes were so subtle that few professional drivers could tell the difference. The problems caused by camber deflection inherent with the rubber bushings are overstated, in my experience, and the 'cure is most often worse than the problem. So stay with the rubber bushings for now.

The solid sway bar frame mount is definitely not recommended wi?h GM sway bars. So for the purposes of this improvement program, leave these bushings stock rubber, too. Picking the right size sway bars will be discussed in coming articles.

While you're checking the ball joints and bushings, also check the tie rod ends for wear, following the instructions in the Chevrolet Service Manual.

The idler arm is another weak point to check. That rattle at the steering wheel you hear and feel when you hit a sharp bump (railroad tracks, etc.) is the right front wheel rattling around loose. The idler arm loses its controlling ability quickly on pre-'84 Corvettes. In fact, if you Gymkhana your Corvette, it may lose this control immediately, depending on your braking force! For street driving, you can replace the stock idler arm preferably with a heavy duty replacement. If you race, nothing short of a bearing idler arm will suffice.

The final components to check before beginning this improvement are the shocks. Shocks are the most frequent contributor to that "loose" feeling. We'll address shocks in a forthcoming article in detail.

Tools Needed:

- -7/16, 1/2, 5/8 combination wrenches
- -9/16, 3/4 sockets
- -11/16-12 point socket
- -rachet and short extension
- -ball joint fork
- -hammer
- -large channel lock pliers or adjustable wrench
- -3/8 to 1/4 adapter
- -inch lbs. beam torque wrench, preferably O-25 scale (example:Matco tools *#DR251)*
- -common screw driver
- -pliers
- -flat punch or drift
- -2-4 jack stands
- -jack
- -wheel lug wrench
- -bench vise

Getting Started:

Removal and replacement of the gear box can be done per the Chevrolet Service Manual. Following is a synopsis of the removal procedure (refer to figures 1 & 2).

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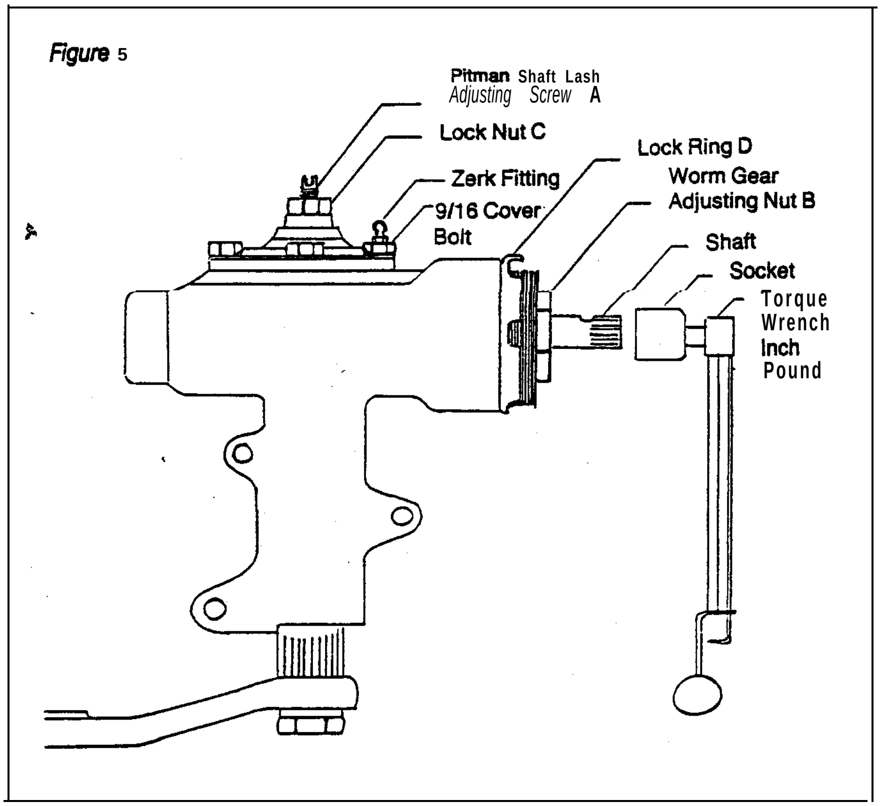
*Steering gearbox prior to **removal** showing **installation** of **Zerk fitting** in cover bolt. **Zerk** fitting provides capability to lubricate. (Figure 4)*



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Removal Procedure:

- Jack up front end of car.
- Place jack stands under shock towers.
- Lower jack and check stands for safety.
- Remove driver's side front wheel.
- Raise hood and place steering wheel in center position and lock. (NOTE: Pre-1969 cars do not have locking steering mechanisms.)
- Remove 9/16 nuts from steering shaft flange to flexible coupling.
- Remove 7/16 bolt from steering shaft flange and slide it back on splined shaft.
- Remove cotter pin and 3/4 nut connecting Pitman arm to relay rod/control valve. (NOTE: Pitman arm is press fitted to the steering relay rod/control valve.)
- Place the ball joint fork between rubber boot and Pitman arm. Pound fork with hammer until Pitman arm pops off.
- Push gearbox bolts through frame.
- Remove gearbox. (Note: some cars may require removal of gearbox from the top, although normal removal is from the bottom.)

Steering Box **Adjustment** Instructions:

Resetting the tolerances in a Corvette steering gear box is a major step towards a tighter, more controllable car. Having the information on how to properly adjust the gear box will give you the ability to adjust the box yourself or to have the box serviced properly by a reputable shop at a fair price.

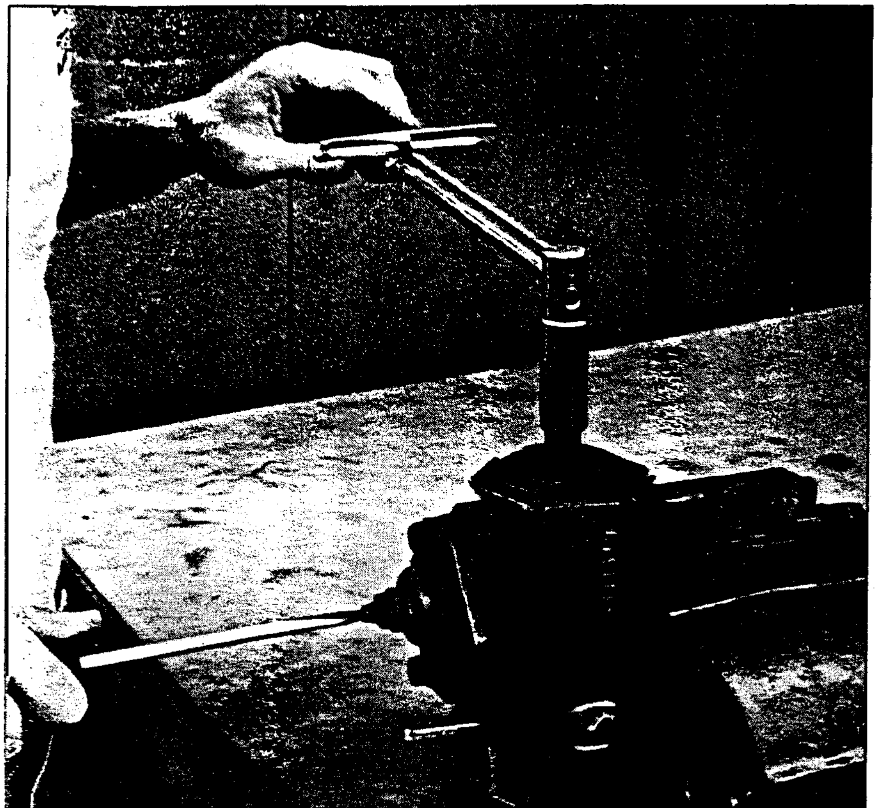
Post-1977 cars have factory preloaded steering boxes and should not be adjusted until after 15,000 miles. Before starting the adjustment, lubricate with GM#1051052 Steering Gear Lube and work in thoroughly. To accomplish this and to make future lubrication easy, remove one bolt from the cover plate of the gear box and drill a hole through the bolt with a #7 drill bit. Next, tap the hole with a 1/4-20 inch tap. Install a zerk grease fitting, then reinstall the bolt. Using the installed zerk fitting, grease the box and work in thoroughly. (See figures 3, 4 and 5).

Now procede with the actual adjustment. Put the steering box in a vise securely with the shaft straight up. Loosen lock nut "C" (see figure 5.) Next, turn the Pitman shaft lash screw "A" two full turns counter clockwise. Using an inch-pound torque wrench, with 11/16-12 point socket that will engage the splined end of the worm gear shaft, turn the shaft through full travel while reading the torque wrench. Pay close attention not to turn the shaft hard against the stops at either end of the travel. (See figure 6).

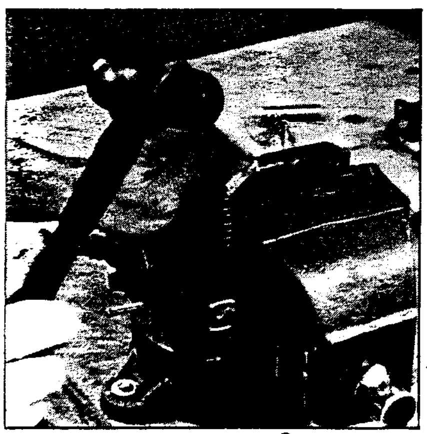
The first readings should be set at 7 to 8 inch-pounds on a worn gear box and 9 to 10 inch-pounds on a new gear box. To change the reading, loosen lock ring "D" with a hammer and drift, and turn the worm gear bearing adjusting nut

"B" clockwise to increase the torque wrench reading. Once the desired reading is reached, tighten the lock ring "D" and recheck your torque wrench reading. (See figures 5 & 7.) At this time, the torque wrench should have an even, smooth, reading through its full travel. If the gear feels "lumpy" or the reading varies, there is probably damage in the gears or bearing from previous improper adjustment or severe impact. Although the damaged parts should be replaced, satisfactory replacement of these parts is not likely. We recommend replacement of the entire gear box with a used gear box in excellent condition.

Now, count the total number of revolutions when turning the shaft through full travel. Rotate the shaft to center position. Read the torque wrench while turning the shaft a half-revolution in both directions. Tighten the Pitman lash adjusting screw "A" until you read 14 inch-pounds an the torque wrench as you pass over center. This reading will drop back to the original 7 to 9 inch-pounds on both extremes of the center position but will remain 14 inch-pounds ~~on both extremes of the center position but will remain 14 inch-pounds~~ over center. Retighten lock nut "C" and you are finished. Following is a synopsis of the steering box adjustment procedure:



...rning the shaft through full travel while reading the torque wrench. Caution: Do not turn shaft hard against stops in either direction. (Figure 6.)



Using drift to loosen lock ring D prior to adjustment (Figure 7)

Further loosening or tightening lock ring D prior to and after adjustment. (Figure 6)

Synopsis of **Adjustment** Procedure:

- Grease gearbox through the newly installed fitting and work lubricant in thoroughly before attempting adjustments.
- Mount gearbox in bench vise with splined shaft pointing up.
- Remove 7/16 bolt from flexible coupling and remove coupling from shaft.
- Back-off lash adjuster screw counterclockwise approximately two turns after loosening 5/8 socket on shaft.
- Place 11/16 socket on shaft.
- Using torque wrench, rotate shaft through its full travel and observe readings.
- Loosen locknut on gearbox assembly in a counterclockwise direction with hammer and drift.
- Tighten worm bearing adjustment nut in a clockwise direction until 7 inch lbs. is indicated through full travel.
- Tighten locknut and recheck torque reading.
- Rotate shaft gently from one stop to the other, carefully counting the total number of turns. Rotate shaft exactly halfway, to center position.
- Turn lash adjuster screw clockwise until 14 inch lbs. is indicated while rotating torque wrench over center. (NOTE: This reading will drop to 7 inch lbs. over center.)
- Turn lash adjuster screw clockwise until 14 inch lbs. is indicated while rotating torque wrench over center. (NOTE: this reading will drop to 7 inch lbs. on both extremes of center position, but should remain 14 inch lbs. over center.)
- Retighten 5/8 locknut.
- Install flexible coupling and bolt.

Be sure to properly tighten the steering box when reinstalling in the car because it flexes at the frame when loaded. ■

by JOHN GREENWOOD

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IDLER ARMS
STRUT ROD BRACKETS

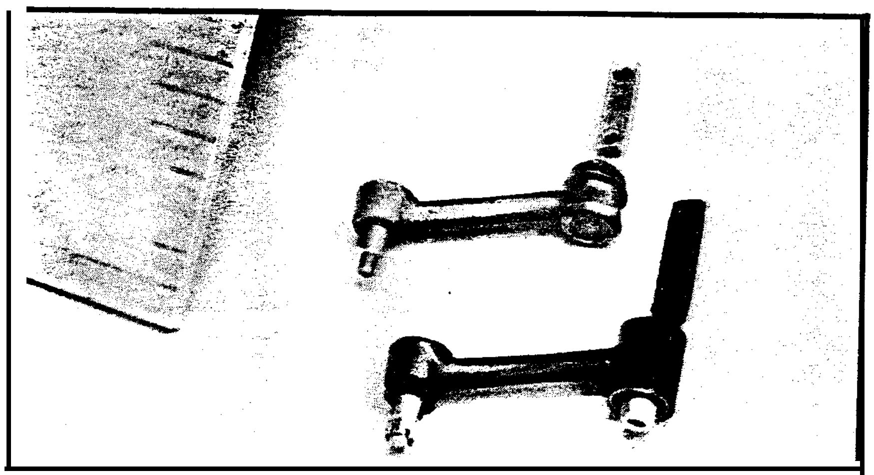
PART TWO

After the feedback received from VIP Part I, I felt it might be helpful to be more descriptive and specific in more of the areas of tightening the suspension. In this VIP Part II article on idler arms and strut rod brackets I will point out several variations in applications so you will be able to make changes that will be in line with your intended use of your car (i.e., tight, smooth street driven car, a high performance street car, or a car for autocross or competition only).

This article will not get into the combinations of spring and sway bars, etc. Instead, our objective is to get the car ready for suspension tuning and at the same time we'll make sure there isn't something in the suspension that is improper and causing problems. I take this approach because there are some products on the market for the Corvette suspension that are not properly engineered. Some may have the wrong materials for the way they're being used, or they may be designed around someone's concept of what they think will work, vs. true back-to-back testing that delivers the desired results consistently. As we get into the changes, I'll show you what the desired results are and what could happen if you make the wrong changes.

Idler Arm

The idler arm is the next major problem area in steering performance. Because of the importance of the idler arm, I will start with more information on it. If you have a worn idler arm, the front end of the car will be very loose and sloppy over most road surfaces. You can begin by doing a little road test to isolate what the effects of the idler arm are on the car. Look for a hole or raised area from one or two inches in height or depth — something that will cause a fairly sharp impact (like going over railroad tracks, or a traffic bump in a parking lot), but something you can go over with one side of the car at a time. Drive the car over the bump at 20 mph with the left side (driver's side) first. The car will be controlled and nothing too noticeable will happen. Now drive the right side over the bump. This time, the steering wheel will shake, the front steering will shudder with a different loss of control and the front fiberglass will bounce. The loss of control you experience at that point is ever present. You can do a simple test just by backing up 5 or 10 mph in an empty parking lot and apply the brakes hard (but don't lock the brakes up). First you'll hear a clunk on the right front side; next you'll feel the car turn a little. You will experience a different loss of control.



Top: Stock Idler Arm. Below: Bearing Idler

With the car on a hoist, try to move the idler arm. You'll find you can move it up and down maybe ½''. When you go over bumps, it will move that much. It will also move under hard cornering.

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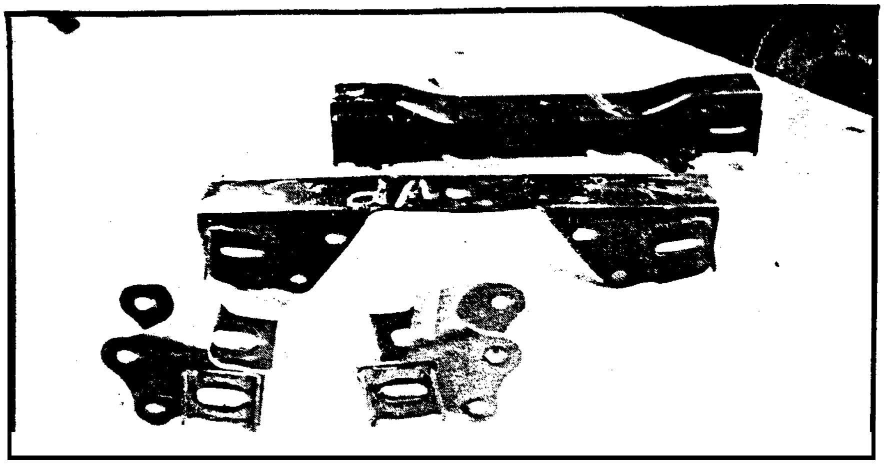
Clearly, the idler arm is very important in a race car. Without the Proper idler arm, you would never have good control of the right front tire. It turns in and out for all different track conditions.

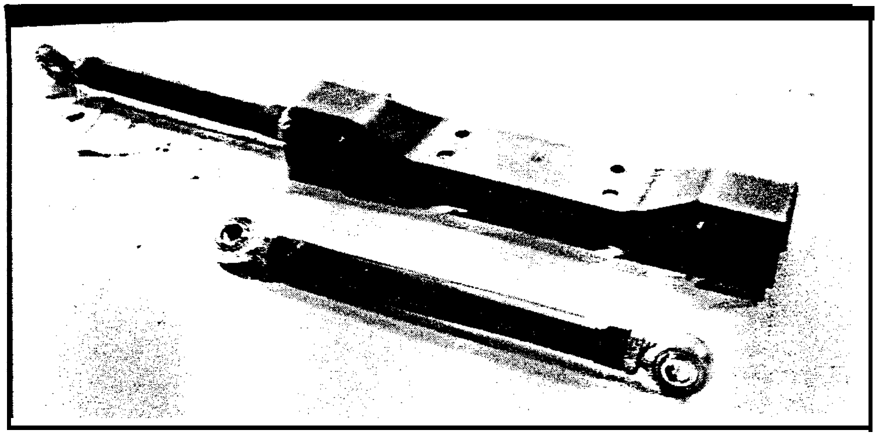
Now let's talk about the fix. There are many idler arms on the market. Some are called heavy duty. The fact of the matter is they all have about the same load rating. For this reason, don't buy the most expensive. If your idler arm is old, replacement with a stock idler arm will improve the steering feel and the car's tightness. NAPA makes a good heavy duty stock application. However, the only way we have been able to get total control of the right front tire (as you did on the left front when you adjusted your steering box) is to develop a bearing idler arm. We feel the bearing idler arm is mandatory on all race applications, and very desirable on all street applications. The improvement in tightness and response will equal the steering box adjustment on a very used box. The bearing idler arm that we make is the only one on the market to my knowledge. We have made this item for a number of years and it has had extensive testing.

In addition to the idler arm, to improve front end tightness, the lower ball joints should be replaced after 25,000 to 30,000 miles. After 50,000 to 60,000 miles, replacement is essential.

Perform all such removal and replacements in accordance with the appropriate GM shop manual for your car.



All Stock Brackets. Top: '63-'79; Center: '80-'82; Bottom: '84-'85



Strut Rod Kit with Rod Ends (hiem joint)

A Arm Bushings

The front A arm bushings are the next source of front end looseness. They should be replaced with stock GM rubber units. There is no bushing material on the market at present that I know of that will function properly under the different load conditions experienced at the lower A arm shaft during high performance cornering. The only alternative would be roller or spherical bearing units. The expense of such a package is generally prohibitive for street use -and it's totally unnecessary. It has been stated that these rubber bushings have so much compliance defection, or give, that the camber related to this characteristic on the car's handling can be changed enough to affect the direction of the car, or the direction in which the wheels are pointed. Although this is true with some cars, it is not true with the '63-'82 Corvette.

We have compared the rubber bushings with bearings and the 'lap times' difference could not be measured. The advantage of the bearings on a Corvette is that you are able to fine tune the rest of the suspension better (to be covered in a future article). The use of other bushing materials in the lower A arm causes the opposite of what you want. The characteristics of directional stability in every type of turn are different.

Front Sway Bar Bushings

Speaking of bushings, the GM front sway bar is another area where you should be careful of parts that look good. There are several bearing materials on the market to mount the sway bar to the frame, however, some will not work properly when using GM sway bars — though for another reason. Because the GM front bars are not straight, they will bind up, causing the rate of change to increase. Again, the load varies and will always be different under all cornering conditions. The effect on the car will be to push more and more the harder you corner. There are ways to get around this, which wilt be discussed later, but at present make sure you use rubber at the frame mounts on GM front sway bars.

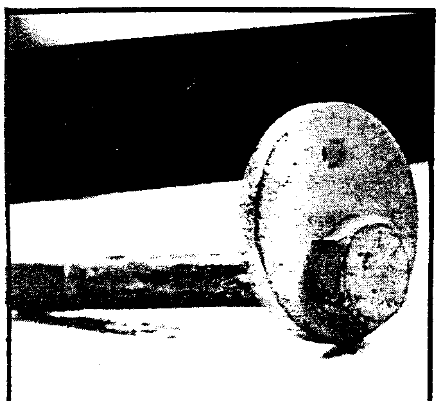
Strut Rod Bracket

Moving to the rear, the lower camber strut rod bushings are the biggest contributor to looseness and controlability. There are several changes that can be made here that will improve several functions. depending on your desired application. or how you use your car most. You can have a noticeable improvement, reasonably inexpensively. Change the lower strut rod bracket to part #356932 for about $18.95. To lower the roll center of the rear and make the '63-'67 Vette hold the road better in constant turns. It cuts down the amount of camber change which results in better rear tire wear.

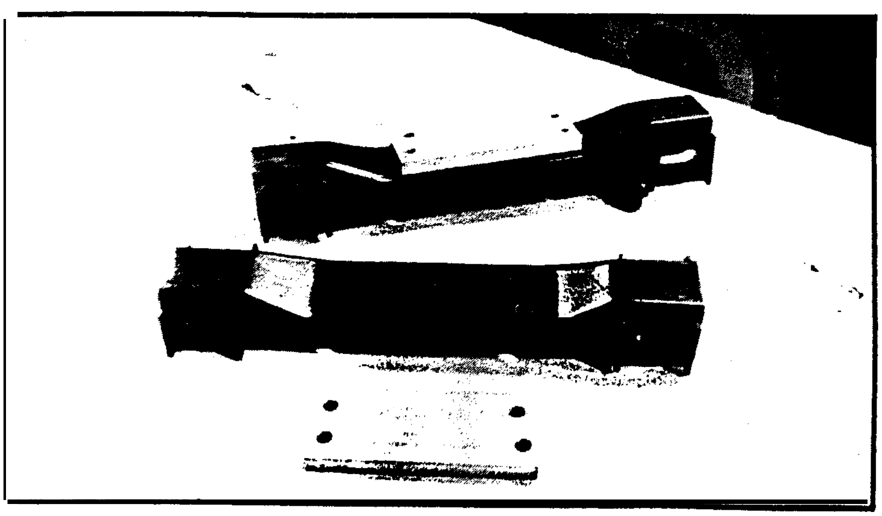
A lower roll center can also be achieved on the '68-'79 Corvette by installing a ½" drilled spacer between the strut rod mount and the bottom of the differential. You will need a ½" plate, which can be aluminum. Use the strut rod bracket to get the location of the four holes to drill. You will need four grade 8 bolts that are ½" longer to hold the bracket to the differential. Make sure these bolts are properly tightened when reinstalling. Also, you should use Loctite on the threads to be sure the bracket never gets loose. If it does — and it can — the rear end will feel like it moves back and forth when you're driving.

To perform this same function on the '80-'82 and the '84-'85, you will have to modify the existing brackets and lower the holes down ½".

To take the assembly apart, you will have to remove the camber adjusting cam bolts. If your bolts are old and rusty, be certain to replace them because they will probably strip when properly tightened. To prevent these bolts from moving during rapid acceleration, it is important that they are properly tightened. If they are fairly new, clean the threads and reassemble with anti-seize compound.



Camber Bolt



Strut Rod Bracket / Spacer
1963 - '79

Strut Rod Bushings

The strut rod bushings are next. Improved performance can be felt on cars three or four years old, or with 30,000 to 40,000 miles. There are three ways to go. If your 1975-'79 Corvette is only used for street use and maximum ride softness is desired along with improved tightness, you should change the lower strut rods to part (GM) #459076. However, although this is a 1975-'79 part number, it can be used on 1963-'74 Corvettes to achieve the same results. You cannot buy the bushings separately; they come installed in the strut rods for approximately $38 each.

If your application leans more to maximizing street performance and sometimes Gymkhana, but you would like to keep the expenses to a minimum, you can use the '63-'74 strut rod bushing part (GM) #3775762, approximately $5.65. These strut rods have smaller bushings which allow less rubber deflection and therefore provide a little quicker response. However, there is a little loss in ride isolation over sharp bumps.

The last application is for competition. This involves the use of rod ends (hiem joints) and threaded strut rods in place of the stock strut rods. This will provide an accurate camber setting that will not change under various loaded conditions -drag racing or road racing. Also the performance of the rear handling response and controlability are improved for more accurate driving response.

One thing to keep in mind when using this application is that the lower strut rod is a very loaded area of the suspension and cheap rod ends can cause several problems. I have seen the rod ends break on Corvettes more than once. This will get you and your car in trouble. Don't use cheap rod ends because they wear quickly and make the suspension loose and noisy. Also, don't use rod ends with grease fittings because it weakens the hiem joint considerably. The best rod ends to use are made from stainless steel and are Teflon lined. These units will hold up for years and stay quiet. The NMB Corp., and the Aurora Bearing Co., make very good rod ends, The cost per rod end is from $45 to $55.

Although this third application focuses On a racing competition application, I suggest a stainless steel or chrome moli (chrome molibdinum) Teflon lined rod end for street application. These parts are available from mail order houses, many of whom advertise in this magazine. ■

inside diameter, Teflon-lined high pressure stainless steel braided lines. Typical brake systems can produce as much as 1,600 PSI so watch out for aged or surplus lines when you buy.

Never use braided lines longer than 18 inches if at all possible. If loo much braided line is used in the system, the slight expansion of even the braided lines will cause a spongy pedal. Use steel lines whenever possible in your system.

Also, when replacing steel lines and fittings, do not use anything but all steel fittings and couplers. Brass and aluminum fittings can generally handle no more than 300-500 psi of fluid pressure. Since your system can aenerate over 1.600 osi. mismatchina components could cause unevenperformance or worse -premature brake failure! Mismatching is a common mistake because many auto stores do not carry proper sized steel fittings.

Brake Pad **Break-In.** Break-in of organic pads is pretty simple. Go easy on them for a few hundred miles and that should be sufficient.

Semi-metallic and metallic pads require a little more effort. The bonding resins need to heat up and cool down *several* times in order to cure properly. If you brake them in too hot and fast, the first 1/8" of the surface will glaze and harden. Breaking in too slowly does not allow even hardening and will lead to premature pad wear.

Here's how to break in your pads properly: Find a place where you can legally get up to 70mph. Once you have the car at 70mph it will be necessary to slow down to 20mph over approximately two tenths of a mile, three times in a row. Between each slow-down, allow the pads to cool off by driving a few minutes at about 50 mph.

Now repeat this procedure another 1 O-l 2 times, while slowing down over shorter and shorter distances. Allow the brakes to cool between each stop. The last few should be controlled panic stops (hard stops without locking up the brakes). After this initial break-in procedure is competed, let the brakes cool thoroughly and you're ready to ao.8

VIP
VETTE IMPROVEMENT PROGRAM

Test Group Report #2: Strut Rods and Idler Arms

Following are the comments from our voluntary Test Group on Part II of the VIP series, which appeared in the March/April issue.

Paul M. Herzing (1978): A few questions please — 1) You mention 'the bearing idler we make.' Who are you? *[Note: Greewood referred to his own firm. See his ad for address.]* 2) Replace lower ball joints. Why only lower? [Note: *Replace both if worn, but lower ones wear out faster.]* 3) I get the impression you want only the lower A-arm bushing changed. *[Note: Rep/ace upper also, if worn.]*

Sue Ellen Cooper (1980): We had to reread the section on modifying the strut rod bracket for application on our 1980 Corvette. You should mention how you lowered the hales in the strut rod brackets ½" for the '80-'85s. Without looking at the bracket we couldn't decide whether they were re-drilled or elongated. This was only cleared up when we removed the bracket.

Larry F. Grimenstein (1972): I wasn't sure whether after adding lowering plate I should have to readjust the camber bolt. I put mine back to the location prior to removal.

Kenneth G. Miller (1972): My only problem was with frozen bolts,.

Results of the Test Drive:

James Dunn (1978): Idler arm made the best improvement.

Mike Munro (1979): In looking at the car before, there was noticeable idler arm wear. Afterward, I noticed extreme tightness, less 'clang' from right wheel when going over nara stuff.

Sue Ellen Cooper (1980): After 'doing the work the car handled better. The steering seemed tighter and more responsive.

Rick Maddaleni (1973): My car seemed to be noticeably tighter. The front and rear suspension felt tied together instead of fighting each other. Also, in cornering the trailing throttle oversteer wasn't as severe. I had expected the changes would return the tightness, but did not anticipate the additional results with the trailing throttle oversteer.

Anthony Rushin (1981): With the new A-arm and strut rod bushings, it took out some more of the aged mileage play and added *some* more of that new car feel. Now it feels tighter and more predictable than ever. The improvement was more than I had expected.

Gary Dixon (1972): The results were amazing. Solid road feel. Tightness. Quick response.

John Stickley *(1975):* Car is crisper and tighter.

Skipper Stubbs (1980): Better Cornering, nice firm ride and a feel of owning the road.

Gary Compton (1980): Car corners better at high speeds and is smoother.

Jan Gaskin (1979): The rear end stiffened up considerably. I did notice some mare control. It would probably have made a lot more difference had my car not had the Rancho springs.

Kenneth G. Miller (1972): Handling was far more precise afterward. Car responded more accurately to inputs. Less lead and quicker recovery when swerving or turning.

John J. Glover (1969): The car was much more stable. Corvettes should have come from the factory with Heim jointed strut rods. Granted, my bushings were shot, but comparing this car to the other Vettes I've owned would be comparing apples to oranges. It's a much safer car. The improvements in this part were more than I expected. The combination of the plate and strut rod fit really tightened up the rear end. It's not a white knuckle experience to drive the car hard anv more. The car used to be a handful just changing lanes at 130 mph. Now it's solid.

Suggestions to Other Readers Trying the Idler Arm and Strut Rod Changes

Mike Munro (1979): If time and mechanical limitations prohibit your own installation, have dealer do it. Had. stock idler installed for $60 (including labor). Don't forget alignment or at least "toe-in" check.

Sue Ellen Cooper (1980): You should be aware that some of the procedures discussed may require the use of pullers and a press.

Rick Maddaleni (1973): When replacing the strut rod bushings make sure that the rust and old rubber stuck to the inside of the strut is removed. They press in a lot easier. A wheel cylinder (brake) hone works great.

Larry Grimenstein (1972): They should be warned that the price of a bearing idler arm is $180!

John M. Stickley (1975): Now is time to inspect rear spring seat on rear end housing. Mine was broken.

Skipper Stubbs (1980): Read instructions and don't get into a rush. Double check your work (checklists never hurt).

Philip Tiberio, Jr., (1970): I think readers who want to improve handling should first check out the condition of their suspensions. Just hanging on sway bars, shocks and wheel/tires and ignoring the remainder of the system will be disappointing.

Jan Gaskin (1979): On the rear strut rods, after replacing tnem my rear ena had to be realigned. They might need to check their alignment.

John J. Glover (1969): The rewards are very worthwhile. Make sure you find an alignment shop that knows how to do the rear of your Vette. One shop wanted to heat and bend the stock strut rods. ■

IMPROVING BRAKE PERFORMANCE

VETTE IMPROVEMENT PROGRAM

BY JOHN GREENWOOD

PART THREE

In the remaining three parts to this series I will cover shocks and springs, followed by tires, bearings, and alignment. Since we will be introducing you to some new maintenance and repair concepts, you may not wish to replace any of these parts unless it is absolutely necessary.

This part is devoted to improving brake system performance. The majority of complaints from owners of 1965-82 Corvettes pertain to braking. Unfortunately, the solution to these problems is complicated by the variety of driving situations. Accordingly, prior to b&ginning work, you must decide the level of braking performance appropriate for your driving needs, and therefore, which of my recommendations are appropriate for you. The information and recommendations are based on the result of many years of road racing experience in mid-year Corvettes. When we won the National Championships and the Trans Am series, the rules stipulated the use of stock rotors and calipers. So we devoted our attention to getting the most from stock equipment. This gave us a "real" advantage over competitors concerned with brakes only when they experienced problems.

Calipers. The most important and expensive component is the caliper. Stock GM calipers on 1965-82 Corvettes have been very good performers,and under many kinds of street applications they are generally trouble-free for many years. However, with age and heavy use, yo'ı can expect problems with fluid leaking topping the list. And the most probably cause is corrosion. When moisture collects inside the calipers, it causes corrosion of the cylinder walls and pistons resulting in seal leakage.

Prevent Moisture Accumulation. I've found that the best way to prevent moisture accumulation and corrosion in a street car is to flush the brake system every two years with fresh fluid. I recommend you use a pressure brake bleeder and DOT #3 polyglycol fluid for normal street use and DOT #4 fluid with hard braking use or with semi-metallic pads which create more heat. If you have or are going to install full metallic pads, use GM 550 or L.E. polyglycol fluid because of the higher operating temperature. *(See Take A Brake, Parts 1 &* 2 by Dave Emanuel, Jan/Feb and Mar/Apr '85.) I know that there are strong proponents for silicone brake fluid, but don't get too excited about it. We used it in our race cars for two years of long distance racing, and we found that the silicone fluid does not have the responsiveness of regular polyglycol brake fluid. True, silicone fluid does not mix with water, but moisture still gets into the system, and since it does not mix with silicone fluid, the moisture collects at the lowest point in a small area in the piston bore. We have found that silicone fluid and water seem to accelerate corrosion. The Japanese road racing motorcycle teams have verified this accelerated corrosion problem and now use only polyglycol fluid.

Corrosion Gets to You. If-it is too late to prevent corrosion, the calipers will have to be repaired. If you have the experience and equipment you may decide to make the repair yourself. If you do, you will have to replace the caliper halves with new castings or install stainless steel sleeves, a process involving machining the caliper bores and installing stainless steel sleeves. *In* all probability, new pistons will be required. The reassembly is simple enough. Replace the pistons using new seals, and reassemble the caliper halves and properly torque the bolts.

The alternative to rebuilding your own is to remove your old calipers and purchase a set of reconditioned stainless steel sleeved calipers which are ready to bolt on.

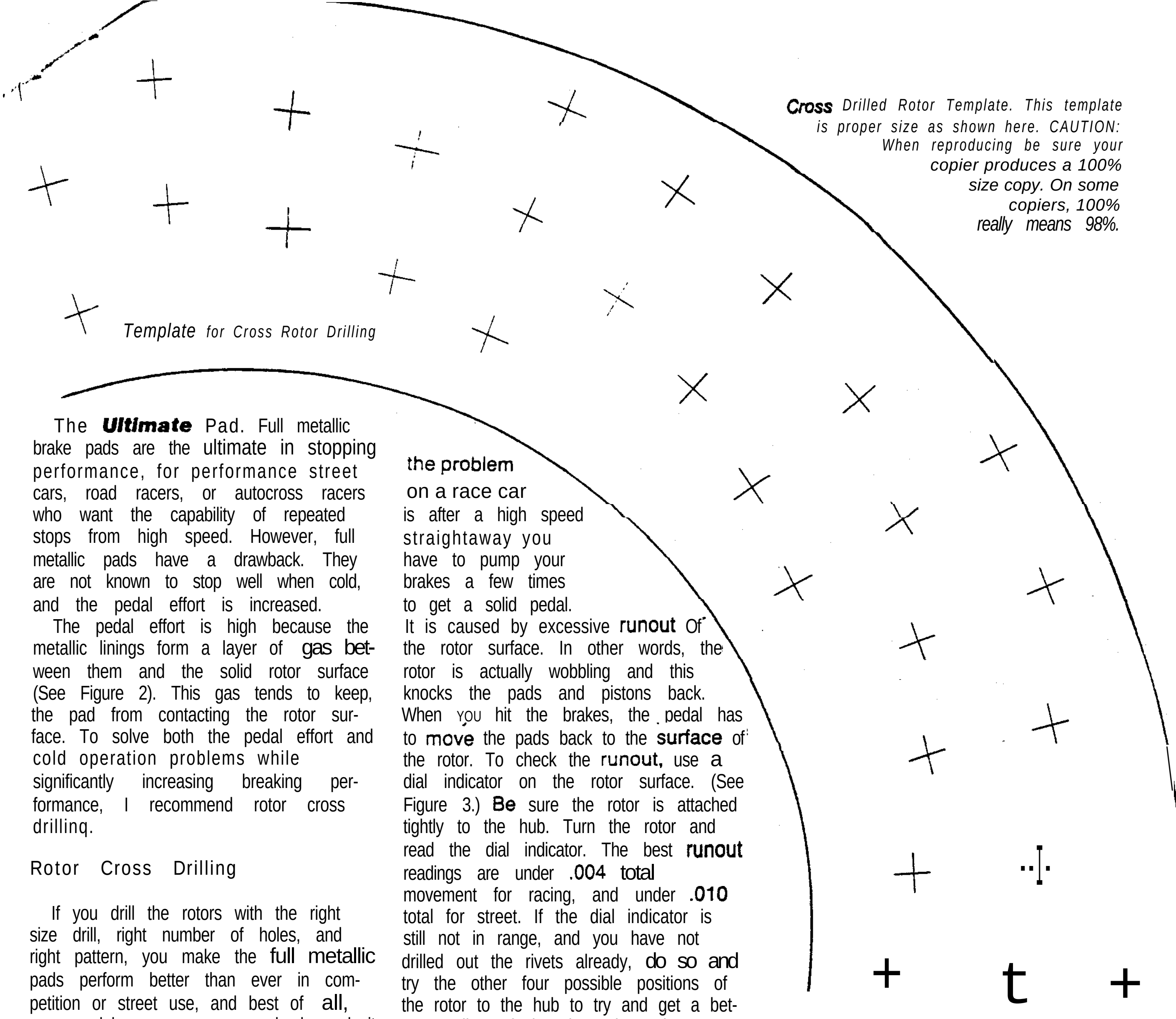
There are many manufacturers of Corvette calipers. These rebuilt stainless steel sleeve calipers can be purchased from reputable re-manufacturers for $59.95 to $150, so shqp around.

Make sure that the'calipers have new pistons, new seals, stainless steel sleeves, new bolts holding halves together and a finish that brake fluid won't attack, such as nickle plating or epoxy finish.

To avoid buying inferior calipers, watch out for: No warranty, lack of testing or improper testing, and defective caliper castings. One last thing: watch out for stainless steel bleed screws. Because they are harder than the caliper casting itself they may not seal properly. Under some conditions the harder threads of the bleed screws will "pull out" of the softer caliper threads. We learned from racing experience that it's better to replace a bleed screw than a caliper, so don't use the stainless screws, use standard steel bleed screws, don't tighten the screws more than 65 inch pounds, and always use a six point box wrench or socket. I recommend the above approach if your Vette is a street car and you do limited autocrossing.

Brake Pads. Brake pads also have specific characteristics and applications. Organic brake pads (asbestos fiber and resin binders), standard equipment on mid-year Corvettes, are adequate under normal conditions. However. if you are inclined to run autocross in a shopping center parking lot on a Sunday afternoon, they may become inadequate. Should it become necessary to make repeated panic stops from 70 to 80 mph, effectiveness is marginal.

In the event that you are not interested in making vast improvements in your brakes, there are several good replacement organic pads on the market equal to GMs. Bendix claims they have a lining that cuts down on squealing. But semi-metallic brake pads are a step up. You will truly appreciate semi-metallic pads if you autocross. The reputable manufacturers all have a line of semi-metallic pads, but we use Bendix in Greenwood cars. Because semi-metallic pads generate higher temperature, it is recommended that you go to DOT #4 brake fluid which has a higher boiling point than DOT #3. These pads are used on mid-size cars, including the '85 Corvette now as standard equipment. This is probably the cheapest and smplest way to increase braking performance.



Template for Cross Rotor Drilling

Cross Drilled Rotor Template. This template is proper size as shown here. CAUTION: When reproducing be sure your copier produces a 100% size copy. On some copiers, 100% really means 98%.

The Ultimate Pad. Full metallic brake pads are the ultimate in stopping performance, for performance street cars, road racers, or autocross racers who want the capability of repeated stops from high speed. However, full metallic pads have a drawback. They are not known to stop well when cold, and the pedal effort is increased.

The pedal effort is high because the metallic linings form a layer of gas between them and the solid rotor surface (See Figure 2). This gas tends to keep, the pad from contacting the rotor surface. To solve both the pedal effort and cold operation problems while significantly increasing breaking performance, I recommend rotor cross drilling.

Rotor Cross Drilling

If you drill the rotors with the right size drill, right number of holes, and right pattern, you make the full metallic pads perform better than ever in competition or street use, and best of all, your pedal response comes back and it feels like a power brake again. In addition, the brakes perform well hot or cold. The holes allow the gas to escape and also clean the dust from the surface of the pad which makes the pads last longer. Drilling the rotors also works well with semi-metallic pads.

We have found there is an optimum number of holes needed to effectively remedy this problem without hurting the longevity of the rotor. Holes that are too large, or are in the wrong places, can cause early cracking.

In preparation, jack up the car and put it on jack stands. Remove all wheels. Prior to removing the rotors, check the rotor runout. One possible reason for a spongy pedal is "pad knock back" caused by the rotor not running true or wobbling. If you have a spongy pedal problem wiht a street car and bleeding the brakes doesn't seem to help, this could be your problem. This could be the problem on a race car is after a high speed straightaway you have to pump your brakes a few times to get a solid pedal.

It is caused by excessive runout of the rotor surface. In other words, the rotor is actually wobbling and this knocks the pads and pistons back. When you hit the brakes, the pedal has to move the pads back to the surface of the rotor. To check the runout, use a dial indicator on the rotor surface. (See Figure 3.) Be sure the rotor is attached tightly to the hub. Turn the rotor and read the dial indicator. The best runout readings are under .004 total movement for racing, and under .010 total for street. If the dial indicator is still not in range, and you have not drilled out the rivets already, do so and try the other four possible positions of the rotor to the hub to try and get a better reading. If the rivets have been removed, secure the rotors to the hubs with lug nuts and washers. If you cannot obtain an adequate reading, replace the rotor or have the hub and rotor turned as an assembly.

Cross Rotor Drilling Procedure. The rotor drilling procedure requires an inexpensive drill press, a 3/16" carbide, center punch, and a champhering tool.

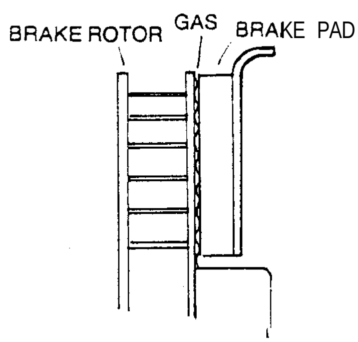


Figure 2. Drawing indicates area where full metallic pads generate a layer of gas.

1) Permanently mark rotors and hubs. You must maintain matched sets. Be sure to mark location on the hub. NOTE: Rotor and hub are manufactured as a unit to maintain runout within limits.

2) Remove rotor from hub. Drill out retaining rivets. NOTE: Center punch rivet head then drill a small pilot hole, followed with a 3/8" drill. Notice the rivets are located in recessed area on the face of the rotor "hat." Drill in the center of the rotor hat recessed area, because the flattened rivet heads are not always centered in the recess, but the stud that you want to remove the rivet head from is centered. *Don't drill any deeper than necessary for the rivet head to come off.* On reassembly, merely position the rotor on the studs

Continued on page 48

Continued from page 31

and install caliper and pads. The wheel studs will hold rotor in place. This procedure is used on the new '84-5 Vettes.

3) Make template. Use the template pattern provided in this article which is full size, but represents only 3 ot the 10 segments of the pattern of holes required to complete the pattern on the entire rotor. Each pattern segment is 36°, therefore with a photocopy machine, if you make four copies of the portion provided, you can tape the four segments together (there will be some overlapping.) to make a circular pattern with the full ten 36° segments. Alternatively, use the pattern segment provided by repositioning it around the rotor as you go.

4) Transfer pattern to rotor. Place starting point on rotor so that the center of the row of three holes will be centred between the webs of the rotor. Each hole must be centered in between the webs and the outboard hole must be 5/16" to 3/8" from the rotor edge. With template in place, center punch each hole location, moving the pattern segment around the rotor. (See Figure 4.)

5) Drill holes and chamfer. Using a drill press and 3/16" carbide drill, drill holes as indicated. With chamfering 45° to 60° tool, relieve the edge of each hole by chamfering each hole on both pad surfaces of the rotor.

High Speed and Severe Braking. For continuous, fast lap racing applications generating sustained high temperature operation, I recommend you install the GM pistons and insulator assemblies from the old GM J56 brake option (front insulator #5463822, rear #546699593). This will help insulate the rotor heat from the brake fluid. For continuous heavy duty use I further recommend installation of the GM front caliper support brace for the J56 heavy duty brake package which bolts to the steering arm and caliper.

High Speed **Racing** Pads. When selecting high speed racing pads, pay particular attention to how the lining material is affixed to the backing plate. Riveting is not adequate. The pad material must be bonded througn noles in the backing plate. Also, pads come with both single and double pin backing plates. I recommend the double pin, L-shaped backing plates for hard use. If you are going to autocross regularly or you have 450 HP or more, you shculd definitely consider using double pin brake pads. Straight single pin backing plates can flex up to .020 under hard brake application. To modify your calipers to allow the L-shaped backing plate to fit properly, cut the single pin mount off both sides with a hack saw and file smooth. Then using the double pin pad as a template, mark the new holes and drill with a 3/16" size drill. (See Figure 5). Also, when buying the double pin L-shaped pads, be sure to get the pads with original GM backing plates made of Inconel steel. Some remanufacturers are making their own backing plates and I don't think they are as gocc.

Brake Lines and Fittings.

Many of you contact us quite regularly with questions about braided brake hoses and steel line replacements Here are some important facts that could save you a lot of time, money and aggravation.

Replacement of stock rubber brake lines with steel brake lines makes a lot of sense. However, be sure to use

Figure 1. Remanufactured caliper ready to boit on.

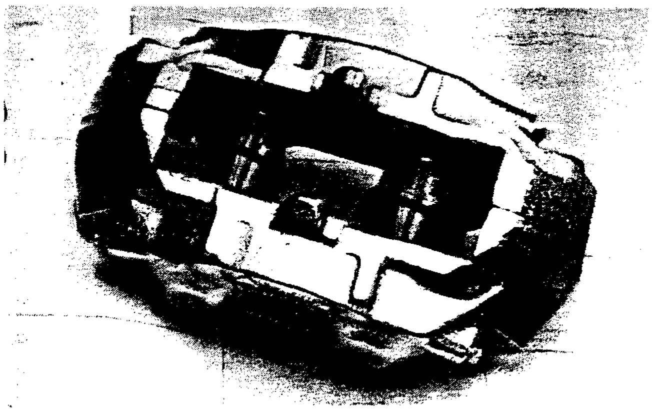


Figure 3. Checking Rotor Runout. High speea racing: do not exceed .004 in. Street use: do not exceed .010 in.

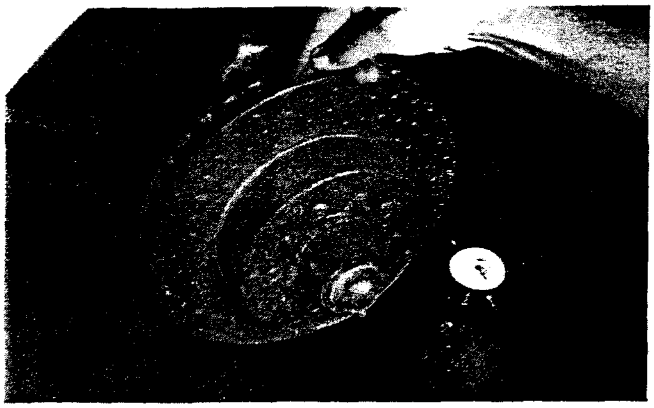


Figure 4. Cross drilled rotor. Note that center of hole at arrow should be 3/8" from edge. Holes must be centered between rotor webbing. *Warning: do not drill just front or rear • Drill all four rotors!!*

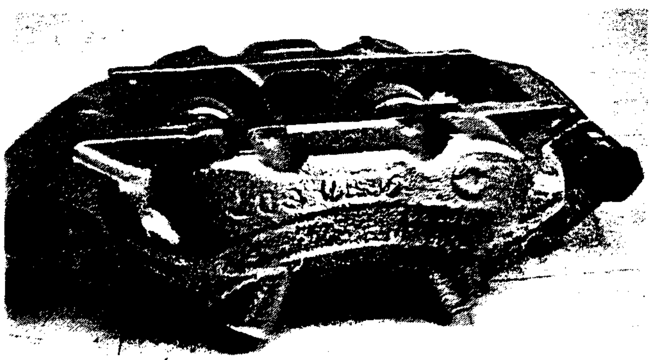


Figure 5. Brake caliper modified to accept two pin L-shapedpads.

inside diameter. Teflon lined, high pressure stainless steel braided lines. Typical brake systems can produce as much as 1,600 PSI so watch out for aged or surplus lines when you buy.

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Jan Gaskin (1979): The rear end stiffened up considerably. I did notice some more control. It would probably have made a lot more difference had my car not had the Rancho springs.

Kenneth G. Miller (1972): Handling was far more precise afterward. Car responded more accurately to inputs. Less lead and quicker recovery when swerving or turning.

John J. Glover (1969): The car was much more stable. Corvettes-should have come from the factory with Heim jointed strut rods. Granted, my bushings were shot, but comparing this car to the other Vettes I've owned would be comparing apples to oranges. It's a much safer car. The improvements in this part were more than I expected. The combination of the plate and strut rod fit really tightened up the rear end. It's not a white knuckle experience. to drive the car hard any more. The car used to be a handful just changing lanes at 130 mph. Now. it's solid.

Suggestions to Other Readers Trying the Idler Arm and Strut Rod Changes

Mike Munro (1979): If time and mechanical limitations prohibit your own installation.. have dealer do it. Had stock idler installed for $60 (including,. labor). Don't forget alignment or at least "toe-in" check.

Sue Ellen Cooper (1980): You should be aware that some of the procedures discussed may require the use of pullers and a press,

Rick Maddaleni (1973): When replacing the strut rod bushings make sure that the rust and old rubber stuck to the inside of the strut is removed. They press in a lot easier. A wheel cylinder (brake) hone works great.

Larry Grimenstein (1972): They should be warned that the price of a bearing idler arm is $180!

John M. Stickley (1975): Now is time to inspect rear spring seat on rear end housing. Mine was broken.

Skipper Stubbs (1980): Read instructions and don't get into a rush. Double check your work (checklists never hurt).

Philip Tiberio, Jr., (1970): I think readers who want to improve handling should first check out the condition of their suspensions. Just hanging on sway bars, shocks and wheel/tires and ignoring the remainder of the system will be disappointing.

Jan Gaskin (1979): On the rear strut rods, after replacing them my rear end had to be realigned. They might need to check their alignment.

John J. Glover (1969): The rewards are very worthwhile. Make sure you find an alignment shop that knows how to do the rear of *your* Vette. One shop wanted to heat and bend the stock strut rods. ■

Test Group Report: Brake Performance

Comments on the instructions for drilling the rotors (May/June issue):

Rick Maddaleni, 1973: It took me a while to realize that I should drill both sides at once.

Jim & Cindy Dunn, 1978: Good information; especially on the silicone fluid. Also, since we had the brakes apart, some mention of the parking brake would have been helpful.

Comments on test driving:

Rick Maddaleni, 1973: Brake pedal felt noticeably firmer. Pedal travel seemed reduced. Braking is so much better there is no comparison. No fading at all. Feels as though it will stop on a dime. I had expected better stopping power, but not the reduced pedal travel and the firmer feeling brake pedal.

Kenneth Miller, 1972: Result was smooth, even pedal pressure throughout the full range. Stopping was more predictable, even after repeated high speed stops.

John Glover, 1969: I had already changed to semi-metallic pads, steel braided flex lines front and rear, and stainless steel sleeved calipers. I had also changed to silicone (DOT 5) fluid. Initially, the pedal was good and hard but progressively got softer and softer. After reading the comments on silicone fluid I flushed the system and filled it with DOT 4 glycol based fluid. The brakes are working great again.

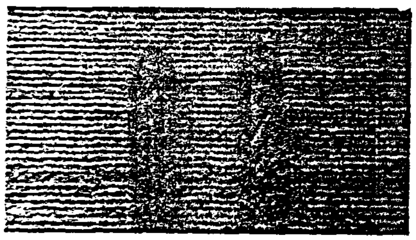
Gerald J. Rodrigez: Results were better than I expected. Quicker stopping and no brake fade. The car felt like it had two power brake boosters.

Charles Stroppel, 1965: With semi-metallic pads, I don't think you could ever "run out of brakes."

M. Fi. Schroeder, 1979: The brakes were a lot better after. The semi-metallic pads worked very well without any noise.

Suggestions for readers' trying the changes recommended in Part Three on Improving Braking Performance:

Rick Maddaleni, 1973: On some drill presses it will be necessary to use a longer than normal 3/16" drill bit because the size of the chuck won't allow it to come close enough to drill the inner most holes. The same holds true for the chamfering tools. An old ½" drill bit, ground down to the chamfering tool angle, works great (See photo). When center punching for



the holes, it may be necessary to move the punch to one side of the mark or the other (but don't change the distance of the marks from the center of the hub), in order to make sure the holes will be centered between the webs of the rotor. Finally, make sure that there isn't any casting flash between the webs. It only takes a small piece to catch the bit and snap it.

Kevin Patnode, 1969: I used metallic pads on rear and regular ones on front of my car. On a friend's car I used metallic on all four wheels. I have noticed a great deal of powdering and excessive rotor wear.

John J. Glover, 1969: Use a pressure bleeder. It's the only way to bleed the system properly.

Charles Stroppel, 1965: As long as you are in there add braided stainless lines and new wheel bearings.

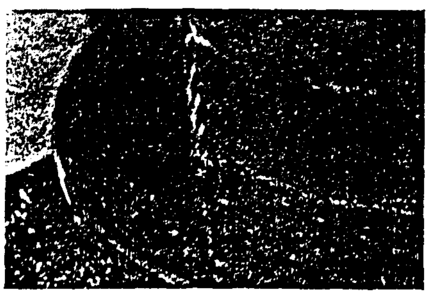
Raymond Knecom, 1980: If you have access to a rotary table as I did it makes the job much easier.

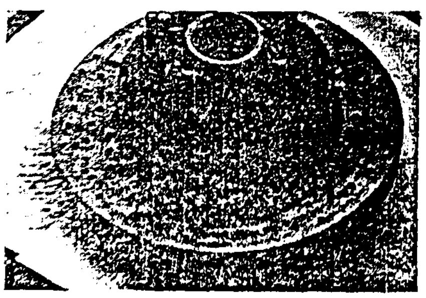
Dennis Penberthy, 1968: It always helps to have manuals or someone with Vette experience to assist. I had problems once when I hit the brakes very hard from about 120 mph. I had no brakes to speak of until I pumped them a couple of times. I checked everything, bled the brakes twice and the master cylinder with no luck. A friend of mine told me to bleed them is sequence RR-LR-RF-LF and the brakes were perfect after that.

Gary Compton, 1980: Use semi-metallic pads and do not drill the rotors. Too much work for the average driver.

Gerry Peterson: Greenwood's comments concerning silicone brake fluid will surely spark a controversy. His reasoning does make sense. The phenomenon of gas generation with metallic pads is a new concept to me and I thought I had heard of everything! Although my style of driving does not require metallic pads and dual pin brakes with drilled rotors, it's nice to know that braking system upgrading is a relatively easy, straightforward operation.

Jim & Cindy Dunn, 1978: First, don't touch the brake system unless you know what you're doing. Second, take your time and do it right.





Thanks to Rick Maddaleni for these photos of the rotor drilling operation.

VIP
VETTE IMPROVEMENT PROGRAM

by JOHN GREENWOOD

PART 4

Springs, Swaybars, Shocks for better performance

In this our fourth article in the VIP series on better handling performance, we're going to discuss improvements that rely on and work with other suspension components for best results. There won't be much theorizing, but I will show you how to realize exciting improvements based on our years of racing experience and actual field testing of these procedures.

You'll see how the best handling improvements come from a combination of the lightest springs possible for your driving style, quite heavy sway bars, and good shock control valving.

Springs. Best performance is realized from using suspension travel and weight transfer, not just the tire footprint. To realize suspension travel, use as light a spring as possible for your driving conditions. If the car bottoms out, the springs are too light. The standard suspension springs will work the best for most applications until you get into race tires and high speed tracks.

The front suspension geometry on the Corvette is very good for performance and actually sticks better than the rear end. To improve performance it is necessary to get the relationship between the front and rear harmonized a little more to help the rear stick better under power (acceleration). We want the rear springs to be lighter in relation to the front, than they are from the factory. To achieve this balance, you can either make the rear springs lighter or the front springs heavier. The balance you are looking for is a rear spring rate that is 20-30% lighter than the front. If you already have F-41 springs, you should lower the rear spring rate 20-30%. If you have standard suspension springs you can raise the front spring rate 20-30% (as explained later).

Sway bars. The sway bar's job is strictly to control roll in any transition, quick manuever or turn. To bring the front-to-rear roll stiffness back to where it should be, we will increase the rear sway bar rate by 20-30% over the front.

All Corvettes need a rear sway bar. When one is added it will generally require an increase in the front sway bar diameter also. A good starting point for sway bars would be 5/8" to 11/16" diameter rear and a 1" diameter in the front.

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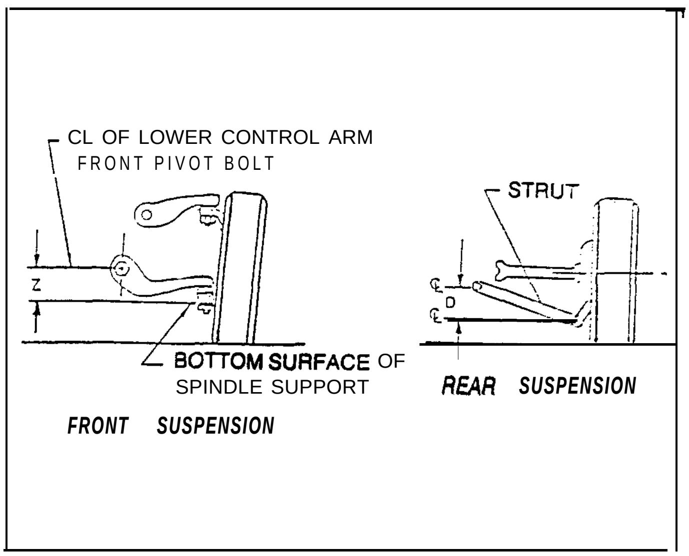

Figure 1.

-1 coil tight end / -1 coil open end

SPRING COMPRESSION CHAR	A STD	B	C	D F.41	E Daytona
FREE LENGTH OF SPRING	16.187"	15.250"	13.625"	12.25"	10.50"
INCH OF TRAVEL 1"	250#	225#	300#	525#	850#
2"	500#	525#	575#	1050#	1700#
3"	725#	725#	875#	1625#	2550#
4"	1000#	1025#	1250#	2250#	3475#
5"	1250#	1325#	1600#	2900#	
6"	1600#	1650#	2075#	3475#	

Figure 2.

VETTE IMPROVEMENT PROGRAM

Continued from preceding page

Shocks. Shock absorbers are meant to dampen the car-to-tire movement in relation to road surface. Shocks are the most important suspension improvement area and offer very dramatic and noticeable gains in performance.

Most drivers think of shocks only to control hard bumps and high speed float. Shocks actually play an important part in controlling the cornering force of a car. They control the tire contact over the road surface to maintain maximum adhesion. in order to properly control a car with light springs and heavy sway bars, you need shocks with lots of rebound control.

For good rebound control, adjustability for wear and dampening, long life, and soft ride, our single recommendation is the Koni Gas Shock. In our experience we haven't found anything better.

Adjusting ride height.

The basic geometry in the front of a Corvette is generally considered very good for performance. This good performance can be atributed, at least in part, to the amount of negative camber, or **camber gain, that develops when it goes through full suspension travel or jounce. When your car is set up at the proper height for your desired application, the static camber (camber the car has under normal driving) will be between (0) to 1/4 degrees negative camber for** street use and up to 3/4 degrees negative camber for full race use. The camber change should give your car the maximum tire "footprint" on the road under ail types of performance.

To determine proper front-end height, you must consider how the car will be used. Negative camber increases for every inch of suspension travel into jounce (this is called camber gain), in proportion to the amount you lower the front-end. As you lower the front-end you increase the amount of camber change and the center of gravity (CG) of the front-end is lowered resulting in better cornering power.

Optimal "Z" height for best performance is one inch. Lowering the car can be accomplished by changing the length of the front springs.

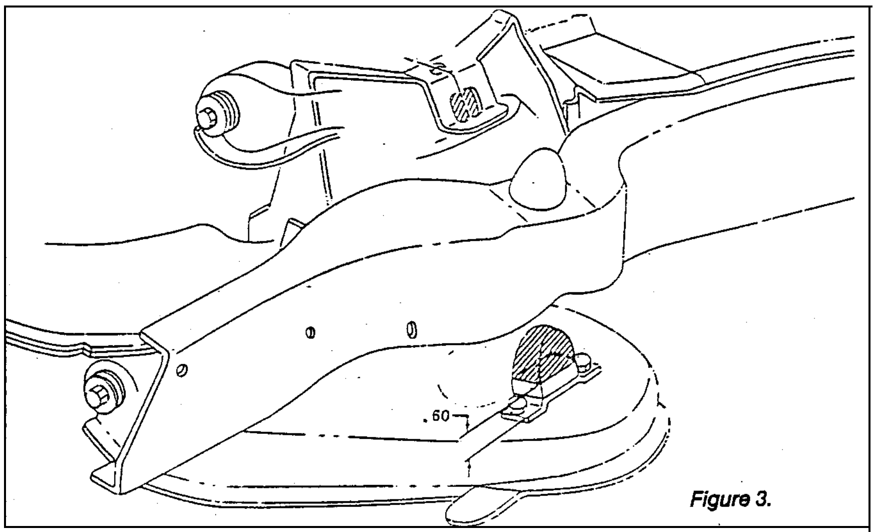

Figure 3.

To check and set the height of your front-end, measure the "Z" height at the front (figure 1).This is measured from the center of the lower control arm shaft to the ground and from the bottom surface of the spindle support, where the lower bail joint goes through, to the ground. The difference between these two measurements is the "Z" height.

Changing the length of the front springs can be accomplished two ways. (1) Replace the spring with a longer or shorter one. (2) Shorten existing springs by cutting coils off.

Most standard springs are

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SHOCK MOUNTING

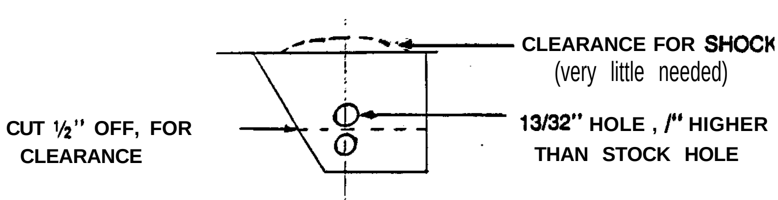

Figure 4.

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Continued from page 34

referred to as progressive rated springs. These have a few tightly spaced coils at one end and more: openly Spaced coils over the rest of the spring. **To lower the car without changing the spring rate drastically, cut the coils from the tighter spaced end.**

If you want to further increase the spring rate, cut one coil off the open end of the spring. This procedure will give you an increased rate of approximately 20% per coil!! Should you decide to **use the F-41 spring,** buy part number **3832518; they are already shortened.** This spring installation will put your car's "Z" height in the ball park without cutting spring **coils.**

Spring rates. The following springs and chart (figure 2) show the increase in rates of springs as they are compressed one inch at a time, to give you an idea what to expect when you modify or change springs in your car.

Spring (A) is a standard spring part number 331318, rated at 250 pounds per inch of travel. (B) is the same spring with one coil removed from the tight end. (C) is the same spring with a coil removed from the openly spaced end. Spring (D) is an F-41, part number 3832518, rated at 550 pounds per inch of travel. (E) is the Chevrolet Daytona spring, part number 3986032, rated at 860 pounds per inch of travel.

After lowering the front-end, adjustments must be made to the rubber bumpers. Cut the bumpers shorter on the lower A-arms. Leave **approximately ½" of rubber (figure 3). To keep the shock absorbers from bottoming out under full jounce or compression, mount the lower shock down with ¾"** steel sleeve spacer and longer grade-8 bolts.

Finally, the caster and **camber** alignment shims should be drilled and wired in place, or removed and replaced with round washers to insure their integrity under competitive use. When the car is under hard cornering, these adjustment bolts can stretch enough for the shim to fall out unless secured as described.

"D" height (rear end). In order to bring front and rear end performance into the proper **relationship**, the following procedure is necessary. First, check the height of the rear end -the "D" height. lower strut rod by measuring the center of each end to the ground (Figure 1). This dimension normally should be l-1 /4" with driver aboard and full fuel load. But we use the D height only for reference. We set the rear end suspension height at the half shaft as described later.

Relocating Differential.

To complete the ride height adjustment procedure, lower the strut rod bracket under the differential down about ½". (Figure 4). This lowers the roll center and lessens the camber change in the rear. It's basically the opposite of what we did in the front. In both instances we are trying to get better tire contact with the road in cornering conditions.

As your car goes into a hard cornering condition, the loaded side of the rear will start toeing out causing the rear to oversteer. So next, set the half shafts by measuring at the center of the universals to the ground! Set the **inside U-joint, next to the differential, ½" higher than the outside. The lower the half shaft at the differential** when you set the ride height, the more toe out or oversteer you'll experience.

Raising and lowering half shafts. To raise and lower half shaft heights, you can lengthen or shorten the bolts at the ends of the leaf spring.

The multileaf steel spring has a progressive curve and it dampens the suspension travel, which is the shock absorbers job! This takes away from the suspension and shocks tuneability. You can improve this condition some by taking the spring apart and greasing between the leafs, **reassembling and putting a bike inner tube over it to keep it clean. A more efficient and permanent fix would be to replace with a fiberglass leaf spring. The fiberglass spring has a straight or constant rate which allows the shocks to do their job properly!**

Looking at the Toe Steer Chart Figure 5, Rear Suspension), note

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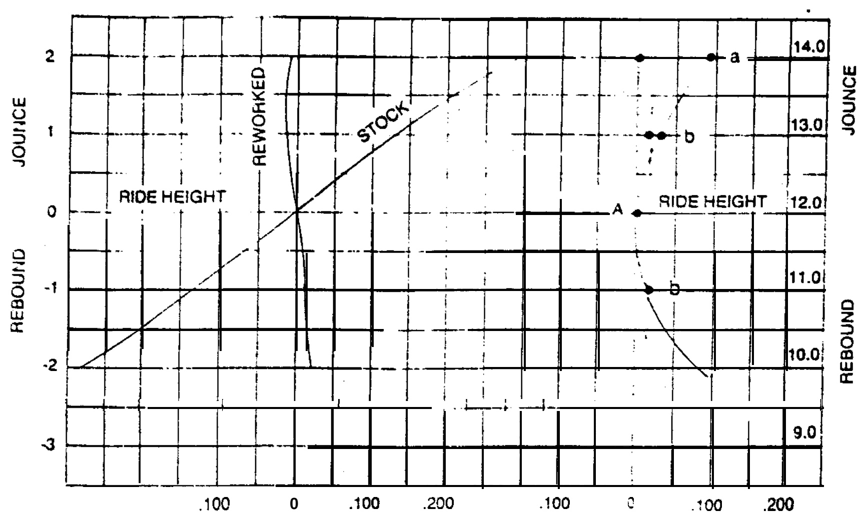
TOE STEER

Figure 5.



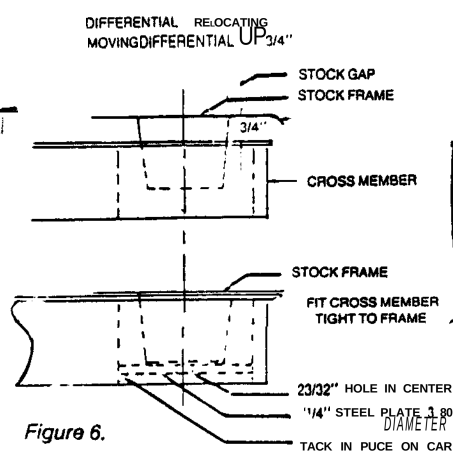


Figure 6.

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that the swing arm Corvette suspension has a lot of toe-out on either end of ride heights. Whether you are hard cornering with the rear end compressed or hard braking with the rear end light, you will experience enough toe-out to actually steer the car!

Check this out. If your half shaft is level when the car is at ride height, look at how much toe-out you get through 2 inches of wheel travel. (Example a.) But if you start with half shaft higher at the differential (example b), and go through the same 2 inches of travel, you end up with the tire going through a small curve but ending up almost straight ahead with .010-.015 toe-out. (Example b) Now look at the difference in the amount of toe change!

After raising the half shaft height ½", you may find the car body sits a little higher than you like. To bring it back down, take the rubber biscuits out of the differential cross member and raise the rear cross member up into the frame 3/4". This does not change the geometry but lowers the CG back to its proper point and mounts the differential solid — a performance change.

Cut a circle with a diameter of 3.8" from quarter inch steel flat stock. In the center of the circle drill a 23/32" hole. Put the cross member up into place. Flatten the shoulder on the frame where the rubber biscuit was captured. Hold the cross member tight to the frame. Put the 1/4" steel plate in with the bolt and tack-weld the plate to the cross member. (Figure 6) Remove the finish welding securely. Use a shim under the front differential mount. Now move the tip shock mounting hole up ½". Cut ½" off the bottom for clearance. Last, shorten the rubber bumper down to ½" like the front. (Figure 3)

Changing to 'quick **steering'** on the **1963-67** Corvette. A simple and very effective change you can make to improve your car's steering response is what we call the "Quick Steering" changeover. There are two holes in the steering arms where the tie rods can be located. Until the 1977 model year, tie rods on manual steering cars were located in the rearward hole positions. By simply relocating the tie rods in the forward hole position, and resetting the toe-in, you can convert your car to "Quick Steering".

A companion procedure to "Quick Steering" involves changing the steering geometry for high performance street use, autocross, or racing. In driving terms, this means that the better your tire performance (road grip and/or tire width) the more you will experience 'darting' (the result of tires that follow road imperfections and ruts) under hard braking and over rough or uneven road surfaces. This condition is caused by toe-change and can be improved dramatically with some very simple changes.

Referring to the toe steer chart (figure 5, front suspension), note the toe change the steering "sees" as it goes through full suspension travel, often called "jounce". Zero on the chart represents ride height. As you can see, when a stock car goes through full suspension travel, there is quite a change in the direction the tire travels (from 1/16" toe-IN to 1/4" toe-OUT). With our recommended modifications, your car's steering will be much straighter and controllable. See the reworked curve in the chart.

Toe **adjuster** blocks. Figure (7) shows several bolt-on toe adjuster blocks. These blocks will help you to make the proper adjustments for your particular model year.

These units are fairly easy to install by drilling out the tapered hole, with a 21/32" drill, in the steering arm and bolting the blocks in place. On cars with only one tapered hole in the steering arm, drill it out and bolt the block into place using it to line-up and mark the other hole. Repeat this procedure for the other tie rod end.

There are several important points to note when buying adjuster blocks. (1) The block on the left does not have an angle-cut bottom and should be checked for tire clearance. (2) The block with the angle-cut bottom should cost more due to extra manufacturing costs for milling. (3) When these blocks were first designed, three different thicknesses were made each for separate "Z" height. Be sure to ask your dealer for a chart or graph showing the steering curve for the "Z" height you have selected. ■

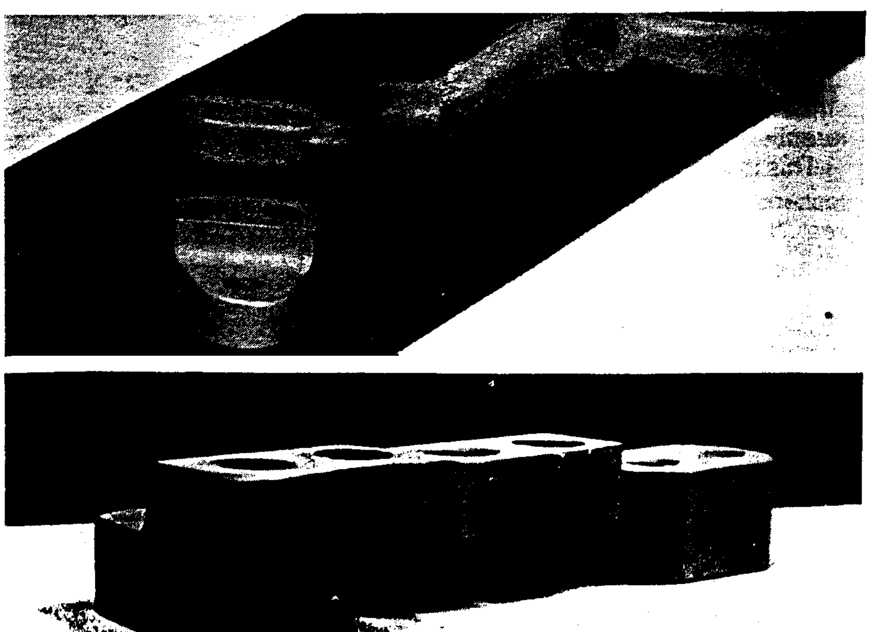

Figure 7.

by JOHN GREENWOOD

VIP VETTE IMPROVEMENT PROGRAM

PART 5

Wheel Bearings

In the following article, we will give you recommendations of what has worked the best for us over the past 15 years regarding Corvette wheei bearings, basic procedures and bearing care applying to the 1963 to 1962 Corvettes. You will have to get your GM service manual out for this one and follow their procedures for most of the disassembly and assembly of the bearing units.

All Corvettes will require the disassembly and replacement of the bearings at some time. The bearing assemblies come from the factory with enough grease to last from 40,000 miles up. Some people have been luckier than others as to how long they lasted and where they were when they finally failed.

By showing you some of the do's and don'ts, it might help you when your time comes to do it yourself or have it done properly.

If this is done right with the right parts (grease,etc.) you should never have to do it again, or at least not for a few hundred thousand miles. Figure A shows what we will be discussing.

Notice the size of the cavity for grease. The factory puts a little grease at both ends, like a finger width.

If you were to grease the inner bearing with an external greaser while the car is still assembled, the grease would not reach the outer bearing.

There are two designs of spindle supports (pnoto 1). The early design is the same as shown in Figure A. The walls of the casting are thinner giving it a bigger cavity. I have never seen one break or' come apart, but I have crackedthem before where I marked in Figure A. This is an area to inspect on your units when they are apart, and if they are cracked, they should be replaced. I think the new casting must have come in around 1975.

Remove-the spindle from the spindle support housing per the GM service manual.

Drive out the old bearing cup from the spindle support housing. Be very careful not to damage the housing walls. Use a brass drift behind cup or race in notches in housing.

I prefer to remove the spindle support from the swing arm for better control of cleanliness and accuracy. For this removal procedure, again refer to the GM service manual.

When you remove or install the cone, the pressure should always be against the face of the cone and should not contact the cage. The cage should be free to rotate when the press or puller is in position. See Figure B to familiarize yourself with the parts of the bearing assembly. Damage to this mild steel cage may cause the bearing to fail.

Wash the bearing out with kerosene or mineral spirits: use both cold. After the bearing has been cleaned, it should be dried with compressed air, making sure no water is in the air line. The compressed air should be directed at the bearing so that it goes through the bearing from one end of the rollers to the other. Do not spin the dry bearing with the compressed air as it may score due to lack of lubricant. (Photo 2.)

If the bearing is found to be satisfactory, it should be dipped in oil and wrapped in clean oil paper if not used immediately. If either the cup or cone needs to be replaced, both should be changed. Do not use old cones with new cups or vice versa. We highly recommend *new* bearings be used. Timken bearings have been our choice.

To insure against wear from any source, all parts and assemblies coming into contact with or operating together with the bearing should be thoroughly cleaned. Particular attention should be paid to the hubs and spindle support housings to remove any loose chips or particles of dirt which may have accumulated.

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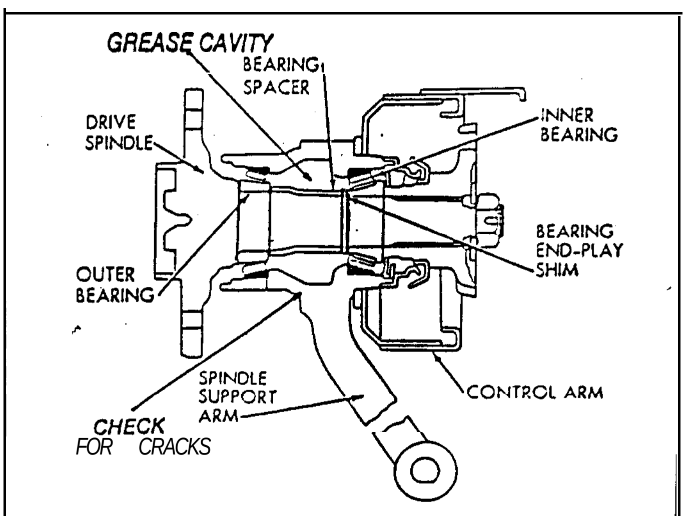


Figure A. Bearing locations

Photo 1. Spindle supports

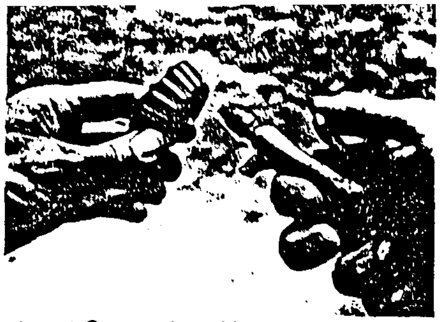


Photo 2 Dry Bearing with ***compressed air.***

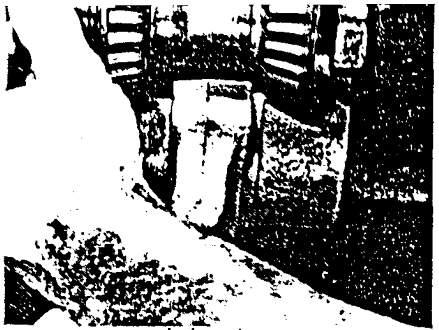


Photo 3. Set ***end play*** clearance

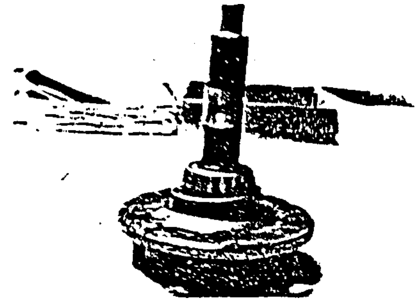


Photo *4.* ***Installing*** *outer seal* ***and bearing***

VETTE IMPROVEMENT PROGRAM

Continued from page 45

Along with the bearing inspection, the spindle shaft and bearing housing should also be checked. Any burrs on the shaft **or in** the housing should be removed. (Figure C.) These can prevent the bearing parts from seating properly causing misalignment or faulty bearing setting (adjustment). The burrs or chips may also work loose in service and get into **the** bearings.

All seals should be replaced with new GM parts. Worn seals allow dirt and **water,to** enter the bearing housing. Proper maintenance of bearing **seals is** vital to the good performance of any **bearing.**

New bearings are packed in card-board cartons to give them proper protection against dirt and moisture. Replacement bearings should be stored in a clean, dry place and should not be removed from the cartons until ready for use. There is no need to wash new bearings as the rust preventive will not harm the recommended lubricant.

After a new bearing has been removed from the carton it should be in-stalled immediately or placed on a Clean surface. **Never** place bearings on a **floor** or a dirty workbench. Do not **leave them** exposed where dirt, dust and moisture can reach them. Extra care on your **part** at this time will be repaid in the future with longer bearing life.

The tight fitted cups can be pressed into the bearing housings by making **a** simple driver. Take the old cups, one in-ner **and outer** rear and cno outer front and grind the outside **diameterwhile** turning until they will drop in the housing they came out of with no pressure. Put new cups into place in the housing. Use the old ground cups to tap them down with a hammer. Work your way around the diameter many times to keep straight. The driver should hit **only** the face of the cup.

Final seating of the cup against the shoulder in the housing should be in-spected. This is very important.

Now we have to **set** the **rear bearing** end-play clearance. We will be **a** little more demanding than the service manual with tolerances. They call **for .001** to **.008.** We want **.001** to **.0025** (Photo 3). You can use the tool GM lists **in** the manual, or you can use an old spindle and polish down the shaft so the bearings will slide on and off. Next, do as the service manual says: put the tool together with the bearings, sleeve and space in the spindle support with new cups installed. Now, we will be more careful with checking the clearance. When you move the tool or spindle in and out to check the reading on the dial indicator, hold a little pressure down on it. Keep the pressure even while checking the tolerance. This will give you more accurate readings.

Now before putting together the rear bearing assembly, we recommend changing a little from the GM procedure by installing the outer seal and bearing on the spindle prior to using the GM tool to put the inner bearing on the spindle (Photo 4). **Be** sure you put the outer seal on the spindle shaft the same way it came off so it will go into place when the time comes to seat it. Lubriplate the seal at the shaft surface. The GM installing tool puts pressure on the inner cone rear face surface, which is fine, but the pressure on the outer bearing during in-stallation is on the rollers and **on** the cup and cone roller surfaces. We never assemble bearings with pressure in this area. It's not worth finding out if something happened, and it took enough pressure to score or mark any of the surfaces which could shorten the life of the unit.

This is one of those areas that you might say has always been close to my heart. It's kind of a confidence of not having to worry about a bearing failure in the banking of **Daytona** at well over 200 mph. We never have had a bearing failure and many others have.

When a press is not available, you can freeze the spindle and heat the **cone** and

Figure C. *Check for* burrs

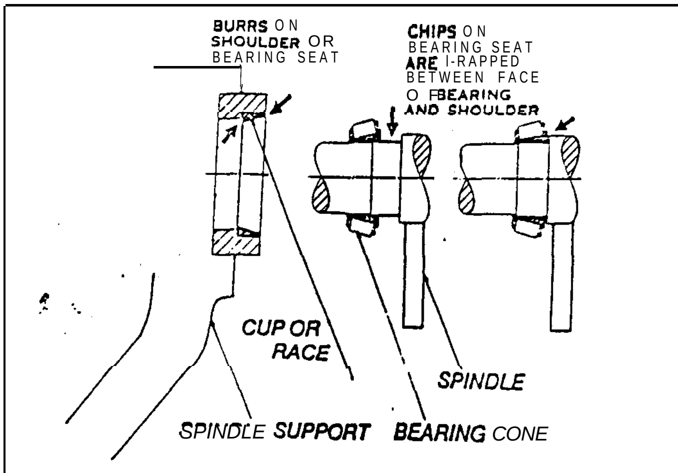
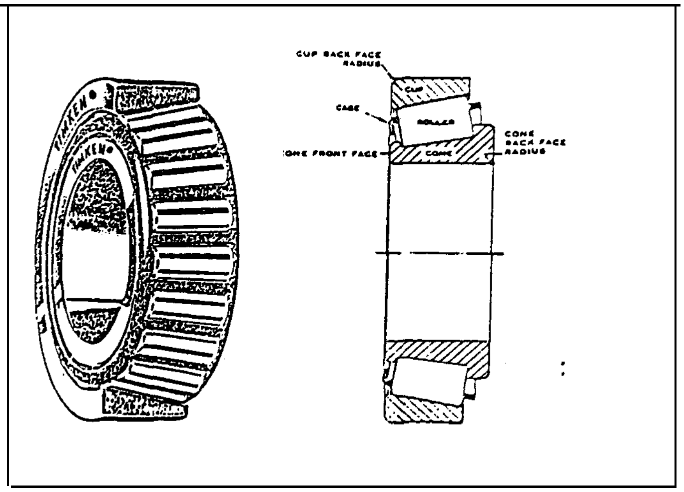


Figure *B.* ***Parts*** *of* ***Bearing*** *Assembly*



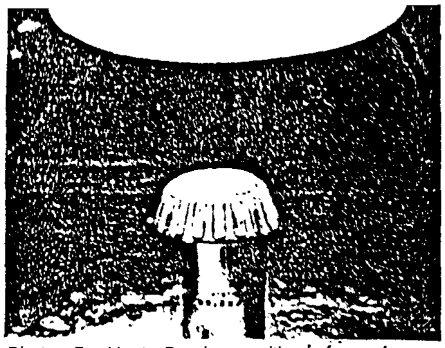


Photo 5. Heat Bearings with Infrared lamp.

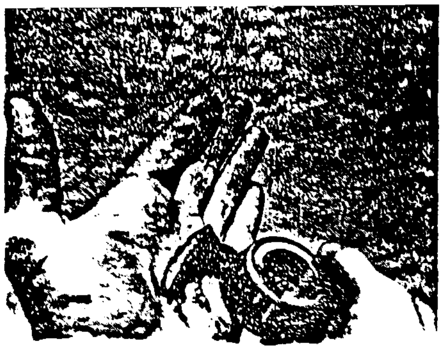


Photo 6. Force grease from large end.

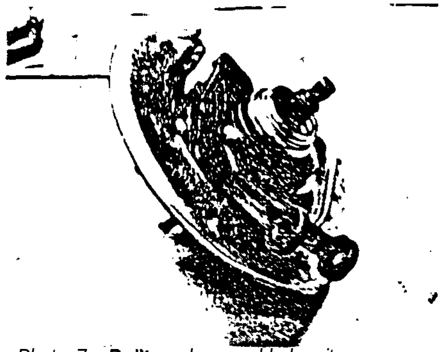


Photo 7. Built and assembled units are available.

assembly without a press.

Infrared lamps are a simple method for heating bearings. This method assures maximum cleanliness. A torch should never be used to heat the bearings. Be careful that the bearings are not heated over 275°F to 300°F. The expansion of the bearing cone can be checked with inside micrometers to insure sufficient growth to permit the cone to slide on the shaft. Be sure to put the outer rubber seal on first. Don't let it touch the bearing until it cools.

Asbestos gloves should be used to handle the heated cones. The hot cone should be held solid against the cold shoulder on the shaft until the cone seizes. Compressed air can help speed the cooling.

Many cases of "loose" bearing settings and excessive end play have been caused by an unseated cone working back against the shoulder in service.

Before assembly, thoroughly grease the bearings, making sure the grease gets in between the rollers and the cage and not just on the outside of these parts. Forcing the grease through the bearing from the large end of the rollers will ensure proper grease distribution. (Photo 6) Additional grease is added to the bearing housing before assembly. The bearing housing cavity is filled, leaving enough room for the spindle shaft to go through only. Use the best grease you can get. We use Lubrication Engineers Almagard #3752 tube. .

Reassemble the spindle in the spindle support per the GM service manual, paying particular attention to cleanliness until all is sealed up. Note the outer spindle seal will have to be put into place just before the spindle is almost pulled all the way in. Use a big screw driver and carefully work your way around pushing the seal into place. Do the balance of the rear assembly per GM service manual.

The front hubs use the same procedures for inspecting, cleaning and installing the cups as the rear spindle supports, We also grease the bearings and fill the hub cavities with grease. When installing the seals, lubricate the seals on the lip next to the spindles.

Adjusting the Front Wheel Bearings: The recommended method is to tighten the nut, while rotating the wheel, until a light bind is obtained in the bearing, thus insuring proper seating of all parts. Then the nut is backed off one slot and locked with a cotter pin. This results in a free running clearance in the bearing. The bearing is rotated in order to seat the rollers against the cone rib. This rotation should be done when making any bearing setting with an adjusting nut.

For competition, where speeds are maintained over 200 mph, you should set the front bearing tolerance at ,004 end play.

If all this is too much to do yourself, you can buy units built to these specifications already built and assembled (Photo 7).■

VETTE IMPROVEMENT PROGRAM

Test Group Report:

Part 4 of our program described a series of adjustments that could be made to your Corvette, depending on the type of driving you do. Most of the Test Group reported they use their cars for street driving only, while 5 of the 19 who reported back on this part indicated they are active autocrossers. These comments indicate which portions of the changes were made.

Adjustments

Mitch Barach (1973): I chose to check all height dimensions. I bought a Rancho kit which improved the car. With it I changed rear leaf, added a rear sway bar and larger front sway bar and Koni shocks. All proved a noticeable improvement, but with your recommendations I was able to fine tune these bolt-ons to work together.

Bob Carry (1980): Installed Koni shocks. Plan soon to install the fiberglass rear spring, but for now I removed, cleaned and lubed the original. Ride is firmer with less 'float' on the parkway.

Robert A. Chauvin, Jr. (1978): After changing the shocks my car cornered better than I could have imagined. Seems to have much quicker response and the ride has greatly improved. Just when I thought my tires were "sticky" enough, gas shocks changed my mind in a hurry.

Gary Compton (1980): I cut one coil off open end of front springs and added RPOFE7 rear stabilizer from dealer (at $110 for the bar and all hardware). Results were the car had a lower height of about 1 1/2". Very smooth at high speed cornering. This VIP program can save you a lot of guess work and money. VIP changes plus engine mods to my 1980 L82 and an '85 doesn't have a chance.

Sue Ellen Cooper (1965): After reading the article I decided my '65 coupe was best suited for the changes. The car is set up to look like a "mean street machine," and the fender flares with wide tires and wheels help enhance this effect. The only problem is that the car is a prime example of a "darter" on rough or wet road surfaces. We installed a set of Koni gas shocks. After that we opted for the "quick" steering change along with the toe adjuster blocks. These three sounded like the best bet to help cure my "darter."

When we took the car out with the new shocks we couldn't believe the difference they made. The car no longer wandered from one pothole to another. We felt as though we had some semblance of control over the car — that we were driving *it* for a change. The quick steering and toe adjuster blocks saw even more improvement in the car's handling. Driving the Vette was once again fun and not a chore.

Larry Grimenstein (1972): I added 3/4" rear sway bar (had already lowered strut rod bracket and lowered front springs 1/2"). After this change the car did not fishtail as easily as before. The improvement was better than I expected since only the rear bar was added — a little work made a big change.

Bob Marshall (1968): The shocks seemed to make the biggest difference in ride comfort with a lot less leaning. The Quick Steering changeover meant a very little difference. I got more change

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VETTE IMPROVEMENT PROGRAM

Continued from page 47

In the steering with the idler **arm replacement** in Part One.

Joanne Mason (1973): I cut **F-41** springs, added Bilstein shocks, fiberglass rear Daytona Spring, relocated differential and toe adjuster blocks, **and changed** to 1" **front** sway bar and 5/8" rear sway **bar**. It increased **cornering ad**hesion, reduced body roll, and reduced oversteer.

Ty McDowell (1970): I changed to a rear fiberglass spring, gas shocks, magnesium mags and 255 60 **R/5** Eagle GT tires and noticed great improvements in handling and driveability. The rear sits up a little high so next I think **I'll** use longer spring bolts.

Charles W. **Stroppel (1965): I** changed to **a 1"** front sway bar, **9/16"** rear bar with poly bushing, **#33138 front** springs with one coil cut from open end, 270 lb. fiberglass rear spring with longer bolts, **Koni** gas shocks, quick steering adjustment. I found the fiberglass spring and **Koni** shocks are just unbelievable. The choppy Corvette ride is almost eliminated. The ride is great, yet I have no problem with bottoming out no matter how **hard I push the car into corners. As** with every previous part of this series, I am impressed with the improvements.

Chuck Villa (1976): I installed a rear fiberglass spring (300 lb.) mostly to replace sagging steel spring on a 95,000 mile car, and cut front coils (removed one coil). **The** rear now rides much better, but need to put on gas shocks to alleviate some of the bounciness now present. On the front spring cuts. it took three tries to get it just the way I wanted it. I finally removed total of 1 coil per spring.

Bill Ware III (1976): I changed the shocks, changed to F-41 springs and replaced rear leaf spring with a **one-**piece fiberglass spring. The car rides better. The front end seems tight and the car feels good. The shocks and rear spring made a big difference. Much more improvement than I expected.

Suggestions For Other Readers **Considering** the Changes:

Mitch Barach (1973): Determine what you want from your car before spending unnecessary money.

Gary Compton (1980): Do these changes at the same time you replace ball joints and A-frame bushings and save yourself a lot of work.

Sue Ellen Cooper (1965): Those who have Vettes (especially mid-years) with super wide tires and wheels would be very wise to follow some of these **suggestions. It will be money well spent.** They will find out they can have the "street look" they desire without having to sacrifice the sports car handling.

Jan **Gaskin** (7979): If you are a driving enthusiast and want a great handling car, it is the way to go. However, like all good things, you have to pay the price of rough driving and low clearance. Personally I think it is great. I **really like** this program.

Larry Grimenstein **(1972):** I was afraid to cut front springs because of spoiler and tire clearance. To try it, I added coil spring U-bolts and dropped front **½"** with no permanent change.

Bob Marshall (1968): Do **only** the suggestions for your type of driving.

Joanne Mason (1973): The majority of these changes are an excellent advantage for autocrossing. however, the street-only driver may not want to get quite as deep into suspension modifications.

Dennis Penberthy (1966): To cut down on expenses I recommend you try and locate used parts with the right part numbers.

Charles Stroppef (1965): Don't go overboard on stiff shocks and springs. **Keep the springs as soft** as **possible** without the suspension bottoming out **and** you'll have a much more enjoyable **ride** and will still maintain a high **cornering force.**

Continued on page 67

VETTE IMPROVEMENT PROGRAM

by JOHN GREENWOOD

PART 6

Performance Finer Points

In this final article of the series we will deal with some of the finer points of improving Corvette performance.

Shifter

The shifters on the standard transmission cars have several areas that need attention to get the best positive control for performance driving. If your shifter is to your liking the way it is, you may not be ready for this, but you should understand what the changes could do for future reference.

When a shifter gets sloppy from wear, it is difficult to get it working well again without replacing the worn parts or the whole shifter lever. (See figure 1.)

The areas we will deal with will be improving the strength of the shift lever and rods, shortening the distance the shifter travels between shifts and remounting the shifter on the '67-'82 cars for, again, more control.

All removals and reassemblies of shifter parts can be done per the GM service manual.

We will start with the shifter lever or tower itself. We have seen and experienced the shifter handle breaking off where it is installed in the lower casting. To eliminate this problem, you should heli arc weld the two where they are assembled. (See figure 1.)

In 1967, Chevrolet changed the shifter lever mounting from a transmission mount to a frame mount. The purpose of this change was to cut down on rattles and vibrations coming from the shift lever. As it turned out, it also cut down on some of the control positiveness of the shifter. Under hard power, the engine torques over and binds up the shifter so you can't change gears. To change the shift lever mounting back to the transmission, it will require the purchase of a few Chevrolet parts. You will need three tapper headed Allen screws and one mounting plate. These parts are for a 1966 or earlier Corvette. Again, the installation would be the same as the GM service manual for 1963-66. (See figures 1 and 2.)

To shorten up the length of travel between shifts, replace the shift arms attached directly to the transmission with shorter arms. These shorter arms are the standard part number for 1965-66 Chevelle.

If you are having a problem with the transmission popping out of gear on acceleration or deceleration, it is very possible that the transmission is not centered to the engine crank shaft.

This can be corrected by using the offset bushings in the back of the engine block that line up the bellhousing. These off-set dowel pins are available through Mr. Gasket suppliers. To check the bellhousing for center to ?he crank shaft, use a dial indicator on the flywheel. Check indicator in the opening that the transmission goes through and turn the crank shaft while reading the dial indicator. The off-set bushing comes in assorted off-sets. It will probably take a few tries before you get the right combination.

Lubricants

This is an area that is abused probably more than any other. Everyone knows if any of the moving parts on the car run out of lubricants thev will fail in time,

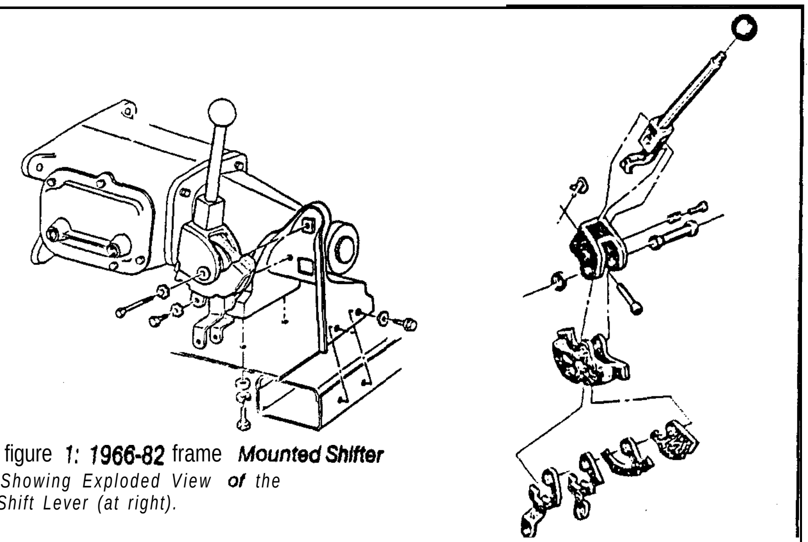

figure 1: 1966-82 frame Mounted Shifter
Showing Exploded View of the Shift Lever (at right).

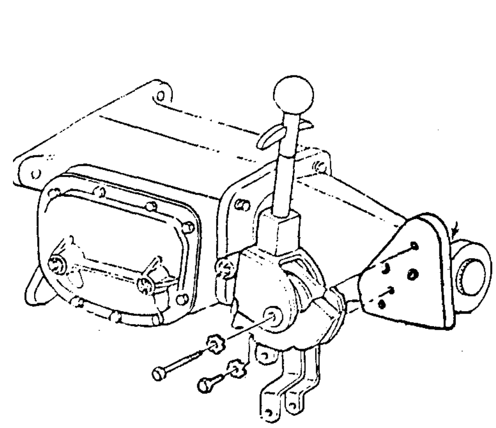

Figure 2: 1963-66 Transmission Mounted Shift Lever

...g not many people pay much at-
...n to is the maintenance of engine ... transmission and rear end fluids, etc. If these lubricants were properly maintained, and possibly belter lubricants used, the life expectancy of the moving parts would be greatly increased. In their proper functioning state, this could be doubled or tripled. It can only help your car to change the engine oil every 2,000 to 3,000 miles and the transmission fluid and filters every 20,000 miles. The differential and power steering can go for 50,000 miles. Warm car up thoroughly before draining fluids per GM service manual.

Our first area of concern is that you use the best lubricants; not all oils or lubricants are the same. Some brands break down quicker than others and lose their ability to lubricate properly.

We have tried everything we could get our hands on over the last 20 years. We have finally found a product line that noticeably improved lubrication and quietness of differentials, transmissions and power steering. We change all the fluids in every new Corvette we work with. When we race, we can get just about any brand lubricants we want for free, but we now only use one company, and we buy the product, which is not even cheap. The product is not on the general market because they service only industrial equipment, so we have to buy it by the pound. Should it become available their name is Lubrication Engineers, Inc., a Texas company. For us this has been a noticeable change.

Now back to some basics, proper warm up of engine and drive line are also essential to longevity. When you start a cold engine, never rev it up, let it warm up completely before any hard use. This will most certainly cut down on wear and failures.

For racing applications, autocross, etc., here is a tip on warming your car up before making any runs on it. The oils take about 3 times longer to warm up as the water does. You should warm the car up by driving or jacking the back end of your car up and letting the transmission and rear-end turn with the engine. The colder the outside temperature, the longer it takes. When we race. and the temperature gets below 40° at night, we drain the engine oil after the last practice and take a case of oil to our room to keep by the heater. In the morning we put warm oil in the cold engine. Next, we turn the oil pump to get pressure and start the engine. I have seen many people wipe out their cam shaft starting a cold engine. Don't take chances.

Power steering and the automatic transmission will be noticeably quieter and smoother with the L.E. 7500 power fluid. When you drain the automatic transmission, use the GM service manual because you have to remove the lower pan, and the only way to drain the torque converter is to remove it or drill it. We drill them to drain and put a small pipe plug in or a dead head rivet. Then we turn the converter 180° and do it again to equal the weight for proper balance.

The standard transmissions are also quieter using the L.E. Vari-Purpose SAE 90 weight gear lube. Anything heavier will cause a little tightness in shifting until it warms up. For racing you can use the 140 weight gear lube; just warm it properly.

The differential uses the L.E. Vari-Purpose SAE 140 weight gear lube. If you have a positraction differential, which most Corvettes do, use the GM positraction additive (part no. 1052358) with the L.E. gear lube.

If you are doing any competition beyond one-lap-at-a-time autocross, it will be necessary to duct air over the differential. If you're running past 15 minutes continuously, you need an oil cooler.

Rear End Oil Cooler

If you use an oil cooler, it should be mounted below the oil level of the differential so as not to over fill the differential if the pump is off or fails. The differentials are always better a little under filled than over filled When routing the oil lines, always fill the cooler from the bottom so that the hot oil takes longer to pass through and cools better.

A good rear axle cooler to use is the Harrison oil cooler (part no. 3157804) and electric driven oil pump, Jabsco (part no. 6360). (See figure 3.)

You will need to rework the rear differential cover to install fitting for the oil cooler lines. Drill and top the rear cover on a vertical line ¾" to the left of the center line or middle vertical rib in the rear differential cover. Drill the top hole, down 1 ¼" from the cross member surface and the bottom hole up 1 ½" from the spring mounting surface. Tap both with a ½" pipe thread and install fittings with thread sealer. Grind off the fittings inside the cover so they are flush with the cover.

The lower hole in the rear cover is used to pick up the oil and go through the pump where it's pushed in the bottom of the cooler and comes out the top and goes in the top hole in the rear cover and sprays on the ring gear.

Alignment

When getting ready for the alignment of the suspension, there are several things that should be considered before you go to the alignment shop. These are things you probabiy can check at home.

Fill the gas tank to weight the car. Check the tire pressure to make sure they are set to your desired pressures.

Now, to get an accurate alignment, the car needs to be level from side to side, which is essential to get consistent handling in both directions. The sway bars will needed to be neutralized or evened up (more on this later).

First, disconnect the front and rear sway bar linkage on both sides. Now measure the frame to ground clearance on each side of the car to be sure that it's close to the measurement on the other side. Level the rear of the car first. This can be done by using washers or shims at the long outside bolts holding the leaf spring. Once the rear end is level side to side, measure under the front frame.

If it is close, leave it alone. If it is very far off, see if any of the suspension parts, like A-arms, are bent. If everything is OK, you may need to change the springs or shim one of them.

Now that the car is fairly level, take it to the alignment shop with the sway bars still disconnected. There is no danger of the car turning over, but it will be a little twitchy so just take it a little easier.

The actual alignment will have to be developed round your specific use for the car. If the car is used for street and autocross, you will use the higher limits listed for the camber, while for the street use only, you should use the lower limits on the camber. If you have the F-41

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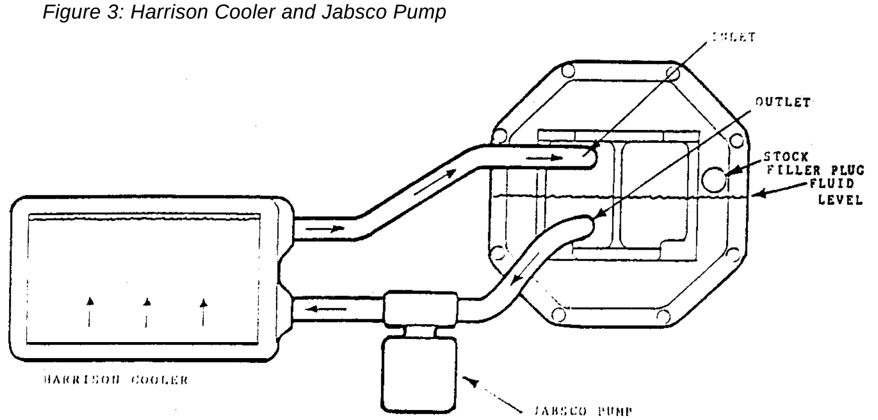
Figure 3: Harrison Cooler and Jabsco Pump



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seven leaf rear spring, you will use the higher limits or more negative camber, because the car doesn't squat as much on acceleration.

The caster is another area that will require a little thought. The more positive caster you use above 1 ½° positive caster, the better the straight line road holding ability. The cars with the 255 x 60 x 15 tires and some of the others may have a clearance problem of tire to rear wheel well when your wheels are in full turn conditions. Check this before you start, if your car has a fair amount of Clearance, you should be able to use more positive caster — the more the better.

On the '63-'82 Corvettes, always set the right front caster about ¼° to ½° more positive than the left front. This will also help in the straight line feel.

Continued on next page

V.I.P. Test Group Report

VETTE IMPROVEMENT PROGRAM

Test Group Report #5 deals with the wheel bearing change discussed in the September/October issue.

Gary Compton (1980): I believe this should be done by a repair shop. It's too much trouble to do at home for most people, and most don't have the needed tools.

Sue Ellen Cooper (1965): We had replaced rear wheel bearings on some of our vehicles before, so this was not an entirely new undertaking for us. If this is your first attempt, you should be aware that it is not always an easy task..Do some fast talking at your local Chevy deafership and arrange to borrow their wheel drive spindle remover. Even with their puller there is still no guarantee the disassembly will follow the easy procedure described in the GM service manual.

We elected to change the bearings in our '65 coupe as, so far as we knew, they were the original ones, which may-well be why we had problems. We ran into problems trying to remove the strut rod bolt from the spindle support arm so that we could attach the spindle remover. The bolt had apparently rusted to the metal sleeve inside the bushing. and wouldn't come out. Once this was solved — and it happened on *both sides* -the rest went as described. With the problems we had, we don't care to change them again for at least a couple of hundred thousand miles, and preferably never. This is definitely not a job to be undertaken by a novice mechanic. The older the car, the more likely you are to have problems. After you start tearing the car apart, if you find you are in over your head and have to pay someone else to finish the job, they could end up being very expensive wheel bearings.

Jim and Cindy Dunn (1978): As we didn't have the puller tool we had the local Chevy dealer do this work.

Larry Grimenstein (1972): I already did the rear wheel bearing when I did the brakes.

Paul M. Herzing (1978): We had a local Chevy dealer check out the car and decided that at 28,000 miles it wasn't necessary to replace the wheel bearings yet. I have read many articles on rear wheel bearing replacement and many tell you how easy it is to do it yourself. This is pure grade #1 bull-! My '63 was a likely candidate for bearing replacement at 76,000 miles and regularly autocrossed. To remove the bearings on the '63 with drum brakes they must be cut out with a torch. There is no tool made to remove them. This is a very time consuming and messy job if done by an inexperienced backyard mechanic. At a cost of $120-$140 per side just for labor to cut the bearings out (parts and labor added) I feel confident and safe having had the work done by someone else.

Raymond Knecum (1980): I already had the rear bearing carriers rebuilt when I rebuilt the rear end. It was a lot easier to do it all at the same time.

Bob Marshall (1968): MY best suggestion to other readers is the last paragraph of part 5 (buy a pre-assembled unit). I tried to replace the wheel bearings on my Vette last winter. Even using the proper pullers I was never able to free the assembly from the trailing arm. Maybe because of the age of my car they were frozen in the trailing arm. I eventually replaced the whole trailing arm because of damage to it.. I did manage to salvage the drive spindle,- and supporting parts.

Bob and Joanne Mason (1973 and 1985): These comments are from an ASE technician who consistently beats flat rate and does the job right at the same time: "Regarding setting the bearing up and spindle end play (shims) I run the spindle on a lathe and use a mini belt sander to take off *just* enough so the bearings will slide on by hand. This way the unit can be assembled, proper shims determined, disassembled, shims installed and then fully assembled with grease. I've done this on dozens of Vettes as well as our race car. Done properly it's a correct repair and we have a zero comeback rate. In addition, I check the rear assembly on each car I've done every time it's in the shop and have found no sacrifice in longevity. Furthermore, this trick works great on the race car."

Ken Miller (1972): This is a rather complex procedure for a low-grade mechanic like me so I had a speed shop do the work.

Dennis Penberthy (1966): The spindle support has a tendency to break if you use the tool that bolts to it and presses the axle out. Be sure you have access to some extra ones if you use that tool.

Gerry Peterson (1968): I replaced both wheel bearing assemblies and trailing arms on my 1966 roadster. The following areas presented varying degrees of difficulty: (1) Removal of the strut rod from the spindle support arm (caused by corroded lower shock mount). (2) Separation of the bearing housing from the trailing arm. My Corvette had seen a few winters in the salty midwest and as a result, the bearing housing and trailing arm were rusted together. I used a combination of heat and a hydraulic press to separate the two. (3) If you suspect the integrity of the trailing arm, replace it at this time. It will never get any easier. I had to use a cutting torch to remove rusted T-arm pivot bolts. (4) Install stainless steel parking brake components. (5) Finally, while Greenwood gives you the actual method of blueprinting rear wheel bearing assemblies, I feel that it is more economical (in terms of frustration, labor and down time) to have these assemblies rebuilt by one of the firms that specialize in this job. Mine were rebuilt by Van Steel Co., in Clearwater, Florida and came with a "bullet-proof" guarantee.

Roger Reid (1978): Since I have experienced rear bearing failure a couple of times before, I had my favorite garage do the recommended procedure. I also have more high speed confidence now.

Anthony Rushin (1981): Take it to a dealer. It's more trouble than it's worth doing it yourself, especially if you are just going to grease the wheel bearings.

M. R. Schroeder (1979): I tried to buy the grease that was recommended and was told it was only available in 55 gallon drums. I also could not find Almagard #3752 so I used Alemite #4. In the past I used Lubriplate Mavine-lube A or Lubriplate wheel bearing grease.

Charles W. Stroeppel(l965): I thought I was in trouble with this article until I got to the last paragraph. I had mine replaced with units revuilt by Van Steel. I feel a lot better knowing I should be able to go another 20 years without trouble. -- While you have everything apart, go for a stainless parking brake kit.

Philip Tiberio, Jr. (1970): When I disassembled and removed the bearings they were dry and scored: failure was going to be soon! My advice is don't ignore the wheel bearings. I was fortunate that I was able to change them when I did. It was time consuming, but worth the effort. I suggest taking Polaroid pictures while doing this for the first time. They do come in handy.

'63-'82 CORVETTE ALIGNMENT SPECIFICATIONS

Caster Front

	LEFT	RIGHT
OK	1½° positive	1 ¾° positive
DESIRED	3° positive	3¼° positive

Camber

	FRONT	REAR
Street	0-¼ ° negative	0-¼ ° negative
Performance	up to ¾° negative	¼-1 ° negative

Toe-In

FRONT	REAR
1/8" total toe-in	0-¼ " total toe-in

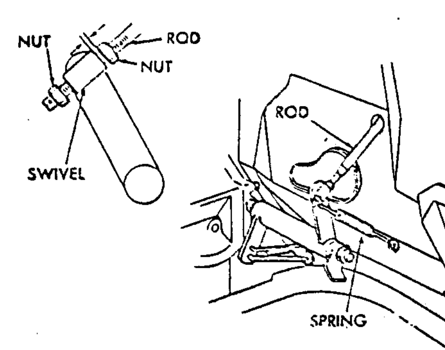

Figure 4: Clutch Pedal Return Spring.

Clutch

Probably most important to the clutch longevity is the adjustment of free play.

Clutch free play is not regulated by where the clutch engages or disengages as you push the clutch pedal return spring in. (See figure 4.) Loosen the lock nuts on both sides of the swivel. Push the shaft up against the pedal and the swivel down against the clutch and leave a ¼" of clearance or free play between the swivel and the upper nut.

I ne oest flywheel pressure plate and driven disc assembly we have ever used for performance, street or racing, was the GM performance unit.

The following procedure and parts will get you the. maximum durability from the clutch components:

- The crankshaft pilot bushing should be replaced if the original bushing shows any eccentricity or wear.
- The clutch housing transmission mounting face must be parallel to the crankshaft flywheel mounting face or the rear face of the clutch housing should be machined to obtain parallelism.
- The clutch housing pilot hole for the transmission bearing retainer must be concentric to the crankshaft centerline. Offset dowel pins are available to adjust the concentricity.
- The clutch driven plate should be checked for any burrs or roughness on the hub splines which might impede movement on the transmission input shaft. It is advisable to "lap" the clutch disc on the clutch gear to remove any burrs.

The following clutch components have proven to be satisfactory during high performance usage:

- RPO L-88 nodular cast iron light weight 12%" diameter flywheel (part no. 3991406).
- Clutch cover and pressure plate (part no. 6273958) using a nodular iron pressure plate, flat drive strap, higher release load spring, and nominal 3200 lb. pressure plate load.
- Clutch driven plate (part no. 3991428) using a bonded aluminum backed clutch facing, heavy duty splined hub, and low height cushion springs. ■

V.I.P. Test Group Report

Following are the comments of the Test Group to the changes suggested in the "fine points" segment of the Vette Improvement Program:

Victor Bailey (1969): As I have a Doug Nash 5-speed with Hurst linkage I did not perform the adjustment on my '69. Instead I used a 1970 Vette with 4-speed and had no problems with relocating the shifter or shortening the throw. The improvement was excellent and should be a standard requirement on all late models.

Among the changes I noticed were smooth, quick shifting, elimination of vibration and twitchiness at cruising speeds, and many rattles seemed to disappear. Other improvements were in comfort and predictability. I have used many different techniques to try to get these results over the past ten years, but this series has had more positive noticeable improvement in less time than I could have hoped for. I wish I had had the information years ago. It would have saved a lot of money in worn out tires, drive trains, and mechanical breakdowns.

The results of your trial and error accomplishments have been a great money saver to me. First, after using this series of improvements, my high performance Corvette will perform at least equal to a new Corvette, so I don't plan to sell mine any more. Also, the mechanical work and maintenance suggested will be quicker and easier from now on. I have fought and stumbled my way through hundreds of hours of rebuilding my Corvette where this information would have quickly and easily solved a major problem. Basic understanding of the equipment is probably the most important thing I learned from this program, and I am now very comfortable with any mechanical problem that I might encounter with my Corvette. It is also now fully capable of the performance standards that I feel are imperative in a world class performance car. It must be dependable from 0 to 150 mph, and capable of 12 second quarter mile times with precise handling during acceleration, cornering, and braking. Before, it was always close, but could get loose and dangerous very quickly. Now I have driven 248 miles at speeds from 0 to 152 mph and the car is perfect. That is what I've always wanted. Thanks on behalf of all Corvette owners.

Rovert Chauvin (1 9 78): I elected to make the transmission oil change. I noticed much more deliberate and positive gear changes. I don't have easy access to the "L.E." products mentioned, but I've found Pennzoil transmission fluid, which is an over-the-counter product, to perform well in both hot and cold weather.

Sue *Ellen Cooper* (7980): Other readers might want to think in particular about neutralizing the sway bar. This is something we have overlooked in the past. After reading the article, we wondered how we could have expected an accurate alignment without first "leveling" the car.

You should be aware of the possible danger of incorrectly unbolting the rear spring. Readers should make sure of using a floor jack under the end of the spring at the point it is bolted. The jack should be "jacked up" to the point where the tension is off the spring before the bolt is undone. This process should be followed on both sides. Without the use of a jack they will find the spring releasing its tension with terrific force, and a serious injury could occur.

James and Cynthia Dunn (1978): We change the oil every 3,000

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VetteSpondence

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miles. We also added magnetic plug. With oil change, we also change the filter and check out the car as far as lubricants. We have replaced the water pump, refilled with coolant and lube, the power steering pump and lube and will re-do the trans next.

John J. Glover (1969): After the alignment procedure, high speed stability was very much improved with the increased caster. Old setting was 1.5 degrees left and right. Set per the chart at 3 degrees left and 3.25 degrees right made a big change. I would suggest that readers planning to do this talk things over with the technician who will be doing the work. Show him the chart.

A/an Larson (7969): I would do the oil cooler earlier when the car is torn apart. No use tearing car apart for every little change. I did the suspension all at once but tried my best to decipher what effect each change had. Rear end stub shafts were shot, left rear bearings going, parking brakes shot. front and rear bushings and strut rod bushings were really bad. Sway bar links front and rear were shot, steering box had much free play, etc. Suspension in general was in bad shape. I think the steering box and rear strut rods (heim jointed), rear end mount made the most difference. As well as stiffer springs to limit body roll, Koni shocks added earlier made a big difference, too. Front and rear bump steer changes in geometry really do help bump steer immensely. Wheel does not shimmy over bumps as before. Much more controllable. Some things such as rear wheel bearings are best done professionally. Rear cooler should be done when rear crossmember is done. Reinforcement welding should be done I believe in a number of points. Trailing arm full length, rear strut mount, and rear cross member pads on frame, also lower control arm mounts where sway bar bolts mount. As per the Chevy Power Book, Rancho sway bars are very efficient, I believe, but may be too harsh (front) for street.

Rick Maddaieni (1 9 73): On rear bearing replacement, the easiest way to go is to replace the rear bearings and not try to reuse the old ones. It seems that the new bearings are much easier to work with.

Anthony Rushin (1981): I suggest readers be sure to disconnect the sway bars and check the car's level. Mine was off by half an inch from left to right in the rear. I've had the car since new in 1980 and it always had more fender clearance on the passenger's side but never knew how to fix it. Putting on a set of Koni shocks did help until now when it's finally right.

Chuck Villa (1 976): As I understand it, our cars use the same basic front suspension design as other Chevies. so don't let an alignment shop take you for a "Corvette special" price for front alignment. (The rear is understandably different). Also. check the front adjustment (shim) bolts after you get home. I lost most of my shims because the guy neglected to torque them down (I've since double-nutted them). ■

VETTE MART CHART

A representative sampling of selling prices of Corvettes from twelve U.S. cities, including: Atlanta, Boston, Chicago, Dallas, Denver, Detroit, Houston, Los Angeles, Miami, New York, Phoenix, and Washington, D.C.

Year	No. For Sale	Highest Price	Lowest Price	Average Price
53-55	1	22,000	22,000	22,000
56-62	18	24000	8,500	12,980
63-67	69	25,000	6,000	11.843
68-72	73	15,000	5,000	8,501
73-75	57	13,995	5,200	7,832
75R	10	18,000-	8,500	12,791
76-77	90	14,600	4,400	6,054
78-SA	24	14,000	7,000	10,519
78 PC	10	17,000	9,990	13,895
78-79	97	15,990	7,400	9,977
80-81	99	16,500	8,800	12,925
82	58	20,000	11,950	16,468
84	115	23.500	16,250	19,310
85	29	27,248	22,500	24,585,

This Information Is from many sources from which there can be no warranty or responsibility.

Source: A & B Investments, Inc.

Wheelin' and Dealin'

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right. There are few of them available used. We sold quite a lot of new ones. I've seen a couple on the wholesale market at $20,000 to $22,000. These were low mileage cars -only about 2,500 miles. But in all it's been a good season. We expect to continue at this same level right up to the onset of cold weather. It drops way off then.

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Philip Tiberio (1970): Installing new springs, shocks and sway bars are not a cure-all for a worn suspension. The condition of the entire suspension system including wheels and tires is important. Adding these changes to a worn out suspension will only make it worse.

Chuck Villa (1976): I found the easiest way to remove front coils was to support frame on heavy duty stands, place floor jack under spring seat of lower arm, and remove spindle from ball joints. (I got lots of practice and took it slow, cutting off a 1/3 coil at a time and rebending the spring so it would seat flat