

**STEERING WHEEL & STEERING SYSTEM CENTERING PROCEDURE
(CORVETTE 1963-82, CAMARO/FIREBIRD 1967-69, AND NOVA, SKYLARK,
VENTURA, APOLLO 1968-74, & OTHER GM REAR STEER VEHICLES)**

Procedures Addressed in this Paper	Page
SETTING THE GEAR EXACTLY ON CENTER	2
CHECKING CONDITION OF FRONT END COMPONENTS	3 & 4
STRG COLUMN SHAFT TO STRG WHEEL HUB ALIGNMENT	4 & 5
DRIVE EVALUATION	5 & 6
ADJUSTING TIE RODS	5 & 6

This procedure is valid for power and manual steering systems for the following GM vehicles; C2/C3 Corvettes, First Generation F-Cars (1967-69), X-Cars (1968-74), and other vehicles derived from those bodies. Also other GM vehicles with steering systems where the steering linkage tie rods connect to steering arms that are located behind the centerline of the road wheels (commonly known as rear steer vehicles).

All of the steering components (i.e. steering linkage, pitman arm, steering gear, flexible coupling, steering column, steering hub, and steering wheel) were designed by General Motors and Saginaw Steering Gear Division such that they could be put together with great integrity, reliability, and dependability. They were designed so that they only went together one way and when assembled there was good visual indication that the assembly was correct.

It is very important that steering components be in good condition and assembled correctly (not only from a safety standpoint) but for the following functional reasons:

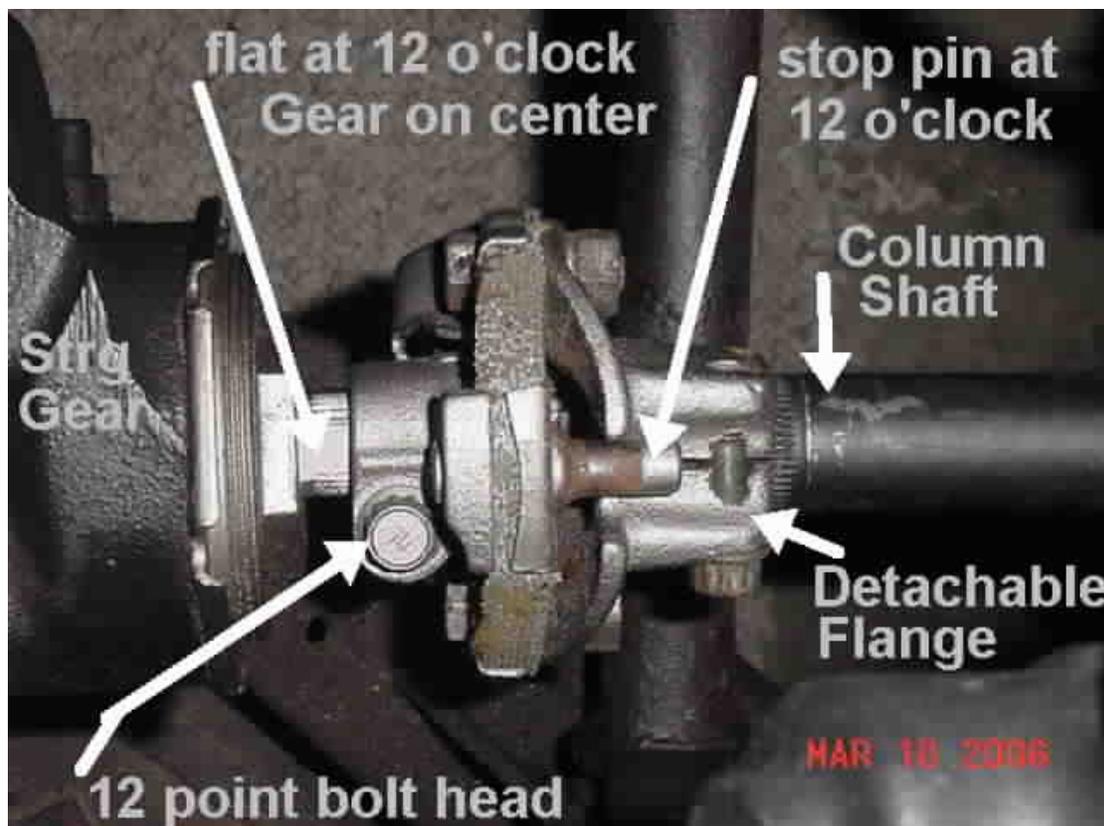
- 1). All Saginaw recirculating ball steering gears (power, manual, variable ratio, etc) are designed so that when the car is driven straight down the road, the steering gear should be exactly on its design center. This is because the gear teeth inside the steering gear was manufactured with slight interference or a "high spot" exactly on center to insure a crisp and precise steering feel. Starting about one half turn either side of center, the gear mesh actually has a small amount of clearance designed into it. If your steering gear is not exactly on center when the car is driving straight, you could be feeling some "looseness" in your steering from this designed-in gear mesh clearance.
- 2). Starting in 1969 all Saginaw locking steering columns were designed such that the turn signal switch cancels equally from right and left turns with the column right on its design center position. The canceling cam has a very limited movement since it sticks through the steering column locking plate. So locking steering columns have a 12 o'clock position just like steering gears.
- 3). The left and right tie rods depend upon the gear being on center so that they will be of roughly equal length with the proper front wheel toe settings.

Setting the Steering Gear Exactly On Center

Before beginning any inspection or adjustment procedure it is best to set the steering gear right on center. Here is the procedure. Turn your steering wheel from full lock to full lock. Carefully count the number of turns and partial turn (X). Now take that number and divide it in half (X/2). Starting at full lock, come back exactly X/2 turns. Your steering gear should now be very close to its design center. Here is the most important part, on all gears from around 1969 forward, the flat on the steering gear input shaft will be exactly at 12 o'clock when the gear is on center. Please note that clock positions are given as you look down the steering column from the driver's position.

Please note that there are a few GM A & G-cars (1973 and 1974) that actually have slightly more travel right turn than left. If you suspect that you have one of those gears, approximate the center of travel as above but then place the input shaft flat at 12 o'clock to determine the exact center.

Now, take a piece of chalk or a crayon and mark the flexible coupling right at its top most position (12 o'clock.) With the mark you can just peek under the hood and know when your gear is right on center.



Picture of a C3 Corvette looking over the front fender, straight down at the steering gear, flexible coupling, and steering column flange. Components are shown with the steering gear exactly on center. Many GM steering columns have a press fit, stamped, lower flange instead of the cast detachable flange as shown.

Checking the Condition of Front End Components

Because most of us were not privileged to be around for the approximate 30+ year history of our cars, we really don't know if Bubba messed with any of the steering components. For this reason I have provided some Visual Identification (**VIS-IDEN**) clues to help assure that components and assemblies are correct.

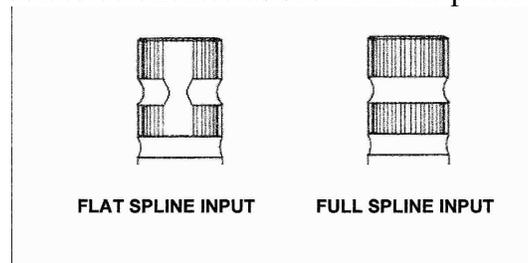
You will need to have a floor jack where you can raise and lower your car for inspections and to adjust the tie rod lengths. **IN ADDITION USE JACKSTANDS TO SECURELY SUPPORT THE CAR.** It is also a good idea to have the car in a location where it can be let down and easily driven forward a short distance when adjusting tie rod lengths. This paper assumes that the front end is aligned acceptably.

First you should inspect your front end and all steering components to look for obvious problem areas. Look for such things as a bent frame, damaged tie rods, control arms, or relay rod, bent steering arms, pitman arm, etc. One possible hidden condition can be the steering gear sector shaft being twisted from a severe front impact.

(VIS-IDEN) With the gear exactly on center, the pitman arm should be pointing forward straight down the centerline of the gear.

(VIS-IDEN) With the gear exactly on center, the flat on the input shaft should be at 12 o'clock and the twelve point head on the bolt that attaches the flexible coupling to the gear should be sticking straight up. The stop pins on the flexible coupling should be vertical (one at 6 o'clock and the other at 12 o'clock) as shown in the picture on page 2.

(VIS-IDEN) Up until early 1969 the steering gear input shaft and the flexible coupling had what is called "full serrations." There was no flat on the gear input shaft nor was there a flat machined into the flexible coupling flange that attaches to it. This means that the flexible coupling will assemble on any of the 30 spines (or serrations) on the gear input shaft. However, you still want the gear to be on center and the flexible coupling stop pins and the pinch bolt to be oriented as shown in the picture on the preceding page.



Early in the 1969 model year, steering gear input shafts and flexible coupling flanges were changed so that they had mating flats. The flat on the gear input shaft will be at 12 o'clock when the gear is exactly on center. You can see a portion of the input shaft flat sticking out from the flexible coupling flange in the photo on the previous page.

The flats insured that they could only assemble together one way. So it is possible to have the flexible coupling incorrectly indexed on the gear on vehicles built before 1969.

Checking the Condition of Front End Components (Continued)

Also, it is possible to mix and match an early flexible coupling (one with full serrations) such that it will install on any of the serrations of a later gear with a flat.

(VIS IDEN) With the gear exactly on center, now is a good time to check the position of your pitman arm. Go under the car and look. It should be pointing straight forward along the centerline of the gear.

As noted above, it is possible to actually have a twisted sector shaft from an accident in the past. If you pull the pitman arm, it is sometimes possible to see the twist in the sector shaft splines. Sometimes the pitman shaft can be twisted inside the gear box. Needless to say, if this type of deformation is noted, throw the gear away and purchase a new one.

67-69 Firebird/Camaro and 68-74 Nova, Skylark, Apollo, & Ventura Only

(VIS IDEN) These vehicles had separate sub-frames in the front and rear of the car. The sub-frame mounting to the body could have shifted or the frame itself could be damaged. This can cause the steering to be off center. Here is a websight with some critical dimension and alignment specs:
http://www.pozziracing.com/Media/F_gen_Firebird_sub.jpg

Steering Column Shaft to Steering Wheel Hub Alignment

First check to determine that your steering wheel hub is assembled to the steering column correctly. There should be a chisel mark on the very end of the upper steering column shaft and a corresponding mark on the steering wheel hub. On standard (non-adjustable) or tilt columns remove the horn cap (or pad) and remove the steering wheel nut to check if the two marks are aligned. On vehicles with T&T columns, there are a few more parts to remove. You must first remove the horn cap, horn contact, shim(s), "star" screw, and telescope lock.

(VIS IDEN) With the steering gear exactly on center, the chisel mark on the end of the steering column upper shaft should be at the 12 o'clock position and the steering column will be right on its design center position. If the chisel mark is NOT at 12 o'clock the turn signal switch will not cancel equally left turn versus right turn.

(VIS IDEN) The marks on the steering column upper shaft and the steering wheel hub should be right in line with each other. If they are not, there is a problem somewhere in the steering or suspension system. If they aren't aligned, you should pull the hub and align the marks before beginning any centering procedures.

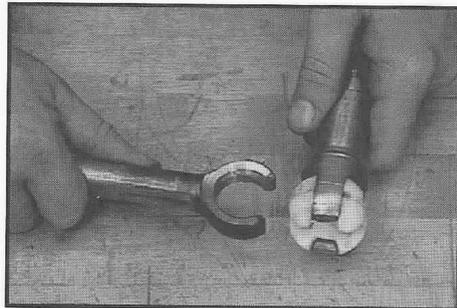
(VIS IDEN) On T&T or tilt columns, with the chisel mark at 12 o'clock the lower end of the column must have its clamp bolt horizontal and passing through the 12 o'clock position on the column shaft (As shown in the photograph on page 2.) Note that there is a notch on the steering column lower shaft that allows the clamp bolt to pass through. So the chisel mark on the upper steering column shaft and the notch on the lower steering column shaft must both be at 12 o'clock when the steering column is on center.

Steering Column Shaft to Steering Wheel Hub Alignment (Continued)

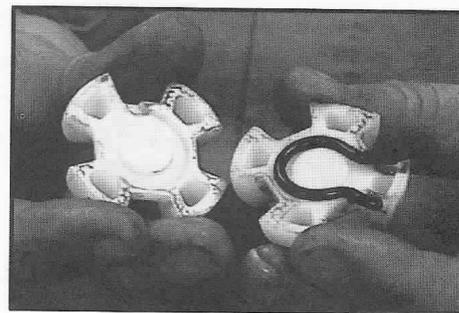
If the clamp bolt is horizontal and on the bottom of the shaft (the 6 o'clock position) when the chisel mark on the upper shaft is at 12 o'clock, Bubba has incorrectly assembled the upper to lower steering shafts inside the steering column by 180 degrees. You have a choice of the following procedures:

1). **Repair the Column (the correct fix)**

Remove the steering column from the car and disassemble the steering column head so that the upper steering shaft can be reoriented to the lower column shaft at the plastic tilt sphere. It will be very helpful to download the appropriate adjustable steering column disassembly and repair papers from the host website for instructions.



Separating Upper and Lower Shaft Sections



Joint Preload Spring in Centering Sphere

2). **Modify the Flexible Coupling (the easy fix)**

Disconnect the two nuts and lock washers that attach the flexible coupling to the steering column flange. Pull the steering column back into the car a short distance. Remove the flexible coupling from the gear. There are two different size bolts that attach the flexible coupling to the steering column flange. With the gear on center, the larger bolt (3/8-24) should be at the 9 o'clock position. The smaller bolt (5/16-24) at the 3 o'clock position. Interchange them. This will rotate the steering column shaft 180 degrees and the turn signals will cancel correctly.

Drive Evaluation and Tie Rod Adjustment

Now drive your car a short distance on a flat surface in order to determine the steering wheel and gear position when it is traveling a straight path. With the front wheels in the straight ahead position, now check your mark on the flexible coupling. The mark should be right at the top (at the 12 o'clock position.) If it is not on center, then the gear has somehow been moved off its center position and you will now need to adjust the tie rods to reposition the gear back so that the mark is again at 12 o'clock.

If your steering wheel needs to be rotated clockwise to bring the gear on center and the mark on the flexible coupling to the 12 o'clock position, you will need to shorten the left tie rod assembly and lengthen the right tie rod assembly. If your steering wheel needs to be rotated counterclockwise to bring the gear on center, the left tie rod assembly will need to be lengthened and the right one shortened.

Drive Evaluation and Tie Rod Adjustment (Continued)

Loosen the tie rod adjuster tube clamps on both the left and right tie rods, then turn both tubes an **equal number of turns in the same direction** to bring the gear back on center. **DO NOT** turn the sleeves an unequal number of turns. If you closely follow this procedure you will not change your front toe setting. If you turn the tubes in one direction and the steering wheel position gets worse, start turning them in the opposite direction. Just make sure that you rotate them the same direction and the exact same number of turns.

For a more complete explanation as to C3 Corvette tie rod ends, clamps, and adjuster tubes, you can refer to the following paper and pictures entitled Steering Linkage Tie Rod Adjustment Specs Explained - Revised 21JA06 [Link](#) . This paper explains the engineering terminology on the C3 AIM sheet which displays how to correctly orient and tighten the tie rod clamps at the end of the adjustment procedure.

I do not have any information on the tie rod clamps for Gen I Camaros or Novas. Please refer to your AIM sheets or other shop manuals for this important tie rod clamp location and orientation information.

Final Steering Wheel and Tie Rod Adjustments

With the wheels straight ahead and the gear on center, check the steering wheel alignment. The 6 o'clock steering wheel spoke (or the center of the very bottom of the steering wheel rim) should be pointing straight down into your lap. If you measure at the steering wheel rim, that center point should be within 1 inch of being exactly straight down. If the wheel is close but not in exact alignment, remove it and try to reindex the hub on the steering column shaft by one spline to center the wheel as closely as possible. With 30 serrations on the steering wheel hub and steering column shaft, you should be able to get the steering wheel centered within 6 degrees or less. (If your steering wheel is off by more than 6 degrees, there are other problems in your steering system.)

Now, if you want to fine tune the steering wheel to get it perfectly on center, you will have to adjust the tie rods one last time. If the steering wheel needs to be adjusted clockwise to get it on center - the left tie rod will need to be shortened and the right lengthened by equal amounts. If the steering wheel needs to be adjusted counterclockwise – the left needs to be lengthened and the right shortened.

SteeringSystemCenteringC3Rev28JL2009
JIML82@aol.com