Rebuilding the Ford Non-Integral Steering Box

This section pertains mostlt to the Saginaw-designed Non-Integral Reciprocating Ball Steering Box used by Ford from 1960-1980

This style of steering box was used extensively by Ford on most of its car lines until phased out by modern rack-and-pinion steering.Often cursed and reviled, it is actually a simple and effective system that was state-of-the-art for many years, being used on everyday drivers and high performance cars alike. Although it could never match the precision of R&P systems, the only real problem with the reciprocation ball system is one of extreme mileage, neglect and misunderstanding. Few people know how to properly rebuild or even adjust a steering box, causing much misinformation to be spread about its supposed weaknesses and problems. But properly assembled and adjusted, a good rebuildable core can be made to operate as well as a new unit again.

Rebuilding a Ford Non-Integral steering box is seldom an easy thing to do. Before you consider or attempt a rebuild, there are some problem areas you should be aware of. This first part is not designed to scare you off from attempting your own rebuild (well, maybe just a little), but to show you what you may encounter along the way. We have done hundreds of steering box rebuilds and see these problems on a daily basis. These are the things not mentioned in any instruction sheet or shop manual.

Rebuilding the Steering Box

Can you rebuild your own steering box? It depends. It depends on the condition of your steering box core, how you remove it from the car, how good of a rebuild kit you are using, and how good the instructions are. Any one of these items can cause you trouble and most boxes have more than one of these problems during a rebuild. The biggest problem is - you don't know what condition your parts are really in until you remove the assembly from the car, tear it down and inspect it. By that time you are into it pretty deep and will have to decide whether to continue on your own or turn it over to a professional.

By definition, a rebuild means that there are some parts you will retain while reconditioning them to proper working order. There are several important parts inside the steering box that are not a part of a rebuild kit and these are the parts you hope to reuse. Unfortunately, these parts are often damaged due to rust, wear or improper removal/installation, and so have to be repaired or replaced to make for a successful rebuild. We will start with the parts that are universal to all steering boxes and those parts that are most often damaged.

Problems You May Encounter (And not really be aware of)

WHAT HAPPENS

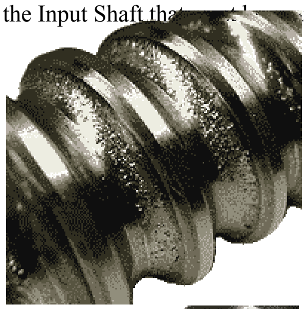
In most cases, a steering box needs rebuilding because it has become so loose that it is hard to keep the car going straight down the road without a lot of constant correction. Causes of this looseness is due to excessive play in the bearings or gear wear surfaces or play in the bearing and gear mesh adjustments. This looseness is caused by two main problems; wear and corrosion. Wear is caused by high mileage, poor lubrication and improper adjustment. Corrosion is caused by water getting inside the box and pitting the critical surfaces.

THE 3 MOST IMPORTANT PARTS

The three most important parts in the steering box are the Input Shaft/Worm Gear, the Rack Block and the Sector Shaft. It is the condition of these three pieces that determine if a rebuild is possible. Each one has its own vunerable areas that must be examined to determine if the part is re-useable.

Input Shaft: The Input Shaft is turned by the steering wheel. Before 1968 (except in big Fords and trucks) the Input Shaft was a long piece that went all the way up to the steering wheel. Starting in 1968, Ford went to a short Input Shaft design with a coupler connecting the another shaft that went to the steering wheel. This was due to the implementation of the collapsable-style steering column. Regardless of the Input Shaft length, the end that went inside the steering box was made as a Worm Gear. The recirculating balls ride in this twisted gear, moving the Rack Block up and down its length.

There are two areas on the Input Shaft tha[illegible]mined.



The grooved surface of the worm area on this Input Shaft is pitted due to abrasion by metal particles. This type of damage is usually found in the center of the worm area, the place where 99% of all driving is done. Most likely the hard-chrome plating has flaked off of some of the balls or one or more of the balls has broken apart and fragmented inside the Worm Gear/Rack Block area. This hard metal has been ground into the Worm Gear, pitting it as you see here. This Input Shaft cannot be used. The recirculating balls will be ground up by the rough surface and the problem will quickly escalate. This Input Shaft will have to be replaced.

The grooved surface of the worm area of this Input Shaft is pitted due to corrosion. Water has gotten inside the box, settled around the recirculating balls, and rusted the gear. As in the example above, this Input Shaft cannot be re-used. The rough surface will only destroy the recirculating balls and damage it further until it locks up.

The grooved surface of this worm gear has a faceted look to it. There are small flat areas on the sides of the groove, right where the recirculating balls roll. This irregular wear pattern is usually found in the center of the worm gear. A small amount of this pattern is usually not harmful but will cause accelerated wear. A steering box used in a car that is not driven much will

probably be alright. If the car will be driven daily, or have a lot of miles put on it, a shaft with this type of damage should be replaced.

This picture shows the end of the Input Shaft where the lower Input Shaft Bearing rides. There is a similar area at the other end of the Worm Gear. The surface has been pitted from corrosion. This is very common since this is the lower-most area inside the box and where water will eventually settle. Obviously, a bearing will not ride smoothly on this surface and a proper bearing-load adjustment cannot be made.

Fortunately, this kind of damage is usually repairable.

Here is an Input Shaft where the bearing surface has been machined down to a nice, smooth surface again

Here is a picture showing both bearing surfaces freshly machined. The marking bluing is still evident.

It is usually neccesary to shim the upper Input Shaft Bearing to compensate for the metal removed during this process.

Steering boxes with the long-style Input Shaft are threaded for a nut to retain the steering wheel. If your threads are so badly damaged that cleaning them with a die will not leave enough thread to properly torque down the steering wheel, we can machine down the shaft to a smaller diameter and provide a smaller retaining nut to match. No need to replace an otherwise re-useable Input Shaft just because the threads are damaged.

Email

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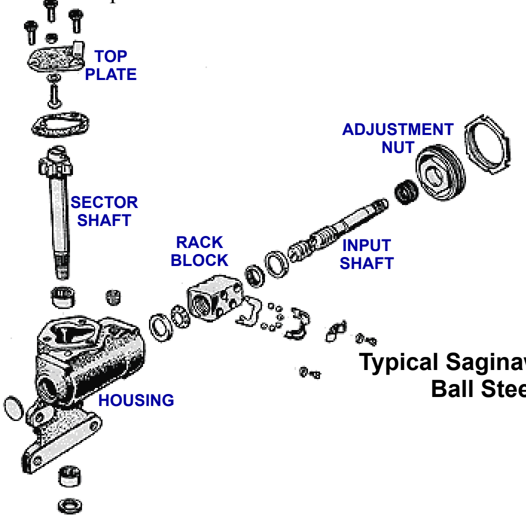
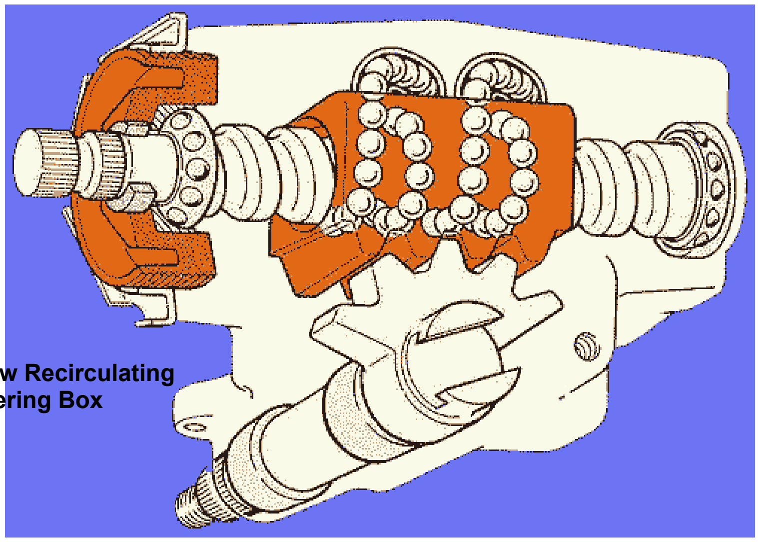
HOW DOES IT WORK?

1956 - 1978 Non-Integral Saginaw-style Steering Box

A basic working description of the Ford recirculating ball style steering box with attention to the critical adjustments and the common problem areas. The information below pertains specifically to an early Mustang/Falcon/Fairlane steering box, but other models are similar in operation.

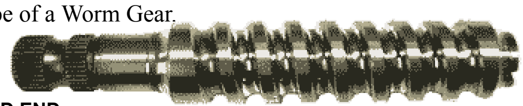




Typical Saginaw Recirculating Ball Steering Box

Input Shaft/Worm Gear

The top end of the Input Shaft is splined, either to mount directly to the steering wheel, or to connect to a coupler from the steering wheel. The bottom end of the Input Shaft is machined into the shape of a Worm Gear.

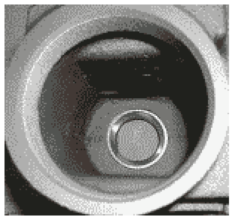


SPLINED END WORM GEAR END

On both ends of the Worm Gear section are areas where caged ball bearings ride. The shaft itself acts as the inner race for these ball bearings. There is an outer race for one of these ball bearings located inside the steering box Housing, and another race sets inside the Adjusting Nut. It is these two ball bearings that locate and hold the Input Shaft in place and the shaft rotates in them.

ADJUSTMENT NUT
with
BEARING RACE

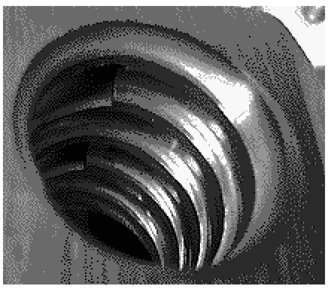
INPUT SHAFT
with
UPPER & LOWER BEARINGS



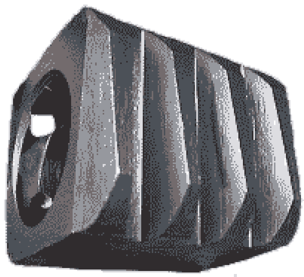
LOWER BEARING RACE
in
HOUSING

Rack Block

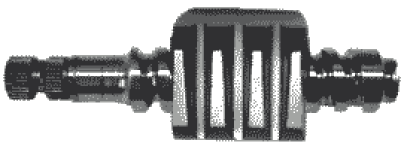
The Rack Block is machined in two different ways and serves two purposes. The inside of the Rack Block is machined in a screw-shaped design, just like the Worm Gear. The individual ball bearings roll inside the Rack Block just like on the Worm Gear.



The outside of the Rack Block has four straight teeth machined into it. These teeth mesh with the four teeth on the top end of the Sector Shaft.

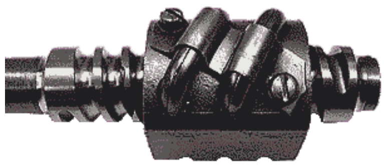


The Worm Gear goes inside the Rack Block and the individual ball bearings fill the grooves cut into both gears. The Rack Block has Ball Guides mounted on it that allow the balls to roll from one end to the other of the grooves cut into the Worm Gear and Rack Block. It is this recirculation of the ball bearings inside the Rack that gives the steering box it's recirculating-ball designation.



INPUT SHAFT
and
RACK BLOCK

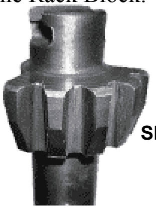
RACK BLOCK
SHOWING
BALL GUIDES



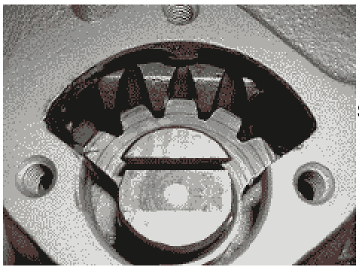
As the Steering Shaft is turned, the Worm Gear is turned. The screw-action of the Worm Gear causes the Rack Block to move up and down the length of the Worm Gear. The recirculation ball action inside this setup acts to make the movement smooth and as friction-free as possible.

SECTOR SHAFT

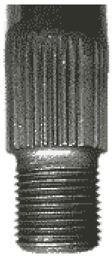
The top end of the Sector Shaft has five vertical teeth machined on it. The bottom end is splined and threaded to hold the Pitman Arm in place and for the nut and washer that secure the Pitman Arm to the shaft. The steering box Housing has (in most cases) two needle bearings mounted inside it for the Sector Shaft to turn in. Some early 60's boxes use bronze bushings instead of needle bearings, but their function is the same. The Sector Shaft sets down in these needle bearings and serves as the inner race for them. The teeth on the top of the Sector Shaft mesh with the external teeth of the Rack Block.



SECTOR SHAFT TEETH



SECTOR TEETH MESHED WITH RACK BLOCK



PITMAN ARM SPLINES

BASIC OPERATION

When you turn the steering wheel, you are also turning the Input Shaft and the Worm Gear. Due to the screw-like design of the Worm Gear, the Rack Block moves up and down on the Worm. The teeth on the outside of the Rack Block also move up and down in the box and push or pull on the teeth of the Sector Shaft, causing it to rotate. The rotation of the Sector Shaft causes the Pitman Arm to move left and right in the car, moving the steering linkage with it. This movement of the steering linkage causes the spindles to rotate on the ball joints and turn the wheels and tires. Simple.

The design of the Worm Gear and Rack Block converts the twisting action of the steering wheel into a forward/rearward reciprocating action in the box. The design of the Rack Block and Sector Shaft converts the forward/rearward action into a side-to-side reciprocating action that can then move the steering linkage as it needs to. The use of the recirculation ball action makes the conversion smoother and easier that it could be done with gear teeth alone.

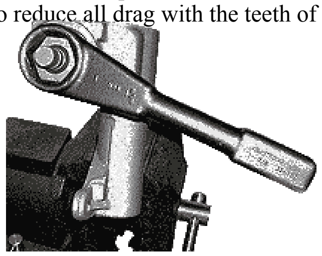
CRITICAL ADJUSTMENTS

There are only two adjustments when rebuilding a steering box; Input Shaft Bearing Load and Gear Mesh Load.

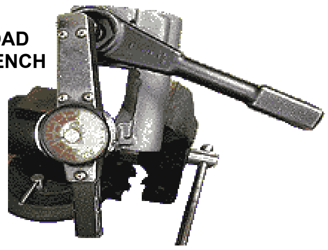
Input Shaft Bearing Load

The Input Shaft sets in two caged ball bearings and acts as the inner races of these bearings. The bottom bearing is mounted in the steering box Housing and is stationary. The top bearing is located in the Adjustment Nut and is therefore adjustable. Turning the Adjustment Nut in brings the two bearings closer together and clamps the Worm section of the Input Shaft between them. The tightness here must be enough to eliminate any play in the Input Shaft and keep it securely located in the Housing. However, the tightness must not be so great that the bearings bind or wear excessively. The proper tightness is determined by measuring the amount of drag it takes to turn the Input Shaft. This measurement must be taken without any additional drag from the other components in the box, so the Sector Shaft must be disconnected from the steering linkage and be removed or adjusted so far out as to reduce all drag with the teeth of the Rack Block.

ADJUSTING TENSION ON INPUT SHAFT BEARING

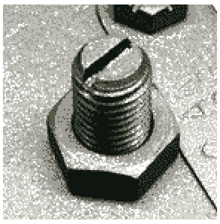


CHECKING BEARING LOAD DRAG WITH TORQUE WRENCH

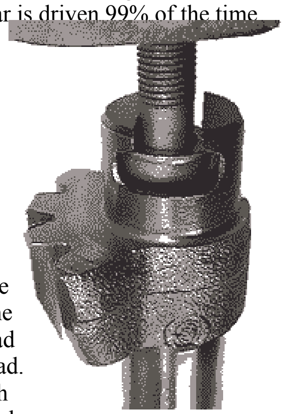


Gear Mesh Load

The teeth of the Rack Block and the teeth of the Sector Shaft mesh together. The space between the two center teeth on the Rack Block is machined slightly smaller than the other spaces and contacts the center tooth of the Sector Shaft more tightly. This design causes the the mesh of the teeth to tighten at the center of travel, which is where the steering box is when driving straight down the road. This center tightness is designed into the box so the box is tighter and the car has less tendancy to wander when going straight down the road - which is how the car is driven 99% of the time.



The Gear Mesh is adjusted by turning the Adjustment Screw in or out of the Top Plate. Screwing the Adjustment Screw in pushes the Sector Shaft down into the box and forces the teeth to mesh with those of the Rack Block. Unscrewing the Adjustment Screw raises the Sector Shaft and unloads the teeth from each other.



When properly adjusted, the mesh of the Rack Block teeth and Sector Shaft teeth add little or no additional drag to the turning of the Input Shaft, except at the center of travel. At center, the mesh should create an additional drag due to the designed interference of the gear teeth. Measurement of this additional drag at center is the Gear Mesh Load. This load must add a certain amount of additional load to the turning of the Input Shaft over the drag caused by the Bearing Load. This measurement must be taken with no additional load from the steering linkage or steering column. Too little Mesh Load and the box will not be tight at center and the car will wander the road when traveling in a straight line. Too much Gear Mesh and the teeth will bind, causing accelerated wear and, in some cases, breakage of the gear teeth and steering box failure.

Because the Gear Mesh Load is drag that is measured in *addition* to the Input Shaft Bearing Load, the only proper way of adjusting the steering box is to set the Input Shaft Bearing Load first before attempting to set the Gear Mesh Load.

For directions and specifications for actually adjusting the Steering Box, go to the **Steering Box Adjustment page**.

PROBLEM AREAS

Most problems in the steering box are caused by either excessive wear or corrosion.

Excessive Wear

As can be expected, the Input Shaft and Sector Shaft bearings eventually wear and loosen, causing excessive play in the gear mesh. Sometimes the caged ball bearings even disintegrate, spreading metal bits throughout the inside of the box. Replacement of the bearings with new pieces and resetting the bearing and gear mesh adjustments will restore these areas to proper operating conditions. The main area to be concerned with is the wear of the teeth of the Rack Block and Sector Shaft where they mesh in the center of travel. The extra tightness that is designed into this area must be present for a rebuild to be possible. If the inside edges of the two center teeth on the Rack Block, and both tooth faces of the center tooth of the Sector Shaft, are so worn that they no longer produce a higher gear drag together, then one piece or both must be replaced to restore the original gear mesh settings.

For pictures and more information on gear tooth wear, go to the **Can I Rebuild My Own Steering Box? page.**

Corrosion

Though it doesn't seem likely, it is fairly easy for water to get inside the steering box. It doesn't take much water to cause problems because once inside it never leaks out again. If the engine compartment is steam-cleaned or washed out, water can make its way into the box, usually through the area where the Input Shaft goes into the Housing. On steering boxes with long input shafts, there is no seal at all to prevent this, as you can look down where the shaft goes into the Adjustment Nut and actually see the upper Input Shaft ball bearings. If you find a steering box in a salvage yard that has been sitting in the open with no hood, you can bet that water has gotten inside the box.

You would think that a box filled with grease could never rust, but you would be wrong. Water is a powerful solvent and will easily wash the heaviest grease off the internal parts of a steeing box and rust the parts away. Water will particularly settle between gear teeth or inside of the ball bearings. About a third of all steering box cores sent in for rebuilding have major internal pieces damaged beyond use due to corrosion.

For pictures and more information on corrosion in the steering box, go to the **Can I Rebuild My Own Steering Box? page.**

Steering Box Adjustments & Measurements

For Ford/Saginaw designed non- integral style steering boxes

This section deals with the Saginaw-design Ford Non-Integral Steering Box. This style box was used from the late 1950's on up to their replacement by rack-and-pinion systems. The non-integral refers to the box having no internal power assist and having no hydraulic lines connected to it. The power assist system, if there was any, was remote and separate from the steering box.

There are four adjustments and measurements that need to be made to properly set up a non-integral steering box**:**

1) Input Shaft / Worm Gear bearing preload
2) Adjustment Screw to Sector Shaft end play
3) Sector Shaft to Rack Block gear mesh load
4) Sector Shaft movement degree-of-arc measurement (Optional)

It is important that Steps 1-3 be done in order as one step affects the next. If the first three Steps are made correctly, step 4 should fall within tolerance. Therefore, Step 4 is optional and needn't be done if you do not have the tools to do it..

These steps must be made in this order to correctly assemble, adjust and check the steering box. These are the steps outlined by Ford in shop manuals and technical bulletins for proper setup by a qualified mechanic.To make these adjustments requires the use of**:**

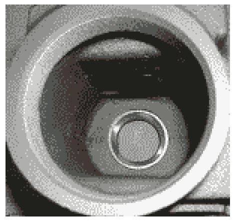
1) Direct-read (dial or digital) Torque Wrench capable of measuring 0-10 **in/lb** in 1 in/lb increments
2) Feeler shim gauges to measure **.**002"-**.**005"

Input Shaft / Worm Gear Bearing Pre-load: The end of the Input Shaft that is inside the steering box has a **worm gear** design. Both ends of the worm section have ball bearings that secure the shaft inside the housing and allow the shaft to rotate freely. The surface of the input shaft acts as the inner race to these bearings. The **Input Shaft Bearing Nut** tightens down into the box and tightens these bearings to the input shaft. This loads the bearings so that they are tight and hold the worm section of the input shaft securely. This bearing load must be sufficient to remove all movement and slack from the input shaft and yet loose enough not to have the bearings bind or wear excessively as the input shaft is turned. They must hold the input shaft in place as the steering action of the sector shaft places a deflecting action against it. This bearing load is determined by measuring the drag on the bearings as determined by rotating the input shaft.

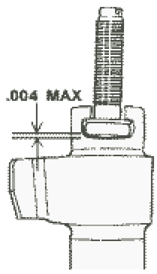
OUTER BEARING RACE in ADJUSTING NUT

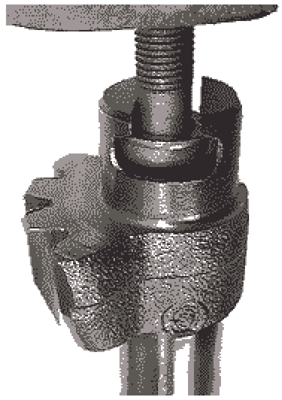
ADJUSTING NUTS

OUTER BEARING RACE in HOUSING



Adjustment Screw to Sector Shaft End Play: The Adjustment Screw lowers the Sector Shaft into the housing and forces the Sector Shaft Teeth to mesh with the teeth on the Rack Block. This screw also sets the amount of end play of the Sector Shaft. This screw must have enough clearance to allow the Sector Shaft to turn without binding on the screw, but no so much that there is excessive end play in the Sector Shaft to affect gear mesh.
The clearance is adjusted by changing the shim located between the Adjustment Screw and the top of the Sector Shaft. Different thickness shims allow for correction of production tolerances and wear compensation.

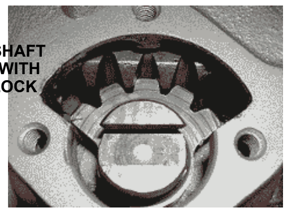


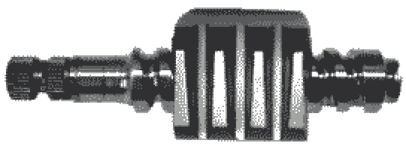


Gear Teeth Mesh Load: The teeth on the Sector Shaft mesh with the teeth on the Rack Block, which is mounted to the Input Shaft Worm. The center gap on the Rack Block is designed tighter than the other gaps so that the center tooth on the Sector Shaft has a tighter fit when meshing with it. This tightness is designed into the center of the box because this is the position the box is most often in - steering the car straight down the road. This tightness in the center keeps the box tighter when going straight down the road so the car doesn't wander. The mesh load is determined by turning the steering box through its full travel and measuring the increased drag in the center of travel.

SECTOR SHAFT TEETH

SECTOR SHAFT MESHED WITH RACK BLOCK





RACK BLOCK TEETH

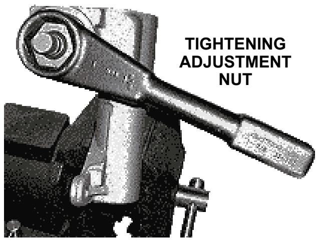
The most common problem and complaint about steering boxes is the excessive amount of play in the steering wheel. It is not unusual for the steering wheel to move several inches without causing the tires to actually turn at all. While there are many reasons why this this can happen, the part most often blamed for this situation is a loose steering box. This section will address the steering box's role in this problem and how to resolve it.

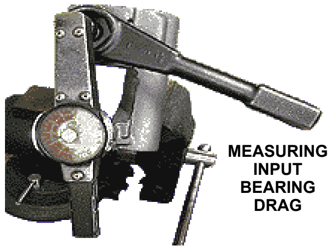
Any looseness in the steering box will cause play in the steering wheel and steering linkage. Small amounts of excessive play in the box will cause larger movements elsewhere. Many things can cause play in the steering box**:** worn sector shaft needle bearings, worn teeth on the sector shaft or rack block, worn balls in the recirculating assembly as well as worn worm gear grooves. Over time the bearings inside the box also wear and become looser, adding to the problem. While the gear tooth mesh may contribute only a small part to the looseness of the box, it is this adjustment that can remove most of the play found inside the box. However, tightening this adjustment alone will only provide a temporary fix and can cause problems in the future.

There is only one ***proper way*** to adjust a steering box. To do this requires:

a) All internal parts must be in good condition. That is, the bearings must be in good condition, the tooth surfaces of the sector shaft, rack block and worm gear must not be excessively worn, the recirculating balls must not be worn down, and the bearing surfaces of the input shaft must be smooth and clean.
b) The steering box must have no outside drag imposed on it. Meaning, the pitman arm must be removed or the adjustment screw turned all the way out so that the sector shaft teeth are not providing any drag on the rack. The pitman arm must be removed from the sector shaft or the pitman arm disconnected from the steering linkage so that there is no drag imposed by them.The steering wheel and column must be removed so they add no drag to the input shaft.
c) The Input Shaft Bearing Load must be done first. For this measurement to be done, the adjusting screw on the top of the box must be turned all the way out to remove the drag of the sector shaft from the rest of the assembly.
d) The Gear Teeth Mesh Load can now be done until the correct total of center mesh load is obtained.
e) Measurement is done using a *direct-read inch-pound torque wrench* mounted to the end of the input shaft. The wrench measures the drag imposed on the input shaft by the adjustments. The proper loads are small and impossible to measure accurately without such an instrument.

That being said, here is the proper way to adjust the steering box:





1) Mount the torque wrench onto the end of the input shaft. On long shaft boxes this can be done by threading a large nut onto the threads that secure the steering wheel to the shaft and using the proper socket on the wrench. On short shaft boxes an 11/16" 12-point socket will usually slip over the splines and allow the shaft to be turned.
2) Measure the amount of drag needed to turn the input shaft. If the input shaft is in a more-or-less horizontal position, take the measurements while lifting the wrench to get a more accurate reading.
3) If the reading is less than 4 in/lb, loosen the Bearing Nut Lock Ring. Tighten the Bearing Nut and take another reading. Continue until you get a consistant reading of 4-5 in/lb of drag.
4) Once you have gotten the proper reading, tighten down the Lock Ring with a hammer and drift. Check the reading again. Sometimes tightening down the Lock Ring with tighten down the Bearing Nut, sometimes it will loosen it. Re-adjust Bearing Nut and Lock Ring until reading is correct with Lock Ring tightened down.
5) Slowly tighten down the Adjusting Screw while turning the steering box from lock to lock until you feel the box tighten while passing through the center of travel.
6) Lock down the Adjusting Screw and measure the increase in drag while passing through the center of travel. The drag reading should stay around the original 4-5 in/lb of drag until the center of travel is reached. The drag should then increase slightly and then go back down to the 4-5 in/lb reading. The desired increase at center is a total of 9-10 in/lb of drag.
7) Once the total drag has reached 9-10 in/lb at center, with the Adjusting Screw locked down, tighten the Lock Nut securely.

PROBLEMS:

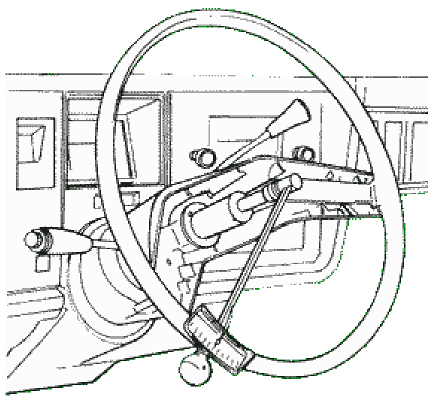
When checking for the gear mesh center drag, if the reading stays the same throughout the travel of the box, and the adjustment is turned as far as it will go, then the center teeth on the rack block and/or sector shaft are worn out and must be replaced.

If the drag reading goes up more than 2 in/lb just before you reach the end of travel on the box, then the Sector Shaft is dragging on the inside of the housing because it has moved too deeply onto the Rack Block. This indicates that either or both of the Sector Shaft or Rack Block are worn out and must be replaced.

If there seems to be two peaks at the center of travel and not just one, then the Sector Shaft and/or Rack Block are worn out and must be replaced.

In-Car Adjustment

Many people want to adjust their steering box while it is still mounted in the car, often without the accuracy of using a correct torque wrench. Sorry, but it just can't be done this way - *properly*. And since this is the way the engineers who designed the box intended for it to be done, this is also the way I recommend too.
I know, you have all heard from people who told you to tighten down the adjustment screw and that will take out all the slack - easy, no problems - hey, it worked for me!



Okay, maybe it did. It probably made some improvement, at least temporarily. But often the slack will come back. The amount of mesh load on the gear teeth is a very small measurement and can't be done without the correct torque wrench. I can set the load properly without one but that is because I have built hundreds of steering boxes and know how it feels. Still, I use a torque wrench for accuracy, anyway. It is very easy to tighten the adjustment far tighter than it is supposed to be. You will never feel it because the leverage of the steering wheel makes feeling such a small amount of drag impossible. This will cause the teeth to mesh under a much greater load and will accelerate their wear. That is why the slack comes back. Only now the gear teeth are really worn out and will have to be replaced. If the adjustment is really tightened down, teeth can actually break off of the rack block and cause the box to lock up.
The factory suggested measuring the bearing and gear mesh loads by attaching a torque wrench to the nut holding down the steering wheel, as in the picture to the right. This was after disconnecting the steering box from the steering linkage either by removing the pitman arm from the box or removing the linkage from the pitman arm.

Although this sounds good, it doesn't allow for the extra drag caused by the bushings centering the steering box shaft in the column, any drag of the steering wheel on the column or the possible drag imposed by the steering coupler.
If you must try to adjust the box in the car, without proper tools or in the wrong order, do so in very small increments and at your own risk!

IMPORTANT NOTE

A critical thing to remember is that the loads being adjusted and measured are actually very small. We are talking about **inch/pounds**
here, not **foot/pounds** like most torque values on the car. You must have a tool capable of measuring accurately to one or two i**nch/pounds**, which you cannot tell the difference from by turning the input shaft by hand. Trying to judge bearing load and gear mesh by hand, you can easily over-tighten by a dozen inch/pounds or more. A torque wrench capable of accurately measuring in single inch/pounds is not a common or inexpensive tool, but is the only way to measure a box properly.

For examples of what can happen when a steering box adjustment is tightened too much, go to my Damaged Parts page.

STEERING BOX ID TAG DECODER

Passenger Car Steering Box Codes

1960-1979

MODEL CODES: **A** = Galaxie & big Fords **B** = Fairlane
F = Mustang & Fairlane **G** = Granada
P = Maverick & Comet **S** = Thunderbird
U = Bronco **X** = Falcon & Comet

TYPE CODE: **M** = Manual Steering **P** = Power Steering
SHAFT: Length
SECTOR: Diameter
RATIO: Box Internal Ratio
MIXES WITH: Functionally, the same box

ID TAG CODE

ASSEMBLY DATE CODE

Tag Code	Ratio	Type	Shaft	Sector	Year	Model	Mixes With
HAA-AY		P			61/62	S	HAA-BJ Pin lock coupling
HAA-BD		P			62	S	Rubber Coupling
HAA-BF		P			63/64	S	HAA-BG
HAA-BG		P			63/64	S	HAA-BF
HAA-BJ		P			61/62	S	HAA-AY
HCA-AB		P			61/62	A	HCA-AF, AP Ford
HCA-AE		M			61/62	A	HCA-Z, AN
HCA-AF		P			61/62	A	HCA-AF, AP Ford
HCA-AH		M			61	A	Saginaw
HCA-AJ		P	7 3/16		61	A	Saginaw
HCA-AN		M	40		61/62	A	HCA-Z, AE
HCA-AP		P	7 3/16		61/62	A	HCA-AB, AF
HCA-AV		M			62/63	B	
HCA-AW		P			62/64	B	SMA-F
HCA-AX			40		63/64	A	HCA-AY, BL-BX Ford
HCA-AY			7 3/16		63/64	A	HCA-AX, BL-BX Ford
HCA-BL			7 3/16		63/64	A	HCA-AX
HCA-BN		M	7 3/16		61/62	A	HCA-BW Ford
HCA-BP		P	7 3/16		61/62	A	
HCA-BU		M	7 3/16		65	B	
		M	7 3/16		64	B	
HCA-BV		P	40		65/71	B	HCA-BZ, CE, SMA-B w/7 3/16
HCA-BW		M	7 3/16		61/62	A	HCA-BN
HCA-BY		P	39.5		66/67	B	HCA-CD, SMA-A w/39.5
HCA-BZ		P	39.5		65/71	B	HCA-BV, CE, SMA-B w/7 3/16
HCA-CA		M	7 3/16		66/67	B	SMA-C w/39.5
		M	40	1.125	66/67	X	SMA-C w/39.5
HCA-CD		P	39.5		66/67	B	SMA-A w/39.5
HCA-CE		P	7 3/16		65/71	B	HCA-BV, BZ, SMA-B w/7 3/16
HCA-G		M	39.5		60	A	HCA-H, K, L Ford
HCA-H		M	39.5		60	A	HCA-G, K, L Ford
HCA-J		M	39.5		60	S	
HCA-K		M	7 3/16		60	A	HCA-G, H, L Ford
HCA-L		M			60	A	HCA-G, H, K
HCA-Z		M	40		61/62	A	HCA-AE, AN Ford
HCC-AF		M	40	1	63	X	HCC-AS 8cyl
HCC-AG		P	40	1.125	63	X	
HCC-AJ		P	40	1	63	X	HCC-AK, BA
HCC-AK		P	40	1	63	X	HCC-AJ, BA
HCC-AM		M	39	1	65	X	HCC-AM1 6cyl
		M	39	1	64	X	HCC-AM1 6cyl
HCC-AM1		M	39	1	65	X	HCC-AM1 6cyl
		M	39	1	64	X	HCC-AM 6cyl
HCC-AN		P	39	1	64	X	HCC-AN1
HCC-AN1		P	39	1	64	X	HCC-AN

Most Ford steering boxes have a metal ID tag attached to them by one of the top cover plate bolts.
The top line is the **ID Tag Code** of the box. The charts on the following pages are listings of Ford passenger car steering boxes from 1960-1979.
The first part of the second line is the **Assembly Date Code** listing the date the box was assembled - not the day it was installed in the car. After the date code is the Shift Code, indicating the work shift during which the box was assembled that day.

Using the tag shown above as an example, the ID Code (HCC-AW) shows the application to be for a 1965-1966 Mustang with Power Steering and a 16:1 ratio.

The date code follows standard Ford date decoding. The first position is a number indication the Year of build. Decoding the ID Code on the tag shown above shows that the box was installed in 1965-1966 Mustangs, so the first digit '**6**' means the box was assembled in **1966**. The second position is a letter indicating the month the box was built.

A = January	G = July
B = February	H = August
C = March	J = September
D = April	K = October
E = May	L = November
F = June	M = December

FORD NEVER USED THE LETTER ' I ' IN THEIR DATE CODING SINCE IT WAS EASILY CONFUSED WITH THE NUMBER ' 1 '

On the example tag, the letter ' **F** ' indicates that the box was built in **June**. The third and forth positions are the day the box was built. On the example tag the numbers ' **17** ' indicate that the box was built on the 17th.
So, the box for the example tag was built **June 17, 1966**, during the ' **B** ' work shift.

NOTES:

Steering boxes were built in batches by code. It is not unusual for Mustangs all across the country to have HCC-AT steering boxes all assembled within a 3 or 4 day span. We have seen boxes come in from all over the country for rebuild and notices that many of the same ID code have exact or similar date codes.
Comparing the casting dates on the steering box housings, often boxes were built from 3 to 10 days after being cast up. Mustangs especially were being built so fast that it seemed that the cases barely had time to cool down before they were being used to build new boxes.

MUSTANG
Steering Box Differences

March 1964 to early 1967 used 41 7/8" long **Input Shaft**
Later 1967 to August 1970 used 6 3/16" long **Input Shaft**

March 1964 to 5/1/67 1967 used 1.000" diameter **Sector Shaft**
5/1/67 1967 to August 1970 used 1.125" diameter **Sector Shaft**

1965-1970 Steering Boxes came in only two **ratios:**

HCC-AP		M	39	1.125	65	X	HCC-AP1	8cyl
		M	39	1.125	64	X	HCC-AP1	8cyl
HCC-AP1		M	39	1.125	65	X	HCC-AP1	8cyl
		M	39	1.125	64	X	HCC-AP	8cyl
HCC-AS		M	40	1	63	X	HCC-AF	8cyl
HCC-AT	19/1	M	41 7/8	1	65/66	F	SMB-A	
HCC-AW	16/1	M	41 7/8	1	65/66	F	SMB-B	
HCC-AX	16/1	P	41 7/8	1	65/66	F	SMB-B	
HCC-AZ		P	40	1	65	X	HCC-BB	

SMA-Y		P			76/	G			
SMB-A	19/1	M	41 7/8	1	65/66	F	HCC-AT		
SMB-B	16/1	P / M	41 7/8	1	65/66	F	HCC-AX	HCC-AW	
SMB-C	19/1	M	6 1/5	1	67	F			
SMB-D	19/1	M	6 1/5	1.125	67/70	F			
SMB-E	16/1	P	6 1/5	1	67	F			
SMB-F	16/1	M	6 1/5	1.125	67/70	F			
SMB-H	19/1	M	41 7/8	1.125	67	F			
SMB-J	16/1	P	41 7/8	1.125	67	F			
SMB-K	16/1	P	6 1/5	1.125	67/70	F			
SPA-AA		P			72	A	SPA-E4 a 2/1/72		
		P			72	S	SPA-E4, a 2/1/72		
SPA-A1		P			69/70	A	SPA-A2, A3 Ford built		
SPA-A2		P			69/70	A	SPA-A1, SPA-A3 Ford		
SPA-A3		P			69/70	A	SPA-A1, A2		
SPA-C		P			65/66	S	HCF-B		
SPA-E		P			67/68	S	SPA-F		
SPA-E1		P			69/72	S	SPA-E2, E3, E4 b 2/1/72		
SPA-E3		P			70/72	A	SPA-E4 Ford built	b 2/1/72	
SPA-E4		P			72 / 72	A / B	SPA-AA	a 2/1/72	
		P			72	S	SPA-AA, a 2/1/72		
SPA-F		P			67/68	S	SPA-E		
SPA-H		P			65/68	A	SPA-N, HCE-B		
SPA-N		P			65/68	A	SPA-H		
SPA-S		P			71/73	F	SPA-U, Saginaw Constant Ratio		SPA-AC,AE
SPA-T		P			71/73	F	SPA-V, Variable Ratio		SPA-AD,AF
SPA-U		P			71/72	F	SPAS, Saginaw Constant Ratio		
SPA-V		P			71/72	F	SPA-T, Variable Ratio		
SPA-Y		P			72	B	b 3/15/72		
SPA-Z		P			72	U	f Ser P40,001		

		M	7 3/16	1.125	68/70	X	
		P	7 3/16		62/64	B	HCA-AW
		M			75/	G	
SMA-F1		M	7 3/16		70/72	P	SMA-F
SMA-R		M			71/73	F	SMA-T
SMA-T		M			71/72	A	SMA-R

Pitman Arms: (3590)

1965-1966 6cyl Manual
1965-1966 6cyl Power
1965-1966 V8 Manual & Power
1967 6cyl & V8 Power built before 5/1/67 with 1.0" sector
1965-1966 Shelby only (Quick Steer Kit)
1967 6cyl & V8 Manual built before 5/1/67 with 1.0" sector
1967-1970 6cyl & V8 Manual built after 5/1/67 with 1.125" sector
1967-1970 6cyl & V8 Power built after 5/1/67 with 1.125" sector
1971-1973 6cyl & V8 Manual
1971-1973 6cyl & V8 Power

Pitman Arm Page

16:1 Quick Ratio - used on Power steering and all GT's
19:1 Slow Ratio - used on Manual Steering cars

1965 - 1966
GT Steering Box

Mustangs equipped with a special option "handling package", which included all factory GT-equipped Mustangs and K-code Mustangs, came with "quick-ratio" steering setup. Part of this package was a quicker ratio steering box to reduce steering wheel movement when turning. This was accomplished by installing the 16:1 ratio steering box in the car. If the car had **Power Steering**, it already had the quick ratio box which received the normal power steering ID tag code. If the car was equipped with **Manual Steering**, the quick ratio box was installed and received a special ID tag code.
There is no special GT steering box for a power steering equipped car. They simply received the same identical box as all other power steering cars.
The only special GT steering box was one installed in a manual steering car. The ID tag is a unique code that only came in GTs.
The only difference between the power steering 16:1 box and the GT manual steering 16:1 box was the bearing load and gear mesh settings when it was built. It was set up just a little bit tighter since a manual steering box has more strain on it and tends to loosen up more than a power steering box.

Long Shaft / Short Shaft

Ford changed the Mustang steering box from a long shaft to short shaft for two reasons: the short shaft box was needed for cars with tilt-wheel options and for the coming introduction of the collapsable steering column.

MUSTANG
Steering Box
Castings & Interchange

Box Housing:
1965-1967 Mustangs with the 1.0" sector shaft used the C4DR-A casting, which is a Falcon casting
.Later in 1966, Ford went to a C6ZR-A casting

1967-1970 Mustangs with the 1.125" sector shaft used the C7ZR-A casting housing, though some used a C4DR-B Falcon casting also

Long Shaft Boxes:
All long input shaft boxes used an Adjustment Nut with the long snout and no rubber seal. Bcause of this, the top of the box is vented through the top input shaft bearing, so it uses a non-vented grease fill plug

Short Shaft Boxes:
All short input shaft boxes used an Adjustment Nut that was very short and had a rubber seal mounted in it around the input shaft. Since this style box could not vent through the bearing and seal, they were equipped with vented grease fill plugs.

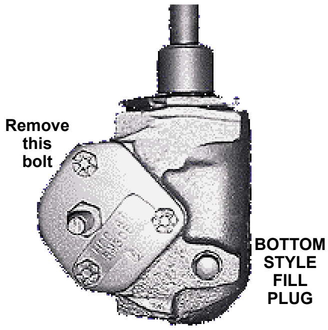
Email

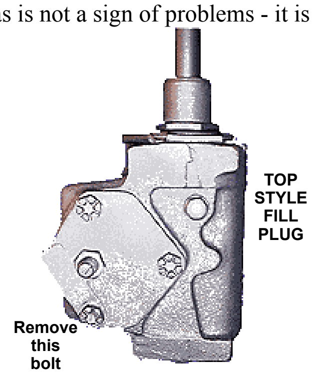
Ford Non-Integral style Steering Boxes

Lubrication

Ford manual-style steering boxes (those that do not have power steering fluid running through them), use a grease internally as a lubricant - not a fluid. This grease is a moly or lithium-based grease like used in lubricating the suspension and steering linkage. It is thick enough to cling to the internal pieces as they move but soft enough to flow through the box also. The steering box's location near the exhaust manifold and engine also causes the grease to soften and move freely. A liquid lubricant would settle to the bottom of the casing and leak out the bottom seal.

The inside of the steering box needs to be as fully packed with grease as possible with very little air pockets. As the rack block moves up and down the input shaft, and the sector shaft teeth move across the rack, they should push the grease back and forth inside the box, constantly redistributing the grease and keeping the parts covered at all times. An insufficiently filled steering box will not have enough grease in it to flow around and the parts will only have what grease clings to them for lubrication. Soon this grease will wear off and the parts will be rubbing metal to metal. It is not really possible to overfill a steering box with grease if it is vented somehow. Boxes with long input shafts have no seal where the shaft goes in and excess grease will find its way out there. Short input shaft boxes have fill plugs with venting and excess grease will be forced out there. Grease coming out of the box in these areas is not a sign of problems - it is just venting excess grease and will stop when equalized.





Lubricating the Steering Box

1) Locate the Fill Plug on top of the steering box housing. This is usually a stamped, hollow metal plug with a 1/2" hex shape on top. NOTE: As mounted in the car, small boxes such as used in Mustangs, Cougars and early Falcons have the Fill Plug located at the bottom end of the housing. Cars such as Fairlanes, Torinos, Galaxies and Mavericks have the Fill Plug towards the top of the housing. Look at the pictures above and determine which location style your box has.

2) On Bottom Plug style boxes, turn the steering wheel all the way to the right. On Top Plug style boxes, turn the steering wheel all the way to the left. This action moves the rack block inside the housing to the end opposite the fill plug and leaves the area empty.
Remove the Fill Plug. Note that there are three hex bolts holding the Top Plate to the housing. Locate the bolt that is the *farthest* away from the Fill Plug and remove it. On Bottom Fill Plug boxes this is usually a 1/2" bolt, on Top Fill Plug boxes this is usually a 9/16" bolt.

3) Insert the hose end of the grease gun into the Fill Plug hole. Pump grease into the box untill grease starts to squirt out the top plate bolt hole.

4) Reinstall the top plate bolt and the Fill Plug. Turn the steering wheel all the way the other direction. Remove the Fill Plug and top plate bolt and begin pumping grease into the box again. Stop when grease starts to come out the top plate bolt hole.

5) Reinstall top plate bolt and Fill Plug and tighten properly. Turn steering wheel lock-to-lock a few times to distribute grease inside the box.

Some grease may appear around the vented-style Fill Plug or where the input shaft goes into the box. This is normal and just the box venting out excess grease.

The Proper Lubricant

Ford used a moly-based grease inside the steering box. It lubricates the mechanical actions of the box well, is thick enough to cling to parts without running off and settling to the bottom, and is soft enough to flow back and forth inside the box by the pumping action of the rack block and sector teeth. Heat from the exhaust manifold and engine will soften it on cold days and yet the grease stays thick enough not to liquify and seep out of the bottom seal. A good moly or lithium based chassis grease will work in this situation and is easy to find in tubes and install using a common cartridge-style grease gun..

Do not use a liquid lubricant (such as 90w axle fluid) in a steering box. Liquid lubricants will settle in the box and not lubricate the upper portions of the gears. It will also seep through the bearings and leak out the bottom seal. **Do not** use wheel bearing grease inside the box. Wheel bearing grease is too thick to coat and work properly. Wheel bearing grease is designed for the high heat enviroment of the brake system and does not soften with heat and will not flow through the box like a moly-based chassis lubricant will.

WARNING

Adding lubricant to a steering box will not help if the box is already damaged or worn inside. A steering box that has excessive play that cannot be adjusted out, rough or ratchety action when turning, or binding will not be cured by lubrication. Installing a heavier grease or a lighter oil will not help. Lubrication is designed to prevent wear and corrosion on parts in good condition and will not compensate for damage or wear caused by prior insufficient lubrication, rust corrosion or improper bearing settings and adjustments.

Email