Tech

Development of Second and Third Generation Corvette Steering Couplers

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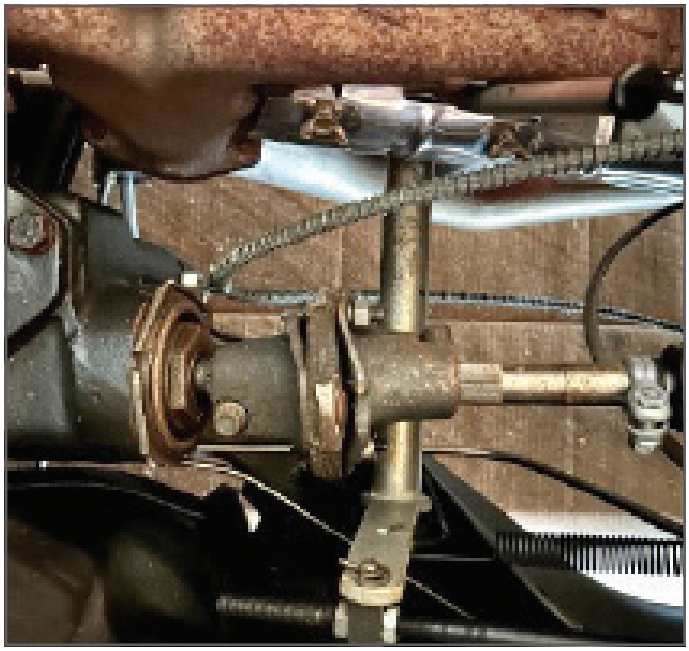
Beginning with the 1963 model year, the second generation of the Corvette was the first to use a flexible steering coupling (rag joint). The C1 Corvette steering column was connected directly to the Steering Gearbox with no flexible coupling between them.

Generic C1 Steering Shaft Connection*



Generic C2 Steering Shaft Connection*

For cars without telescoping steering wheels from 1963 through 1966, the couplers were all the same. These couplers used the same casting (# 5686624) on both sides of the coupling. Both the steering shaft coming out of the firewall and the steering gearbox input used a full round 3/4" diameter splined shaft. The casting number of the flanges was the only visible part number anywhere on the steering coupling. However, the 5686624 number was a Saginaw Steering Gear (SSG) number and only relevant to the casting, not the machined part, or the coupling assembly. These parts have been seen with and without the casting number, as well as some with very faint or partial casting numbers. At this point the author assumes the reason for the differences was the repair of individual tool cavities.

The 5686624 casting was machined to fit the 3/4" diameter shaft with a 36-count (for a full round diameter) spline. The steering shaft flange and the steering gearbox input flange were machined identically and secured with a 12-point 3/8-24 UNF threaded bolt with an integral washer P/N 5686553. The pinch bolt was finished in black phosphate. No separate washer was used. The bolt was originally released in 1957 and there was no head mark specified on the drawing found in an NCRS Technical Discussion Board post. This means there may have been vendors required to apply their head mark, while others were not. The length of the pinch bolt was 1 3/16" and the threads did not extend up to the head. For safety reasons, the round portion of the body was used to engage a slot in the shaft, as long as the pinch bolt was present, the coupling could not come off the shaft because the pinch bolt was engaged in the slot.

**Pictures courtesy of Jim Williams*

The flexible rubber disc (rag joint) was made from (8) layers of neoprene rubber and (7) layers of cotton cloth bonded together in alternating layers. The layers added up to approximately 3/8" thick. This material was then die cut to produce the 3 1/4" OD of the disc, the center hole and the (4) hole bolt pattern.

The disc was held to one of the castings with (2) rivets and (2) reinforcing plates. The reinforcing plate went under the head of the rivet and over the rubber disc. One rivet had a thin copper strip between the rubber disc and reinforcing plate. This copper strip has also been seen both below the reinforcing plate and above the reinforcing plate. The copper strip completed the horn circuit ground path. The copper strip was formed in a round shape which covered about 270 degrees of a circle leaving the free end in the correct location to attach to the other side of the coupling. These copper strips were notorious for corroding and interrupting the ground path for the horn.

1963-1966 steering coupling disc as used with Non-Telescoping steering shafts

The rivets were shouldered such that the larger shaft diameter of the rivet fit the holes in the disc, and the larger diameter was the same length as the reinforcing plate plus the disc thickness. The smaller (5/16") diameter of the rivet extended through the casting and was formed with a press. The larger diameter of this rivet would support the casting at nearly the same thickness as the disk while the press formed rivet head held the joint solidly together. Typical formed head sizes are approximately 0.10" thick and 0.40" diameter, but these dimensions would vary. The formed head would be a single diameter with a flat surface when the tooling was new, but the 5/16" diameter of the shaft would wear a 5/16" diameter into the tip of the punch leaving the formed head with a 'stepped' look. Not surprisingly, the 'worn' tool is more frequently seen than the 'new' tool.

The other casting was held to the rubber disc with special bolts. The bolt threads were 5/16-24 UNF and a lock washer was used beneath the nuts. The bolts had round flat heads similar to the rivets, but with a round pin extending up from the bolt head far enough to engage the cast slots in the riveted casting. This meant that even if there were a complete failure of the rubber disc, the pins mounted to the bolted casting would extend through the riveted casting to provide a means to steer the car. There would be significant play in the wheel, enough that any reasonable driver would have the steering checked. The pins on the bolt heads were the same length, but two different diameters.

There is a frequent design variation noted in these special bolts. The alternate design was of the same length, thread size and pin diameters, but the round head was changed to a 1/2" wide hex. This author has not been able to find any mention of the different bolt shapes in NCRS Technical Discussion Board Posts, or other online forums. Both designs have been seen on multiple Corvettes throughout C2 production. This author assumes that there was an optional construction specified on the drawing, and some manufacturers chose one or the other. More observations and research are needed.

1963-1966 Steering Coupling with Non-Telescoping steering shafts. ***Note bolt head (round and hex) extending through slot in casting.***

For Corvette production in 1963 and 1964 there was a single steering coupling used P/N 5690809. The GM drawing had no paint specification, but as often as not, these coupling flanges are seen with black paint. The 1963-1966 Standard (non-telescoping) steering column was designed by the Chevrolet Division. In 1965 Saginaw Steering Gear released the telescoping steering column which used a different steering coupling P/N 5692974. This GM drawing called out black paint per SSG spec. 4239.

So, for 1963 and 1964 there was only one steering coupling used in production, and in 1965 and 1966 there were two. The difference was the telescoping steering column required a shorter steering coupling which was P/N 5692974. The shorter distance was accomplished by redesigning the flange used for the steering gear side of the coupling. It became the 'Bowtie' shaped casting used with only minor changes through the 1982 model year. The steering shaft side of the 5692974

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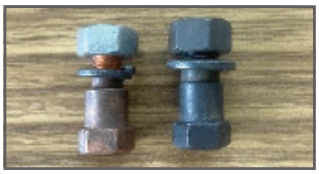
coupling remained the same casting machined for a ¾" diameter 36-count splined shaft and used the same rivets as in previous model years.

Original 1963 design flange casting with the new for 1965 casting

One unique feature of the 5692974 coupling for 1965 and 1966 was it used (4) rivets and no bolts. The steering gear side of the coupling was retained by two rivets with pins that extended up through the opposite side flange in the same manner as the bolts used in previous years. This begs the question as to how it was assembled to the vehicle. Presumably, this coupling was also shipped as part of the steering gear from SSG to the Assembly Plant.

The 1967 model year began production with coupling P/N 5699250 which had several changes from previous years. In 1967 the collapsible steering column was introduced and Saginaw Steering Gear became the sole source of Corvette steering columns. This change meant that one steering coupling could again be used for all Corvettes regardless of whether they had a standard or telescoping steering column, manual or power steering. This remained true for all Corvettes from 1967 through the 1982 model year, only one steering coupling was needed regardless of the options purchased.

In 1967 the 5699250 coupling was introduced with a rivet using a 3/8 diameter pin that was 0.63" long. The 0.63" length was changed to 0.83" in August of 1967. The longer pins were introduced as it was possible the body of the car could move relative to the frame of the car stretching out the flexible steering coupling. The longer pins maintained engagement between the flanges. The 1967 steering coupling also went back to a combination of rivets and bolts to hold it together. The bolts both had ½" hex heads, and 7/16" shoulders for the flexible disc, but the threads differed. The smaller thread was 5/16-24 UNF and the larger thread was 3/8-24 UNF. Normally, this would mean two different size hex nuts would be used. However, GM used a 5/16 heavy hex nut which has the same 9/16" hex as the 3/8" standard hex nut. GM also used a light copper plating to change the torque /tension relationship of the 5/16" thread. This allowed the assembly plant to use a single tool set to a single torque and induce the correct tension in the different size threads. A split lock washer was used under each nut.

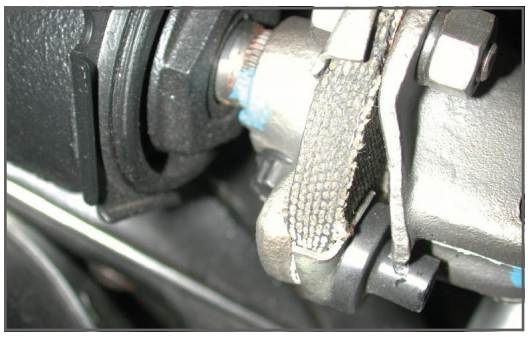


1967 hex shoulder bolts used on coupling number 5699250 as used at start of production

When the rivets were changed to a longer head extension, an extension of 0.42" diameter by 0.56" high was added to the hex bolts. The rest of the dimensions, nuts, washers and copper plating stayed the same.

Hex bolts with extended heads as revised on coupling 5699250

The short rivets for 1967 also used a rubber rivet cap P/N 7800470. This cap was removed from the 5699250 drawing in March of 1967. This could have been a running change in the 1967 model year, or a change for start of 1968 production. More observations and research are needed.



1967 Corvette with 7800470 rubber rattle cap installed over the rivets

The collapsable steering column also introduced a larger 1" diameter steering shaft with a 48-count spline for 1967. This change required a new flange for the steering shaft side of the steering coupling. This new casting was P/N 7807000 (again only relevant as to the SSG casting). This casting number has been seen with two somewhat different cast shapes, but the functional surfaces are identical.

Shape 'A' of casting 7807000

Shape 'B' of casting 7807000

Shape 'A' of casting 7807000

Shape 'B' of casting 7807000

Splines as used on C2 Corvette steering couplings:

C2 flanges used from 1963 through 1966 were all ¾" diameter with 36-count splines. Spline count in this article refers to how many splines would fit around the full 360 degree diameter.

The earliest flanges in 1963 had serrations all around the inside diameter to fit the shafts. Saginaw Steering Gear determined that full serrations would actually prevent the flange from wrapping as tightly around the shaft as possible. For this reason, they eliminated some of the female splines in the flange machining. The number of splines eliminated did vary over the years and this author has seen flanges with all splines machined, a few missing, several missing and half of the splines missing. The shafts themselves were always fully splined and the male splines would embed themselves in the female casting enough that when removed, the casting may look at first glance as if it was machined with full splines. Extensive testing must have been done before these different connections made it to customer vehicles. This author believes the number of female splines is unimportant if the correct pinch bolt (GM P/N 5686553) is installed and torqued to 25-35ft-lbs.

Two different C2 flange castings with different numbers of splines C2 Copper ground straps

The ground strap on the left in the picture below is an accurate reproduction of the part used in the 1963-1966 non-tele steering coupling P/N 5690809. The middle ground strap is another reproduction part that appears to be a later design. The tabs in the smaller diameter hole would allow improved contact with the bolt threads. The indentations around the larger hole would create improved contact with the rivet. This ground strap has been seen in a production 1967–1968 coupling P/N 5699250.

The ground strap on the right is another reproduction part that appears to be made of a heavier gage of material than the others. This author has not seen this design of ground strap used in an original production steering coupling. This may have been either a Corvette production part or a service part more observations and research are needed. These ground straps are all notorious for breakage or corrosion causing an inoperable horn.

Original 63-66

Available Reproductions

Original 63-66

Paint on C2 Couplings:

Almost all of the C2 steering couplers seen by this author have had black paint on both of the flange castings. The coupling half attached to the steering gearbox was attached by Saginaw Steering Gear prior to shipping the components to the Assembly plant, while the Steering Shaft Flange was installed by the Assembly plant.

Some Saginaw Steering Gear drawings do not call for black paint while others do. If the steering box is painted, at least the steering box half of the coupling should be painted, and if the steering box is unpainted, the steering coupling should be unpainted. It was also possible for steering couplings to be partially painted during the blackout process. As any combination of these conditions could be considered correct, this issue also needs more observations and research as of this writing (July 2024).

C3 Steering Couplers:

In 1968 the P/N 5699250 coupling was carried over from the previous model year. This was the

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revised version with longer pins and hex bolts with extended heads. The 5/16-24 and 3/8-24 threads remained along with the copper plating, lock washers and 9/16 wide hex nuts. In 1969 Corvette production began with a new steering coupling P/N 7806391. The 7806391 drawing was released for production in March of 1968, in April of 1968 plastic alignment spacers were added. Mr. Jim Shea related in an NCRS Technical Discussion Board post that "As I recall the rubber "boot" type parts that went on the rivet stop pins were used in 1967 (and maybe 1968) to eliminate rattle between the flex coupling pins and the column flange. I think that they found that if they used the plastic alignment spacers and followed the mandatory steering column assembly instructions in the AIM the rubber boots were not needed." In a separate post Mr. Shea mentioned the alignment spacers again 'One month after the alignment spacers were added to the flex coupling drawing the following note was also added. "These spacers are for alignment purposes only and must be removed after final assembly with mating flange. Pins must not contact upper flange in either radial or axial direction after assembly."

This author gives great weight to the statements of Mr. Shea as he was the Saginaw Steering Gear Engineering Supervisor responsible for these parts at the time.

Another change was made to the pinch bolt. In July of 1968 Pinch Bolt 7807271 was released. This bolt was the same part as the bolt originally released in 1957 with the addition of a yellow nylon locking patch. This patch was added so that the bolt could not be installed 'finger tight' and appear to an inspector as if it had been tightened with a wrench. The line worker could no longer turn the bolt all the way to the point of contact unless a wrench was used.

Late in the 1969 model year, there were more changes to the Steering Coupling, when Coupling and Flange Assembly 7808553 was released. This time a flat was added to the steering gear input shaft. This flat was added as an assembly aid, and as a safety feature. The assembly was improved because the part could only go on in one orientation. Even if the flange was loose and the splines were completely stripped, the flats on the flange and mating input shaft would still allow some ability to steer. Another change at this time was the spline count on the steering gear input spline. This changed to 30 splines in a full 360 degree circle. Full diameter flanges will not fit shafts with a flat because the splines do not match. The steering shaft remained a 1" diameter with a 48-count spline. The 7807000 steering shaft flange first introduced with the collapsible steering column in 1967 remained until the end of C3 production in 1982.

The flange on the left is a 1967-1969E part with a full 3/4" diameter and a 30-count spline. The flange on the right is a 1969L-1982 part with a 3/4" diameter with a flat and a 36-count spline. Another late 1969 change was the addition of the 'capturing strap reinforcement'. This strap went under the bolt heads and over the flange for the steering gear input shaft. When this capturing strap was added, it was no longer possible for relative motion between the vehicle frame and body to 'pull apart' the steering coupling. The last change is the one piece reinforcing plate. The new reinforcing plate has a center section that creates a depth stop for installing the coupling to the steering gear.

At this time, there is still some uncertainty as to how late in 1969 production these changes were made. Corvettes with a September 1969 build date are known to exist that were assembled with the 'early 1969' steering components.

For the 1970 model year, Flange Assembly 7808553 was used from the previous model year.

Flange Assembly 7808553 was also used for the start of 1971 production. In Feb 1971 the grounding strap was eliminated and replaced by a wire mesh laminated to the rubber disc. Steering coupling 7813351 was the first production Corvette steering coupling to use the wire mesh grounding method. As the wire mesh grounding method is more reliable and less expensive, this may have been a running change for 1971 rather than a 1972 production start.

C3 Steering Coupling with capture strap and wire mesh grounding method

For the 1972 and 1973 model years, Flange Assembly 7813351 was used from 1971.

Flange Assembly 7813351 was used for the start of 1974 production. In November of 1973 Flange Assembly 7818568 was released for production. The only difference noted between this part and 7813351 was the washers that capture the bolts prior to final assembly. This would make these two parts appear identical from the outside. For this reason it is difficult to say when this coupling actually entered production.

Flange Assembly 7818568 was used for the start of 1975 production. At some point during 1975 production, Saginaw Steering Gear determined that the capturing strap would prevent the steering coupling from being pulled apart and the extended heads on the bolts were removed. For the 1976 through 1982 model years, Flange Assembly 7818568 was used for Corvette production.

The final change this author is aware of was made to the 7807271 pinch bolt in 1980. At that point a chart was added to the drawing. The chart specified a second color for the nylon patch now either yellow or red would be used depending on the manufacturer. The chart also listed head markings for the manufacturers who produced this bolt. The head marks listed are 'M', 'N', 'O' (with a line through it), '-', 'E' and 'P'

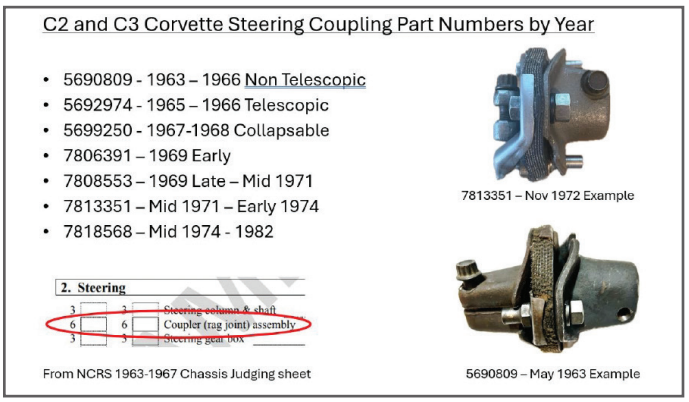

Chart courtesy of Jim Williams

Steering Coupling Service Parts:

Per a comment from Jim Shea, the paint daubs on the formed ends of the rivets was not done on production couplers until the late 1970's (actual date is uncertain). This indicates that for all C2 and early 70's C3 Corvettes, only service couplings would have this paint mark on the rivet not the parts that were used for production.

Different paint colors were used on the C2 flexible rubber discs to identify the various types, but again only on service parts. As mentioned earlier, all Corvettes used 7 ply discs. The paint has been seen fully covering one side of the disc, or as if the paint had been allowed to drip on one side of the disc leaving colored stripes. This color code was also used on C3 service couplings. The colors used were as follows:

Yellow Paint - 7 ply disc without screen
Purple Paint - 4 ply disc without screen
Orange (Red) Paint - 7 ply disc with screen
No Paint - 4 ply with screen

Steering Couplings that were sold as service parts may be identified by the color coding on the face of the rubber disc. The practice of Saginaw Steering Gear was to adopt production improvements for service parts as time went on. For example, steering couplings made as service parts for C2 and C3 cars that originally had copper ground straps were produced with the wire mesh grounding method after the wire mesh was introduced into production parts in 1971. To assure fitment, the flanges and machining stayed the same for service parts, but everything else was updated to the latest production version.

Three different service Steering Couplers – The one on the left is NOS and never installed. The one in the middle is a C3 with a one-piece reinforcing plate. The one on the right is a C2 with a wire mesh ground (introduced after 1971). Note paint on discs and on formed rivet heads

The information gathered here is from my own experience working with C2 and C3 steering couplings and the posts of several gentlemen on the NCRS Technical Discussion Board. Most often Jim Shea, Joe Lucia and Gary Ramadei but there are many others. The importance of these posts to this article cannot be overstated and I am grateful to NCRS for the Technical Discussion Board. The posts on the NCRS Technical Discussion Board are an exceptional resource for most any question you might have. If you need help with your Corvette, or you have an interest in writing an article for the magazine, it's a great place to do research. Hopefully, readers of this article will chime in with any information they may wish to offer. I know there is much more to be learned regarding these parts and the NCRS community is full of very knowledgeable members.

To that end I can be reached at tkrause@engineeredspares.com and your feedback on any facts presented in or omitted from this article would be greatly appreciated.