RODDIN' & RACING

THE ABC'S OF ROD ENDS

BY JOHN DiBARTOLOMEO

When you come right down to it, the only thing holding the rear end assembly in your car are usually just the rod ends on the end of your four-link or ladder bars. Should one or more of them break, chances are you're in for quite a ride. And when you think about it in those terms, shouldn't you be more careful when it comes to maintenance and replacement of those rod ends?

And while you're at it, rod ends are used in a number of other areas such as carburetor and shifter linkage, which require as much inspection and worry as anything else. However, it's important to know the differences between the various rod ends along with where and why they're used.

The S&W Race Cars catalog lists five different styles of rod ends available and commonly used in race car applications. From two-piece commercial to three-piece precision and one-piece solid ends, there are different material grades that can handle low loads to very high load applications. This is up to the end user or race car builder to determine what will be the best for their application.

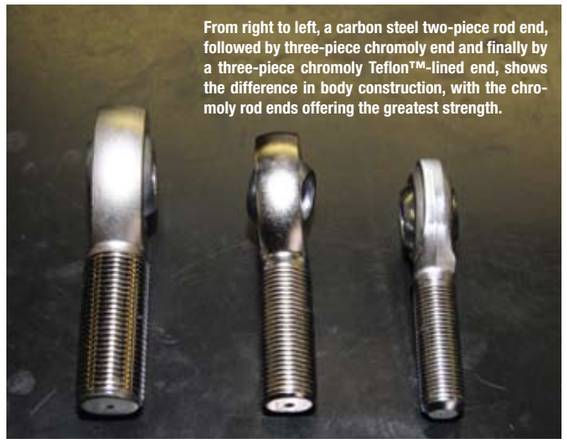
Rod ends come in many different styles, which should be matched to the intended use. A little bit of knowledge can go a long way in this case.

A two-piece rod end consists of a ball, which is installed into a body after which the body is swaged, or cold-formed around the ball to hold it in place. These ends are available in both a carbon steel and chromoly.

A three-piece rod end uses a ball and bearing assembly, which is pressed into a body and then the bearing is cold-formed to hold the assembly in place. These rod ends are available with a Teflon insert (left). The Teflon keeps dirt from getting in the rod ends and helps keep the rod end tighter.

A Teflon™-lined rod end held in your hand takes quite a bit of force to move the ball. However, when it's in the car in a loaded condition, there is less amount of friction required to move the rod end than a metal-to-metal rod end.

A solid rod end can be used only in areas where there would be no angularity change, such as in the rear of a set of ladder bars.



From right to left, a carbon steel two-piece rod end, followed by three-piece chromoly end and finally by a three-piece chromoly Teflon™-lined end, shows the difference in body construction, with the chromoly rod ends offering the greatest strength.

Knowing the differences between rod ends and where they're used is useful information. Rick Jones says, "A two-piece carbon rod end will work fine on a set of wheelie bars for a sportsman-type car, but in a Pro Stock or similarly powered car, it's necessary to use a high quality chromoly end or else they'll break."

A rod end is designed to operate in both an oscillating and axial motion and uses a spherical bearing mounted in a body.

A two-piece rod end is comprised of (big surprise) two pieces, the outer shell or body and an inner ball. The body is manufactured, after which the ball is inserted and the body is swaged, or cold-formed, to encapsulate the bearing.

Steve Audi of FK Rod Ends, a manufacturer of rod ends used in our sport along with a supplier to S&W Race Cars, says, "A two-piece rod end is a low cost alternative compared to a precision grade. It offers high load characteristics without the high costs. The chromoly version can handle higher loads and both the low carbon or alloy heat-treated versions come in metal-to-metal or PTFE (polytetrafluoroethylene), or the more commonly used DuPont trademarked name Teflon lined. Two-piece rod ends tend to have more initial play, but can handle a larger load in the axial direction due to the increase in swaged material around the ball."

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A three-piece rod end is composed of a body, ball and a race. The race and ball assembly is staked or mechanically locked into the body, giving it a better bearing surface compared to a two-piece style. Audi says, "The 3-piece rod end has a larger bearing surface giving it better wear over time. These are offered in both metal-to-metal or Teflon™ lined."

Teflon does offer an advantage over metal-to-metal because it's self-lubricating and has the lowest coefficient of friction. There is virtually no play between the ball and race. This is an advantage because dirt or any other contaminants will be wiped away before it can enter the bearing surface. A metal-to-metal rod end will have to be lubricated and will attract dirt.

Scott Weney of S&W Race Cars said, "We typically recommend the Teflon™-lined rod ends for use on street machines. They tend to be less harsh riding then a metal-to-metal joint, but we have run these on some race cars as well."

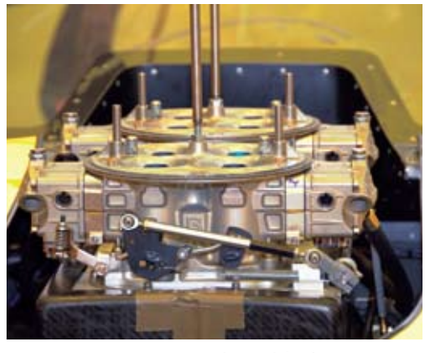
It's interesting to note that most all of today's Pro Stock cars utilize a Teflon™-lined rod end. A Teflon™-lined rod end eliminates any clearance between the ball and the race or body, offering a snug and tight fit to the rod end. While a Teflon rod end held in your hand might seem to take quite a bit of force to move the ball, when it's in the car in a loaded condition, there is a less amount of friction required to move the rod end than a metal-to-metal end.

Rick Jones of Quarter Max and RJ Race Cars said, "The Teflon keeps dirt from getting in the rod ends and helps keep the rod end tighter."

There are two numbers by which a rod end is rated. One is the radial load, which is the load applied to the bearing bore axis and parallel to the shank axis. The other is the axial load, which is the load applied along the bearing bore axis. In most drag race applications, there will be no, or very little, axial load, which is side loading of the rod end. In a four-link suspension, there can be a very slight amount of side loading, but in most cases, radial loading will always be more predominant.

That fact changes somewhat when rod ends are used in a steering application where changes in angularity can affect the load characteristics of the rod end.

The radial load of a 3/4" by 3/4" two-piece low carbon rod end is 14,290-pounds. A three-piece chromoly rod end in the same size has a rating of 28,090. What this means is if you were to pull the two-piece carbon rod end with a force of 14,290-pounds, it would break. The same for a chromoly end at 28,090-pounds. The amount of load on a rod end in a static condition such as when the car is sitting still will usually be fairly light. In the case of a four-link suspension where there would be eight rod ends, it would simply be the amount of weight on the rear end of the car divided by eight, although there would be some variables such as bar angles, pre-load, etc., to take into account. However, you can easily see where the load number would be on the light side.



Today's race cars use rod ends in a variety of places, such as this carburetor linkage where a carbon steel two-piece rod end will suffice due to the small amount of tension in that area.

Most rod ends are out in the open, especially in a dragster, meaning they're susceptible to dirt and the elements. Race tracks can be a dusty environment and for this reason, it's important to inspect and clean your rod ends on a regular basis. Should dirt or dust build up between the actual bearing surfaces, it will promote wear.

Something to bear in mind though is that the recommended operating load should be anywhere from 10- to 30-percent of the rated load. This would mean that a chromoly rod end rated at 28,090-pounds shouldn't see more than 2,800- to 8,000-pounds of load. This is a safe operating limit.

However, all of that changes when the car starts moving. The highest load would be when the car leaves the starting line under power. Here's where the amount of load becomes a lot harder to calculate as engine torque, car weight, tire size, traction, etc., are just some of the variables which affect the end result. While there might be some mathematical or engineering calculation to ascertain the amount of force placed on a four-link bar, the most precise method would be the use of a strain gauge on the bar itself and hooked to a data logging unit, although in our inquiries, this hasn't been done as of yet.

In most cases what you'll find is the load placed on the bar is far less than the radial load limit of the rod end. In fact, depending on the size and type of material the four-link bar is manufactured from, in most cases the material will fail before the rod end does.

Does this mean there is no reason to purchase a more expensive rod end? Absolutely not. As we mentioned earlier, in most cases the rod end is your only connection to keeping your rear end in the car. In a steering application, it's what keeps the wheels connected to the steering. With all that you have invested in your car, can you really afford to cut corners here?

Why then, in the case of a four-link rear suspension, do we continue to use a relatively large 3/4-inch rod end when a smaller one will suffice for the load anticipated? More than likely it's a case of what's been used for years and has worked.

John McCrory of Aurora Bearing said, "In the early days when four-link suspensions were coming into play, we certainly didn't have the quality of rod ends available today. A smaller precision rod end today does have as much, if not more, radial load capacity as the carbon rod ends used 20 or 30 years ago. But I think the sizes used today are due to continuity in maintaining traditional tube and bracket sizes. However, chassis builders have been going to larger diameter tubing to construct four-link bars in an effort to cut down on flex. This is much the same theory as the larger pushrod diameters used today. Four-link bars can be found in diameters ranging from 1-1/4-inch on upward. Certainly a smaller rod end could be installed, but there still is a need to have a threaded bung in the tubing to accept the rod end. When you look at it from a cross-sectional area, you may as well use a 3/4-inch rod end."

Today it's not uncommon to find most four-link suspension systems using a rod end with a smaller bore (5/8- or 1/2-inch) than the shank. This is done in an effort to place the adjustment holes closer together to allow a racer greater control over suspension tuning, as well as offer more access for wrenches and sockets.

Rod ends might seem to be simple, but in today's world of high tech equipment, mega-inch motors and high horsepower cars, we've come to learn just how important they are. ***DRA***

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