Universal Joints

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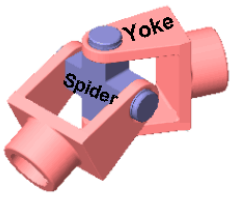
From time to time I experience a situation where the name of someone or something that I have not thought of in decades comes up, out of the blue, twice in quick succession. That happened to me recently in regard to Robert Hooke. I haven't thought of Robert Hooke since 7th grade physics class where I learned Hooke's Law concerning coil springs. I can still recite it today, "Hooke's Law states that a spring will stretch to an amount proportional to the force causing the extension".

Just a few weeks ago, Hooke's name came up when a radio program reviewed a new biography of him. It turns out that the English physicist Hooke (1635 –1703) was a much underrated. Besides expounding on springs, he was one of the first to understand the value of the microscope, he redesigned metrological instruments such as the barometer, anemometer, and hygrometer, so that they are usefully accurate and he invented the camera iris, the anchor and balance wheel used in watches and the universal-joint (U-J), that we all have in our MGs, and which is sometimes called a Hooke's Joint.

A couple of weeks later I was reading the Chicagoland MG Club journal *Driveline* in which Tom Sotomayor had written an article about U or Hooke's joints, so there was Mr. Hooke's name coming up again. As it turned out, I was grateful to Tom for his article which reminded me that a single U-J is not the best transmission system for transmitting motion in a non-straight path.

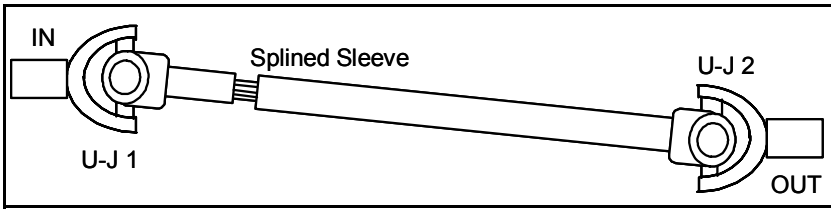


As you probably know, the drive shaft from the back of the gearbox makes the connection to the rear differential and onward to the back-axles and wheels. Because the back-axle is usually somewhat lower then the tail of the gearbox and moves up and down with the rear suspension, some means is needed to transmit the power along this constantly varying crooked path. The U-J provides the method, but it is not by any means a constant velocity joint. If its output shaft is at any angle other than straight, every half revolution its output will speed up and slow down relative to the input. In fact Tom's article includes a graph that shows that at a 30° angle, the input to output speed will be from 87% to 115%.

In practice, the situation is not nearly as bad as that. Two U-Js are invariably used and if the gearbox tail shaft and the differential input shaft are parallel, the varying speed of one U-J will cancel out that of the other. Moreover, on a vehicle like an MG sports car, with a low slung engine and relatively large wheels, the engine and differential are almost in-line and the angle of the driveshaft, on the MGB for example, is only about 4°. However, Tom Sotomayor reckons that about 75% of the vehicles he sees have the U-Js misaligned, so that instead of canceling the speed error, they add them together, with the result that that the car goes along the road pulsing or throbbing as the wheel speed constantly varies. Any apparent throb is mild with only a 4° offset. I calculated that traveling at a nominal speed of 60 mph with the U-Js 90° misaligned, the speed would vary from 59.7 to 60.3 mph. Even if this small variation, which occurs twice per shaft revolution, is imperceptible to you, the drive train components will be under duress as they experience constantly reversing impact loads.

The drive shaft needs another variable connection and that is a sliding splined sleeve that allows it to grow and contract as the distance between engine and back-axle varies under changing suspension height. Unfortunately, that spline can be easily reassembled at a number of angles and cause U-J misalignment. Tom Sotomayor's article prompted me to check the U-Js on my running MGB, especially since I had some problems with the tail end of my gearbox last year. Sure enough, they were exactly 90° wrong — as bad as you can get — although I knew I had thought about the alignment when I replaced the U-Js about 3 years ago. The problem occurred because I consulted an incorrect exploded view of the drive shaft in the Haynes Repair Manual; had I flipped the page I would have seen a correct alignment drawing. Those club members with Spridgets (other than the 1500 cc) need not bother to check the drive shaft because it is solid, the splines being on the back of the gearbox, not on the shaft, so the U-J yokes cannot be moved relative to one another.

Maybe it's my imagination, but I reckon my MGB runs much more smoothly now.



Time to check your driveshaft? The correct relative orientation of the yokes is shown here.

Rick Astley

U-J Error Chart Available

For the purposes of producing the article on page 1 concerning Universal Joints, I created a spreadsheet to calculate the error as the shaft rotates both for different shaft angles and relative positions of the front and back U-Js. It produces tabular and graphical representations of the error for the first U-J and the final effect of both U-Js in combination.

Although I did this for my own interest, I have made it user friendly. If you are interested you can download it from www.wdmgc.com/uj.xls

Rick Astley