## Steering Boxes

*by Tom Mason*
*Minnesota AHC*

I received a letter from Emmett Grizzell of Sparta, NC. Mr. Grizzell was thoughtful enough to include some stamps for a return reply—that was very considerate. Mr. Grizzell wanted to know about steering box repair. Here's my reply to him.

First, I would try to get a new steering rocker shaft or one from a junkyard that is good. I believe that chrome plating would be too expensive. I even looked at having that shaft sputtered with a plasma torch. It's possible that a machinist could take a light cut off the shaft as the bushing is oversize.

I found that a machine shop will hone or ream the bushing to fit for a very nominal fee. The fit has to be very good. There are washers under the steering rocker shaft that have to be adjusted for the fit of the peg. This adjustment borders on being an art. There's a guy in England who did this for a living; I wish I could talk to him.

Healey Surgeons, Fourintune, and Norman Nock will all service a steering box if you mail it to them. They charge about $150 to refurbish a gearbox. If you are a good mechanic you can try to set it up yourself. For a lot of the owners, sending the box in may be a good bet. Take your pick.

I finally got a shaft from a boneyard and had a machinist hone the bushing to fit. I set the box up where I thought it was right; I had the whole box in a vise where I could turn it and check the way that it worked. Don't overlook tie rod ends and other suspension parts that could be loose. Check your shock absorber bolts and the bolts on the front spring plate, too.

Sometimes I think that we all should convert our cars to rack and pinion with a safer steering absorbing unit. The cars probably will need dual brakes, too. If we want to keep driving them in the next century, it is something to think about.

HEALEY TECHNICAL

# SWAY BARS

**Jim Hockert**
**Dallas, Texas**

## What is a sway bar?

A sway bar — also known as an "anti-sway bar" or "anti-roll bar" (ARB) — is a device that is attached to the front or rear cross-beam of the chassis of your car at two points along the bar and is attached to the suspension at each end of the bar. The bar is a round section that is shaped like a "U" with an elongated center section.

The center section attachment points along the bar are installed with bushings that permit the bar to rotate in its mountings. The end attachment points are fixed with joints that permit the ends of the ARB to move in an arc as the suspension moves up and down.

## What does it do?

The ARB performs several tasks:

1. It acts as a torsion spring so that when the coil suspension spring on one side of the car is compressed, the bar rotates in its mountings and compresses the coil suspension spring on the other side of the car (front suspension);

2. It transfers load from sprung weight to unsprung weight;

3. It reduces weight/load on the unladen wheel and tire (the inside tire as a turn is being made);

4. It can lift the inside wheel and act as a droop limiter in a turn if the ARB is oversized;

5. It reduces body roll (sprung weight roll);

6. It changes the angle of the load on the primary laden wheel; and

7. It can affect the location of the roll center of the car depending on the suspension design.

## What the ARB does not do:

1. It does not change the center of gravity of the car either in static or motion conditions;

2. It does not change the instantaneous centers of the suspension components;

3. It does not substitute for properly set up shock absorbers and springs; and

4. It has no effect on longitudinal load transfer.

## How does it work?

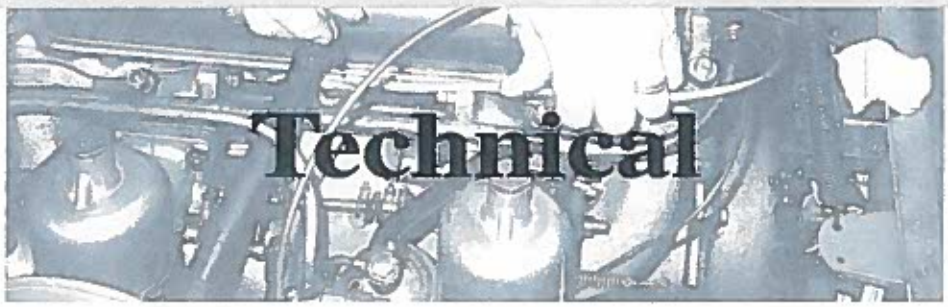
When driving the car in a straight line and encountering a bump that is equal to both tires (like a speed bump), the ARB performs no function. The bar rotates in its mountings as both wheels move equally up and down.

If only one wheel encounters a bump, the ARB comes into play. As the bump in the road causes the suspension spring to compress, the bar tries to rotate in its mountings but is resisted by the spring on the opposite side of the car. This action has the effect of making the spring that is absorbing the bump stiffer. The action also transfers a portion of the sprung mass load (the car chassis, engine and body) that is being lifted by the bump over to the suspension components on the opposite side of the car. Since the suspension is unsprung weight, there is a transfer of sprung weight to unsprung weight, which in extreme cases can result in wheel hop.

The same effect occurs when the springs compress as a result of body roll.

When the car is in a turn, many more factors come into play. By limiting the roll (sway) of the sprung weight, the ARB alters the load center over the laden wheel in a turn. This can be either good or bad. The goal is to center the load over the center of the tire by matching sprung weight roll with the effective camber at the time of the turn. Of course, the wheel camber is changing constantly as the driver steers the car and as the wheels move up and down in response to road irregularities. Because the front suspension has castor built into its design, camber changes as the wheels are turned in and out. In addition, camber changes as the wheel moves up and down.

By adding the ARB, we are trying to control the load center over the tire while all the camber motion is happening. If the ARB does not locate the center so that the average is over the center of the tire, grip on the road will be diminished. Thus, the ARB can be too big or too small and must be matched to the car design, weight and suspension set up.




## Solving Healey Ground Clearance

***By John Lore***

I have often read about the propensity for Healeys to suffer from very low ground clearance. I felt that with the new suspension parts I installed during the restoration of my Austin-Healey BN7, including the front and rear springs, that my car would certainly be the exception. Of course, I was wrong. I quickly realized my car was scraping the muffler on the ground.

Later, when I took the car on an extended highway tour, I noticed the car would bottom-out going over uneven highway pavement. At high speeds this can be very annoying and even dangerous. Still, I wasn't convinced that my car was sitting any lower than factory specifications. So I brought out the workshop manual, a ruler and a pencil.

What I found in the workshop manual under *"General Data/Dimensions"* was that the AH 100's ground clearance should be 5½ inches. The MKI and MKII models were listed as 4⅝ inches. However, it didn't say where those measurements were taken.

Reading on, I discovered the AH 100's approximate weight (with overdrive and wire wheels), was listed as 2,436 pounds. The MKI and MKII models were listed as weighing 2,460 pounds. I thought the six-cylinder motor would've added considerably more overall weight to the car than just 24 pounds. The minimal weight difference explains why there is no variance in the springs between the two models.

Before taking measurements I removed anything I had placed in the trunk. I also verified that the correct tire pressure was indicated on all four tires. With that done, I began taking measurements. From the front brace to the garage floor I measured 4⅛ inches. Next, I measured from the oil pan to the garage floor and got a distance of 2 15/16 inches (that explains why I had to straighten out the oil pan during restoration).

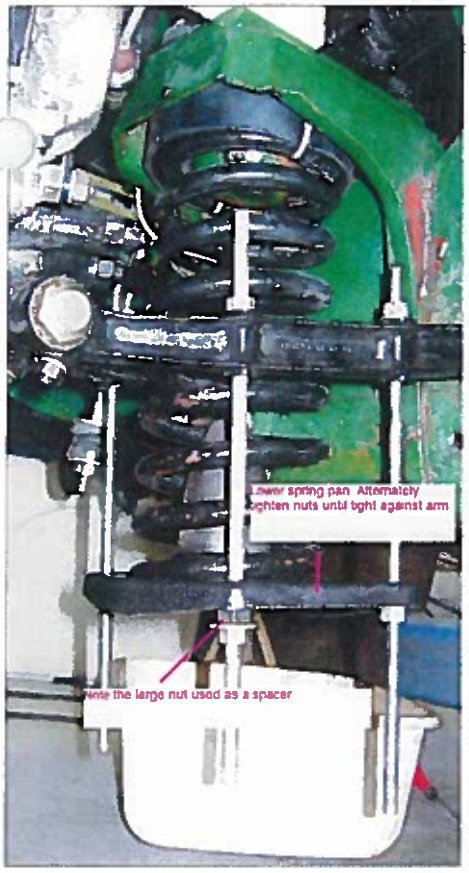
Continuing on, I measured from t muffler to the ground and got a distance of 2 11/16 inches. By the way, I replaced the original muffler with a stainless steel exhaust system. Finally, I measured from the rear brace to the floor and got a distance of 6⅜ inches. I now realized something had to be done to raise the car to an acceptable level.

First I asked some Healey experts for guidance. I was told having the springs heated, stretched and re-arched would raise the car. But then I worried about the accuracy of the results. I wouldn't want my car to be higher on one side than the other. Nor did I want the car to ride like a buckboard. And to be honest, I didn't want to spend much money.

Another alternative was to replace the 165R15 tires with a taller tire. But I don't need new tires. My friendly NAPA auto parts dealer suggested adding front coil spring boosters. These rubber circular devices are grooved to fit the coil springs and can be placed on the top or bott of the springs. They only cost $15 each and can be installed at home. The NAPA part number is #1285 and they are made



*Left: Before installing booster. Above: After booster has been mounted.*





***Left:** Going up. **Above:** Everything back in place.*

Mr. Gasket. They advertise a net thickness of one inch. But when installed on the springs and compressed, I figured about ¾ of an inch rise would be realized.

I began installing the boosters by first chocking the rear wheels, engaging the emergency brake and placing the car in second gear. I lifted the front of the car up and placed jack stands under the frame rails. Next I removed the wheels. The shop manual suggests placing two-inch spacers under the front lever shock absorber arm (opposite the rubber bump stop), to help keep everything at near normal height. You'll have to raise the assembly to do so. I placed a bottle jack under the lower spring pan and found I could easily raise the suspension up enough to slip in the wooden blocks I had made.

Now with that done you're ready to remove the coil springs. Earlier in my restoration I made a set of coil spring movers. I purchased two 24-inch lengths of 3/8-inch diameter all-thread (coarse thread), at least eight 9/16-inch nuts and washers (all should be available at your local hardware store). Cut the all-thread in half and you'll have four 12-inch long bolts that are plenty long enough for our use.

To begin removing the springs, remove the two opposing bolts on the lower spring pan and replace them with the 12-inch rod. Attach and tighten the washers and nuts. On the lower end I found it useful to put a spacer between the pan and the washer/nut. The reason being, it allows a 9/16th inch wrench to rotate without hitting the spring pan. A large nut works well enough. I only used two lengths of all-thread to remove the coil springs. But I needed all four to install the spring.

Now, remove the other two bolts on the spring pan until only the two all-thread bolts are holding the spring pan in place. Begin alternately loosening each lower nut until there is no more tension. At this point the coil spring can easily be removed. Place the coil spring booster on the spring. I put the booster on the top so it'll be less noticeable. I also placed two plastic draw ties on the booster to hold them in place. You'll have to cut the booster where the two ends meet. They cut fairly easily using a sharp knife. Now you're ready to replace the spring.

Attach all four all-threads to the arm leaving the nuts/washer/spacers off the lower end. Slide the coil spring (with the booster attached sitting in the lower spring pan) onto the four all-threads, and while holding all in place, attach one spacer/washer/nut onto the lower spring pan. Now attach the other three-spacer/washer/nut combinations and begin tightening until the spring is firmly in place. At this point you can begin replacing the all-thread bolts (one at a time) with the proper bolts/washers/nuts you removed earlier.

After completing both sides, you're ready to lower the car. Don't forget to remove the wooden blocks placed under the shock arms. Does the car look like it sits a little higher? Let's go for a ride around the block to let everything settle down.

I found I could drive over my driveway curb without scraping. The ride seems a little firmer, but not jolting. After a short drive, I'm now eager to re-measure the ground clearances.

From the front brace to the garage floor, I now measure 4 7/8 inch, versus 4 1/8 inch previously, a ¾-inch difference! Eagerly I move on.

The oil pan to the floor was a whopping 3 5/8 inches – almost another ¾-inch gain in height. The all-important muffler-to-the-floor distance was 3-1/8 inch, which was only 7/16th inch higher, but I'll take it. The rear brace to the floor distance was 5 7/8 inch, a little lower, but remember you in effect raised the whole front of the car.

All in all, for the little time and money I spent, I'm very satisfied with the results. The car still rides great and I can now drive over uneven pavement without worry about bottoming out. Will the rubber coil spring boosters last? I don't know. I do know you can spend a lot more money for spacers made of aluminum, that in effect do the same thing. Maybe a fellow reader can offer other alternatives. Until then enjoy your Healey.

# OVERDRIVE

*By Steve Jekogian*

The weather has been great this spring and the car show circuit is in full swing. I am sure you have been to the shows checking out both the "regular" cars as well as the "fresh out of the body shop" jobs. And because we are who we are, I'm sure that whole comparison thing is going on in your head -mine is cleaner, mine is a driver, he just paid "what" for that paint job etc.

What always catches my eye is the underside of the car-has it been cleaned up and especially the easy to see areas like the front suspension. The front springs, shocks, wishbones and other related front suspension hardware is very visible and really takes a beating from stones, road grime, grease, motor oil brake dust, you name it. In addition, there are so many "nooks and crannies" in that area to catch and hold dirt it is hard to keep clean. Or is it? This months Flash, easy to do Saturday project, is all about cleaning up and painting the front suspension and it is easy to do, you need only limited tools (a socket set and a 9/16 open end) and of course some gloss black paint.

The design of the Big Healey is unique because it has a "built in spring compressor" which makes the job of taking apart the front end easier. Four things to buy 1) a can of Gunk, 2) black gloss paint and a small 1 inch brush, 3), 2 feet of threaded metal 3/8 rod, 4) 6 nuts and a couple of washers for the rod.

1) Gunk the front suspension, it is always better to work on a "clean machine".

2) cut the threaded rod to 2 lengths of 51/2-6 inches long and put 2 nuts on one end and tighten them together

3) jack the car up, put a jack stand under the frame and remove the wheel

4) Undo the sway bar link on the suspension and check the rubber bushings, if bad replace them.

5) A WORD OF CAUTION --WITH THE SPRING UNDER TENSION YOU CAN NOT REMOVE THE SHOCK BOLTS UNLESS YOU HAVE A JACK UNDER THE OUTER EDGE OF THE SUSPENSION - UNDER THE KING PIN.

6) To remove the spring, locate the four bolts and nuts that hold the lower spring plate on -2 front and 2 rear. Remove 1 nut and bolt from the front and insert the threaded rod from the top --double nuts up and tighten the single nut up from the bottom Helper a very deep 9/16 socket makes this a lot easier. Remove one bolt diagonally from the rear of the spring plate, put the other threaded rod in, and tighten up.

7) Now remove the two original spring plate bolts and nuts, and slowly and evenly unscrew the bottom nut off the threaded rod. As you do the spring plate will lower and the spring will uncompress.

8) Sometimes you have to jack up the outer suspension -under the spindle or kingpin to allow the spring plate to clear the frame rail. You will see.

9) Now (After the spring is out) remove the bolt holding the shock arms to the spindle -sometimes loosening the bolt connecting the two shock arms together helps it come off the spindle bushings. Check these bushings for wear/distortion and replace if necessary. Remove the four shock bolts and out it comes.

10) Clean up everything and paint it black. The springs were black but also had color codes on them in the factory see list below. For example, late 3000 have had red and white strips painted on them. According to the concours guidelines "the strips were about ¾ inch wide and sloppily painted as if someone just took a brush an drug it over the spring". You might not be going concours but why not make it as it was. Shocks were also black and BJ 8 shocks were color coated with a brown and white dot of paint on the top.

11) Installation is simple, shocks in first, then the spring and spring plate and DO NOT FORGET THE SWAY BAR PLATE - the hole goes close to the frame. Insert the threaded rods in and slowly and evenly tighten them up-watch

out that the plate does not hit the frame rail. Use the jack if it does. Once tight, insert the original bolts with the long ones in front because of the added length of the sway bar plates.

12) Sometimes you have to tap the spring plate around to get the bolt to go through

13) Attach the sway bar, and grease all the fittings.

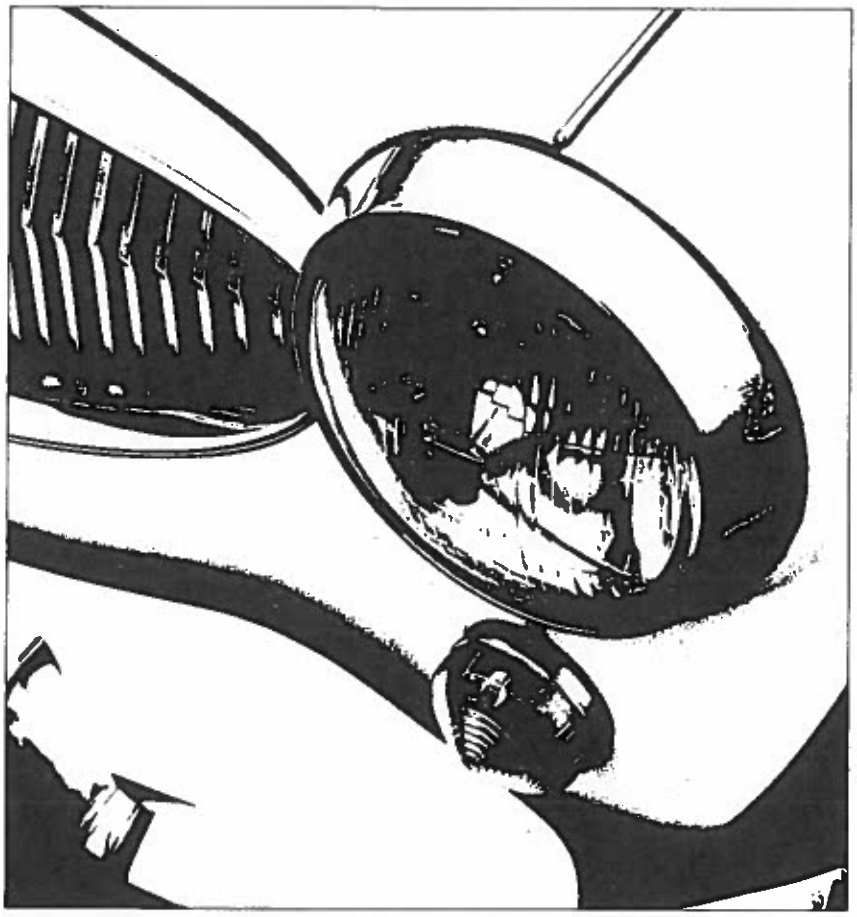
At the next car show, turn the wheels so people can see "what a clean machine" you have. Enjoy

| Series | Chassis # | Striping |
|---|---|---|
| BN1 | 138031-228046 | None |
| BN 2 &BN 4 | 228047-35706 | white, 1/2 -3/4 inch wide |
| BN4 BN6 BT 7 BN7 | 35707- 10302 (BT 7) or 10328 (BN 7) | Green 1/2 inch wide |
| BT7 & BN7 | 10303(BT7) /10329(BN7) to end | Red 1/2 inch wide |
| BJ7 & BJ 8 | 17551-to end of BJ8 | Parallel red and white 1/2-3/4 inch wide |

# BASIC HANDLING PRINCIPLES, Part 3

**John Dowsett**
**Australia**

Before I leave the subject of spring rates, I should discuss the effect of the relative stiffness of the front and rear springs, because this relationship is critical in determining the balance and stability of the car whilst cornering. On passenger cars, the usual aim is to achieve a neutral or slightly understeering cornering characteristic. If Mr. Average takes a corner a little too fast, and the car starts to understeer slightly, this can be easily corrected by merely lifting the foot off the accelerator. This causes a weight transfer to the front wheels, which will then grip the road better, and pull the front of the car safely around the corner. On the other hand, if the car has a built-in oversteer, in the situation above it will be the rear of the car which will start to slide first, and lifting off the accelerator will only make the situation worse.



The way in which this relative balance is achieved is this: to reduce understeer, either increase the stiffness of the rear springs, or soften the front springs. To reduce oversteer, the opposite applies.

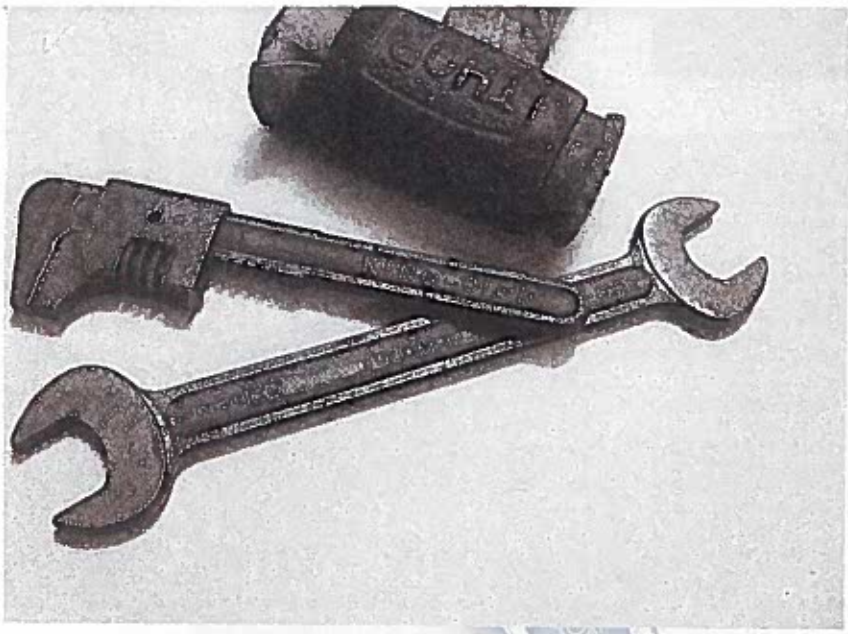
An easy way of increasing front spring stiffness is to increase the size of the anti-sway bar. (I don't recommend fitting a rear sway bar to an Austin Healey — I tried this once on my race car, and the result was diabolical oversteer.)

Using the 4-cylinder Austin-Healey as an example, the original BN1/2 was fitted with a very light 1/2 inch diameter front anti-sway bar and fairly stiff rear springs. This model also had an unenviable reputation for being "tail-happy," or prone to oversteer or to "swap ends" rather alarmingly in the middle of a corner, especially when striking a rough piece of road. As I said last month, I recommend wherever possible to soften the rear springs to help rear wheel adhesion, but another solution is to increase the stiffness of the front anti-sway bar. This in fact was done on the 6-cylinder cars, where the size of the anti-sway bar was increased from 1/2 inch to 5/8 inch diameter. It was soon found that by fitting this larger bar to the 4-cylinder cars, the handling was significantly improved. What was actually happening was that the stiffer front end was counterbalancing the stiff rear end, giving a better balance between the front and rear adhesion.

The aim should be to increase the size of the front anti-sway bar just sufficiently to give the car a neutral balance or a very slight understeer. To go any bigger will be counterproductive and will merely introduce undesirable understeer, as well as placing additional stresses on the chassis and mounting bolts.

There seems to be an unfortunate perception abroad that if a slightly bigger anti-sway bar is good, then a much bigger one will be even better. Perhaps an understanding of the above principles may help to make an appropriate choice of size. I personally feel that 20mm diameter is as large as is necessary in most cases, but if you decide to go larger, by all means do so with a proper understanding of the reasons.

Also don't overlook the fact that the bigger the bar, the bigger the stress on the fixing bolts, and the chassis may require strengthening or repairing to prevent subsequent failure or cracking.



# Front Hub Servicing

**Michael Jennings**
**Bel Air, Maryland**
***Capital Area Austin-Healey Club***

Members of the Capital Area Austin-Healey Club attended a tech session hosted by Healey Surgeons in Takoma Park, Maryland, on Saturday, March 16. Run by Bruce and Inan Phillips, Healey Surgeons is well known to Healey enthusiasts in the mid-Atlantic area. They supply a wide range of Healey parts and Bruce performs comprehensive service work on Healeys. The subject of the tech session was how to service the front wheel bearings on Big Healeys.

Bruce demonstrated the correct way to disassemble the front hubs, re-grease the bearings, set them up properly with the correct shims, and then put everything back together. Here is a summary of Bruce's demonstration.

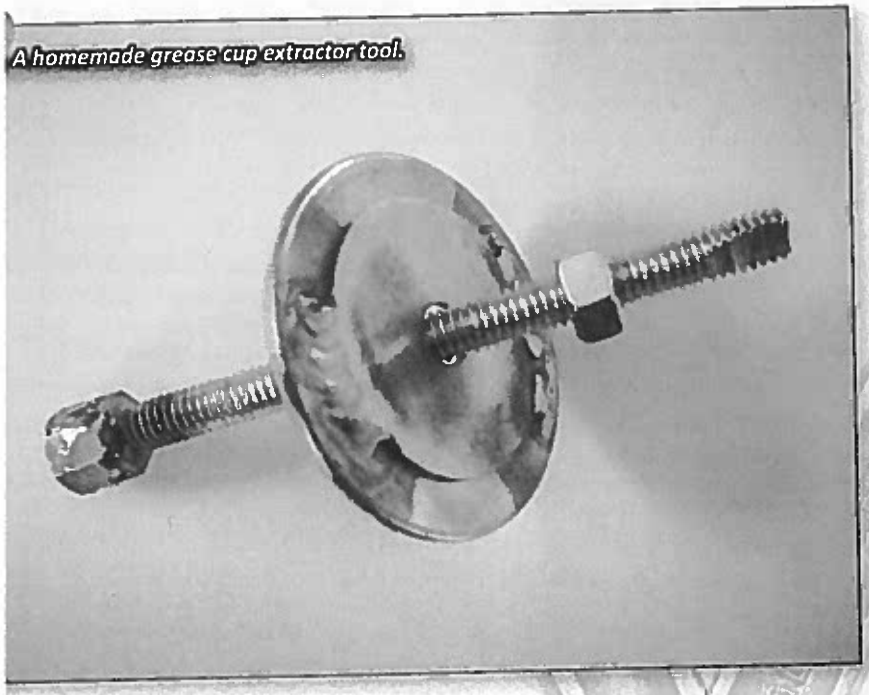
*1. Ready for hub disassembly.*

After safely placing the car on jack stands, remove the wheel. The first step would be to remove the brake caliper. Photo 1 shows the hub ready for disassembly. Note the caliper assembly is hanging behind the disc supported by a copper wire. To do this, remove the hydraulic hose clamp and the two nuts that secure the dust shield (present on BJ8s, not on earlier cars). An alternate approach is to disconnect the hydraulic line, but that would require bleeding the system after reassembly. It is probably easier to remove the caliper with the hydraulic line attached. Remove the clevis pins holding the caliper securing pins and withdraw the pins. Pull the pads half out, then use them as a lever to push the caliper pistons in. This makes the caliper removal easier. NOTE: If you start with a full hydraulic reservoir, pushing in the pistons may cause the reservoir to overflow. Then remove the caliper securing bolts with a 5/8-inch wrench. Carefully remove the caliper and support it with a wire support; do not let it hang on the hose.

*2. The authentic grease cup extractor tool.*

Now we are ready to remove the grease cup in the center of the hub. There is a special tool for this shown in photo 2. However, most of us do not have access to this, so a simple extractor tool can be made with a 5/16 bolt and nut, a 5/16 fine-thread nut and a couple of fender washers. The fine thread nut needs to be welded onto the head of the bolt and flats ground on the other end of the bolt. This homemade extractor is shown in photo 3. Attach the fine thread nut onto the stud on the grease cup and turn the nut on the extractor to pull the grease cup out of the hub. Hold the bolt using the flats on the extractor bolt end if required.

There is a castellated nut in the hub secured in place with a cotter pin. The pin needs to be removed using long-nose pliers or side cutters, if required. This can be a little difficult due to


A homemade grease cup extractor tool.

e tight space, but persevere. While it may be tempting to st shear the pin off using brute force on the 1 1/8-inch nut, is could damage the stub axle or threads. When the pin is moved, remove the nut. The entire hub assembly can be moved from the stub axle.

ost modern cars have two tapered roller bearings, an inner d outer and the correct setting involves merely tightening e axle nut until a slight bind is felt while rotating the wheel, en backing the nut off until the wheel is free with no end ay. The Healey wheel bearing setup is not like that, even ough it has two taper roller bearings. Instead, it has two ular distance pieces and selected shims that are torqued while allowing the wheel to turn freely. Bruce inted out that this configuration does two things. st, it strengthens the stub axle assembly by nsferring the bending moment from just the root the stub axle to a wider area being the contact tch of the inner distance piece. (See photo 4.) cond, it prevents the inner bearing races from nning on the stub axle as they are held in place the castellated nut being tightened.

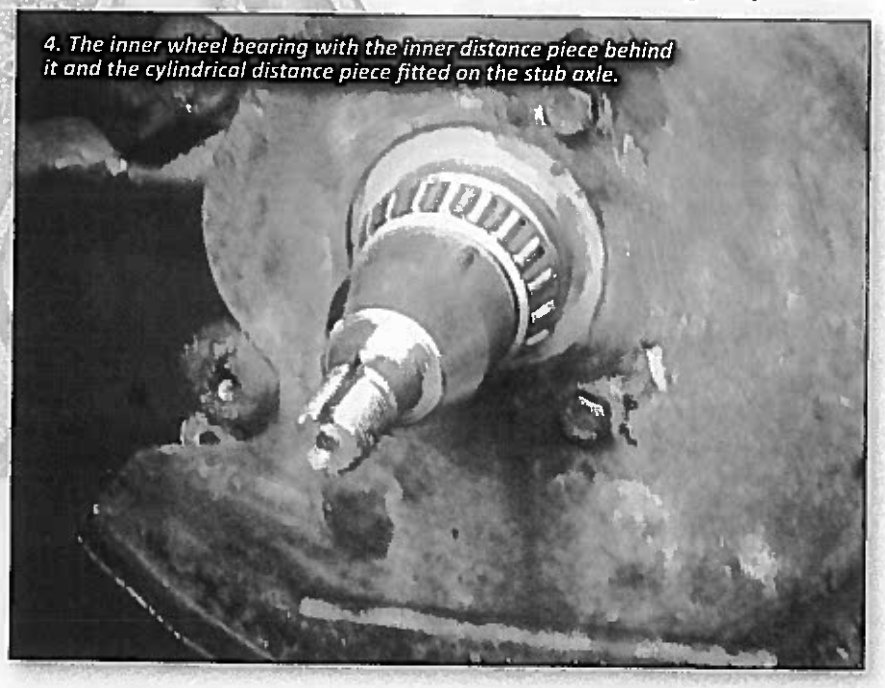
ıen the hub assembly is removed, collect efully the tab washer, the distance pieces and shims. If the axle was NOT noisy and spun ely, it may just be necessary to re-grease the ırings and reassemble. If new bearings and es are installed, a new shim setup will be uired.

te the stub axle has horizontal and vertical holes the cotter pin to pass through.

w clean everything thoroughly with solvent l blow them out with compressed air, but do allow the bearing to spin dry. From here on, cleanliness is very important. Examine the cleaned bearing rollers and races for any pits, spalls, rust, damage or discoloration. If discoloration such as bronze or bluing is present, then it is likely the bearing has been overheated. If any of these faults are present, renew the bearings and races. The outer one is more likely to be compromised.

The old races can be removed with a drift. Look down the hub center and you will see where you can apply the drift. (See photo 5.) Tap each side sequentially and avoid getting the race cocked sideways. Then make sure that the race seats are clean, apply a little oil or WD-40, and tap the new races into position. (Authors note: I have always had good luck by heating the hub – wrap it in aluminum foil and put it on the barbecue grill for a few minutes – and putting the races in the freezer. They go together more easily in my experience.) Again, it is important to make sure the races are fitted squarely and that they are fully seated. A small inspection mirror can be used to make sure the races are seated. Bruce has a seating tool just for this purpose and he installs the races by tapping them in with the service tool on his anvil. When the races are seated, the hammer blow on the seating tool changes its sound. It is good practice to replace the inner grease lip seal in the hub even if the bearings were not replaced.

It is now time to reassemble the stub axle bearings. Put the inner distance piece on the axle first with the concave face away from the bearing. Fit the inner bearing with the smaller taper facing outward. Bruce's technique is to oil the bearings with SAE 80W/90 gear oil, get it shimmed up correctly and then disassemble everything, pack the bearings with grease and then reassemble. Accordingly, if following this process,


4. The inner wheel bearing with the inner distance piece behind it and the cylindrical distance piece fitted on the stub axle.

# FRONT WHEEL BEARINGS

**Roger Moment**
**Longmont, Colorado**

Q: I need to change my front wheel bearings. I haven't started the job yet so everything is still assembled and I have the following questions:

1. Do I need a hub puller or any other special tools?

2. What should I buy: two inner and two outer bearings, two oil seals, two of each size shims, new locking washers, new cotter pins, grease?

A: First, I hope you have a shop manual and have looked it over carefully. While bearing change is really trivially easy, you can get into some problems if you don't know how the design is engineered and the parts work.

As for the parts I list below, be sure they are for the proper hub. At chassis BJ8 26705 the bearings and shims changed, and from this point on they have a smaller ID. Prior to this chassis number, the bearings are the same for all big Healeys, starting with the BN2 (the BN1s use thrust-type ball bearings).

First things you'll need are a gallon of mineral spirits (paint thinner/solvent) and a two-pound size coffee can. A metal tray for washing parts and some cheap brushes are also very handy. You won't need all of the gallon, and maybe only a quart, but this stuff is great to have around for cleaning things, and a gallon is much cheaper than by the quart.

1) You should get two inner and two outer bearings, plus two inner cups and two outer cups. The bearings and cups are sold separately.

2) You need two seals.

3) You should have available to use at least six 0.003", six 0.005", and four 0.010" shims. You'll need to buy these quantities if whoever replaced the hubs previously decided to leave all the shims out. If your shims are there and had been adjusted properly, then you will need to buy just half the quantity.

4) You'll need two cotter pins that are two" long (total length, including eye) and 1/8" in diameter.

5) A 1 1/8" socket.

6) You should have a 3/8" steel rod about 8" long with the ends filed flat.

Follow the sequence described in the manual exactly. Here are some tips that will make the job easier:

1) The dust cap has a 5/16" threaded stud pointing out. The factory tool would thread onto this and then allow you to pull the cap out. If you use pliers on the thread you can damage it unless you are gentle. I usually find the caps come out very easily. If you want to make a tool, use some 1/2" steel rod and drill and tap a hole in one end 5/16"-24. Screw the rod onto the thread and pull on the rod.

2) The cotter pin is difficult to remove. Use a long screwdriver to unfold the bent ends and long nose pliers to manipulate it down inside the hub. I use the screwdriver to push from the tip end. If it is not bent, you might be able to feed it out through the access hole in the side of the hub. Otherwise you'll have to bend it outward inside the hub and work it free. Long nose pliers are essential. A good diagonal cutter that you can poke down inside the hub may also be useful to grip the cotter head with and pull it outwards as you work the shank sideways through the axle hole.

3) Pull straight out on the hub and try to minimize cocking. Some sharp yanks should free it. What will be sticking, if anything, is the bearing onto the stub axle, both inner and outer. If it seems to jam, don't force it. Push it back in and try again.

4) The back seal sort of retains the inner bearing. Its inner diameter is smaller than the bearing's outer diameter. With a hard tug you might end up forcing the inner bearing through the seal's rubber lip, but that is no problem since you will be replacing all parts with new ones.

5) The adjusting shims will likely be stuck to the inside face of the outer bearing or the outer face of the spacer. Look carefully for them as there is no reason why they can't be reused if they haven't been damaged (more below on this). Keep track of the left and right side as I often find the original shims work perfectly when replacing the hub after changing the bearings.

6) The spacer is trapped in the hub by the inner bearing. It won't come out the front of the hub.

7) There are some arc cut-outs that give you access to tap the bearing cones out of the hub. I use the 3/8" steel rod and work them alternately from the opposite sides. Try to avoid cocking them as they can get very stuck if jammed.

8) When replacing the cones a large metal "pusher" (disk, large socket, etc.) is important to keep the cones from cocking and make sure they are fully seated.

9) Insert the spacer before putting the rear bearing into the hub. Be sure to thoroughly pack the bearing with proper grease. Also pack grease into the hub cavity around the spacer. First, however, test slide the inner bearing, by itself, onto the axle to see how easily or tight is goes. It should slip right on if properly aligned. Use 600-grit paper to smooth the axle surface if needed.

10) Check the axle spindle for burrs where the seal rubs against it and dress off with a fine file and 600-grit paper if needed.

11) Do NOT grease the outer bearing yet!

12) Tap the seal into the back of the hub, being careful to have its face even with the edge of the hub's cavity.

13) Slide the hub with spacer, greased inner bearing, and seal onto the axle. Slide on the outer bearing, tab washer and run down the retaining nut. Tighten the nut so that you can feel drag on the hub and then tighten it more to where the hub won't rotate at all. This step is to make sure the cones are fully seated into the hub.

14) Remove the nut, tab washer and outer bearing. To get the bearing out, pull on the hub until the bearing slips free, but don't pull the hub off the axle. You'll need your longest, thinnest fingers for reaching into the hub to grab the bearing. Long nose pliers are the likely substitute for long, skinny fingers.

15) Put on the original shims and replace the bearing, washer and nut. When inserting the shims note that there is a small step on the axle and it is CRITICAL that you get the shims over this step and onto the shaft. I've seen many shims with their inner diameter bent over because they were trapped and sheared by the bearing because they hadn't been totally inserted onto the axle first. If the shims were missing, put on one 0.010", one 0.005", and two 0.003" shims for starters. Keep the shims, bearing, et al. free from grease as it is much easier to remove them to change thickness if they are dry. The final proper adjustment is correct when you can tighten on the nut and the wheel does not show any reduction in ease of turning (and, of course, has no play).

16) Once you have the correct shim thickness, take the outer bearing off again and now you can pack it with grease. Then reassemble all, tighten the nut, position the slots, and insert the cotter through the hole in the hub. You only need to pull one tab of the cotter forward and bend it back over the axle end.

## Kingpin Oilite Washers

Rich Holman wrote recently, "I am reassembling my kingpins after having them rebushed I was curious what, if any, grease/oil I should put on the "oilite" washers — did not see it in the instructions."

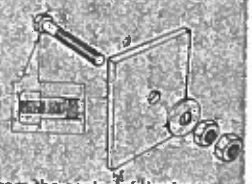
Steve Byers responded, "The Oilite washers are sintered bronze, with microscopic pores in them that will retain lubricating oil. They are intended to be self-lubricating, but I like to soak similar parts in engine oil for 24 hours or so before using them." Jack Aeckerlin from The Netherlands added, "I used to be the Dutch agent for Oilite. Their recommendation is to submerge the bearing(s) in any type of engine oil you have around, heat to 90 degrees C (about 195 degrees F), take away the heat source and let the oil cool to room temperature with the bearings still submerged. Take the bearings out, which by now should have expelled all air from the pores and replaced it with oil."

Rich wrote back, "I took Jack's recommendations and just as he said, when the oil was hot, small bubbles started appearing as the oil permeated the bearing. I tried again, but no bubbles. I guess once is enough."

In order to keep peace in my family, I have come up with a way to do this outside rather than on top of the stove in the kitchen. In testing thermostats, I use a pot (flame proof such as cast iron) full of water and a candy thermometer. The thermostat is submerged in the water and I place the pot on my outdoor barbeque and watch for the thermostat to open making note of the temperature on the candy thermometer. I am sure that this same procedure can be used to be sure that the temperature is correct for the bearings.

# Wire Wheel Hub Grease Cap Removal

Subscribing to the restoration philosophy of "Owner Bonding" and maintaining a rolling restoration, I was undertaking to restore my Healey by rebuilding subsystems of the car over a period of time instead of the "Catastrophic Restoration" method which requires total disassembly of the car. Being a red blooded American male, I was convinced that REAL men don't need special tools, they can rely on that twenty fourth chromosome (the innate mechanical ability gene) to get them through the most complex mechanical problem. With this conviction, I had set aside a recent Sunday evening to begin the rebuild of the front end of my Healey which would include the replacement of the front wheel hubs and various other front end components.



The process of jacking the front end of the car up provided no major challenges, nor did the removal of the front knock-offs. Then things got interesting. During the pre-rebuild preparation period, I noted that removing the grease cups on the front wheels of the car would require a special tool to pull the grease cup from the center of the front hub. I immediately discounted this as an unnecessary requirement. The removal of those grease cups very nearly brought the entire project grinding to a halt.

Necessity is indeed the mother of invention and the inevitable combination of a Sunday evening (approximately 7:30 with no chance of finding a decent hardware store open) and the gnawing feeling another weekend has escaped without getting started on a Healey project (which has been postponed repeatedly) can bring out the creative genius in anyone.

Panic sets in. The problem appears to be pretty straightforward. What should I do? Until the grease cups are removed, the front end is not going to come apart. Examination of the threaded studs that protrude from the grease cup revealed a previous owner (Does this sound familiar? What will the next owner say about those clever solutions of mine?) had attacked the stud with a pair of needlenose vise grip pliers and mangled the threads in the process. That obviously wasn't a great idea. Just to make sure, I tried it. No, it didn't work for me either. Wait for anger to subside, feel the power of the creative forces. Light bulb appears over my head. (Yes, the light is on.)

Now, for the solution! On an Austin-Healey, the thread on the grease cup studs is 5/16" - 24 tpi. I chased the threads that had been mangled by the vise grips with a nut of the same size and this cleaned them up enough so that the threads were usable again. Once I had the grease cup out of the hub, I was able to run a 5/16" die down the threads to complete the restoration. I scavenged the following parts from the bits and pieces bin under the work bench:

- 1 x 1/2" x 3" bolt
- 1 x 2 1/2" square piece of 1/4" steel
- 1 x 1/2" flat washer
- 2 x 1/2" nuts for the 1/2" x 3" bolt
- 5/16" x 24 tpi tap
- 17/64 drill bit
- 1/2" drill bit
- center punch
- electric drill or drill press

Locate the center of the 1/2" bolt as best as you can and mark it with the center punch. Dead center is nice, but not required. Holding the bolt so it will not spin, drill a hole in the hex head of the bolt. The hole will need to be at least 3/4" deep. A 1" deep hole allows plenty of room, so the tap will not bottom out when you are tapping the hole. I generally will drill a small pilot hole and progressively enlarge the hole until it is the correct size for the tap that will be used (in this case a 5/16" x 24 tpi). Tap the hole in the head of the bolt with the tap.

Next, mark the center of the 1/4" steel with the center punch. The intersection of diagonal lines drawn from corner to corner will locate the center of the piece of steel. I recommend starting any hole to be drilled in metal with a small pilot hole, enlarging the hole progressively with larger drill bits until arriving at the final hole size. This will help to maintain control when drilling a large hole. The finished hole in the center of the steel plate should be 1/2".

Now you are ready to assemble the tool. The head of the bolt with the 5/16" x 24 tpi hole tapped into it, screws onto the stud that protrudes from the grease cup. Slide the 2 1/2" square steel plate with the 1/2" hole over the threaded part of the 1/2" bolt that is now extending from the center of the splined hub. The end of the splined hub will stop the plate. Slide the 1/2" washer onto the bolt and thread the 1/2" nut onto the threads of the 1/2" bolt. If it is necessary to tighten the 1/2" bolt on the grease cup stud, thread two 1/2" nuts on the 1/2" bolt and lock them against themselves using two wrenches. Then tighten the 1/2" bolt onto the grease cup stud and loosen the 2 nuts on the 1/2" bolt and remove one of the nuts. Tighten the remaining nut down to the washer on the steel plate. As you rotate the nut on the threaded shaft, the grease cup will be pulled out from the splined hub.

I am sure that modifications can be made to this basic puller. The steel could be substituted with a piece of hardwood. The length of the bolt can be increased or decreased depending on the hub from which you are trying to extract the grease cup. The basic idea is to remove the grease cups without doing a root canal on your wallet buying special tools, if they are even still available. I would rather spend my money on parts to repair my Healey, not buying special tools. Good Luck!

John E. Palmer
Bethesda, MD

# WHEELS

*They make your Healey stand out in a crowd. But as beautiful as they are, they come complete with their own set of unique maintenace issues. In the following pages, we will explain some useful things of which you should be aware.*

## HUBS, SPLINES AND KNOCKOFFS

BY STEVE DAY

### TAKE A CAREFUL LOOK AT THOSE HUBS!

One of the most overlooked safety issues on a wire-wheel-equipped Healey is the splined hubs. These are the necessary accessories that bolt onto the rotor or drum in order to accept the wire wheel, which is made secure by means of a threaded knockoff.

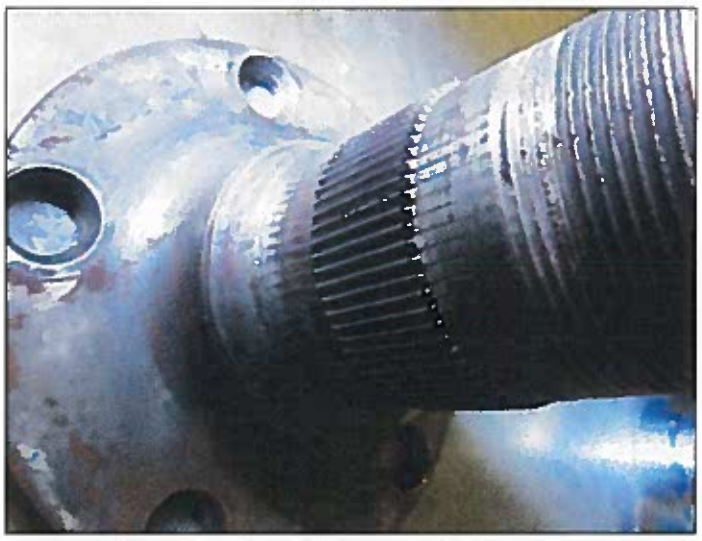
The hubs have splines on them that must be periodically cleaned and coated with a quality grease to prevent wear and rust on both the male hub splines and the female wheel splines. When done properly, this keeps the wheel from rusting permanently to the hub. Sometimes removing a neglected, rusted wheel from the hub must be done by cutting the spokes and even the hub.

Almost every wheel I have removed at my shop contains either a dried, crusty rust or a gooey black mess on the splined area. However, due to the hidden nature of the wheel-hub interface, it is difficult to see the physical wear that is present on those splines without the removal of the wheel. The splines may be damaged beyond the point of cleaning them back to factory condition without you knowing it!

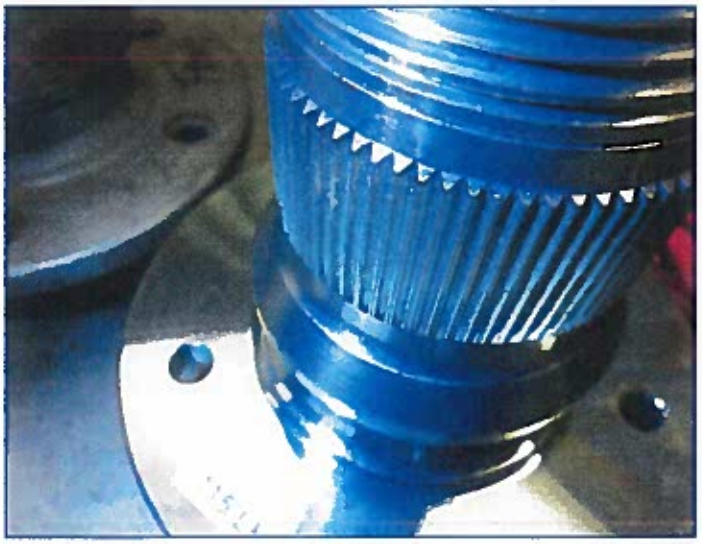
This hidden wear is the focus of our discussion. We will explore the recognition and accessing of potential damage to the splines and how to prevent it.

So, what's to worry about a little wear on the splines? Consider this: every time you let out the clutch, the engine applies power to the rear wheels through those splines. Every time you put your foot on the brake to slow down or stop, that stopping power is transmitted through those splines on all four hubs to the tires. If this spline wear is bad enough, they will strip and nothing is transmitted to the tires. Now, you either will be sitting still or wishing fervently that you were!

How do we spot this spline wear? With the wheels still on the ground and the wheels chocked, slightly loosen the knockoffs. Then jack up the front or rear of the car, place jack stands under the frame, and remove the knockoff. If your tires were balanced on the car, mark the hub and wheel so you can put it back in the same position. Now remove the wheel and start cleaning. A drip tray under the hub will help while you scrub

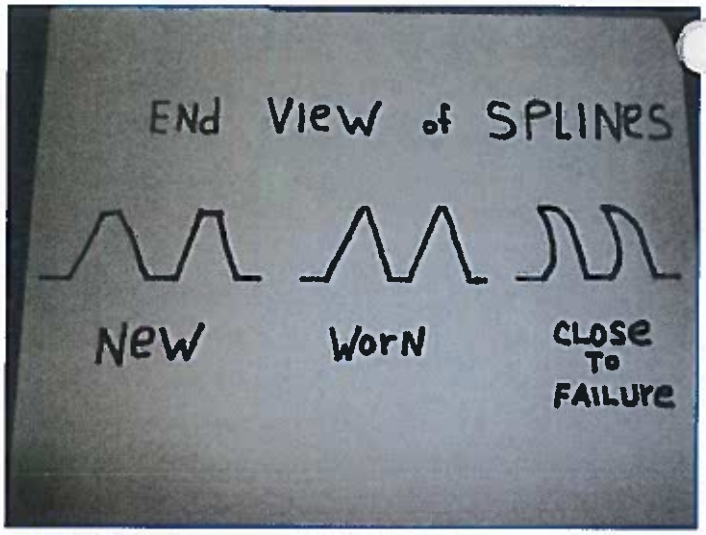


Damage to splines and threads, vertical lines worn into hub.



Brand new hub with lots of meat in the splines.

An old hub cleaned to show splines worn sharp at top, wear in the face of the spline, wear in the threads.




A side view diagram of new, worn and close to failure splines.

the splines with a non-flammable cleaner and toothbrush down to bare metal. Now you can start the inspection.

Look at the pictures and notice the different examples of wear. Now, on your hub, run your finger LIGHTLY over the splines around the circumference to see if there is a sharp edge to the splines, created by wear. Be careful not to cut your finger!

Next, look at the splines from the knock-off end and compare what you see to the picture. Are the tops of the splines nice and flat or worn to that sharp point you may have felt? Sometimes they are worn so badly that the top of the splines look like a cresting wave.

With this new info in your brain, imagine a twisting country road Healey tour in the sunlight at 45 mph (okay, so maybe it is a little faster for you) and a panic stop is needed. Perhaps a car pulls out, a child runs out, a yard sale sign is visible. If the force applied is more than the worn splines can take, they strip and are unable to apply stopping power to the tires. This means you plow through the obstacle, or if only one hub fails, you lose control of the car and drive hard left or right.

I should have your full attention now on how to prevent that from happening.

At least once a year, all four wheels need to come off, be cleaned and inspected for spline condition, all rust removed and regreased. When you do find wear, replace the damaged hubs and/or wheels, regrease and install.

When installing the knockoff, make sure you apply the right amount of tightening torque. You want enough to snug the wheel and remove the free play so it won't come loose, but not so much that you strip the brass threads in the knockoff or make the wheel too difficult to remove on the road for a flat tire. A bit of practice will give you the right feel for it. The carrying of a knockoff wrench in the boot will aid in t process.

When first learning, it helps to have that corner of the car off the ground and supported on a jack stand, while a helper sits in the car. Using your tool of choice, tighten the knockoff to where you feel it is less than snug. Have the helper put the brakes on and with your hands at 9 and 3 o'clock on the tire, try to rotate it forward and back. If you feel a bit of play, tighten the knockoff and check again. Continue this process until the free play is gone between the splines of the wheel and the hub.

**CAUTION!**
At this point I am assuming you have checked the splines and they are flat-topped and good. If you have wear on the splines that would also cause too much free play in this test, I would suggest that you replace the worn part (wheel, hub or both).

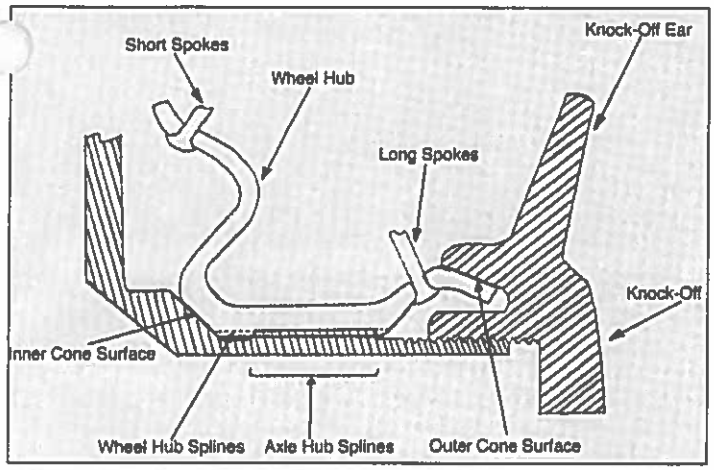
So, be safe, check those splines, and you see at Rendezvous in Alderwood!

# Wheels and knockoffs

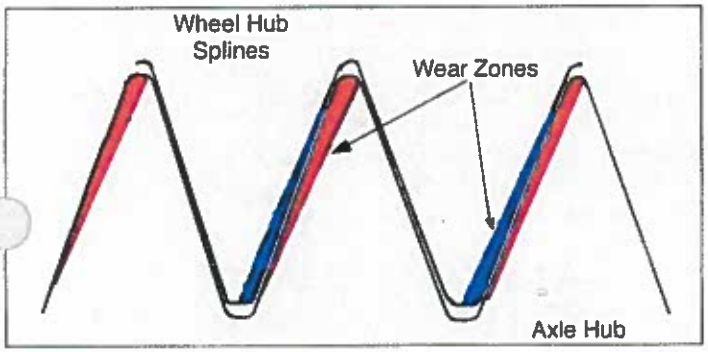
BY ROGER MOMENT, *TECHNICAL EDITOR, AUSTIN-HEALEY MAGAZINE*

## Wheels

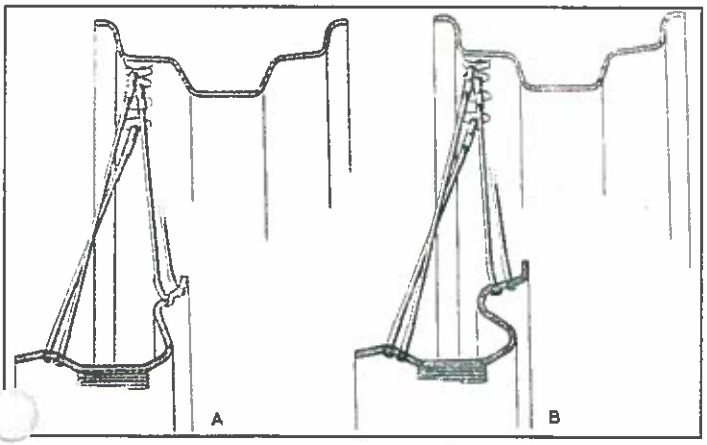
Years ago, the first thought people had when finding their wheels did not run straight was to have them trued. Maybe some spokes were rusty, bent or missing, or there were deformations in the rim edge. What is not generally appreciated is that the cost of labor to make a wheel run true can easily be far higher than that of a new replacement. Th is because you cannot bring an old wheel into alignme by simply tightening selected spokes. Such adjustment will work on new wheels where the nipples are not rusted onto the spoke threads, but typically you need to loosen all of the spokes and then retighten them as you adjust the off-




This drawing shows a cross-sectional view of the axle hub, wheel hub, and knockoff, as well as features of each. There is no radial pressure between the axle hub and wheel hub splines, as the weight of the car is actually supported at the conical surfaces.




This drawing shows how splines wear to a sharp knife-edge. The wheel hub splines in this drawing wear in the areas shaded blue – the axle hub splines in the areas shaded red. Wear on rear splined hubs results from both acceleration and deceleration (taking your foot off the throttle pedal) on front splined hubs mostly from braking.




The later style 48-spoke wire wheel (right) had a stronger hub than the earlier one (left). Note the slight change in rim cross-sectional shape. Spokes for the later wheel are not directly interchangeable with those on the earlier wheel – differences include head diameter and length.

set, make the rim concentric with the hub, and correct for wobble.

Even more important, and what should be examined FIRST before even worrying about the spokes is condition of the hub splines. Wire wheels do not rest on the axel hub splines, but rather are suspended, using cones, on the inner and outer surfaces of the wheel hub. The mating axle hub has a cone at the base of the splines, but the other supporting cone is machined into the recess that surrounds the threads in the knockoff. This arrangement makes positioning of the wheel, relative to the car axle, dependent on the conical surfaces, with the splines merely applying rotational force in the forward or reverse directions.

You can tell how severe the wear is on your splines by carefully sighting down through a cleaned wheel hub. The axle hub splines are not as long as those in the wheel hub, so the inner 3/8" or so of the wheel's splines are not in contact with the axle splines and thus don't experience wear. Therefore, you will see (and can feel) a transition between any worn wheel hub splines and the virgin part of them. And, looking at the worn areas carefully, you should be able to tell if they have a sharp edge, or are still blunt, as when new. Badly worn splines can be be very sharp and cut you when sliding your finger along them to feel for the transition. BE VERY CAREFUL!!

You should probably have an expert check your splines to help you decide whether they are safe enough to reuse or not.

All of this becomes an academic question if your wheels are old and rusty, for new replacements are usually far less expensive than rebuilding. There is one exception to this. Early Healey 100s, up through chassis 159801, had a noticeably flatter shape to the wheel center hub. Starting with C. 159802, the hub was made stronger by forming a deeper contour in it. The rim cross-section also was changed slightly, and I've noticed that the rim steel on the earlier wheels appeared to be a bit thinner, as well.

New wheels of the first style are no longer available, but it is possible to locate very serviceable originals (with a lot of effort). If you find such wheels for your car and the splines are in good condition, rebuilding is your only option if you want to stay "original." Even this option has some special challenges, as the spokes on early 48-spoke wheels are different from those on the later ones. There will be a fair amount of custom work involved to make new spokes to fit the original hubs and rims. Just be aware and mentally prepared.

Finally, Dayton wire wheels are reputed to be stronger than Dunlop ones (I'm referring to new versions of each manufacturer). However, Dunlop wheels also have one particularly significant difference in that the center portion of the rim stands taller, relative to the edge, and reduces the clearance gap between the rim midpoint and brake drum (this can be noticed on ALL Healeys – BN1 through BJ8). This is perhaps a point to keep in mind when deciding what brand of new wheels to purchase.

# Wire Wheels

## Knockoffs


You would think that these items would be straightforward to evaluate. However, there are some fine points that often go unnoticed and of which owners who are particularly concerned about originality will want to be aware.

Knockoffs on Healey100S and 100-Six models; up through some point that has not yet been precisely identified were made of steel. This is easily checked using a magnet. Original ones, if the lettering has not been damaged, can easily be restored by welding the ears and replating.

All Healey knockoffs, up to where the eared style was replaced with the octagon ones (during roadster production in some European countries, and for Healeys imported into the USA after January 1, 1967) had fairly thick ears, from the base to the tip, when viewed on edge. Modern replacements have a very noticeable taper. You can easily see the difference if you look at this detail wherever there are a number of Healeys (or even other British marques) gathered.

Bronze knockoffs appear to have been introduced sometime in 1957 (or possibly 1958) and these often are more severely deformed on the ears than the earlier steel ones. However, such damage can also be repaired by brazing on additional bronze followed by rechroming. Besides having knockoffs with the original shape, you will be assured that yours have the correct markings on them. (Some replacements have incorrect lettering, and the characters are stamped much more deeply – i.e., look crisper – than originals.)

Another note on this topic: copper knock-off hammers will damage chrome plating and deform bronze (and sometimes steel) knockoff ears, particularly if you whack the ears too hard. I have found that a soft lead hammer is fine for breaking loose a stuck knockoff or adding the final tightening blows. But once the knockoff is free (on removal), or until it seems close to being tight enough (on installation), I prefer to use a 3-pound plastic-faced dead-blow hammer, as this type causes no damage, yet is hefty enough to do the job. You should always face toward the wheel rather than standing alongside the car and swing in a plane parallel to its body so if the hammer slips off the ear and veers left or right, relative to the plane of your swing, it will go off into space rather than possibly striking (and bending) a spoke.

Finally, it is preferable that knockoffs be tightened with the car's weight off of the wheel. This is so that the conical surfaces of the wheel hub, splined hub, and knockoff can properly nest.

This is particularly true when installing wheels onto the car but not necessary if just adding a whack or two to check knockoff tightness.