When devising a breather, remember that you will also need to be able to put oil into this compartment. If a really small (1/8" or so) breather is devised, you'll probably need to make a second hole so you can add oil to one hole while air comes out the other. If you make the breather hole large enough, you may be able to feed a tube down through it so you can feed oil in through the tube while air escapes around it; a capillary tube on a syringe would work well. If you can figure out how to get the oil in via the zerk fitting, great, but otherwise you might want to remove the zerk fitting and plug that hole with a screw. Again, the enlarged hole with felt or cotton jammed in it provides the simplest solution: remove the felt or cotton, fill up the chamber with oil, and jam the felt or cotton back in.

When set up this way, you want the assembly *full* of oil; that's the only way oil will get to the rollers at the top of each bearing, since they don't spin. Griffiths points out you want to keep the seal lips wet, too. So, add oil until it appears at the breather. This will still leave some air pockets, but driving uphill or downhill will help make sure those upper rollers get oiled every now and then. Driving over bumps may splash some oil around in there.

Tom Wilson says, "Thoughts on oil filled hubs bring back a time when Bell Helicopters figured out that the oscillating movement of the pitch change on the rotor blades would tend to work the lube out of the needle bearings and would allow metal to metal contact. They went to great lengths to seal the blade grip to yoke contact point, and even supplied a clear reservoir so one could easily check the oil level in the grips. It was for the most part a failure and you will usually only see a UH-1 with an oiled head in a museum. The point of this tirade is simply that on a worst case, that being an oscillating load the oiled bearing was replaced by greasing. Replacing the felt wiper with a rubber lipped seal and using a synthetic grease like Mobil (that horrible red stuff you always see being slung out of the heads of Bell helicopters) will almost guarantee that the wheel bearings will outlast the rest of the car."

REAR SWINGARM OUTER PIVOT - SERVICING: Do your pivot joints need attention? Probably. Patrick MacNamara's did: "Old bearings were completely shot. The worst were the ends closest to the front of the car. The starboard side inner race was almost a rusted solid mass and the outer race was pitted and dented. There had been so much movement that it had chewed and straightened one of the annular spacers. The yaw I used to experience when letting off the gas at speed is now gone as well as a little rear end steer/swaying when changing lanes at speed. I think these things should be disassembled and regreased as well as rotated a few degrees every few years."

Greg Meboe had sloppy bearings. "This can be noticed as a light to medium growling vibration as you're driving on the freeway. This occurs only during the transition as you gently press and release the throttle. This can be misdiagnosed as a differential problem. To test, jack up one side of the car under the steel lower suspension arm, then remove the wheel. Pry a flat-blade screwdriver between the aluminum hub carrier and the steel lower suspension arm. Try to wiggle the carrier forward and backward, while the suspension is at ride height. Otherwise, you can look for evidence of scraping between the carrier and the lower arm."

If you only need to rebuild the outer pivot joint, here are some things you *don't* need to do: You don't need to drop the rear suspension cage. You don't need to fiddle with the shocks and springs. You don't need to fiddle with the radius arm. You don't need to mess with the rear anti-sway bar, if you have one.

The fact is, working on the outer pivot is pretty easy; just slide the axle out of the hub and remove the fulcrum shaft from the pivot, and you can work on the hub carrier on the bench while leaving the swingarm in the car. This hub carrier removal is clearly described in Section 64.15.01of the ROM, but is not as clear in the Haynes where the section on rebuilding the outer pivot itself follows a section on removing the entire swingarm from the car. This seems to imply that outer pivot work requires removing the swingarm from the car first, and that would involve some serious work. Removing the swingarm is totally unnecessary; if you're using the Haynes, just follow steps 1, 2, 5, 6, 7, and 8 of Chapter 8, Section 4. Then you can begin taking the pivot apart according to Chapter 11, Section 22, and as soon as the fulcrum shaft comes out you can relocate the hub carrier to the bench.

The hub carrier removal procedures call for removing the cotter pin and the castellated "Jesus nut" holding the axle in the hub. If you just happen to have wheels that permit access to this nut, it's easier to break it loose *first* while the car is still sitting on the wheels.

The procedures also call for a special Jaguar tool JD.1D to get the axle out of the hub. A generic hub puller will do -- but you might not even need a puller at all, it might just slide out. If you can get the Jesus nut off while the wheel is still on -- or put the wheel back on afterwards -- you can yank outward at the top of the wheel to jar it loose.

Still sounds like too much effort? Then forget removing the hub carrier; rebuild the outer swingarm pivot right there on the car! Patrick MacNamara says, “Very simple job to replace the fulcrum bearings without disconnecting the hub from the splined axle. I just laid an 18" 2x4 across the lower arm fork and rested the hub carrier on its side on the 2x4 for the pounding out of the old bearing cones.”

Section 64.15.07 of the ROM and Chapter 11, Section 22 of the Haynes manual provide step-by-step procedures for rebuilding this pivot. However, many owners have expressed confusion; in fact, apparently Jaguar was confused, because there are different procedures described in the manuals for different cars that all use the same rear suspension assembly. John Napoli says, “I have opened up three fulcrum assemblies on three different Jags (my XJ6, my XJ-S and another) and each had the parts in a different sequence, none of them matching the various and sometimes ambiguous manuals.”

The confusion is also partly because you need something more than step-by-step procedures -- you need to know what the hell you’re doing! There are two separate shimming procedures involved. Both are described in the following pages; once the objectives are understood, the step-by-step instructions should begin to make more sense. Figure 22 shows the assembly, assembled at the right and the individual parts to the left indicating the order of installation. The fulcrum shaft has been omitted, since it makes the diagram clearer and you know where the fulcrum shaft goes.

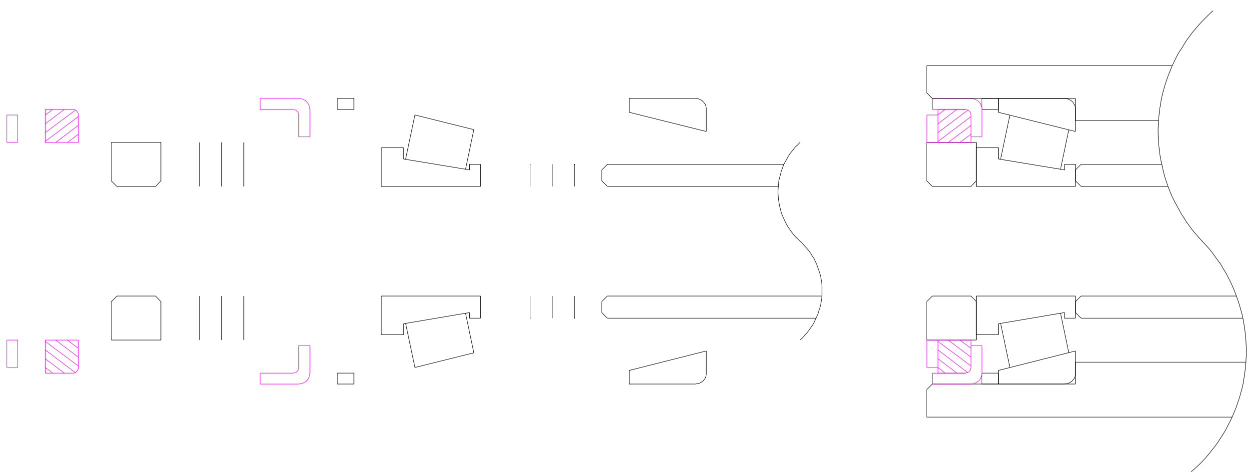

Figure 22 - Rear Swingarm Outer Pivot Assembly

Section 64.15.07 of the ROM includes instructions for rebuilding the outer pivot and for rebuilding the wheel bearings, all in the same sequence. That only causes more confusion; although both bearing assemblies are within the same hub carrier, they are unrelated operations and should have been described separately. If you are only rebuilding the pivot joint, you only need concern yourself with steps 1-3 and 18-31. The Haynes manual does describe them separately -- in fact, in separate chapters, as the wheel bearings are covered in Chapter 8.

Disassembly is fairly straightforward until right after you remove the felt seal ring itself. There is a metal ring with an L-shaped cross section (looks like an oil seal with the rubber part missing) that the felt seal ring sits in, and this ring is pressed into the hub carrier. There doesn’t seem to be any non-destructive way to get it out; you just have to put a screwdriver in there and pry, which will usually mangle it beyond reusability. So, if you plan to rebuild using the OEM felt seal scheme, you probably should order four new rings C20179 in advance; Craig Sawyers says, “this is an expensive part - the price I have is £7 (about $10) *each*, and there are four on the car.” Better idea: rebuild using the oil seal scheme described below, which doesn’t require these rings.

While you have it apart, take a flat file and file a small bevel on the inside corner of the outboard ends of the swingarm fork. Don’t make it at 45°; rather, make it nearer to parallel to the flat inside surface of the fork tine, perhaps a 10° angle. These bevels will make it easier to get the hub carrier back into place in the fork.

The outer pivot reassembly calls for a “dummy shaft”, JD.14. John Robison suggests you use a 5/8” wooden dowel.

Cut it to exactly 6" long. Note that a 5/8" wooden dowel may not be machined all that precisely, so trial fit it through a new bearing before you get started. If it fits snugly at all, spend a few seconds with some sandpaper on it. It needs to be a slip fit, so it's easy to slide in and out of the bearing assembly. If it's humid out, you may need to sand it some more.

Richard Dowling had another idea: "In my collection of rubber items I had some 5/16" ID rubber fuel hose that was near as dammit 5/8" OD. This made excellent dummy shafts, especially for the inner fulcrum shaft that needs a real belting to get back into position. With hard dummy shafts that belting can easily propel the dummy out and drop a big collection of seals and spacers all over the bench. The rubber dummy is much less likely to be inadvertently propelled and thereby helps keep your blood pressure low."

The fulcrum shafts in the author's '83 have a little dowel tip on one end. Purpose unknown. If installed pointing to the rear, it may permit the use of a simpler ride height setting tool than the one shown in Figure 17 on page 358. Other than that, the fulcrum shafts can be installed with this tip pointing forwards or rearwards, it won't make any different to the pivot joint itself.

REAR SWINGARM OUTER PIVOT - BEARINGS: Craig Sawyers says, "Jag supplied a couple of cut-outs on the inside of the hub so you can get a brass drift in to knock them out. Of course, that will be buried in grease, so you have to go by feel, but it is not a difficult job." It helps somewhat to have a drift that's shaped just right at the tip, so you might consider grinding the tip a bit -- flatten one side, etc. Also, it doesn't need to be brass unless you plan to reuse the bearing; a steel rod will do. And make sure to switch back and forth between sides with *every* whack; you don't want to get that race cocked sideways.

Generic bearings can be used, of course. Gregory Wells says, "Inner cone and bearing is Timken 03062, outer race is Timken 03162, for Jaguar p/n C-16029." Duncan Williamson indicates that NSK bearings use the same numbers. Ron Moore says "These are the same bearing and cap as those fitted to the Triumph Herald front wheel bearing outer." Moore is in New Zealand; if you're in the US, it might be more useful to know that it's also the same bearing as the outer front wheel bearing on the Triumph Spitfire and TR6 which were actually imported to this country.

Wells, a Jaguar parts vendor, adds, "Don't assume that because these bearings can be ordered by numbers from a bearing house that they will automatically be cheaper than from the parts peddlers like ourselves. Jag vendors will be cheaper than bearing houses on the Jag-specific bearings a goodly percentage of the time."

Sawyers: "Replacing is easy. Stick the hub in the oven (I waited until my dearly beloved was out) at 100°C. Put the bearing track in the freezer. The two parts just drop together, and then tighten up as the assembly cools down. When it is cool, give the track a knock or two with a drift just to confirm it is completely seated in the recess."

Conversely, Patrick MacNamara -- who didn't remove the hub carrier from the car so it couldn't very well go in the oven -- used a length of threaded rod with nuts and washers to pull the bearing races into place.

The author used a similar method, except using the fulcrum shaft and nuts themselves. You *will* need two 5/8" flat washers with a 1-1/2" OD, and it's nice to also have two 5/8" flat washers with a 1-3/4" OD. Use the 1-3/4" OD washers to pull the races in until they are flush with the ends of the hub carrier, then switch to the 1-1/2" OD washers for the rest of the way. The threads on the fulcrum shaft aren't very long, so you have to stop a few times and add more spacers. The old bearing inner races make fine spacers.

REAR SWINGARM OUTER PIVOT - REPLACING BEARINGS WITH BUSHINGS: Tapered roller bearings work best when rolling continuously; the motion helps feed grease in between the contact areas, and the continuous motion ensures a uniform wear track. But the bearings in this pivot don't roll far enough. Hence, the wear is not uniform, but rather in local spots on the race. And the grease can get pushed out from between the contact points, piled up between rollers, and the contact points actually run dry. The result is a pattern of dimples on the bearing races.

Greg Meboe agrees: "As a mechanical engineer, I must say that the choice to use tapered roller bearings in the hub pivot area is poor, really poor. A roller bearing is designed to roll continuously, not sit in a static position. This pivot has a high amount of stress on it during acceleration, braking and cornering, yet never turns more than one or two degrees total! As a result the race become brinnelled, indented by the rollers which press but don't turn." Note: the roller bearings in this location are not only subject to brinnelling (impact damage), but also "false brinnelling", which is a wear pattern that looks like brinnelling but involves no impact. Doesn't really matter which, either way the bearings are ruined.

Gran Turismo Jaguar (now defunct) offered a kit to replace the tapered roller bearing idea entirely with brass bushings. Concours West (page 708) offers urethane bushings. Either of these has the considerable benefit of being an order of magnitude easier to install, since there is no need for adjustment and fiddling with shims.

However, whether or not going to bushings is actually an improvement is far from clear. First, note that the entire point of renewing these bearings is to eliminate sources of slop in this joint, but you cannot adjust the slop out of bushings. If the bushings don't fit *very* snugly on the fulcrum shaft, the slop may get worse rather than better. And even if the bushings are really snug, of course, any wear in those bushings would cause slop -- if you're unlucky, more slop than would be caused by the wear rate of the OEM tapered roller bearings.

There's also the question of the quality of design and construction. For example, the OEM assembly provides a stack of parts all the way through the assembly so that the fulcrum nuts can be torqued down tight without being concerned about distorting the fork on the end of the swingarm. The same stack clearly won't work since there are no longer any inner bearing races, so a well-designed bushing set would either provide a single sleeve to surround the fulcrum shaft and fit inside the bushings, or short sleeves for use with the OEM spacer tubes. Steve Stewart says, "The solid bushes I put in the E-type were from Classic Jaguar in Texas (www.classicjaguar.com). No sleeves at all. The shafts fit straight through the bushings which are a nice push-in fit to the hub carrier and wishbones." Apparently you must be careful not to overtorque the fulcrum nuts so as not to distort the swingarm.

Seals are apparently another issue. Stewart continues: "I don't believe that grease retention is as good as the roller bearing set up though as there are no seals used. Also instruction to grease these every 3000 miles or so."

Actually, urethane or nylon bushings might be better than brass or bronze. With plastic, it may be possible to assemble a really tight fit, and wear could be minimal if the load distribution is within the capacity of the plastic. The plastic bushing might serve as a seal without requiring a separate seal; it might even be molded with a sealing lip. It still should have a metal sleeve around the fulcrum shaft, though.

All in all, it might be best to just maintain the OEM roller bearings properly and replace them periodically when they get worn. They are not expensive, and replacement is pretty easy.

REAR SWINGARM OUTER PIVOT - SEALS: One common suggestion here is to reverse the felt seal and cup during assembly, but this is probably because the exploded diagram in the Parts Catalogue shows the felt seal and cup backwards and these people have just figured out the way it's *supposed* to go.

Even installed correctly, there is considerable history of rust, corrosion, and water damage with the outer pivot bearings. Craig Sawyers says, "The truly awful felt seal ships water like you would expect; it simply acts like a wick."

In his column "Tech Talk" in Edition 82 of The Jaguar Magazine, Ron Moore recommends the seal C20178, its container C20179, and its retaining washer C20182 be omitted; if you printed this book in color, these parts are shown in magenta in Figure 22. In their place, Moore recommends a "common oil seal PR6354" be installed instead -- backwards, with the flat side of the seal facing the bearing.

More info on that seal: PR6354 is a Repco part number, and it cross-references to a Federal-Mogul/National 471652 or a C-R 11124. Timken also calls this seal a 471652. The dimensions of this seal are 1.125 x 1.624 x 0.250. Duncan Williamson says that Farrell Bearings Ltd stores in New Zealand provide a seal number TC12044 23560R. Sawyers reports that Classic Spares (page 693) offers an "outer fulcrum bearing kit" that includes the bearings, an assortment of shims, and suitable oil seals instead of the OEM felt seals.

Moore has a point about that backwards installation. Seals are normally used to keep fluids *in*, but in this case they are used to keep fluids *out*. The main lip within such a seal, which has a spring behind it, will hold fluids securely in the direction that would result in fluids coming out the flat side, but not as securely in the direction of fluid entering the flat side.

That wisdom notwithstanding, this author is going to recommend that you install the oil seal forwards, with the flat side on the outside. Modern oil seals have two lips, the main one facing one way and a tiny one facing the other way, and either one of these seals -- facing either way -- is likely to seal far better than the felt seal assembly ever dreamed of sealing. But perhaps more importantly, installing the oil seal flat side out would seem to provide better protection from physical damage; most of the delicate parts of the seal are enclosed behind the metal surround.

Moore also suggests that the spring on the seal be removed and replaced with an O-ring BS024. This is probably just because, with the backwards oil seal installation, the spring will eventually rust away since it is on the side of the seal exposed to the elements. A suitable O-ring sold at Discount Auto Parts is made by O-Tite!, number 64024; it is 1-1/8" ID, 1-1/4" OD, 1/16" thick. It even comes in packages of four. Of course, you can omit the O-ring substitution and just leave the spring in there; it'll probably last ten years, perhaps long enough you'll need to be back in there to replace bearings anyway.

If you install the oil seal flat side out, you should *not* make this O-ring substitution for the spring. Rust won't be a problem, since the spring will be inside the assembly and presumably well greased. But the grease used may attack the nitrile of an O-ring.

There is a spacer C20180 within the OEM assembly that holds the outer ring C20179 surrounding the felt seal away from the bearing. A similar spacer is called for with the oil seal, but the oil seal is narrower than C20179 and therefore needs a wider spacer. You have several options. First and perhaps easiest, you can wrap a length of 0.064" steel wire (14 gauge) around a big socket to form a loop, and install it alongside C20180. Since C20180 is about 0.095" wide, this will make the total about 0.160" wide, about right. Figure 23 shows the oil seal and the wire loop spacer in red. Another option would be to cut a strip of sheet metal about 0.150" wide and wrap it around a big socket to make a loop and use that -- and throw C20180 away.

Sawyers provides another option: "Classic's verbal instructions for their kit of bits is to throw everything away except the seal track (C16628). You just tap in the new grease seal until it is flush, or slightly recessed from the face of the hub." That'll work if you're careful and don't tap it in too far.

When you're putting all this together, remember that water is sneaky. With a good lip seal keeping the water from getting in between the seal and the seal track, that water might still sneak in there between the ID of the seal track and the fulcrum shaft itself. Hence, it would probably be a good idea to put some sealant between the seal track and the fulcrum shaft, although it's not clear how to get any to stay in there through the process of inserting the fulcrum shaft while driving the dummy shaft out.

A better idea may be to apply a sealant such as Loctite 518 to both ends of the distance tube, both ends of each inner bearing race, both sides of each seal track and both sides of every shim. This way, when the assembly is tightened up, all those joints will be sealed. Water could conceivably get in along the fulcrum shaft, but it couldn't get from there to the outside of the stack of parts along the shaft where the bearings and grease are. A workable plan, but be careful not to slop too much sealant on any of those parts; you don't want a lot of sealant squeezing out and getting into the bearings.

While you're being so careful to keep water out, note that Jaguar provided a nice little hole above the grease fitting to let in plenty of water. See the section on greasing these bearings 390.

REAR SWINGARM OUTER PIVOT - SHIMS: As described below, there are two separate and distinct shimming procedures involved in rebuilding the rear swingarm outer pivot joint. These two operations require two different shim designs; both need to fit on a 5/8" shaft and both require an assortment of thicknesses for adjustment, but the OD's of the shims need to be different. Craig Sawyers explains Jaguar's shim numbering scheme: "The parts book has two distinct types of C16626:

C16626/1	0.003"	for fork centring
C16626/2	0.007"	for fork centring
C16626	0.003"	for preload
C16626/3	0.007"	for preload

Preload shims: O/D 7/8", I/D 0.695 (11/16" clearance)
Centring shims: O/D 1-1/8", I/D 0.695 (11/16" clearance)

"As you'll see, the preload ones are real skinny, with a wall of rather less than 3/32", as compared with the larger ones with 9/32"."

"Centring" is gonna play hell with my spellchecker; why can't the Brits learn to spell?

The shims used for setting the bearing preload *must* have an OD smaller than 15/16" or they will interfere with the free movement of the bearing roller cage. Shims with an OD smaller than 1-1/8" would work as fork spacing shims, but they will weaken the assembly somewhat; best to use the intended items.

A comment from the author as engineer: The guy at Jaguar who decided to give these two distinct and non-interchangeable types of shims the same part number with different suffixes deserves a thump on the head.

Note that you *will* need some preload shims to do this job. The selection procedure involves assembling the bearings with too many preload shims, measuring the slop, and removing shims accordingly. You can't do that if you don't have too many shims to begin with. Just order a couple of each of the four shim part numbers while ordering the other parts you'll need, and just put it down as the cost of a rebuild.

Of course, you can find generic shims. Grainger (page 711) offers an "arbor shim assortment", stock number 3L739, for less than $10 that contains 19 different thickness 5/8" ID shims. The OD is 1", which really isn't right for *either* preload shimming or fork shimming, but you could conceivably cut the OD down to use them as preload shims.

You could also make shims, of course, by simply cutting them out of steel or brass shim stock.

You need to know just how thick your shims are, so you know how many to remove to set the preload correctly. It's probably not a good idea to rely on Jaguar's indication that its shims are 0.003" and 0.007"; Patrick MacNamara says, "My C16626s came from the dealer at .004"." This author measured his brand new shims as 0.004" and 0.006". If you can, measure yours for yourself.

REAR SWINGARM OUTER PIVOT - BEARING PRELOAD SHIMMING: The first shimming procedure involved in the rear swingarm outer pivot assembly is to preload the tapered bearings properly. When you tighten the nuts down on the fulcrum shaft, you're gonna be jamming the cones of both tapered bearings down tight into the cups, so there is a "distance tube" -- or maybe two distance tubes end-to-end -- that space the cones apart. Shims C16626 (.003") and C16626/3 (.007") need to be selected and installed to space the cones the precise amount necessary to provide the correct amount of preload; too many shims and the bearings will be rattly, too few and they will be jammed too tight. The shimming procedure is described in Section 65.15.07 of the ROM in steps 18 through 28, and also in the Haynes manual, Chapter 11, Section 22, in steps 10 through 16. Basically, the idea is to put the assembly together with too many shims, measure the axial play, and then take it apart and remove shims equal to the play plus .002" -- yes, the assembly should be two thousandths *tight* when done.

Both the ROM (step 22) and the Haynes (step 14) mention using an inner swingarm pivot thrust washer in this trial assembly; you measure the play between the washer and the edge of the hub carrier with feeler gauges. Obviously, if you don't have the inner swingarm pivot apart, that washer isn't available -- and you aren't going to want to take it apart just to borrow that washer for a minute. All you need is a flat washer with a 5/8" hole in the middle and an OD of at least 1-3/4". Note, however, that it would be best to have a really *good* flat washer, as anything flimsy or with a rough or uneven surface may affect the feeler gauge reading -- and you're looking to get the shim measurement right, not just close. You might opt to file or machine on the face of that washer facing the hub carrier to get it as flat and true as possible. Also: mark both the washer and the hub carrier housing so that you are always using the feeler gauges at the same spot.

Of course, you could measure the end play using other methods. You can set up a dial indicator, for example.

The shims can be installed anywhere in the stack between the bearing cones -- at one end, the other end, or in the middle between the two distance tubes -- and it will accomplish the same thing. The manuals describe putting them in the middle between the two distance tubes (steps 27 and 28 in the ROM, step 11 in the Haynes). However, at some point Jaguar figured out that manufacturing one long tube requires less machining than two short tubes. The Parts Catalogue, ©1987, shows it as a single long tube C.16623/1. In fact, every XJ-S owner who has reported says they found a single long tube rather than two short tubes. So, just put the shims at one end or the other; it doesn't matter which end.

The cross-section diagrams in the ROM show a shim in the center between two short tubes. If you have one long tube, don't waste too much time trying to figure out what that drawing is trying to show you there.

The ROM recommends tightening the trial assembly to 97-107 ft-lb, and the Haynes recommends 95 ft-lb. Basically, this is final assembly torque. Here, I will differ with the official recommendations and suggest you do *not* tighten the trial assembly that much; go to 40-50 ft-lb only.

Here's the reason: at trial assembly, you will be turning the two nuts against each other, and somewhere in the stack between them there must be slippage. This slippage will probably occur at the shims. In achieving full assembly torque, the thin shims may decide they've had enough and get ripped out of the stack forcefully by the shear loads. This isn't a problem at final assembly, because the ends of the swingarm fork are involved; they positively prevent any twisting within the stack, and force the nuts to slip on the swingarm fork faces as they are tightened. The shims won't be harmed by pure compression.

REAR SWINGARM OUTER PIVOT - SWINGARM FORK SHIMMING: The second shimming job isn't as critical as the bearing preload; the idea here is merely to make the bearing/seal stack nearly the same as the width of the fork on the swingarm so that as the nuts are tightened down the swingarm doesn't get distorted. Basically, insert shims C16626/1 (.003") and C16626/2 (.007") until the hub carrier fits snugly between the ends of the swingarm; put in as many shims as you can and still fit the hub carrier into the swingarm fork. And put some of the shims at the front and some at the rear in order to position the hub carrier approximately centered in the fork.

This shimming procedure is described in the ROM in Section 64.15.01 in step 10. Or, I should say, *isn't* described in step 10. It just says to put the shims in. The description in the Haynes, Chapter 11, Section 22, steps 18 and 19 is *much* better, brief as it is.

Richard Dowling says, "When it was time to check for the large shims which ensure the assembly is a neat fit in the fulcrum fork, I first put all the bearings etc. into the hub and tried that in the fork. It is just too clumsy and difficult to make sure the bearings are tight and at the same time check the end float for shim size. Instead I went back to just putting the bearings, spacers and shims on the shaft and torquing it up with some spacers. I then offered the shaft up to the fork and checked with feeler gauges. Of course the shaft is not fully into the fork but it is easy to handle and measure. On final assembly it is simple to see if you got that wrong, either the hub fit into the fork is too tight or there is obviously too much endplay."

Both the ROM and the Haynes seem to imply that these shims get installed between the hub carrier assembly and the swingarm fork, and the exploded diagram in the Parts Catalogue confirms it. *Don't* put them there! Install these shims *inside* the oil seal track, between the oil seal track and the bearing.

REAR SWINGARM OUTER PIVOT ASSEMBLY: Confused? Yeah, that's understandable. So, here is a brief summary of the assembly procedure using the oil seal in place of the felt seal. Refer to Figure 23, which shows the assembly together at the right as well as the individual parts to the left -- indicating the order they should be installed. This procedure assumes that all parts are clean and ready for assembly, and whatever you decide to do with the grease relief vent has been done and any metal chips or whatever have been cleaned out.

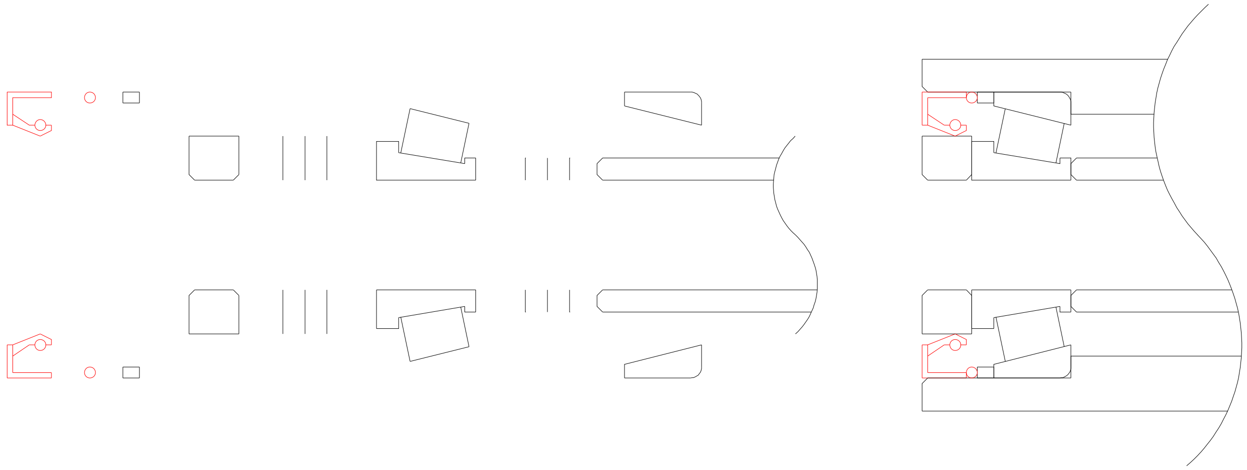

Figure 23 - Rear Swingarm Outer Pivot Assembly w/ Oil Seal

1) Install the outer races.
2) Trial-assemble the center stack using the real fulcrum shaft, distance tube, preload shims, bearings, seal tracks, one 5/8" fender washer, the inner races of both the old bearings as spacers, and the nuts. Use 0.010" more preload shims than came out of it. Tighten the nuts to around 40 ft-lb and measure the end play.
3) Take it back apart, and remove preload shims equal to the end play plus 0.002".
4) Reassemble the distance tube, selected preload shims, and bearings, using the dummy shaft this time.
5) Divide the fork spacing shims that came out of it into two nearly equal groups. Insert one group of fork spacing shims against each bearing, and put the seal tracks in.
6) Trial fit the hub carrier to the swingarm fork again. If it isn't a snug fit, you need more shims. If the clearances between the edges of the hub carrier and the inside surfaces of the swingarm fork aren't nearly equal front and rear, you need to redistribute the fork spacing shims.
7) Insert the skinny spacer ring C20180 in each end against the outer bearing race, along with an additional spacer made by forming some steel wire about 0.060" thick into a ring.
8) Remove one of the seal tracks. Push the seal track into the center of an oil seal, and check it carefully to make sure the lips are positioned properly on the track. Install the pair together, carefully tapping the seal in until it seats on the spacer rings. Repeat for other end.
9) Install the hub carrier in the swingarm fork. Insert the fulcrum shaft, pushing the dummy shaft out the other side. If the fulcrum shaft starts to hang up on a shim inside somewhere, merely turn the shaft to screw the shaft past the shim.
10) Install washers, the link to the shock absorber bolt, and the nuts, and tighten.

REAR SWINGARM INNER PIVOT: Unlike the tapered roller bearings at the outer end that are sealed with felt, the bearings at the inner end are non-tapered needle bearings and sealed with rubber rings with an X-shaped cross section. These seals don't really seem to be a problem. The rubber sealing rings can be replaced with an O-ring in a pinch, but the OEM rings C17213 are probably better.

The bearings will still have the wear problems associated with non-rolling roller bearings. Gran Turismo Jaguar (now defunct) offered brass bushings to replace these needle bearings; you could probably have bronze bushings fabbed up at any machine shop. Since the OEM roller bearings are not tapered and have no adjustment, you should be able to easily attain comparable or less slop with bushings as with the OEM bearings.

IRS UPGRADES: When searching the various sources for products to improve the XJ-S suspension, keep in mind that the Jaguar rear suspension has been largely unchanged since the introduction of the E-Type. This assembly is very popular with the hotrod and custom car types. As a result, ads for parts for improving this suspension can occasionally be found in some decidedly non-Jaguar publications.

CHEAP REAR SUSPENSION UPGRADE: On the SportsPack, the bushings at both ends of the radius arms are different. The bushings at the small end are made with a stiffer rubber. However, the bushings at the front end are the same as on the standard XJ-S except that they are rotated 90º. These bushings have two holes through the rubber, and on normal cars the holes are aligned with the radius arms so that push/pull forces apply directly at the holes. On the SportsPack, the holes are aligned crossways to the radius arms, so push/pull forces apply to solid rubber. If you'd like your IRS to be a little stiffer, you could apparently do some good with a press without even buying any new parts.

REAR ANTI-ROLL BAR BUSHINGS: If you are adding a 9/16" bar to the rear of a car with no rear bar or simply wish to replace the existing bushings on a pre-1982 model, in place of the stock bushing C44931/2 and bracket C42114 you can use a generic 9/16" polyurethane bushing and bracket assembly available from many aftermarket sources. J. C. Whitney (see page 694) offers "A" and "B" style "ProThane" bushing/bracket sets (see Dee Engineering, page 715), with the "B" type being a little larger and more substantial. The "B" bushing must be modified slightly for the XJ-S by cutting notches along the bottom edges, but polyurethane is easy to cut with a razor knife or hacksaw so it only takes a minute and this makes an excellent installation. The "A" type would probably also work in this application.

If you are adding a heavier rear anti-roll bar or replacing the stock bushings on a Sportspack model, Addco (see page 713) also offers polyurethane bushing kits in sizes 5/8" and up and in several different styles. Their "B" series is their "small shoulder style"; their "D" series is the larger, heavier unit with no shoulders; and they also have a "W" series that is a large shoulder style. Any of these can be made to fit the XJ-S rear, although the "B" series requires that the slotted holes be enlongated a little with a round file to fit over the studs. The "D" and "W" come only in urethane, while the "B" normally comes with rubber bushings but can come fitted with urethane if you ask. The "W", being similar to the J. C. Whitney "B" type described above, may require the same minor trimming on the urethane bushing. Addco's catalog lists their "B" for the rear of the XJ-S, but the "D" or "W" are actually better choices.

As with the Addco front bushings, cutting a slit in the polyurethane rear bushing will make it much easier to install and won't hurt anything. At the rear, the loads are vertical but the bushings are mounted at an angle, so the cut should ideally be made at an angle so it is located horizontally when installed.

ANTI-SWAY BAR END LINK BUSHINGS: If your XJ-S has an OEM rear anti-sway bar, the "dogbone" end links (C42907) that connect it to the radius arms come complete with pressed-in bushings; when they are shot, Jaguar expects you to purchase the entire dogbone. Joe Bialy found the individual bushings, though: "Try C10940. They're $3.57 each from Welsh. I think they're an E-type part, but they are an absolute perfect press fit into the dogbone."

If this is true, maybe somebody makes a urethane part for an E-type that could be used here. Or, maybe a larger bushing intended for something else could be machined down for use here.

It isn't all that important anyway; the OEM bushings are actually pretty stiff. The real problem is in the radius arm bushings; see below.

GT Jaguar (now defunct) offered a rear anti-roll bar kit in which the end links appeared to be totally rigid, having metal ball-and-socket joints at both ends. Note that, if a lack of harshness or noise is important, it may not be necessary to have soft components at *both* the end links and the center mounts; rigid links at the ends may work fine for street use if combined with rubber or poly center mounts. One would expect, though, that using rigid end links together with the rigid blocks for center mounts might be best considered a competition-only configuration.

REAR ANTI-ROLL BAR MOUNT STIFFNESS: While you are trying to stiffen the mounts of the rear anti-roll bar to increase its effectiveness, note that the end links on this bar don't connect to the hub carriers. They connect to the radius arms, which in turn are connected to the hub carriers via a very soft bushing. Hence, even if you make the anti-roll bar mounts and end links totally rigid, much of its effect will still be absorbed in the soft bushings at the rear end of the radius arms. Conversely, if you replace the soft bushings at the rear end of the radius arms with something more rigid, you will suddenly find your rear anti-roll bar more effective. Note that the bushings at the rear end of the radius arm on the SportsPack models are stiffer than the basic units.

REAR SUSPENSION REINFORCEMENT: Among those who have developed more torque at the rear wheels of a Jaguar, the rear suspension cage mounts are a known weak spot. If your car can smoke the back tires, it apparently can also rip these suspension mounts fairly readily. According to Mark McChesney, "There are hard rubber mounts available from SNG Barratt" (see page 696). British Auto USA (page 692) also offers a set "in a bonded neoprene of higher durometer than stock."

However, the problem isn't really with the stock mounts; it's a result of the way in which the rear cage is supported -- which is in turn a result of the way the rear suspension works. Since the lower swingarms swing about a pivot parallel to the centerline of the car, the hub carriers need to move only vertically and laterally through the suspension travel range. The radius arms, however, pivot around their forward mounts and therefore try to pull the hub carrier axially forward and back a little as the suspension travels. If all of the mounts and pivots were totally rigid, the whole suspension would seize up. Since the cage is mounted at the top with four rubber mounts that are fairly close together, the entire cage is free to tilt slightly forward and back to allow the radius arms to pull the hub carriers forward and back a little. Also, the rubber mounts at both ends of the radius arms are very soft, so they can give a little to reduce the hub carriers axial motion.

This all works very well under most conditions, but doesn't take to drag racing well. The radius arms are supposed to absorb the forward loading at the hub carriers, and also prevent excessive tilt of the cage assembly -- they attach to the lower swingarms, but those in turn are rigidly pivoted (needle bearings) at the diff to only move up and down and not forward or back, so cage rocking should be effectively limited. However, the radius arm mounts are soft and a lot of torque apparently causes the entire cage to flex and twist, and the upper cage mounts seem to suffer.

The best solution appears to be to add some sort of additional link to accept the torque loads within the cage while allowing the stock mounts to deal with weight loading only. Several of the aftermarket outfits reportedly offer some sort of kit along these lines.

REAR SUSPENSION GEOMETRY CHANGE #1: The combination of rigid needle bearings and soft rubber mounts in the rear suspension assembly have a net effect of pulling the rear wheels forward a little as the suspension travels either direction from normal ride height; effectively, the hub carrier rotates about an axis that is roughly a line from the inner end of the lower swingarms through the forward mounts of the radius arms -- an axis that is at a rather severe angle to the centerline of the car. In other words, as the wheel moves away from level, it also moves forward and turns in a little, providing a little rear-wheel steering. The effect of this stock design is to provide a lot of stability on the freeway, making the car impervious to crosswinds and the like. (And you thought it was just because the car is heavy? Get real.)

In racing, such stability due to rear wheel steering is also desirable, but to a much lesser extent -- a lot of it tends to make the car corner poorly when fitted with racing tires and driven near the limits of adhesion. So, the radius arm is often altered to move the forward pivot closer to the centerline of the car. The axis of suspension travel is still a line from the inner end of the swingarms to the forward mounts of the radius arms, but since the forward mounts of the radius arms are closer to the center of the car, this line is much closer to parallel with the centerline of the car. This reduces the rear wheel steering effect and allows the driver more control over how the car drives at the limit of adhesion. According to Mark McChesney, "Terry's (page 696) is now selling a full kit to convert to a diagonal radius link (with diff cage supports). I'm not sure the kit will work on an XJ-S, I think it's intended for E-types."

REAR SUSPENSION GEOMETRY CHANGE #2: The Jaguar IRS is commonly used on hot rods, Cobra replicas, and other custom applications. In these applications, it is typical to mount the differential rigidly to the chassis of the car and eliminate the radius arms altogether, in order to provide the cleanest and most visually attractive chassis. Some people advocate making the same change to the stock Jaguar; the components are certainly strong enough to do this. However, this is a radical geometry change from the stock IRS in the XJ-S resulting in no rear-steering stability whatsoever and will make a quite noticeable change in the handling of the car. Also, having the diff rigidly mounted will result in more gear noise and road noise transmitted into the car.

In both the hot rod and Cobra applications, the suspension is normally sprung so stiffly as to not move much anyway, you're driving a go-kart rather than a car, suspension geometry is not an issue. The Jaguar XJ-S is an excellent handling car even though it is softly sprung. If you wish to maintain this, you should not consider eliminating the radius arms.

Wheels and Tires

ALLOY WHEEL SEIZING: Believe it or not, one of the places where Jaguars are known to have seizing problems is between the alloy wheel and the hub. Robert Woodling suggests use of anti-seize compound on the mating surfaces, especially at the hole in the center of the wheel.

If your wheel is already stuck, you might as well try loosening all the lugs about two full turns, take the car down off the jack and drive it up and down the street. Swerve left and right a couple of times. Of course, if the tire is flat you won't want to do this -- so you might want to check if your wheels are stuck *now* and take corrective measures *before* you're stuck on the side of the road with a flat tire.

XJR-S WHEELS: John Goodman reports that the XJR-S uses "8" wide special alloys (the front and back wheels are not interchangeable because of different offsets)."

SPOKE WHEELS: Yes, a Jaguar with real wire wheels really looks good. Unfortunately, it generally doesn't drive worth a hoot. The spoke wheels available have a reputation for trouble. Spoke wheels were a good idea in the '50s when Jaguars needed to maximize air flow to cool their brakes. Since that time, two changes have conspired against spoke wheels:

1. The advent of tubeless tires. Many spoke wheels won't work with tubeless tires, so you must install a tube. A tube installed in a speed-rated tire (the XJ-S should be fitted with V-rated tires) completely negates the rating, and renders the tire unsafe at speed. Don't drive fast with inner tubes in your tires!
2. The advent of low, wide tires. A spoke wheel is a reasonable structure when it's tall and skinny, like a bicycle wheel or the automobile wheels of the '50s. But it is a structurally poor design for modern low, wide wheels.

Furthermore, Jaguar XJ wheels need an offset (distance from mounting surface to centerline of wheel) of around 1¼", which is not conducive to spoke wheel strength. It requires all the spokes to be crammed together near the outer edge of the wheel rather than centered and optimally oriented for strength.

Spoke wheels tend to need truing on a regular basis. This is not a job for the home mechanic, and finding someone who can do it right is a challenge. Often the wheels must be returned to the manufacturer for truing. Truing will obviously require removing the tire, remounting the tire afterward, and rebalancing -- so it probably would make sense to plan on a wheel truing whenever new tires are fitted.

Modern spoke wheels normally have stainless steel spokes, which is a big improvement over earlier designs. However, spoke wheels generally still have chrome-plated steel rims and centers, leading to rust problems, flaking chrome, and associated air leakage at the tire/rim seal.

By the way, if it's a weight reduction you expect, forget it. There is nothing lightweight about spoke wheels.

It should also be noted that since the spoke wheels are more flexible than alloy, the handling will suffer somewhat. With a car this heavy, the difference in the way the car corners is noticeable. You may even get sounds, as the spokes strain and creak with the load.

Note that older Dayton wire wheels had 60 spokes while later designs have 70 spokes, with the 70-spoke versions reportedly better. John Tompane says, "The 70-spoke wheels weren't available until I think '89. I have 70-spoke Daytons on my wife's XJ6 and they have been trouble-free for years. When I got the new XJS it came with the same wires already on the car. Since I sometimes drive harder than my bride, I had planned to replace them with sport lattice wheels like I had my '88. But frankly, so far they have been great. I've pushed them pretty hard and they have stayed in balance. I think I'm going to keep them at this point. If I were going to race, autocross or really push the car hard for long periods it would be stupid to use them. They aren't designed for that. But for everyday driving and little spirited driving they're pretty damn good. Not great, but not nearly as bad as advertised. The 60-spokes were true nightmares (or is it untrue nightmares?) and should be avoided at all cost."

Peyton Gill counters: "The Daytons which failed on my '86 XJ-S were 70-spoke. The point of failure was the wheel. Cracks formed between the spokes. In some cases the cracks meet from one spoke to another. The car had not been subjected to any abusive or aggressive driving."

"I bought my XJ-S from my sister who bought it new. She had one wheel self-destruct when a car pulled in front of her. She did not hit the car but the action of hard braking caused one wheel to collapse."

There are (or were at one time) also 50-spoke wire wheels made by TrueSpoke. Brett Kelien says, "I have had enough problems out of 60-spoke Daytons and TrueSpokes to say they will never be on a car of mine. I have broken them going down the highway. On the good side Dayton did make me a good deal on the 70-spoke wheels which I really like."

Actually, it appears that Dayton will make anyone with their 60-spoke wheels a good deal. Steve Gallant says, "I called Dayton Wire Wheels and found that they would not repair the wheels under any circumstances. However, they would replace them with new ones for a very low price. And these new ones had both a larger spoke diameter and more spokes. Dayton was trying to get these wheels out of circulation by offering good replacement deals. I'm sure they could see the liability issue coming to bite them in the ass sooner or later with wheels not sufficently strong for the intended application."

For more info, surf to

http://www.daytonwirewheels.com

and drop them a line. Or contact their warehouse distributor, Floristar, at 1-800-782-7050.

So, if spoke wheels are so much trouble, why did Jaguar fit the car with them? The answer: they didn't. If you have wire wheels, they were either installed by the dealer or by an owner. Jaguar wouldn't wish those things on you, and won't accept responsibility for problems you have with them.

Now, despite the problems mentioned above, many XJ-S owners will use wire wheels anyway. They came with the car and you don't feel like paying for a good set of alloys; you bought them before you read this book; or you just like the looks regardless of the problems. Whatever, I provide the following tips for those who insist on driving around on wires.

Dayton wheels apparently come with stainless steel lug nuts. These sound like a really good idea, but for some reason they tend to gall the threads on the Jaguar studs. The problem may be avoidable by the use of anti-seize compound and/or chasing the threads in the lug nuts with a tap before use, but if you don't want to take the chance you can purchase generic 1/2" fine thread chrome-plated steel acorn nuts at just about any auto parts store. You will usually have a choice of shoulder length, so you need to check the thickness of the flange on the wire wheel before buying. The chrome-plated nuts match the chrome-plated center of the wire wheels better than the stainless steel nuts! Remember to make sure that you have an emergency tire wrench in the boot that will fit your lug nuts, since the aftermarket nuts are likely to have a different hex size than the Jaguar OEM nuts.

If you need to buy replacement center caps for wire wheels, note that the center caps may be something that looks like a big domed nut or it may look like a 3-bladed knock-off. The item used on the TrueSpokes looks like an 8-sided nut. Regarding Daytons, Gallant says, "The 60-spoke wheels came with the hex caps, the 3-spoke knock-off spinner was optional and could be purchased separately from Dayton." Note that the knock-off style caps seem to get lost regularly, so if you have this type you might want to check the attachment scheme. If they attach with a bolt, use Loctite or some such, or even better figure out how to apply locking wire.

Note that there are at least two configurations of Dayton knock-off; Michael Mongelli explains: "I have, if you can believe it, two different types of spinners on my wheels. The one that fits best is 2 1/2 inches in center diameter; the blades are 2 inches. The other type is about 3 inches in center diameter with a shoulder; this one fits but it requires a round shim that fits over the wheel center to make it tight..the blades are 2 1/8"."

CHROME PLATED ALLOY WHEELS: Nope, these didn't come from Jaguar! Chrome plated alloy wheels, like spoked wheels, are trouble; Jaguar would never provide them from the factory and won't warrant them. The dealers, on the other hand, are only too happy to take the wheels off the brand new cars in their showroom, send them off to some disreputable plating shop, and pass the costs on to the new Jaguar buyer. If your chrome-plated wheels are more than a few years old, you will probably note flaking chrome. Mark Stoner says, "My XJ-S has the chromed starfish wheels and they are nothing but trouble. The chroming was done by the dealer and all chroming is not done with equal quality. My problem is that the chrome starts to peel (mainly on the inside of the tire) and causes bad corrosion. I couldn't get one wheel to hold air so I had the chrome turned off of the bead with a lathe. It still leaked so I put a nice bead of silicone on the beads and it seems to be working as a temporary fix."

Rod Fleming, who worked with chrome-plated alloy on motorbikes, says, "When you chrome a piece of steel, the first layer you apply is copper, which sticks well to steel. This is very thin, and serves only as a bed for the next layer, in order to make it bond well. This next layer is nickel, which is black until polished. This layer is quite thick and it is this which actually protects the underlying steel. The nickel needs the copper layer; it won't stick to steel, but it sticks like the proverbial to copper.

"In the early days of the car industry, the nickel was then polished to give a lovely silver sheen. However, nickel is very soft, will wear through easily, and goes black with oxidation. So in the 1930's people started putting a layer of chrome on top. Chrome is very hard and durable and will stay bright, but, and it's a big but, it's porous. It offers no weather protection at all, and the layer that is applied is very thin. So "chrome plate" is actually a complex interaction of the properties of several metals applied in very thin layers.

"Now the trouble is that you can't, try as you like, get that all-important copper layer to stick to aluminium alloy. So you have to get the nickel to plate directly onto the alloy. This it is not very happy to do. The bond is okay for say, engine components or interior applications, but leave it out in the salt and rain, not to mention the gritblast of road use, and it will come off in short order. As soon as it is penetrated, the underlying alloy starts to swell and oxidise, popping off more plate, and pretty soon you've got the shameful mess we all recognise.

"In addition, the thickness of the nickel layer is important; if it is not thick enough, then it will fail. Nickel is expensive, and platers have been known to cheapskate...this is why you can leave a '74 Norton Commando out in the rain for years and still have decent chrome, yet a '74 Moto Guzzi's chrome would have turned to brown lizard-skin after two weeks. (Not that any you see today will be wearing the original stuff.)

"I doubt if the effect has much to do with differing thermal expansion rates; we are only talking about a few microns thickness here. At least, no one ever mentioned it, and I would expect it to be more of a problem on engine parts -- but these, as I said, seem to suffer less.

"As for rechroming/chroming, old chrome (and the nickel, etc.) is removed the same way it goes on: just by reversing the electroplating current. The electroplater uses it again. Not really a problem.

"The real issue with any kind of chrome plating, by the way, (leaving aside the specific issues above) is polishing the metal to be plated. The slightest blemish will show; indeed it will be greatly magnified by the plate. Also, a smooth surface is important to the long term integrity of the plate as it is very difficult to build up a decent thickness on high points. Frankly the thought of polishing a lattice wheel properly fills me with dread!

“It's hard to find a plater whose work is good enough for restoration use, largely because of the polishing; it's all man-hours, and they cost. Most platers are used to doing new bath taps and the like, not polishing the pits out of already well used components.

“Stripping and lacquering wheels is definitely a better idea than chroming; in the UK at least there are many firms who will do this very cheaply and who turn out a very high quality finish.”

WHEEL SIZES: Over the decades that the XJ-S was offered, tires were gradually becoming lower profile -- wider and/or not standing as far above the rim (which requires a larger diameter wheel to maintain overall diameter). This is a *good* thing; shorter and wider is more stable than taller and skinnier. Basically, Jaguar cars came fitted with the best arrangement of tires and wheels commonly available at the time -- but as the best arrangement available kept changing over the years, the tires and wheels fitted to Jaguars changed to keep up. In general, owners of older cars can improve their cars considerably by moving to the later tire and wheel configurations.

The wheels used on the pre-H.E. XJ-S are 6” wide. The wheels used on the H.E., both the “domed starfish” pre-ABS and the “lattice” on ABS cars, are 6½” wide. Owners of pre-H.E.’s, therefore, might consider installing later wheels onto their cars. While ½” may not sound like much, a wider wheel provides the casing of a tire more stability. The difference is noticeable, even if you reinstall the same tires.

The wheels on some late-80’s/early 90’s XJ6 (XJ40) models are 7” wide, and will bolt onto the XJ-S. This gives owners of all XJ-S’s with 15” wheels an option for wider wheels yet. The 7” wheels work very well with the 235/60 tires.

D. C. Cook (see page Error: Reference source not found) offers some snazzy 7.5x16” and 8x16” wheels for Jaguars, and you can also get 16” wheels directly from Jaguar; 90’s XJ-S’s and XJ12’s came from the factory with 16” wheels. In fact, if you go shopping for aftermarket wheels, you may find that 16” is the way to go; the aftermarket shops seem to offer more in 16” than 15”. But besides the wheel availability, it also may be easier -- and cheaper! -- to find speed-rated tires in 16” sizes to fit the Jaguar. Specifically, the 255/50R-16 size is suitable, and is widely available for less money than V-rated 15” tires. John C. Palm reports that “Corvettes used 255/50-16’s from ’83 to ’87. Camaros & Firebirds have long used 245/50-16’s.”

And, yes, you can go beyond 16” and install 17” or even 18” wheels on an XJ-S. In fact, the Aston Martin DB7 -- which was based on the XJ-S floorplan -- comes with 18” wheels, and these wheels will fit the XJ-S. Justin Pashley reports that buyers of DB7’s quite often opt to install custom wheels on their brand-new cars, so the OEM wheels are commonly available in the UK as “take-offs” for reasonable prices. “I use a 225/40-18 tyre which look great. I have had no problems with clearance.” Note that the DB7 wheels have a smaller offset (14.5mm) than XJ-S wheels, which means that the 225mm tires are about the widest that will fit without flaring the fenders.

Paul Hackbart adds, “There is the Aston Martin wing emblem on the center cap. It is the same diameter as the plastic Jaguar face on OEM center caps.”

James Dichter says, “Very important!!! If you are considering Aston-Martin DB7 wheels make sure they are stamped "1G" on the inside back of the rim. If the rims are not stamped then they are *defective*! The wheels will bend out of shape when driven over rough surfaces. This was just brought to my attention by an Aston-Martin/Jaguar dealership.” Pashey looked into this and reports that “defective” may not be the right word; the earlier wheels are fine, but it was found they can be damaged by hitting a curb or pothole at speed so AM beefed them up a bit. The 1G apparently indicates the heavier version.

The bolt pattern on Jaguar wheels is the same as on some full-size Chevys. However, the offset (the distance from the mounting surface to the centerline of the wheel) is 28.5mm, or about 1” greater than most Chevy wheels. If a set of typical Chevy wheels is mounted on an XJ-S, they will stick out the sides of the car, since they will be located 1” farther outward.

The world of Chevy wheels is not that simple, though. Some Chevys have different offsets than others; some cars even have different offsets in front than in back. And aftermarket Chevy wheels can be anything, since sometimes additional width is added entirely on the inside, increasing the offset by 1/2 the additional width. With a little care, it is possible to find aftermarket Chevy wheels that will work on a Jaguar. If the wheel has enough meat to it, it may also be possible to machine off some of the mounting surface, thereby increasing the offset.

When fitting non-Jaguar wheels, it is highly recommended that the center hole fit snugly around the pilot diameter on the hub. While some wheel manufacturers claim the wheel will be held satisfactorily by the lugs themselves, this is a much looser tolerance arrangement and has been known to cause problems. If you buy wheels with too large a center hole and have problems, it is possible to have a machine shop make a set of plugs that will provide a proper size center hole in the wheel, and then you will need to get the tires rebalanced with these plugs in place.

The lower ball joint from the XJ40 (the 1988-on boxy XJ6) will replace the ball joint on the XJ-S. The part number is CAC9937. According to XK's Unlimited, this will provide more clearance for wider wheels. See page 368.

ALLOY WHEELS -- AVOIDING DAMAGE AT TIRE SHOPS: The specified torque on lug nuts on earlier Jaguar alloy wheels is 45-50 ft-lb., and 75 ft-lb. on later ones. This impresses some people as not being very tight. However, higher torque is unnecessary and causes damage to the aluminum wheels; this is true of all alloy wheels, and in this day and age your tire store should know better. If the shop installs your wheels with an air wrench, tell them where to get off and take your business elsewhere.

There are now machines in better tire stores that mount tires on wheels by gripping the wheel from the inside with soft grippers and never touching the wheel's pretty outside surface. Check out the price lists for new Jaguar alloy wheels and decide for yourself if it's worth finding a store with this equipment.

You might also want to watch how the wheels are mounted on the balance machine. Some shops will happily spin a retaining ring onto the machine that presses down on the face of your wheel, sometimes leaving little dings whereever it touches. The gorillas in the shops normally don't consider this significant and act perplexed when you object.

WHEEL STUDS: The studs on the front end of an XJ are different than the studs at the rear. The studs at the front work like Chevy or Ford studs, with a head and a knurled interference fit. To replace them, you have to separate the brake rotor from the hub -- which means you might as well have the assembly on the bench and be repacking wheel bearings while you're at it. Thread a scrap nut onto the stud and whack it with a hammer to remove. To install a new one, lube the threads well and use a nut and a couple of washers to pull it in.

If you need new studs for the front end, it is possible to find Chevy or Ford studs that will work. The 1/2"-20 threads are common on American cars. What you'll have more trouble with is the head; Chevy and Ford studs typically have a square corner under the head, but the Jaguar front wheel studs have a countersunk style taper under the head. Chuck Sparks points out that this really doesn't hurt anything; find a stud the right length, right thread, and the correct shoulder diameter and pull it in, it'll work fine. However, it's really not too difficult to chuck the studs up in something and grind a small taper on the underside of the head so they actually fit perfectly. Tip: I found that the shaft holding my grindstone was 1/2"-20, so I merely removed the grindstone and used a lug nut to hold a stud onto the end of the shaft. Fire up the motor and hold a file or stone against it, voilà! Tapered head. It doesn't need to be a full taper; just a little bevel on the bottom corner so it sits flush against the countersunk hole will do it.

The studs at the rear are 1/2"-20 thread on both ends with a little shoulder about 1/2" from one end. These are threaded into the hub and staked on the back side to keep them from coming out. In theory you need to have the hub off to replace them, not to thread them in but to do the staking; there's a shield in the way when assembled. You can just screw them in on the car with Loctite studlock and they'll work fine, but each time you have the wheel off make sure the stud is fully seated and secure before putting the wheel back on.

With the hub on the bench, the way to do that staking would be to screw nuts onto all five studs and set it down on a hard surface. Unscrew the nut on the stud getting smacked a little bit to make sure it's firmly against the surface, not held aloft by the other four nuts. That way, the force of a smack will be transmitted straight from the stud to the nut and to the deck, rather than stressing the threads in the hub. The original arrangement uses a cute X staking, like a chisel whacked once and then turned 90° and whacked again, but really you can use a punch stake if you just make a little circle of punches on the end of the stud.

There is one plausible scheme to use non-OEM studs here. Buy generic studs that have a very long 1/2"-20 end and cut them to the overall length you need. Then cut a shallow rounded-bottom groove 1/2" from one end, making sure not to cut beyond the base of the threads; the threads don't really contribute to the strength of the stud, but you don't want to neck down the solid core of the stud any. Fashion a bit of 1/8" wire into a loop that will just fit inside the recess on the hub. Cut this loop in half. Screw in your stud (with studlock on the threads) and hold the two halves of this wire ring into the groove as it pulls into the recess in the hub. This will work sorta like the collets on a valve keeper and trap it all together in the recess. You can stake it if you have the hub off. This all works, but really it's usually easier just to buy the OEM studs.

There are those who don't care for the threaded-and-staked attachment scheme at all; there's not much thread holding the wheel to the car. If you need to replace the rear studs, consider drilling out the threads and boring the holes to a suitable diameter to fit pull-in studs like on the front. You will then need to carefully trim the heads so they don't interfere with the shield on the back side. Even better idea: rather than bore out the threaded holes, drill entirely new holes in between them, leaving the original threaded holes in case you ever want to return to the original configuration.

If the pull-in type of studs get loose in their press fit, the result is usually an obnoxious ticking when rolling slowly. This isn't normally a problem with the XJ with alloy wheels since the lug nuts should be installed with a torque wrench. A gorilla in a tire shop using an impact wrench can screw them up, though. You can tell which ones are screwed up because you can usually wiggle them a bit with your finger. The only solution that seems to work is to replace the studs.

Race cars often have the heads of the studs welded to the hub so they won't get pushed out during a fast tire change in a pit stop. It's not recommended for street cars, though; welds can cause localized stresses and cracks in the hub, and may also cause some distortion.

LONGER WHEEL STUDS: The OEM studs are kinda short; the fronts protrude about 1" from the wheel mount surface. Whether or not you'd like longer wheel studs may depend on the type wheels and lug nuts you're using. If your lug nuts show, you probably have acorn or dome nuts and they may bottom out on longer studs before tightening onto the wheel. You might still be able to use longer studs, but you'll need to be careful and measure the depth of the lug nuts you'll be using with them.

On the other hand, the author's car has a hubcap covering everything and would *definitely* be better off with longer studs. The "Majestik" wheels (from a '90 Vanden Plas) come with black nuts threaded clean through, but when tight the end of the stud is still way down inside the nut! It's better to use longer studs so they protrude through the nuts so you're using all the threads in the nuts.

For the front, you can find an auto parts shop that has a red-and-black metal cabinet of Dorman fasteners and look for stud #258. As described above, it will work OK as is or it will fit perfectly if you grind a taper under the head. When installed, these studs will protrude about 1-5/16" or about 5/16" longer than the originals.

For the rear, Chuck Sparks points out that XJ40 rear wheel studs are exactly the same as XJ-S rear wheel studs except they are 1/4" longer. The part number is CAC 3878.

Of course, there are Chevy and Ford wheel studs in obnoxious lengths like 3", apparently for racing applications. These can be installed using the same methods described above, and then you can cut them down to whatever length you desire.

WHEEL BALANCING: Incompetence is rampant in the retail tire industry, at least here in Florida. Left to their own devices, most of the meatheads in a tire store will happily mount your Jaguar alloy wheels on a balance machine incorrectly, give them a static balance only, then beat the weights onto the rim with a BFH.

The first challenge is getting the wheels mounted on the balance machine correctly. When you mount the wheel on a machine that spins it to check the balance, it must be mounted centered properly -- meaning centered the same way it is centered on the car. On the XJ-S (and on just about any other car), correctly-fitting wheels will be centered by the back side of the center hole fitting closely around a machined diameter on the hub. If the wheel is a style in which the center hole is a couple of inches deep and has a motif cap clipped into the outer opening, note that the inner half inch or so of the center hole of the wheel has probably been carefully machined, while the rest of it may not have been machined as carefully or even machined at all. In the worst case, the two portions of the same hole might not even be concentric, although one would hope that they are very close. The point is, the wheel needs to be held centered on the inside portion of the center hole -- not the outside portion, nor any other part of the wheel. The inside portion of the center hole is how the hub on the car holds the wheel centered, so it must be the basis for the balance machine to hold it centered as well. As you watch the balance machine operator pick through the selection of adapters he has to mount your wheels on his machine, you will understand why it is important to keep an eye on what he's doing and raise objections if he's doing it wrong.

There are two basic types of imbalance. The old-fashioned bubble balancing, which engineers refer to as static balancing, only corrects one type of imbalance -- the type that causes the wheels to hop. This is generally adequate only for wheels that are very narrow, and should be considered unsatisfactory for any modern automobile.

The other type of imbalance, dynamic imbalance, is the type that causes wobble. A wheel that is statically balanced may still be dynamically imbalanced by having a heavy area on the outside edge of the wheel and an equivalent heavy area 180 degrees away on the inside edge. Although the wheel would appear balanced on a bubble machine, when spinning the two diagonally opposite heavy areas cause the wheel to wobble. It's usually not too noticeable on the rear wheels, but on the front wheels it can cause steering wheel shudder. And you may eventually wanna rotate the rear wheels to the front, so it's kinda nice to have them all correct.

To correct a dynamic imbalance requires that weights be placed in two separate planes -- usually (but not necessarily) the inside and outside edges of a wheel. It requires more lead than static balancing. It also requires a machine that actually spins the wheel; the bubble balancer is out. Use of these machines has come to be called "computer balancing". However, note that a switch on the machine allows the operator to specify a static balance only, so asking for "computer balancing" does not guarantee a proper dynamic balance.

The meatheads generally understand that the owner of alloy wheels is not thrilled about balance weights on the visible outside surface of the wheel. They will often ask: "Do you want the balance weights hidden inside the wheel?" and when you answer "Yes" their response is to set the balance machine on "static" and apply all the balance weights to the inside rim of the wheel. This actually makes the dynamic imbalance worse, since even in the days of the bubble balancer the operator knew to put half the weight on the inside edge and half on the outside.

Insist on watching what is going on. The machines normally operate in "dynamic" mode, and there are two displays showing the amount of weight that needs to be added to each side of the wheel. There is also a button or switch marked "static", and when selected the machine will read imbalance values on one display and the other display will go blank. If you see this happen, you need to politely interrupt the balance operator and instruct him to put it back in dynamic mode.

At this point, there will probably ensue a discussion with the balance operator. He will often insist that you have two choices: either you want a static balance, or you have to put up with weights that show -- but he is wrong, you are not limited to those choices. If this discussion deteriorates into an argument, you may have to take your business elsewhere until you find a balance operator willing to work with you to get the balance right.

Eventually, it will probably be necessary to show a balance operator how to do his job. Set in dynamic balance mode, the machine will specify the amount of weight to be applied to each side of the wheel, but you're not going to be applying any on the outside surface. Instead, select a piece of "stick-on" balance weight of the size specified by the machine for the outside edge, but install it on the ID of the rim as far outward as possible, right up against the inward side of the center structure. Then install the weights on the inside edge using either clip-on or stick-on weights, whichever you prefer.

If you have a 5-spoke wheel or some such, you can take this idea one step farther and hide the stick-on weights behind the spokes -- even if the machine tells you to put them between spokes where they show. Simply split the balance weight into two portions, and put portions behind the spokes on either side of the correct location.

Usually, after spinning the tire once more, the machine will indicate that the wheel is balanced. However, in theory both installing the outer weights a couple of inches inwards and splitting a weight into two pieces and spreading it actually require slightly more weight to be used. You can either anticipate this and use a slightly larger weight than the machine calls for to begin with, or you can wait and see if the machine tells you you didn't install enough. Either way, always insist that the balance machine indicates zeroes (0.00 or "Ready" or whatever) on *both* indicators before the wheel is taken off the machine and installed on the car. At this point, the balance operator will probably be astounded; he has never seen an alloy wheel get a workable dynamic balance without the weights showing, and is wondering why nobody showed him how to do it before.

There are newer balance machines that actually have both of the procedures described above built into the machinery. They can properly balance the tires by applying weights in any two planes, not necessarily the outer edges; the desired location for the weights is a separate setting in the balance procedure. They also can "split" a balance weight callout into two smaller weights, telling the operator where to put them both. But if you understand what's going on, you don't need to find this fancy machine; the more basic dynamic balance machine will do the job.

Finally, if you are less than impressed with the competence of the shop balancing your wheels or of the condition or calibration of their balance machine, you can ask to have one of your just-balanced wheels put *back* on the machine and spun up again. Balanced is balanced, folks: if they've done it right, it should come up all zeroes again, even if mounted rotated to a different position on the machine or even mounted on a *different* balance machine altogether. If it comes up calling for weights, either their centering procedure for installing the wheel on the machine is NFG, or their balance machine is out of calibration, or something else -- but you don't really care what, you only know that you are *not* getting a viable balance job here, you might as well head on to another shop.

BALANCE WEIGHTS -- STICK-ON VS. CLIP-ON: Steel wheels commonly use "clip-on" weights that are hammered onto the rim. Some alloy wheels are designed with a rim that can accommodate clip-on weights, but they may not attach as well to the thicker aluminum. And use of a hammer to install is not good for aluminum, especially if the meathead responds to difficulty with a bigger swing.

When the steering on an XJ-S is turned full lock, the clearance between the inside edge of the wheel rim and the front anti-roll bar is very small. If wider-than-original wheels are used, clip-on balance weights may actually hit the bar, resulting in a blip-blip-blip as you roll around a tight turn. And, of course, the balance weights may actually get ripped off.

The proper balance weights to use on alloy wheels are called "stick-on", and are attached to the inner surface of the wheel with a layer of foam tape attached to the back side of the lead weight. One problem is that they are not reusable; once peeled off, the tape is not reusable, and the shops customarily throw them away. I guess using generic foam tape has not occurred to them, or just isn't worth it, even though they often complain loudly that these weights are expensive and charge the customer accordingly.

The problem is exacerbated by the meathead not knowing how to use the machine properly and having to do a by-guess-or-by-gosh balance job. With the clip-on weights, he can just keep prying them off and reinstalling them until he gets it right, but he can waste a lot of stick-on weights. An intelligent operator, of course, will be able to set the machine up properly and get the correct weight applied the first try.

Owners of alloy wheels should always insist on dynamic balancing using stick-on weights in two planes within the wheel -- one near the inner edge, and one just inside of the outer face of the wheel. Since these planes are closer together than the edges of the wheel, more lead will be required to correct imbalances. But the weights won't show, and nobody will need to use a hammer to install them. Always insist that the balance machine shows zeroes on both indicators before the balance is accepted.

The only real problem with stick-on weights is a reputation for getting lost. Since clumps of mud and other debris sometimes gets dragged around the inside of the wheel and jammed between the wheel and the brake caliper, the foam tape can be ripped away. Two suggestions are in order, and neither is likely to be done by the tire shop, so the owner should bring the materials necessary and do them himself while the wheels are off: First, mark the locations of the stick-on weights with a permanent marker. Then, secure them with a piece of aluminum tape (available at air conditioning shops). Don't use duct tape; it quickly dries up and falls off, often taking the balance weight with it. The aluminum tape appears to be light enough to not affect the balance when added; or, to be safe, you could simply add a dummy piece of tape on the opposite side of the wheel.

WHEEL MOTIFS: If you wish to replace the growler motif on an 80's XJ-S wheel, you'll find that the puddy tat itself and the retainer holding it are two separate parts. The puddy tat is C42191 or CAC6502 or CBC2660, and the retainer is CAC5073. However, in the late 80's Jaguar switched to a single-piece item, CCC6347. The one-piece motifs also fit the earlier wheels, but may not match the two-piece motifs well; you'd probably be well-advised to get a set of four.

Also note that Jaguar apparently had some really bad quality control problems with the one-piece motifs around 1990; some of them look really bad, with the puddy tat face distorted as though it has melted, and some of the motifs even fall apart and lose pieces on the highway. Within a couple of years after that, the motifs started looking a lot better, with a clearly-defined and attractive puddy tat face.

The one-piece motifs are available in five different colors; if you need to buy a couple anyway, you might consider finding a color you like.

TICK, TICK, TICK: Chip Lamb had an irritating tick from one of his wheels. He was all set to tear into bearings when Roger Homer pointed out that it may just be the Jaguar logo in the center of a wheel cover coming loose. "Pulled both hubcaps - it *was* the kitty on the right rear. Quick fix with duct tape and some black RTV!"

TIRES: If you want to maintain the originality of the tires on your car, you'd better take them off *now* and store them in the attic! Tire manufacturers change their models regularly and discontinue the older designs. The XJ-S has been out of production long enough that it's unlikely you'll be able to find an "original" new tire for any of them, even the mid-90's models. If you drive your XJ-S, you will *have* to find a modern tire to fit.

Be very careful when mixing tire types, sizes or makes on a Jaguar. The XJ-S and the XJ6 have a suspension design in which the entire suspension assemblies are attached to the car with flexible mounts, and the relative stiffness of the mounts is premised on all the tires being the same. Mixing tire types, even outwardly similar ones, can result in dangerous instabilities in this suspension system. This is no joke; having one type of perfectly good tire on one end and another type of perfectly good tire on the other can result in you being rudely introduced to a tree when you aren't even travelling that fast. If you must put different tires front and rear, take the car for a test drive and put it through its paces away from traffic and trees before accepting the arrangement as safe.

The problems with mixing tire types, combined with the fact that tire manufacturers are constantly discontinuing tire models as they design newer and better tires, means that you will probably want to keep an eye on your wear rates and rotate tires as required to get them all to wear out simultaneously. If you wear out the pair on one end first, you are not likely to find a replacement pair of the same model, so you will be well advised to replace all four tires with a new model -- and you'll end up pitching two tires with good tread still left on them.

When replacing tires as a set, you don't have to stick with the brand of tire that came on the car. In fact, it may be better to change brands according to Michael Neal, who works on Jaguars for a living: "I've seen hundreds of the 215/70 Pirelli P5s rip out at the sidewall near the bead. These are the original equipment tires on the US-spec XJ6 Series 3s and early XJ-S's. Sorry, but I would not even consider buying a set of these. The 235/60 P600s had the same problem." Reportedly the still-later Pirelli P4000's were better.

If you have internet access, you can check for tire availability and prices online. Peter Cohen suggests

http://www.tirerack.com

and David Littlefield suggests

http://www.discounttire.com/dtcs/home.do

“This is the website for Discount Tires Direct, an online version of Discount Tires stores. The Discount Tire site will allow you to look up the right size tire for your vehicle..” Note that there’s an option for checking the local dealers or Discount Tires’ mail-order service, and you want the latter; the pages for the local dealers only lists tires that are kept in stock by the local dealers, and you want to consider special-order stuff for a Jag.

It is impractical to list the attibutes of particular tires in this book, because tire models change so often. All the tire companies have been bought out by other tire companies anyway, it’s nearly impossible to tell which company is actually making your tires any more.

TIRE SIZES: According to Mike Morrin, the pre-H.E. XJ-S was fitted with 205/70-15 tires mounted on 6” wide wheels. A 225/60-15 tire would be effectively the same diameter and a little wider.

The early US-spec XJ-S H.E. was fitted with 215/70VR-15 on 6½” rims. Later models came with 235/60VR-15 tires, still on 6½” rims. In theory these H.E. sizes are a hair larger diameter than the pre-H.E. tires, but there reportedly was no corresponding change in suspension or speedometer.

If your car still has 70-series tires, when they wear out you probably should replace them with 60-series tires; the additional width is beneficial for stability, and there is no appreciable disadvantage with modern tire designs.

Still later cars came with 16” wheels.

The tire size code works like this: The first three digits, such as 215, is the width (mm) of the tire at the widest point -- the middle of the sidewall. It is always rounded to a number ending in 5. The two digits after the slash, along with an implied decimal point, gives the aspect ratio: the height of the tire above the rim divided by the width described above. For the 215/70VR-15, this is .70, and the height of the tread above the rim is 215 x .70 = 150mm. If there is no aspect ratio indicated within the tire size, the aspect ratio is .80. The R in the tire size merely indicates it is a radial tire; it is sometimes omitted. The -15 indicates it fits a 15” wheel.

The one thing you normally don’t want to change is the overall diameter of the tire, since this would affect your speedometer and odometer readings as well as your ride height. Changing the ride height can have adverse effects on the suspension geometry, even if you don’t mind the altered ground clearance. To maintain overall diameter when you go to a wider tire, you also have to change the aspect ratio to a lower value. It is easy enough to calculate the overall diameter given the size; just multiply the width number by the aspect ratio, multiply that result by 2, and add the diameter of the wheel (remember to keep your units straight!). However, remember that the number you started with, the tire width in mm, was rounded to a number ending in 5, and may not even be *that* accurate. The aspect ratio is likewise subject to some creative estimating by the tire manufacturer. Trying to draw conclusions about a quarter inch this way or that is just silly. There are online tire size calculators that give you the results out to several decimal points, but don’t be fooled into thinking that there is really any such accuracy involved. And remember that, once you figure out the diameter, you’re gonna set the car down on this tire and squish it a bit, throwing all your calculations into the wastebasket!

In general, tire manufacturers increase the width number by 20 while decreasing the aspect ratio number by 10 to provide the equivalent diameter tire in a wider size; this is true even if the math doesn’t really come out right -- they make the tires the right size and round the numbers to these sizes anyway.

Tire manufacturers list a “loaded radius” in their specs, the distance from the ground to the center of the wheel with weight on it. This measurement is meant to include the deformation of the tire under load so the consumer can determine the actual ride height, and is usually far more accurate than trying to use the tire size formula since there is no rounding involved in the numbers given.

If you have access to the WWW, there is an online tire size calculator for determining which size tires will replace stock sizes. The URL is

http://www.dsm.org/Fun/TireSize.html

Today, you really don’t need to worry about arithmetic. If you want to move to a wider size tire, you can merely opt for a “plus zero” size on any tire selection listing.

Regarding what will actually fit: In general, the widest tire you can fit on the XJ-S seems to be around 235 or 245, depending on the profile details of the particular brand of tire. However, a slightly wider tire can be fit at the rear by increasing the offset of the rear wheels. The XJR-S took this tact and used rear wheels with 33mm offset and is fitted with 255's at the rear -- but don't try that without either going to the larger offset or flaring the fenders. Since you don't want to change the offset of the front wheels that way, this tactic requires two different pairs of wheels, and rotating becomes problematic.

Within each wheel well at the rear, directly above the hub carrier is a rubber bumper attached to the subframe. At full suspension compression, the top of the hub carrier smacks this bumper. The E-type guys (who have trouble fitting tires wider than 180mm) remove this rubber bumper to allow the installation of wider tires. They then install rubber doughnuts around the shafts of all four rear shock absorbers to provide a bump stop. This idea should work on the XJ-S as well -- but you'll need to increase the wheel offset to widen the tires in the inboard direction without widening them in the outboard direction and rubbing the fenders.

TIRE SPEED RATINGS: If you live in some parts of Europe, you are required by law to fit tires with suitable speed ratings for your car. In the case of the Jaguar XJ-S, that means a V rating or better.

Interestingly, the V rating has changed over the years. In the 80's when many of our Jaguars were built, a V rating meant the tire was rated for 220 Km/h, or 137 mph. Today a V rating means the tire is rated for 240 Km/h or 149 mph. Just as well, since this rating better fits the capabilities of the Jaguar anyway.

The speed rating also used to be indicated within the tire size, as in 215/70<u>V</u>R-15; such were the specifications called out in the glovebox and owner's handbook for the author's '83. This has changed as well, though, and now the speed rating is listed with the load index (see below) adjacent to the tire size, as in a 98<u>V</u>. There remains a special rating called a Z rating that calls for the letter Z to appear within the size; sometimes this is called a ZR rating, since the Z is followed by the R for radial. You can learn all about speed ratings and other tire specifications from dozens of places on the internet.

For Jaguar XJ-S intents and purposes, a tire with a speed rating of V, W, Y listed with the load index and/or a Z in the size is acceptable. Any lower speed ratings (H, U, T, S, whatever) will be illegal in some areas and should be used with caution anywhere else.

Speed ratings are intended to indicate suitability for Autobahn-style driving -- continuous high speed. Generally, the limiting factor is heat buildup in the tire. High-speed-rated tires either run cooler or are made of higher-temperature material, or both. Much of the heat generated is dissipated to the air *inside* the tire and away through the rim, so inner tubes invalidate the ratings (the flexing of the inner tubes themselves *adds* to the heat buildup). There are also concerns about how patching holes affects speed ratings; it is recommended that the owner check the literature that comes with the tires before opting for a low-cost "plug" repair to his tires.

Since the flexing of the tire is what generates the heat, tire manufacturers usually achieve a high speed rating by making the sidewalls stiff. Therefore, the high-speed-rated tires drive differently than normal tires, even at low speed. For this reason, many recommend the V-rated tires even to those who don't drive fast. This is especially true for the XJ6 and XJ-S, because the soft suspensions get downright mushy with the softer, lower rated tires. There are reports that S-rated tires used on these heavy cars will flex so much that they will wear out quickly.

The heat buildup due to tire flexing is also the reason you must have fully inflated tires when driving fast. Blowouts aren't caused by the tire pressure being too high; they're caused by the structure of the tire failing due to excessive heat. If you're going to go fast, it would be better to err on the side of too much tire pressure than too little.

As the tread wears, the speed rating of the tire will actually improve. A thinner carcass generates less heat when flexing and dissipates heat better. There have been promotions claiming street tires were successfully used for racing; in these cases, typically the outer half of the tread was shaved off before the tire was even put on the car.

The Pirellis and Goodyears that came with these cars were designed with a luxurious ride in mind. Most 60-series tires with a V rating, however, are designed with performance in mind, which makes sense to everyone except a Jaguar owner. The original Pirellis and Goodyears are NLA, so any suitable replacement tires are likely to result in better traction and handling but perhaps at some sacrifice in ride quality.

TIRE LOAD INDEX: The load index is a number between 0 and 270 that indicates the load-carrying capacity of the tire at max pressure. There doesn't seem to be any rhyme or reason to the load index numbers themselves; you have to find a chart to determine the rating in pounds or kg.

Iain Burgess says, "The 89 model owners manual says we need a load rating of 98 (745kg) for a 235/60R-15 and 97 (730kg) for the 215/70-R15." It's unknown why the requirement would be different for different size tires on the same car, but the skeptical among us would suggest it's because they are promoting a particular brand of tire rather than providing an honest minimum specification. The fact that their specs would seem to be far in excess of what would reasonably be expected may lend support to this theory: a load index of 98 means the tire is rated for 1653 pounds -- far more than adequate for each corner of a 4000-lb car with 800 pounds of people and luggage in it.

Remember, though, that most of us don't run our tires at the maximum rated pressure; we run them at pressures considerably lower than that, so some margin in the load index would be a good idea. If you install tires with a load index in the 80's the rating is marginal for this car and you might want to keep your pressures up -- especially when loading lots of people and luggage.

This is yet another reason to upgrade to 16" wheels. Burgess claims it's far easier to get tires with adequate load indexes in 16" sizes.

TIRE WEAR RATINGS: They sound useful, don't they? Gary Penovich says, "You can't compare the wear rating from one manufacturer to another. For some stupid reason, that number is relative *only* to tires from the same manufacturer."

UNIDIRECTIONAL: Some modern tires are "unidirectional", meaning they are intended to roll in only one direction. They have a distinctive tread pattern intended to efficiently clear water at speed. This must be a good idea, because racing rain tires all look like this. The disadvantage is that you cannot rotate tires left-to-right without pulling the tires off the wheels and remounting. Since rotating front-to-rear is usually what you want to do anyway, this doesn't present a problem.

Obviously, if you use a unidirectional tire as a spare it'll be on the correct side on one side of the car and wrong on the other side, so be careful about which side of the car you run over nails with! Seriously, they'll work fine rolling backwards, they just won't clear water as well at speed. If you have one rolling backwards, be careful in the rain.

Typically, all four tires in a set of unidirectional tires are actually the same tire. They must be installed so they all roll forwards, so the right side of the tires on the right side of the car will be visible while the left side of the tires on the left side will show. This means the labelling on the sidewalls is the same on both sides of each tire so it looks the same on both sides of the car; the manufacturer cannot put raised white letters on one side or some such and give you the choice of mounting them facing inward or outward.

Despite the similar appearance on each side, the serial number -- which includes the date of manufacture -- is only on one side of each tire, so they'll be easily readable on one side of the car but you'll need to look on the inside on the other side of the car.

ASYMMETRICAL: Asymmetrical is not the same thing as unidirectional. Asymmetrical tires are different on the inner edge than on the outer edge. Sometimes it's just the tread pattern -- closer to a "slick" on the outer edge for cornering with bigger grooves at the inner edge for water clearing -- while some tires actually have different rubber compounds on the different sides.

If your tires are just asymmetrical, you could rotate them all around the car since once mounted on the wheels correctly the inner edge will be the inner edge whereever you put them. However, most asymmetrical tires are also unidirectional.

This means you cannot rotate them side-to-side, period; while you could rotate the unidirectional tires side-to-side by remounting them on the wheels, doing this with an asymmetrical tire will put the inside edges on the outside. Asymmetrical-and-unidirectional tires must actually be different tires on the left and right side; if ordering online or some such, be sure to order two lefts and two rights.

TIRE AGE: You might want to be careful about buying tires that have been sitting on the dealer's rack for several years. David Littlefield says, "If you read the fine print in the tire warranty, it will tell you that the warranty for tread life and defects is only good for a *maximum* of five years from the date of *manufacture*. Thus, when you buy a three-year-old tire your actual warranty is only two years."

The concern about buying old tires may be news to some people, but it's a legitimate concern here. The tires that fit the XJ-S with 15" wheels are fairly unique; in fact, the 235/60R-15's appear to be a Jaguar-only application. Hence, it's entirely plausible that the tire dealer -- or the supplier he gets his tires from -- has had that set of tires sitting around for too long waiting for a Jaguar owner to sell them to. While buying tires for your Toyota might not raise such concerns, you might want to pay attention with the Jag. Fortunately, the tires that fit the XJ-S with 16" wheels appear to be shared with Camaros and Firebirds, so old stock can be expected to be less of a problem. Opting for 225/60R-15's may avoid problems as well, since this size is reportedly used on Mustangs.

The date of manufacture is also included in the data written on the side of a tire. Prior to 2000, the last three digits following the DOT serial number were two digits for week of year and one digit for year. If there is a little triangle after these three digits, the tire was made in the 1990's; if not, it was made in the 1980's. Starting in 2000, it became the last four digits, two digits for year.

15" TIRE AVAILABILITY: All of the above seems like a lot to think about, but when you get to the tire dealer and actually try to buy tires you may find things get a lot simpler. The tire companies make tires to fit cars rather than in a general range of sizes and specifications, so the tire dealer just types in your make and model and up pops the tires intended for use on your car. For example, for the '83 the computer will list all the 215/70R-15's as original size, 235/60R-15's as a "plus zero" size, and various 16" tires as "plus one" and 17" tires as "plus two".

Once on that computer, you'll find that most of the 235/60R-15's have a load index of 98. That's correct, the tire companies intend them to fit Jaguars. Interestingly, many of these tires are not V-rated; they presume you don't need the speed rating in the US.

If you have trouble finding 60-series 15" tires, Wade Ramsey suggests: "215/65-15's will work as well. What I mean by "work" is the outer diameter for both tires is almost identical. The 235/60-15 OD is 26.10 inches, 215/65-15 OD is 26.00 inches, while the OEM 215/70-15's OD is 26.85 inches. The reason I mentioned this is simply to let others know that there is an *abundant* supply of 215/65-15's available in H and V speed ratings."

Another option is to go to the plus-zero size tires appropriate for the pre-H.E. -- 225/60R-15. These tires invariably have a load index of 95, apparently because they are intended for a Mustang and that's what Ford says is the load index needed on that car. This is still a load rating over 1500 pounds per tire, seemingly plenty for an XJ-S and possibly even for a Jaguar saloon. And many of the tires available are V-rated or better, often Z-rated.

As of this writing, this author would recommend you go to the 225/60R-15 when you get a chance. Not only is the selection far greater, but there is less chance that the tire model will be discontinued within six months of buying the set leaving you screwed when you tear up one tire on a pothole.

It's easier and often cheaper to buy tires with adequate speed and load ratings for 16" wheels than for 15" wheels. Since this is likely to be more and more true in the future, anyone considering buying new wheels would be well-advised to opt for 16" wheels.

TIRE PRESSURES: John Goodman says, "Most of us here (UK) have long junked our 15" wheels and run 16" or 17" rims, but the less competitive drivers, or those who do a lot of city streets always keep the tyre pressures down quite a bit. We run them up to 8psi lower than the handbook stated figures. My handbook says 35psi front and 32psi rear, so I run at 30 front and 27 rear. On 245/50 or 225/55 x 16" this gives only *very* slight loss of handling at extremes of cornering, but a very noticeable improvement in ride comfort. Has no effect on tyre wear either. This was a local Jaguar dealer recommendation!!!" Note: perhaps a workable plan for those who value ride quality, but high continuous speeds should be avoided without full pressure. Also note that lower pressure will provide less protection for your rims, so don't drive over curbs at speed.

Goodman's car is an XJR-S, perhaps explaining those high tire pressure recommendations; the earlier plain-vanilla XJ-S's recommended rather low tire pressures (on narrower tires to boot!) and then recommended you go to higher pressures if driving fast.

Regardless of the peculiarities of one XJ-S vs. another, one thing must be pointed out: the nearly religious devotion many automobile owners pay to the "recommended tire pressures" is *completely* uncalled for. As long as you don't exceed the pressure limit written on the side of the tire itself, tire pressures can be varied considerably to provide the owner with the desired performance and ride. If the handling balance doesn't seem right to you, you can also vary the front/rear pressure distribution to alter it.

For optimum tire wear, an excellent plan is to keep an eye on the wear at the edges of the tires vs. the center. If they're wearing faster in the center, lower the pressure; if they're wearing faster at the edges, raise the pressure. This helps configure the car for the owner's driving style, since a driver that corners hard will scrub the corners of the tire more and *should* be using higher pressure. It even helps compensate for drivers that dive into turns as opposed to drivers that accelerate through turns, since the different styles will cause different tire wear patterns and correspondingly altered pressures. Of course, bad alignment or other complicating factors can easily screw up the data.

Rob Ward tried to follow that guidance and ended up with tire wear in the center of the tread of his Goodyear Eagle NCT 235/60ZR-15 rear tires despite low pressures. In response, someone posted this excerpt from a discussion on a Porsche list: "My info, which is slightly counter-intuitive, is that fatter tires need slightly higher inflation pressures to stiffen the tire carcass and prevent the centerline bulge that causes premature wear in the middle of the tire. Apparently, the theory is that no matter what you do, fat tires will tend to higher diameters at speed in the middle of the tread, due to centrifugal force when you twist it up. Increasing the tire pressure tends to stiffen the tire, preventing the center bulge, rather than accentuating it as one might expect. It's actually enough more complicated than that that you need empirical data to come to any kind of useful conclusion. I put 42-44 psig in my 245/45x16 rears and they have always seemed to wear evenly."

If you can't tell, the XJ-S is nose heavy, and one would expect that the front tires will always need more pressure than the rears -- unless you're carrying sandbags around in the trunk.

Paul Bachman says, "The strangest thing happened yesterday. I was checking the tire pressure on the XJS and discovered that they were quite low at about 28 PSI. After bringing them up to proper pressure (32 PSI), the minor (but irritating) shudder in the brake system completely disappeared! Coincidence? I don't think so."

WINTER TIRES: In some US states, you are required by law to have either snow tires or "all season" tires on your car during the winter months. According to Bill Weismann, "For a tire to be labeled "All-Season" it must be labeled (By federal law...) "M+S" on the sidewall.

"It's a lot more than tread design that qualifies a tire as an all-season; the main problem with High Performance tires is that they have to be at somewhat high temperatures in order for them to "stick". An all-season tire usually offers two features for it to work in the snow.

1) A tread compound that will remain pliable in the cold (below 40° F or so..)

2) A tread design that will work in snow."

Europeans laugh at the idea of all-season tires. For people in places like Norway, an all-season tire means it sucks in all seasons. If you get only a couple of weeks of inclement weather per year a set of all-season tires is a good option, but if you get a serious winter where you live you should opt for a separate set of wheels and tires for winter. Some tire stores and garages offer to store your alternate set of wheels for you.

As long as you're going with a separate set of snow tires for the winter, you should also note that, in snow, the narrower the tire the better. For the XJ-S you'd want to go back to the 215/70R-15's and possibly even to a 195R-15. You also will want to find some really junk wheels since snow, sand, and salt make both steel and alloy wheels look really crummy very quickly. Stainless steel wheels would be ideal, but apparently the wheel manufacturers haven't figured that out yet.

Carefully consider your options. Winter driving often involves snow, ice, mud -- as well as a far portion of nice clean pavement, since many road departments are really good at keeping roads clear. One highly-rated type of snow tire is called a Blizzak which has a porous compound that grabs snow and holds on until it looks like your tires are made of snow; they work really well on dry snow, but are reportedly not much good in mud, wet snow, ice, or dry pavement, and they wear quite rapidly on dry pavement.

Studs are another option that the owner might regret. Great on ice, but not particularly beneficial anywhere else. Also, they will damage pavement, so they are frowned upon or banned outright in some areas. They also have a detrimental effect on the rolling resistance of the car, so your fuel economy gets much worse and the car feels like the brakes are dragging or something.

As far as speed ratings go, snow tires typically have a speed rating of Q. Don't drive them fast. A rubber compound that works in freezing weather will *not* like the heat generated by high speed.

BRAKES

BRAKE FLUID: Use DOT 4. Period.

DOT 5 BRAKE FLUID: Many people swear by "Dot 5" silicone-based brake fluid, and others swear at it. Silicone brake fluid does not absorb moisture, does not harm paint when spilled, and has a very high boiling point. It is also non-toxic.

Some of the arguments are based on it not absorbing moisture. If there is no water in your brake system to begin with, theoretically none will get in by being absorbed by the fluid in the reservoir. But if there is water in the system to begin with, the silicone fluid will not absorb it, and it may puddle in local spots and cause corrosion.

Silicon fluid absorbs more air than conventional fluid, meaning that the brake pedal will feel spongier, even when fully bled. Of course, this will not be apparent at first, since it takes some time to absorb air within the reservoir and for the air to diffuse throughout the system.

It is important that the two types of fluid not be mixed. Silicon fluid is less dense than normal fluid and won't mix with it, so it is theoretically feasible to fill the reservoir with silicon fluid while bleeding the conventional fluid out at the wheels. If you've had the calipers apart, you probably don't believe this; maybe it'd be better to only change fluid types in the midst of a full caliper rebuild.

The name is a deliberate misleader. DOT 3 and DOT 4 brake fluids are referred to as such because they conform to Department Of Transportation standards. "Dot 5" silicon-based fluid, however, is a trade name, not a DOT standard. There are even reports that DOT has now issued a standard #5, and it is *not* for silicone-based fluid but for something else.

Older (pre-XJ-S, actually) Girling systems require DOT 4 fluid to keep the natural rubber seals pliable to seal properly. Some components are reported to get hard when exposed to silicone fluid; others are reported to absorb too much silicone and swell so much as to jam the works.

According to Jim Beckmeyer, who had a master cylinder resleeved: "White Post (page 703) said that the warranty would be voided if I used DOT 5". Draw your own conclusions.

WHEN TO BLEED BRAKES: Bleeding the brakes is essential after disconnecting brake lines in order to get air out of the system and ensure a "hard" pedal. Bleeding is also a periodic maintenance action, sorta like changing the oil; brake fluid absorbs moisture, either that was already within the system or from the air in the reservoir, and this moisture is not good for the insides of the brake cylinders. Moisture also lowers the boiling point of the fluid. Also, the fluid eventually becomes contaminated with tiny particles of metal from wear within the cylinders, and the particles only serve to accelerate the wear. So it is beneficial to occasionally bleed the brakes even if there is no air in them, and to bleed them enough that the entire system is filled with fresh fluid.

Steve S says, "In Delphi-AP Lockheed tech notes I came across the following quote:

> In addition to regulations that define performance hydraulic brake fluids are required to meet international standards with regards to their colour. The following classifications have been established:
>
> - less then 0.006 Abs Colourless
> - 0.006-0.100 very pale straw
> - 0.101-0.197 pale straw
> - 0.198-0.296 straw

- 0.297-0.397 very pale amber
- 0.398-0.530 pale amber
- 0.530-0.800 amber

The figures relate to Abs (absorbance units). Delphi Lockheed ensures its colours conform by using an in-house absorbance scale at 455nm with a 1cm cell.

End quote."

This means that the color of the brake fluid indicates how much moisture it has in it. So, it needs to be close to "colourless"; if it's closer to "amber", it's time to bleed that stuff out and get new, dry stuff in. Of course, you can't see the color of the fluid anywhere except in the reservoir, but that's where moisture typically gets into the system in the first place.

Modern brake fluid reservoirs are translucent white plastic. This is so that you can see not only the level but also the color of the fluid without removing the cap, since removing the cap introduces more air and moisture into the system. Of course, with the OEM reservoir on the pre-ABS XJ-S, the reservoir is vented anyway so it will gradually gain air and moisture even if you don't ever remove the cap; see the idea for replacing the reservoir on page 596 if you'd like to correct this shortcoming.

BRAKE BLEEDING: Before beginning the bleeding procedure, remove all of the old fluid from the reservoir using a turkey baster or something. And, of course, get any dirt or crud out that you can. It simply doesn't make sense to try to pump that crap through the system to get it out; get it out the easy way, and fill the reservoir with fresh, clean fluid before starting.

Bleeding the old-fashioned way requires two people. One person sits in the car and "pumps" the pedal to get the pedal up where it belongs, and then holds pressure on the system while the other person opens one of the bleed screws to allow the fluid to squirt out. A small piece of hose routed into a container helps reduce the mess. When the bleed screw is opened, the pedal will go to the floor, and the person in the car must *keep* it there until the bleed screw is closed once again; if the pedal is allowed to rise, it will draw air back in through the bleed screw. After the bleed screw is closed, the pedal is pumped back up and the cycle is repeated. If a clear hose is used on the bleed screw, it is easy to see when the crud is gone and clear fluid is coming through. You must pause every now and then to top up the reservoir with fresh fluid.

If you want to make things easier or require only one person, there are numerous gadgets available to help. Dan Welchman suggests the "Eazi-bleed" kit: "I think they're made by Gunsons but I'm not sure. This device uses your spare tyre as a compressed air reservoir which pressurizes a large plastic brake fluid reservoir via a hose and footpump-style valve connector. A tube dips into the bottom of this reservoir and feeds fluid up to an air-tight cap that screws onto your brake fluid reservoir on the car (the kit comes with a wide range of different caps and rubber gaskets to fit most cars).

"Once you've fitted this and got it air-tight you can bleed the brakes by just opening each of the nipples and letting the fluid flow out until it's bubble free (or longer if you're changing the fluid). No pumping, no assistant needed, and no worrying about having to top up the reservoir for fear of running out of fluid and pumping air through the system. They're extremely cheap and work pretty well."

Many owners install Speed Bleeders, not only because it makes bleeding brakes quicker and easier but it also makes it a one-man job. It's just a bleed nipple with a check valve in it.

Speed Bleeder Products, Inc

13140 Apakesha Rd. Newark, IL 60541 USA

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Toll Free Number 1 888 879 7016

e-mail: speedbleeder@earthlink.net

http://www.speedbleeder.com

BRAKE PAD WEAR WARNING SYSTEM: The XJ-S doesn't have one! What a cheap car. Even the author's mid-80's Hondas have little warning squealers on the pads; when the lining gets too thin, the squealer contacts the spinning rotor, and the resulting racket is usually enough to get the owner to visit the shop and complain even if he has no idea what the squealer is for. The Jaguar XJ40 goes a fancy-schmancy route, and actually has little electrical contacts in the pads connected to a warning light on the dash. But the XJ-S has nothing, zilch, nada; the first indication the driver gets that the pads are worn is the expensive sound of steel pad backing plate against iron rotor. Ray Thackeray says, "I was shocked to find my 1995 XJ-S didn't have pad warnings - I just had to replace the disks because I started grinding."

Of course, many Jaguar owners would replace the rotors when replacing pads as a matter of course, so saving the rotor may not be an issue. But steel against iron also provides really lousy braking, so it is a good idea from a safety standpoint to replace the pads before the linings are gone. Not only will steel on iron reduce braking effectiveness, but the fact that it will probably do it on one wheel before the others may also surprise you with a violent pull.

The XJ-S owner would obviously be well-advised to inspect his linings every now and then -- even though it requires getting under the car to inspect the rear ones. The lining on new pads is 3/8" thick. The Jaguar literature specifies a wear limit of 1/8"; this is apparently conservative since the linings are only 2/3 used up, but they are cheap so replacing them at this point is a reasonable policy. Note also that the rear pads could theoretically be used right up to just before the steel backing plates hit, but the fronts have anti-rattle clips that sit against the pad and will be the first thing that hits the rotor when the linings get thinner than the wire that clip is made of.

Actually, there may be another reason to replace pads with that much thickness left on them. Roger Bywater says the 1/8" minimum thickness is "to retain adequate heat barrier to the fluid." In other words, the facing material itself serves as a layer of insulation to keep the heat generated at the friction surface from getting to the brake fluid. Of course, if you always drive gently enough that the brakes never get very hot, you might not care.

If you keep track of your pad wear rate and don't change your driving style, you can usually predict fairly well when you need to start checking for worn pads. Of course, it still wouldn't hurt to check them every now and then; it's a good way to catch other problems such as leaky calipers or sticking caliper pistons.

CHOOSING NEW PADS: Choosing new pads is largely a matter of matching the product to your driving style -- which means that you, as the owner of the car, should be involved in the decision. Merely allowing a mechanic or dealer to install whatever pads they normally provide is not necessarily the best way to maximize your driving pleasure and safety.

Much of the discussion of pads -- and brakes as a whole -- centers on the issues of how well they perform when hot vs. when cold. So, the first thing that needs clarification is just what is meant by "hot" and "cold". We are talking about when the *brakes* are hot or cold, not the engine. If you've been driving down the freeway at 70 mph for the past hour, your brakes are cold -- but if you just used them hard once coming to a stop on the exit ramp, they are now hot. Whether or not brakes are hot depends only on how hard you have been using them in the past few minutes. And they cool down faster if you've been moving than if you've been parked.

It's simply amazing how many "experts" miss this very simple point. If your brakes don't work right the first time you apply them in the morning but work fine the rest of the day, that has nothing to do with hot vs. cold. You have some other problem, possibly a sticking caliper, but very likely either your pads or rotors are rusting and the first application in the morning scrapes all the surface rust off.

Obviously, if you are going fast enough, the *first* application of the brakes could result in hot brakes by the time the car comes to a stop. The most severe test on level ground, though, is in accelerating to around 60 mph and coming to a halt repeatedly. If you accelerate to higher speeds, there is more time between applications to cool down, and more airflow around the car to help cool the brakes. Of course, the real torture test for brakes is going down a mountain, where you can easily perform such a test without even using the engine -- or worse, using the engine to accelerate to 60 mph much faster than you could on level ground -- and then using the brakes repeatedly or constantly to limit speed. It is not reasonable to expect Jaguar -- or *any* automobile company -- to design brakes that will withstand whatever downhill road you can possibly find. If you are going down a hill that is clearly beyond the norm, either proceed slowly (which allows the brakes more time to dissipate heat), or downshift to a lower gear to use engine compression to absorb some of that energy.

Just driving around town, gently applying the brakes when you come to a stoplight, etc., results in cold brakes at all times. The only time Granny will *ever* experience hot brakes is if she goes down the mountain road, which of course makes it all the more dangerous since she probably has no idea what she's doing nor what to do when her brakes begin to fade. Driving that Cadillac at 25 mph may make some sense after all.

From a safety standpoint, for street use it is of utmost importance that the brakes work well when cold. Your typical panic stop is done with cold brakes. This should be kept in mind when considering new pads.

In simplest terms, people talk about three types of brake pads: organic, metallic, and semi-metallic. Organics are best considered a cold-stop pad only. They have four advantages: 1) They generally require the least pedal pressure for a given braking action, making them popular with Granny and her arthritic legs; 2) They wear themselves out without doing much damage at all to the rotors; when replacing organic pads, not only may you not need to replace rotors, you may actually get away without even having them turned! 3) They are quiet; you basically cannot hear the brakes in operation; and 4) They are cheap.

Their disadvantages show as soon as they get hot, though. Organic pads have a relatively low melting point, and the melting point is what results in "brake fade" -- the friction surface of the pad melts, lubricating the brake. When this happens, the driver still feels a "hard" pedal, but the car doesn't want to stop. Organic pad materials don't conduct heat very well, either, and this results in the fade being very sudden and complete; the brakes at one end of the car go from working properly to basically not working at all very suddenly and with little or no warning. And when the brakes at one end quit, the other end (which is usually pretty hot by now already) takes up the additional load and promptly fades as well. The suddenness of the transition from good brakes to no brakes is arguably as much of the danger as the fact that they fade at all.

The other extreme is metallic pads. The friction material on such pads is typically sintered iron or the like. Having the melting point of iron, such pads are pretty much impervious to fade up to the point where iron melts -- at which point your rotors are in trouble! This makes metallics the traditional choice for racing, but unfortunately they have disadvantages for street use. First, they tend to build up a surface layer of rust -- which can cause really serious problems on that first stop in the morning. Second, they require a good deal more pedal pressure to effect a stop -- which the racers actually consider an advantage, since the higher pedal force makes it easier for them to modulate their braking. But Granny probably won't like it. It was a much larger problem prior to the advent of power brakes, of course. Third, their coefficient of friction is generally higher when warm than when cold (the iron gets "softer" as it gets hotter, giving it more grip), so stopping the car when the brakes are cold -- which is basically every stop in typical street use -- requires that much more pedal effort. Fourth, they make a considerable amount of noise. We're not talking about squealing here; squealing can be a problem with any pad, but is easily corrected with the proper application of anti-squeal compound to the back of the pad. The noise we're talking about here is a scraping sound, the sort of sound you'd expect from metal-on-metal. Fifth, metallic pads play hell with the rotors; whenever the pads are replaced, you'll be replacing the rotors as well.

Semi-metallic pads have a friction material that is typically an organic material with particles of metal interspersed through it. To a certain extent, this represents a cross between the organic and metallic pads; when the organic portion fades is just when the metallic portion is getting heated up enough to work best, so with any luck at all (or careful design on the part of the pad manufacturer) the pads will seem to work equivalently well either hot or cold. There's more to this than the simple mixture of friction materials, though: the metal particles -- which often look like shavings -- help to conduct heat away from the contact surface, and therefore help keep the organic material cool and resist fading. Some semi-mettallics appear to have copper in them instead of iron, apparently trying to maximize this effect -- or maybe just to avoid the rusting problems. With either copper or iron, semi-metallic pads not only have far greater resistance to fading than organic pads, but when they do fade they seem to do so gradually, telling the driver that he's getting close to trouble and perhaps should take caution.

Of course, in this day and age this discussion must be considered oversimplified at best. There is also a type of pad referred to as "low-metal", apparently similar to semi-metallic only leaning closer to organic. Kevlar, basically a type of really strong plastic, is available in pads. Asbestos is still around, but nowhere near as popular as it once was -- but you can get pads made with ceramic fibers which behave very similarly to asbestos, some suggest even to causing similar health problems. You can now get pads with carbon in them; carbon has a much higher melting temperature than iron but doesn't conduct heat well at all. You can even get carbon-carbon pads (carbon fibers bonded together with a carbon substrate) which will hold together until the rotors melt -- which, of course, helps explain why many racing venues have gone to carbon rotors as well.

In the US, the DOT now requires that new pads be marked with a pair of letters indicating their coefficient of friction (CF). The first letter is the CF at room temperature, and the second letter is the CF at 600°F -- which is not really all that hot as brakes go, possibly indicating DOT's concern with panic stops rather than performance under severe or racing conditions. Whatever, if you have power brakes it's probably of little concern to you just what the letters are; if the CF is low, you just push a little harder on the pedal to stop the car. Your bigger concern should be that the two letters are the same. If the first letter indicates a higher CF than the second, these pads fade a little by 600°F, which is a pretty low temp to be fading at. If the first letter is lower than the second, these pads don't work as well when cold as when hot. Of course, being only one letter off or so is probably not a big deal.

You might also note that the letter E in the DOT designation indicates a CF that is fairly close to bare steel-on-steel. If you are the type that never checks for pad wear until disaster strikes, this might actually be important. The XJ-S has no warnings of pad wear until the lining is gone, and when that happens you will be running steel-on-steel -- and probably on one wheel first. If the linings have a CF a long ways from that of steel-on-steel, your brakes suddenly pull to one side -- if it's the front brakes, probably pretty severely. If the CF is E, though, it stops pretty well the same way it did before, it just makes a lot more noise. Still, this is a minor point at best; the better idea is to be inspecting the pads periodically and replacing them before they're gone.

You also want the front pads to match the rear pads to maintain brake balance (the importance of brake balance is discussed on page 431). This important criteria is confirmed by Jaguar; with VIN 109447, the XJ-S switched from organic pads to semi-metallic pads from the factory, and notes in the parts list indicate clearly that if one end of an early car is upgraded to semi-metallics, the other end must be upgraded at the same time. It is of considerable importance from a safety standpoint that the pads behave similarly both hot and cold. At the very minimum, the CF letter designations on the pads should be the same for the front and rear; better yet, just use the exact same brand of pads on both ends of the car.

It has come to this author's attention that many so-called experts consider it a good idea to use semi-metallic pads at the front and organic pads at the rear, "since the fronts run hotter." This dangerous concept is apparently so popular that many shops don't even discuss it with their customers, they just go ahead and install the pads accordingly! For your safety, this is one place where you need to have a discussion with the shop working on your car. If they subscribe to this idea, tell them in no uncertain terms that you do *not*, and insist upon matching pads front and rear. If they have a problem with that, take your business elsewhere.

REPLACING BRAKE PADS: Replacing brake pads in Girling brake systems -- if you don't need to turn or replace the rotors -- is pretty easy: Just remove the retaining pins, slide an old pad out, squeeze the piston back into the caliper to make room for the thicker new pad, slide the new pad in, repeat with the other pads, and reinstall the retaining pins. There are a couple of tips to add here, though.

First, although you can just squeeze those pistons back and push the brake fluid back into the master cylinder, it's a better idea to open the brake bleeder and squeeze that fluid out of the system instead. This tip goes from being merely a good idea to absolutely imperative if you have ABS brakes.

Second, it is recommended that you remove and replace one pad at a time. When pushing that piston back, even with the bleed screw open, you may push another piston out if there isn't a pad in its way.

BEDDING IN NEW BRAKE PADS: The frequency of this complaint, on Jaguars as well as other cars, indicates that the following advice should be followed closely. Allan Charlton explains: “My son works in a car parts firm, and they have had disk pad bedding-in problems. It seems that the new asbestos-free pads need to be bedded-in properly or they can cause damage. In their experience (mostly VW Golf, but also BMW and M-B) disks were blued and warped, but the following procedure has eliminated the problem entirely.

“Accelerate to 60 km/h. Use moderate brake pedal pressure to slow to 5 km/h. Do not stop the vehicle, but accelerate to 60 km/h again. Repeat ten times, with about 500 metres between applications, then stop and let the brakes cool.” Note: it’s probably not really a good idea to stop. A better idea would be to continue driving for at least ten more minutes or so, allowing the rotors to cool while turning rather than while parked.

“Use the brakes moderately for the next 300 km, and do not get them hot. After that, they should be OK. The procedure is intended to be used when you first install the disks--it won’t repair damage already done.”

Peter Cohen adds, “Jaguar actually includes a paper with approximately these instructions in the box with their brake pads.”

It’s not entirely clear just what this is supposed to accomplish. The iron rotors are not the problem. The cast iron either has casting stresses, or it doesn’t; if it does, they’re gonna warp the first time they get hot, and a bedding-in procedure won’t stop that. If they run straight and true, you can warp them by overheating them and then parking or otherwise abusing them, but under normal circumstances they will work fine for their life -- even if used hard.

The problem is apparently in the pads themselves. One idea may be that the pads are not perfectly flat and mated to the surface of the rotor to begin with, and such a procedure is needed to get them applying consistent friction across the surface -- but it’s not clear why you couldn’t get there by just using them for a while rather than needing to do this bedding-in procedure.

There is something about new pads that isn’t good. Apparently, the manufacturing process results in the surface of a new pad that is different than the interior of the pad, in much the same way that the surface of concrete is smooth while the interior is full of rocks. This virgin surface may not only result in different braking characteristics when new than after bedding in, but it may cause some other detrimental effects. Apparently one problem is that this new surface may deposit substances on the rotor, and only in some places rather than all over. Then, with continued light use, the areas where the deposits are are protected from rotor wear while the uncoated areas wear, and from then on the inconsistent wear patterns result in pulsing brakes -- even after the deposits are gone.

Starting with VIN 125760, the XJ-S came fitted with “scorched” pads. It is unknown whether or not this was intended to address the new pad problems, but it’s not likely they did it for nothing! Various aftermarket brake pad companies offer “burnished” pads or “machined” pads, either of which may be methods of getting rid of the virgin surface before installation.

BRAKE HOSES: All automobiles have flexible hoses connecting the hard metal brake lines on the car out to the brake calipers that are bouncing up and down with the wheels. Most cars have one hose per wheel, but Jaguars with inboard rear brakes are a little different; since the brakes are at the final drive unit rather that bouncing up and down with the wheels, a flexible hose to each rear wheel is not required. However, since the entire subframe is attached to the car with rubber mounts, a single flexible hose is used to connect from the car to the subframe. Hence, there are three hoses on the XJ-S with inboard rear brakes: two front and one rear.

As one might expect, such hoses won’t last forever. Like other items made of rubber in the car, they need to be replaced periodically -- preferably *before* they fail in this case.

The OEM brake hoses come with a stripe down the side. It’s there for a reason: so you can tell if you’re twisting the hose as you install it. Make sure you don’t.

The front brake hoses on the XJ-S come with a coil around them. This helps prevent kinking as the steering and suspension move, and it also help protect the hose from abrasion if a tire manages to rub against it. On some of the original hoses, this coil was plastic. On replacement hoses, it's often steel. Either seems to work fine. However, it's a simple matter to unwind the plastic ones off the old hoses, while the steel ones get thrown out with the hoses. If your old hoses have plastic coils, you might want to keep them just in case you ever need to install them on replacement hoses.

BRAIDED BRAKE HOSES: When replacing hoses, owners often seek something *better* than the OEM -- usually deciding right off that braided stainless steel hoses simply *must* be better. Unfortunately, that is usually false; the OEM hoses may look plain, but they are excellent and safe, and one should be very careful indeed that replacing with something prettier isn't taking a serious risk.

Mike Morrin says, "In *this* country (New Zealand), stainless steel braided flexible brake hoses are illegal." Brian Schreurs adds, "They were in the US as well, until quite recently, for the simple reason that they could not be made (or no one was willing to make them) to federal DOT standards. Just in the last couple of years a company has started making DOT-legal steel braided brake hose."

Jim Downes explains: "I have seen steel braided lines being the cause of the suspension of an aircraft's airworthiness certificate. This resulted from specific, documented cases of the line flexing due to movement and vibration. In turn the braiding cut the internal material. The other argument against steel braid is that its presence is useless as a means of containing any liquid, yet it prevents any kind of inspection of the internal components."

Apparently, the DOT-approved lines are teflon tubing surrounded by braiding. The teflon tubing is fully capable of holding the fluid pressure without the braiding, but is susceptible to stone damage so the braiding serves as physical protection. The stainless steel braiding won't chafe the teflon, either, it will simply slide back and forth on it without discernable damage.

When ordering aftermarket brake lines, you need to double-check that what you are ordering will fit -- see

http://www.jag-lovers.org/xj-s/book/SSBrakeHoses.html

for details on why. For the front of the XJ-S, each of the two front hoses needs to be about 18" long tip-to-tip and have 10mm x 1.0 threads on both ends. For the rear of the pre-1994 XJ-S, the single hose used needs to be 10" tip-to-tip and has the same 10mm x 1.0 threads. Besides the thread requirements, the fittings also must be "bulkhead" fittings, meaning they must have the extra length necessary to insert them through a bracket and thread a nut down to hold them securely and still have enough thread left to attach the rigid line without the coupling nut bottoming on the mounting nut. Of course, if you plan to replace the hard lines that these hoses connect to or change the mounting scheme, you can end up with whatever fittings and lengths you wish.

Note also that some suppliers provide braided brake hoses with AN fittings on the ends and some screw-on adapters to connect to the fittings on the car. This is not really a problem as AN fittings are quite reliable, but nevertheless it would obviously be preferable to get hoses with the correct fittings so adapters are not necessary. Walter Acker IV found a company that will provide such hoses custom-made:

Baker Precision Bearing Company
1-800-959-7757
e-mail: Baker16@ix.netcom.com
http://www.bakerprecision.com

"The cost of the hose was less than the price of a new rubber hose." In order to get them right, Baker Precision wants you to ship them one of your old hoses.

Either the OEM rubber hose (which actually is a very tiny plastic tube surrounded by a very thick rubber casing) or the teflon surrounded by braiding is probably an excellent hose material for the application, but the attachment schemes used to fasten these hoses to the fittings seem to differ. Of the braided hose assemblies I have seen, the braid/hose is slid over a barb and a separate sleeve is crimped down onto the outside of the braid to secure the hose to the barb. As a result, the entire weight of the hose is supported by the barb itself -- and the barb is pretty tiny on a brake line. One could easily envision this barb snapping off if the hose has been bouncing around for a while or something yanks on it hard enough.

One could also envision the hose pulling off of that barb, or being blown off by high pressure. The chances of these problems occurring may be small, and nobody has reported such problems, but nevertheless it's something to think about.

Conversely, the OEM hose has a vastly superior attachment scheme. The hose is once again crimped onto the barb, but the sleeve that is crimped around the hose is not a separate item -- it is part of the fitting itself. Hence, the crimped sleeve provides mechanical support for the hose and securely prevents it from being pulled off the fitting or blowing off. If you hooked a tractor to this hose, you'd probably rip the hose apart before you got it to come off the fitting.

If you can find a braided hose made with the same type fittings as those used on the OEM hose, go for it. If you can't but nevertheless insist on replacing the OEM hoses with braided hoses, *don't* try to use hoses that mount the same way the OEM hoses mount. Instead, find a way to support the braided hoses by installing support clamps around the hose itself rather than holding it by the fittings at the end. This may require devising some custom support brackets, bending or replacing some of the OEM hard lines, and getting braided hoses a little longer than the OEM hoses.

BRAKE CALIPER JAMMING: Supposedly a fairly common problem on Jaguars, even though looking at the way the calipers are designed it's difficult to imagine how the pistons could jam. Jan Wikström says, "Crud in the cylinders. I think the mechanism is that the crud settles to the bottom and gets sticky, so when pressure is applied the piston tilts and jams -- and once it's jammed, more crud settles in the baps and keeps it that way. I had that on both front brakes, as I discovered when the brakes started pulling to the right. I had to use the Big Bad-Assed Pry Bar to shift one inside piston on the right and three out of four on the left. Once I had managed to shove them in, compressed air would (reluctantly) move them back out, but to restore them fully I had to split the calipers and clean the bores as well as the pistons. Mega-gunge, collected since 1977..."

I'd like to suggest that regular flushing of the brake fluid -- bleeding old fluid out and new fluid in -- would keep the calipers free of this mega-gunge, but it is clear from the configuration of the calipers and ports that the stuff won't come out without a rebuild; the bleed port is at the top, so it will clear air, not mega-gunge. However, what regular brake fluid flushing *will* do is help keep moisture out of the calipers. Moisture, absorbed in brake fluid that's been in there too long, causes the insides of the iron calipers to rust, and the rust particles undoubtedly contribute to the mega-gunge.

BRAKE CALIPER DETERIORATION: The author had a brake caliper fail after 17 years. Obviously, therefore, it would be a good idea to rebuild the calipers *before* they are 17 years old to avoid nasty surprises while driving. I can confirm that when the one failed, the other three on the car wouldn't have been far behind if I hadn't gone ahead and addressed them all.

The pistons are chrome-plated steel, so the recess in the side facing the pads rusts big time -- but who cares? The outside surface of the piston, which is where the seal rides, is completely enclosed behind a boot, and hopefully coated with some red grease besides. Between the boot and grease outside the seal and the brake fluid (flushed regularly) inside the seal, the piston should stay functional forever.

The boot, however, will not. Either from age or from the brakes running hot (or just from being British rubber!), the boot will eventually deteriorate. Once it is old and rotten, it *still* might work a good long while if it never moves -- meaning the pads don't wear so the pistons don't come too far out of their cylinders. Once the pads wear close to their 1/8" service limits, the pistons protrude from the cylinders a bit, stretching the boots -- and pulling open tears in them if they are old and rotten. Once opened to the elements, water gets in and washes the grease out. This, in itself, is not noticed by the driver, since the seal keeps the water out of the fluid and the brakes continue to work fine. However, the chrome-plated pistons start to deteriorate on the important outside surface; the chrome starts to flake off and the steel underneath starts to rust, causing more chrome to flake off. If it doesn't cause brake failure out on the road, it most certainly will cause brake failure the next time the pads are replaced and the rusty exposed portion of the piston is pushed back in past the seal.

If you rebuild your calipers and replace the boots *before* they tear open and expose the pistons to the elements, the pistons might last forever -- which makes that caliper rebuild significantly cheaper. So, learn from my mistakes and subtract a few years from 17 and plan on a caliper rebuild when the boots still look good.

If you replace your pads before they get anywhere near their wear limits, you may be able to go longer between caliper overhauls because you're not stressing the boots as much. It's probably not worth it, though; the boots probably won't last much longer, and pad changing isn't that minor an operation since you need to remove the rotor and turn or replace it each time.

BRAKE PAD RETAINING PIN CLIPS: Now that you are fully aware of the importance of the boots on the caliper pistons, note that the little clips on the brake pad retaining pins tend to poke holes in those boots! Aaaaaargh! Basically, the ends of the clip can hang over the edge of the boot, and then as the pads wear and the pistons protrude farther, the boot is pulled into the ends of the clip.

At first blush, it seems easy enough to install the clips turned either this way or that and thereby avoid problems. However, whichever way the clips are installed, the pins can still rotate far enough to poke holes in the boots. The only way the clips could be installed to avoid boot damage is from the inside out, and that appears to be either difficult or impossible to do.

Here's the simplest solution: Take some steel wire, 16 gauge seems about right, and form a ring that fits snugly around the pin. Slide it onto the pin and up against the head prior to installing the pin. Now, when the clip is installed, it will be held close to the inner surface of the caliper. It will be held close enough that it will be *beside* the edge of the boot rather than *over* it. Hence, you will have to turn the pin to the correct position to install the clip, and once installed the pin will not be free to rotate.

Richard Dowling came up with another fix: After installing the clips, he tied the loops on the two clips to each other with a thin piece of wire. By pulling those loops towards each other, the pointy ends are kept away from the boots.

Another idea might be to simply toss the clips and use lockwire in those holes. Or perhaps tiny cotter pins, if you can figure out how to install them properly without damaging the boots.

On the rear calipers, there is yet one more possibility, and that is to buy or make longer pins and drill holes in the opposite end from the head. Then you can install the clips on the *outside* of the caliper where they can't do any damage. Unfortunately, this idea isn't as workable for the front calipers due to the configuration of the outside surface of the caliper.

BRAKE CALIPER DISASSEMBLY: The repair manuals suggest using compressed air to get the pistons out. This works pretty well on the first piston -- provided the pistons are not seized in the cylinders. Unfortunately, when a piston is seized, the non-seized pistons will be the first to move, and you'll be left with a piston stuck in a caliper and open cylinders where the compressed air blows out. To get the stuck piston to move, you would need to securely plug the empty cylinders (with the pistons) and plug all but one of the brake fluid passages while applying air to the one remaining.

If you get into such problems, you're probably going to want to separate the caliper halves anyway. If so, forget about the compressed air trick. Once separated, turn a caliper half over and clamp the lip of the piston in a vice. Then carefully twist the caliper back and forth as you slide it off of the piston.

The ROM says: "CAUTION: Under no circumstances must the caliper halves be separated." The page of directions that comes with the Lucas rebuild kits says the same thing, and since this appears to be a generic set of directions ("Publication XZB214"), it probably indicates a general rule that you shouldn't separate the halves of *any* brake caliper. Nobody seems to know where this rule comes from, but it is clearly BS -- at least as applied to the calipers on the XJ-S. Many people have chosen to ignore this warning because separating the halves is obviously necessary to properly clean up the cylinders, and there have been no reports of problems. There is a seal issue on the front calipers, however -- see page 436.

The tool of choice for removing the old seals from their grooves in the cylinders is a dental probe with a slightly curved needle point -- but a straight pin is almost as good. Just stick the point into the rubber itself and use it to peel the ring out of the groove; you're just throwing the seal away anyway. This method cannot possibly damage the surface of the metal in the caliper unless you really screw up with the pin and scratch something, so with any care at all it'll be perfect. The same cannot be said for using a screwdriver or some such to try to get under it and pry it out.

BRAKE CALIPER RESTORATION: Old brake calipers are commonly restored to usable condition by the fitting of brass or stainless steel sleeves. However, notice that this will serve no purpose on an XJ-S. First, sleeving is normally done on aluminum cylinders where wear can be a concern in long-term use, but the Jaguar calipers are cast iron. Second, sleeving is normally only called for when the caliper is NLA, because buying a new caliper generally costs less than sleeving. At least as late as 2000, Jaguar XJ-S calipers were still readily available and reasonably priced.

However, the most compelling reason not to bother sleeving XJ-S calipers is because of their design! As Chad Bolles points out, "Take a look at the design of the caliper. You will note the piston has *no* seal on it, the seal is in the body of the caliper itself. Therefore if the bore of the caliper is rusted and pitted it would make no difference, 'cause the seal rides on the piston not the bore." As a result, the sealing surfaces in these calipers can be completely renewed by simply replacing the pistons -- and the pistons are available separately for this purpose. Just ream any big chunks of corrosion out of the caliper so the piston doesn't hang up on them and reassemble; pitting or the like inside the cylinder does no harm.

STAINLESS STEEL CALIPER PISTONS: The caliper pistons that come in the XJ-S are chrome-plated steel. On this author's '83, a brake failure resulted when these pistons rusted and the chrome flaked off, causing a fluid leak past a seal -- but the car was 17 years old when this happened, so it's hard to fault the chrome-plated steel pistons for lacking durability. Just the same, I will be using stainless steel pistons from now on, so I never have to worry about that particular cause of brake failures again.

Greg Wells points out that calipers assembled with stainless steel pistons seem to go through seals quicker, though. An investigation soon revealed the reason why. The chrome-plated steel pistons are as smooth as a baby's bottom; they have a ground finish, not commonly seen on chrome-plated parts (chrome is usually polished, not ground). The stainless steel items, on the other hand, have an as-machined finish that, although very pretty, is quite rough; if you run your fingernail down the side of the piston, it "sings" to you as the nail runs across all those tiny machining ridges. As these pistons slide back and forth as the brakes are applied and released, they will file away at the seal.

At P&WA where this author once worked, the finish on parts that rubber seals moved against was considered critical, requiring essentially a mirror finish. It is therefore recommended that, if you plan to install stainless steel pistons, take the time to polish the outside diameter on them before installation. This will require a buffing wheel and some buffing compound suitable for use on stainless steel; using a hand cloth and a jar of household silver polish won't get it. When buffing, hold the piston against the wheel so that the wheel is buffing either axially or diagonally along the surface of the piston, not circumferentially; you want to polish those machining grooves out, not enlarge them!

About 30 seconds on the wheel makes the surface *feel* considerably different, although it doesn't look much different. The fingernail still sings, but it doesn't sing anywhere near as loudly and it somehow seems less harsh -- sorta like the difference between a new file and a worn file. This 30 seconds of work per piston would probably triple the lifespan of seals in the caliper.

With perhaps ten minutes per piston, they actually *look* a bunch smoother; maybe not mirror finish yet, but the singing when a fingernail is run down it is almost gone. The problem here is that the job takes patience, because the pistons get too hot to touch after a couple minutes on the buffing wheel, so you've gotta set them down and go check your e-mail or something. You could just dunk them in water to cool them, but I chose not to mix water with the polishing compound.

I have been unable to measure any diameter change associated with this polishing.

Obviously, when done these pistons must be cleaned *very* thoroughly to remove all traces of that polishing compound. Wouldn't be good in a brake system.

BRAKE CALIPER PARTS CLEANING: Using the wrong solvent here could be bad, and water might not be too good an idea either. Fortunately, any auto parts store sells a spray can of brake parts cleaner. In fact, they often seem to offer two types of brake parts cleaner, often made by the same company; one that's a basic cleaner, and the other is more environmentally-friendly or something. They both seem to work pretty well, and they evaporate quickly without trace.

BRAKE CALIPER ASSEMBLY: FYI, the calipers in the XJ-S, both front and rear, correspond to illustration "D" on the generic page of directions that comes with the Lucas caliper rebuild kit. The new seals go in either way, there is no inside or outside to them. The groove itself has a tapered bottom, which tilts the inward edge of the seal up against the piston so it seals properly.

The Haynes manual implies you should use only brake fluid when assembling pistons into calipers: "Dip each piston in clean hydraulic fluid and enter it squarely into its cylinder." Many mechanics concur that the only substance that should be used when assembling pistons in brake calipers is brake fluid. It doesn't work too well, though; brake fluid tends to run right off of clean steel or stainless steel, leaving the assembly basically dry while you're trying to slide the piston through seriously tight new seals.

The ROM has a better idea: coat the seals and pistons with Girling disc brake lubricant. Time was when a Girling rebuild kit came with a small packet of "red grease" for this purpose, but the modern Lucas rebuild kits do not include such a packet; you need to buy some separately. Craig Sawyers says, "I have a tube of the stuff, and the data sheet for the different greases right here. It is Girling PFG102, described in the table as:

> Rubber Grease (red), For use on rubber items in or near to DOT brake fluid.
>
> For use on hydraulic units in direct contact with brake fluid, providing extra protection against corrosion and ingress of dirt e.e. packing dust covers of master cylinders and brake piston dust covers.
>
> Warning - not other grease to be used in these areas.

"It is, well - dark cherry red and greasy!"

Another tube of red grease was labelled "Genuine Castrol Girling Rubber Grease -- Specially prepared by Castrol for Girling". The only number on the tube is "Code 64947010". It might be worth noting that this tube appears quite old; Sawyers' report above probably refers to a more recent product.

If you can't find the genuine Girling red grease, be *very* careful about substitutes. There are substances intended to lubricate pistons in calipers during assembly, and there are substances intended to lubricate pads in calipers or the slides on floating calipers, and these are *both* commonly described as "brake caliper grease". However, the latter substance is usually black (it contains graphite) and will say on the package "Do *not* use on internal caliper parts." Chuck Sparks won't even use packets of red grease if they're not properly labelled from Girling; he'd rather use the stuff in the tube, since he *knows* that is the right stuff.

It appears to be a common belief that silicone lubricant may be used for assembling pistons into calipers. Nobody seems able to point to any official recommendation, though, and some mechanics suggest it is dangerous at best. Jeb Boyd says, "I don't know if that would be from the same family as silicone brake fluid, but I do know that mixing silicone brake fluid with glycol based fluid produces a gelatinous mess that will trash a hydraulic system in a hurry. I would steer clear of silicone grease...unless you are using silicone fluid." Play it safe and use the recommended red grease.

Although the ROM advises coating the seal and the piston with grease, you might consider coating more than that. If you coat the inside of the cylinder, it should help the piston slide into place without scoring. And if you coat the lip area of the piston, it should help the boot slip into place better -- but be sure to remove any grease from the surface that contacts the pad, since you should be using a different substance there. If you coat the areas of the piston and caliper under the boot but outside the cylinder seal, maybe it will help keep things from rusting, and perhaps catch any dust or rust scale that happens to get in there and prevent it from getting into the seal. Finally, you might consider using this grease on the threads of fittings and bleeders.

Richard Dowling reports that there is one place you probably do *not* want to apply red grease. "The shoulder around the bore, which takes the outer part of the boot, saved Girling a few cents by not having a groove machined onto it. Hence the boot is retained by friction between the rubber and the shoulder, with the large circular clip applying the force. No groove means if you grease the boot it slides off very easily, and I doubt if it would stay put for long." It actually might not be a bad idea to apply some sort of sealant here to help the boot stay in place. A sealant resistant to brake fluid is not necessary since it should never *see* any brake fluid, so any sealant that won't attack the rubber of the boot will do.

CRC makes a substance called "Disc Brake Quiet" that is red and comes in a 4-oz. plastic bottle. This stuff is intended to be applied to the back side of brake pads immediately before installation, after which it dries to a rubbery glue that bonds the pads to the pistons. I do *not* recommend the use of this stuff on the pads in the XJ-S, because it also bonds the pads to the boots -- and as Dowling says, those boots aren't held down very well, so as the pads wear they can end up pulling the boots off the calipers. However, it might make good sense to use this stuff when installing the boots! Just apply a small bead around the shoulder before installing the boot with its clip.

WARPED ROTORS: The way to check for warped rotors is to mount a dial indicator on the upright or axle and position the tip against the friction surface of the rotor. As you turn the rotor around, ideally the needle should stand still. Moving less than 0.005" is good. Big swings back and forth are bad, and will result in pulsing or shuddering brakes.

Some people suggest that warped rotors are caused by tightening down the rotor attachment bolts or the wheel lug nuts too much. This is hogwash, pure and simple, but if you don't think so it's still a simple matter to avoid the problem. Simply use a torque wrench to attach the rotor to the hub. If you aren't already using a torque wrench to mount the wheels, well, shame on you.

Warped rotors are usually caused by defective rotors. In the most obvious incarnation, the guys making the rotors machined them crooked. Such mistakes should result in the rotors being returned for credit and a vow never to use that supplier again. In a less obvious cause, the casting of the iron rotor itself prior to machining is faulty and results in residual stresses in the metal. Then the rotor is machined straight, but the first time the rotor gets really hot these stresses relax, and the rotor warps. It will shudder from then on. If the warp is in the friction area of the rotor, you can merely have the rotor turned and it'll completely fix it; the residual stresses are gone, it will never warp again. However, if the distortion included the hub mounting area, you'll either need to remachine that as well or toss it and get a better rotor.

Casting iron is not rocket science; it's been done for thousands of years, and every casting company knows how to do it correctly to avoid residual stresses. The problems occur when they put their profit margin ahead of quality control and start taking shortcuts in the casting process. If you buy rotors that warp the first time you get them hot, do us all a favor and return them for credit. Allowing companies to get away with making substandard products doesn't help anybody.

Yet another possibility involves rotors that are straight with no residual stresses, but have non-homogeneous metallurgy. A little carbon here and there can make some portions of a cast iron rotor something closer to hard steel. Such hard areas not only have different coefficients of friction that result in pulsing brakes, but they also wear at different rates. When one area wears faster than another, they gradually become effectively warped and start shuddering.

It is possible to warp good rotors. Typically, it requires getting them very hot and then letting them cool with an asymmetrical force or load on them. That asymmetrical force can be gravity, if the car is parked rather than rolling; if you get the brakes really hot, make sure to drive a few miles to let them cool off prior to parking. Another possible cause is a stuck caliper piston, which will first help get the rotor too hot in the first place and then hold a pad jammed against it while it cools.

Of course, there are dumb things too. If you leave the car parked for years, the rotors may rust everywhere except where the pads sit. When the brakes are next applied, the rust is all sloughed off, leaving high spots where the pads were. If parked in a flood-prone area, the rotors may rust on the bottom half!

ROTOR TURNING: Rusty Beard says, “I took the front rotors off to get them turned. I went to the NAPA parts store (a reliable U.S. chain) to get the rotors turned, and the parts clerk looked up the Jaguar in his book. The book was footnoted that the rotors could not be turned, but *only* replaced. Further, the minimum tolerances were not even printed, just left blank. Thus, he would not do the work. I went two doors south to a brake shop and that man had the book with all the minimum tolerances printed, and no further notes. He did the job, and I got my car back together.”

This problem probably stemmed from the bonded laminate rotors used at the rear; see page 437. It shouldn’t relate to the front rotors, which are a conventional cast iron vented rotor design and can be turned like those on any other car. In fact, it shouldn’t relate to the rear rotors if the original laminated rotors were replaced with solid rotors at some earlier time, which would be obvious because they don’t have the loose iron ring around the outer edge.

BRAKE SQUEAL: Dean Gosselin sends this tip: “I have traced a major source of brake squeal on my 1991 XJ-S to a tire clean/shine product called "Formula 2000". After 4-6 weeks of not using this product the brake squeal is nearly gone. I traced this cause to the spray-on tire cleaning product after my father used the stuff on his Audi and it immediately resulted in major squeal under braking.”

If you’re not using tire cleaners and still have a brake squeal problem, there are three distinct types of products available to address it. One is a substance that you spray on the back side of the pads and allow to fully dry before installation. Typically this stuff is blue. It dries to form a tacky layer that serves as a damper between pad and piston. The second type is a red goo that comes in a 4-oz plastic bottle that is applied to the back side of the pad immediately before installation, and dries to bond the pad to the piston; as mentioned under BRAKE CALIPER ASSEMBLY above, this stuff is not recommended for the XJ-S. The third type is an aluminum shim material that is cut to shape and stuck onto the back side of the pads.

Some owners, however, report that the final fix for squealing brakes was to replace the pads with a different type. Notably, the organic pads tend not to squeal, while some types of semi-metallic pads squeal like crazy. Since organic pads are undesirable from a performance and safety standpoint, there’s something to be said for insisting upon semi-metallic pads from a reputable maker.

DIRTY FRONT WHEELS: Dust from the front brakes tends to get the wheels dirty, especially if you use them hard. There is a device available to prevent this problem. It’s called KleenWheels, and it’s essentially a disk that seals the wheel on the inside so the dust can’t come out through the openings. They are available at many auto parts stores. Ed Avis reports that the no-name “turbo-vented dust shields” sold by J. C. Whitney, catalog number 78xx6976BF, are in fact genuine KleenWheels. He also provides the info on the company itself:

KleenWheels
5000 Oakes Road, Suite H
Ft. Lauderdale, FL 33314
+1 (954) 791-9112

It would be logical to assume that cutting off this airflow path would result in a reduction in brake cooling, and therefore poorer braking performance under severe, repeated braking. However, most users don’t notice any detriment -- perhaps because they never use their brakes hard enough for overheating to be a problem. The primary cooling airflow is from the inboard side of the brakes to the inside of the hub and outward through the vented disk. The warmed air can then go either out through the wheel or inward under the car. The use of KleenWheels prevents the first exit, so all the air goes inward. So, the use of KleenWheels won’t reduce the airflow to the brakes, but it may cause more of the warmed air to recirculate back through the brake again. Considering the airflow underneath the car during any activity where hot brakes are a concern, this is probably insignificant.

BRAKE PERFORMANCE IMPROVEMENT: Brakes *will* get hot; that cannot be avoided, since the entire point is to absorb the energy of the vehicle's forward motion and convert it into heat. The differences in how well brakes accomplish this generally result from A) how much mass there is to absorb the heat (only works once, though; the mass won't help the second time if it's already hot), B) how well the brakes dissipate the heat they have absorbed to the surrounding air, and C) just how hot the brake components can get before problems occur. In general, automotive brakes intended for street use are designed with enough mass in the iron rotors to absorb the energy of one stop, and then they are supposed to dissipate that heat to the air before the *next* stop. If the rotors aren't heavy enough, they'll fade during the first stop. If there isn't enough cooling airflow, they'll fade during subsequent stops. You can improve brakes greatly by replacing parts such as pads and brake fluid with items that work at hotter temperatures, but eventually you will only be able to improve so much without either increasing the rotor mass or the cooling airflow. Since makers of road cars typically concern themselves with the first stop, it's more likely that airflow is needed than additional mass.

Remember that the amount of energy brakes must be able to dissipate rises with the square of the vehicle speed. Stopping a car from 120 mph requires dissipating four times the energy as stopping the same car from 60 mph. Slowing a car from 120 mph to 60 mph requires dissipating three times the energy as stopping from 60 mph. If you plan on stopping from top speed, keep this in mind. If you plan to soup up your car so the top speed is considerably higher than stock, take note. Fortunately, when speeds are high is when there's plenty of airflow around to help cool the brakes, so with careful airflow and duct design you can obtain a significant amount of brake cooling during the *first* stop.

BRAKE BALANCE: Ideally, the relative action of the front and rear brakes should be balanced properly so that when the brakes are applied hard enough to approach the limits of adhesion, the limits of adhesion at both ends are approached at nearly the same time. Having one end lock up the tires while the other end is still not braking very hard is not good.

In the simplest arrangements, such balance is achieved by careful design. The designers of the car, hopefully using some actual road testing as a basis, design the front brakes and the rear brakes properly to obtain the correct balance. Typically, the diameters of the pistons in the calipers or the diameters of the pistons in the master cylinder are adjusted to obtain the desired balance. This is the idea behind the design of the XJ-S brakes, at least in the author's '83.

The racer's method of accomplishing the same thing is to install two separate master cylinders side by side, one serving the rear brakes and one serving the front. A beam connects the plungers of the two cylinders, and the pedal is connected to the center of this beam -- or a little off center. By moving the pedal connection closer to one side or the other, the proportion of force applied to each master cylinder can be easily varied. The driver takes a few laps and then gripes to the mechanic that one end or the other is locking up, and the mechanic adjusts the pedal connection accordingly.

Once the proper brake balance is established, it is important not to screw it up by doing something silly like using different type pads on one end than the other. The brakes in the XJ-S were designed for similar pad materials at both ends, so if you use metallic pads at one end and organic pads at the other, the balance will be a mess.

Of course, the proper balance is not a fixed thing. On dry pavement, heavy braking will result in a considerable shift of the weight forward onto the front wheels, endowing those tires with better traction. So, the proper balance on dry pavement is with the front brakes doing considerably more than half of the braking. But what happens in the wet? Or worse, in snow or icy conditions? In such cases of reduced traction, there will not be as much shift forward of the weight of the car, and proper balance would be closer to equal between front and rear. But such a simple system as that found in the '83 XJ-S will still provide the same balance as on dry pavement, so one could expect the front tires to lock up first under icy conditions.

There are ways to deal with this. In many automobiles, there is a device called a proportioning valve that is incorporated into the hydraulic line to the rear brakes. When the brakes are applied lightly, as one would do in snow or ice, the full pressure from the master cylinder is applied to both the front and rear brakes. When the brakes are applied more forcefully, however, such as when trying to stop quickly on dry pavement, the proportioning valve only permits a certain amount of pressure to the rear brakes and no more. In such cars, it is appropriate to design the actual brake hardware with the balance a little stronger to the rear. When applied lightly in snow or ice, the rear brakes will thus be stronger than the fronts, which is helpful in such conditions. The proportioning valve then limits increased braking at the rear to avoid locking the rear wheels under hard braking in dry conditions.

The author's '83 has no such proportioning valves. However, Figure 9.11 in the Haynes manual shows such a device --

of course, the British can't use conventional names so they call it a "Pressure Conscious Reducing Valve" or PCRV. So, apparently some XJ-S's or XJ12's come fitted with such a device.

Yet another method to accomplish a similar benefit was used in two British sports cars owned by the author in years past. Instead of having a brake booster between the pedal and the master cylinder as on the XJ-S, the pedal assembly and master cylinder were the same arrangement as a non-boosted brake system. The Girling booster was an in-line device -- pressurized fluid coming in one end resulted in boosted pressure coming out the other end. Neat, because it could be mounted anywhere. But these boosters were mounted in the lines to the *front brakes only*. As a result, when the brakes were applied lightly, the rears would come on strong first. But as more pedal pressure was applied, the booster would increase the pressure to the front brakes.

Of course, modern cars all have ABS -- which doesn't change a thing! It is still important to have a good balance on your brakes, since you don't want to lock up either end and get the ABS system involved before the other end is doing its part.

Snow and ice aren't the only conditions where the OEM brake balance might not be appropriate. If your car was designed decades ago but you have mounted some modern super-sticky tires on it, you may be able to stop considerably faster than the designers of the car expected you to. As a result, you will get *more* weight shift towards the front than they planned for, and may end up in a situation where the rear tires are skidding while the fronts still have more traction available. To optimize your braking system under such conditions, you would need to alter the balance to either reduce the braking effect at the rear or increase it at the front.

It should be noted that proper brake balance is important for reasons other than avoiding wheelskid. When using the brakes hard, as when going down a mountain road, the amount of braking done by each wheel is what determines how hot each brake gets. If one end of the car isn't doing its share of the braking, the other end is going to get hotter than it should -- and possibly get into brake fade sooner than you would like.

When modifying or upgrading the braking system, many owners are justifiably concerned about effects on their brake balance. Regarding the vented rear rotor upgrade described beginning on page 441, there is good news -- or bad news, depending on your viewpoint. Since that upgrade uses the OEM caliper pistons to push the OEM pads against a rotor that is the same diameter as the OEM rotor, it cannot possibly affect the brake balance of the car. The only way it could is if the vented rotor were made of a significantly different material than the OEM rotor, but hopefully they are both something close to basic cast iron. From a performance standpoint, the only thing the vented rotors accomplish is to keep the brakes cooler so they can be used harder without fade. When used lightly, this upgrade should make no difference at all. Of course, if your solid rotors are covered with oil and the vented rotors prevent oil from getting on the friction surfaces, the upgrade will most certainly affect the brake balance -- putting it back where it was supposed to be!

If you wish to alter the brake balance, you will need to either A) change calipers to something that has a different effective piston area; or B) change rotor diameter. You could also change pad material, but most people concerned with serious braking select pad material for the best fade resistance they can get rather than to adjust balance. You can also change the *size* of the pads or the breadth of the swept area of the rotor (either change will typically require a caliper replacement) but such changes are more likely to affect the ability of the brakes to absorb heat than to actually affect brake balance.

CROSS-DRILLED ROTORS: There are three topics that should never be discussed in polite company: religion, politics, and cross-drilled brake rotors. Talking about cross-drilling brake rotors always seems to start an argument. There is little doubt that cross-drilling rotors makes them a bit lighter, but other than that everything is opinion. Brian Schreurs says, "I race GM F-bodies at the club level (i.e., budget). Improved braking on a car with a reasonable system to begin with is found almost entirely in the pad selection, *not* the rotors. Those in my club who have tried drilled or slotted rotors have switched back to normal ventilated rotors. The surface tricks are prone to premature cracking and shortening the life of the pads, with no appreciable benefit in braking to make up for it. Outfits such as Baer will try to talk a customer out of buying drilled rotors if the car is intended for the track.

"We (being my club) regard drilled and slotted rotors as appearance items only, harmless on the street but worthless and bordering on dangerous on the track. Our formula is: race compound pads (or an aggressive street pad, depending on application), steel braided lines (for pedal feel and protection from debris), ATE Super Blue fluid (resists boiling), stock ventilated rotors (durable and cheap), and whenever possible, *ducting*."

Others, of course, argue that cross-drilling rotors helps clear dust from the face of the pads during heavy braking and thereby improves braking. Still others argue that the objective is to clear gasses that are generated by the friction. And proponents, of course, claim that their brakes were vastly improved after drilling, and point out that many exoticars come with drilled rotors.

Whichever, cross-drilling should perhaps be reserved for solid rotors such as the OEM rears on the XJ-S. Christopher Riek says, "*Do not* cross-drill your ventilated brakes! Doing so allows air to be sucked in through the holes and would destroy the effectiveness of the venting. It's like putting a squirrel-cage blower in a chicken-wire housing -- it spins fast but doesn't blow much air."

Henry Fok adds, "When some motorcycles switched from solid rotors to crossdrilled (without changing anything else), brake pad life decreased by half.

"It is also thought, in some quarters, that crossdrilling can eventually lead to worse brake performance if the drilled holes load up with debris."

GROOVED ROTORS: Providing grooves across the surface of a brake rotor supposedly has similar objectives to cross-drilling, but with less tendency to cause cracking. However, it has the minor disadvantage that the benefits (if any) vary with wear and resurfacing; as the rotor gets thinner, the grooves get shallower. It has the signficant advantage, though, that it could conceivably be done to vented rotors without affecting the airflow through the internal passages.

BRAKE UPGRADE HARDWARE: For brake upgrade stuff, you can check AP Racing at

http://www.apracing.com/

or Harvey Bailey Engineering (page 714), or Rob Beere (page 714).

Master Cylinder/Reservoir/Booster (non-ABS)

BRAKE FLUID RESERVOIR CONNECTION HOSE: To make the brake fluid reservoir fit under the hood, Jaguar uses a remote reservoir connected with metal lines and short pieces of flexible hose. If these hoses need replacing, do not use conventional fuel line; the brake fluid attacks the fuel line material, and the result will be darkened fluid with lots of crud in it.

The fact is, none of the hose commonly sold at an auto parts store will serve. Also, nylon tubing is unsuitable; the brake fluid soaks right through it, and then it hardens and shrinks.

Of course, using Jaguar original hose is not recommended, as it is a British non-metallic product. After all, you are now having to replace it. But there are other cars that also use hose to connect a remote reservoir to the master cylinder, including Mercedes, BMW and Fiat, so you can check other dealers for suitable hose. Andrew Weinberg says, "Volkswagen Beetles also use a remote reservoir, and the hose stocked for that application works perfectly... The hose is available from any VW supply shop. The only hitch is it's a (nice?) blue color."

Non-automotive hose is also a possibility. You can visit an industrial supply store and attempt to find a clerk who knows his stuff, or a reference manual that lists acceptable applications for different hose materials. Commercially available air hose works well in this application; it is red with a black inner lining, and is sold in many hardware stores. It's so cheap that many Jaguar owners can't believe it could ever work. The inner lining is EPDM, which is compatible with brake fluid. Note that this hose will *not* withstand the pressures seen in other parts of a brake system, such as the lines from the chassis out to the brake calipers on the suspension; air hose can *only* be used on non-pressure portions of the brake system such as the reservoir connections.

Keep in mind that this application sees *no* pressure, so high-pressure brake or hydraulic hose is unnecessary and will only make it very difficult to install over the plastic fittings. Some suggest that you use lines that will hold perhaps 30 psi in case you ever want to "pressure bleed" the system, but just about any hose will handle 30 psi.

While you're replacing the hoses, you might consider tossing the original metal tubes and simply run the new hoses all the way from the reservoir to the master cylinder. This makes for a cleaner appearance under the hood. You need to take care, however, that the engine shaking on its mounts doesn't cause the corner of the air filter housing to rub on the hoses and eventually cut a hole in them. If it did, the reservoir would drain and the warning light would come on in the dash before there were any operational problems with the brakes, but you still wouldn't be happy with brake fluid all over the engine compartment peeling all the paint off the chassis.

BRAKE FLUID RESERVOIR LOCATION: A brake fluid reservoir must be located above the master cylinder so that fluid will gravity-feed into the master cylinder and air bubbles in the master cylinder will rise into the reservoir. Unfortunately, the remote reservoir location on the pre-ABS XJ-S is stretching the definition of "above". It works OK when kept topped up, but if you ever have air in the hoses or master cylinder for whatever reason it is suggested that you unbolt the reservoir from its support bracket and position it about six inches higher, merely allowing the hoses connecting it to the master cylinder to flex. With it in this position, operate the brake pedal a few times. You might also just wiggle it a little. With any luck at all, any air in the hoses or in the master cylinder will bubble up into the reservoir. Once all the air is cleared, you can bolt the reservoir back onto its bracket.

BRAKE FLUID LEVEL SWITCH: Hey, it's electrical, so it's discussed on page 596.

BRAKE FLUID RESERVOIR CAP FAILURES: Apparently the cap occasionally breaks into a center portion and an outer portion. According to Michael Neal, "This is a problem and tends to reoccur if you don't modify the reservoir. This is on the pre-abs XJ-S brake reservoirs. Usually just flattening the sharp vertical ridge on the reservoir with a file will do it."

Better fix: replace the entire reservoir with one from a Mitsubishi. See page 596.

MASTER CYLINDER REBUILDING: There was an "early" type master cylinder used before 1977½, and a "later" type used up until the advent of ABS brakes. However, apparently not all of those "later" types were the same. In the Jaguar manual section 70.30.09, step 14, a seal is installed on the secondary piston with the lip facing forward. In step 15, a second seal is installed in a second groove facing rearward. Chapter 9, section 7, steps 13 and 14 in the Haynes manual say essentially the same thing. However, some master cylinders only have one seal on the rear end of the secondary piston rather than two. The one in the first step is the one that was omitted; if only a single seal groove is available, the lip on the seal should be installed facing rearwards. Of course, if you have purchased overhaul kit #M7673, you will have one seal left over.

POWER BRAKE SERVO: The (non-ABS) servo assembly comes apart in the center, by twisting one half until the retaining tangs line up with the cutouts. There is a special tool for this job, but Bruce Hayes reports the tool can be improvised. He carefully mounted the master cylinder in a vice, and fashioned a tool to attach to the studs on the housing to turn it.

Front Brakes

FRONT BRAKE PAD GROOVES: Some of the pads offered for the front of the XJ/XJ-S have grooves across them. Ferodo pads, for example, have two parallel grooves across the face of each pad the short way; each groove is about 1/8" wide, and they are about 1-1/16" apart. These grooves might help with cooling, or getting dust out from between the pads and the rotor, or letting water get out on rainy days, but Chuck Sparks says the primary objective is to prevent squealing; the grooves break up the long, solid surface of the pad into three separate shorter panels.

If you get pads without grooves, you might opt to cut your own grooves. Brake pad facing material is not difficult to cut; a hacksaw will do it. The Ferodo pads are not grooved all the way to the backing plate; the grooves stop about 1/16" short of the base plate.

FRONT CALIPER REMOVAL: The front brake caliper is attached to the hub carrier with two bolts. The steering lever is likewise attached to the hub carrier with two bolts. And, just to make things interesting, one of those bolts is shared; there are a total of three bolts, two short and one long. Some of these parts are clearly illustrated in the ROM: the hub carrier (also called a stub axle carrier) is shown at the beginning of Section 60 under "Accidental Damage". The steering lever is shown in Section 57.65.01. The way the three components come together is shown as clearly as can be expected in Section 70.55.02 or Section 57.55.29.

When removing the long bolt, don't lose the shim that falls out. See below.

The two short bolts are the same length. However, the short bolt holding the upper end of the caliper to the upright has a smooth shank and safety wire holes in the head. The short bolt holding the forward end of the steering arm to the upright looks like a regular high-strength bolt, threaded to the head and no wire holes. I guess brakes are considered critical and steering isn't.

Removing two bolts will get the caliper loose -- but won't get it off. There is also a hard brake line wrapped in a semicircle between the outer end of the brake hose and the port on the lower end of the caliper, and this line is firmly attached to a bracket that is attached with the two bolts holding the steering arm. Hence, if your objective in being in here is *not* to rebuild or replace the caliper you will want to remove all three bolts in order to get the caliper to come off with its hard brake line attached. Otherwise, you'd need to disconnect the line and get involved in brake fluid. By unbolting the bracket you can hang the caliper by a wire to avoid stressing the hose and just bolt it back on when done.

Remember to turn the steering back and forth while trying to remove and reinstall the forward steering arm bolt. Otherwise, the shock absorber is in the way.

FRONT BRAKE CALIPER SHIMMING: As mentioned above, there is a shim (or a couple of shims) between the steering arm and the brake caliper at the long bolt. The objective of this shim is to compensate for variations in the thickness of the caliper mounting lug to avoid stressing the steering lever as the bolts are tightened. If your plan is to take things apart and put them back together with the same hub carrier, caliper, and steering lever, you need to take care not to drop or lose those shims when you take the long bolt out. If you put it back together with the same shims in place, you should be OK.

If you do plan to replace something -- exchanging the caliper for a rebuilt, for example -- you will need to measure for the correct shim thickness. Mount the steering lever with its short bolt tight and the long bolt threaded in but not tightened; you may want to fit a flat washer on the short bolt between the dust shield and the steering arm to make up for a bracket attached to the caliper being omitted here. Measure between steering arm and upright at the long bolt, and subtract the thickness of the caliper mount lug to determine the shims needed.

New shims are available from Jaguar in two thicknesses: C44146/1 is 0.004" thick and C44146/2 is 0.010" thick. It's really nothing more than a thin flat washer, so you could just buy arbor shims locally or cut washers out of shim stock.

Whenever changing shims or anything else involved in this steering arm attachment, the car will need a new alignment afterwards.

It is apparent that the shimming between the caliper and steering lever was originally the only place shims were intended to be used here. Step 4 of Section 70.10.10 and step 3 of Section 70.55.02 in the ROM clearly indicate this is the only place to be looking for shims upon disassembly. However, apparently Jaguar decided that shims might also be needed between the caliper and the upright, either to center the caliper or to align it properly. There's no excuse for the machining incompetence that would require shims here for either reason, but Craig Sawyers and others report that their cars came with shims in these locations. Steps 10-14 of Section 70.10.10 and step 5 of section 70.55.02 discuss shims between caliper and upright for centering and aligning the caliper.

The Parts Catalogue doesn't list any shims for between caliper and upright, but obviously the shims intended for between caliper and steering lever will serve.

It's pretty easy to get shims in between the caliper and steering lever. Getting shims between caliper and upright is nowhere near as easy.

If you add shims between the caliper and the upright, you need to be *removing* the same thickness of shims between the caliper and the steering lever!

FRONT BRAKE ROTOR REPLACEMENT: Jaguar chose to bolt the rotor to the inside of the hub flange, rather than the outside like some cars. As a result, the hub must be removed to get the rotor off.

The various manuals suggest unbolting the rotor from the hub during this process by inserting a tool through the opening in the dust shield. However, Nance O'Neil points out that there is no need to unbolt the rotor before removal, and instead the hub/rotor assembly can be removed as a unit and then disassembled on the bench. Either way, the brake caliper must be unbolted from the upright.

John Himes adds a tip: "The 5 bolts that hold the rotor to the hub assembly can be very stubborn, especially when working alone. If you place the wheel face down, then place the lug nuts through the holes, now you've got a nice big vice to hold it in place without buggering up anything."

Matthias Fouquet-Lapar has an alternative suggestion: "I actually took the hub out and put the disk in a large bench vice. When I mounted the new disk, I simply used the old brake pads to protect the disk from the vice."

If you intend to have the rotor turned, don't separate the rotor from the hub. Leave them together; you get a more accurate turning job by allowing the machine shop to mount the assembly by the hub.

FRONT BRAKE CALIPER SEPARATION: On the front calipers, fluid communicates between the two sides via drilled passages through the caliper halves themselves. Hence, there are seals between the two halves to prevent leakage. If you separate the caliper halves, you'll want to put it back together with new seals. Note, however, that the square-section O-ring seals used between the halves may be difficult to find, and the Lucas caliper overhaul kit SP2887 does *not* include them. A normal nitrile O-ring -- square-section or not --- won't work; if you don't believe me, put one in a jar with some brake fluid and watch it for a few weeks.

Chuck Sparks says the seals are Lucas part number 67320782. The package these seals come in says they are .325ID, .495OD x .070, but measuring one found it to be .079" thick. Basically, they are 1/2" OD, 1/16" thick (the ID doesn't really matter as long as there's a hole). Each front caliper needs two, so you need four per car. The burgerflippers in the local auto parts store are likely to give you a blank stare when you ask about such seals, but according to Rob Reilly you can get them from John Farrell (page 710). John Robison says, "XK's unlimited sells the caliper seals separately."

It's also been suggested that you can find suitable seals at a Chevy dealer.

Coventry West (page 693) sells an O-ring, 1/2" OD and 1/16" thick and made of EPR. Apparently this works OK; according to their rep, "The o-ring will seal better on uneven surfaces than the square seal. We've never had a problem with the o-rings sealing. Not a single warranty or return." Nevertheless, most mechanics would probably agree that the original Lucas square-section seal is preferred. It does provide an idea for buying seals locally, since any industrial O-ring supplier can presumably provide EPR O-rings.

Brian Schreurs found that Motorcars Ltd. (page 695) lists a "caliper half O-ring" part number IN101648.

Joe Bialy says, "If you want to cut your own gaskets, McMaster Carr sells EPDM rubber sheeting, a 12" X 12" piece 1/16" thick is $3.78. Part #8609k31. I'm sure they'd have the cutters too. I don't know if it's applicable for this, but they also sell 1/2" OD X 1/16" width EPDM O-rings." See page 711 for McMaster-Carr.

On the rear calipers, the fluid communicates between the two halves via an external hard tube so there are no issues with seals.

FRONT BRAKE HOSES: The front brake hoses have coils around them to prevent kinking and to protect the hose in case of a tire rubbing against it or debris flying around in the wheel well. On the '83, the coil around the original hose is plastic about 1/8" thick. Replacement hoses, however, as well as the originals on some other year cars, come with a steel coil around the hose. Obviously, the plastic coil won't rust -- but if your steel coil is rusty enough to be a concern, it's probably time to replace your brake hoses anyway.

Ed Sowell says, "The new hoses I got came w/o coils. I reused my original plastic ones." This is a workable plan, since it is a simple matter to wind the plastic coil off the old hose. If your old hoses have steel coils, though, they apparently cannot be removed without destroying them or the hose itself. Since it probably would not be a good idea to operate the vehicle without coils at all, if you don't have the plastic coils you should either make sure your new hoses come with coils or try to get some plastic coils from a junkyard. And if you're replacing hoses with plastic coils with new hoses with steel coils, you may want to wind the plastic coils off the old hoses and store them away in case you need them *next* time you replace hoses.

FRONT BRAKE COOLING -- '92-ON: The 1992-on XJS comes from the factory with air scoops for the front brakes built into the front spoiler. According to David Buchner, it also comes with an inlet built into the dust shields on the front brakes themselves. To obtain the same sort of ducted cooling that race cars have, all you need to do is connect flex ducts from the back side of the spoiler to the dust shields on the brakes, and tie them up so the front tires won't rub them when turned full lock. Simple. The opening at the back side of the spoiler is a rectangle, but you might actually be able to find a section of flex duct sold in auto parts stores for engine intake ducts that has a rectangular end on it. Otherwise, any place that sells air conditioning supplies can provide a small sheet metal transition piece for connecting a round duct to a rectangular opening.

TWR FRONT BRAKES: Alan Heartfield owns an '85 TWR, and relates the following info from a TWR brochure: "This document states that the front rotors are 295mm X 35mm. The calipers are AP Racing 4 pot solid calipers." Obviously, this may provide some guidance to anyone looking to upgrade the front brakes on a non-TWR XJ-S.

Inboard Rear Brakes

REAR BRAKE HOSE: There is a single hose on the driver's side connecting the line from the car to the line on the subframe. This hose, CBC1393 or CAC6143 or GHP65, is unique to the XJ-S; the saloons use a different hose.

INBOARD REAR BRAKE ROTORS: The OEM rear brake rotors are described as "externally damped". This means they have an iron ring around the circumference that actually fits rather loosely. If the disk tries to "ring", this ring will rattle, and the rattling will absorb the energy trying to cause the disk to ring. IOW, the iron ring is to help keep the brakes quiet.

Michael Neal pointed out that the OEM rear brake rotors are a “sandwich” construction. This probably has something to do with fabricating a disk with the external iron ring. “The stock rear rotors have the actual thin outer rotor surface attached to a solid core. These thin outer surfaces are very brittle and break easily.”

There are also reports of the ring breaking and coming out and jamming things up.

When rebuilding, Neal recommends the use of aftermarket rotors made from a single chunk of iron. Often, when you order new disks, suppliers will send you these aftermarket rotors without even asking; the aftermarket parts are what they stock. The aftermarket rotors don’t have the iron ring, but nobody seems to have noise problems with them. The aftermarket rotors are arguably quieter, since the loose rings on the OEM rotors sometimes jingle when you close the car door or the like.

“Never turn the rear rotors, the oem style rotors are sandwiched construction and would probably self destruct when you put a bit to them. The aftermarket style could probably take one light surfacing but it just isn’t worth it, price them sometime, they aren’t that much.”

Randy K. Wilson concurs: “Don’t bother turning the rear rotors. It’s around eight hours of labor to get the things out. If they are bad enough to require turning, the labor involved warrants replacing them with new ones. Besides, it’s rare for those rotors to be torn up and still be turned down and remain in spec.”

INBOARD REAR BRAKE ROTOR REMOVAL: The instructions in the manuals are for removing and replacing the rotors with the rear suspension subframe in place. However, many suggest dropping the entire subframe to make the job easier -- and dropping the subframe is really easy, much easier than most people expect; see page 384. Note that, regardless of whether the subframe is in the car or not, the lower swingarms will either have to swing down a *long* ways or be removed altogether to get the rotors out. This means that the shock absorbers will have to be disconnected from the lower swingarms, so you might as well get to it. It also means that the tie plate on the bottom center of the subframe will have to come off, because the swingarms hit it before they swing down far enough. All in all, a case could be made for leaving the subframe in place if you’re not doing other work that requires dropping it; at least, with it attached to the car, you don’t have to worry about how to support it while working on it!

If you have the cage out, swinging the swingarms down far enough to get the rotors out means you have to get the cage a couple of feet off the ground -- and supported in such a way as to allow the swingarms to swing down. Peter Cohen suggests, “since the cage is out, just tilt the cage backward so that the input shaft is facing up, and then swing the swingarms to your heart's content.” Note, however, that before doing this you will need to either cap the differential vent or drain the differential, or it’s gonna drain itself!

The ROM, Section 70.10.11, Step 8, says that after you remove the nuts holding the axle inner U-joints to the brake disc and output shafts, you are supposed to “Tap disc mounting bolts towards final drive unit.” Those bolts are welded to the output shafts; if you manage to tap them towards the final drive unit, you have screwed up big time! The Haynes manual, Chapter 9, Section 12, Step 8, contains similarly erroneous instructions.

The rotors will not come out without removing the calipers. Hence, before tackling the job of rotor replacement, read on about two different methods for disassembly of brakes mounted on a Salisbury final drive unit as well as the disassembly of brakes mounted on a Dana final drive unit.

DANA VS. SALISBURY: Much of the work on the inboard rear brakes is dependent on which type differential you have; see page 349. If your car is in the 1985-88 range, check your differential before ordering parts or planning your work. It’s fairly easy to check: if the differential has a drain plug, it’s a Salisbury; if not, it’s a Dana. If it’s ’84 or earlier or ’89 or later, you can safely presume it’s a Salisbury. You have to check in the ’85-88 vintage because the official Jaguar repair for a Dana is to replace it with a Salisbury.

INBOARD REAR BRAKE CALIPER REMOVAL (SALISBURY): Removal of the left inboard rear brake caliper is straightforward using the steps described in the manuals. However, removal of the right inboard rear brake caliper might be considerably more tricky due to the proximity of the pinion shaft of the differential. The pinion is located to the right of center so there's lots of room on the left side, but the right side is tight. Specifically, the lower bolt holding the caliper to the output bearing flange is trapped and won't come out other than with the caliper itself, and it just barely comes out *with* the caliper! If the bolt was a quarter inch shorter this job would be a snap -- but you don't wanna shorten the bolt!

The particulars here vary from car to car, so some people won't even understand what the problem is while others will have trouble. This author couldn't get that caliper out for two days -- and then it finally came right out without doing anything noticeably different! Peter Cohen says, "Correct! I have had experience with that bolt. There is a single caliper position and bolt angle at which it will come out, and when it does, it happens so unexpectedly that you will not remember what you did."

Here are some tips that might help. When trying to get the caliper out, hold the upper end of the caliper rearward -- toward the disc. Once you've moved the bottom of the caliper forward and upward and reached the point where it doesn't want to move any more, twist the forward edge of the caliper (the edge where the pad retention pins go) in the outboard direction, away from the differential pinion. If you can't twist it far enough to get it to come loose, you may need to remove the nuts holding the axle and rotor to the output shaft to allow the rotor to wobble a little.

INBOARD REAR BRAKE CALIPER REMOVAL (SALISBURY W/ BREMBO ROTORS): If you obtain Brembo replacement brake rotors for a Salisbury, they come with a pair of large access holes drilled in the mounting flange -- and no explanation. Tim Dapper figured out what they were for: Using the access holes, you can remove the five bolts holding the output shaft bearing assembly onto the differential. Remove the exhaust pipe hanger attached to the top of the cage with two bolts. Then slide the output shaft bearing assembly out of the car with the rotor and caliper still attached! The caliper mounting bolts can then be dealt with on the workbench.

The shims between the rotor and the output shaft obstruct the access holes a bit. Before installing the shims, cut suitable notches in them. Dapper suggests that if you find your car already has rotors with access holes but they are obstructed with the shims, it's easier to break out the Dremel and trim those shims in situ than it is to remove the brakes using the method described in the ROM.

When working on the handbrake caliper, you'll want to have the new rotor securely bolted to the output shaft. Since the axle isn't in place, the nuts won't thread down far enough to seat on the rotor; you'll need to provide some washers or spacers.

Obviously you need new O-rings for reinstalling the output shaft bearing assembly. This should be considered a *benefit* of using this method; any opportunity to seal that thing up better is good.

"But what good does this do me? The old rotors on my car don't have the access holes." Dapper nevertheless suggests you get Brembo replacement rotors with access holes. That way, you can sweat and cuss and skin knuckles getting the calipers and rotors off, then take the output shaft assemblies out, then assemble them all together with the new rotors on the bench and reinstall them as a unit. "I must admit I was quite surprised when the whole thing just slid into place. A little jiggling is needed to get the splines to align. This is *so* much easier than dealing with the caliper bolts and no clearance!"

When installing the five bolts in the output shaft bearing assembly, you must screw each one all the way down before turning the rotor to install the next. There is precious little room between the heads of these bolts and the heads of the axle bolts on the back side of the output shaft flange. If you start turning the rotor around with the bolts only part way in, you can get it jammed and have to struggle with an open-end wrench to get moving again.

INBOARD REAR BRAKE CALIPER REMOVAL (DANA): If you have a Dana final drive unit, trying to make sense of the disassembly procedures in the ROM will only cause confusion. The manuals describe the Salisbury attachment in which the brake calipers are bolted to the inside of the flange holding the output shaft bearings in the final drive unit, and therefore the bolts back out towards the centerline of the car. On the Dana unit, however, the calipers are bolted to the side of the final drive housing itself, so the bolts point the other direction -- they back out towards the sides of the car.

There apparently are no Jaguar publications describing the removal of the brake calipers from the Dana differential. Fortunately, it's not difficult to figure out once you're in there; in fact, it's easier than working on the Salisbury. Jim Moore says, "Bolt access holes exist in the rotors and you can see them if you slide back the dust covers on the axles. Not mentioned in Haynes, not obvious whilst on your back with halogen lamp heating up the back of your head." Use these access holes to remove the two bolts holding the caliper in place. Once the caliper is off, you can then remove the rotor.

If you're ordering parts beforehand, make sure you get rotors with the access holes if you have the Dana final drive. Such rotors are usable on the non-Dana cars as well, although the access holes won't serve any purpose.

If you've ordered the wrong rotors and don't have time to exchange them, Tony Bryant says, "you *can* use the non-holed rotors on the Dana diff. It's just a royal PITA to juggle the caliper bolts into place, and then do them up with a open ended spanner. But it can be and has been done..." Really, if you have the non-holed rotors you might be better advised to take them to a local machine shop and pay them to put holes in them while you wait. There are dimensions in Figure 24 that will help, even though the two-piece rotor hub looks different.

DANA VS. SALISBURY/BREMBO ACCESS HOLES: With OEM rotors, the difference between Dana and Salisbury rotors is obvious: the Dana has access holes. With the aftermarket Brembo rotors, the difference is no longer so obvious. John Wynne says, "I purchased both sets of rotors. *Both* sets had the access holes in them. The only difference was the location of these holes."

Charlie Welkie says, "Guess which (Brembo) rotors I got first! Yes, the ones with holes that didn't work -- they were too close to the center of the rotor. They were completely on the flange surface. Try as I might I just couldn't get the caliper bolts in. By now I had determined that I had a Dana and the rotors went back for exchange. The replacements went in very smoothly (perhaps due to all the practice I had by now). They have access holes out further that are partly on the flange and partly in the stepped portion of the rotor.

"The Altrom number for Brembo rotors for the Dana diff (hole spacing further apart) is 094-1106. The other - smaller spacing - number is 094-1104."

Both sets of access holes are shown in Figure 24; the holes closer to the center are for Salisbury diffs, and the holes closer to the outer edge are for Dana. You can check the dimensions to determine which access holes you have -- or you can just lay the rotor on the paper and see which holes line up.

5/8" SOCKET: Whether you are using the access holes to get at the caliper mounting bolts on a Dana final drive or to get at the output shaft bearing bolts on a Salisbury, the tool is the same: a 5/8" socket. Various reports, probably reflecting variations in hardware, describe the access holes as being anywhere from 7/8" to 1". If they happen to be 7/8", you will need the right socket to fit. A high-quality six-point socket will usually fit through a 7/8" hole with a bit of wiggle room, but a clunky 12-point from Taiwan hasn't got a chance. If the access hole happens to be located a hair off so the bolt head isn't perfectly centered under it, well, things just get harder.

I'd suggest you buy a thinwall socket, except that thinwall sockets are also usually deep sockets -- and you'd be better off with a short socket here. It's best to just shop around with a dial caliper in your hand and buy the smallest OD short 5/8" socket you can find.

Remember: 5/8" is functionally the same size as 16mm. So, check the other drawer in the toolbox for sockets that might work before heading for the tool store. And while you're at the tool store, that gives you more sockets to check for a small OD.

Of course, you could just make sure that the access holes on your rotors are large enough -- by boring them out, if necessary. Going to 23mm, 15/16" or even all the way to 1" will provide enough clearance for the bulkiest of 5/8" sockets.

ONE MORE DISASSEMBLY METHOD: In addition to the two disassembly methods for the Salisbury and one for the Dana described above, there is one other method that should work for either: splitting the caliper. Remove the bridge tube connecting the two halves of the caliper, and remove the pivot pin for the outboard handbrake caliper. Remove the four large bolts holding the halves of the caliper together, which allows you to remove the outboard half of the caliper from the car. Then you can remove the rotor, which will permit better access to the bolts holding the inner half of the caliper in place -- whether Dana or Salisbury.

BRAKE COOLING: If you regularly drive your car hard enough to get the brakes hot, you would be well advised to improve the cooling air flow to the final drive area. A scoop on the bottom of the car directing air up into this space might help; the Series Three E-Type came with such scoops, and it was a lighter car.

UPGRADING TO VENTED ROTORS: Jeffrey Gram installed vented rear brake rotors in his car. The interesting thing was his reason for doing so: to reduce the tendency for the brakes to cook the final drive seals. He expects that the use of vented rotors, even if braking performance is insignificantly improved, will extend the life of his final drive unit. Jan Wikström -- who drives a long, twisty mountain road to work -- also installed vented rotors: "They worked well. The old brakes worked pretty well too, and I certainly never got them hot enough to induce fade, but the oil seals didn't last, and they seem to last well with the ventilated disks."

There is yet another possible reason for upgrading to vented rotors. The author noticed that the outboard pads were much more worn than the inboard pads, and Andreas Boedenauer explained: "I owned a couple (about 15) of Citroens with inboard front brakes. All of them had almost unworn inboard pads (lubed with oil from the diff) even when the outboard pads where completely gone. You only had some wear on the inboard pads on a brand-new car (the first 2 years). I doubt that the differential -- especially the output shaft -- on a Jaguar is 100% dry and without any greasy surface. Maybe I am wrong and there are Jags with immaculate bone-dry new or rebuilt differentials on the road -- if yes, I want to see them."

What does this oily brake situation have to do with vented rotors? Because vented rotors may avoid the problem. When oil comes out of the differential output shaft seal, some of it runs along the shaft to the disc and ends up running down the inboard disc surface. But with vented rotors, it will come to the inner end of the air passages through the rotor before it gets to the inboard friction surface. The oil will then pass through the air passages all the way to the outside edge of the disk, completely bypassing the friction surfaces. Hence, if your diff output seals leak, having vented rotors can improve your braking considerably, even when cold.

If you're interested in upgrading to vented rotors, there are kits available. See XK's Unlimited (page 697), Terry's Jaguar (page 696), or Bob Greene Developments (page 716). All of these kits provide ventilated rotors (which inherently must be thicker than the OEM solid rotors), spacers to put between the halves of each caliper to provide clearance for the thicker rotors, and several small parts that are necessary as a result of the caliper widening.

Brian Schreurs says, "I talked to Terry's about their kit two days ago. According to them, their kit makes *no* accommodation for the handbrake whatsoever; they assume you're not going to be using it." So, if you'd like a working handbrake, you might want to consider other kits -- or consider the possibilities described below for obtaining the handbrake parts you need.

If you ask around, you may find negative reports on vented rear brake kits for Jaguars. This is because GT Jaguar (now defunct) offered vented rear brake kits that were garbage -- they didn't fit right, you had to grind on your final drive output shafts to bolt them in, they came with distorted hubs that caused runout in new rotors, etc., etc. Perhaps this helps explain why they are now defunct. Whatever, note that these problems have *only* been reported with the GTJ kits; the kits from all other vendors reportedly fit and work well.

If you wish, you can upgrade to vented rotors without a kit. All you really need are the rotors themselves and a few minor knickknacks. This has the potential of saving a little money or a *lot* of money, depending on your abilities to fabricate parts yourself as opposed to employing a machine shop to do the fabrication work.

This author has installed such a do-it-yourself rear brake upgrade (making small parts but hiring a machine shop for the hubs), and will provide considerable detail here; if you're not interested, skip the rest of this section.

The rotors described here are two-piece style -- as are the rotors in *most* (not all) of the kits mentioned above. Two-piece rotors are largely unknown in production automobiles where obviously it is cheaper to set up a casting process to create the entire rotor as a single part. However, two-piece rotors are very common in the performance and competition arenas, where they are well proven. In their simplest incarnation, they provide a simple benefit: the outer portion of the rotor, the part that has the cast-in ventilation passages, can be machined from a standardized casting (or even from brake rotors designed for other cars) rather than requiring a custom casting for each application. The center hub portion of the two-piece rotor assembly, commonly called a "hat" because that's sorta what it looks like in most applications, is a non-wear item that sports most of the unique features -- bolt patterns, offsets, pilot diameters, etc. -- that make a rotor assembly a custom fit to one car or another. Not only does using a two-piece rotor make it cheaper to obtain the custom rotor design needed, it also makes it considerably cheaper to maintain: when the rotors get worn, only the standardized outer portion needs to be replaced.

There are other features often incorporated into two-piece brake rotor designs including aluminum hats to save weight, "floating" attachment schemes to better deal with thermal expansion issues, carbon outer discs to save weight and work at higher temperatures, etc. For our purposes, we'll be sticking with a basic design to keep the costs within reason; the ventilation is the feature we're looking for here.

Alan Heartfield found a company that'll provide special-order outer discs:

Essex Parts Services Inc.
125 Hampton Court
Cramerton, North Carolina 28032
Phone (704) 824-6030
Fax 800-335-7223 or 704-478-1030
http://www.essexparts.com/

There are other companies that can provide such discs, including Wilwood.

Ordering discs through Essex involves filling out a "Custom Brake Disc Order Form" which they can fax to you. In the middle of the form there is a chart where you must fill in "Nominal Dimensions" of the discs you need. Fill the form in as follows:

ØA OUTSIDE DIAMETER	B THICKNESS	ØC EYE DIAMETER	ØD FLANGE INSIDE DIAMETER	E OFFSET	MOUNTING HOLES			APPROX. WEIGHT
					NO.	DIAMETER	ØM PCD	
10-3/8"	3/4"	6-3/4"	4-3/4"	3/8"	8	5/16"	5-3/8"	

The rest of the form is fairly self-explanatory -- name, address, credit card number, etc. I recommend you opt for no cross drilling and no face grooves. I also recommend opting for straight vanes, since curved vanes result in the left rotor being different than the right, probably more expensive, and of dubious benefit in this application.

Essex will quote you a price once they get the form. I try to avoid quoting prices in this book, but you'll be happy with Essex's quote.

Next you need a pair of "hats" to mount the discs on. For the Jaguar with inboard rear brakes, the term "hat" is not appropriate; they are basically a flat disc with a step machined in one side. Just take a copy of Figure 24 to your friendly neighborhood machine shop and ask for two, please.

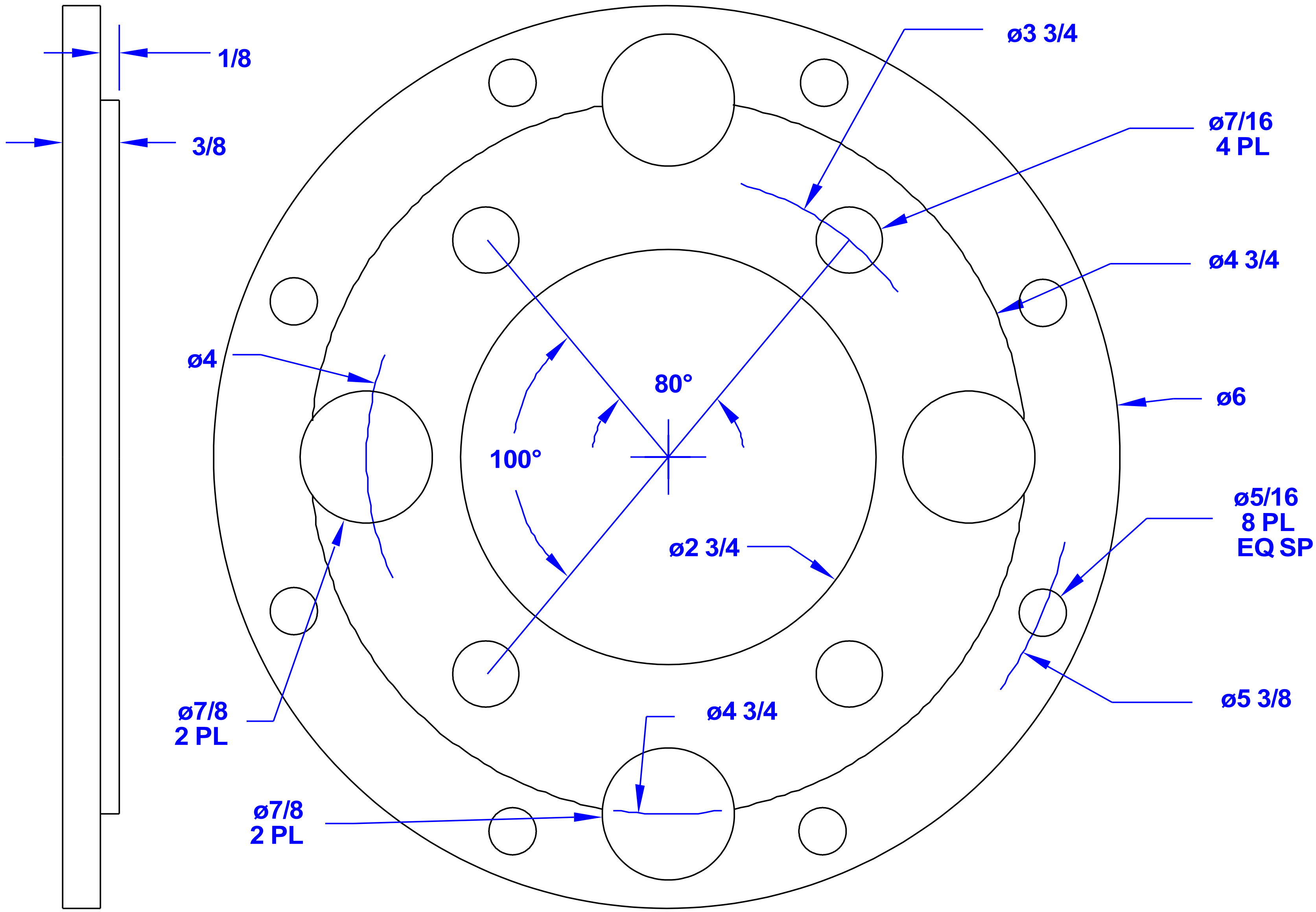


Figure 24 - Hub for Vented Rear Brake Rotor

Make very sure to clarify to your machinist that all three flat surfaces on this part must be flat and true, as close as he can get them. That means that all three surfaces must be machined; you cannot hack this part out of a rusty plate with an acetylene torch and expect acceptable runout when you install your discs. Also, insist that the flat surfaces be machined on a lathe or turntable that rotates the part, not on a milling machine where the part sits still while the cutter moves back and forth over it. Milling was one of the problems with the GT Jaguar kit, as the hub would warp a bit during the milling and cause runout.

As a guide to cost estimating: When I had a pair made, the shop charged me for 5.5 hours machining time plus a pittance for the metal. Mine were made from 1/2" steel plate; you might be able to save a little machining time by starting with 3/8" steel plate, since the machinist won't have to hog off so much metal. However, by the time the hubs have been "skimmed" on both sides to make sure they are flat and true, they will be a little thinner than 3/8". As a result, you will need to add a couple shims C33440 to avoid altering the rear wheel camber.

You can make these hubs out of either steel or aluminum. Aluminum costs a few cents more in material, but the machine shop might give you a break on the machining since aluminum is easier to cut.

The two 7/8" holes closest to the OD of the hub are helpful to those with the Dana final drive unit. The OEM Dana rotors have two similar holes in them. Note that the Dana access holes shown are located differently than on an OEM Dana rotor; they are rotated 90° around the hub. Brian Schreurs developed this idea for relocation to make it possible to remove the calipers without removing the rear axles first. With the original location, the U-joint on the axle obstructs the access hole. With the location shown, the U-joint still obstructs the access hole -- but once the axle is disconnected at its outer end, you can swing it out of the way without removing it. The shims on either side of the rotor obstruct this revised access hole location, so trim the shims prior to installation.

You might look for a 5/8" socket with an external hex on the back end so you can turn it with an open-end wrench. Spark plug sockets have this, but they're too long. There are some odd tool designs that feature an external hex on the back end of a short socket for one reason or another, though. If you find such a socket, you might be able to snake it under the U-joint and into these relocated access holes and turn it with an open end wrench, allowing you to remove the caliper without having to disconnect the outer end of the axle from the suspension. Alternatively, you might just grind flats on a standard socket, or drill cross holes in it and turn it with a bar.

The two 7/8" holes closest to the ID allow for removing the brakes from a Salisbury final drive as a unit along with the output shaft bearing assembly, same as with the aftermarket Brembo rotors as described above.

Note that, if the vented disc has a continuous ID of 4-3/4", it will obstruct all these access holes. To make them usable, the disc needs to be scallopped between holes. Fortunately, Essex scallops their discs without even asking.

Read the notes above on making sure you have a 5/8" socket that will fit easily through these 7/8" access holes. If you prefer, make the access holes a bit bigger in your hubs, like 23mm or 15/16".

If you have a Salisbury final drive unit, you can omit the Dana access holes when making the hubs; they will do nothing for you. If you have a Dana final drive unit, you can omit the Salisbury access holes; they will do nothing for you -- although you might consider the possibility that your Dana gets replaced with a Salisbury in the future. Finally, if you have either the Salisbury or the Dana, you can omit all the access holes if you wish, since it is possible to rebuild the brakes on either final drive without access holes; simply remove the bolts holding the outer disc to the hub and remove the hub, leaving the disc in place within the caliper, and this will provide all the access you need to get to the bolts behind the rotor. In fact, Alan Heartfield's TWR came new with a Dana final drive and two-piece vented rotors with no access holes. Having the access holes makes things easier, though.

Ask if the company providing the discs will also make the hubs for you if you send them the drawing. Brian Schreurs found that Essex will, and for an excellent price, too. In addition to simplifying the procurement process and obtaining a good price, they can also make sure the two parts fit together properly.

Note that if you keep this car long enough to wear these rotors out, the only thing you will need to renew is the discs from Essex -- send that form in again. The hubs will last forever.

To assemble the discs and hubs, you will need 16 bolts and 16 nuts -- 5/16" Grade 8. 1" is the length needed, but 1" bolts are typically threaded all the way to the head. Since it is good engineering practice to have a smooth shank within the joint between such parts, you'd be better off to find bolts about 1-1/2" long and cut them down to 1" to get a smooth shank between 1/4" and 1/2" long. You need self-locking nuts, but don't get nyloc -- things might get too hot here for the plastic inserts.

There are other ways to obtain suitable rotors for this project. According to Chad Bolles, "The rear rotors on a Maserati Quattroporte are vented and are the same pattern as the Jag. The calipers are the same as a Jag, but with a spacer to make up for the wider rotor." Unfortunately, a www search found a price for Maserati rotors well over $400 each. There are reports that Aston Martins also use a similar rear brake except with vented rotors; Bill Sotiras says, "Aston also moved the rear caliper setup from in front of the final drive to the rear, for better accessability (from under the car). They used to have an inspection plate under the back seat." Unfortunately again, there are also reports that owners of these cars converting to the Jaguar solid rotors because their replacement vented rotors are so expensive! If you know of any Aston Martin or Maserati owners, you might tell them about Essex and the two-piece rotor design described above; it might fit their car perfectly and save them considerable money at rotor replacement time.

Terry's Jaguar also sells their one-piece rotors individually, apparently as wear replacements for owners who have installed their kit.

On to the other brake hardware you will need to use your vented rotors. You will need spacers to widen the calipers. These can be made from 1" wide 1/4" thick steel stock, or from any 1/4" steel plate you happen to have lying around. They can also be made of 1/8" thick or even 1/16" thick stock; just make more of them and stack them up. When you split the caliper halves, it will be apparent where these spacers go and what shape they need to be.

You need 8 new bolts to hold the caliper halves together, longer than the originals. 3/8"-24, 2-1/2" long, Grade 8.

You need pad retention pins that are 1/4" longer than the original pins. You can buy such pins from Jaguar; the ones for the front of the XJ will fit perfectly! They are part number 12798. Or you can just make some pins out of long 1/4" bolts (you'll need a smooth shank about 3" long) or even from 1/4" steel rod if you want. If you go with steel rod and therefore end up with headless pins, you will need four more retaining clips just like the ones that are in there.

The main calipers have a bridge pipe that connects the sides. Since you have inserted a spacer, this pipe needs to reach a little farther. Fortunately, it is a simple matter to bend the pipe a little bit to make it fit.

You'll need to deal with the bronze fork on the handbrake calipers. This fork is supposed to hold the handbrake pads away from the rotor, but just a little bit -- and to take a permanent "set" as the pads wear. Since you must cut this part in half to get it on the widened calipers, you must come up with a way to hold each half still so it cannot turn around the pivot pin, which would defeat its purpose. Jan Wikström just brazed in a spacer. Other ideas include fashioning a plate to go over it with a lip that prevents the halves from turning, or ordering four bronze forks and cutting a long half from each one in such a way that they interlock when bolted into place.

Alan Heartfield's TWR has a bronze fork in which the holes had been slotted outward to the ends. I do not recommend this; the tines of the fork are attached here, and cutting open the loop at each end of the fork weakens this attachment and results in the fork bending here as the handbrake pads wear rather than bending over their length as they are supposed to. Obviously, you also have to bend the fork to begin with with this idea. Better to cut the fork in half and space it.

If Aston Martins and Maseratis came with similar brake calipers already spaced, perhaps parts suppliers for those makes can provide a bronze fork of the correct dimensions.

You also need to address the issue of locking the handbrake pivot pins so they don't unscrew; the original locking plates won't work. You can drill the heads for lockwire -- if you're really good with a drill; for most of us, that job will require a drill press. Or you can make your own locking plates from sheet metal. You can combine this homemade locking plate with the plate needed to hold the bronze fork halves if you want.

Alan Heartfield reports that his TWR does have a locking plate. Apparently TWR either found or made a locking plate to fit. No known Jaguar part number, though. Again, perhaps finding out what Aston Martin or Maserati did here would be informative.

Some seem to feel that just omitting the locking plate and tightening the pins securely is good enough. I would not recommend this; the length of the pivot pin between the thread and the head is far too short to expect enough "stretch" to ensure the pins won't loosen during thermal expansions, and even if it was, this is not a good place to rely on simple bolt tension to ensure nonrotation. The handbrake calipers are rotating around these pins; if they develop a little friction in that pivot, they can be trying to forcibly unscrew the pivot pins! This assembly calls for a positive retention feature of some sort. Lock washers or Loctite are better than nothing, but we are talking about brakes here, do you want to take chances on something that *might* hold?

Regardless of whether you buy a kit or assemble your own vented rotors, the lower swingarms may contact the wider discs during assembly. This must be corrected by some minor grinding on the arms themselves. The problem is obvious; bolt the rotor to the output flange on the diff, try to swing the lower swingarm up into place, note where it hits the rotor, and grind metal away from the swingarm until it clears. This doesn't seem to cause any problems -- this swingarm has plenty of strength to spare!

Chances are pretty good that your exhaust system looped through the rear cage very close to the bleed screws on the calipers -- and you just moved those bleed screws 1/4" in the wrong direction. You will find it helpful to disconnect the exhaust pipes at the adjustable joint just ahead of the IRS and at the front end of the rear muffler and realign them from scratch. If you have the older style assymetrical exhaust pipe supports within the cage, as discussed in the ROM Section 30.20.02, you should install them the *opposite* way as shown in that section in order to position the exhaust pipes farther outboard by about a half inch. Reportedly later cars have a symmetrical support, so it won't matter which way it is installed.

When installing the pads, install the new longer pins in the upper end of each caliper from the inboard side outward. Installing the other way may make them difficult to remove later because the exhaust pipe is in the way. Install the pins in the lower end of the caliper from the outboard side inward, since the nose of the differential will prevent installing the other way.

This entire vented brake rotor upgrade is documented in photographs at

http://www.jag-lovers.org/xj-s/book/InboardBrakeUpgrade.html

MORE SERIOUS REAR BRAKE UPGRADE: The rear brake upgrades mentioned above involve a set of spacers and other small parts to reassemble the OEM calipers wider to fit the wider vented rotors. Alternatively, any of several high-performance brake manufacturers could provide a completely new rear brake system, complete with fancy racing calipers -- all of which would obviously cost more. However, if your calipers need rebuilding or replacing, you need to add the costs of repair to the costs of the upgrade kits before comparing to the cost of an entirely new brake system.

RETROFITTING OUTBOARD BRAKES: When the Jaguar XJ-S was raced competitively, sometimes the inboard rear brakes were relocated to outboard (whenever such modification wasn't against the rules, of course). The move to outboard seems a bit odd since theoretically inboard should be the better configuration from a performance standpoint, but apparently there were at least two other factors involved. First, the inboard location is prone to getting oil on the brakes, either dripping off the differential or being blown back from the engine compartment. Second, in any race longer than a few hours, a heavy car such as a Jaguar will probably need to replace brake pads during a pit stop -- and having to replace inboard rear brake pads will result in a long pit stop indeed.

Moving the inboard brakes to outboard makes some sense to the everyday driver, too. It will certainly make brake service easier.

If you feel the need, it shouldn't be too difficult to retrofit the outboard rear brakes from the XJ40 or mid-90's XJ-S to the earlier cars. A cursory inspection of the rear hub carrier from an XJ40 indicates it is a bolt-on retrofit to the XJ-S suspension. If you don't have ABS, just leave the sensors out. Chuck Sparks says that this retrofit may require the use of the XJ40 axle assembly, though. Or, perhaps just the outer stub shaft -- but Sparks says the U-joints are different, so mating them up might be difficult. Just grab the entire axles while you're in the junkyard.

Note that when the XJ-S went to outboard rear brakes, it was first fitted with solid rotors, and later upgraded to vented rotors. You might prefer to pirate parts from a later car with the vented rotors.

Retrofitting the outboard brakes should actually make the rear end of the car ride a hair higher, since it is taking the weight of the brakes themselves off the rear springs and putting it directly on the tires. There also may be a slight difference in the center distance between the outer swingarm pivot centerline and the hub centerline, with the XJ40 being about 1/4" shorter -- which should also raise the rear ride height by about 1/4".

Obviously, after all this fiddling is done, you'll need to realign the rear suspension.

Handbrake/Parking Brake/Emergency Brake/Whatever

In the ROM, under "General Specification Data", page 04-2, the handbrake is described as "Mechanical, operating on rear disc pads". Technically correct, but perhaps misleading; they operate on their *own* rear disc pads, not on the main pads that are operated by the footbrake.

CABLE ADJUSTING: In short, don't. The cable adjuster is right behind the lever under the carpet on the XJ-S (different location on the XJ12, which has a pull handle under the dash), but is not intended to need adjusting as the pads wear. The handbrake calipers have a self-adjusting feature and should maintain proper operation of the handbrake throughout the life of the handbrake pads. If the handbrake seems to need adjustment, the self-adjuster has probably seized. You should address this; don't try to get by with adjusting the cable.

Gregory Wells of Coventry West concurs: "The vast majority of handbrake calipers we see in our shop on inboard rear brake cars are seized and/or frozen up. The things rust up badly in service and whatever grease Jag used on the handbrake calipers on the assembly line does a wonderful imitation of glue after a few years. I would suggest pretty strongly that the handbrake calipers be inspected first before performing the cable adjustment."

Of course, if the calipers have been out for service or some nimnul has been fiddling with the adjustment, the cable may very well need adjustment. Section 70.35.10 of the ROM stipulates that the handbrake lever should be released and the cable adjusted so there is some detectable slack. This is misleading. There are two different situations possible, and I shall explain how to adjust the cable under both conditions.

If the calipers have just been serviced and reinstalled, the self-adjusters within the handbrake calipers are presumably adjusted fully out and a new bronze fork has been installed in each side to hold the new handbrake pads well away from the rotor. With the cable not yet in place, the handbrake caliper levers will be pulled outward against their stops by the spring on each side. Note their position; in fact, you might simply measure the distance between the two cable clevises. Install the cable, and then adjust the cable to just pull these levers *off* their stops. The tension of those two springs should be applied entirely on the cable, not against the stops within the calipers. If the springs are permitted to pull the levers against their stops, it tends to rock the caliper and pads such that one pad rests against the rotor, which can cause squeaks as well as premature handbrake pad wear. And, of course, since the caliper will adjust to compensate for that wear, it will continue to wear until it's metal-to-metal.

Adjusting the cable this tight will not cause the handbrakes to bind if they aren't binding to begin with. The self-adjusters work when the travel of each lever exceeds a certain amount; it doesn't matter if they start at their stops or a little off their stops. If the levers never release past a given point, they will never adjust to be binding at that point.

If the system is together and operating but you just read that description above and now realize that your handbrake cable is adjusted too loosely -- the levers are sitting against their stops when released and the cable is slack -- you'd like to adjust the cable tighter. Unfortunately, presumably by now the handbrake adjusters have worked, so tightening the cable adjuster now may cause the pads to drag -- and this is what the instructions in the ROM are warning against.

You have two options. One is to take the handbrake calipers back out and reset the adjusters back to fully out and start over. Presuming you don't wanna do that, your most viable option is to adjust the cable tighter gradually, making sure not to cause the pads to drag.

If the cable is really sloppy, you can take all the slop out of it right away. As long as you're not pulling the levers off of their stops, you're not really making the handbrakes any tighter, you're just taking slop out of the cable. Once you have the cable tightened to the point where the levers are beginning to come off their stops, then you must be careful. Tighten the cable adjuster only a little bit farther, and check that the wheels still turn freely. Then leave it alone for a while, allowing the pads to wear a little; you might even opt to make some of your stops while driving by using the handbrake to help it wear a bit faster. Try not to ever pull the handbrake handle hard enough to cause the adjusters to tighten up. Then, when you can get the handle up to the first click without any noticeable drag, go back in and adjust it a bit tighter. Repeat until the levers are just off their stops with the handbrake released.

By the way, the ROM fails to mention that the way to get at that adjuster is to unbolt the seat belt from the floor on the driver's side.

DISCONNECTING THE HANDBRAKE CABLE: In the Haynes manual, Chapter 9, Section 18, step 5 describes disconnecting the handbrake cable from a caliper operating lever by extracting a split pin and a clevis pin. The arrangement they are describing is illustrated in Fig. 9.18. Must be an XJ12 thing, because the handbrake cable on the XJ-S isn't attached that way. The ROM shows the connection correctly.

In the ROM, Section 70.55.04, steps 1 and 2 describe peeling back the carpet near the handbrake handle and backing off the cable adjusting nuts. This is totally unnecessary; just make sure the handbrake is in the completely released position. If the cable is adjusted properly, it should not require loosening in order to disengage or reengage the cable at the levers on the brake. It should be possible to pull the levers together enough to pop the cable off or to pop it back on. Note that it will require moving *both* levers, however; one is operated by the cable itself and the other by the housing moving the opposite direction, but both movements will be needed to disengage the cable.

Step 4 in the ROM starts with "Using suitable lever..." in describing how to disconnect the handbrake cable from the caliper arm. Any sort of lever is unnecessary; the cable is easily disconnected by hand without tools. Merely pull the two levers towards each other and pop the cable tip out of the block at the end of the caliper arm on the passenger's side. Then pry the little rubber boot off the end of the cable housing at the block at the end of the caliper arm on the driver's side (as mentioned in step 5), and slide the cable housing back and out.

HANDBRAKE LEVER DAMAGE: As mentioned above, the cable attachments on the XJ-S don't require the removal of a split pin to remove; they can be engaged and disengaged by hand, slipping the cable into each clevis through a slot in one side. The author found those clevises to be damaged, though. They get spread a little bit, which just makes the ends of the cable fit loosely in the holes. But the clevis no longer pivots; it gets jammed, since it is spread wider within the side plates of the arm. It actually spreads the ends of the levers themselves a little bit. This might not be a huge deal, since they seem to get jammed in nearly the correct position.

This whole situation didn't seem cause for major concerns; there are no known reports of the thing actually coming apart in service. Just the same, though, while in there, I made two changes. First, I carefully squeezed the clevises back to their original shape so that they would spin freely in the lever arms. Second, when refitting the cable, I turned the clevises around so that the slot faced towards the lever rather than away. This makes cable attachment far more fiddly since you must feed the end through the tiny gap between the clevis and the lever before sliding it through the slot. The opening is so tight that it actually wouldn't fit; I ground three flats on the sides of the cable tip to help get it to fit through the levers. Once the cable is in place, those flats have no effect. With the clevises turned around this way, it seems far less likely that they will spread open because the lever itself will prevent them from spreading.

Another option, of course, might be to convert to the other design attachment using the split pin -- but that would probably require buying new handbrake calipers, and that would require finding them. Perhaps an easier fix would be to simply cut the weak clevises out and fabricate some replacements with more meat to them.

DUMB MISTAKES WHEN CONNECTING THE HANDBRAKE CABLE: You got the cable off, but now you can't get it back on! It turns out that if you're fiddling with the cable end underneath the car and push the cable into the housing a bit, it applies the handbrake! Up at the lever inside the car, the same thing happens that would happen if you pulled the lever up and set it back down: it doesn't *look* any different, but the handbrake is applied! Doesn't make any sound, either, no clicks, nothing to tell you what you've done.

You can go into the car, pull up the handbrake, push the button, and lower it back down, and you'll put it back into released position -- but it's hard to tell you've done anything until you get back under the car and find you have more slack! And good luck getting the cable latched onto the ends of the levers without accidentally pushing the cable in a little bit again, and have to get back out from under the car and manipulate the handle again.

HANDBRAKE CALIPER REMOVAL: Both the ROM and the Haynes describe how to remove the handbrake calipers without dropping the rear subframe from the car. Jan Wikström describes the work: "It's a fairly tinkery job, and definitely easier the second time... If you have a reasonable manual with a good picture of the system, patience is really all you need (you'll be working by feel as you can't see the upper side of the handbrake bits)."

Note that the reinstallation is considerably trickier than the removal. The pivot pins in the main caliper that the handbrake caliper attaches to also hold a bronze fork with tines that insert into holes in the top of each caliper half. The purpose of this bronze fork is to act as a spring to pull the pads back off the disk a little bit -- but just a little bit. As the handbrake pads wear and the caliper moves closer to the rotor, it pulls the bronze fork far enough to deform it -- which leaves it just the right shape to pull the pads back just a little bit again.

So, to ensure proper operation, this means that prior to assembly the tines on the bronze fork should be positioned to hold the handbrake calipers away from the rotor a little bit. Simultaneously, the caliper adjuster itself should be adjusted to hold the pads away from the rotor a little bit. So, after the calipers are in with the fork properly installed, the lever on each handbrake caliper can be manually actuated a few times to allow the self-adjusters to bring the calipers back up near the rotor -- and properly "set" the bronze fork to be applying the correct amount of retraction. Manually operating the levers also serves to confirm that both adjusters are working prior to connecting the cable.

Several owners have reported errors in installing the pivot pins -- missing the entire inner boss on the main caliper, apparently. Bob Gallivan says, "Not only will they thread in but they *look* to be correct while missing the lower hole completely. Been there & have the crick in my neck to prove it..." After Carlos Artal was told this might explain the problems he was having, he reported: "I put the car on ramps again, and proceed to take the h/b calipers off. Well, not 1 or 2 of the fixing bolts were out of place, but 3 of them were, with just one poor guy left there to do all the work!"

Another common problem is that the tines of the bronze fork end up on the disc side of the caliper -- against the disc side of the pad backing plate -- instead of in the holes in the caliper where they belong.

Tip: Use a pair of 1/4" rods about 3" long to assemble the calipers instead of the pivot pins. This allows you to install the calipers with these substitute pivots first, then finagle the bronze fork into place (since there are no heads on the substitute pins), and finally to carefully remove the substitute pins one at a time and replace them with the actual pins. You can grind a tapered end on the substitute pins to make insertion easier; in fact, you could use 3/16" or 6mm rods just to make insertion really easy.

If you have the main caliper out, by all means take advantage of the situation and trial-assemble the handbrake calipers on it before putting it in the car.

HANDBRAKE PAD CHANGE: Since the handbrake calipers on Jaguars with inboard rear brakes are separate from the main calipers, they also use dedicated pads. Really, these pads should *never* need replacement -- what are you doing, using them to slow going downhill or something?

The lining on new handbrake pads is about 7/16" thick, all the way across. However, since the calipers pivot around the attachments on the main caliper, as they wear they become tapered. This is normal, don't panic. If they get worn too far, though, the rear end of the caliper will hit the rotor. The service limit of 1/8" on the main pads is probably a good number for these pads as well, but you need to be measuring the lining thickness at the thin end.

Technically, the handbrake pads could be removed and reinstalled without taking the handbrake calipers out of the car.

Unfortunately, that won't do any good, because to install *new* (thicker) pads you will need to readjust the self-adjuster and install a new bronze fork. In other words, the handbrake calipers have to come out.

Do you really need a new bronze fork, or can you just rebend the old one? Well, if the handbrake pads are not being replaced, you only need to spread the bronze fork a little bit prior to reinstalling, and you will probably get away with it. If you're replacing the handbrake pads, though, you will have to spread the bronze fork all the way back to its as-new shape. Mike Morrin says, "Really *bad* idea. I have seen a couple of cases where the fork has broken due to metal fatigue. In itself not a big problem, but both times the rotor was destroyed before the fault was noticed. Always replace the forks when you have the hand brake calipers off. They are cheap."

When you go to removing the pads from the handbrake calipers, the ROM, Section 70.40.04, says "remove nut and spring washer securing pads to brake pad carriers, remove pads." The Haynes says the same thing in Chapter 9, Section 18, step 10. Removing that nut and spring washer is unnecessary; merely loosen it two full turns and the pad will slide right out, leaving the bolt, nut and washer loosely in place. They even provided a little hole at the top center of each pad to make it easier to grab and pull out. Of course, the new pads come with new screws in case you want to replace them, but there's really no need unless you strip them or something.

Just getting the nuts loose may be a challenge, though: The nut is 0.325" (8.25mm) across the flats. This isn't even a standard Whitworth size! Craig Sawyers says, "The nuts that secure the handbrake pads to the arms are 2BA. And *only* a 2BA socket will get in there to remove the nuts." Paul Burke says, "BA stands for British Association - believe it or not. BA threads start at size 0 (zero) which is the biggest, and the bolts and nuts get smaller as the number gets bigger."

Well, at least you know what to look for. This author used an 11/32" socket which worked but didn't fit too well; a 21/64" would have been better, if such a thing exists.

The bolt that this nut threads onto has an unusual head, but the threads are standard 10-28 fine thread. So once you get those weird nuts off, you could put normal-sized nuts on to replace them -- but that might not work well, either. The nut on the outboard side fits down into a well, and installing a nut with a larger 3/8" hex will probably mean you can't get a socket or wrench on it. This author found an excellent solution: the nuts used on military jet aircraft are extremely high strength and high temperature, yet they are very tiny and require a 12-point box end wrench or socket to install. If you can find a source for such nuts, they are highly recommended for this application. And you can leave the spring washer out, since the military nuts are self-locking. You will need to find 12-point sockets or box-end wrenches in 1/4" or 5/16" sizes; Snap-On makes them. I can guarantee they'll be easier to find than 2BA -- at least here in the US.

The facing of the handbrake pads is a rectangular shape with a corner cut off diagonally. The end with the corner cut off diagonally must go towards the rear of the car, or away from the pivots on the main caliper.

All agree on one important point: make very sure the fingers on the bronze fork are correctly in place in the little holes when it's all together. If one has slipped out, the handbrake pad will ride against the rotor, and this will damage the rotor itself in only a few hundred miles.

HANDBRAKE CALIPER REBUILDING: Jan Wikström says, "The self-adjusting ratchet mechanisms in the pad holders are quite likely to be clogged with semi-carbonized grease and dysfunctional; open the pad holders up, clean out the ratchet mechanism and grease very lightly with high-temp grease or MoS_2 (molybdenum disulfide). Drowning them in grease as the factory did is just silly; the ratchets may rotate one turn every few months and don't really need lubrication."

Mack Kamna describes rebuilding the handbrake calipers on Jaguar inboard rear brakes: "In the past my parking brake lever had to be pulled quite a ways to be effective. I found the self-adjusting nuts to be galled up with dry grease and very tight on adjuster bolt threads. I cleaned them up and dressed the gear teeth with a small file, then greased both the adjuster bolt threads (using C5A, anti seize), and the adjuster nut gear teeth (Hi-temp brake grease). I then installed the handbrake mechanism assembly with new retraction plates, and adjusted the handbrake "system" per the manual. When I pulled the handbrake lever, you could hear the adjusters smoothly clicking, and the pad assemblies tightened right up. I make no claims on my choice of lubricants; none of my 3 reference books on this maintenance task mention lubrication, they have just worked well for me in the past.

"...With the lever released there is *no drag* on the rotors, yet it only takes three clicks to make the wheels unmoveable by hand. I hope this can be of help to those of you who like myself have long suffered anemic handbrakes."

This author went a different way with lubricants, and lubricated everything in the handbrake caliper self-adjusting mechanism with graphite only. Graphite is good to extreme temperatures, won't ever dry out (it's dry already!), and won't collect dust and grit. The only concern is that it might not protect ferrous parts from rusting, and then the rusting could cause the adjuster to seize up.

HANDBRAKE ADJUSTER LUBRICATION: It is possible to lubricate the adjuster *too well*. Peter Cohen: "Upon refitting each handbrake assembly, it is an easy matter to operate the arm to check that the adjustment mechanism is clicking, and, in fact, to adjust them up. The first one I fitted worked fine. The second one refused to click. I removed the cover and refitted the mechanism to watch it in action. When the lever arm moves, it moves the piece of spring steel that has a pawl that is supposed to catch the toothed wheel and drag the toothed wheel back a notch, if necessary. What was happening on this one was that, when the spring steel moved, it was moving the toothed wheel in both directions, accomplishing nothing. I couldn't figure out what is supposed to put drag on the toothed wheel to prevent this from happening. Cleaning all lubricant off the threads wasn't sufficient. I finally applied a bit of dirt to the threads to add more resistance, and now the adjuster works fine. I'm sure it is not what the designer had in mind, but it worked."

THE ULTIMATE SOLUTION TO HANDBRAKE PROBLEMS: Some so-called "Jaguar experts" actually recommend removing the handbrake calipers from the inboard brakes entirely and throwing them away. This is probably because they can't figure out how to assemble them correctly. Obviously, it is irresponsible to recommend that an automobile owner simply remove a piece of safety equipment, but it is interesting to note that the handbrake calipers *can* be removed without adversely affecting the operation of the foot brake. The Jaguar is a rare example of a car on which this is possible.

SCRAPE, SCRAPE, SCRAPE: Ron Ickse describes the cause of a scrape, scrape, scrape sound that seems more pronounced when turning one direction and goes away when turning the other direction: "I've had this now three times on Jaguars over 20 years. In each case, it turned out that the retracting spring on the handbrake mechanism on one side or the other had failed, allowing the handbrake pad to remain in contact with the disk. Eventually, the pad wears down to the metal, so then you hear metal-to-metal contact. If the disk isn't quite true, you'll get the characteristic intermittent scraping noise. Fiddly but not particularly expensive to mend, if you (or your mechanic) knows what's what with Jaguar brakes."

TWR Rear Brakes

The rear brakes on a TWR are essentially the same idea as the do-it-yourself mod described starting on page 441; in fact, the www site listed includes a page of pictures of the rear brakes on Alan Heartfield's TWR.

Heartfield used Essex (see page 442) just to get replacement disks for his TWR since it proved easier and cheaper than trying to find genuine TWR parts. There are other companies that can provide such discs, including Wilwood.

Ordering discs through Essex involves filling out a "Custom Brake Disc Order Form" which they can fax to you. In the middle of the form there is a chart where you must fill in "Nominal Dimensions" of the discs you need. Fill the form in as follows:

ØA	B	ØC	ØD	E	MOUNTING HOLES			APPROX. WEIGHT
OUTSIDE DIAMETER	THICKNESS	EYE DIAMETER	FLANGE INSIDE	OFFSET	NO.	DIAMETER	ØM	

			DIAMETER				PCD	
10-3/8”	0.78”	6-3/4”	4.90”	0.39”	6	1/4”	5.50”	

The rest of the form is self-explanatory -- name, address, credit card number, etc. You can opt for tricky stuff like cross drilling or face grooves if you want. Essex will quote you a price once they get the form.

Note: the design shown starting on page 441 is *not* exactly the same as that used in the TWR -- 8 mounting holes vs. 6 -- so don’t use the Essex order form shown there for getting replacement discs for your TWR.

Heartfield’s TWR happens to have a Dana final drive unit. With the TWR vented rear brake design, it appears that the calipers were offset inboard by about 1/8”. This may have been accomplished by milling 1/8” off the calipers themselves or off the mounting bosses on the Dana final drive unit. If you need to replace either the calipers or the final drive unit on a TWR, you should check these parts carefully to see if the replacements will need to be modified accordingly. If the Dana final drive is replaced with a Salisbury (the standard repair procedure) it would appear that 1/8” spacers would be required between the calipers and the output shaft mount flanges -- spacers that would probably be *lots* of fun installing. If you run into stuff like this, you might opt to rebuild the calipers or final drive unit rather than replace them -- or you might opt to machine a 1/8” step in the inner hubs of your rotors like the ones shown on page 443, since the purpose of that step is to provide an assembly that doesn’t require offsetting the calipers.

Outboard Rear Brakes

Chad Bolles says the outboard brakes used on the later XJS are exactly the same as those used on the XJ40. Stephen Gibson says, “Outboard brakes on the XJS started at VIN 188105 with the solid rear disc for the 4.0 and 6.0 litre. The vented rear discs came in at VIN 198335.”

Handbrake/Parking Brake/Emergency Brake/Whatever

The handbrake used with the outboard brakes on the later XJS is actually a drum brake within the center portion of the disk rotor. Stephen Gibson says, “The outboard handbrake mechanism and shoes are identical for the XJ40 and XJS installation. When the vented rear discs came in the same handbrake mechanism and shoes were retained. They naturally have the same part numbers.”

HANDBRAKE LEVER JAMMING: This has only been reported on the cars with outboard rear brakes. The handbrake will not release, no matter what. Gary Penovich says, “One thing to try before you go through all this is to make sure the hand grip is back as far as it will go on the lever, before pushing the button. It has a habit of moving forward, and blocking one's thumb from pushing the button in far enough to release the brake.” Of course, you might just opt to take the grip off and throw it away.

The problem probably isn’t the grip, though. “It can be fixed. But, unfortunately, to really get good access to the lever assembly, you need to remove the four bolts holding the drivers seat to the floor, and tilting the seat up and away from the lever.

“Once you have good access to the lever assembly, remove the plastic cover. I believe it is held on with only one screw. Once off, you will see that the lever terminates at a flat, round metal plate. In the inner area of this plate is a slot. In the slot is a relatively thin, curved, metal rod. That rod is supposed to move with the lever/plate, when you press the thumb button and move the lever. Unfortunately, it appears that the lever can be over-tightened, causing the rod not to be able to engage properly in the slot.

"Take a large, flat-head screwdriver, and jam it into the slot, so that when you move the lever, the rod will move with it. That will force the rod to disengage the brake. Once disengaged, spray some WD-40 around the whole mechanism, and up inside the underside of the lever in the channel where the rod travels. Also, check the mechanism a number of times before putting the cover and seat back."

Brian Jamieson had the same problem: "I was able to remove the cover on the handbrake lever without removing the seat." He used a Pozidriv tip for an interchangeable-tip screwdriver. "It is only one inch long and with the seat moved forward and the back tilted forward I could get this on the screw and turn it with a small quarter inch wrench. When I got the cover off I pushed/levered the small rod that is connected to the button and then pushed down on the handbrake cable which dropped down and released. I think the cable was binding where it goes into the outer cover. Anyway, problem solved for the time being."

ABS Brakes

Antilock Braking System (ABS) brakes have gotten a lot of press. Essentially, the system involves sensors in the wheels that sense when a wheel has stopped turning and releases the brake on that wheel. When the wheel resumes turning, the brake is reapplied. If the brakes are applied forcefully enough, this results in a "pulsing" as the brakes to each wheel are cyclically applied and released.

When initially developed, ABS was expected to provide a considerable safety benefit; in fact, many auto manufacturers pursued development of ABS in expectation that it would later be required on US cars. After a few years of voluntary application (typically on higher-end cars such as the XJ-S), accident statistics failed to confirm any safety benefit, so proposals to require ABS have been stifled.

In a straight line on dry pavement, ABS brakes do little good; a car with comparable conventional brakes can stop in essentially the same distance. However, the application is different; on the car with conventional brakes, the driver can achieve the best stopping distance by applying the brakes as hard as possible without locking the wheels, and many skilled drivers are very adept at doing so. On the car with ABS brakes, the driver might as well simply jam the pedal as hard as possible and let the ABS work. While this was originally expected to be one of the safety benefits -- the driver no longer needs to be skilled at braking -- it is theorized that this is in fact one of the reasons the statistics haven't panned out; the driver is still trying to modulate the brakes carefully as before, and he and the ABS system don't work together well and result in longer stopping distances.

In a straight line on wet pavement, ABS has little benefit as well. Since the car does not stop as quickly, there is less weight shift from rear to front, and a set of conventional brakes with fixed proportions between rear and front may lock the front wheels. However, the vast majority of conventional braking systems had addressed this problem decades ago, providing more rear braking at light pedal pressures with the emphasis shifting forward as the pressure increased. Perhaps the biggest benefit of ABS here is control, since a car with the wheels locked may turn sideways on slick pavement.

In a straight line with water or oil only on one side of the car, ABS offers a *major* benefit. If the conventional brakes are applied hard, one side of the car will slide and the car will turn violently. Alternatively, if the brakes are not applied that hard, it takes a long distance to stop. ABS allows the brakes on the dry side to be applied hard while the brakes on the wet side are kept from sliding, and the car can be brought to a rapid halt in controlled fashion.

In a curve, ABS provides perhaps its greatest benefit. If conventional brakes are locked in a curve, the car will slide in a straight line, which runs it off the side of the curve and into a tree or over a cliff. Skilled drivers know this and *never* apply the brakes hard in a curve; they will aim the car straight, even if it's aimed off the road, before applying the brakes hard. With ABS, however, it is perfectly workable to apply the brakes hard in a curve, since the wheels won't lock and control will be maintained. Since the curve causes a weight shift to the outside, the outside brakes can be applied forcefully without locking the lightly-loaded inside wheels. However, this is yet another possible reason that ABS hasn't lived up to its promise of increased safety; drivers may still refuse to apply the brakes hard in a curve.

Loose-packed snow, gravel, or the like, may be one of ABS's most notorious shortcomings. On such surfaces, the quickest way to stop a car is often to lock up the wheels and let them dig in. However, ABS prevents this from happening, so the car seemed to roll along forever, pulsing all the way. If the car ahead doesn't have ABS and has dug its wheels in and stopped in short order, this can be a real problem.

Richard Drozdowski says, "Shifting to neutral is almost a must for an XJ-S in the snow or ice. Leaving it in drive tends to push the car ahead and plays havoc with the ABS. The immediate ABS chatter greatly increases stopping distances."

Of course, stunt drivers don't care for ABS. When you see those guys in the movies spin the car around backwards and take off in the other direction, rest assured they do not have ABS; that 180º spin requires that the steering wheel be turned first one way, then the other way hard and the brakes locked. With ABS, they'd probably just drive off the side of the road.

ABS SYSTEM TYPES: ABS brakes were introduced on the XJ-S in March of 1988 (midst of 1988 MY) with the Teves Mk III system, and this system was used until early 1995. The Mk III system can be distinguished by having an electric pump and an accumulator ball; they're on the right side under the hood on LHD cars. It also has no vacuum-operated power brake booster; the master cylinder, which is a long, convoluted assembly, is bolted directly to the pedal housing. The air filter housings on the V12 engine were shifted forwards to accommodate this master cylinder.

From 1995.25 on, Jaguar switched to the simpler Teves Mk IV ABS system for the XJ-S. There is no accumulator ball, and there is a vacuum power brake booster. In fact, the power brake booster as well as the master cylinder look remarkably like the pre-ABS components.

ALWAYS USE DOT 4 FLUID: Greg Meboe clarifies: "ABS systems call for (and need) DOT 4 fluid. Not DOT 3, not "DOT 5" (silicone). This is not the same thing as the early British systems. The fluid required in the 50/60's cars must be compatable with the rubber used. The fluid readily available in the US for this just so happens to be DOT 4 spec. ABS systems require the boiling point (wet) of DOT 4 fluid, and don't care about being compatable with old British rubber."

Reportedly, Pat Goss, the host of the TV show Motor Week, said the following: "Never use silicon brake fluid in an ABS system! [Silicon] brake fluid doesn't like the pumping action of the ABS pump. The pistons move so rapidly that it causes the silicon to foam and all of a sudden you have aerated fluid and you have a pedal that's on the floor."

PAD CHANGE: If the car has ABS brakes and the calipers are pressed back, fluid within the calipers is forced back up the lines and into the master control system. Since the fluid that has been within the calipers for some time often has a high degree of contamination (wear particles from the cylinder walls, etc.), when this fluid is backed into the controls it tends to cause problems -- and very expensive problems at that. It is suggested that when pressing the calipers back (like when installing new pads) to open the bleed port and allow the fluid to drain rather than pushing it back up the lines.

Perhaps this isn't a bad idea with *any* brakes.

ABS TESTING: Michael Neal writes: "I do extreme situation ABS test on cars during major services. I get quite a few surprises. Even from a moderate speed of 45 mph I've had cars yank the steering wheel out of my hands and the car ends up rotating 30 or 40 degrees. This is usually caused by a sticking piston or slide on a caliper."

Pat Goss, the host of the TV show Motor Week, reportedly advised to "exercise" the ABS at least once a month on a gravel road or in a wet parking lot -- meaning, jam the brakes and let the ABS kick in.

Teves Mk III ABS system

TEVES Mk III ABS OPERATION: Here's a brief synopsis of how the Teves Mk III ABS brakes work: There is an electric pump and a pressure accumulator that provide pressurized fluid. When the brake pedal is depressed, the pedal linkage moves a piston within a chamber in the ABS master cylinder. This piston directly applies pressure to the fluid leading to the front brakes, which means the front brakes will work even if the pump stops working.

This leads some to conclude that the front brakes are not assisted, but they are mistaken. The force applied to this piston also actuates a valve that allows pressurized fluid to enter the chamber behind this piston, helping push it forward and applying the front brakes. The result is a 4:1 power assist on the front brakes when the system is working properly.

The pressurized fluid applied behind that piston to assist the front brakes is also ported directly to the rear brakes. The rear brakes are therefore actuated entirely by the power assist to the front brakes. If the pump fails you will have no rear brakes whatsoever, save for the handbrake. Combined with the loss of power assist on the front brakes, the fact that something is very wrong with your brakes will be apparent immediately -- even without all those warning lights lit up on the dashboard.

Now to the ABS operation. There are three systems here: the LF, the RF, and the rear. Each of these has two solenoid valves within the valve block. If a wheel sensor detects that a wheel has stopped rotating, the first solenoid valve closes off the line from the master cylinder so no further pressure can be applied to that caliper. Then the next solenoid valve opens, relieving some of the pressure within that caliper back to the brake fluid reservoir. As soon as the wheel sensor detects that the wheel has begun rotating again, the second valve closes and then the first valve opens, applying more pressure to the caliper. In practice this all happens over and over very quickly, leading to the characteristic pulsing of the pedal.

With the rear brakes that are fed entirely by the pump, that's all there is to it. With the pedal-operated fronts, however, this alternate relieving and repressurizing would quickly allow the brake pedal to fall to the floor. So there is one more valve involved that applies pressurized fluid directly to the front brake circuits during ABS operation to keep the pedal up.

ERRORS IN THE MANUALS: Page 70-4 of Volume 4 of the 1987-on Service Manuals (JJM 10 04 06/20) includes diagrams of the ABS booster unit and a description of how it works. At one point it says "The control valve (3 Fig. 2) opens the unpressurized booster chamber to the reservoir (9 Fig. 2);" The sentence is correct, but the reference to item 9 in Figure 2 is not. Item 9 is the master cylinder piston. There is no item number marking the booster chamber, but it's the chamber surrounding items 2 and 4 in Figure 2.

Item 1 on Figure 2 is called an actuator piston several times, but farther down on the same page they call it an "actuator plate". That's just to confuse you.

Later in that same sentence, the term "preset pedal force" is used. The word "preset" is there just to confuse you. Just leave that word out and you'll understand the sentence better.

On page 70-9, the text says that item 2 in Figure 2 is the connection to the reservoir. This is incorrect; item 2 is the connection to the booster circuit. The connection to the reservoir is unlabelled but it is to the left of item 2. I *think*. I think Figure 2 is somewhat incorrect as well, showing the valve in energized position.

Mike McGaw and Brian Rice add another glitch: "The document in question is March 1991 XJS Service Manual Volume 5 Section 90, page 90.5.10-1. This schematic clearly shows the switch states on the pressure switch as normally closed (whether under pressure or at no pressure is not clear from the drawing). Furthermore, although the document is dated 1991, the schematic does not show the presence of the Brake Inverter Relay, which *is* clearly on 1990 and later cars." You can read about that Brake Warning Inverter Relay below under the Blue Top Combination Switch.

OTHER RESOURCES: Mike McGaw points out that the Teves Mk III system in the XJ-S is similar to the Teves Mk II system in the Buick Reatta, the Ford SC Thunderbird, as well as a few Lincoln models. There are very active enthusiast sites for the Buick Reatta online such as http://www.reatta.net which even offers downloadable GM repair manuals. This also presents myriad possibilities for obtaining replacement parts at reasonable prices.

ECU: The ECU for the Teves Mk III system is in the left side of the trunk. The part number is DAC10056.

BLEEDING: Stefan Schulz points out that the bleeding procedure for the Mk III ABS brakes is neither obvious nor similar to normal brakes. "Details are in section 70.25.02 of the service manual. Most ABS repair operations refer specifically to these procedures, so I guess they're kinda important."

FAULT CODES: George Balthrop says, "The diagnostic connector in the boot, beside the ABS ECU, has 3 wires: Black, Red/Black and Brown/Pink. On my '89, the diagnostic plug is a round, black cylinder, ~ 5/8" diameter, with three female sockets.

"With the ignition OFF, put a jumper between the Black wire and the Brown/Pink wire, and the blink code will begin on the warning lamp in 6 seconds from turning on the ignition to the run position.

"See page 70-22 of the Jaguar Service Manual for the procedure, and subsequent pages for the codes. Each code has two digits. For example, if you see two flashes, then a pause of approximately 2 seconds, and then 3 flashes, that would be code 23. There is a pause of approximately 6 seconds between codes, and you may have two or more codes.

"There are several dozen codes, and you need to determine where the fault is on *your* vehicle by using the codes. What someone else had happen to them would not be helpful to you. Perhaps the most frequent fault is a dirty sensor (the code tells you which wheel), or a damaged wire or corroded connector to the sensor."

Peter Cohen adds, "The ECU is only capable of dealing with one type of fault code at a time, e.g. code 21 will display, but code 22 will not; instead the blink sequence will move to the next fault type, code 31 or higher. Therefore, on completion of the required maintenance work, carry out the ECU memory erase procedure, then repeat the blink display diagnosis procedure. This will indicate any remaining or new faults in the system.

"To erase memory, drive the car at a speed greater than 19MPH (30 KmPH)."

FIX THE EASY STUFF FIRST: Stephen L Abigail describes how he fixed his brakes: "I pulled the ABS relay (yellow one under passenger side of dash), cleaned the terminals and everything's back to normal. I spoke to a Jag mechanic about this and he said "Yeah, that sometimes happens"."

HEAT: Several owners have reported problems with their ABS systems stuck in traffic on hot days that went away when things got cooler. That's clearly not good, but it's unknown at this point what causes the heat-related issues.

It is clear, though, that the pump itself is not rated for continuous operation. The manuals warn against allowing it to run more than two minutes at a time, and it must be allowed to cool down in between. Perhaps, if these drivers were on and off the brakes a lot (understandable in a traffic jam), they inadvertently caused the pump to run too much and quit due to overheating.

RESERVOIR CLEANING: With a conventional brake system, the fluid in the reservoir just sits there. With the Mk III ABS system, it is moving all the time -- and is subject to flow restrictions. Roger Calvert reports: "I cleaned out the brake fluid reservoir because the outlet to the pump was blocked with sludge etc. After 18 years I guess that even with regular fluid changes there will be some 'stuff' that remains at the bottom of that lower part of the reservoir. The clue was that the pump whine would change as some fluid got through, then got noisier as it could only get air. It wasn't that difficult a job to do, just a bit messy."

FLUID LEVEL: Peter Cohen writes, "The ABS cars do not have a problem with a poor quality float in the brake fluid reservoir, but they are *very* sensitive to even slightly low fluid. Mine will flash while the fluid level is still above the minimum line, but topping it up always cures it."

ACCUMULATOR TESTING: The Mk III ABS system includes a black ball that serves as a pressure reservoir to allow the brakes to operate several times after the pump has been shut off. This accumulator contains a diaphragm and a charge of nitrogen. If the incidence of failure reports on the online discussion list is any indication, if you have a Teves Mk III ABS system you will be replacing this black ball sooner or later.

When the diaphragm charge is deteriorating, the pump will kick on more often. When it comes on every application or runs constantly, you need a new accumulator. Rusty Beard: "This is a primary concern. I have had the brakes *totally fail* due to my own negligence. The equipment gets hot, as the pump is not engineered for 100% duty. Please know how active your brake pump is. If it is extremely active, call your favorite parts supplier and buy a new pressure bulb, *like right now*."

Just in case you have any doubts at all regarding the condition of your accumulator or the rest of your ABS system, George Balthrop relates a comprehensive checkout procedure that was developed by the XJ40 guys:

"The data below is from tests on my '89 XJ-S which has a 5-year-old accumulator. I ran these same tests when the accumulator was only 2 years old and got essentially the same results.

"How long your pump will run at startup depends in large degree on how long it has been since the pump last ran, as the system slowly loses pressure after shutdown. The best way to get some uniformity in the results is to *fully* deplete system pressure before testing. So before putting the key in the switch, press and release the brake pedal until the pedal goes hard.

"Turn off the blower switch, the radio, and anything else that will produce noise, as you want to be able to hear the brake electric pump hum from near the right A post, and hear the pump relay click from the right/auxiliary component panel (above right footwell).

"Use a stopwatch to measure time and record as follows:

1. Turn key to run position and start watch; record seconds before "Brake" light extinguishes, but keep watch running; this took about 40 seconds on my 89 XJ-S.
2. Continue to time until the pump hum ceases and the pump relay clicks (must listen carefully as these are hard to hear); this took 52 seconds on my 89;
3. With the key still on, press and release the brake pedal until you hear the pump run/relay click (then quit pressing the pedal), and time the pump run until the relay clicks again to shut the pump off; on my 89, the pump began to run in 2 to 3 presses of the pedal, and ran for 4 seconds before shutoff.
4. Turn the key OFF. Press and release the brake pedal, counting the presses, until the pedal goes *fully* hard. On my 89, about half-way through the process, the pedal feels like it is hitting a stop after it moves maybe two inches, but this is *not* fully hard -- keep pressing and counting. My 89 took about 40 presses to go completely hard.

"This last test (4) is the definitive test for the accumulator. The tests 1 - 3 are tests of the pump, pump control circuit, and the combined pressure warning switch."

BUYING A NEW ACCUMULATOR: OK, so where do you buy a new black ball? It's Jaguar part number JLM1907;

the dealer will charge you about $200. You could go to the source; Peter Cohen says, “The ABS Accumulator Ball is made by Lemfoerder Metallwaren GmbH, 28036 Bremen, Germany. Part Number is 834 000 008 if you happen to be in a place where you can buy or order Lemfoerder parts.”

Note that the 1988-89 XJ40 uses a different accumulator, JLM11659, which will not fit the XJ-S. In fact, the entire ABS brake system in the 1988-89 XJ40 is Girling rather than Teves. The XJ40 switched to a Teves system for 1990, though, and uses the JLM1907 from then on.

But there are lots of cars that have ABS brakes, and there are even lots of cars that have Teves ABS brakes. Including GM cars. Joe Calandriello says, “The original accumulator ball can be replaced with an AC Delco part #25528382. It can be bought at any GM dealer for around $156.00, which is quite a bit cheaper than the original ball. Napa also said they could order it, but their price was about $177.00. I replaced mine with the AC Delco and the #'s stamped on the ball were the same and both said made in Germany; looked identical to me.”

Andrew Weinberg confirms it’s not just an interchangeable part, it’s the *same* part: “The GM part is identical to the Jag; virtually every marking on the two parts (and there were about 4-5 different number sequences) are the same, including a pressure rating- 210 Bar. I also checked the threads -- they are the same, and the GM part also has the same hex drive in the top. It does have a spiffy yellow warning label on it that's different, but who cares? This is an original part for the Buick Reatta. This was for my '89 convert, but I imagine it is the same for all XJ-S with the Teves Mk III system. Check it out. And the price is only $87 or so.”

Bryan LaPlante says, “I not long ago replaced my ABS accumulator ball in the '90 XJ-S -- with a ball listed for the Pontiac 6000. Probably same as the Reatta part, but a lot cheaper car! Took a bit of cross-number checking, but it bolted up fine and looks identical.”

Hey, we’re talking Delco here; there are people selling parts *cheap*. Peter Cohen says, “You can buy the ABS accumulator from Keltner's Automotive (800) 666-3311 (http://www.keltners.com) under AC Delco part number 25528382 for US $72.62.” Hey, don’t hold this book to the price, but clearly it pays to shop online.

Another option, believe it or not, is to have the original ball renovated. Alan Baker says, “I've recently had the sphere re-charged by Pleiades UK (01487 831239) for about 1/3 cost of a new one. Note that they are more used to re-working the XJ40 sphere which has a larger diameter thread, so be aware. The spheres lose around 10% pressure every year. As long as they aren't completely de-pressurised they can usually be re-charged. Look into the sphere, the diaphragm should be seen easily if there is pressure. If the diaphragm is all the way in, chances are the sphere is scrap.”

INSTALLING YOUR NEW ACCUMULATOR: Rusty Beard described how to remove the ball; basically, you apply the brakes *hard* about 50 times with the ignition off to bleed off any pressure in the system. Then you wrap a rag around the threads to catch fluid (it will leak some), then unscrew the old ball and screw on the new one.

Peter Cohen says, “When I did mine, I mistakenly took it to mean "put a rag underneath the threads". Since what happens is that fluid sprays out from 360 degrees, Rusty's instructions are spot on. Just don't misread them.”

Schulz feels the spray is due to inadequate pumping. “The ROM says to discharge the brake accumulator by stomping on the pedal twenty times before attacking it. I stomped on the pedal forty times for good measure and still, when I unscrewed it, brake fluid squirted out far and wide. Not good. Make that sixty *full-pedal-travel* stomps next time.”

Cohen: “I don't think the number of times you pump the pedal has any effect. I think I pumped 50 times.”

Schulz adds, “The ROM also says that the brake pedal should go hard when the accumulator is discharged. With the new accumulator the transition from soft to hard on discharge is sudden and noticeable; with the old one it wasn't.”

John S. Whitford says, "I pumped the brake pedal around 100 times. I had no pressure when I unscrewed it."

Kevin Darling says, "Pumping the brakes another few dozen times beforehand left me with no pressure or spray either. Terrific! The Book should be changed to make that 100 times instead of just 50. :-)"

Schulz also notes that discharging the accumulator will raise the fluid level in the reservoir. If it’s too high to begin with, it “results in a nice little fountain of brake fluid out of the valve in the reservoir cap when you discharge the accumulator."

There's a little hex on the top of the ball. You might not need to use it. "I used a large C Clamp to hold aluminum casting in place whilst removing ball w/ strap type filter wrench, worked great!"

Perhaps it doesn't work for everyone, though. Darling says, "I actually had tried the oil filter wrench thing yesterday... all that happened was that I ended up with a very expensive wrench. :-) The hex bit did the trick, though. I bought a Lisle #12560 8mm Hex Brake Caliper Bit and after some teeth gritting pulls, the accumulator ball finally went "snap!" and broke loose."

Do you need to bleed the system after changing the accumulator? Cohen: "Prior to changing my black ball, I put the question to the list about whether or not bleeding was necessary. The answer was "not necessary". That didn't seem right to me, but, following ball replacement, the brakes worked fine without bleeding."

Schulz disagrees. "The repair procedure in the ROM does not suggest bleeding anything after replacing the accumulator. Since the pedal was ridiculously spongy after I did the work, I bled pump, fronts and rears anyway. Pedal was firm afterwards. Bleeding should be part of the job." Of course, it's possible that Schulz's system would have bled itself within a few minutes of running if he had left it alone.

COMBINATION SWITCH: This switch is mounted on the same manifold as the accumulator. It controls the ABS hydraulic pump and also turns on the malfunction indicator lamp if the pressure drops too low. There are two versions, a "black top" P/N JLM1465 and a "blue top" P/N JLM1908. The black top switch was used on the ABS system in the XJ-S through VIN 165790, and the blue top from VIN 165791 on. The blue top switch was also used in the XJ40.

Mike McGaw describes a failure of a combination pressure switch: "I began to see intermittent ABS lights, then constant light. I could not find the problem initially, but it turned out that the pressure switch failed. And it failed in the most peculiar manner: the case ruptured where the plastic body came into the metal housing. Evidently, fluid got past the seals in the switch and managed to pressurize a region of the switch that should have never seen pressure. This began innocuously enough, and the symptoms presented over several days before I got a constant red ABS warning light."

BLACK TOP COMBINATION SWITCH REPLACEMENT: The black top switch is reportedly NLA. The blue top switch is not the same; the contacts that control the pump are fine, but the contacts for the malfunction indicator lamp are reversed logic -- one is open when the other is closed and verse visa. Some owners have figured out how to make the blue top switch work by adding a relay, but don't bother with that; here's a better way to replace the black top switch, courtesy of "Dave": "Over the weekend I installed a GM pressure switch on the Teves ABS pump in my 89 XJ-S. The GM part no is 25533700. Got it from gmpartsdirect.com for $88 including shipping (NAYY). My local GM dealer wanted $130 + tax. The switch fits fine except that the electrical connector is different. I ended up buying the mating connector from the dealer (discounted to $56 + tax, ouch!). The connector part no is 12117277, gmpartsdirect has them for $40 + handling + shipping.

"The connector pins on the Jag part (my car used JLM1465) are numbered 1 through 5. The GM pins are numbered A through E. I tested both switches by clamping them in a vise and gradually depressing the plunger while monitoring continuity between the pins. Oddly enough, pins 1 and A correspond, 2 and B, etc. I simply noted the wire color code, cut the Jag connector off and spliced the GM connector on (connector includes crimp splices). The GM part is slightly longer, but does clear the side of the engine bay.

"I had suspected the accumulator was the cause of the ABS warning light coming on every time I used the brakes. Then I noticed that the switch was leaking brake fluid around the threads, so at the very least the switch was bad. Glad I replaced the switch first!"

BLUE TOP COMBINATION SWITCH REPLACEMENT: The blue top switch is easy enough to find; you just need to fork over "about $550-$700, depending on whom you ask." Forget that, use the GM switch described above instead.

"My wife's 1990 XJ-S developed a bad ABS accumulator and pressure switch. I replaced them with GM parts and have a recommendation for the re-wiring to accommodate the different GM switch logic.

"Make a 2 or 3 inch wire link with a 1/4 inch spade connector at each end. Pull the "Brake Warning Inverter Relay" out and set it in the spares box. In our US Spec car the relay was green in a red socket behind the driver's side knee bolster. Stick the wires from your wire link in pins 85 and 30 of the relay socket. The relay was there to invert the signal from the Jag switch which is inverted from the GM version. Doing away with the relay brings you back to function *and* generates a spare part. Now how many Jag fixes can do that?"

STEENKIN' DIODE: Andpa says, "I have a 1990 5.3 that recently had abs failure. It kept blowing the pump fuse. After replacing pumps and various items, I spent many hours tracing for a wiring fault and eventually found the diode in the wiring where it goes through the inner guard had failed. After spending 50c AUS all is well."

Philip describes his analysis: "The fuse blows with the pump and the ecu disconnected. A brown with blue stripe wire going to the pump is the same color as the one going to my blown fuse, also a black wire going to the pump. I checked continuity on the black wire with bare metal, my meter beeps. Checked it on the brown/blue wire, my meter beeps!"

Peter Cohen responds: "No, don't tear the dash apart. It's not in there. Looking at my car, it appears that the wiring goes under the right side fender brace and enters the firewall behind the transmission dipstick. If you look at the inner fender just where the brace meets it, you will see several items hanging off the wiring harness. They are shrink wrapped with the wires on one side and flattened on the other. The wrapping may or may not be red. These are diodes. I have one that is labeled -/\/\/\--|>- which suggests a resistor diode. The wiring diagram suggests that the wires to the diode will be white & blue.

"Keep in mind that cut insulation shorting the Brown/Blue wire will do the same thing as a shorted diode, so check the condition of the wire carefully."

"If you want to jettison the existing NU wire circuit and re-create it, rather than finding where it is shorted, you could do that. I would recommend re-creating it with the diode and ground connection, like it was originally, mainly because I have to assume it was there for a reason, even though I don't know what that reason is." The reason is almost certainly to absorb reverse voltage spikes from the inductive pump motor; see page 559. Without the diode it would work for a while, but the control relay wouldn't last long.

PUMP INLET SCREEN: Mike McGaw reports, "I removed and disassembled the pump/motor; the assembly comes apart with two cap screws and reveals, among other things, a very fine fluid filter. On mine, the filter was perhaps 5-10% clogged with a gelled substance. I dipped it in clean brake fluid to clean it as best I could, and reassembled this unit and reinstalled it."

PUMP TESTING: Ron R. says, "I can hear my pump come on, run and stop but I always have an ABS light on, this wasn't of much concern until I got near the bottom of a long curvy hill and was using both feet on the pedal and pulling on the steering wheel as well, all the while trying to look relaxed so the wife wouldn't panic! But we barely stopped before some behaviour unbecoming to the Jaguar name occurred between us and an econobox.

"Anyway, I get no error codes from ABS ECU, but I followed the troubleshooting guide in the Jaguar service manual. Brakes worked unless used frequently, pump cycled on/off, but the one light never went off. The ABS test from Service manual section 10 step 9 led me to believe it was accumulator so I replaced it with one from GM parts direct. That didn't fix it so I went to Hydraulic System pressure test section 70.00.00. The pressure never made it to 190 bar in 60 seconds or more for that matter. So continuing it says 1. Check pump voltage if greater than 10 volts renew pump, if less than 10 insp. pump motor line. 2. Check for corroded contacts (mine had this, cleaned no change). 3. Check reservoir filter, remove hose from pump and check for free flow through filter and hose if flow good and time to reach 190 bar greater than 60 secs renew pump. This is how I arrived at changing pump.

"I checked the pressure right at the pump outlet high pressure hose using a small length of bubble flared brake line, adapted to NPT and a hydraulic pressure guage. My original pump did not make the 180-200 bar even if I hotwired pump to run manually. I purchased a used pump off ebay and the new one shot past 180 bar so fast I couldn't get the wires unhooked fast enough before I hit 210 bar (3000+ psi). Note to self here, if you're going to pressurize a closed circuit to 3000+ psi you should leave yourself a way to release pressure instead of 2 wrenches wrapped in a rag. No harm came of it, just a little messy."

HIGH PRESSURE HOSE REPLACEMENT: Tom Bennett reports, "I have an '88 ABS car and recently needed to change the high pressure hose. Any of you who have had to do the same will know how dammed expensive this particular hose is! As I was doing my brake hoses in Braided Teflon I figured the same stuff would be ok to use for this hose also; the only problem is the banjo, it's a special! Solution is to cut the banjo end from your old hose and drill and tap it (I used a 3/8" unf tap, cause that's what I had). Then use a short 3/8" unf bulkhead male fitting on that end of the hose. For the other end, the part is a "Female bulkhead fitting with a 10mm x 1.0 thread pitch " available off the shelf. One could apply the same technique as the banjo end if you cannot find this fitting. Then get your hose made up to the length you require."

COMPONENT REBUILDING: That actuator assembly full of control valves where a master cylinder should be can be rebuilt. Stephen Gibson says you'll need a "Valve Block Repair Kit", JLM 11337. Prepare for sticker shock; the kit is more than $500.

Peter Cohen says "Rebuilt ABS control modules are available in the US from Wagner (or resold from Wagner by A1 Cardone & Parts Master) and in the UK from BBA Remanufacturing. The hydraulic unit + pump & motor assembly are also available in the US from the same sources. None of them are cheap, but they are a lot less than new ones."

WHEEL SENSOR ISSUES: Rusty Beard reports: "After start up, the '89 XJ-S would go thru normal light sequence, then after a short roll down the driveway it would light the ABS light. From that point on, it would stay on thru the rest of the trip. Heavy braking confirmed that the ABS was inactive, but brakes were present and fully active, just in a non-ABS action.

"The ABS culprit was the front-left wire to the ABS magnetic wheel sensor. The wire is a simple shielded one, and the shield was broken. One call to the local Jaguar Dealer indicated that the part has a retail list of $260 and my "Good Guy" price was $214. (wowza!). I'm sure other vendors can get it for somewhat less, but I was trying to get this done -- now, not later.

"Reeling in shock from the price, I started to closely examine that wire. Hmmmm. It's just a simple shielded wire, kinda like a thin piece of coax. So, I treated it as a piece of coax, and I did a repair to the shield. I unplugged the sensor from the connector while doing the repair, and did a quality shield repair that my dear ole dad would be proud of.

"It works! ABS is back, the lights go out, and the test-drive indicated that all is well."

WHEEL BEARING FLOAT: LaRue Boyce says, “If you have trouble with the ABS unit, check out the front wheel bearing float; it will cause the sensor to report brake problems when it is working fine.”

Teves Mk IV ABS System

As mentioned earlier, the Teves Mk IV ABS system has no pump and no accumulator ball but does have a vacuum booster just like the pre-ABS brake systems. The ECU for the Mk IV system is in the engine compartment, in the right rear corner. The ECU part number is JLM12004.

FAULT CODES: George Balthrop says, "The Teves IV (vacuum boost) brake system introduced during the 1995 model year no longer has the "blink codes" capability that existed on the earlier Teves (hydraulic boost) systems. The ABS CM is linked to communicate with the Portable Diagnostic Unit (PDU)."

ABS System Removal

ABS SYSTEM REMOVAL: Some people, faced with the prospect of paying serious dollars to repair an ABS system, opt instead to simply remove it and convert the braking system to the far more reliable and easily repairable non-ABS power brake system used on the pre-ABS cars. Sean McKee did this job on his '90, which came with the Teves Mk III system:

"Parts list:
- Complete master cylinder/ vacuum booster/ pedal assembly
- Check valve and vacuum adapter for RH intake manifold.
- front steel brake lines

"There are really no tricks in the installation. The rear brake line screws into the master cylinder. The steel lines for the front simply replace the existing lines. I used the fluid supply line from reservoir to pump to be used as a vacuum line RH manifold to booster. A tab needs to be welded to the pedal to push on the brake light switch.

"Note: the ABS/brake light will remain illuminated, less a rewire, the bulb needs to be pulled.

"Pedal feel is identical to the ABS unit with the free play distance maybe slightly shorter."

Why would you need to weld a tab onto the earlier design pedal? Surely it operated the brake lights, too? True enough, but the pre-ABS brake light switch had a long lever on it that the arm of the pedal itself contacted. Perhaps, instead of welding on the tab, you could retrofit the earlier brake light switch as well -- or just utilize a generic microswitch with a long springy arm over the button. Paul Hanson says you can alternatively "use the cruise control switch up top of the pedal box along with a relay to reverse polarity so the brake lights come on when brake is applied."

Hansen adds: "New non-kinking steel brake lines are available at NAPA, which are a joy to use! Connect the front port of the Master Cylinder to the two front brake lines using a "T" connector and doing some flaring of the ends. The rear port of the MC connects with the rear brake line at the Pressure Delay hexagonal unit on the drivers side inner wing."

Tom Hollingsworth did the same job: "The swap was not difficult. You do need to replace the entire unit, pedal to master cylinder (the pedal/box is slightly different) you'll need a few metric pieces, and a small piece of bubble, not doubled flared, brake line."

Obviously, you'll want to remove much of the ABS equipment such as the pump. Maybe you can get a good price on EBay. The wheel sensors and associated wiring can be abandoned in place.

It might be considerably easier to remove the Mk IV system, since the vacuum booster and master cylinder appear "normal". I have no reports of this having been done, though.

Really, you should inform your auto insurance carrier so they can delete any credit you may be getting for having ABS. This author tried that once with no luck; the insurance company's database showed that that particular model automobile has ABS and there's no way to change that in their computers.

If you decide you want to keep the existing braking system but just disable the ABS function, well, be careful. You can't just pull a fuse and be done with it. You must keep the pump, accumulator, and combination switch working -- and those are perhaps the most failure-prone components! But if the pump and accumulator on the Teves Mk III are not functioning, you have no rear brakes at all, and the front brakes require excessive pedal pressure to stop the car.

It might be more viable to disable the Mk IV ABS system in place since it has vacuum assist and a conventional-looking master cylinder, but details are unknown at this time.

BODY

1991: For the 1991 model year, the body of the XJ-S was significantly altered. The most obvious differences were the totally different taillight arrangement with new "neutral color" taillights that don't look red until they come on, and rocker panels that flared toward the wheel wells rather than being perfectly straight. But despite the outwardly similar appearance of the rest of the car, supposedly almost every panel was altered, so purchasing any replacement body panels will probably require specifying pre- or post-1991.

The more significant change, as far as buyers of used cars are concerned, is that beginning with the 1991 body style revisions the entire body was supposedly made from galvanized steel.

RUST: The following is a description of where to keep an eye out for rust on an XJ-S, courtesy of John Butler, Mike Morrin and others:

- The joint between the rocker panel and the rear fender.
- Lower (i.e. closing) edge of boot (trunk) lid on the inside.
- Top dead center of rear wheel arches.
- Around rear bumper side-arm mounts (and along the horizontal seam behind them; Check inside the boot).
- The lower edge of the panel below the centre section of the rear bumper.
- Around tail-lights; just below them down the seam there and just ahead of them on the rear wing.
- If your back window rubbers are softening check for:
    - accumulation of water in the deep wells on either side of the boot (trunk).
    - water trickling down inside, down the back of the rear seat back and accumulating in the spongy sound-deadening underneath.
- Around the radius arm mountings -- <u>structural</u>
- On the front wing, just ahead of the front door hinge and just above the rocker panel.
- The front end of the sills (or the front of the footwell), behind the front wheels.
- Front footwells under the carpets (wet carpet rust).

Now, about those radius arm mountings. The way *most* owners find out they have a rust problem here is that the car starts wandering aimlessly at speed! The front mounting for the radius arm -- adjacent to the rear jacking points -- rips out of the bodywork along with a large section of sheet metal, allowing the rear wheel on that side to pretty much go where it wants. How does *yours* look?

John Nuttall adds, "I found two places where rust, if left untreated, could cause serious damage:

> 1. Chassis rail/tunnel area. By the chassis rails I mean two heavy gauge steel members that run from near the back of the floor right to the front of the engine compartment. These rails from the backbone of the body. The floor and tunnel are made from two separate pieces, one for each side, joined at the top of the tunnel. There is a step in the lower part of the tunnel. The chassis rail is welded to three faces of this step. The lowest part of the rail is horizontal and extends under the floor about two inches. The two are spot welded together. On my 1987 shell the rail was not formed properly so that the part of the rail under the floor slopes downwards to the outside. Looking under the car I can see a gap between floor and rail that was not filled by sealer. Looking at the floor from above I can see depressions in the floor at each spot weld where the tongs of the welder forced the thinner floor metal down to meet the rail.

> The consequence of all this is that rust has started in the space between rail and floor and has spread to the vertical part of the step in the tunnel to such an extent that rust is visible on this part of the step when viewed from inside the car. The rust is eating away this part of the floor/tunnel stamping.
>
> The serious implications to the structural integrity of the body are obvious. This fault appears to be caused by improper manufacturing of the rail and lack of quality control, and it probably occurred on other vehicles.
>
> 2. Front lower outer seat belt anchorage. On the '77 and '79 cars this anchorage is a nut welded inside the vertical face of the inner sill. Presumably it was thought that this was not strong enough, and at some point before '87 the anchorage was moved to the sloping part of the floor adjacent to the sill. A thick plate was welded and bolted to the underneath of the floor to reinforce the area. Unfortunately, the floor has a ridge in at this point and there is a gap between the floor and the plate here. The undercoating has proven inadequate to stop rust between plate and floor. This rust has spread between undercoating and floor. Rust is visible from the inside on parts of the floor, which means that rust has eaten through the floor. The strength of the anchorage is clearly at risk. This fault is mainly due to poor design, I would think, and it is certain to be present on many other vehicles.

"I urge owners of cars that might be affected by these problems to inspect their vehicles. Inspection from the inside requires that carpet and insulation be removed."

RUST AVOIDANCE - TRUNK LID: Julian Mullaney sends this tip: "Beginnings of rust under the lowermost lip of the trunk (boot) lid. There are not enough drain holes here where the two sheets of steel are spot welded. I will drill a couple more drain holes."

RUST AVOIDANCE - TAILLIGHT AREA: Julian Mullaney points out that water may collect behind the taillight fixtures, since there is no drain from this area. If it appears to be a concern, perhaps the best solution is to merely coat the metal with something to prevent rust, since it doesn't show.

The gaskets around lenses on cars generally follow one of two schools of design: they either attempt to totally seal thereby not allowing water in, or they include a notch at the bottom to allow water to drain out. This author's observations and experience indicate that the second idea is more often successful. Jaguar, of course, uses the first. To drain the water from the area behind the taillights, the gasket between the fixture and the body can be cut prior to installation to form a drain channel. If done at the bottom corner near the boot lid, it will scarcely be noticeable.

RUST AVOIDANCE - GENERAL: Car enthusiasts generally recommend a product called Waxoyl (see Brit-tec, page 701) for treating the areas of bodywork prone to rust. According to Frans Hoekemeijer, "It can be painted or sprayed. It can be thinned with "white spirit", which evaporates rather quickly. Only a very thin layer is sufficient to protect metals against corrosion as the molecules are polarized and cling to the surface through electrostatic action, in the same way water molecules do unfortunately. It sets to a waxy substance. If used on the outside of the underbody of the car it has to be renewed every so often."

In the UK, Waxoyl sells a "pump kit" which screws onto to can of Waxoyl and you manually pump it and it becomes a spray gun. It comes with a thin lance so you can poke it into various holes and get good coverage. Pete Hamel says "It's quite thick at normal temperatures so you can either thin it with white spirit or immerse the can in a bucket of hot water to make it more sprayable.

"The beauty of it is that you do not have to completely clean all dirt off the surfaces you apply it to as it creeps into small crevices and through dirt. It's good for hard to reach areas. You can also apply it over surface corrosion (remove any flaking rust). It does leave a slightly waxy/sticky surface though so you don't want to use it anywhere that appearance matters."

There are some people advertising in *Jaguar World* who come to your house and treat the car for you.

Another product favored for protection is called P.O.R. 15. According to Vince Chrzanowski, "A customer once painted the exterior of a car radio with POR (don't ask me why). When we tried to remove the stuff, we found it was nearly like porcelain in hardness and durability. We had to change to a more aggressive abrasive in the bead blast cabinet. I hope never to see POR on a radio again, but wouldn't mind it on the frame of my Mark IX."

PAINT: Jeffrey Gram reports: "Here in Europe many cars imported from the US are eventually repainted, and even many professionals are not aware of a pitfall in this area. According to a local "spritzer" the paint used on US cars are of a different and higher elasticity than Europe paint to be able to cope with extreme temperature variations causing expansion and contraction of the body sheet metal. If a US paintwork is spraypainted with EU paint, cracks will appear since the EU paint cannot cope with the expansion and contraction of the US paint layer. The solution is to either repaint from bare metal, or to spraypaint the US paint with a couple of layers of "bridging paint" before the new paint layer."

FASTENERS: All fasteners on the exterior of a car need to be stainless steel. On the XJ-S, it appears that most of them are -- if nobody's been working on your car. If there's a chance that some of yours have been replaced by some repairman or PO that didn't know any better, check all of them with a magnet (a magnet won't attract stainless steel) and replace any that are not stainless. This includes all the screws holding lamp lenses on. Here in the US, another good indicator is to carefully inspect the cross drive head; if it's Phillips, it is not the original screw -- the original screws were Pozidriv.

This author was unfortunate in that the turn signal bulbs in my front bumper had not burnt out in a long time. I say unfortunate because the screws that hold the lenses on had corroded and seized so badly they had to be drilled out -- four out of four, 100%. These screws were plain steel; since it is probable that Jaguar originally fitted stainless steel screws to these lenses, I may have been a victim of a previous repair. If your screws are still removable, I highly recommend you check to make sure they are stainless, and if not to purchase four 10-32 x 1-¼" Phillips drive oval head stainless steel screws to replace them with. Even with stainless steel screws, be sure to apply some anti-seize compound when reinstalling -- the clip nuts are not stainless.

Here in Bubbaland, 10-32 stainless steel screws are difficult to find, so I replaced the elaborate clip nuts on the bumper with conventional #10 clip nuts (available at auto parts stores) and bought some #10 x 1¼" stainless steel Phillips drive oval head sheet metal screws at a marine supply store. I never have to worry again about getting them out.

Stainless steel fasteners can be found at most marine supply stores and many better hardware stores, although fine thread or metric sizes are often a challenge.

ADHESIVES: According to Charles Daly, "A call to 3M produced the following info: If it's neoprene, as in a fitting, washer, etc., then 3M-8001 (Neoprene) is best. If it's weatherstripping type application and the rubber is EPDM (Ethylene Propylene Dieme Monomer) (which is what most auto weatherstrip is) then use 3M-80119 (which is called weatherstrip adhesive)."

WATER LEAKS - A/C SYSTEM: Bob Tilley investigated the cause of water leaking from his air conditioning system during rainy weather. It turned out that the plastic cover over the windscreen wiper motor had deteriorated and started breaking apart -- a common problem discussed on page 618. In Tilley's case, the various parts of the cover found their way into the drain pipes that feed from the wiper area through the engine compartment and out through the wheel wells. The drains end with a rubber elbow, and the plastic parts got lodged in it and plugged it, causing the wiper compartment to fill with rainwater and start draining into the air conditioner. Tilley recommends that the drains be fully disassembled to ensure that all plastic scraps (as well as leaves and other debris) have been cleared.

WATER LEAKS - FLOOR: Hunt Dabney reports: "At some time in its past, someone lifted my car improperly. This caused the seams at the front of the floor, both sides, to become separated just enough for water to wick in during heavy rains. No apparent structural damage, but lots-o-wet-carpet. I sealed this from below with silicone seal, and while at it popped out the drain plugs from each floor section, cleaned them and reinstalled them, also with silicone."

WATER LEAKS - DOORS: Ian Finlay suggests applying talcum powder to the seals, then closing the door and applying a hose. The talcum should make the location of the leak obvious.

WATER LEAKS - A-PILLAR DRAIN: At the corners where the rain gutters meet the windshield, the seal appears to have a gap underneath the chrome trim. This is deliberate, providing a drain for this area of the roof down the inside of the A pillar. It'd be a bad idea to try to seal it up.

Pat Johnson was getting rainwater on the floor, and finally figured out it was coming from these drains at the top front corners of the roof. Water that finds its way into these drains -- a goodly amount, to be sure -- is supposed to run down the pillar between the chrome trim piece and the structure and through the bodywork in front of the door. Somehow, it was being diverted inside the structure, and ended up in the carpet instead. The solution involved removing the chrome trim piece covering the A-pillar. "Being a novice at this, I was a little (a lot) scared to start removing rivets. They look so permanent! But I bit the bullet and started drilling. It was easy! I found gaps between the body and the molding. After calling a glass repair shop and getting some silicone, I went to work. I filled all the crevices and opened the drain hole. I then refit the chrome and put my first rivets in. I must say, I think I did a pretty good job. It looks just like new and the lake is gone.

"It is supposed to drain in front of the door. Leaves and some other unidentifiable gunk were plugging it. The channel was also narrower than I think it was supposed to be due to the black rubber material under the chrome spreading toward the center."

Harry Trafford elaborates: "After drilling out the little pop rivets, carefully pry the chrome off. It will come off. I used a small stiff detailing brush to clean it all up under there. I took a very small screwdriver and ran the blade under the gasket edges to clean them out. A lot of dirt was removed. I purchased a tube of Permatex Auto Glass Sealer, then using the screwdriver end, I gently lifted the gasket edges, sliding the tip down the glass and followed right behind it with the sealer. The sealer is thin and is supposed to run into the crevice. If you get the sealer smeared all over, use acetone or nail polish remover to clean it up. *Do not* get acetone or nail polish remover on the car's paint!

"I used small 1/4" to 3/8" sheet metal screws to reattach the chrome strips on the "A" pillar. Works fine." Stainless steel is recommended.

WATER LEAKS – FRONT WING ATTACHMENT: In the December 1996 issue of Jaguar Enthusiast magazine, John Wood describes tracking down and correcting a leak from the "wing rail", which made it into the area beside the footwell and managed to soak the carpets. This particular problem was apparently aggravated by body work done on the sill.

WATER LEAKS -- MIRRORS: Emile A. Des Roches says, "My wife's XJS had a seemingly "irremovable" white mineral dripline under the outside mirrors -- the only blemish on her 16,000 original mile '95 XJS coupe. After many experiments with paint rejuvenation problems the blemish was removed -- until the next rainstorm. It seems that water builds under the mirror, minerals gather from the various metals involved in the plating process, screws and blind nuts holding the mirror to the body and the oxidized product finds its way out under the black plastic piece separating the mirror from the door.

"The fix is to disassemble & clean the back side of the door mirror/plastic escutcheon assembly, then to put RTV or similar sealant around the inside of the black plastic escutcheon. After a couple of months, it worked so well that I tried it on my car too. Incidentally, the excess H_2O will drain into the door and out the bottom drain holes harmlessly."

This author has never had this problem; when I first got the ’83, the black plastic gaskets were so badly deteriorated that they were immediately replaced with pieces of rubber cut from an old inner tube. Since the rubber is more pliable than the plastic ever was, it apparently sealed effectively without the addition of sealant.

Des Roches responds: “OK, I admit to cheating and using "black again" on the crappy-looking grey plastic escutcheon. As I recall from my friend's mid-’80’s S, the newer cars have a thicker (about .4") escutcheon around the outside mirror. Wish I had thought of the rubber however.”

SUNROOF -- FACTORY OR DEALER ADD-ON? The question of whether the XJ-S ever actually was fitted with a sunroof from the factory always seems to generate more argument than definitive answers. Whether or not any sunroofs were actually built into the car at Coventry, it is apparent that many of the sunroofs that came on new cars were installed by dealers to boost sales. In this case, each one may be different. Steve Draper, who owns an ’88, says, “I note that in my XJ-S manual, the sunroof switch is located on the center panel between the window switches, on the same plastic panel. In my car, the switch is under the steering wheel, and when viewed closely has the aftermarket name on it. An easy indicator of factory installation may be the switch (which I wish was on the center panel).”

“I, Chad Bolles, do hereby state for the record once and for all that Jaguar *did* offer a sunroof in the XJ-S and I do not care what anybody else says. Quoting from Jaguar XJ-S Drivers Handbook publication part no. JJM 18 02 03/85, in the index section 5: “Fittings - Sunroof-Coupe: page 71” and on page 71 we see how to operate same and on page 72 we see how to operate in the manual operation mode. If those who know everything had taken the time to look in the parts book, part no. RTC9888CE dated August 1987 on page 2J 11L you would see part no. BBC2682 and I will be damned if it doesn’t look like a sunroof and even has the title “Sunroof” and uses part no. JLM440/ND Headlining Cloth. Then try page 2J 11R and what do you know all the pieces for the roof are listed. Next try page 2J 12L and I will be darned all the elec pieces are listed there.

“The roof was offered as an option in 86 and from then on as a kit.”

WATER LEAKS - SUNROOF: At least some of the sunroofs installed, as well as the ones fitted to the XJ6 at the factory, use drains on the front corners to route water down the A-pillars and out the bottom of the car. These drains are thin and easily plugged with debris. If a wire is used occasionally to keep them clear, the tendency of the sunroof to leak water to the interior is greatly reduced.

There also may be some problem with the connection between the sunroof and the drain tube. It may be helpful to inspect the connection and, if necessary, apply some sealant.

SUNROOF REMOVAL: Since sunroofs for XJ-S’s don’t exist, your ROM may not tell you how to remove it; so, here are instructions provided by Murray Trotter. Note that these instructions actually apply to the XJ6, but apparently the sunroofs are similar. Also note that when he says “hood lining”, he means the headlining. “To remove the metal outside skin of the sunroof, slide back, undo the phillips head screws along the front edge, slide roof forward, on switch until almost closed, lift up front of roof and pull forward, back edge is clipped in. Take care not to lift roof too high otherwise you will mark it on the outside edge of the roof. Quite simple to remove with a bit of care.

“The actual body of the roof is a little bit more difficult, removal of the hood lining is required. First remove the outside rim around the hood lining; this requires removal of the sunvisors, etc. Then prise all the covered mouldings off carefully. This is hard to do and I always seem to end up breaking a clip or two. The actual lining can then be dropped. It is glued around the outside edge. Careful with this one, it is easy to rip the lining. You will then see the the actual sunroof is all one unit which has four metal brackets, like legs coming off it. These are pop-riveted to the inside edge of the roof; drill these out, and you can drop the whole thing out as unit. Don’t forget to unplug the wiring.”

WATER LEAKS - CONVERTIBLE TOP: Julian Mullaney says, “I’ve never had a single drop come in my 1991 XJ-S Convertible, but I did adjust the top to fit tighter. This is simple, just screw in the hooks a turn or two on each side of the top rail. This makes the top clamp harder to the windshield gasket. When I did it, it eliminated a small squeak when body flexing over bumps."

WATER LEAKS - WINDSHIELD: Most modern automobiles glue the windshield to the structure and then attach a piece of trim over top to conceal the joint. You can tell such arrangements because the glass itself has a black pattern printed on it; the black is to keep the sunlight off the glue, which would cause it to deteriorate. Supposedly the Jaguar XJ-S went to this sort of attachment scheme in the 90's.

On the earlier cars, Jaguar actually used a real rubber gasket that fits around a lip on the car and fits around the edge of the glass, holding it in. The seal is called a Clayton-Wright type seal, meaning that it involves a locking strip; the seal and glass are installed, and then a hard plastic strip is pressed into a groove in the seal which jams it firmly against the glass. If you remove the four stainless steel trim pieces, the locking strip is hidden underneath. Once you remove the locking strip, the glass can be removed and reinstalled fairly easily.

In an article in the February 2002 issue of Classic Jaguar World, Ray Storer of National Windscreens Romford points out that water can get in between the laminates of a windshield and cause whitening of the glass. To prevent this -- or prevent it from getting any worse once it's already begun -- Storer applies liquid rubber to the edge of the glass itself.

If you're lucky, you may be able to stop your leaks without removing the glass. Remove the stainless steel trim remove the locking strip, and then it's a simple matter to pry the edge of the seal away from the glass. Clean all the crud out, clean it all really well with alcohol or some such, then apply some clear flowable windshield sealant and jam the plastic strip back in. As the strip presses the seal hard against the glass, the flowable sealant will ooze out. Wipe off the excess, reinstall the stainless trim strips, and you should be leak-free.

You're supposed to use a small loop of metal wire to reinstall the locking strip. The loop fits into the slot and the strip passes through the opening, so just sliding the loop along the slot puts the strip in place. You can buy a special tool, but you can also just make one from a coat hanger.

WINDSHIELD SCRATCHES: Chip Lamb suggests: "I was told Bon-Ami household cleaner works *great*. Removes pits and scratches. Removed the scratches made by my windshield wiper ends on my Saab 1991 900 2 or so winters ago. Worked like a charm."

Somebody else suggested toothpaste -- the abrasive kind, not the gel kind.

WINDSHIELD REPLACEMENT: Chad Bolles says, "What you really need is a glass shop that knows what it is doing. The seal will not fit if you install it on the glass out of the car, it will be loose, but once installed will be tight. The seal must be sealed to the body and to the glass itself, if the glass shop says anything different, then take your car elsewhere, they do not know what they are doing. The factory manual says to seal it that way."

Mark West concurs: "My experience with a new windshield in my '89 XJ-S, installed by the *dealer*, was enough to convince me that a broken windshield is equivalent to a blown engine in terms of severity. Three tries, two new seals, a glass shop that claimed to know what they were doing but installed it with the seal in upside down once (gave the car a sort of "Mickey Mouse" ears), and gallons of antacid later, I finally had a windshield that didn't leak, seemed to fit okay, didn't make too much noise going around corners, and was generally 80% acceptable.

"Don't think that Joe's Local House of Glass can do the work. You'll hate yourself in the morning."

HOOD GAS STRUTS: If you're tired of your XJ-S hood falling on your head, but don't want to pay the $$ for new Jaguar struts, Herbert Sodher provides a suggestion. There is a device made by Pylon called Lift Lock, and it is sold at auto parts stores as well as Wal-Mart and Kmart for about $8. It is a device which is clamped onto the plunger of the strut, and has an arm that slides along the outside of the strut housing as the hood is opened. When fully open, the arm clears the end of the strut housing, falls against the plunger, and jams against the end of the strut housing to hold the hood up. To close the hood, the arm must be manually lifted to clear the end of the strut housing. Since the device is an unobtrusive black, it is suggested that the arm be painted a bright color to make it more noticeable. Sodher judges that, in the event a hamhanded mechanic does a pull-up trying to close your hood, the $8 device would break before the $1200 hood suffered any damage.

Peyton Gill came up with another idea: buy a "split bolt connector" of a suitable size and install it on the strut plunger. A split bolt connector is a device used to connect two copper electrical cables. They are made of solid copper or bronze, so it probably won't even scratch the strut plunger. Just raise the hood, slide the connector down, and tighten the nut. When you want to lower the hood, just loosen the nut, slide the connector back to the far end and tighten it down there.

If you want to replace your struts, you can use a reasonably-priced aftermarket strut intended for another type car that will work on the XJ-S. Aftermarket struts such as Motormite's "MIGHTY LIFT!" (lifetime warranty!) are available in discount auto stores for about $20 each. Of course, you can have a discussion with your local junkyard as well. For the late 1976-on XJ-S, the gas struts for a Chrysler LeBaron Hatchback (MIGHTY LIFT! no. 95018) are close to the original length and can be made to work with a few 3/8" washers. Larry Barnes adds that the struts he fitted to his wife's '92 "are mfg. by "STEDY LIFT", PN# D072-157, $19.99 and they come with a Life Time Warranty."

Note that aftermarket struts are a good deal more powerful than stock struts. This is OK for most cars; customers are happy when the hatchback on their LeBaron opens more forcefully than it ever has. However, it may cause minor problems on the XJ-S. While you no longer will have problems with the hood closing on your head, you may have trouble closing the hood; you probably will have to hold the hood down against the latches while operating the lever under the dash, and in the worst case you may require an assistant on the other side of the car to get the hood closed.

You should always replace both struts together; one strut stronger than the other distorts the hood, and it bangs the fender on one side when closing.

Note that the pre-late 1976 XJ-S used a different strut.

Michael Neal says that Jaguar is now making struts with a built-in locking device to hold the bonnet open even if the gas pressure is gone. Your only remaining problem will be getting your fingernails under the edge of the bonnet to lift it up.

LONGER HOOD GAS STRUTS: With the stock struts, the bonnet doesn't open very far, making it a pain to work in the engine compartment. Jaguar apparently limited the range of opening because the bottom center of the grille contacts the top of the front bumper. However, Michael Neal points out that the contact doesn't appear to do any harm!

John Napoli figured out how to replace the stock struts with longer ones so that the bonnet opens a reasonable amount without having to disconnect the struts. The first step in replacing the struts is to make sure your bonnet will open far enough to use them; the alignment of the bodywork varies slightly from car to car, and breaking the front grille will not make you very happy. So, with the aid of an assistant, disconnect the struts and gradually tilt the bonnet farther and farther toward vertical, keeping an eye on the grille/bumper contact. See if you can open the bonnet enough that the mounts for the struts are separated by 22-1/4".

Note that there may also be a minor interference between the hinges and the plastic filler piece between the bumper and the car. If there is a problem here, the openings in the plastic for the hinges can be enlarged slightly.

If this much opening presents no problems, go to your local auto parts store and purchase a pair of aftermarket struts intended for a 1984-85 Honda Accord 3-door. They are made by Pro Lift, part number 92307, or by Motormite, part number 95038. The ends of these struts are thinner than the stock Jaguar struts, so you should add some spacers to the mounts to make sure the body of the strut doesn't contact the mounting brackets. Actually, suitable spacers may come in the package!

The XJ-S requires a strut that will collapse to 13-1/4" or shorter, and the application catalog lists the Honda struts as having a minimum length of 13.4" -- too long. However, measuring the struts themselves indicates they will compress as far as 13", perhaps even a hair under. Therefore, they work fine, and hold the bonnet a lot farther open than the stock struts. If yours end up not quite short enough, you should be able to make them work by elongating the holes in the ends a little with a file.

Note that the OEM Honda struts will *not* work. The struts needed are those sold as aftermarket replacements for the Honda, not the original struts.

Here's the measurement from the corner of the opening for the hood to the corner of the hood when fully open with these new struts: 46.5" Go measure yours!

PROTECTING THE HOOD STRUTS FROM HEAT: Michael Neal claims that heat in the engine compartment will toast most aftermarket struts, and that only the Jaguar originals will do. Of course, the aftermarket struts have a lifetime warranty and the Jaguar struts don't. And the Jaguar struts seem to fail as quickly as any, while several owners have reported long-term success with the aftermarket struts. However, heat probably is a serious concern here, and it's easy to provide any strut with a measure of protection by merely wrapping it with some aluminum foil. In this case, it is very convenient, since the width of aluminum foil matches the length of the strut nicely; just tear off about six inches from the roll, and wrap it around the strut, crimping it a little near the bolted end to keep it in place.

GETTING THE HOOD OUTTA YOUR WAY: On most cars, if the hood is in your way when working, the option is to remove it. With the XJ-S, however, there are several options in between. Michael Neal found that if the gas struts are disconnected, the hood can be opened to a nearly vertical position, greatly improving conditions for the mechanic. The plastic grille contacts the front bumper, but that doesn't appear to hurt anything; the grille simply flexes.

Neal commonly disconnects the struts when working on customers' cars, holding the hood in a wide-open position by removing a rubber plug forward of the strut mount and propping the bottom end of the strut, with the bolt, in this large opening.

Jim Isbell points out that another option is to remove the grille first. Then, with the struts disconnected, the hood can be opened to vertical, and the front edge rests on a rubber portion of the front bumper. Putting a cloth in between may be wise, and providing a prop so the wind doesn't blow it down on your head would be nice.

When using any of the above methods, keep an eye on the plastic filler panel just under the grille. It has openings for the hood hinges, but the openings may not be large enough for the wider opening and the plastic may crack. It may be helpful to remove this piece, or to enlarge the openings in it.

HOOD POP: John Napoli says: "Here's a cool mod for your XJ-S. It works best if you have good hood (bonnet) gas struts, and really well with the generic (Honda) replacement listed in Kirby's book.

"Remove the hood safety latch. Just pull the pin and it comes off. There are not many failure modes on an XJ-S where you need this feature anyway, so I wouldn't worry about it being gone.

"Now, when you want to show off your V12, just pop the release handle from within. The hood rises silently and majestically. Everyone is impressed. Men stand in awe. Women weep. Children cheer. Way cool."

HOOD LATCH: Up until at least 1993, the XJ-S was fitted with a hood latch that is closed from the inside; set the hood down on the latches, and operate the lever on the inside to pull it shut. Starting in '94 or '95, the XJ-S was fitted with a hood latch that works more like a typical American car, you slam it to shut it.

Of course, anyone familiar with the newer cars will now join the list of boneheads that will be slamming the hoods on the older cars. Anyone meeting the engineer responsible for this revision, please give him a thump on the head for the rest of us.

HOOD ORNAMENT: The flat disk emblem on the hood with the puddy-tat face (commonly referred to as a “growler”) apparently may be either blackened silver or blackened bronze in color, but it is supposed to be blackened. The one on the author’s ’83 is metal so polishing may be possible, but Stefan Schulz reports that his is plastic and therefore should *not* be polished lest the plating be removed to expose the bare plastic.

LEAPER: Most Jaguar owners feel that the “leaping cat” hood ornament looks really bad on the XJ-S. If you just gotta have one, note that it would be wise to remove the disk emblem and install the leaper in its place, keeping any additional drilling located so that reinstallation of the disk would cover it up. Also note that the leaper is available in a couple of sizes, and the smaller ones will be less obnoxious in this application.

Finally, note that hood ornaments are regulated as safety hazards in some areas. In order to minimize harm to pedestrians you run over, they may be required to be mounted on springs or some such. This not only makes installation more complex, but it also makes it easier for a thief to steal the ornament.

Most leapers are made to be mounted on a nearly level surface, so on the XJ-S they appear to be leaping downhill. However, Michael Kenrick reports on one made specifically for the XJ-S: “It’s modeled on the early MkV (?) version and sits on a round base that is directly interchangeable with the authentic OEM bonnet badge, bolted from underneath. And the plinth is beveled to take account of the sloping bonnet. Contact:

Bill Tracy
4050 Red Rock Lane
Sarasota, FL 34231 US
+1 (941) 924-9523

“I have one mounted on the hood: it certainly looks very good, and adds a subtly different character to the car.”

UPPER RADIATOR GRILLE: If you have a pre-1992 car, face it: your old grille looks pretty bad. The chrome is flaking off, and it’s cracked in several places. And a new one is expensive. The solution: install the 1992-on grille.

The newer grille makes a substantial difference in the appearance of the car. Where the earlier cars had the all-chrome plastic grille with chrome frame, three horizontal chrome ribs, two vertical chrome struts on each side, and the V12 badge in the center, the ’92-on grille is all black with a single chrome strip across the top edge. There is no V12 badge. The chrome strip makes a match with the narrow chrome strip across the top of the bumper, surrounding the grille top and bottom.

Another difference is the profile. The earlier grille forms a distinct angle from the nose of the bonnet downward and rearward. The ’92-on grille is more “bulged” giving a rounded profile.

The ‘92-on car also came with oblong composite headlights that bulged, so the front of the headlights forms a continuous surface with the front outline of the grille. How well the bulge of the new grille matches the non-bulged four-lamp headlight bezel is therefore a point of concern. The bulge of the ’92-on grille results in the ends of the grille protruding farther forward than the headlight bezel, so the *edges* of the grille are clearly visible. These edges of the grille were presumably never intended to be visible, since they would be covered by the bulging composite headlamps. However, the appearance of the ends of the grille are quite acceptable indeed, since the chrome strip continues around the corner and the black plastic surface is still black there. The only problem -- and it’s a minor one indeed -- is that the black plastic ends just a hair short of where you’d like it to, leaving a triangular opening at the bottom rear edge of the end of the grille. You’ve gotta be looking for a problem to notice it. But having compared this configuration against what the factory-designed earlier grille did here, I can’t say it appears any less deliberate or properly fitting.

Photographs of the ‘92-on grille installed on the author’s ’83 are available on the WWW at:

http://www.jag-lovers.org/xj-s/book/92Grille.html

As far as mounting goes, the ’92-on grille mounts a little differently but can be adapted. The ’92-on grille mounts with 5 screws, two on each end and one at the center top, all installed pointing towards the rear of the car. The earlier grille installed with 6 screws, two at the outer ends near the bottom pointing rearward and four along the top edge pointing upward. These upper screws screw into plastic inserts that snap into square holes on the bonnet. The outer two inserts correspond to notches in the '92-on grille and can remain, but the two inner mounts interfere with the '92-on grille since there are no notches in the grille to clear them and the plastic inserts stick down from the bonnet 1/8" or so. Simple solution: pry the plastic inserts out of the holes and throw them away. None of the four will be used again, so you might as well pry them all out.

The next thing to do is trial fit the new grille. It should be held in position so that its top surface fits snugly against the mating surface on the bonnet. With it held so, the necessary alignment of the mounting brackets will be apparent. The outer bottom mounting holes on the '92-on grille appear to be in the same place as on the earlier grille, but when fitting one realizes that the grille is not in the same place. The bulge has resulted in these mounting holes being about a half inch farther forward than the brackets the old grille mounted on. You can deal with this by stacking washers and using a long screw if you want, but that's not the way I do things. The mount bracket itself is an absurdly simple item bolted to the hinges, so I merely unbolted them and made new ones a little longer.

Just behind the upper edge of the grille is a flange on the bonnet, completely hidden by the grille. Simply drill three holes in this flange directly above the upper mounting holes in the new grille and fab brackets to screw to the flange. Add standard clip nuts to these brackets and install the grille with 5 black trim screws.

With the '84 Honda Accord struts described above, the hood opens a *lot* farther than stock. With this new bulged grille, the bottom center of the grille most definitely *does* contact the rubber on the top of the front bumper when open. Doesn't appear to hurt anything. It flexes a bit, no problem.

One of the prime reasons to consider the '92-on grille is that it is structurally a *vastly* superior item. Where the earlier grille had spindly little ribs, this grille's ribs are substantial, and appear designed to survive bird hits. Where the earlier grille had chrome on plastic that flaked off, the only chrome on this grille is a separate piece of metal that is mechanically attached to the plastic grille. Add to these facts that the '92-on grille costs *half* what the earlier grille costs, and you have enough data to make your own decision.

Another possibility is the JaguarSport XJR-S grille, which has no chrome at all. You could paint the chrome strip from the '92-on grille for similar effect; a really durable trim paint is suggested, since if you use ordinary spray paint every bug hit will leave a shiny spot. You could also opt for the '92-on grille and find a way to cover the chrome strip with black tape or some such.

HOOD VENTS: Lots of people feel that providing vents in the hood of the XJ-S might help with cooling problems, as well as look neat. It probably wouldn't do much for cooling when moving, but it might have considerable benefits after the car is parked -- allowing all the residual engine heat to rise out of the compartment rather than just building up in there and cooking the wiring and hoses.

Of course, cutting holes in the XJ-S hood is a non-reversible act, so a good job is essential; cutting rectangular holes with a Sawzall and slapping on a pair of stamped steel residential air conditioning grilles with pop rivets ain't gonna help your resale value.

Marty Sullivan suggests that the hood vents from a Datsun 280Z might fit the XJ-S perfectly. They are separate parts (not an integral part of the hood) so perhaps they could be removed from a 280Z in a junkyard and installed in suitable holes cut in the hood of an XJ-S with little fuss. They could be painted flat black before installation so they'd look like they match the center air grille, and you wouldn't have to paint the whole car.

Derek Spicer says, "I have seen an XJ-S with an early model Honda Accord hood vent fitted to its hood up near the windscreen on the hood. It's a very natural fit and looks as if it was supposed to be there."

Paul Bachman says, "I have been trying to lay my hands on some hood scoops from a 1988 Turbo Thunderbird. These also appear to be of proper size and shape to retrofit in an XJ-S."

Stephen Wood adds more details: "I looked at some different vents recently in a junk yard recently, that would / wouldn't work:

"79-83 280 ZX (FI Car): Description: Semi Triangular Black Plastic, but the plastic in them is not very good so if you are in a sunny climate they will be brittle. Replacement part is pricey and supposedly not available from the dealer (Nissan Dealers are scum...). However "Tweeks Ltd." does stock all of that stuff.

"80-83 280 ZX (Turbo-FI Car): I am still trying to find a 280 ZX turbo in a junk yard (I will be going again this weekend) that has a different vent, and see how they attach. They only have one vent on the passenger side of the hood but they look pretty neat, a NACA scoop followed by a grille. If you could find two of them, you could locate them further forward in the XJ-S hood and have "Ram Air" (oooooh cool.)

"The 75-78 280Z vent is different right from left, and would require modification and "dremeling" and is really small, I'm not sure if it would make a worthwhile difference (to vent or not to vent, that is the question).

"Idea: the 78-81 Camaro Z28 had some fenderwell vents on the side, top rearward portion of the fender; those may be big, but you could mount them on the hood of the XJS.

"1989-92 Firebird: Small hood vents in front nose portion, could be cool. I need to get dimensions.

"1979-84 Mustang GT. Cowl hood type. Mounts with 4 bolts and allows removal of block off plate for a 1"x18" opening. This is severe but could be helpful in hot climates."

You should remember that openings in the hood will allow rain in. Many cars -- including Jaguar E-Types -- have rain collectors underneath their hood louvers to divert rain into drains and out the bottom of the car. If you just cut holes in the hood and call it a day, the rain may find its way to an exhaust manifold and create a large cloud of steam. That might be a little more drama at the stoplight than you need. And that's not to mention the effect of rain on electrical hardware and other stuff in the engine compartment.

One other concern I can foresee is that add-on vents might protrude into the engine compartment an inch or so, and maybe hit something -- like the diagonal struts. Best to double-check clearances before cutting.

FRONT SPOILER: Fido may have only cost his owners $10 at the local pound, but he becomes quite costly when you run him over with the Jag. The front spoiler, when removed by force, often takes the bottom panel and the front section of the two front wheel wells with it. The spoiler was expensive enough; the package of four parts starts getting into some real money.

You will need to get the original spoiler BD45624 from Jaguar to make the car look right. However, the other three pieces (BCC4462, BAC4350, BAC4352) really don't show, so you can make substitutes. A tough plastic is recommended, as any sheet metal or fiberglass would get banged up too quickly in this application. 3/16" black ABS sheet plastic seems to be ideal, making these parts somewhat heavier than the originals.

For those who can't find such plastic, it can be ordered from:

Freddie's Plastics, Inc.
P.O. Box 1319
Plant City, FL 33564-1319
(813) 754-5567 FAX: (813) 754-0943

They sell it only in 4' x 8' sheets, enough to do several Jags. They may cut it into quarters for ease of shipping; this requires that the bottom panel be made as two pieces, which may be preferable anyway. Some aluminum angle (used to connect the bottom panel with the vertical wheel well panels), some screws, some clip nuts and a couple hours fabricating are all that is needed to make a satisfactory installation. One such installation has already survived a 'possum at 100+ MPH.

DOOR HINGE SPRINGS: The springs in the upper door hinges that hold the door open tend to develop rust problems, which in turn causes cracks to form at the stress points; they break and fall out with a clank, and then the door is always closing on you when you're trying to get in and out of the car. If your car has not yet developed such problems, you should make an attempt to prevent rusting on the two lower corners of these springs. Paint them, coat them, grease them, something.

If your springs have already failed, you can buy a replacement hinge. With luck, maybe you can buy just the spring itself; Robert Hyndman says, “I had a broken door spring on my ’87 XJ-6 when I bought it. I purchased a door spring from Johns Cars...” (see page 717)

Of course, if you get more of the same springs, they may just break again. A better alternative may be to *make* one. To make a replacement spring, buy some 1/4” music wire from a hobby shop. Normal 1/4” steel rod won’t do -- music wire is extremely high strength, necessary for a spring. Suitable 1/4” spring material may also be available from a junkyard as the straight springs used to hold the trunk lid open on many cars. Bend and cut the wire to the same shape as the original spring, except replace the bottom two 90° bends with one continuous U-shape. This will reduce the stress concentrations caused by the 90° corners. Be careful to get the distance between the vertical portions of the spring right; a slight difference has a pronounced effect on how firmly the door stays open. Please be careful bending 1/4” music wire or spring; it is extremely strong, and care must be taken when bending it to keep it from springing loose and injuring you.

The door must be removed from the car to install the new spring. Don’t try to do this alone unless you don’t care about your bodywork. It is best to have at least two helpers to hold the door while you remove the nuts and washers from inside the footwell. Before installing the new spring, it should be protected from rust -- its biggest threat.

DOOR HANDLES: John Butler sends this tip: If you need to replace a door handle (apparently not that rare; they tend to break) and try to buy a used one, be sure to get one with a <u>key</u>. If not, then there are two designs of lock. On one you can spring a little shim in the barrel; the barrel withdraws and a key can be cut. In the other you can spring the shim but the barrel won’t withdraw unless it is turned, meaning you must have the key already.

Alternatively, you can buy two locks, demanding a discount because there are no keys. On one, save the barrel by destroying the handle; on the other, save the handle by destroying the barrel. Have a key cut and combine parts to make one door handle assembly.

Mack Kamna says, “Always save the best key to have copies made from. In an ideal world one would save an original "uncirculated" key for this purpose. Replace a key when it starts to show rounding of the edges, or any scarring. Keys are much cheaper then lock assemblies.

“The only lubricant to use in the tumbler mechanism is molybdemum disulfide, as it does not attract dirt and allows the naturally-occurring metal particles to dissipate. It can be found under the trade name Dri Slide and many other names. It can also be purchased in both aerosol and "squeeze cans". I normally spray it in all my tumblers, (ignition, doors, trunk, etc.) about every six to nine months. The process is as follows: Shake the can *very* well, as it tends to settle worse then any other product I have seen. Using the applicator tube spray short burst(s) into lock mechanism, while moving the applicator in and out. Immediately afterwards, insert the key and turn a full rotation, repeat the key insertion several times. In addition, on some sticky locks I have sprayed it onto the key.

“Caveats: It is smelly stuff, use as sparingly as possible. It also helps to do it on a nice day so you can air the car out afterwards. Keep a rag or paper towel handy, and make sure you check the key the next few times you use it for residue before tossing it into your nice sportcoat pocket. I find the aerosol spray is messier, but it does seem to "free up" sticky locks better then the other types.”

DOOR HANDLE LINKAGE CLIPS: The door handles and locks in the XJ-S involve rods that connect the inside controls with the latch and the like. These rods have a 90º bend at the end which is inserted through a hole in a lever and retained by a clip -- similar to just about any other car on the road. The clips on the XJ-S, however, are unusual. With most cars, the diameter of the rod and the size of the hole in the lever are the same, and the clip is a carefully shaped piece of spring steel that surrounds the lever, has the tip of the rod inserted through it, then snaps onto the straight section of rod to hold it in place. With the XJ-S, there is a plastic bushing involved. The hole in the lever is therefore larger than the diameter of the rod. Also, the clip does not surround the lever, but instead relies on the plastic bushing to hold it to the lever. To assemble, the metal clip is offered up to the lever and the plastic bushing is pressed through the clip and the lever, snapping into place. Then the rod is inserted and the the clip snapped onto it.

The bushing probably would prefer to remain motionless relative to the lever, and simply let the rod rotate within it when the parts move. The clip, however, is securely snapped to the rod and therefore moves with it, but is retained *between* the bushing and the lever. Since the bushing hence has parts rotating both inside and outside, it tends to move with the rod, and wears on its outside diameter. Of course, when it wears through, the linkage starts rattling, and sometimes will even fall out of the lever since the bushing was the only thing holding it together.

If you drop into your favorite auto parts store, you will find assortments of metal door linkage clips for sale. None of these clips will fit the XJ-S; all of them are intended for use without any plastic bushings, and therefore have the hole where the rod is inserted the same size as the rod -- not big enough for a bushing. If you find a really big clip, it might fit the bushing, but it's too big to clip onto the rod. Besides, it's probable that it's the bushing you really need, not the clip.

It is possible to replace the bushing alone by purchasing some of those plastic nuts that press into a hole and accept a self-tapping screw. You will need to bore the center out to the diameter of the linkage rod, and then slide the part onto a #8 screw, hold it in place with a nut, and chuck the assembly up in a lathe or drill and cut the OD down to fit the hole in the lever. You may also need to trim the flange down, since the plastic nut will typically have a large square flange that won't sit properly against the clip.

NAPA sells a "Door Latch Rod Retainer 735-2637" for "Ford, Lincoln, Mercury". This one-piece clip is entirely made of plastic, and functions very similarly to the combination of bushing and clip in the XJ-S. This particular part fits the XJ-S rod diameter perfectly, but the OD of the integral bushing is too large -- about 6.5mm, as opposed to the hole in the Jag levers being about 5.5mm. The simplest solution here may be to chuck the entire clip up on that #8 screw and cut the OD down.

That may not be the best solution, however. It's entirely probable that the OD of this bushing was established by engineers at Ford who knew better than to make the walls of that bushing as thin as Jaguar made them. Note that you are having to replace that Jag bushing. Hence, it may make more sense to enlarge the holes in the Jaguar levers to fit this clip without modification. Unfortunately, most of the levers within the XJ-S door are not accessable for drilling without a considerable amount of disassembly.

There are ten bushing/clips per door, including one in the inside locking lever that's a little different than the rest. Also note that the ones on the driver's side are likely to be more worn than those on the passenger's side.

SIDE MIRRORS: Martin Fooks wanted his car to look stylish, so he installed side mirrors from a Pontiac Fiero. "The mirrors are fairly easy to fit as only one of the 2 bolt holes has to be slightly widened and the angles of the mirrors to the car are just about perfect. My car used to have manual adjustable mirrors and the electric wires for the Fiero items come through the hole that the manual rod used to use.

"The mirrors are bolted to the doors from the inside, thus (unknowingly at the time) removing that easy route into the XJ-S. (ed. note: see "Breaking In" on page 476)

"As I did not have electric mirrors before, I used the complete Fiero harness and switch, although as you will be aware electric mirror wiring is hardly a challenge..."

If you have WWW surfing capability, you can take a look at Fooks' car at:

http://www.geocities.com/motorcity/8382

BREAKING IN: If you get locked out, Victor Naumann provides this tip: "you can unscrew the outside mirror, and carefully reach through with a long blade and flip the lock handle to unlock." This works entirely too well. If you happen to have a Slim Jim (the long blade that is inserted between the glass and the seal -- standard car thief's tool), it works just fine too.

If it's the boot you're locked out of, Cliff Sadler says "The latch is held in by two sheet metal screws. If you ever need to get into a locked XJS trunk, simply grab the handle, and pull straight up with a snap; then, replace the screws with bolts." If you use really good bolts, maybe this won't work as well next time!

WINDOW GLASS: Reportedly, some XJ-S windows have the metal "runner" riveted to the glass through two small holes about 1/4 inch from the bottom; in this setup, pulling on the window is a very bad idea -- it will break easily, since the rivet holes form a starting place for cracks. Later ones are glued, making the glass itself much less likely to fracture.

If you have to replace a window, make sure the correct one is ordered -- with or without rivet holes.

REAR QUARTERLIGHT REMOVAL: Both the Haynes manual and the Jaguar repair manual describe removing this glass, but the descriptions vary. Both start by removing interior trim panels, but then the Jaguar manual says "Using suitable tool prise rear quarter glass and rubber from body." The Haynes manual says "With an assistant pressing the glass outward, peel back the rubber weatherseal from the body at one corner until the glass can be pushed out of its frame." The Haynes method works fine, no "suitable tool" required.

SIDE VENTS: The vents on either side of the C-pillars (the "buttresses" on the XJ-S) are functional. When the A/C system is blowing outdoor air into the interior, these vents are allowing air back out. They also allow air out when a door is being shut, preventing that obnoxious problem of doors that won't shut unless a window is rolled down. The actual route the air takes begins with mesh grilles in the top of the cubby holes above the rear armrests. From there it goes through the bodywork, through a set of three flaps on each side of the car, and then out the slot on the outside.

The repair manuals provide no information on how to get these vents apart. So, the following is from Mike Morrin:

1. Remove the quarter side window glass and rubber (see above).
2. Remove the little chrome corner corner piece at the bottom rear of the vent cover (nut reached from inside boot).
3. Pry off the chrome strip at the rear edge of the vent cover.
4. Drill out the rivets which held the chrome strip and rivets which are behind window rubber.
5. Remove the cover piece.
6. Remove another 6 rivets holding the vent assembly into the car.
7. Lift out assembly and wonder why you went to so much trouble.

Note that the rivets under the chrome strip not only go through the center of the retaining snaps themselves, but also through three tiny washers behind each one of them. Don't lose the washers; they are there to keep the rubber seal from being crushed by installation of the rivet.

Despite Morrin's skepticism about the value of this job, the flap assembly within this vent may actually need attention. Each of the three flaps consists of a metal plate with a layer of foam on the face, suspended from a piece of cloth. There is a foam bumper on the back side to keep it from making noise when it opens forcefully enough to bang the housing. All of this is British non-metallics, so the foam face has long since rotted away and the metal plate itself is closing over the opening. This makes a quite distinctive racket, especially when closing a door.

The flaps themselves are also installed with pop rivets. It is a fairly simple matter to drill them out and rebuild each flap, using materials that hopefully will be more durable and quieter. You might wanna have some headliner material handy; it might make a suitable face material. The type of nylon fabric used to make backpacks and light jackets might work well as the "hinge", but I simply used vinyl upholstery material; make sure that whatever you use doesn't crinkle or otherwise make noise as it flexes. A can of 3M's "Super Trim Adhesive" #08090 will also be helpful. For the bumpers on the back side, some 1/8" thick 1/4" wide foam tape weatherstripping will do nicely, sold in building supply stores for sealing windows and doors. Get the heavy-duty high density closed cell stuff, this is no place for the flimsy foam.

You might find it helpful or necessary to remove a cover from the flap assembly that is held on with staples. Therefore, you might want to have a box of 1/4” length Monel staples that fit your staple gun on hand. Monel staples are considerably more expensive than normal staples and a lot harder to find, but they won’t rust.

There are (or were) a couple of strips of foam seal along the back side of the cover, but they have dried up and fallen off. They can easily be replaced with some 1/4” thick 1/2” wide weatherstripping, similar to that described above except the next size thicker.

To reassemble, you’re gonna need a lot of 1/8” pop rivets (1/4” grip length) -- at least 24 per side of the car. The original rivets are a special type with a closed end, intended to prevent leaks. These type rivets are very expensive and difficult to find, and it’s not like anything here is truly airtight. The only conceivable reason for using these rivets is to avoid a whistle, but if you’re concerned you can accomplish the same thing by covering each rivet with a piece of aluminum tape or some silicone sealant.

The four rivets underneath the rearmost chrome strip must fit inside the snaps for the strip, and chances are the rivets you have won’t fit. It is a fairly simple matter, however, to chuck the rivets up in your drill and file the head diameter down a little bit.

These same four rivets end up recessed within these snaps. This presents another problem, since the “anvil” of the rivet gun must sit squarely on the head of the rivet when installing, and of course that anvil isn’t small enough to fit within the snap. So, you will need a little sleeve to fit around the nail of the pop rivet when riveting, or a few very tiny washers will serve. You must be careful not to lose them after each rivet pops.

TAILLIGHT REFLECTORS: Many people fail to realize the importance of the reflectors to the appearance of taillights, turn signals, etc. Jaguar XJ-S reflectors are mostly chrome-plated plastic, which is fairly durable; but the chrome sometimes deteriorates, and the neutral plastic color is only a fair reflector. Also, the metal panel that separates the taillights from the brake lights can get pretty dull.

To make your taillights look good, you should restore the effectiveness of the reflectors. You can cover them with aluminum foil or aluminum tape. The best method, however, is to mask the bulb sockets and paint the reflectors with flat white spray paint. Flat white gives a more diffuse appearance to the light, which is prettier than the bright center appearance of the original. If you want to make the light even more diffuse, you can paint a white spot on the bulb to prevent a direct view of the filament.

BRAKE LIGHT LENSES: There’s a little panel with a chrome frame along the inside edge of each pre-1991 taillight lens that may or may not have paint on it. David Cleary explains, “The center section of the boot lid was painted black up to about 1977, at the same time the B posts were chrome, and the lenses were also black.” Mike Morrin says, “I think that they only had the black paint on the boot lid between the tail lights for 1975 and 76. I presume the paint on the lenses was deleted at the same time. The parts book shows that the part number changed at 2W4023(RHD) and 2W54660(LHD). I presume that this is the same change.”

What it changed to is not as clear. This author’s ’83 had silver paint, while later cars just left the underlying chrome uncovered. Cleary says, “Both my 79 and 82 cars came with silver finish on the rear lenses. I have only ever seen the silver finish lenses available from the factory. No spares or autojumble retailer has them, only the black or chrome.

“At a recent autojumble I wanted a pair of rear lamp lenses. I noticed that the early ones with a black finisher were much cheaper than the ones with the chrome (£15 a pair rather than £25). With 10 minutes work and some careful application of thinners you can save yourself £10 by removing the black paint to reveal the chrome - simple eh?”

The silver paint comes off just as easily. I said this author’s lenses *had* silver paint. They don’t any more -- one look at someone else’s car with the bare chrome, and that silver paint was outta here.

The panel in question is actually a separate piece from the lens itself. The chrome plating is applied to a metal panel, and then the panel is attached to the plastic lens assembly with press-on clips. If the nonremovable clips are removed (!), it's a lot easier to work on getting the paint off -- you can dunk the whole thing in a can of solvent. Or, Cleary says you can “Use masking tape to protect the chrome when using thinners. That way you don't have to remove the bit from the lens and chance breaking it."

If you're having the car painted, you might consider something really radical: mask off the chrome rim and the rest of the lens and have them prime and paint those panels the same color as the car. This will give a unique look, since none of the XJ-S's apparently came from the factory with this panel painted body color.

THIRD BRAKE LIGHT CUTENESS: John Himes sends this tip: "If you wanted to get creative, remove the entire housing and place a piece of custom cut metal or cardboard or something with the leaper cut out, paint black and place against the window. Now when you brake, instead of just a light there, you will be showing a glowing red leaper to all that you leave behind."

LICENSE PLATE LIGHT LENSES -- PRE-1992: This lens is actually an assembly of two parts: the lens itself, and an opaque white plastic hinge that the lens attaches to. The hinge is provided to facilitate bulb replacement, since it's not all that easy to get a screwdriver into this area. Both the lens and the hinge are often problem areas. Patrick MacNamara says, "British/Auto USA flyer has an XJ-S license plate light repair kit which includes the flexible plastic hinge piece, lens and bulb." See page 692. Chuck Sparks points out that the lens is the same item as used for license tag light lenses on the '74-76 MGB and the '75-76 Midget; it is offered by Victoria British (1-800-255-0088) as part number 0-6912 for less than ten bucks.

The bulb holder is integrated into the lens, which is unfortunate; otherwise, it would be a simple matter to replace the lens with any flat piece of transparent plastic. As it is, such a replacement of the lens requires figuring out some other way to hold a bulb.

One repair possibility is to simply buy a suitable automotive light fixture, throw the original hinge and lens away and mount the entire fixture within the space. The space is shallow, but the sheer variety of aftermarket light fixtures available means that something can usually be found to fit. Be sure to check truck stops, which sell a wide variety of "marker lights" for the corners of tractor trailers.

Alternatively, you can *make* something to hold the bulbs; this author simply made some connectors that clip onto both ends of the bulbs the way a fuse is held in a fusebox and mounted them with suitable plastic cut to serve as insulators. Remember, whether you buy or make, there's no good reason to stick with the original style bulbs; any 12V bulbs of comparable wattage that can be made to fit in the space should work.

Once you've fabbed bulb holders, you will need to provide lenses. This author purchased a small piece of plexiglass (Lucite) at the local building supply store, 8" x 10" x 0.093", for less than $2. It comes with either thin plastic or paper on both sides to protect the finish (paper is better); leave the stuff on until *after* you have finished cutting and drilling. It's really easy to cut and drill. Trapezoidal pieces were cut with two holes each to replace the hinge *and* the lens with a single piece. When done, one side was sanded with 320-grit sandpaper to provide a "frosted" appearance; the other side could be done to make it even more frosted, but going to a coarser grit makes the individual scratches too prominent and a finer grit seems to not do enough. Finally, the edges of this lens could be wrapped with strips of aluminum tape or (better) stainless steel tape to make it look more professional, but in this author's opinion the finished product *already* looked neater and more esthetically pleasing than the original cobbled-looking assembly. These lenses are not all that prominent, although they are plainly visible when the trunk is open and are apparent in the reflection in a well-cleaned rear bumper as well.

Julian Mullaney: "I also made replacement lenses for my old XJS. It is better if you use polycarbonate (Lexan) instead of acrylic (Plexiglass). Unlike acrylic, polycarbonate can easily be cut with scissors (or metal snips) without cracking. It can also be folded along a straight line without heating."

If your lenses are not that far gone, Ed Avis provides a fix for the hinge itself: "I removed the old flaps and used them to trace the pattern onto a plastic VCR tape case and simply cut out new flaps. The nice hinged cover on the tape case served the same purpose as the hinge on the original flaps. Total cost of the repair was about $1 for the tape case.

Mullaney has his own ideas for that hinge, too: "PET (polyethylene terepthialate sp??) is very good for this application too. This is what Coke bottles are made of. A good source for this is the large clear bottles with spring water at the supermarket. Although a bit on the thin side this is what I used."

CHROME-PLATED PLASTIC: If you ever find yourself needing to remove chrome plating from plastic, John Goodman suggests: "You can probably remove the chrome by removing the paint underneath, with oven cleaner, or any of those concentrated cleaners containing sodium hydroxide. Wear eye protection and rubber gloves. Liberally spray the part with the goop, seal it in a plastic bag, and wait.

"I haven't tried oven cleaner to remove chrome from plastic, but I have used it to remove paint from plastic. Works like a charm, doesn't harm the plastic. Model railroaders use it on their delicate miniatures"

See COTECH, page 702.

BUMPER VARIATIONS: In some countries that don't require high-impact bumpers, the XJ-S has been fitted with lighter, less obtrusive bumpers. The front bumper is fairly thin, and the turn signals mount on the bodywork rather than in the bumper. The locations for the turn signals are clearly evident on US-issue vehicles, hidden underneath the heavy bumper.

Scott Horner says, "if they are UK based, then the difference in Pre-'82 to post-'82 is in the bumpers...Pre-'82 (Pre-HE's) used the impact absorbing bumpers without chrome tops...the same for all markets; but at the H.E. for all markets (except the USA) Jaguar fitted slimline bumpers without the impact absorbers.

"This means that most trim kits like the TWR & XJR-S packages sit very close to the body and don't use the rubber bumper beam cover - which I've seen on some US kits...."

For the US, the bumpers changed in 1982 as well -- but both pre-82 and 82-on were impact-absorbing type. Section 76.22 of the ©1975 ROM obviously applies only to the pre-82 bumper design, but the ©1982 Supplement covers the revised design.

Note that the 1982 bumper change also entailed a change in the front turn signal assemblies.

LICENSE PLATE FASTENERS: No matter how pretty your Jag is, having streaks of rust on the tag streaming downward from the attachment bolts doesn't help. There is apparently no consistency in attachment schemes here, it looks like each dealer fastened the tags whatever way he saw fit -- and rare indeed is the dealer that springs for proper stainless steel fasteners. It shouldn't be too hard to find some stainless steel fasteners that will serve. On the author's '83, the tag was held on with chincy sheet metal screws directly into the metal of the trunk lid, so a nice chrome license plate frame was added with four stainless steel screws.

REMOTE TRUNK RELEASE: Bob Whiles says: "There are several "Trunk Release Module" kits on the market. All you get is the actuator (solenoid), a button, fuse holder and wire. But Chevy has a pretty nice - heavy duty - one in some of their "upper" models. Just look for a Monte Carlo or above in the junkyard. All you will need then is a momentary button, wire and fuse/holder. Cheaper and better than the kits."

REAR SPOILER: Welsh Enterprises (page 697) offers a rear deck spoiler for the XJ-S. JaguarSport does too, and John Goodman reports: "There are actually two types of (JaguarSport) deck spoilers available. The post-'92 deck spoiler has more "sweeping ends" to compliment the revised tail lights and I'm not sure, but maybe an integrated brake light." Several of the vendors listed starting on page 713 also offer spoilers, some with slightly different styles, so hopefully you can find one that suits you.

Note that rear deck spoilers have a hole for the antenna to poke through. Also note that rear deck spoilers are attached to the trunk lid while the antenna is attached to the fender, so opening the trunk with the antenna up won't work. If you are concerned about this, the Jaguar fix is to provide a wiring change so that when the trunk is opened and the light comes on, the antenna goes down. This could easily be done by anyone; it only requires a relay.

Now, if you have the earlier XJ-S, you know those springs that hold the trunk lid up when open? Do you think they will still hold the trunk lid up with the additional weight of the new spoiler on it? Not likely! Reportedly, the fix is to fit the earlier cars with gas struts, just like the later trunk lids have. Goodman again: "The struts and the relay with harness come with the spoiler if you buy them from a Jag dealer."

STYLING KITS: Several outfits, including Welsh Enterprises (page 697), JaguarSport (page 8), and several other vendors in the listing starting on page 713, have developed styling kits with components to add all around the bottom edge of the bodywork -- from the bumpers downward at both ends, and along the rocker panels under the doors. Some kits cover the bumpers, while others mount underneath the bumpers with the bumpers protruding through.

The Welsh kit supposedly fits any XJ-S 1982-on, apparently due to some problem with bumpers on earlier cars. John Goodman says (regarding the JaguarSport versions), "There are three different body kits, pre-'92 and post-'93 US with rubber bumpers and '93 UK."

Michael Minglin reports: "I have installed a ground effects kit (body styling kit) that I purchased from the dealer. From the pictures it appears to be the same kit Welsh is offering. The kit installs over the shock absorbing beams on my '84 XJ-S. The chrome top trim and the black rubber end pieces are removed. I find this preferable to the newer kits that do not have the shock absorbing beams protruding through the spoiler. It may not look as nice, but it provides excellent protection in the event of slight bumps, like backing into a post I didn't see. The kit is fiberglass and would easily crack if it was not for the shock absorbing beams.

"The negatives on this kit are: You have to be very careful when pulling straight into a curb, or one of the concrete parking curbs in parking lots. The front spoiler is so low it will hit the curb and break. This point must be stressed when leaving the car at a shop or using valet parking. In addition I have noticed that the engine runs a little warmer on the open road since I installed the kit. It seems to restrict the airflow somewhat. But, it sure makes the car look great.

"FYI, this kit is manufactured by Arden, a German company." Arden is listed on page 713.

LUGGAGE RACKS: Herbert Sodher wanted to make his car look different, and found that a luggage rack designed for a 1968-75 Corvette will fit on the XJ-S trunk lid nicely. He chose a really nice stainless steel model rather than the basic chrome. He opted not to use the mounting scheme included, since it was intended for fiberglass; instead, he visited a good hardware store and purchased some stainless steel flush head sheet metal screws. He carefully measured locations and drilled some small pilot holes, and with very little effort was receiving complements on the appearance of the installation.

MUD FLAPS: If you drive in mud, snow, slush, etc., you probably are sick and tired of cleaning the slop off the car. The place to get mud flaps for your Jaguar is at the Jaguar dealer. In fact, the panel behind the front wheels already has a set of square holes for mounting the flaps.

H.E. VS. V12 EMBLEM: If you feel that "V12" is a more descriptive emblem than "H.E.", you may be happy to learn that the V12 emblem is available as a stick-on item, and will perfectly cover the holes used to mount the original H.E. emblem. If you purchase the V12 emblem (part number BEC4717 - don't get the earlier 4-piece emblem), merely pry the H.E. emblem out, clean the surface, and stick the V12 emblem on.

COLOR COORDINATION OF WHEELS: Coordinating the color of the wheels with the body color of the car -- via some accents in the pattern or the like -- can make a dramatic improvement in the appearance of any car. This is almost never done at the factory, presumably because tracking different colored wheels to make sure they end up on the correct color cars on the assembly line would require too much extra cost and effort. If you have to have your wheels repainted or powder coated anyway, consider asking the shop to apply an accent color that matches the color of the car.

If your car happens to be red, green, black, or grey, this color coordination of the wheels might be easy! Just replace the little growler emblems with ones that match! Richard Mansell points out that Jaguar offers wheel emblems “in the following 5 colours: Silver/Green, Gold/Ruby, Silver/Ruby, Black/Gold, Grey/Silver (Jaguar), Gold/Ruby, Grey/Silver, Black/Gold (Daimler).” Available at the dealer. The Silver/Ruby part number is MNA 6249EA.

Apparently Jaguar’s intent was not color coordination, which may explain the limited selection of colors. David Buchner says, “each year model has its own color. '94 uses red...” Maybe more colors will be available in future years! The early H.E. domed starfish wheels came with a two-piece emblem (growler and retainer) while the 90’s Jaguars use a single-piece emblem, but the single-piece item fits the domed starfish wheels just fine.

WHEEL ARCHES: These are bright metal trim pieces that fit around the edges of the wheel wells; they are available in either chrome or gold. They are another item about which opinions vary, with many owners finding them gaudy and tasteless while others love them. Of course, if the edges of the wheel wells are where your car is rusting, you might suddenly decide they look good!

John Dyson says, “I have the chrome wheel arches on my ’91 "Classic Collection." It is my impression that they are part of the limited edition trim which includes chrome wheels, gold bonnet badge, leather interior with contrasting piping, and "Classic Collection" badge on right rear.”

CONVERTIBLE RIGIDITY: In the old days, cars had a rigid frame and the body merely went along for the ride; chopping, removing, or otherwise screwing around with the bodywork did not functionally affect the car. However, a frame is now considered a waste of steel, space, and money, and the body of the car is usually the stress-carrying structure.

About the same time this change was taking place -- early 70’s or so -- convertibles also disappeared, largely in anticipation of safety regulations that never actually materialized.

In the 90’s, the convertible made a comeback -- including the lovely XJ-S version. Unfortunately, the stressed-body concept doesn’t take well to a convertible; removing the roof removes a great deal of the structural rigidity, and such cars often end up weighing considerably more than the hardtop versions due to added structural reinforcement needed elsewhere to compensate.

Early XJ-S convertibles were structurally good but not great. With the bodywork revisions in mid-1991, mounting points were added under the car for a system of front and rear cross-bracing to add rigidity. This renders the structure truly excellent. Unfortunately, the 1988-1991 convertibles lack the mounts for installing the bracing.

The cross-bracing can be added to earlier cars. A kit including all the parts is available from Classic Engineering (see page 715), but installation involves some welding. They are reportedly working on a similar kit for the rear bracing, but the front is the more important.

According to Julian Mullaney, the rear brace is very similar to the front, but fashioning mounting points is harder. “This brace mounts on the chassis in front of each rear wheel and crosses to attach on the opposite side, behind the rear end cage on the bottom of the trunk (boot). This is where the problem is. In the new cars, the trunk well is stamped with two downward pointing depressions to which a brace can be bolted. In the early convertibles some sort of stand-off (about 2-1/2 inches deep) must be mounted to the bottom of the trunk-well in order to attach the brace.”

Meanwhile, similar cross-brace kits are available from Harvey Bailey Engineering, page 714, but theirs apparently require no welding. Chris Carley installed both front and rear cross-bracing: “Heck knows why it works but it really does make the car feel so much more solid. When you hit a bump you just get a normal tire thump - no rattles or shakes. It also improves the handling, which surprised me; feels like much less roll and more firmly planted. Fitting: front was dead easy; need 1-1/8" socket for subframe mounts. The rear fitting is just fiddly to get the thread started in a blind hole (took hours and lots of 4-letter words).”

MAKING YOUR OWN CONVERTIBLE: Discussing chopping the top off a coupe, Scot D. Abbott says "I've seen several XJ-S coupes made into convertibles. I also saw several XJ-S bodies cut apart just for examination and have experience evaluating convertible conversions. IMHO, changing the XJ-S unibody to open configuration must be done with some care to minimize strength loss, and reasonable stiffening elements can be added back to make a sound car. This must be done properly and can be done in many ways.

"Roof removal is *not* necessarily the main thing that can take away body integrity/strength in a conversion. I cut the roof off an XJ-S, towed it on a dolly 2000 miles, and still the door gaps remained the same. I could raise the car with a jack and not twist or deform it significantly differently from an XJ-S with its roof intact. Please note that I kept the sundeck/rearward bulkhead intact.

"Compromise of the rear sundeck/rear bulkhead system or removal of the rearward bulkhead (i.e. the sheetmetal wall behind the rear seats and between the rear wheel wells) from the XJ-S makes the car very flimsy, especially to torsion stress, and it permits undue flexure during motoring which will likely fatigue the sill/floor joints with time.

"Removing the rearward bulkhead is done to make room for a large power top to fold down. An alternative to this is to use a compact folding top and thus avoid creating the basic problem.

"A commercial version of this conversion design strategy is available locally (Driver's Seat of Delaware, Inc., Box 542, Montchannin, DE 19710, 302-998-7889)."

STATION WAGON: See Lynx Motors International Ltd., page 719.

XJSS: A radical kit car based on the XJ-S offered by Autostyle (page 714). Pat O'Keeffe got the literature, and reports that the blurb says:

> PREPARATION: The bonnet (hood), boot (trunk), bumpers, lights, front wings and doors are unbolted. The rear wings and roof are removed. Note that the windscreen pillars and glass are not disturbed. The tubular sill reinforcer, which is supplied, is fitted. The fuel tank is adapted. The rear boot lid support assembly, which we supply, is fitted.
>
> ASSEMBLY: The one-piece front body section is fitted. The bonnet is fitted. The one-piece rear body section and sill covers are fitted. The boot lid is fitted. The XJSS door skins are fitted and the doors returned to their original locations. The lights and number plates are fitted.

PAW PRINTS: Cats love cats; those flea-bitten varmits just love to stroll around on your freshly-washed Jaguar with their filthy paws and leave little prints all over it. Aside from solutions involving firearms, the following suggestions have been made:

Peter Cohen says, "There is a product called a ScatMat. You place it on the car, plug it into the mains and it administers (chuckle) a mild electric shock to the little bugger. I actually own one of these devices. The bad news is: 1. The cat figured it out and just doesn't step on it. 2. My wife drove off with it still on the car. I found it 2 weeks later in the bushes, 3 streets away. My only workable solution is: the Jag goes in the garage, the cats may not go in the garage."

Chuck Wood says, "I know some of you will laugh, but it really works if you have cats that know they should not be on the car and get off when you come out or you yell at them. I took a motion detector which had two lights. I took one light out and put a receptacle in it. I then recorded my voice on tape very sternly telling the cats to get down using the word No and whatever other words that they are used to hearing when they are doing something they should not be doing. The recording was about 5 minutes long. Set the motion detector for about the shortest time on and position the sensor to pick up anything moving on top of the car. It should not go off when the cat walks on the floor any where. When this is set correctly, the cat gets on the car which activates the sensor which turns on the light and activates the recording telling the cat to get down or off.. It shuts off in about 5 seconds. The recorder is in the play mode all of the time. It really works well if the cat is conditioned to knowing it should not be up on the car."

David Danvers says, “I have sprinkled red cayenne pepper around my carport to keep them away...it is a great deterrent and cheap...go lightly so you don't track it in the house or car and re-apply after it rains....they'll get the point pretty quick...” Apparently, the reason this works is because the first thing the cats do when they get settled on the car is to start licking their paws.

Stefan Schulz suggests, “Dihydrogen Monoxide, the colder the better, and lots of it. Apply by slinging it with a bucket. They will get the message. It also goes some way to remove the paw prints.”

Hess & Eisenhardt Convertible

VIBRATION: The Hess & Eisenhardt convertibles have chunks of lead mounted behind the headlights, probably to address a resonance problem. Julian Mullaney says, “Actually, one of them had come loose and was rattling around in the headlight cavity. This is a problem with a ~15 lb. lump of lead. It beat the sheetmetal in the cavity until it cracked open, and the lead almost dropped out into the wheel well. I patched it up and bolted it back in place. I think the vibration may have been slightly less afterwards, but not a huge difference.”

CONVERTIBLE TOP REPAIR: Steve Wilke reports: “Had problems when one of the hydraulic lines chafed its way to oblivion. Resulted in a good bit of hydraulic fluid in the boot. I found that our local auto parts store carries a hard black emissions control tubing, which looked very much like the original tubing. A couple of trips to Home Depot's plumbing department got me the fittings I needed to splice the tube, and Home Depot also had hydraulic jack oil in gallon jugs. After splicing the tube and purging the lines by raising/lowering the top several times, each time refilling the pump with hydraulic oil utilizing a turkey baster, the top worked better than ever.”

INTERIOR

Note: The instrument panel is discussed on page 590.

CHANGES FOR 1988: The interior was significantly changed for the 1988 model year. Changes included:

> Chincy plastic door sills replaced with beautiful chrome-plated steel sills with "Jaguar" written in them.
>
> Painted metal "ski slope" (panel surrounding the shifter) replaced with wood burl version. The cruise control switch was relocated from the shifter pedestal down to the ski slope itself.
>
> New seats with heaters and electrically-adjustable lumbar support. Switches are on the sides of the console.
>
> New steering wheel.

LEGROOM: If you are tall, you may be pleased to know that the front seats in the pre-'88 XJ-S's have two sets of mounting holes. The cars came from the factory with the seats mounted on the forward holes. Simply unbolt the seat rails from the floor, turn the seat over and unbolt the rails from the seat. Remount the rails to the seat using the alternate set of holes, and the seat will adjust farther rearward.

Note that the '88-on seats don't have the second set of holes and are bulkier to boot, making it much more difficult for the larger driver to fit. When Jaguar incorporated electric motors in the seat adjustments in the early 90's, they got bulkier still.

Tall people should also avoid the H&E convertible. Relocating the seat mounts rearward will do no good, because the housing for the convertible mechanism limits rearward motion of the front seats.

SEAT RAIL SPACING: John Nuttall notes that the seat rail spacing on pre-'88 cars was 17½" while on later cars it was 16½". Obviously, the seats will not be interchangeable.

SEAT MOUNTING BOLTS: On the early cars such as the author's '83, the four bolts that hold the front seat rails to the floor tend to be aggravating. The front two bolts go into rectangular block nuts that do *not* hold themselves in place, although it usually isn't too difficult to hold them in place with a large screwdriver until you get the threads started. The rear bolt near the door threads into a trapped nut that can move around for alignment. The rear bolt adjacent to the console is threaded directly into a boss welded to the floor; since this is the only corner that cannot be moved for alignment, this is the one that locates the seat. When putting the seat in, it is a good idea to get all four bolts started before tightening any, and then tighten the rear one near the console first.

Mike Wilson reports that both rear nuts are firmly attached on the 1990 model, neither one can move around for alignment. Still, it would probably be better to have all four bolts started before tightening any, and tighten the rear two first.

To make the job a little easier, you can replace the two rectangular block nuts at the front with clip nuts that will hold themselves in place. The clip nuts are described as an "extruded U nut, 5/16 Regular" or "Long". The "regular" means that the clip part is 5/8" deep, while the "long" has a clip about 7/8" deep. Suitable U-nuts were bought at Lowe's and made by Curtis Industries, Inc., Eastlake, OH 44095. The Curtis part number is 838758 for the regular and 838759 for the long. Similar U-nuts are also sold by auto body parts shops, with the regular having a part number 4016.

The best course of action seems to be to have a selection of regular and long U-nuts on hand to do this job. On the author's car, the regular fit the locations near the doors while the locations near the console required the long. You don't wanna use the long on the locations near the doors if you don't have to, since they would protrude more than necessary and possibly hurt someone's ankle or run pantyhose.

Of course, strength here is of some importance; you don't want that seat coming loose in an accident. However, even though the U-nuts are extruded from sheet metal, they are probably *stronger* than the original rectangular block nuts -- which are made of something related to silly putty. Since the U-nut is a clip, it is made of spring steel and therefore quite strong. And the extruded threads are perhaps twice as long as the threads on the rectangular block.

Since U-nuts seem to only come in coarse thread and the original mounting bolts are fine thread, you will have to replace the front two bolts as well to get the U-nuts to work. The shape of the head of the bolt is crucial, since the wrong shape may obstruct the adjustment of the seat. The bolt to use with it is a "socket head cap screw, 5/16-18 x 1". Curtis part number 835558, but this is a fairly common critter and can be found most anywhere. This is driven by a 1/4" Allen wrench. The original lock washer may be used with this bolt.

On the earlier cars, these bolts were Pozidriv #3 head. This makes them quite difficult to get really tight, especially the rear ones since it may be difficult to get a screwdriver to engage the bolt head straight on; if you have Pozidriv bits for a changeable-tip screwdriver, you might try using one with a 1/4" box-end wrench or a 1/4" socket with a ratchet here. Later cars use Torx T-40 bolts instead, a big improvement. The Allen drive cap screws also work quite well; if you have the Pozidriv, you might consider picking up some 3/4" long fine 5/16" fine thread cap screws for the rear locations, making all four removable with an Allen wrench.

SEAT DIAPHRAGM: If you take the seat out and turn it over, you will find that the bottom cushion is supported by a rubber diaphragm stretched across the frame and hooked on with hog rings. This diaphragm is classic British non-metal stuff and is rotten and torn, and that's why you seem to sink farther into the seats than you did when you were younger. Ron White says, "They are available for the Jag from BAS Ltd." See page 699. Note that this is valuable information; apparently many Jaguar suppliers (including the dealers) will not sell you the diaphragm, they want you to buy the entire seat cushion assembly.

Still, installation is no picnic. The foam of the cushion is glued to the diaphragm, so replacing the diaphragm will entail carefully cutting the foam away and gluing it to the new diaphragm. You'll need good glue, like 3M Super Trim Adhesive #08090.

Note also the above comment about the seat rail spacing change. It is unknown whether a different diaphragm is called for between the two types of seat, but some owners have commented that the diaphragm was really tough to install, requiring serious pulling -- but maybe it's supposed to. Also, there are reports that the replacement diaphragm required a somewhat different mounting hole pattern in the frame, so a few new holes had to be drilled.

This author took a different route and left the old tired diaphragm in place and reinforced it with a piece of plastic sheet above it (between it and the foam) and a webbing woven of curtain rod cord underneath it. The webbing is remarkably easy to do, just loop back and forth between the same hog rings that hold the diaphragm itself, stretch it tight, and tie it; it might be advisable to do this while the diaphragm is still in good shape, thereby postponing the cushion regluing considerably.

COMFORT: Some of us prefer the bottom portion of the front seat to be inclined somewhat; this helps hold the occupant in position with less effort on his part, as opposed to having to brace one's feet against the floorboard to keep from constantly sliding forward. This is especially a problem if you like the seat back reclined somewhat.

The seats in the '83 XJ-S have no angle adjustment on the bottom. However, a small amount of incline can be permanently added by inserting a few 5/16" washers under the front end of the seat rails, around the front mounting bolts. It wouldn't be a good idea to add more than 1/4" or so since you may start distorting the rails, but 1/4" can make a dramatic difference. If you need more, you can also insert washers between the upper rails and the seat itself. Beyond that, you need to make some tapered washers to be able to bolt the rails to the floor without distorting them.

LEATHER: Robert Olman of New York sends this tip. If your leather interior has areas where the dye has worn through and the color of bare leather is showing, it can be re-dyed. The original leather, by Connolly Leathers, is painted with dye rather than vat dyed like other cars -- if you look at the back side of the leather, you see the undyed color. Connolly uses a lacquer-based dye; you'll need 2-3 pints for the entire interior. Before using, you must determine which pieces are leather and which are vinyl, as the lacquer-based dye will destroy vinyl (Some XJ-S's are all leather, others have vinyl in areas that don't contact humans such as the sides of the seats). Or, you can use a non-original non-lacquer-based dye.

You might want to remove seats, console, etc. from the car to make the job easier. Clean the leather with lacquer thinner, sand it lightly with fine sandpaper to remove the shine, then clean again with lacquer thinner. Then apply the dye evenly, perhaps in two coats.

If it is humid, it will take a long time to dry. Heavy coats will also require a long time. Heavy coats in damp weather may require a week to dry.

If you would rather spray the dye, you will have to remove all items from the car, thin the dye with 5-7 parts thinner to 1 part dye, and apply many thin coats. It will require more dye due to waste. Many marine supply shops sell disposable aerosol sprayers (about $6) with replaceable aerosols (about $3). You'll need about three aerosols.

A complete restoration kit is available directly from Connolly (see page 699), with instructions.

Note that Jaguar has used at least three different colors called "biscuit". To get the correct one, you must specify model and year.

FOOT ROOM: The footwells are tight enough; does the brake pedal have to be so big? Of course not! It doesn't have to be any bigger than a brake pedal in a manual transmission car. John Ashcroft says, "Just a small mod: cut 20mm off each side of the brake pedal to gain much needed foot room. What a difference it made!" Note that you don't even have to cut equally off each side: you can cut entirely off one side if you'd like.

Tip: Go to the auto parts store *first* and check out the sizes of replacement brake pedal pads available. Choose the size you want, take it home, and then trim your pedal to match.

You can take the brake pedal out fairly easily, if it will make it easier for you to trim.

INTERIOR WOOD: There are two different types of wood commonly used in the XJ-S interior, elm burl and walnut burl. The elm burl is a light honey color, while the walnut is dark. Neither type holds up well in direct sunlight, so it is recommended that all XJ-S owners purchase sunshades to put in the windows when parking ina sunny parking lot -- especially if you have a later car with the wood ski slope, which is positioned to get more direct sunlight than any wood trim in the earlier cars.

INTERIOR WOOD WORK: Gene Halaburt says, "An excellent article on wood finishing for Jaguars appeared in the October 1996 issue of "Jaguar Enthusiast" Magazine. Written by John Sundberg dba "A&B Leather & Wood Renovation." (see page 698).

INTERIOR WOOD TRIM REFINISHING: Rick Lindsay provides this suggested procedure for refinishing the wood trim:

- Sand the veneered wood *very* carefully with 200 or 400 grit paper removing only enough wood to freshen the surface. Even with 200 grit sandpaper it is easy to cut through the thin veneers used in britcars - especially on edges. I've found it better to leave a bit of the 'old finish' than to sand thru the veneer and have to stain the substrate. Pay particular attention to edges that should be left crisp - not rounded. It adds a professional look. Always sand linearly, not in circles.

- Clean and tack cloth the fresh wood. I use the vacuum cleaner to suck the sanding dust up out of the cracks and pores in the wood. It's remarkable how much comes out!
- Dilute into a clean glass jelly jar about a half jar of MinWax brand exterior Spar high gloss urethane. To that, add an equal amount of new clean mineral spirits. Mix well (stirred, not shaken).
- With a small fine brush, paint the wood surface. The fresh wood will soak up the thin urethane mixture like a sponge. This is, of course, the idea.
- Allow to dry 24 hours.
- Sand lightly (basically to remove high spots) with 400 grit paper.
- Vacuum clean.
- Repeat about 5 times to build up a thick coat. By this time the pores in the wood should be completely full; if not, you're not done with the diluted coats.
- Sand the last time with 400 grit paper to a matte finish.
- Here's where things have to be *really* clean. In a clean environment away from all dust, spray the wood with MinWax brand exterior Spar high gloss urethane straight from the spray can. A thin, smooth coat is fine.
- Allow to dry 24 hours.
- Carefully wet sand with 1200 grit paper. The kind used to 'block' or 'color sand' a new paint job is best. After all, that is what you are doing.
- I only use two coats of spray because finish is all that you are adding.
- Block again carefully, polish as if it were a new paint job. Buff if you have the courage. I do it by hand as a buffer in my hands is a license to screw up royally.
- Finish the job with a coat of Carnauba.
- Admire and drink beer.

Alastair Lauener provides an alternative method of stripping the wood: "I used a chemical called Nitromors, a paint stripper, water soluble, to strip off all the old varnish, and washed under cold water. I tested on an old spare dash first. Careful not to let the wood get too wet. Allow to dry out for a few days. Be careful not to scratch it."

'88-ON SKI SLOPE: Removal of the earlier metal ski slope was obvious, three screws. With the wooden ski slope, however, the screws are hidden. Matt Dillon reports: "In order to remove it, you need to take out the lighter and cruise switch. This gives you access to the bolt on each side that hold the ski slope in place."

John Keppler: "I would like to suggest an alternative approach. The cruise control switch and the cigar lighter are held in place with plastic tabs that are bevelled to snap on, but not to snap off. I don't believe you can reasonable expect to pry these fixtures off without breaking at least one of the four tabs on each (as I ended up breaking one of mine). I would suggest instead the the ashtrays be removed first. The bolts that secure the console lid are mounted horizontally with their heads pointed toward the car's center immediately next to the electrical fixtures. They hold the console with a vertical tab which has a slot that slips down over the bolt. The bolts only need to be loosened to remove the lid. Reach back through the ash tray openings in the lid with a 5/16" wrench to loosen the bolts. Once the lid is removed, you have a much better chance of removing the CC switch and cigar lighter without damage. Reinstall the ash trays, remove the electrical items, and reinstall the lid. Then the bolts are easily accessible for tightening, and the wiring is easy to reattach."

The wooden ski slope is notorious for cracking and peeling, perhaps because it gets more direct sunlight than the other wood in the interior. Dillon suggests a repair: "The ski slope is a piece of metal that has the wood veneer glued to it. I took a belt sander to it to remove the old veneer. I ordered the veneer from Constantines and re-applied it as per their instructions. The veneer was a little lighter than the rest of the wood, so I used a little stain to darken it up a little. I then found an epoxy based clear coat to put a thick shiny finish on it. Much easier than applying coat after coat of varnish or polyurethane. This is a pour on finish and has held up very well so far. I did this about a year ago, so obviously I haven't been able to duplicate 8 years of having the sun cook it, but am hoping that it will last.

"I did go to the dealer to price a new one. They told me somewhere around $250 and couldn't guarantee that it would come even close to matching the rest of the wood. The wood veneer from Constantines cost me about $25 with the can of veneer glue to go with it. The epoxy coating was about $10 more. Aside from being a whole lot cheaper, it allowed me to get the color very close." Constantines is on page 699.

"I called them and just asked them for a piece of their "premium" burl walnut veneer and gave them the measurements. I specified a piece much larger than what I actually needed just in case the edges were a little rough. They sent me 3 pieces. In order to make it fit, I used 2 of the pieces with the seam running straight down the middle. It wasn't obvious to me, but the original Jag piece also had a seam in the middle. The pieces are matched, so it looks really nice. The left side is a mirror image of the right side. There were a couple of knots in the veneer, but I liked that. They're very helpful, and I'm sure that if you send them a piece, they'll try to match it."

CONSOLE PANEL: For those of us who own an '83 XJ-S, removing the panel from the top of the console is easy and obvious -- there are three clearly visible screws. However, John S. Whitford has an '89 with one of those newfangled wood veneer panels, and apparently somebody decided that visible screws would be passé. "The cruise control switch and the cigar lighter can be pried out and that exposes a sheet metal bolt into the console wall locking down the lid on each side. Getting those out allowed me to raise the lid and slide it back some and there are two pegs on the front edge of the cover that fit under the radio-A/C cover."

ADHESIVES: If you're doing interior work, you need to know about adhesives. The following is from Timothy J. Hesse; "I am the product marketeer for the ITSD Industrial Aerosol Adhesives and I formerly was the product marketeer for Auto Trades Aerosol Adhesives."

"74 Foam Fast Adhesive is an excellent foam bonding adhesive which performs well up to about 120°F. Above that temp, the adhesive will soften, and with sufficient stress, you can pull the foam apart. It is possible to experience up to 150+ degrees in a closed car, and the seat part does see a fair amount of stress when a person is sitting on it.

"Another 3M product which is a good foam bonder and has 160° temp resistance is General Trim Adhesive, pn 08080, which is sold by the Automotive Trades Division. This would be a better product to try for seat bottoms.

"76 is a good product---but does *not* have very good plasticizer resistance. Vinyl material is typically loaded with plasticizing oils, and in time these plasticizers migrate from the vinyl to the adhesive, and they soften the adhesive to the point the adhesive becomes very soft and gummy and "lets go". 76 has 160°F temp resistance and would work on foam bonding, but vinyl bonding would not be a long term success.

"A better product for bonding vinyl is Super Trim Adhesive, pn 08090, also sold by Automotive Trades Division. Super Trim is a neoprene-based contact adhesive in an aerosol can. It has 200°F temp resistance, and is plasticizer resistant. In fact, Super Trim is very good for reattaching vinyl tops, vinyl trim, etc. in auto restoration projects."

HEADLINER: Apparently, if you don't want to have headliner trouble with an XJ-S, you'd better get a convertible! They all seem to fall down sooner or later, and the roof light is poorly placed to help keep the headliner off your head when it does.

The material used in a headliner is a fabric bonded to a thin layer of foam. The failure mode of headliners (not just Jaguar) is that the foam rots and falls apart. While it appears tempting to just find some way to glue it back up (and there are people who are willing to sell you products to "inject" glue in there with), the fix will not last; once the foam is shot, gluing it back together only makes it fall apart again above or below the glue layer.

The only real solution is a new headliner. Fortunately, this problem affects cars other than Jags, and a competent craftsman can usually be found locally to do this job well for a reasonable cost.

You will be given the choice of insisting on genuine Jaguar headliner fabric or just installing a generic material. You should have learned about British non-metallic materials by now; if not, let me point out that you are *replacing* a genuine Jaguar headliner! True, it appears that American headliners fall too, but it isn't any sooner than Jaguar ones. The only reason to get the original material is to match the color perfectly, but most of us aren't that picky about headliner colors.

While this is a good example of work best left to professionals, there are those who want to try doing it themselves. Frank Perrick says, "The trick is to buy only 3M spray adhesive and read the can. There is only one 3M adhesive recommended for this job. The wrong can will say 'not for head liners', and the first hot day you will be wearing your headliner. Headliner kits including fabric and clips are available at local auto parts stores." The correct stuff is Super Trim Adhesive #08090.

By the way, the headliner fabric in the XJ-S is bonded to a piece of stiff cardboard or fiberglass. It is somewhat of a challenge to get this thing out of the car; the Jaguar manual specifies removing the windshield! Apparently, that isn't really necessary; Rob Ward reports: "You need to get someone to support the other side while you turn it through 90 degrees. Moved the seats back and lowered the headrests, moved steering wheel fully in. Mine came out through passenger door no problems. (RHD)" Regardless of the methods attempted, everyone who's tried it agrees you will need at least two people.

Richard Dowling offers some guidance for fiberglass repair of that headliner structure: "I pulled the old headlining and used a fibreglass repair kit to beef up the crumbling edges of the moulded roof panel. That was a big mistake, because the rear edge of the moulded panel fits into a slit in the rear window seal. Now my panel is a bit thicker around the edges and perhaps 5mm longer. It pushes the new and pliable rear seal outwards even with the window in place. This has distorted the seal, although it does not leak. The problem is the distortion does not allow me to put the bright trim pieces back in."

FACIA: On the dashboard, just below the speedometer and tachometer on either side of the steering column, there is a panel covered with a fuzzy black fabric intended to be nonreflective to prevent glare on the gauges. This fabric tends to come apart after a few years' exposure to sunlight. To replace it, visit any shop that installs automobile headliners. These two pieces would qualify as scrap to them, you might even get it for free. Take the panels out, remove the old fabric and install the new with contact cement.

GLOVEBOX: The lining on the inside of the glovebox is -- you guessed it -- headliner material.

MOTORMOUSE SEAT BELTS: John S. Whitford relates his experience: "The passive restraint shoulder belt (that I hate), got stuck in the engaged position. I just unsnapped the belt and forgot about it. But it kept trying to return to the disengaged position and that eventually ran down the battery. When I connected the recharged battery back up, I heard it straining, and a little fiddling got it unstuck."

Sean Straw's motormouse seat belts went nuts. "I've noticed on more than one occasion the passenger side passive seatbelt decide that it wants to freak out as it is closing - it reaches the (upper) stop point, then backs off as much as a couple of inches, then reactivates to the stop point again. Back and forth. It'll do this as much as a dozen times (usually less) then stop and act normal. The same thing has occurred on the driver side perhaps twice. Less occasionally, the passenger seatbelt will not actuate until the driver side door has been closed. I can count the number of times this has happened in the past five months on two hands. This seatbelt weirdness only occurs when the vehicle is at a stand still, and just after I've inserted the key into the ignition -- it isn't as if I'm driving along and it freaks out."

Bob Morazes says, "I have a 92 VDP with the same bizzare seat belts."

John Wynne says, "I had a similar situation with my seat belts. Only the driver's side was affected, but not only did it joggle the belt back and forth, it would also trigger the door open buzzer and activate the interior lights. The first time it happened was late at night during a heavy rain storm and it scared the hell out of me. Lights coming on and buzzers going off are not an expected event on the highway.

"It was only occurring during and after heavy rains so I unwisely ignored it for a while, until the day the belt started to move into its open door position and suddenly changed directions pinning me so hard into my seat that I thought it was going to dislocate my shoulder. The retractable portion of the seat belt located to the rear and right of the drivers seat had finally siezed from all the erratic passive belt movement. I was surprised to find that the belt motor had that much force to pin me into the set like that. To top it off I was going about 45 mph into a pretty sharp turn. Talk about panic!

"Basically, what I'm trying to say is don't be dumb like me and let it act weird until a mishap like mine. I was really upset with myself when I found that the cause of all the mayhem was the driver's side door plunger. You know, the one that activates the open door buzzer, turns on interior lights and causes the seat belt to retract. I can't believe the symptoms were so obvious and I ignored it for almost a month.

"It might be one location for you to check out before digging under the dash or inside the track mechanism. The way I tested mine since things seemed fine with a multimeter, was to tape a quarter to the metal plate on the door which contacts the door plunger. This forced the plunger to seat a little further and eliminated the problems. A local parts store had a suitable replacement for about $2."

The good news: According to John Alexander, since the motormouse seat belts are supposed to be a substitute for air bags, they are "warranted for life in US -- had mouse motor repaired and car washed gratis by my dealer."

Morazes agreed. "My Jag dealer replaced them for free. Yes, I said *free*. Its not every day that you get a free trip through the dealership."

Charles Maraia wasn't happy with the warranty: "I took my '88 to the dealer and they said the motor is warranteed, but nbo the other parts. Well, guess what? They found fault with all the switches and on. Cost me over $100 to fix a warranteed item. And I still pull the fuse! That won't happen again."

Maraia may have been ripped off, but it doesn't always happen. Ned Wesley says, "I took my '88 in to purchase the seat belt assemblies and was told move the car in line for service. The service manager attempted to operate the belts. When they would not operate, the entire system was replaced at no cost to me. The right and left side seat belts had an invoice of $1,900 for parts and labor. I believe that the motors are invoiced at $500 U.S. each."

REAR SEAT SHOULDER HARNESSES: The 1983 XJ-S doesn't have rear seat shoulder harnesses, it has lap belts only. However, it has the *mounts* for shoulder harnesses, hidden behind the rear quarter upper trim pad. Since studies have indicated that wearing a lap belt only in a rear seat is *more* dangerous than using no restraint at all, those who actually have occupants in the back seat might want to consider adding shoulder straps.

MORE WOOD: Since more is obviously better, the tasteful touches of burl wood in the interior of the XJ-S can be supplemented with other panels ad nauseum. The '88-on wood veneer ski slope reportedly will *not* fit the earlier cars -- the console itself was changed at the same time; however, Autostyle Ltd (page 714) can provide wood veneer ski slopes to fit any XJ-S. They also offer burl wood panels to replace the radio facia, the little panels around the headlight switch and ignition switch, and the panel surrounding the gauges within the dash, as well as burl wood shifter knobs.

DOOR SILLS: The '88-on metal door sills are a *lot* more impressive than the earlier plastic items. As soon as you see one, you're going to want to retrofit a pair into your earlier car. Patrick MacNamara says, "I had to machine about 1/2" off a center ridge the entire length of the underside of the plate to adapt it to my '82. It was either that, or cut out/remove part of the carpeting and underlay where the sill plate sits. The center ridge does not allow for the plate to sit flat and down tightly on the older cars."

While the plastic sills were one-piece, the metal sills have separate finishing caps at both ends and a series of clips underneath. Richard Mansell provides a parts list: "The part numbers for the coupe are:

Tread plate RH	BDC 4642

Tread plate LH	BDC 4643	
Finisher end	BDC 9742	(RH front, LH rear, 2 required)
Finisher end	BDC 9743	(LH front, RH rear, 2 required)
Clip for tread plate	BBC 9853	(total of 10 required)”

Note that the sills for the convertibles are different. On the other hand, one might presume that the H&E convertible probably uses the same sills as the coupe.

Mansell also reports that there are aftermarket firms in the UK offering metal sills.

CUP HOLDERS: The XJ-S doesn’t have one! What a cheap car. Gary Penovich says, “I definitely needed a cupholder in NYC. How else was I gonna drink, drive, and give somebody the finger at the same time?”

There are lots of cheapie drink holders available; a visit to any truck stop or auto parts store should reveal a wide selection. One place to consider installing a foldable drink holder might be the inside surface of the glovebox door. On the ’83, the glovebox door has a pop-up mirror on one side and nothing on the other, so you could install a drink holder on -- or in -- that other side. But if it’s a surface-mount, you might even mount it on the pop-up mirror.

One of the best ideas is to refab the ski slope with simple recessed cup-shaped cup holders where the ashtrays are. Suitable cupholders are available at marine stores, since apparently it’s common practice to cut holes in your boat and slap one in. You need to be careful to find one of a suitable depth, but there’s one at

http://www.marineeast.com

that appears to be about right.

Your only problem then will be: whattaya do for ashtrays? But this is a much easier problem, since ashtrays can be installed in vertical surfaces -- such as the door panels. It should be easy enough to find suitable ashtrays in any junkyard. There are even ashtrays sold at

http://www.westmarine.com

that are designed to fit into a cupholder! Of course, if you’re a nonsmoker you can just forget it.

CLIMATE CONTROL

PERFORMANCE CHECK: On max cool, this system should provide air at the center vent in the dash in the upper 30's F. Steve S says, "My '85 XJ-S with R12 achieved 35°F at the vents, at idle, doors open, fan auto, max cool on a UK 70°F day after I'd topped if off in July of this year."

If your car ain't getting that cold, it ain't working right. There are a few things to check. First and foremost, while the system is trying as hard as it can to cool, check the sight glass at the receiver/dryer along the front edge of the radiator upper support rail. There should be *no* bubbles visible in the glass -- zero, zip, nada. If there are *any* bubbles, the freon circuit is undercharged. See page 514.

If the charge is OK, other things to look at include the adjustment of the linkages on the Delanair MkII system (see page 535) and checking for leakage through the heater valve when closed (see page 495).

SYSTEM TYPES: From the inception of the Jaguar XJ-S until 1987, a climate control system known as the Delanair MkII was used. In 1987, the Delanair MkIII was introduced, and continued in use until the XJ-S ceased production. The housing within the dash was a sheet metal assembly painted gloss black in the MkII, while the MkIII is largely plastic. The MkII is controlled by a single servo assembly via a conglomeration of linkages within the right side of the console, while the MkIII uses multiple local servos and controls. Both systems underwent several detail changes over their production lives.

The compressor and freon circuit is essentially common to both systems, as are a few other things. Within the dash, however, the two systems are totally different. So, the climate control tips are divided into three sections: Things that are common to all systems, things that pertain to the MkII only, and things that pertain to the MkIII only.

Was there a MkI? Yes, but it was used in SI XJ6 and XJ12 saloons only; it had been superceded by the MkII prior to the introduction of the XJ-S. Hence, it will not be addressed in this book. Mike Morrin says, "The Mk1 system did not have an electronic amplifier and servo, and relied on a thermostatic bellows controlling a set of vacuum valves for temperature and air flow control." It also had considerably less cooling capacity.

The 1995-on XJ12's, which are based on the X300 body, use the climate control system that was introduced with that body. It's not Delanair. Obviously, it likewise is not covered in this book. It has an electrically-operated heater control valve, as opposed to the vacuum-operated valve used in the XJ-S. It also features an electric pump in the heater line.

POLLEN FILTERS: Richard Mansell reports: "If you are interested you can get pollen filters for the ventilation system. I have no idea how or where you fit them but according to a Jaguar accessories brochure from 1997 three are available:

93.5-96	JLM11696
92-93	JLM11355
Pre-92	JLM11108

One might expect that these pollen filters would only fit the Delanair MkIII system, so that "Pre-92" probably really means 87-92. If you have an older car, at least ask first before spending the money.

Common Features

WINDSHIELD FOGGING: If your windshield fogs up more than it should, the first thing to do is determine if the fogging is on the inside or the outside -- wipe your finger on it, or turn on the wipers. If it's on the outside, the problem is that your air conditioner is pumping very cold air through the defroster vents, chilling the glass and causing condensation on the outside. There are two common causes for this malady:

First, the flap that is supposed to close off the defroster vents is not closing properly, or the sealing foam on the surface of the vent has rotted away. In the MkII system in the XJ-S, the flap is operated by a vacuum capsule immediately to the right of the center facia vent, but it's really difficult to get to without pulling the dash (note that the MkII system in the saloon is different in this respect, having a vacuum capsule on each side). The flap itself is basically impossible to work on without a total disassembly of the dash, including purging the freon system and pulling out the entire A/C assembly. Sometimes the problem is the hinge the flap moves on, a cheap plastic item that should be replaced with something more substantial if you ever have the opportunity.

Fortunately, the second cause is more common (on the MkII, anyway): the linkage controlling the entire A/C system is misadjusted, causing the air coming through the upper half of the system to be colder than it should be. Readjust the control linkage as described on page 535.

If the fog is on the inside of the windshield, it is usually due to one of two causes: either the condensate drains are plugged up causing the system to fill with water, or the heater core has sprung a leak. To determine which, John Shuck sends this tip: "This sounds crude, but wet your finger and touch the window. Taste your finger now. If it tastes sweet, that's antifreeze that's coming from guess where....heater core."

CONDENSATE DRAINS: All air conditioning systems must have a condensate drain to drain the water that condenses when the air is cooled. The XJ-S has two -- small plastic tubes protruding downward and ending well above the exhaust system on either side of the transmission. When working properly, these tubes will be dripping water on the exhaust pipes during muggy weather. However, when the lines plug up, the water fills up inside the A/C system, causing wet spots on the carpet, reduced airflow, etc. It will sometimes dump water on the driver's or passenger's feet when cornering. It also appears to be the culprit in a strong tendency to fog up the windshield immediately upon starting the car after it was recently shut off.

From under the car, run a piece of stiff wire up through each of the tubes until it goes all the way into the A/C unit. Compressed air might also work. Since Jaguar made these tubes entirely too small (they are twice this diameter on most cars) they get plugged easily and need to be opened up regularly.

If your drains are plugged beyond this simple repair, Hunt Dabney provides a description of more serious work: "Remove the side panels from either side of the transmission tunnel (the ones that have the vents in them). On the left side, if you look at the front-most 'corner', all the way to the left when viewed from the side, you should see a rubber reducing nipple attached to the lower portion of the compartment containing the A/C coils. This has a piece of 3/8" poly tubing protruding from the bottom, down and through a grommet which passes through the top of the transmission tunnel. This one is easy to get to and remove. To replace, use new hose clamps, and possibly silicone seal if the grommet has problems (or a new grommet).

"Above this point is a duct, about 4" in diameter and which extends under the dash from the heater a/c unit to the left side dash vents. By rotating the end a bit ccw, it may be withdrawn from the heater box. This will allow you to look in the box and inspect for dust and debris. Clean out through here if you can.

"The right side is very similar, but the A/C servo linkages may get in the way and require removal. In fact, it may be necessary to remove the servo unit. Getting in through the duct, as previously described, is workable, but you have to remove the glove box."

According to Larry Lee, the drains may be getting plugged with bits of the foam insulation used in the system; being British non-metallic material, it rots and falls into the drains. The insulation itself is not worth replacing unless you're doing other major work, because it requires tearing the dash and A/C system apart.

Note that Technical Service Bulletin #8218 describes a problem with the condensate drains after the airbags were introduced in 1989 and up to VIN 165565. Apparently a revision of the A/C system was necessary, and as a result excess sealant on the drain separator plate may plug the drains. After VIN 165565, the sealing was omitted. Later, after

VIN 168340, an additional hole was provided in the separator plate.

PLUGGED CONDENSATE DRAINS -- PREVENTING SECONDARY DAMAGE: Hunt Dabney says, "Last time the drain tubes clogged up on mine, it dumped quite a bit of water over the servo and ruined the feedback pot. I made a mylar shield to prevent this from happening again. I took a sheet of 6mil mylar (used to use for PC board layout before CAD), cut it so that it would fold over the servo assy from the mounting surface side, with tabs folding over the corners and openings where required to clear the operating levers, cable and tubing. Then, crease the folds, install over the servo and reinstall the servo cover. I cut an opening where the foam "friction" piece that pads between the servo and the mounting surface go, so that it would not slide due to the mylar."

See also the note on the official Jaguar protection for the stereo on page 665.

HEATER CONTROL VALVE: The Jaguar heater control valve is a vacuum-operated pot metal contraption located in the dead center of the firewall, under the rear loop of the fuel rail. It consists of a metal cylinder with a hole through it within a ported housing; the cylinder is rotated to align the hole with the ports to allow flow, and rotated so the ports face the blank sides of the cylinder for shutoff. This valve is expensive, difficult to get at, and prone to corrosion and seizing.

Note that a heater valve should provide a total 100% shutoff of water when vacuum is applied; if it is leaking when closed, even slightly, it introduces quite a lot of heat into the climate control system when it is supposed to be in full cool mode. While the supply air from the vents may still seem cool thanks to the operation of the flaps bypassing the heater core, the system won't work as efficiently as it should. When in doubt, test it; connect the valve to a 5/8" garden hose with a hose clamp, turn on the water faucet, and suck on the vacuum line with your mouth. If the flow doesn't completely shut off, you need a new valve.

It's a fairly simple matter to remove the intake manifold crossover pipe, and doing so may provide vastly improved access. On the '83 XJ-S, the mount bracket is held to the firewall with two bolts that thread into nuts welded onto the firewall. However, Michael Bain reports that some models use nylon nuts within the wiper motor area. In this case, it may be easier to remove the intake grille/wiper motor assembly and unbolt the heater control valve from the back side, but if the nuts aren't nylon you won't get anywhere going that route.

Do not simply eliminate the valve and plug the hoses. The hot water supply is necessary for proper operation of the climate control system, even when it's in cooling mode. A temperature sensor in the heater core will limit the blower operation if the water isn't warm enough.

When the Jaguar valve causes problems, whatever you do, don't replace it with another valve just like it! That metal thing is junk. A better option is to go into an auto parts store and ask for a heater valve for a Jaguar. Some stores may stock the original, but most places -- notably the cheaper places -- will hand you a generic heater valve such as one made by Factory Air, part no. 74803. This valve is made almost entirely of plastic, and costs only about $10. Although some people don't like plastic, the design of this valve is so superior that it is undoubtedly the most reliable choice. This is a domed poppet valve rather than a rotating-cylinder valve, so the reliability of a total shutoff when closed is much better. Discount Auto Parts and Pep Boys sell this valve, and they always seem to have it in stock.

Note that any vacuum-operated heater valve with 5/8" fittings that is open when there is no vacuum applied will work. This valve does not throttle; it is strictly on or off, and the temperature modulation is controlled with flaps inside the car.

Note that the vacuum hose in the XJ-S is 1/8" while the connection on the Factory Air valve is 1/4". You will probably not want to try to stretch a 1/8" vacuum hose over a 1/4" connection, so plan accordingly and buy an adaptor and a short piece of 1/4" vacuum hose while you're in the store.

Also note that the plastic valve is so lightweight there is no need to mount it; it can be merely suspended in the hoses. Take advantage of this fact and relocate it towards the passenger's side of the engine compartment rather than trying to put it anywhere near where the original was. This will require some 5/8" heater hose and clamps, and perhaps a "hose repair kit" for joining two hoses together, so pick all this stuff up while you're at the store as well. Note that, in addition to straight 5/8" heater hose, most auto parts stores have a large selection of "molded hoses", 5/8" hoses with sharp bends and curves formed in them. You might consider choosing a couple of these and using them to make your heater valve relocation look more professional.

Getting to the OEM valve is a pain -- so Peyton Gill came up with another idea: abandon it in place. As long as it doesn't leak externally (they usually don't) and it's not stuck shut (they usually aren't) then simply disconnect the vacuum line (leaving it open all the time), cut the heater hose somewhere over near the right side, install a new valve, and connect the vacuum line to it.

BLOWER FANS: The XJ-S uses two fans, one on each side. Therefore, there is one more failure mode possible than on other cars. If your A/C is putting out cold air but doesn't seem able to cool the car, check that both fans are working. If one runs and the other doesn't, the system appears to be working but capacity is severely reduced. Since both fans feed a common plenum, failure of one fan reduces airflow at all outlets but does not affect one outlet more than another. When both fans are working, airflow is quite forceful indeed at high speed, and cooling should be more than adequate.

The blower assemblies are different between the earlier system and the Delanaire MkIII, but they are similar enough that the discussions in the next few paragraphs apply to either.

BLOWER MOTORS DISCONNECTED: The wires to the blower motors go through a grommet into the blower housing and then attach to the motor itself with spade connectors. Duncan Smith had troubles here: "The +12V spade connector had detached from the post on the motor due to the wiring harness being too tight. Fix: unbind the harness, pull the connector through further until there was a bit of slack and rebind."

BLOWER FANS - REMOVAL: The blower housings are outboard toward either side of the car and connected to the center core with flexible rubber ducts. To remove each blower assembly requires removal of the underscuttle cover, fusebox, a couple wires, one vacuum line and two bolts.

In the Jaguar repair manual, one step in removing the blowers is to open the recirculation door and block it open. The next step listed is to remove the bolts holding the blower in. Please do not infer from this sequence that the blower retaining bolts are within the recirculation door; the door must be blocked open simply because it is linked to the outdoor air intake, which must be closed to prevent hanging up while the fan is being removed. The blower retaining bolts are on the outside of the housing and are obvious. Both steps are necessary but unrelated.

Duncan Smith says, "Clothes pegs are perfect for holding the lower door open."

BLOWER FANS - MAINTENANCE & REPAIR: Take the blower assembly out (it's easy), then take it apart to get the blower out (also easy) and remove the impeller from the motor shaft. Look at the motor and see if there's any obvious damage, like wires hanging out, burnt windings, foreign object damage, etc.

The blower motors are not overhaulable. The motor itself is held together by peening over some tangs, and reassembling would be difficult. However, it is possible to repair many problems the motor might encounter.

Since the British engineers saw fit to make these completely open motors exposed to whatever dust and debris comes through the ventilation system, it may be helpful to remove lint and foreign objects from the inner workings of the motors.

Since the bearings are exposed as well, some fresh lubrication will be welcome, but don't over-oil the rear bearing; excess oil may find its way onto the commutator, gumming up the works. Use a light machine oil, like sewing machine oil.

If the motor looks OK but is seized, force it -- whattaya got to lose?

Remove the C-clip from the shaft, and remove the stack of washers against the front bearing; be sure to keep track of the washers and the order they are installed in. Turn the shaft and observe the front bearing, which should remain motionless within the housing. If the bearing turns with the shaft, a positive anti-rotation modification is called for. One method is to drill a hole through the steel housing and into the bronze bearing and install a tiny self-tapping screw. Make sure the tip of the screw doesn't contact the shaft itself, and that the head doesn't interfere with the C-clip and washers.

Pull the little covers off the brushes and remove them. If they are too short, replace them; don't bother trying to find original Jaguar brushes, just find some slightly larger at a motor or vacuum cleaner shop and file them down to size.

While the brushes are out, use a VOM to check the continuity at the segments of the commutator. There should be some form of continuity between any two segments you test. If you find a segment that doesn't seem to connect to anything, you're in trouble. If you can see why (a winding disconnected or some such) you can decide for yourself if it's possible to fix. Don't use any solder, it won't take the heat, connections must be made mechanically or by tack welding.

If you're like me, you'll grind a small flat on the shaft for the setscrew in the impeller. I just don't like setscrews on a plain shaft.

Before reassembly, inspect the condition of the three rubber mounts. If they are dry and hard or crumbling, renew or fashion suitable replacements from grommets, hose, whatever.

If your blower fans are toast, Vicarage (see page 704) carries replacements at reasonable prices.

BLOWER FANS - REINSTALLATION: The rubber duct may be a neat feature, but it can be a real pain to reinstall. To make life easier, attach the duct securely to the blower assembly before installation. I suggest the use of aluminum tape.

VACUUM: The control system relies on a supply of vacuum from the engine, and stored in a reservoir. As Tom Wagner discovered, it pays to make sure the supply is working before troubleshooting the rest of the control system. There is a check valve in the line to allow the reservoir to hold vacuum when the throttle is opened, and this check valve stuck shut -- preventing either the reservoir or the control system from getting any vacuum.

VACUUM CHECK VALVE: One might expect that the normal failure of the vacuum check valve is that it fails open, but Mike Morrin had the opposite problem. "My A/C system has always had marginal performance of the vacuum actuators, with the heater valve (new) and centre vent flaps always slow to operate. I got tired of the centre vent taking 5 to 20 minutes to open.

"Tonight I decided to check the vacuum non-return valve, which seemed to be working. While trying to decide what to do next, I was sucking on the non-return valve, and it occurred to me that I was sucking rather hard before any air got through.

"On impulse I tried to pull the valve apart to see what was inside, but it was too tight (or glued together). I then poked a piece of steel wire in the end where the air goes in, and there was a small click. That must have been the rubber thingy unsticking from its seat, because the valve is now much easier to suck through (but only one way). After refitting, all the vacuum actuators are now working like clockwork.

"That is the easiest repair this week.

"The XJ-S help book mentions that these valves sometimes block up completely, but this was only partial, and seems to have been fixed by a poke in the eye with a blunt stick."

CENTER VENT: The center dash vent on most XJ-S's has three sections: a section on the left and right ends that can be adjusted to aim where desired, and a center section with no adjustability that simply blows straight rearward. Here in Florida where the weather is both hot *and* humid, this center portion can blow enough cold air straight back to cause the rear windshield to fog up -- which is a real pain, because the rear window defroster has a timer and won't stay on indefinitely, you have to keep turning it on and off to maintain visibility in the mirror! Those who don't have fogging problems still dislike that center vent blowing air to the rear, since only sadists ask anyone to actually sit in that rear seat. Peter Cohen confesses, "Over the years, I have developed the unconscious habit of driving with my elbow resting on the console, arm up, and my hand positioned as a diverter to direct the cool air toward me."

Emile A. Des Roches suggests two possible fixes: "The Cheap Solution -- Lift off the surrounding wood (gently); the plastic vent will come out with gentle even pressure. Cut a piece of relatively stiff black cardboard to the height of the inside (towards inside of dash) vent and to a width roughly 2" narrower than the width of the center vent. Place same (black side facing cockpit) in the vent and reassemble. This solution performs the same function as resting one's hand in the air to divert air towards the driver and is far more sanitary."

This author made a similar modification to his center vent, except he used black plastic instead of cardboard and shaped it into a V so it would more definitely deflect the air to the sides. Using the simple flat piece may cause more blockage rather than deflection -- which may be desirable since it would result in more air flowing out all the other vents.

To all this, Franck Guilloteau adds: "While my car is an '85, the wood trim is in immaculate condition and I found that after several unsuccessful tries it wasn't worth the risk of breaking or chipping the trim. I resorted to an alternative method of removing the two directional vents of the main center vent. A small screwdriver, X-acto blade and minimum dexterity will do the job in five minutes. Directional vents have a small leaf spring that increase the friction and hold them in place; it can be pushed out prior to removing the vent. These openings allowed me to slide black cardboard (or plexiglass covered with black felt in my case) and wedge it in place from behind. All told a really "cool" mod."

Des Roches continues: "The More Problematic Solution -- Replace the center vent with one from a very late XJS. At some point after 1993, the center vent design with moveable vanes at the edges and fixed vents at center was replaced with a design that consists of two (no space between) adjustable vents. This is a direct (no trimming) replacement for the earlier unit which presumably could be obtained from either Jaguar spares or a wrecking yard." Dean Gosselin adds that the part part no. is BEC-26361.

Dan Jensen adds, "I changed out the center vent on my XJ-S... It makes a dramatic difference in the amount of cold air that can be directed over the driver and/or passenger. I would offer one additional note to the installation instructions. While the replacement vent has the same width and height as the original in my car, it was approximately 1/8 in. deeper. The extra depth resulted in the vent face extending out a comparable distance from the metal dashboard and prevented the wood fascia from sitting firmly against the dash. As a result, I had to get out a wood rasp and file off 1/8 in. around the inner perimeter of the vent. This took about 15-20 minutes, including the time needed to get all the little specs of plastic off the louvers when I was finished. In addition, it was necessary to file two small central notches in the metal dash to accommodate two added bulges in the new vent. This took no more than a minute or two with small round file."

Samuel Louw provides an incredibly detailed description of this job, in response to the concerns that many people had about damaging their wood trim: "It is really simple and you don't have to be an engineering genius to be able to do this. The most scary part is actually to remove the wooden center fascia, since this holds the vent in its place. It really sits tight. There are four metal springloaded pins that are attached to the backside of the fascia and are pushed into four holes which are in the metal dash plate behind the nice wooden fascia. When the fascia is replaced, the four metal pins are pushed into their holes and the springloaded clips are compressed, not in the direction of the pushing action but by the sides of the holes, since the clips are V-shaped. Now when you want to remove the fascia, you first have to overcome this spring action. Since you think the fascia is waferthin and will break, you might want to give up, but that piece of wooden fascia is almost 8mm thick in places. You have to open the glove compartment and slide the blade of typically a steel table knife underneath the fascia. Then you must start wedging it away from the dash. The right side steel pins are app 5mm away from the top and bottom of the fascia and app 35mm in from the glove box side from where you will be wedging. The left side bottom pin is also app 35mm from side, but the top pin is app 70mm from the side and in the area where the fascia is only about 13mm wide. Be careful of breaking the wood there. I hope that by knowing beforehand how things look at the back it will make you more comfortable to do the job.

"The new vent has four small plastic flanges with holes in it, two per side along the two long horizontal sides of the vent. The flanges are about 10mm x 10mm. They have to be removed, since the pre-'93 cars do not have holes through which the vent is fixed in position. This is definitely not needed, since the vent is held in position by the center piece of wooden facia, and that really sits tight. So, you have to remove those flanges (can be broken off carefully with normal pair of pliers) and then just file the leftover away.

"The other small job is also due to a small difference on the new vent, but again, this is small and easy to do. The new vent has has two small D-shaped bulges on both sides. This will most probably interfere with the metal plate of the dash where you have to push in the vent. Just mark the position of those bulges and file away the notches in the metal plate (About 5mm wide and 3mm deep and halfround shape; use small round file).

"I did not notice the problem of the new vent being deeper than the original, as was noted by Dan Jensen. Thus I did not have to do that filing to make it less deep. My new vent pushed in all the way until it settled against the rectangular sponge seal and there was no interference with the wooden fascia due to a bit of vent protruding. If you do find this problem, just file away the required amount from the rear of the vent.

"The correct Jaguar part no for the new vent is BEC26361. Do remember to buy the new foam seal as well. You are not likely to save the old seal, as it will have rotted and deformed.

"You will have complete control over the direction of air flow both up and down and to the sides. If you live in an area with hot weather as I do, it is essential. You won't believe the difference."

AIR CONDITIONER COMPRESSOR: Up through 1992, the Jaguar A/C compressor was labelled "Harrison" but was in fact the standard GM item referred to as an A-6 -- and therefore comparatively cheap to replace. In fact, it is generally recommended to simply replace the compressor rather than attempt even the simplest repairs. After a few years, the O-rings start to fail, and each time you correct a leak you must have the system evacuated and recharged. With the current regulations on R-12 refrigerant, the cost of a single charge can exceed the cost of the compressor. If you are having the system recharged anyway and the compressor is more than seven or eight years old, it might be wise to simply replace it even when it is still working fine.

Although you can find an A-6 compressor *really* cheap, Randy Wilson says, "The compressors should be good for *many* years. Continuous failures are not the fault of them being rebuilt units. It's the fault of them being cheap quasi-rebuilt units. This is a fairly major problem we fight in the auto industry. I can buy these A-6 compressors from a local distributor for $49 per unit in very small lots... with no core return. These units, I can tell you from experience, have an average life expectancy of around a month. Many fail the first day. I have found a rebuilt compressor that I like. It's a *lot* more expensive. But I haven't had one of them fail yet."

James Teston describes a quality rebuilt compressor: "There should have been a nitrogen charge under pressure in the compressor that gave off a distinctive hiss when you loosened the cover plate. This is to prove to the installer that the unit is 100% leak proof. Kind of like the tin vacuum safety lid on grocery jars in reverse."

Before selecting a rebuilt compressor, read about the clutch below.

The threads on the replacement compressor are likely to differ from the original, in which case you will have to replace the mounting bolts. In particular, the two mounting bolts at the bottom rear and the long bolt that holds the inlet and outlet connections in place are 10mm on the OEM compressor and may have to be replaced with 3/8" bolts (either fine or coarse, they vary) when installing a replacement. 3/8" is only slightly smaller than 10mm, so sleeving will not be necessary. Also, the small front mounting bolts are 8mm x 1.0 (metric fine thread) and may have to be replaced with 5/16".

Aggravating the thread situation is the fact that rebuilt compressors tend to be delivered with the threads all boogered up, and covered with paint besides. This makes it difficult to tell which thread it is, since *no* bolt wants to thread into it. It's no fun getting to these bolts when they're down in the vee, so you're advised to determine what threads they are while the compressor is on the bench and to chase the threads with a tap so the bolts go in easily.

The new A-6 compressor also may not fit the protection switch that was in the original compressor. Read the section on the COMPRESSOR PROTECTION CIRCUIT on page 504.

The A-6 compressor is supposed to have a pressure relief valve screwed into the back end. If the rebuilt you get happens to have a plug in its place, transfer the pressure relief valve over from the old compressor. If the thread isn't right, Peter Havas suggests you just swap out the entire rear plate of the compressor! The XJ-S has a history of problems getting enough air through the condenser/radiator to keep the high side pressures down, so this is one car that really needs to have that pressure relief valve in place.

From 1993 on, a Sanden compressor was used. While many may bemoan the discontinuation of the excellent A-6, the Sanden likewise has an excellent reputation among A/C mechanics. Note that fitting a Sanden to an earlier car would probably require replacing the hood as well; the later hoods have a different shape primarily to accommodate the AJ6 engine, but they allow room for a larger diameter compressor on the V12 as well.

COMPRESSOR RELOCATION/SUBSTITUTION: Many owners feel it's worthwhile to try to replace the all-iron A-6 compressor with some other compressor that weighs less -- for example, the Sanden used on the later models. Obviously hood clearance is an issue -- unless the compressor is relocated around the side of the engine.

The capacity of a compressor is generally described in terms of the number of cc's it moves per revolution. If you want to compare the capacity of one compressor installation vs. another, you need to compare the cc's per revolution *and* the relative sizes of the pulleys in the belt drive. If you install a compressor with the same cc's per revolution but a larger pulley, the capacity will be decreased because the compressor is turning slower. Conversely, you may be able to achieve adequate capacity from a smaller compressor by putting a smaller pulley on it -- or a bigger pulley on the crank, which may be easier -- to turn the compressor faster. You must be careful not to overspeed the compressor before the engine reaches redline, though.

All that said, one must suggest that the A-6 is probably oversized for this application. The system is rated at around 2 tons, but the compressor isn't likely to be the limiting factor; it's limited by the size of the evaporator and the ductwork. Even if you installed a compressor that moves far less freon at a given engine speed, you're not likely to notice the difference except perhaps at idle.

There is a minor concern about relocating the compressor to a lower location. Having the compressor up high -- especially above that hot engine -- has the advantage that it will prevent liquid freon from pooling within the compressor while the car is parked and then causing a compressor lock on startup. Compressors in household air conditioners generally have a "sump heater" in them that prevents freon from condensing in that location. It evidently isn't a great concern in automobiles, because many come from the factory with the compressor mounted low. Since the condenser is likely to always cool down faster than the engine and the compressor, perhaps the problem is avoided. Perhaps the compressors mounted low are designed that they'll just push liquid into the high pressure line rather than trying to compress it.

In whichever case, it's always a good idea to route the high pressure line so that it goes up high and then back downward to get into the condenser. This prevents liquid in the condenser from draining back into the compressor while the car is parked.

It's also a good idea to have an electric fan that runs on after the engine is shut off. Besides addressing heat soak in the engine, it helps to cool off the condenser quickly and causes the freon to condense and pool there rather than in the other parts of the system.

COMPRESSOR CLUTCH: The assembly built onto the nose of the compressor is the clutch, the system that engages or disengages the drive as the climate control system calls for cooling. When disengaged, the compressor is nothing more than an idler pulley. When engaged, the drive plate on the very front of the compressor is turning with the pulley, making it very easy to visually confirm operation. If the engine is not running, you can still confirm operation; when the clutch is disengaged, you can turn the drive plate fairly easily, turning the compressor. When engaged, you can't turn the compressor by hand because it's locked to the belt drive, you'd have to turn the engine.

The clutch is magnetic. Under the pulley is a coil that is energized when engagement is called for. This magnetizes the pulley. The drive plate contains a rubber isolator to absorb vibration and also features three straps riveted at one end to the rubber isolator and at the other end to the clutch face plate itself. These three straps can flex to allow the face plate to move forward and aft fairly freely, but they're springy and tend to pull it forward away from the pulley. The magnetism pulls this face plate against the front surface of the pulley, engaging the drive. This is a steel-against-steel friction drive.

The clutch is serviceable separately from the compressor. A replacement clutch can be purchased from local auto parts stores, and the old clutch removed and the replacement installed. This does not involve disturbing the freon circuit.

A replacement clutch may include the drive plate, the pulley, and the coil, or it may include just the first two items; if you need a coil, you should ask. Note that the A-6 compressor has been used on *lots* of different automobiles (not to mention road graders, agricultural machines, you name it) but there were several different pulley arrangements involved. Since the replacement clutch includes the pulley, you'll need to find the correct type. It's still very common, since it was used on several GM cars; the computer terminals in the auto parts store should bring up the correct item.

You can buy a new clutch, or you can buy a "rebuilt" clutch. A clutch having been rebuilt *should* mean at least four things: First, the steel-against-steel friction surfaces on the drive plate and the pulley have been machined to render them flat and new-looking again. Second, the rubber in the drive plate has been replaced; the rubber is bonded to the hub of the drive plate on one side and to a flat steel disk on the other, much the way a motor mount is made. Third, the pulley should have a new bearing in it. Finally, if it comes with a new coil, presumably that has new windings inside.

Why am I telling you all this? Because apparently you need to know. A properly rebuilt clutch costs as much as some of the rebuilt compressors discussed above. When buying a rebuilt compressor, you apparently can get any of at least four different treatments of the clutch on that compressor. One option is that you can buy a rebuilt compressor without a clutch, apparently so you can install your own. This is probably for mechanics who want to make sure the clutch is good and installed properly; it's not likely anyone would opt to reuse their old clutch with a compressor replacement. Second, you can get a rebuilt compressor with a rebuilt clutch. Third, you can get a rebuilt compressor with a new clutch. And, finally, believe it or not, you can get a rebuilt compressor with a non-rebuilt clutch!

Yes, that last option is totally unacceptable. You can easily tell what's up with the rebuilt compressor someone is trying to foist upon you. First off, you can look carefully into the gap between the plate and the pulley and see if the surfaces appear to be freshly machined. Second, you can look at the layer of rubber built into the drive plate. It'll be coated with new black paint, but don't let that fool you. If it's new, the rubber will be a neat shape with clean edges. If it's an old part with fresh paint, the rubber may be distorted, bulging on the sides, maybe even cracked. Send that compressor back, and don't consider any other compressors from that rebuilder.

The incidence of rebuilt compressors with non-rebuilt clutches may explain a couple of the other options available. Getting a compressor without a clutch enables the mechanic to install one himself, so he knows what parts were going in. Getting a rebuilt compressor with a *new* clutch is perhaps a response to mechanics getting rebuilt compressors and having the clutches fail shortly thereafter; it's possible that a rebuilt clutch would have been just as good, but they didn't realize the clutch on the compressor they were installing had not been rebuilt, so they conclude that a rebuilt clutch is unacceptable.

Of course, it's also possible that rebuilt clutches *are* unacceptable -- or, more likely, *some* rebuilt clutches are unacceptable; perhaps some rebuilders don't bond rubber to metal well or use weak rubber or some such.

BELT WIDTH: Automotive V-belts are commonly available in two different widths. The narrower belts, often used on alternators and the like, are about 10mm wide and the edges of the matching grooves will be 10mm apart. The wider belt, typically used to drive A/C compressors and other heavy loads, is 13mm wide. In modern parlance, the part number of a 10mm belt will usually have a 15 in it somewhere, while a 13mm belt will have a 17. I hope that makes perfect sense to you.

The other three digits are the length in tenths of an inch. So, a 58-1/2" belt 10mm wide is a 58515 from some makers, a 15585 from others. A 58517 or 17585 is the same length but a 13mm belt.

If you're fiddling around with accessory drives, the crank pulley on the XJ-S has grooves designed to work with either width belt. A 10mm belt will sit deeper in the groove, so the crank pulley effectively becomes a smaller diameter pulley -- moving the 10mm belt slower than a 13mm belt would move in the same groove.

COMPRESSOR CLUTCH REMOVAL AND REFIT: The SIII XJ6 ROM includes instructions on replacing the clutch and so does the 4-volume XJ-S Service Manual. However, the author's XJ-S ROM does not and neither does the Haynes. Since these are the manuals most owners are likely to be relying upon, instructions are provided here. Of course, these are presented differently than those in the Service Manual.

A warning, though: this is commonly regarded as a difficult task with considerable risk of failure. There are many people with experience at this job thanks to this being a GM product, and you might be wise to seek out such an experienced person rather than try this yourself.

First off, the Service Manual says you need to discharge the freon and remove the compressor to the bench. False -- although you may need to unbolt the compressor from the engine to move it around a little.

To R&R the clutch you will need two special tools: a puller to get the drive plate off, and an installer to put it back on. Four Seasons and Factory Air both offer such tools with numbers 59509 (puller) and 59502 (installer), while Discount Auto Parts offers Cool-Aid! tools 34460 (puller) and 34461 (installer). The tools are around twenty bucks each; the installer is a bit more expensive since it includes a ball bearing. Both tools are also commonly included in collections of automotive air conditioning tools, some of which use a couple of generic tools with lots of different attachments to adapt to various types of compressor.

Some auto parts stores will rent or loan these tools to you for free. Or, maybe not. AutoZone includes the puller in its collection of rental tools, but not the installer. They refer to the puller as their rental tool number 27002.

If you don't have the puller, it might help to know that the internal threads the puller screws into are 7/8" x 14 TPI, which is the same as a 1/2" NPT except for the taper. Hence, you can screw a piece of pipe into this hole. If the pipe hits bottom before the tapered threads tighten up, cut a bit off the end of the threads. At this point, you may be tempted to attach a slide hammer or other apparatus for yanking, but note that the Service Manual includes warnings that applying loads to the shaft can cause damage inside the compressor. The thing to do would be to screw a fitting of some sort into the hole and thread a bolt through the center of that fitting to make a tool that works just like the official tool, pushing the shaft out the center of the drive plate.

If you don't have the installation tool, you can use an internally-threaded sleeve and a threaded rod or stud to extend the threaded end of the shaft and use a nut and some washers to pull the drive plate on. The challenge is finding a sleeve with an internal thread of 3/8" x 24 TPI and an OD less than 1/2". Good luck! You might find a long nut or coupling nut, but you'll probably need to grind the points off the external hex to get it to fit. Another idea might be to get a small piece of tiny pipe or sleeve and use a tap to thread the inside.

Incredibly, there's actually a plausible solution here. Discount Auto Parts sells a package of two "Shock Stud Extenders", Superior no. 13-6501, for about four bucks. These things are intended to screw onto the top stud on a shock absorber for rednecks doing heinous things with the ground clearance on their pickup trucks, but the threads are correct for our purposes. They have an external hex that will have to be ground down, but that wouldn't be too difficult. You get two tries, too.

You will also need snap ring pliers -- big ones.

First you need to remove the nut that's down in the hole in the center front of the drive plate. It may be a 9/16" hex, but on the author's car it was a 14mm hex. The socket used doesn't need to be a special thinwall model, but it can't be a big bulky thing or it won't fit in the hole. The nut is regular right-hand thread, 3/8" x 24 TPI (NF).

Next you need to use the puller. If you're lucky, the puller you have will fit between the compressor and the radiator upper rail. If not, you'll need to unbolt the compressor to tilt the nose up to work on it. That's not too difficult to do, and it gives you better access to what you're doing anyway.

Once the drive plate is off, a large and obvious external snap ring must be removed to allow the pulley and bearing to come off. The bearing is not a very tight fit on the compressor, so once the snap ring is off it shouldn't be too difficult to remove. Perhaps a few taps with a plastic mallet or a hammer and wooden drift will help.

The replacement clutch should come with a new bearing already in place in the replacement pulley, but if you need to get at it for some reason: the bearing is pressed into the pulley from the front and is held in the pulley with a barely-noticeable wire snap ring. Walter Acker IV says "The bearing number should be an A/C delco 15-2802."

Once the pulley is off, another large external snap ring must be removed to get the coil off.

It appears that the replacement coil could be installed with the terminals facing several different directions, so make sure they point where you need them to.

Before installing one of these large snap rings, look closely at it. The flat side of the snap ring needs to go against the part being held in place. The other side has a bevel around the ID, and this bevel not only makes the snap ring easier to install but also helps it hold the part snugly. After installing, tapping around the circumference of the snap ring to make sure it's fully in couldn't hurt.

If installing the replacement pulley requires tapping, *do not* tap on the flat friction face; the wire snap ring holding the bearing in the pulley may not appreciate it, and neither will the bearing itself. You need to tap directly on the inner race of the bearing, which means you need to have a sleeve with a 1-5/8" ID to use as a drift. A PVC pipe fitting worked well for me.

The key that goes on the compressor shaft is square, 4mm on a side. It's also bent. No, it isn't damaged; the Service Manual says that it is deliberately bent to hold it in its groove during assembly.

Before reinstalling the drive plate, you need to put the key in place. The Service Manual says to fit the key into the drive plate, and then line it up with the keyway in the shaft during assembly. Unfortunately, if the key is installed in the drive plate it will interfere with the installer tool. The key must be positioned in the keyway on the compressor shaft. And if you do that, the key will probably fall out while you're trying to install the drive plate. It appears that the most reliable method is to position the key in the drive plate but as close to the back end as possible. Put the drive plate onto the shaft, lining up the key, and use the installer tool (threaded onto the shaft as far as possible before it hits the key) to pull the drive plate on just a little. Then remove the installer tool and use a hammer and a nail to drive the key back into the groove on the shaft until the end is flush or below the shoulder on the shaft. Then screw the installer back on, being able to thread it all the way down this time, and continue pulling the drive plate into place. The instructions in the Service Manual say you're supposed to install the tool, push the drive plate on a little, take the tool off, check the key to make sure it's in place, then reinstall the tool and push the drive plate the rest of the way on; perhaps they were inferring that you should be driving that key into its proper position.

The thrust bearing that comes on the Cool-Aid installer tool is a real cheap POS and may not survive the first drive plate installation. Here's my suggestion: the first time you put the tool on, omit the bearing and use a 5/8" flat washer instead. After you remove the tool to drive home the key, put the tool back on with the bearing *and* the flat washer -- perhaps even *two* flat washers if you've got room, one on each side of the bearing. This will prevent the housing of the cheap thrust bearing getting crunched and allowing the drive plate to get cocked during installation. Hold the washers centered until the tool snugs up to hold them in place; if allowed to lay against the threads, they will scrape the threads as the tool is used.

Of course, you could simply provide a *good* thrust bearing.

As mentioned above, applying axial force to the shaft is verboten. Standing the entire compressor in your press to push the drive plate on is not recommended.

The instructions in the Service Manual indicate you're supposed to use the installation tool to push the drive plate on just until the gap between the friction faces is 3/32" or so, then remove the installation tool. The drive plate is pushed the rest of the way into position with the nut. Forget that; use the installation tool to position the drive plate exactly where you want it to end up. Don't rely on the nut moving the drive plate on the shaft at all. Even if it would (which it won't -- see below), turning the nut against the front surface of the hub galls it up and may prevent it going on as far as it needs to. There's a reason the installation tool includes a ball bearing.

According to the Service Manual, the desired gap between the friction surfaces is 0.56-1.45mm (.022"-.057") -- but really, the objective is as small a gap as you can muster without the surfaces contacting when the clutch is disengaged. If you close down the gap too much and the pulley starts dragging, use the puller tool to back it off a bit. In fact, that's really not a bad installation procedure: Install it too far until the pulley drags, and then install the puller and pull just until it spins freely.

The Service Manual says to install the nut narrow boss end first and tighten it down to 15 ft-lb. If you do this, the nut won't get within 1/8" of an inch of *touching* the drive plate. The diameter of the narrow boss end of the nut is small enough for the center hub of the drive plate to pass right over it, and only the tiniest portions of the points on the nut hex could actually contact it. Since the narrow end of the nut will contact the shoulder on the shaft and won't go any farther, the nut will be stopped long before the points get near the drive plate. The only plausible objectives would be to "catch" the drive plate if it decides to slide off -- which it won't -- or to prevent the key from sliding out.

If you'd like the nut to actually help hold the drive plate in place, look carefully at the shoulder of the shaft after the drive plate has been positioned properly with the installation tool. If the shoulder on the shaft is within the hub itself, put a flat washer on the shaft. This washer needs to have a 3/8" ID and a 3/4" OD. Then screw the nut on flat side first. Tighten it down until it gets snug, indicating it has pushed the washer against the hub, and quit. Don't even think about tightening it enough that it might move the drive plate and close up the gap.

If the shoulder of the shaft is protruding from the center of the hub, you'd need to provide a sleeve that sits inside the opening on the front of the drive plate and has an ID of at least 1/2" to fit around the shaft. You might cut a ring from a piece of 5/8" copper pipe. You'll probably need to cut a notch in this sleeve to fit around the key unless you shortened the key before you started -- which isn't a bad idea; the key being a little shorter won't hurt anything. Install this sleeve, then the flat washer described above, then the nut flat side first and tighten gently as described above.

You could reasonably opt to forget all that and just thread the nut on as the Service Manual says -- or even just leave it off. The retention that matters here is the press fit. The pulley on the water pump is held only by a press fit, the impeller in the water pump is held only by a press fit, the hub holding the fan clutch is held only by a press fit, clearly if a press fit isn't reliable we're in big trouble.

FRONT SEAL REPLACEMENT: The Service Manual provides instructions for replacing the front seal on the A-6 without disassembling the compressor. The first step is to remove the drive plate of the clutch as described above. The rest of the procedure involves several special tools. It's doubtful that this would ever be a worthwhile undertaking, since fiddling with that seal requires discharging the freon circuit -- at which point you might as well just slap in a rebuilt compressor.

COMPRESSOR PROTECTION CIRCUIT: Just below the inlet and outlet connections on the A-6 compressor is a sensor held in place with a C-clip, with a wire connected to it. On the 1983 XJ-S, this is a thermally-operated switch that shorts to ground in the event that there is trouble with the freon system. The shorting causes a resistor within a three-connector fuse assembly to heat up, which in turn causes a fuse to melt, breaking power to the clutch and disengaging the compressor. This is a common arrangement on GM vehicles, and the fuse assembly is readily available; Victor part number V-909, "GM Thermal Limiter", is one common replacement. The fuse is usually attached to a mounting hole on the compressor itself.

Do *not* connect the fuse backwards. There is a little tang on the center connector that is intended to indicate which way the plug goes, but it's not very foolproof. If you install it backwards, the clutch will not engage and the fuse will blow immediately.

A replacement compressor is likely to have an aluminum blank-off plug in place of the fault sensor. It is probable that you cannot install the thermal type sensor in place of the plug because there has to be a suitable opening underneath the plug for the tip of the sensor, and there often isn't. However, the sensor wire can just be left disconnected and the system will work fine -- there just won't be any protection for the compressor if the system loses freon. In fact, it is just as well to remove the fuse assembly as well and run the power wire directly to the compressor clutch. Since the standard procedure is to replace the compressor in the event of freon loss anyway, this may be acceptable.

There is a second type of protection switch available: a pressure-operated switch that supplies a ground to the compressor clutch when the freon circuit pressure is normal. This second type is the best to use; the early system with the thermal fuse is temperamental at best. The pressure switch has a plastic body, as opposed to the thermal type which has a metal body with a heat probe protruding into the compressor. Since the pressure sensor has no protruding probe, it can be installed in a replacement compressor in place of the aluminum blank-off plug. According to Stefan Schulz, Jaguars began being fitted with this type from the factory in the mid-80's.

Note that the thermal type switch is normally open and connects to ground in the event of trouble, while the pressure type is normally connected to ground and opens in the event of trouble. To use the pressure type protection switch, modify the harness so the power goes straight to the clutch and the ground terminal of the clutch is wired to the pressure switch; a three-connector fuse is not needed.

If you live outside the US, the A-6 compressor is anything but cheap. Someone could make a million buying compressors in the US and selling them overseas. In any event, after paying top Euro or Rasbutnik or whatever for a new compressor, you're not likely to want to forgo the protection circuit -- but it may be difficult to find either type sensor or the three-connector fuse. Mark Barker of the UK found a solution: "An alternative to factory (one-time acting) thermal fuse is to fit a resettable thermal cutout. It's a small round thing with spade tags and a small red reset button. You glue it (epoxy is fine) to the side of the compressor and it is wired in series with the clutch. Test the wiring by running with one of the spade tags unplugged.

"In the UK it is available from RS Components (http://rswww.com) as stock no. 228-2513 (for a 70°C one) at 3 UKP." Sean Straw adds, "For worldwide (except USA) affiliates, check out

http://www.rs-components.com

"They list numbers for offices in different countries." Robert Egerton adds, "If you are in the UK the retail outlet of RS is called Electromail and you can get them on 01536 294555."

Of course, 70°C is too low. "I found this can trip during a 'pull down' on a hot day." Mike Morrin says, "The compressor (at least on my car) routinely gets to 85°C. Everything in the valley is over 75°C on a hot day." Barker responds, "The sensor is also available as a 90° and higher too, on the same page. Similar part nos. What we need to sort out now is which of the available trip temperature ones is best to use."

Barker adds one last note: "Note that after I did all this, the air-con chap who gassed my system told me there was a retrofit which had high (overload) and low (lost charge) pressure sensors which would be even better; sorry I don't know any more about it."

If your compressor is simply getting too hot, see the section on high freon pressures on page 516.

AIR CONDITIONER COMPRESSOR CONNECTOR & DIODE: It would be helpful to have a diode wired into the compressor clutch connector; see the discussion on inductive loads on page 559. Of course, the Jag doesn't come with one. However, if you go into an auto parts store and ask for the special connector that plugs onto a GM compressor, the connector comes with a diode built in. One such part is made by Conduct-Tite, part number 85143, found in an AutoZone; another is made by Factory Air, part number 37201, found in a Discount Auto Parts. Dennis Kindig, who owns an '87 XJ6, says, "I used this connector to replace my original wiring when I changed compressors and converted from the thermal fuse arrangement to the high-side low pressure switch."

Of course, you can accomplish the same objective by simply buying a suitable diode at Radio Shack and adding it in to your existing wiring.

AIR CONDITIONER COMPRESSOR FRONT BRACKET - A-6: The front end of the A/C compressor is supported by a plate bolted to the front of the timing cover. This plate is *not* symmetrical; it goes in only one way. If you put it in backwards, your compressor pulley won't line up right with the belt. The objective of the asymmetry is to position the compressor a little to the left of center so that the drain plug on the A-6 doesn't jam into the A bank head. The bracket at the rear of the compressor is asymmetrical also, but you couldn't install it backwards if you tried.

AIR CONDITIONER COMPRESSOR - MOVING OUTTA YOUR WAY: As in most cars, the compressor is connected with flexible hoses. This enables some movement of the compressor for such jobs as replacing the spark plugs without disturbing the freon system. Several people, including Victor Naumann and Harry Trafford, have pointed out that a block of wood positioned between the V and the top of the radiator can be very helpful to hold the compressor forward and above its normal position while you're working.

AIR CONDITIONER COMPRESSOR - REMOVAL AND REFITTING - A-6: In order to correct for tolerance in dimensions such as the overall length of the compressor, the holes in the rear compressor support where it is bolted to the valley cover are very slightly slotted, so the rear support can be slid back and forth a bit and then the bolts tightened down. So, whenever the compressor is replaced with a different one or the valley cover has been removed, the proper way to reassemble would be to leave these two bolts loose until the compressor is in place and the bolts at the back end and all four bolts in the front support plate are tight, then tighten the two bolts holding the bracket to the valley cover last.

When you are not fiddling with the valley cover bolts or replacing the compressor with a different one, lifting and reinstalling the compressor without loosening those bolts seems to work well enough if you do things in the right order. Always loosen the two bolts that attach the front mounting plate to the timing cover before lifting the compressor out. During assembly, always have all four bolts at the front (two holding the plate to the timing cover, two holding the compressor to the plate) in place but loose while tightening the bolts in the rear support. Be sure to reconnect the ground wire.

COMPRESSOR HOSE CONNECTIONS: The freon lines connecting to the GM A-6 each have a hexagonal block on the end that fits against the rear plate of the compressor. There is an O-ring in a recess on the back of the compressor that this block fits against, and a single bolt between the two ports pulls a 1/4" thick racetrack-shaped bar against the back side of the hexagonal blocks to hold them firmly against the O-rings and ensure a seal. This same bolt also holds the bracket that mounts the cruise control actuator.

That 1/4" thick bar, C36983, sure looks like a sturdy and massive part -- but it's not. When this system is worked on, more often than not that part is found to be bent in the middle when removed -- and of course the mechanic turns it over so it gets bent back the other way when reinstalled. People leaning over the engine compartment to work on the water pump, etc., and pushing on the hoses apply a terrific amount of leverage towards tilting those hexagonal blocks and breaking the O-ring seal underneath.

Why would GM design something so prone to leakage? Well, perhaps it was a mistake -- but it was a mistake they corrected. Later GM cars don't used these two separate blocks with a 1/4" plate holding them in place. Instead, they make both connectors into one large connector about an inch thick that the bolt holds in place directly. That way, there's no way it'll get distorted -- even if made entirely of aluminum, as most later ones are.

This author relocated the cruise control actuator elsewhere and made a thicker bar to replace the 1/4" thick bar. There's no need for the racetrack shape; simply take a piece of 1-1/2" x 1/2" steel bar, cut a 3" piece off, and drill a 3/8" hole in the middle. With the large flat washer and the cruise control bracket omitted, the original bolt was the correct length to hold this thicker bar. And there's not a chance in hell it'll bend; you can feel the difference just tightening it up.

If you are not relocating the cruise control, it still might be a good idea to fab a thicker bar for this retention. The entire cruise control actuator will be relocated rearward by the amount of additional thickness in this bar, so if you go with 1/2" as I did the actuator will be positioned 1/4" farther rearward than before. Check carefully to make sure it all fits without running into the distributor cap, as taking that bar back out entails discharging the freon circuit. You probably should also provide a bolt that's longer by 1/4" so you're not relying on too few threads in the back of the compressor. An even better idea would be to replace that bolt with a stud; seat the stud fully, then hold the plate in place with a nut.

An alternative idea might be to purchase a second 1/4" thick bar C36983 -- or make one. Then install the two bars with the cruise control actuator bracket sandwiched in between, which will hold it in exactly the same place as before. Again, you'll need a longer bolt.

AIR CONDITIONER COMPRESSOR OIL CHARGE: Section 82.10.14 of the ROM explains how to deal with a compressor delivered with oil in it. However, a typical rebuilt compressor will nowadays be delivered without oil since there are three different types of oil (mineral, ester, or PAG) that you may end up using. Read the tag on the rebuilt compressor.

If it is dry, follow the directions in steps 12-15 of Section 82.10.20 -- but note there's an error there. In step 15, it twice refers to the amount of oil removed in step 14. It should refer to the amount of oil removed in step 13 both times; that's why you were measuring in step 13.

These directions -- as well as the directions that come with the new compressor -- involve draining the oil out of the old compressor to measure how much was in it. Nowhere does it provide any clue *how* to drain the oil out of the old compressor -- or from which opening. James Teston says it's really all openings: "Pull the compressor off, keep it horizontal, and drain the oil you have in it out from the drain plug on the bottom of the sump. Then flip it vertical and drain it from the pressure and suction ports. Then put it any which way and rotate the clutch quickly to blow out whatever oil might be left."

They also tell you to add a similar amount of oil back into the new compressor, again with no clue on how to accomplish this. If you don't do it right, you may end up with oil all over the place -- and no idea how much is in and how much is all over, which would be bad. This author recommends the following: Add no more than three or four ounces to the compressor while it's on the bench. This may be added through the drain plug or it may be added into the suction port while turning the hub of the compressor to suck it in -- but don't turn it more than about one full turn or it'll start pumping it back out the pressure port. Put the caps back on the ports, or go ahead and connect the hoses and cap the ends of them. If time permits, leave the compressor sitting nose-down for a while so the oil can collect around the front seal. Install the compressor. If you need to add more oil, disconnect the suction hose from the fuel cooler, hold this end upward and pour the oil into that end of the hose. Turn the compressor by hand to get this oil into the compressor.

Teston points out that, since the oil circulates around the system, as long as you have some in the compressor when you start it up you can add oil pretty much anywhere. "The A6 has a sump, so the correct amount of oil will eventually find its way into it if you can't fill it all at once. Just add some to each section as you put them back together. Don't dump any directly in front of the expansion valve or put a large slug in the bottom of the condenser."

Finally, just before startup be sure to turn the compressor over by hand a dozen or more full turns to make sure it's not liquid-slugged with oil.

FITTINGS: When buttoning up parts of the freon circuit, please remember that the sealing of these connections does *not* depend on getting the nut tight enough. As parts are assembled, an O-ring is compressed between the OD of the tube and the ID of the fitting, and it's this compression that provides the seal, not the tightness of the nut. The nut merely keeps the assembly from rattling or blowing apart. Just tighten it down snugly and quit; there's no need to be grunting on it and many good reasons *not* to be grunting on it.

PLUMBING -- EARLY CARS: Bernard Embden says, "The fuel cooler on the air cleaner is standard equipment on the post-H.E.'s I believe. Coventry West said that original A/C parts for the pre-H.E.'s were no longer available. Not wanting to have hoses made up, I just scrapped my A/C system altogether and went with the hoses/fuel cooler etc. from the 1988 model."

In this day and age, it perhaps wouldn't make sense to update to the hoses from the 1988 model which was also originally fitted with R-12. A better idea would be to have the original hoses rebuilt with barrier hoses as described on page 522.

FILTER/DRYER: The flow through the dryer is from left to right in the XJ-S. Be sure to install the replacement dryer in the correct direction; they always have flow direction arrows on them. Do not simply install the new dryer so the sight glass is in the same place as it was on the old one; the sight glass may be on either the inlet or outlet end of the dryer.

EXPANSION VALVE: The expansion valve on this system (at least on the '83) is fairly standard; if you look through an A/C shop's parts book you will find there are several interchangeable part numbers, including some from Japanese cars. But further, there are several other part numbers that represent similar expansion valves except that the capillary tube and/or sensor tube are different lengths. The expansion valve called out for the XJ-S has very short tubes, since the places they go are only a couple inches away. But it still may be beneficial to get an expansion valve with longer tubes just to make it easier to install.

Also, some of the expansion valves have the capillary tube attached on different sides or at different angles. Selecting the optimum arrangement here can also ease installation considerably.

The expansion valve may be a common configuration, but it's certainly no fun to get at. I will provide a few tips that hopefully will be of some help. Obviously, don't even consider this job without removing the balance pipe between intake manifolds first. If you still have a heater valve in its original location, you might choose to remove it -- and don't put it back, install the generic version elsewhere instead as described on page 495. Remove the hose that goes to the fuel cooler, both to get it out of the way and to install a new O-ring in it while you're here; advice on removing it is under "Hose Removal" below.

The body of the expansion valve is L-shaped and has male threads on both ends. Hence, the line going into the evaporator behind the firewall has a trapped nut on it. The hex on this trapped nut is 7/8". To get this nut loose, you'll be having fun just finding a wrench to get on it. Chuck Sparks suggests an offset box end with a bit of the box cut out to make it look like a flare nut wrench; slip it over the body of the expansion valve itself, then slide it rearward onto the nut. It's possible to do it with other tools, but this is perhaps the slickest way.

You'll also need a wrench that fits the body of the expansion valve itself. There's a hex on it, but for some reason it doesn't seem to be any standard size. You probably can't get a monkey wrench on it, so the wrench to use is either a 5/8" or 16mm open end. It's a bit loose, but it'll work.

To break the nut loose, Sparks suggests you disconnect all the other lines to the expansion valve first. Then put your modified offset box end wrench onto the nut and turn it to the right (facing the firewall) just enough to take up the slack. Then, using the 5/8" or 16mm wrench, turn the expansion valve itself to the left. This way, Sparks argues, you'll have less chance of damaging the line on the evaporator -- which would be seriously bad.

The nut on the tube coming down on top of the expansion valve requires a 3/4" or 19mm wrench. A crowfoot works great here. If it's really tight, be sure to hold the body of the expansion valve; don't just break the tube off the evaporator. Some expansion valves have a hex below the threads, others have only two flats parallel to the sides of the valve body; either way, it'll be a 1/2" that fits. If you can't get a wrench on it, perhaps you'd be well advised to grip the body with a pair of vicegrips or some such, destroying it if necessary -- you're taking it out, and you won't be reusing it. Far better to ruin a scrap expansion valve than your evaporator. And you won't have a problem putting the new expansion valve in, because there's no need to get that nut that tight.

The nut attaching one sense tube to the return line requires a 9/16" wrench -- but you knew that already from checking the one on the replacement expansion valve.

The other sense tube has a little coil on the end that must be installed against the pipe coming out of the evaporator, and it must have some insulation put over it so that it senses the temperature of that pipe and not the surrounding air. On most cars, this coil is merely strapped to the pipe with a tar-like stuff. However, on the XJ-S there is actually a little boss built onto the evaporator outlet fitting just for this coil. Once you get the old tar stuff off, you must loosen two Pozidriv screws to get the old coil to slide out. Fortunately, this clevis is positioned horizontally so the screw heads face straight up, making it a fairly reasonable job to get a screwdriver on it.

New tar stuff would be good, but other methods of insulation would also work. You can wrap it with foam strip insulation, or you can even spray Great Stuff around it and let it set up in a clump. You can carefully cut a piece of 1/2 pipe insulation (looks like a foam tube slit down one side) to fit, wrap it around and tape or strap it in place. Just make sure that that little coil is as cold as the pipe (which is cold!), not as hot as the engine.

REFRIGERANT LEAKS: Michael Minglin says, "A possible solution is a refrigerant additive available from Cryo-Chem Int'l at 1-800-237-4001. It is called Cryo-Silane and reportedly seals small refrigerant leaks, without clogging the system. It is guaranteed to seal and hold for one year any a/c system that takes longer than six hours to leak down. As I said I have not yet tried it, and it isn't cheap, but this may be the answer to small hard to find leaks.

"On the matter of hard to find leaks, with the a/c service gauges hooked up it is impossible to find leaks in the service ports or valves. If your mechanic cannot clearly show you the leak, have him disconnect his service gauges and check the the service port valves before starting to change out expensive hoses and parts."

HOSES -- BARRIER VS. NON-BARRIER: How do you tell what type hoses you have? With this author's '83, the two low-pressure hoses were non-barrier and the high pressure vapor hose was barrier -- probably indicating earlier service work. The two large non-barrier hoses had a cloth surface -- black, but reportedly red became standard later on. Barrier hoses, on the other hand, seem to always have a smooth black rubber surface. It may say "Barrier" right on it, too.

Barrier hoses are nearly always attached to the metal tubes with a crimped collar. The high pressure vapor hose on the author's '83, however, was attached with worm screw clamps -- worm screw clamps with a tang hanging off the side that positions the clamp properly over the barb within. These worked fine on my car, and reportedly work fine in general.

My non-barrier vapor hoses did not have crimped connections, although other non-barrier hoses may have. If a hose connection is crimped, the crimped collar is usually steel. My hoses had steel tubes with aluminum collars, and the collars had a big hex on the outside. These collars were jammed up against a smaller hex on the tube itself. This whole thing is a threaded hose connection.

The large aluminum collar has a very coarse left-hand thread on the inside that threads onto the outer surface of the hose. In the small end of the aluminum collar there is a very fine right-hand thread that the steel tube screws into. The end of the steel tube, the part you can't see, has a long smooth taper followed by fine threads right up to the underside of that small hex. The collar is threaded onto the outside of the hose while the pipe is threaded into the center, jamming that taper into the ID of the hose and compressing it within the sleeve. Very secure; in fact, you'll probably have trouble getting it apart. You need to hold the hose itself and the pipe still (clamp the hose in a vice and use a wrench on the small hex on the pipe) and turn the aluminum collar in the direction that should unscrew it off the end of the pipe. This is the same direction that will unscrew it off the hose, so turning the collar in this direction will pull the tapered end of the pipe out of the hose.

That all may have seemed like useful info, but it's probably not. The R-12 hose these fittings were designed to work with is no longer manufactured (although there are generic hoses that will work just as well, if you feel the need to rebuild an R-12 hose). The barrier hose will *not* work with these threaded hose connections.

The fourth hose on my '83, the small section of hose on the liquid line, was completely different from the other three in all respects. It was a funny type of hose with an inner layer of what appeared to be plastic tubing, a layer of strong cloth, and an outer surface of hard plastic. It was crimped onto fittings, but it was an unusual type of crimp, probably proprietary. The barb is brazed onto the tubes, and the crimp ring was formed anchored to a groove in the barb so it's not removable. The part number for the entire hose assembly is CAC.5596. It is unknown whether this was a barrier hose or not, but it didn't really matter; by the time I looked at it, it was clearly in need of replacement.

HOSE REBUILDING: If you need to replace barrier hoses because yours are old and rotten, read on. If you need to replace non-barrier hoses, you should go ahead and convert to barrier hoses -- and that means you should flip to page 522.

There are four hoses on the freon circuit in the XJ-S. Besides the three obvious large ones up top, there is a small one on the liquid line below the upper right radiator hose. If you're planning to replace hoses, you might as well plan to replace all of them.

Most A/C shops claim to be able to rebuild hoses. Some hoses are more difficult to rebuild than others, and the more difficult ones require a special crimp tool that, while reasonably priced as shop tools go (no power, hand operated), was introduced later. If the A/C shop is working with the older style crimp tools, it cannot rebuild some hoses. The usual result is that they will cut the fittings on your old hose and braze on sections of tubing that their tools can crimp a hose onto. This looks like crap when done, but it does work.

If the tubes on your hoses happen to be aluminum, *only* the newer tool will work, since brazing is out and the older tool will crush the tube. If the A/C shop doesn't have the newer crimp tools, they will claim that the hose cannot be repaired and order you a new one from Jaguar and collect their markup on the part.

How does any of this apply to the Jaguar? It probably depends on the vintage. This author's '83 had non-barrier hose assemblies with steel lines with threaded hose connections (as described on page 522), so rebuilding with barrier hoses required cutting and brazing. I suspect later XJ-S's came with aluminum tubes with barrier hoses with crimped connections, so brazing should be neither possible nor required to rebuild.

Peter Cohen provides these words on rebuilding hoses: "Take the whole car to the shop, not just the hoses. A/C hoses have almost no ability to twist, and since all but one hose on the V12 have angled connections the odds are that the hose shop will not get the angle right unless they assemble it on the car, put paint marks on the pieces to show the exact positions, and then take it back into the shop to crimp it. The shop I used was reluctant to even make the hoses because of all the come backs from wrong angles."

Actually, you can avoid that problem. The angles at which hoses are crimped to fittings is only a concern when there are angled fittings crimped to both ends; the relationship between the two ends must be correct or you'll have to twist the hose to get things to line up. If there's an angled fitting at one end only, there's no problem; you can simply rotate the entire hose to fit. Of the three larger hoses on the XJ-S, the high pressure hose from the compressor to the condenser and the low pressure hose from the fuel cooler to the compressor each have a straight fitting on one end, so there is no problem. The only large hose with angled fittings at both ends is the hose from the firewall to the fuel cooler, which has 45° fittings at both ends. Solution: rebuild that hose with a 45° fitting at the firewall end and a straight fitting at the fuel cooler end. It will fit *better* this way.

Assemble these parts to attain an overall length of 23", measured in a straight line from end of tube to end of tube (a corner on the end with the 45°). This is about 1-1/4" shorter than the OEM hose that came on this author's '83. The length is somewhat critical, more critical than the lengths of the other two hoses. Ideally, find a way to either measure or trial fit to find the correct length on your car, since your engine may be positioned within the engine compartment differently than mine. Resist the compulsion to make the hose a bit longer "just in case", because too long is a real problem here.

You could forget about crimping and rebuild your own hoses using clamps -- if you have crimped connections to begin with. Tony Bryant says, "I went to my local air con place, picked up 2 metres of R134a rated barrier hose in the correct diameter for <$10, went to my local hydraulic hose place (who wouldn't/couldn't crimp the aluminium fittings), and picked up some top quality stainless hose clamps. These are high pressure items, not worm gear clamps, and use a bolt and cylinder arrangement to forcefully clamp. They also have a continuous band. Each <$5. I replaced the high side hose using these items, after *carefully* cutting the old hose off the aluminium fittings. Holds pressure perfectly."

Bryant lives in New Zealand where apparently you can get good clamps. Unfortunately, here in the US finding clamps such as those he describes can be difficult. Try at a marine store; they offer something called a "t-bolt clamp" which is obviously an excellent item, but unfortunately you probably won't find one small enough for this job. Of course, EFI clamps available at auto parts stores would work except that you probably won't find one big enough for this job. In general a worm screw clamp won't work because the slots in the band dig into the rubber surface of the hose and prevent you from tightening it far enough -- but there are better worm screw clamps that don't have the slots all the way through the band but rather just impressed in the outer surface so the inside surface is smooth. Worm screw clamps also tend to have trouble applying consistent compression under the screw itself, but better ones are available with a shield around the inside to address these problems.

Even if you have a shop rebuild your three larger hoses, you will want to replace the small hose in the liquid line yourself. It's just too difficult to remove that assembly from the car. Once you get the old hose and crimp rings off, you can install a new hose onto the barbs with clamps -- but getting the old hose and crimp rings off is easier said than done. Cut the hose in the middle, disconnect one end of the line from the dryer and remove that piece from the car and carefully work on the hose attachment on the bench. Grind through one side of the crimp ring, being careful not to cut so deep as to nick the barb underneath. You'll probably find things easier if you go ahead and grind through the crimp ring again around on the other side. This crimp ring is retained in a groove at the end farthest from the hose, which means you will need to use a cutting wheel down within that groove to fully cut through the crimp ring -- but alternatively you can just cut the crimp ring all the way around 1/8" from that end and leave that tiny portion in place, it won't hurt anything. When you've figured out how to get the crimp ring and the hose off leaving a clean, usable barb, then repeat the process on the end you can't get out of the car.

Doing this job yourself, in place, also eliminates any worries about getting the length or alignment correct.

If you must get the liquid line out of the car, cut the tube at the RR corner of the engine compartment near the drain from the wiper motor compartment. Then remove both halves of the line from the car, much easier as separate pieces. While you're having the shop crimp a new hose on, have them braze fittings onto the ends you cut so you can screw them back together with an O-ring. Make sure to cut within a suitable straight section of the line, since they can't braze fittings into a curved section.

The high pressure vapor hose assembly is 1/2", so the hose that fits it is 13/32". The low pressure hose assemblies are 5/8", so the hose that fits them is 1/2". The liquid line is 3/8", so the hose that fits it is 5/16". Don't ask me to explain that.

HOSE VS. THROTTLE: Peter J. Havas provides a warning: "If you're not careful, and I wasn't, you can push the low pressure tube down and it will foul the left side throttle arm from the spindle, and lock open in traffic! Neat, huh? Use a wire-tie to secure the hose to the diagonal brace for safety." Please take this warning seriously; Havas isn't the only XJ-S owner who has found his throttle jammed wide open due to the hose fouling the left side throttle linkage.

Tying the hose to the diagonal brace would seem to be the obvious solution, but when working with the hose that goes from the firewall to the fuel cooler remember that the firewall doesn't move and neither does the diagonal brace -- but the engine does move around on its rubber mounts. Strapping the hose to the diagonal brace would seem to be an excellent plan for making sure the engine motion doesn't stress the fitting at the firewall, but be sure to leave enough flex between there and the fuel cooler for engine motion. If the hose assembly is short enough, it may be preferable *not* to tie the hose to the diagonal brace.

The hose being too long, as this author's OEM hose was, probably aggravates the fouling problem. Too long makes it want to loop up high, but then the hood is closed on it -- forcing it both downward and contorted. If yours loops up like that, you might want to try just pushing down on the high part of the loop with your hand and see what happens -- and remember that the loop changes shape as the engine moves around on its mounts.

Perhaps a far better method of keeping the hose from fouling the throttle linkage would be to provide a shield over or alongside the throttle linkage at this point. A small bracket could be fabricated from sheet metal to form a small shelf of sorts that the hose can rest on and slide around on with engine movement and be absolutely prevented from getting into the linkage. Such a bracket could be designed to be installed under the heads of the two upper screws holding the elbow to the rear of the LH intake manifold -- see Figure 25. This can be fabbed from any sturdy sheet metal.

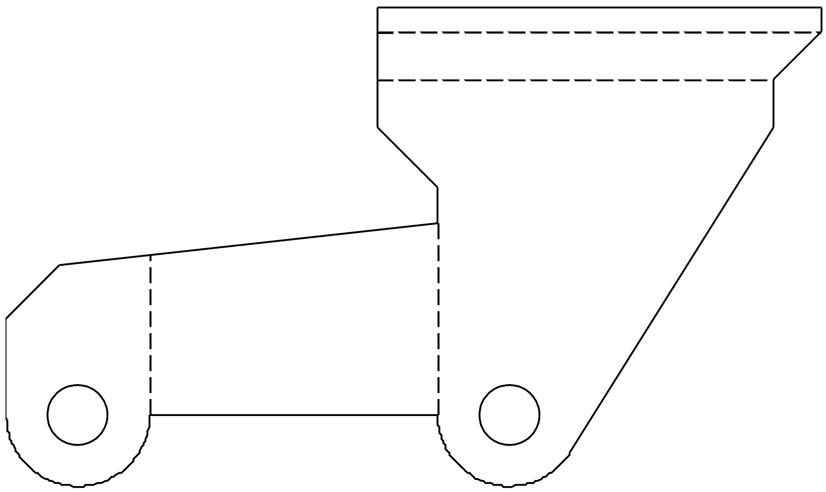


Figure 25 - Throttle Linkage Shield

The sheet metal should be folded about 20° along the vertical dashed lines to form a zig-zag so the shield will bolt down under the bolt heads which are not at the same level. It should be folded 90° towards the front of the car along the lower horizontal dashed line to form a flat area for the hose to sit on, and then fold the edge downward along the upper horizontal dashed line to form a little lip so there are no edges of metal to cut into the hose. If you'd prefer, you can omit these last folds and just cut the panel off at the lower dashed line and slit a piece of plastic tubing and slip it onto the edge to form a surface for the hose to ride on. This would require a bit stiffer sheet metal, since the folds add stiffness.

Or, perhaps a better idea, a shield could be designed to be installed sandwiched between the elbow and the manifold with an additional EAC2650 gasket. The gasket itself could be used as a template to fab the lower portion of this shield.

When done fabbing and installing a shield, be sure to dial the throttle back and forth to check for unobstructed motion when done.

If Jaguar had decided to address this concern, it would have been a simple matter to design the plate holding the linkage at that corner to include this foul-prevention feature.

HOSE REMOVAL: On this author's '83, the hoses on the low pressure portion of the circuit (either end of the fuel cooler) has nuts on each end with a 27mm (1-1/16") hex on them. Presuming you don't have open-end wrenches in that size, you're going to be using the monkey version.

Problem: the connection at the firewall is gonna be a bear to get a monkey wrench on. It calls for a crowfoot wrench -- but you're not going to find one of those in 27mm or 1-1/16" easily.

The solution is as close as the local hardware store. It's called a basin wrench. Now, here's what you're gonna do: you're gonna peer down into the area under the balance pipe where this connection is, then you're gonna go down to the hardware store and look in the plumbing department at a basin wrench, and you're gonna say, "Man, I gotta get me wunna those!" And not just for this job, either; a basin wrench is quite obviously one of those tools you'll wonder how you ever got by without. It's sort of a crowfoot version of a pipe wrench; it has a pair of jaws that will grip when you turn it in one direction, no matter what. It's quite handy at removing sensors, too.

There are three types. One has a shaft perhaps a foot long with a T handle at the top; the jaws at the bottom can flip around the end to reverse direction. This costs about $15. Another type is the same thing, but the shaft is extendable; this costs about $20. The third kind is just the jaws themselves with a 3/8" square hole so you can use it with your ratchet and extensions; you reverse it by pulling it off the extension, turning it over, and inserting the extension the other way. Not only is this the cheapest version (about $10), but it also takes up the least space in your tool box.

An example of that last type is made by Superior Tool Company of Cleveland, Ohio (1-800-533-3244, http://www.superiortool.com), Model No. 03820, "Ratchet Jaw Basin Wrench Attachment" and is sold at Lowe's. It claims to fit 1/2" to 1-1/4" hex and square nuts.

While you're shopping, also note that basin wrenches come in at least three sizes. The one described is the smallest and perhaps the most useful for Jaguar work, but it probably wouldn't hurt to have the larger ones around.

A basin wrench works perfectly on that hose connection. Note, however, that you still need a 13/16" crowfoot on a separate ratchet and extension to hold the fitting still while breaking this big nut loose; if you don't, you may break the fitting off the evaporator, and if that happens -- trust me on this --you *will* end up deciding that air conditioning is just a frivolous luxury you don't really need. Fortunately, a 13/16" crowfoot is not hard to find.

SERVICE PORTS: The service ports on the 70's and 80's XJ-S are a standard 1/4" flare fitting. Well, actually, no, they're not. They are a standard 1/4" flare fitting except there's a Schrader valve screwed down into the center. Hence you cannot slap together some hoses with standard flare fittings on the ends to service this system. You need the kind of fittings that have a pin in the middle to depress that center pin to open the Schrader valve.

SCHRADER VALVES: ...aren't particularly durable. Each Schrader valve has two items in it that are made of rubber: the seat of the poppet valve itself, and the seal around the body that contacts the fitting when the valve is installed. Both pieces of rubber are subject to the same sort of age and deterioration as an O-ring. Whenever the system is discharged for whatever reason, it is recommended that the Schrader valves in both service ports be replaced as a matter of course.

If you've waited too long the old Schrader valve may come out without the seal that was around its body, leaving this tiny ring of rubber stuck down in the hole. Just screwing the new Schrader valve down on top of it is not a good idea. Before installing the new valve, take a good hard look at the old one and make sure it's all there.

The guy who works on my A/C for me has a tool for replacing the Schrader valve in an R-12 service port without discharging the system! It screws onto the port, then allows you to unscrew the valve from the fitting within a glass housing so nothing leaks out. Put a new valve in, problem solved. Only a little squirt of freon is lost when you remove the tool, the amount that filled the volume of the tool itself.

EVACUATION: Before charging a freon circuit that has been broken into, it must be evacuated. You can buy a vacuum pump that operates on compressed air from Harbor Freight Tools (http://harborfreight.com) for $10 plus S&H, but if you don't have an air compressor (and this thing requires a pretty large one, 4.5 cfm at 90 psi or so), a suitable electric vacuum pump will probably cost you more than it's worth; you'll opt to just take the car to a shop for this work.

Some suggest ripping the compressor out of a refrigerator and using it as a vacuum pump. This might work, but then again, it might not; that's a compressor, not a vacuum pump, there's no telling how much vacuum it can pull. Squirting a little oil into the suction line on the refrigerator compressor before connecting it up reportedly helps it pull vacuum better.

Before you start you might want to connect your vacuum pump directly to your vacuum gauge and see what its capability really is as indicated on that gauge. This can save confusion when trying to pull a vacuum on the system; if it doesn't seem to want to pull as far as you expected, you'll know whether it's the vacuum pump or something else causing the holdup.

There are two distinct purposes of evacuation: to remove gaseous contaminants (air), and to remove moisture.

To remove moisture, it is only necessary to obtain an adequate level of vacuum and to hold it for an adequate length of time. This is because the vacuum is causing moisture within the system -- including within the dryer -- to boil off and get pulled out as vapor. Since some of the water vaporizing removes heat from the water remaining and causes it to get very cold, it doesn't want to vaporize. The vacuum must be held long enough for the remaining moisture to warm back up to surrounding temperature and boil away. Using a hair dryer on components of the system will help, especially if you're trying to do this job on a cold day.

The fastest way to remove the moisture, of course, is to fire up the vacuum pump and let it run continuously for at least an hour, preferably several hours. You can accomplish the same thing by letting the pump run for a few minutes to pull a good vacuum, then valving the system shut and turning off the pump, and coming back every hour or so and running the pump a few more minutes. In fact, if you leave the gauge in place, that's one way to tell when you're done: when you come back after an hour and the vacuum is still as low as you left it. Moisture vaporizing will diminish the vacuum, so if the vacuum holds there's no moisture remaining in the system.

Another way of knowing there's no moisture remaining in the system is to pull a vacuum that would be unattainable with moisture in the system. When pulling the moisture out of a system, you will gradually pull the vacuum down until you reach the point where the moisture starts boiling off. The vacuum will then remain at that level despite additional pumping until all the moisture is gone. Once dry inside, then the vacuum will start to move again. Taking advantage of this fact of physics, the directions typically given are to pull a vacuum of such-and-such, with the specified vacuum being lower than the boiling point of water at any reasonable ambient temperature. The only way you'll ever attain that level of vacuum is after boiling off all the water in the system and then continuing to suck. This is a simple and excellent way to assure the system is fully dry. Remember, though, that for moisture removal, you only have to get the vacuum to the point where the moisture has all boiled off; additional vacuum does nothing for moisture removal.

Just exactly how much vacuum is needed to remove the moisture? It depends on temperature of the system, and since vacuum is normally expressed relative to outdoor conditions, it will also depend on the barometric pressure where you are. As an example, if the surroundings are at 70°F, you will need to attain an absolute pressure lower than 0.74 in. Hg within the system to boil the moisture off. If the barometric pressure outside happens to be 29.92 in. Hg (standard atmospheric pressure), you'll need to attain a vacuum of at least 29.92 - 0.74 = 29.18 in. Hg. Heating things up helps, though; if you do this when the surroundings are at 80°F instead, you only need to attain an absolute pressure below 1.03 in. Hg, so at the same barometric pressure you only need a vacuum of 29.92 - 1.03 = 28.89 in. Hg. If you operate your 12-cylinder heater for a while and get everything in the engine compartment up to, say, 140°F, water will boil off at an absolute pressure of 5.89 in. Hg, so you only need a vacuum of 29.92 - 5.89 = 24.04 in. Hg -- although you probably won't get the evaporator behind the dash that warm, so you probably won't get all the moisture out of the system unless you pull to 29 anyway. Getting everything you can as warm as you can while evacuating is always a good idea, though.

To remove gaseous contaminants requires pulling as much vacuum as you possibly can. There is no time function; pull it, valve it off and you're done. If you have a vacuum pump capable of pulling to micron levels, the procedure is then to turn it on and let it run until it reaches such a level. The vacuum level will pause along the way as the moisture boils out of the system, and then once dry it will resume dropping until it reaches the limit of your pump. Valve it off, shut off the pump, and begin charging.

If your vacuum pump can't pull all the way down to the micron level, there is another way to help purge impurities from the system. Pull the best vacuum that you can from one service port, making sure that it's low enough to have removed all the moisture. Then connect up a hose to the other service port and allow some non-contaminant gas to fill the system and dilute the remaining gaseous contaminants. Nitrogen is ideal; refrigerant also works and is convenient, although using R-12 this way would be irresponsible and expensive and the EPA would frown on you using *any* refrigerant this way. Once the system has some gas in it, fire up the vacuum pump and suck it out *again*. This way, whatever the vacuum pump fails to pull out is mostly innocuous gas anyway rather than contaminants. Of course, you could repeat this two or three times to really get things pure in there, but that's a matter of diminishing returns.

Many conscientious mechanics will do a nitrogen purge anyway regardless of how good their vacuum pump is. It can't hurt.

FREON CHARGING: It would normally not be within the scope of this book to describe how to charge a freon circuit, since it should be common knowledge; almost every automotive A/C system is charged basically the same way. However, here in the Big Bend region of Florida, it is somewhere between difficult and impossible to find an auto A/C shop that will actually charge a freon system fully.

Sometimes the shops install a specified weight of freon and declare it charged, apparently unaware that the sight glass is the *final* say on the matter; if the spec says one amount and the sight glass says that ain't enough, the sight glass is correct. Other times they charge until they reach a specified pressure on their gauges and declare it charged, apparently blissfully unaware that pressures are only an indication of temperature in a freon circuit, not of the amount of charge. If the pressures are too high, it's because something is too hot -- usually, in the case of the XJ-S, there isn't enough air flowing through the condenser in front of the radiator, so the condenser is getting hot and not cooling the freon enough. But this is no reason to undercharge the system; rather, it's a reason to investigate and correct the airflow problems at the condenser; see page 516.

There are mechanics that advocate undercharging the freon system because it helps keep the engine from overheating. An undercharged freon circuit will not operate nearly as effectively, so it won't reject as much heat from the condenser, so the air entering the radiator is not as hot to begin with. Makes perfect sense. And if your mechanic thinks this way, I recommend you leave his shop posthaste and never return.

After a shop does work on your A/C system, you should check the sight glass to confirm that it is fully charged. If not, you can go back and bitch about it -- but that's not likely to work since they know it all and you are a lowly customer who doesn't know anything. If all else fails, obtain a license to purchase freon and "top up" the system yourself. Michael Minglin found a page on the WWW "for those of you who would like to be able to purchase R-12, R-134a, or just about any other kind of coolant, to do your own A/C repairs:

http://www.epatest.com

"At this website you can download the EPA section 609 manual free, take the test online for under $10, and print out an instant temporary EPA certification certificate, if you pass the test. The actual certification card is mailed in about 30 days." This author now has his card; the online test works just fine -- but the price had gone up to $19.95. The author has also used his card to buy 12-oz. cans of R-12 at AutoZone, which also works just fine.

Note also that it is an open-book test -- which, when working online, means that while taking the test you can click a button to review the manual. Since computers are very helpful, note that you can cut-and-paste a string of words from the question and use it to "find in page" the exact same string of words in the manual in a matter of seconds. It is *really* easy to pass this test.

R-12 is not cheap, but is available locally. The hose, valve, and fitting you'll need to connect a freon can to the car and charge it costs perhaps five bucks. All that fancy equipment you saw at the shop -- the set of two gauges on the long hose, the vacuum pump, etc. -- is unnecessary for topping up.

So, allow me to describe the procedure for topping up a freon circuit: Connect a can of freon to the low pressure fitting on the car. On the XJ-S with the A-6 compressor, the low pressure fitting is the one on the line from the fuel cooler to the compressor. It is suggested that the valve on the filler hose be cracked open just enough to hiss a little while connecting to the car, as this will help blow air out of the fittings themselves while connecting and therefore keep it out of the circuit. With the system running at full cool (fans on high, doors open), hold the can upright and open the valve and allow the system to draw the freon gas into the system. This will cause the can to get cold as the liquid freon in the can boils off and is sucked into the car. The rate at which freon enters the system is a function of how warm that can is, so if you heat it a little it'll fill faster. Don't use a torch or anything, but holding it in your hands (if you can stand it) will work, as will holding it near warm parts of the engine. Keep filling until there are no bubbles visible in the sight glass, then close the valve, disconnect the hose, and cap the fitting. If you wish, it won't hurt anything to add a little freon *beyond* the point where the bubbles disappear -- say, less than half of a 12-oz. can -- but don't stop *before* the bubbles disappear.

Don't turn the can over. This allows liquid freon into the system instead of pulling gas in. It is a trick used by some A/C mechanics to fill faster, but it risks getting liquid into the compressor -- especially with the connection as close to the compressor as it is on the XJ-S. Just take your time and leave the can upright.

TEMPERATURE VS. PRESSURE: Within a sealed container containing refrigerant in both liquid and gaseous form, temperature and pressure are interrelated. If you heat the container some of the liquid refrigerant will vaporize, increasing the pressure. If you cool it some of the gaseous refrigerant will condense, decreasing the pressure. If you increase the pressure some of the gaseous refrigerant will condense, releasing its heat of vaporization, causing the temperature to rise. If you decrease the pressure, some of the liquid refrigerant will vaporize, absorbing heat and causing the temperature to drop. The net result of all this is that temperature is positively linked to pressure, and this relationship is called the "vapor pressure" of that refrigerant. There are charts available for all of the common refrigerants.

This situation exists in two places within a running freon circuit: in the condenser where vapor is condensing into liquid, and in the evaporator where liquid is boiling off to become vapor. Within either coil, the pressure and temperature are related according to the vapor pressure chart of the refrigerant used.

At any place in a circuit that contains pure liquid or pure vapor, it's possible for the temperatures and pressures to be off the vapor pressure chart. Specifically, pure gas can be warmer or lower pressure than the vapor pressure chart would indicate (superheated), and pure liquid can be cooler or higher pressure than the vapor pressure chart would indicate (supercooled). Being off in the opposite directions is not possible because it would cause boiling or condensing.

In general, noplace in a running A/C freon circuit gets too far from the vapor pressure chart. The pressure within the condenser determines the pressure all the way upstream to the compressor outlet, and presuming there are no blockages neither the pressure nor the temperature will change much along that route. After the refrigerant condenses into liquid in the condenser, it's possible to "supercool" it further so that the liquid in the dryer and liquid line to the expansion valve is a bit cooler than the vapor pressure chart would indicate, but there's not much point to doing that so systems typically aren't designed to supercool much. One might note, though, that any heating of the line along this route might cause some of the liquid inside to vaporize. Specifically, any heating of the dryer -- say, by heat rising off the radiator or condenser -- might cause bubbles in the sight glass if the sight glass is downstream of the dryer. This is a good reason to make sure there is a box fan in front of the car when checking the sight glass, making sure heat from the radiator is blown the other way and the dryer only gets cool air around it. It's also a good reason to ask for a dryer with the sight glass on the inlet end.

One place where a deliberate attempt is made to get away from the vapor pressure chart, though, is in the suction line. After the refrigerant boils to become vapor in the evaporator, the system will usually be designed to try to squeeze yet more cooling from this vapor, thereby superheating it. This is to ensure it remains pure vapor as it enters the compressor. If something cooled the vapor a bit along the way, there could be some condensation, and you'd have some liquid freon sucked into the compressor -- and that would be bad.

An evaporator is usually designed to provide some superheat to the vapor. In the case of the XJ-S, there is an additional superheater: the fuel cooler. Plus, of course, all the lines from evaporator to compressor pass through the engine compartment (and the upper part of it, too!) so it's not likely anything will be cooling that line enough to cause condensation inside.

So, the temperature in the suction line is usually a bit warmer than the vapor pressure chart would indicate. Don't let the term "superheat" fool you into thinking it's *hot*, though; typically, the vapor pressure chart would indicate that it should be around 30°F, so if it's actually around 40°F it is superheated!

Also note that the line that comes out of the evaporator turns directly upward. This isn't only to get over the engine; it's also to help insure that only gas comes out this way, any liquid remains in the evaporator until it boils.

HIGH FREON TEMPERATURES AND PRESSURES: When charging or checking a system, the A/C mechanics keep an eye on the high side and low side pressures. From the relationship between the two pressures they can tell if the system is working properly or if there are blockages in the circuit, the compressor is defective, etc. They can also tell if the system is properly charged.

Unfortunately, an XJ-S sitting and idling is likely to develop the following indications: the low side pressures are about right and the high side pressures are really high. These are symptoms of an overheating condenser. The pressures often get high enough to concern the A/C mechanics and cause them to stop filling the system even though it's not really fully charged and the sight gauge is still bubbling, not clear. This is not a good solution, since an inadequately-charged system won't cool efficiently and will generate excess heat in the compressor.

The way to lower high side pressures is to increase the airflow through the condenser coil in front of the radiator. The airflow is marginal in an XJ-S at idle, since the engine turns slowly and the belt-driven fan doesn't move much air and the electric fan isn't much help. Leaves and debris packed in the air path, notably between the condenser and radiator, reduce airflow. But worse yet, the foam that originally surrounded the radiator and condenser is likely to be deteriorated or missing altogether; the tendency of the XJ-S radiator to get plugged up means that it is removed for renovation periodically, and some morons claiming to be mechanics deliberately leave the foam out during reassembly, claiming it is unnecessary. As a result, the air the fans are pulling through the radiator is taking the easier path *around* the condenser, and airflow *through* the condenser is nil. This can result in high side pressures that are not only high but rising with no sign of stopping. Of course, when the car is moving at 60 mph the airflow through the condenser is fine, but this won't help get the system properly charged.

As you stand looking into the engine compartment, the problems of airflow through the condenser coil are not obvious. You can see the fans turning, and most A/C mechanics naturally believe that if the fans are running the airflow is OK. They are not likely to correctly diagnose the problem as missing foam packing, even though they may comment that the symptoms resemble what happens when the fans aren't working.

Make sure your condenser, oil cooler, and radiator are properly packed with foam to prevent air bypass; see page 226. Make sure the fan shroud flaps are working, too, as described on page 226. Obviously, make sure your radiator fans (belt-driven and electric) are in good working order, including the fan clutch which is notorious for looking like it's working fine while not moving enough air. If your car is an earlier model in which the supplemental air valve is not used to raise the idle speed when the compressor is engaged, consider retrofitting that particular feature; a higher idle with the compressor engaged will cause the belt-driven fan to move more air through the condenser. See page 304. If your car is a later model in which the small electric fan doesn't come on with the compressor, consider retrofitting that particular feature. Finally, consider an electric fan upgrade; see page 219. All in all, any maintenance or upgrade intended to keep the engine cool by improving airflow through the radiator will also help keep the A/C condenser cooler and therefore the freon pressures lower.

Once you have the airflow moving through the condenser like it's supposed to, have the system checked and fully charged as necessary. Make sure the system is fully charged to the point there are no bubbles in the sight glass; if the tech doing the charging has any hesitation about properly filling it due to excessive high side pressures, you need to do more work on the condenser airflow.

To keep those high side pressures down while charging, you could put a box fan standing on the ground in front of the car blowing into the front grille. You can even spray a garden hose into the front of the car, which should bring the freon pressures down considerably. This might help convince you that you understand the problem, but it's not a solution; you want to be able to rely on this A/C system when stalled in traffic on a sweltering summer day, so you need to make sure your system will maintain reasonable pressures without resorting to such measures.

FREON REPLACEMENT: Production of R-12 has been prohibited since 1995, the price for the remaining stocks and recycled R-12 is high and can only be expected to continue to rise, and many XJ-S owners are finding it advantageous to convert the system to an alternative refrigerant.

The most popular scheme is to convert to R-134a refrigerant. This decreases the capacity of the system somewhat, but since the A-6 compressor is adequate to cool a Chevy van it's not likely to lack ooomph in this application.

Another option is R-406a. More expensive than R-134a, but is not only a drop-in replacement for R-12, it also *increases* the capacity of the system by a few percent. There is more info available on the WWW at:

http://www.autofrost.com/ORIG

Other possibilities include a host of substitute refrigerants such as Freeze-12, FRIGC FR-12, Hot-Shot or GHG-X4 (GHG in honor of the chemist who put the formula together, George H. Goble), supposedly direct replacements for R-12 with little or no conversion necessary. Any search of the WWW is likely to turn up a flurry of information on R-12 substitutes. Or call McMullen Oil at 1-800-669-5730 or Monroe Air Tech at 1-800-424-3836.

Tony Bryant touts the advantages of converting to "a non-EPA-controlled refrigerant": "Use 30% BBQ propane and 70% camping gas (make *sure* it's iso-butane, not n-butane). Or just buy a bottle of commercially available refrigerant of roughly this composition. Some states don't allow these blends but they are available commercially and are apparently quite popular, especially in Australia. They work very well, at least as well as R-12, and are practically free. Also they have no problems with moisture contamination. Flammability is obviously a potential issue, but don't let that hold you back. All vented compressor oil is flammable anyway."

There is one overriding advantage to choosing R-134a over all of the other substitutes: it can then be serviced by any auto A/C repair shop in town. Shops are required to have a separate refrigerant recovery system for each type of refrigerant they deal with, and they all have such recovery systems for R-12 and R-134a. Peter Cohen says, "Since every damn one of these refrigerants requires distinct fittings and separate recovery equipment, most shops will only service R-12 and R-134a. People have been scared into believing that no one will fix their car if they have a problem away from the shop that did it in the first place."

CONVERTING TO R-134a: Converting the R-12 system in the XJ-S to R-134a is covered in some detail here. Conversions to other substitutes are not covered at all; you're on your own.

In its simplest incarnation, converting an R-12 system to R-134a requires the following four steps, outlined in any kit available in any auto parts store:

- Evacuate the system, recovering and recycling the old R-12
- Install conversion fittings to the high and low side ports
- Recharge the system with one 11-oz. can of ester oil and the proper amount of R-134a refrigerant
- Apply a sticker indicating the conversion

In addition, many experts will tell you that you need to:

- Replace the hoses
- Flush all the old oil out of the system
- Remove components (compressor, condensor, etc.) and manually drain the old oil out of them
- Replace the O-rings
- Replace the shaft seal on the compressor
- Replace the compressor
- Replace the expansion valve
- Replace the dryer
- Replace the condenser
- Install a high pressure limit switch
- Replace or adjust the compressor cycling switch

I hasten to point out that many of these additional requirements were originally touted by experts when the ban on R-12 was first proposed without any experience to back them up. Now that R-134a conversions have been done for many years, experience has shown that each and every step is absolutely necessary *and* that each and every step is a complete waste of time and money -- depending on the individual situation. Of course, many people will insist one way or the other on each one, largely depending on whether or not they've ever had a problem doing a retrofit. In the following sections I endeavor to explain each concern in enough depth that you understand how the concern applies to your car.

Note that shops who offer to do such retrofits face considerable risk when quoting a price for the basic steps; if it turns out that some of the additional steps are necessary, they could be in for serious losses. Keep that in mind when you negotiate with a shop to do such a retrofit, and try to indicate a willingness to accept that additional steps may be called for and to pay for them. If you don't, the shop is only too likely to quote you an up-front price *including* all those steps whether they prove necessary or not.

I also hasten to point out that the basic steps described in the kits presume that you are converting a perfectly working R-12 system. I'm gonna go waaaay out on a limb here and presume that you are *not* planning to convert a perfectly working R-12 system; the only reason you're in here at all is because something broke. That being the case, note that repairing a damaged system and recharging with a different refrigerant than it had before can result in inevitable uncertainties about just what caused what if the system fails to perform as expected. Keep that in mind when negotiating with a shop to do the repairs, remembering that they will be inclined to quote an up-front cost to cover any and all contingencies -- including the possibility that you, the customer, will be dissatisfied with the performance of a perfectly-functioning R-134a system.

Finally, note that -- as explained in the sections below -- there are some concerns unique to the Jaguar XJ-S when doing an R-134a retrofit. Many shops may have had bad experiences doing such retrofits on XJ-S's or have heard about other shops that did, and may quote you an outlandish price or refuse to work on the car altogether.

Jaguar offers a retrofit kit; the part number is JLM 11610 for the 1993-94 XJ-S with a Sanden 709 compressor, and JLM 11611 for the 1979-92 cars with the Harrison compressor. To quote from Technical Service Bulletin #8239: "The primary changes involve the replacement of the existing compressor lubricating oil with an oil compatible with both HFC R-134a refrigerant and with the residual R-12 lubricating oil. It is not possible to completely flush R-12 type lubricating oil from the refrigerant system prior to changing to Ester oil and R-134a. Additionally it is necessary to replace the input shaft seal of the compressor with a seal compatible with the R-134a refrigerant and oil."

Retrofitting an R-12 system is not the same thing as building a system from scratch to use R-134a. For a comparison, Richard Jackson provides the following excerpt from the August 1993 version of the ROM:

> CLIMATE CONTROL SYSTEM INTRODUCTION
>
> The climate control system fitted to the 1994 Model Year XJS has many features which make it unique. These differences demand changes to current system maintenance and rectification working practices.
>
> Feature
>
> 1.. Refrigerant HFC 134A (Hydro flourocarbon, non ozone depletory).
>
> 2.. PAG (polyalkylene glycol) synthetic compressor lubricating oil.
>
> 3.. Dedicated and improved compressor for HFC 134A refrigerant.
>
> 4.. Quick fit/release self sealing charge and discharge ports.
>
> 5.. Dual pressure switch to control compressor (incorporated into liquid line).
>
> 6.. Clamp retained 'O' ring seals at the expansion valve and evaporator.
>
> 7.. All aluminium evaporator matrix and pipework.
>
> 8.. Aluminium receiver/dryer (without sight glass) and HFC dedicated desiccant.
>
> 9.. Parallel flow extended height condenser.
>
> 10.. Single muffler situated in suction hose.
>
> 11.. Improved electrical system connectors.
>
> 12.. Improved system control panel.
>
> ----------------------------------

"The key point to note from the above is that Jaguar have gone to some lengths to change the system for R-134a in comparison with the earlier R-12 systems. In addition this updated system is fitted with a Sanden SD-7H15 compressor with capacity of 155 cm3 / 9.5 cu inches per revolution (the same capacity as the Sanden 709 fitted to the R12 4.0L XJS)."

If you'd like more information on R-12 to R-134a conversions, there is a Q&A at

http://www.aircondition.com

SERVICE PORT FITTINGS: Regulations require that a different and non-interconnectable type of service port be used with each different type of refrigerant. So the service ports on an R-12 system are different than the service ports on an R-134a system; the R-12 service ports are externally threaded, while the R-134a service ports are a quick-disconnect design with an internal thread to hold the caps on. When you are converting an R-12 system to R-134a, you must adapt the R-12 service ports or replace the hoses in entirety to provide R-134a ports.

If you're buying new hose assemblies as part of your conversion, simply order the correct hoses and they will come with R-134a service ports. If you're intending to reuse/rebuild the R-12 hoses, you will need to screw adapters onto the service ports to render them R-134a service ports instead of R-12 service ports.

This would be simple enough if there were only one type of R-12 service ports, but no such luck. Obviously, it would make sense if the high pressure service port was different than the low pressure service port so you couldn't mix them up. It may be obvious to you and me, but apparently it wasn't obvious to somebody way back when because up until 1976 the two ports on an R-12 system were exactly the same. In 1976 somebody's lawyers pointed out the financial implications associated with freon cans exploding in customers' hands and the high pressure port on R-12 systems was changed to make it different than the low pressure port. In the US, anyways. Then in the 90's GM apparently decided that wasn't good enough and changed the design of the high pressure port again. Throughout all this, the low pressure port remained unaltered.

You need the correct adapters for the type R-12 fittings you have. You have a mid-80's XJ-S so you need the 1976-on versions, right? Wrong. Mike Aiken says, "The Jaguar A/C fittings are pre-1976 standards. Both hi and low sides are the same size, 7/16-20." Jaguar may not be the only import that stayed with the obsolete standard; some kits to adapt these fittings are described as "pre-1976 and Europe" or "pre-1976 and some late model imports".

So, you need to check carefully that the kit you purchase contains the correct adapters -- specifically, that it has the correct high pressure adapter. Note that "fits most cars" usually means it does *not* contain the correct adapter; their definition of "most cars" apparently means "cars built after 1976 in the US" because such kits typically contain the 1976-on adapter and the GM mid-90's adapter but not the pre-1976 adapter. If both service ports are the same on your XJ-S, look for packages of adapters that indicate they fit pre-1976 models.

Aiken goes on to point out that, for the initial charging with R-134a, you don't even need the high side adapter. Charging is done through the low pressure port and those are all the same on R-12 systems, so any kit includes a suitable adapter. You'll need to have the high pressure port adapter on there for future servicing, though.

Interdynamics offers a kit, part number CSR-7, that includes a single can of ester oil and an assortment of port adapters. It includes adapters for basically anything, including the correct adapters for the XJ-S. Discount Auto Parts offers this kit for about $24. It doesn't include the freon itself, but perhaps more interesting is the fact that it doesn't include the valve and hose assembly you need to charge the system.

Interdynamics also offers several bubble packs of adapters. Their part number VA-LH9 includes *only* the correct adapters for the XJ-S. Discount Auto Parts wants only $7 for this. Buying this package and a separate can of ester oil is therefore considerably cheaper than buying the CSR-7 kit above.

There are also adapters offered with a 90° elbow in them. Just in case you need it -- which you could on some cars if the R-134a fitting ended up in a position where you couldn't jam the quick-disconnect on properly. That doesn't appear to be a concern on the XJ-S, however.

R-134a adapters are supposed to be unremovable once installed, and this is accomplished via some red glue on the threads.

Since the two R-12 ports are the same on the XJ-S, I will explain clearly which is which. The port on the line from the fuel cooler to the compressor is the low pressure port and therefore should have the smaller diameter R-134a adapter with a blue cap screwed onto it. The port on the muffler on the line going to the condenser in front of the radiator is the high pressure port and should get the fatter adapter with a red cap screwed onto it.

LOW PRESSURE PORT ADAPTER: The R-12 ports on the car each have a Schrader valve (tire valve) that seals the freon inside unless the pin in the center is depressed. An R-134a low pressure port is a relatively small diameter fitting, smaller OD than the R-12 threaded fitting, so the adapter must hold the R-134a fitting out off the end of it. Of course, that'd make pushing the pin within the R-12 fitting down inside difficult.

The solution used on the Interdynamics low pressure port adapter is to install a floating pin in the center of the adapter. If you hold the low pressure port adapter up to your ear and shake it, you can hear it rattling around in there. There are no springs or seals involved. When this adapter is installed, pressing on the end of this floating pin will depress the pin in the center of the Schrader valve in the R-12 fitting below.

As mentioned above: it's a good idea to replace the Schrader valves whenever the system is discharged, just as you would replace the O-rings whenever working on an assembly. Of course, with that Interdynamics port adapter screwed down over it with Loctite in the threads, that looks like it may present a challenge -- so by all means replace that Schrader valve before installing the service port adapter!

If you're already past that point and need to replace that Schrader valve, you could of course just force the adapter loose, replace the valve, and reinstall the adapter -- or install a new adapter if you messed that one up getting it off. However, it is actually possible to replace the Schrader valve through the adapter. The pin assembly within the Interdynamics adapter can be unscrewed and removed, leaving an opening large enough to get a Schrader valve through. It's gonna be fiddly, though.

Look at the low pressure service port on your XJ-S V12 -- the port on the tube connecting to the left rear side of the compressor, coming from the fuel cooler. On the author's '83 it points upward, although reportedly it may have different orientations on later cars. As discussed above, the R-134a low pressure service port adapter sticks off the end of the R-12 port -- and then there's a cap that screws onto that. Altogether, the adapter and cap sticks up perhaps 3/4" farther than the R-12 port and cap did. If your service port points upward, you might complete the job and close the hood on this project only to be rewarded with a dent sticking up in the middle of your hood! And just because it clears when the hood is closed doesn't mean you're out of the woods, either; when the engine twists on its rubber mounts -- especially if the left mount fails -- the engine could jam that fitting into the hood when you trounce on the throttle. All in all, there is a good argument here for ordering new R-134a hose assemblies, or at least this one, since that fitting will be shorter.

Alternatively, of course, you could modify that tube while rebuilding the hoses, either replacing the R-12 port with a brazed-on short R-134a port or at least relocating the R-12 port somewhere more convenient. Or just abandon that port in place and add a new R-134a port somewhere else in this line. Or, considering how common the GM A-6 compressor is, find a low pressure line from a different type car -- possibly in a junkyard -- and adapt it to the XJ-S.

You might be tempted to try rotating the hose assembly around the connection at the back of the compressor just a bit to lean this fitting over on the side. The problem there is that you will be leaning the service port towards the 1B fuel injector hose. Keep in mind that the quick-disconnect fitting that connects to an R-134a low pressure service port is fatter than the one that fits an R-12 port, so you need *more* clearance around that port, not less. Also note that the R-134a quick-disconnects come in brass or plastic versions, and the plastic versions are even fatter than the brass. You may find that you need to roll that hose the other way to pull the service port farther away from the 1B fuel injector hose!

Since the Schrader valve remains in place within the R-12 port, here's the easiest solution: Carefully pry the O-ring out of the low pressure port adapter and unscrew the floating pin device. Then use a pistol cleaning brush of an appropriate size (about .41 caliber) to scrub all the red stuff out of the threads. Put the O-ring and floating pin device back in. Use some anti-seize compound for good measure, but apply it *only* to the male threads on the R-12 port to make sure it can't get inside the system. Service the system, then remove the adapter and put the R-12 cap back on. Store the adapter in the glove compartment. Apply a label explaining clearly that the adapter needs to be removed before closing the hood.

Interdynamics is not the only company making port adapters. There are adapters made by other companies (sometimes of brass or steel rather than aluminum) that, rather than using that cute floating pin idea, have a Schrader valve built in. You must remove the Schrader valve in the R-12 port prior to installing the adapter. Hence that idea of removing the adapter when closing the hood will *not* work. For adapting the XJ-S, it might be a good idea to insist upon the Interdynamics adapter with the floating pin; listen for the rattle when you shake it.

HIGH PRESSURE PORT ADAPTERS: There are at least two types of high pressure port adapters that will work on the XJ-S. The first type looks similar to the low pressure port adapter described above except larger -- but it works completely differently. While the Interdynamics low pressure port adapter contains a floating pin, their high pressure port adapter contains an actual Schrader valve. Shaking reveals no rattle, since a spring holds the valve firmly seated. With this type, you are supposed to remove the Schrader valve from the R-12 port before installing the adapter.

Make sure the Schrader valve inside the service port adapter is securely tightened down (ask me how I know!). You can try to blow through it before installing it to check for leaks. Using one of those tire valve caps with the Schrader valve tool on the end won't work here, the Schrader valve is recessed too far down inside the R-134a service port. So, you will either need to make a suitable tool from some small tubing, or you'll need to buy a tool. If you're lucky, you may have a pair of hemostats that will work well enough.

The fitting for the R-134a high pressure port is larger than the low pressure port, large enough to fit around the threaded R-12 fitting rather than out in front of it. So, eventually somebody figured out that you could skip building a tall high pressure port adapter with the Schrader valve inside and instead just provide a short adapter that screws around the R-12 port and uses the original Schrader valve in its original location. Very slick, actually. This author actually found kits on the shelf that showed the first type of adapter on the box and in the instructions but contained the second type of adapter and a separate slip of paper indicating the substitution.

The high pressure service port on the XJ-S is located where either type of adapter should fit without hitting the hood. If you are concerned, just make sure to get the second type which is no taller than the R-12 port, just fatter.

OTHER NON-STANDARD STANDARDS: Besides the test ports, there are two other connections on R-134a equipment that differs from R-12. The connection on top of a freon can is different, having a threaded attachment. And the connection between the other end of the test hose and the test equipment (valve or whatever) has a unique threaded fitting. These differing standards are intended to help A/C shops avoid mixing up stuff used with different freons.

They can be a real PITA for the home mechanic, though. Connecting R-134a-compliant hose to your vacuum pump may present a challenge. There are adapters made, but they can be difficult to find. The easiest solution may be to cut one end off an R-134a hose and attach a suitable fitting using an EFI clamp.

HOSES: The concern here is that the molecules of R-134a are smaller than molecules of R-12 and may actually leak right through the materials used to make R-12 hoses. So, even without being able to positively identify a leak, the system seems to bleed down over time. The solution is the "barrier hose", a type of hose that won't leak R-134a and is usable with either R-134a or R-12.

Bob Staff presents a dissenting view: "Barrier hoses are not required for a conversion to R-134a. Experience has shown that the systems operate fine without them. The age of your car may lead you to consider hose replacement." Some suggest that while in theory the non-barrier hoses will leak, in practice the oil in the system tends to coat the inner walls of the hoses and seals them. Others claim that the system will leak, but will only leak a few ounces per year, so it's cheaper to just top it up every now and then than to replace the hoses.

If you buy a hose today -- even one with R-12 service ports on it -- this is a non-issue; all modern automotive A/C hoses are "barrier" type. And at some point in time that probably became the case with the OEM R-12 hoses on a Jaguar XJ-S. However, there was a time before that when the XJ-S came with non-barrier hoses.

Unfortunately, barrier hose cannot be installed using the threaded hose connections found on the non-barrier hoses on the author's '83. Fortunately, as long as the tubes are steel, any industrial hose shop can come to the rescue. They simply saw off that hokey threaded fitting and braze on a barb and crimp the barrier hose to that. It's not even particularly expensive. As an example, I had the two low pressure hoses rebuilt, and the only fitting they had to cut and braze was the one that connects to the compressor with the service port on it; the other three fittings were replaced with brand new aluminum fittings. The total for two new hoses, three new fittings, one braze job, and four crimps came to less than $50.

I can't prove it, but I highly suspect that if your XJ-S has aluminum tubes, it also already has crimped connections and barrier hoses.

See page 509 for general guidelines on A/C hose rebuilding.

You can simply purchase new hose assemblies from Jaguar with either R-12 or R-134a service ports on them -- if you're made of money. Or you can purchase them from John's Cars (page 717), reportedly much cheaper. Remember, it doesn't matter which type service ports it has, a new hose will be the barrier type.

OIL: There are three types of oils to discuss here. The oil used with R-12 is called mineral oil. There are two types of oil used with R-134a called ester oil and PAG oil. There actually appear to be two versions of that last one, PAG 1 and PAG 2.

Mineral oil is worthless in an R-134a system. The oil within a freon system is dragged around the circuit by the refrigerant with the sole purpose of lubricating the compressor. In order to get to the compressor, it must mix properly with the refrigerant and travel with it. Mineral oil will mix with R-12 and travel around the circuit, but it won't mix with R-134a; it just settles to the bottom of the condenser or whereever and the compressor seizes up. So, you must use either PAG oil or ester oil in a system with R-134a.

If you leave the old mineral oil in there settled to the bottom and then use ester oil with the R-134a, you may be in trouble. Mineral oil won't mix with R-134a, but it does mix with ester oil. The result is that the ester oil ends up all dissolved in the old mineral oil, and they both settle to the bottom -- and your compressor runs unlubricated. Just how much trouble you end up in apparently depends on exactly how much mineral oil got left in the system. If you think you'll be leaving a significant amount in there, you should plan to use PAG oil -- which doesn't mix with mineral oil and therefore will lubricate the compressor no matter what.

The recommendations of "experts" fall into two camps here. The major automakers, laying out shop procedures for the mechanics in their dealerships to conduct R-134a retrofits, recommend that the system should *not* be flushed and PAG oil should be used with the R-134a. They claim, as in the excerpt from Jaguar above, that this is because it's not possible to flush all the mineral oil out. Skeptics believe they actually have other reasons. For one thing, not having to even try to flush saves the shop time and effort. But perhaps more importantly, not having to deal with the solvents necessary to flush an R-12 circuit keeps the EPA, the fire department, and the A/C component manufacturers off their backs. In years past, substances used to flush R-12 circuits have included R-12, mineral spirits, and a host of other substances, all of which were trouble one way or another -- and some of which were arguably of limited effectiveness in getting the old mineral oil and contaminants out.

Everybody except the major automakers suggests that you flush the system and then use ester oil with the R-134a. For one thing, suitable solvents for flushing are now commonly available -- although they're not cheap. You can buy flushing solution in any auto parts store for around $15/quart.

For another thing, the mineral oil takes up space within the system; the less mineral oil that's in there, the more R-134a you'll be able to put in. Note that for some reason R-12 systems often seem to have a lot more mineral oil in them than specified. Apparently each shop that works on the system tends to put more oil back in than they took out, probably just to be on the safe side. The massive accumulations of oil over the years of service detract from the performance of the system -- and adding in the ester oil on top of it may result in very poor performance indeed.

There are also theories that the mineral oil, when not being suspended by R-12 any more, tends to coat the inside surfaces of the condenser and evaporator, impeding heat transfer and reducing the effectiveness of the system. When somebody complains that converting to R-134a resulted in less cooling capacity than R-12, it's more likely they're experiencing these sorts of problem than seeing the true difference in the refrigerants.

Note that you're not supposed to flush through either the compressor or the dryer. Plan accordingly.

If you intend to continue to use non-barrier hoses with the R-134a, it's also not recommended that you flush the hoses. The solvents will remove the mineral oil from the inside surface, increasing the likelihood that the hoses will leak R-134a.

This system will require about 10-12 ounces of oil. Ester oil comes in pressurized cans containing oil plus some R-134a; the 11-ounce can provides 8.5 ounces of oil, and the 4-ounce can provides 2 ounces of oil. If all you're doing is converting a working system, one can of each size would be a good oil charge.

If you're replacing the compressor, it is generally recommended that you put some liquid oil into it prior to installation. Ester oil is also available as an 8.5-ounce can of liquid for such purposes.

If the compressor has too much oil in it while it's being installed, some of it may leak out when the caps are removed from the suction and pressure ports to connect the hoses. Aside from being messy, having an unknown amount of oil leak out means that you won't know how much oil remains inside. James Teston suggests "Depending on what you are taking apart, you may be able to connect the high and low pressure hoses to the compressor end before you install the compressor." He suggests you can tighten the attachment bolt enough to effect a seal but loose enough that you can reposition the hoses the way you want them after the compressor is in place.

This author recommends the following procedure for adding ester oil to a dry compressor being installed in a flushed system. First, with the compressor on the bench with the nose downward and the ports upward, put some liquid oil in the suction port -- but no more than three or four ounces. You may need to turn the hub at the front a bit to get even that much oil to go in, but don't turn it more than one full turn because it'll start pumping the oil out the pressure port. Reapply the caps or install the hoses and cap the other ends of the hoses; ester oil will absorb moisture from the air, and you want to minimize that happening. Ideally, let the compress sit nose-down for a while to allow the oil to seep down towards the front seal. Install the compressor. Then with the suction line disconnected from the fuel cooler (disconnect it if necessary), hold that end of the hose upward and pour the rest of the oil from the 8.5-ounce can directly into the end. As it flows down towards the compressor, turn the hub of the compressor slowly by hand to help draw it into the works. After the system is buttoned up and evacuated, add another 2 ounces of oil while charging by connecting a 4-ounce can to the low pressure service port.

O-RINGS: Jonathan Sterrett says, "There is no incompatibility between the refrigerant types and the O-rings in question, but rather between the early R-134a lubricants (PAG) and O-rings used in R-12 systems. The new ester oils are compatible with the O-rings from R-12 systems."

The O-rings used in an R-12 system will not dissolve when used with R-134a or PAG oil. That's not the concern; the concern is with the size. If you take two identical O-rings and use one in R-12 and the other in R-134a, the one in R-12 will end up a bit larger than the one in the R-134a.

Imagine the O-rings in your system are in good shape, rubbery and pliable, and are properly compressed between surfaces in their respective installations. Then the R-12 is replaced with R-134a and the rubber shrinks a bit accordingly. Will this cause a leak? Probably not. The compression of O-rings is generally far more than the shrinkage caused by the refrigerant change. Hence, the kits don't mention having to replace O-rings.

Now, imagine the O-rings in your system are old and tired. They've been in there for a few years being subjected to heat soak every time you park the car in the sun on a hot summer day. If you could pull them out and hold them in your hand, they wouldn't have a round cross-section; they've taken on the distorted shape they got from being compressed. They're still not leaking, though. Now, when you replace the R-12 with R-134a and they shrink a bit, are they gonna leak? You betcha!

Before you go worrying a great deal about this issue, note that all of the O-rings in the XJ-S are relatively easy to get to and replace. Well, except perhaps those at the expansion valve -- but you may be replacing the expansion valve as well after you read about it below.

Yes, there are special O-rings made for R-134a conversions. They are typically blue or green -- but the color is merely a light dusting of chalk, you can rub it off and the O-ring itself is black underneath. The color indicates that this O-ring is a hair fatter than the standard O-ring, making it compress properly in grooves sized for standard O-rings exposed to R-12. The dust also helps you get the parts together, which may otherwise be a little difficult with O-rings that are fatter than the assembly was intended to fit.

Although the colored O-rings are generally easy to find, if you prefer you can use standard black neoprene O-rings. Installed new, they will work fine. Apply a bit of compressor oil when installing to make them slide together easily.

You may be surprised at how few O-rings you need to buy. When this author rebuilt his system, the new compressor and the new expansion valve came with new O-rings. The shop that rebuilt all three hoses returned them with new O-rings for the standard fitting ends. The only component that didn't come with new O-rings was the dryer, presumably because it has female ends rather than male ends.

COMPRESSOR: There are two concerns in the compressor: O-rings and the shaft seal. The O-rings are discussed above. You're not likely going to take the compressor apart to replace O-rings, but as suggested before it's not likely you're converting to R-134a for nothing -- you have probably decided to convert in the midst of a compressor replacement! If so, don't worry about the O-rings; any rebuilt compressor will have been assembled with suitable O-rings.

Joe Bialy says, "Jag sez that only Sanden units need to have their shaft seal replaced for R-134a retrofits. The Harrison does not require any modification at all."

EXPANSION VALVE: The general discussion on the expansion valve is on page 508. The expansion valve is a throttling valve that responds to pressure. As discussed in an earlier section, pressure within a closed freon circuit is a function of temperature. The expansion valve is trying to hold the evaporator at a pressure corresponding to a temperature in the 30's F.

Now you go and replace the R-12 with R-134a. The pressure in the system is still a function of temperature, but it's now a *different* function of temperature. The expansion valve is still trying to hold the same pressure, but that pressure no longer corresponds to a temperature in the high 30's F. It apparently corresponds to a temperature in the 50's, if the reports from people who have done this conversion are any indication.

Once again, the switch to R-134a is blamed for a loss of performance -- but it's not the R-134a's fault, the wrong expansion valve is in there! Regardless of "capacity", the system should provide air in the upper 30's F when lightly loaded. If the wrong expansion valve is used, it'll never get colder than 50's F regardless of load. This isn't a capacity issue, it's a control issue -- the expansion valve is not controlling the refrigerant flow properly.

Ed Sowell reports that the expansion valve he got for his conversion was clearly labelled as being for R-134a. It's not likely anyone would bother with such marking if the expansion valves weren't different for R-12 and R-134a.

Again, the kits don't mention replacing the expansion valve. Perhaps they consider 50°F air cool enough. It's not really, though, since it won't dehumidify as well and it will require more fan speed to achieve comparable cooling. If you want this system to work right, replace the expansion valve.

Having to replace the expansion valve might, at first blush, seem a powerful argument for going with Freeze-12 or one of the other refrigerants that claim to be a functional equivalent of R-12 and therefore don't require an expansion valve change. Not only is the R-134a expansion valve perhaps $35, it's also a serious PITA to get to in the XJ-S. There's one more factor to consider, though: if you're replacing the compressor and the rebuilt compressor you get has any sort of warranty on it, that warranty always requires that the dryer and the expansion valve be replaced along with the compressor. Since the rebuilt compressors seem to vary greatly in quality and reliability, that warranty is important.

You probably want to replace the expansion valve. And be sure to keep the receipts for both the expansion valve and the dryer, especially if you buy them somewhere other than where you get the compressor.

DRYER: The general discussion on the dryer is on page 507. When converting to R-134a, the desiccant inside the dryer must be compatible with R-134a. Apparently all modern dryers are compatible with either R-12 or R-134a, but some original dryers may not be compatible with R-134a. At this point, if there's still a dryer in there that's old enough it might not be compatible with R-134a, replace it.

Again, the kit doesn't mention replacing the dryer. They are describing replacing the refrigerant in a perfectly working system, one that hasn't sprung a leak. They're apparently also presuming the system is new enough that the dryer is compatible with both refrigerants. If your system has been opened or sprung a leak and lost all the refrigerant, you probably should replace the dryer anyway.

CONDENSER: Let's say that in order to transfer enough heat to keep your sorry butt cool, the condenser in your XJ-S must operate at 150°F. With R-12 in the circuit, this would mean that the compressor must produce 235 psi in the high pressure line. Now, you convert to R-134a. To attain the same 150°F in the condenser in order to transfer the same amount of heat, the compressor must now produce 263 psi in the high pressure line.

There are two things you can do about this. One is to upgrade the condenser somehow so that it moves the same amount of heat at a lower temperature than before, so that the pressures are in line with what they were before. In this particular example, getting the temperature of the condenser down to 140°F would do it.

The other thing you can do is -- nothing. Just let the system operate at the higher pressures. Obviously, there are information sources that won't suggest you do this because they don't want to be liable if you blow hoses or destroy a compressor. And there are other information sources that note that operating at higher pressures is not usually that big a deal and perhaps not worth the hassles to address.

Before you latch onto the latter choice, allow me to remind you that excessive high side pressures are already a known concern with the XJ-S. You should be so lucky as to be running at 235 psi with R-12; it's more likely well over 300 already. You can review this problem on page 516. When you consider that the car may already be stressing the compressor and lines to the breaking point, switching to R-134a is just begging for trouble.

If you have the stock belt-driven fan and everything else in the airflow situation is OEM, I would recommend that you do *not* switch to R-134a without addressing the condenser situation. Sure, if your fan clutch is in perfect condition, the idle isn't set too low, the foam surrounding the radiator and condenser is intact, there are no leaves or debris in there plugging up the airflow path, etc., etc., you *might* be able to get away with it. You're still likely to have a system that performs poorly, though.

There are two ways to increase the condenser capacity so that it can operate at lower temperatures. The first is to replace the condenser itself with a bigger one -- commonly described as a "parallel flow" or "multipath" condenser. There are many aftermarket businesses that offer such condensers. According to the documentation quoted above, Jaguar went with a "parallel flow extended height" condenser when they introduced an R-134a system in the XJ-S in 1994; perhaps this unit can be adapted to earlier models.

The other way is to increase the airflow through the condenser. The cheap and easy way would be to add a "pusher" electric fan on the front of the condenser blowing through it. You can simply wire a relay to operate the fan whenever the compressor is engaged. Or, you can wire it to come on whenever the small OEM electric fan comes on, so it can do double duty and help keep the engine cool as well.

Of course, you could go ahead and replace the belt-driven fan with a powerful electric fan or any of the other various suggestions along these lines presented beginning on page 219.

If you have one of the later cars that doesn't bring on the small OEM electric fan when the compressor comes on, by all means revise that wiring so the fan comes on. This arguably should be done regardless, but with the conversion to R-134a it becomes doubly important.

Chuck Sparks suggests that, while you have the system torn apart anyway, take the condenser out and give it a good scrubbing to get all the road grime off the outside. This will make it transfer heat better. Of course, one could argue that it would merely give you false confidence in your system, since obviously it'll have more road grime on it sometime after you get this system together and running.

HIGH PRESSURE CUT OUT SWITCH: If you read that last section on the condenser, perhaps you understand why some suggest installing a High Pressure Cut Out (HPCO) switch that disengages the compressor if the pressure exceeds a certain value. If the condenser capacity problem isn't addressed, such a switch will likely result in the compressor cycling on and off. Basically, the condenser will get hotter and hotter until the switch shuts the compressor off, then the condenser can cool off until the compressor comes back on. This will provide cooling, just at a reduced capacity. It also may cause premature failure of the compressor clutch, what with all that cycling.

Of course, you really should address the condenser issues as described above. It won't hurt to install the HPCO switch anyway, but if you do the condenser job right it'll never come into play.

If you're not confident of your condenser/airflow situation, by all means install a HPCO switch. If the pressure exceeds 430 psi, the pressure relief valve on the back of the compressor will piss away your freon until the pressure drops to safe values. After that your system will remain undercharged and *never* cool as it should, even when there is adequate airflow through the condenser! With the high pressure switch, the compressor can be shut off to limit pressure without losing any refrigerant which leaves it properly charged so it can cool properly when pressure isn't an issue -- such as when the car is moving at highway speeds and there is gobs of air flowing through the condenser. With any luck at all, the high pressure switch will only come into play when the car is idling at a stoplight in hot weather.

"Muxika" describes the HPCO switch: "...a cut off switch connected in series with the A/C clutch set at 350 psi. (GM/AC Delco part # 15-5514)." The GM part number is 15981985. A search of the www turned up switches that cut out anywhere from 325 psi to 410 psi. As reference: Ideally the high pressure side should operate around 250 psi (17.5 kg/cm², 145°F, 63°C), and anything over 325 psi (22.8 kg/cm², 165°F, 74°C) should be considered overheating.

Any suitable HPCO switch has either internal damping or a wide dead band or both to make sure the compressor doesn't cycle on and off too quickly.

White Industries (http://whiteac.com) also offers such a switch, part number 03245-SP. You can also get one that's made by

FJC
Post Office Box 499, Mt. Mourne, NC 28123-0499
101 Commercial Drive
Mooresville, NC 28115
704-664-3587 Fax: 704-664-5522
http://www.fjcinc.com/

Their HPCO switch part number is 3245. Hmmm. Seems related to that White Industries number.

As long as you're plumbing in an HPCO switch, you can plumb in a switch that does more. You can purchase a "binary safety switch" which not only shuts off the compressor if the pressure is too high but also shuts it off if the pressure is too low -- which would mean the freon has all leaked out. Later XJ-S's come with a low pressure switch already built into the back of the compressor, but if you have an earlier car with a 3-terminal fuse you might want to consider a binary safety switch and abandon that 3-terminal fuse idea -- especially if your replacement compressor doesn't have the correct type port to fit the temperature switch that operates the 3-terminal fuse.

You can also opt for a "trinary switch". Besides the two functions of the binary safety switch, the trinary switch will also bring on an electric fan on when the pressure rises above 220 psi. That means it only runs the fan when truly needed rather than whenever the compressor is on.

There are dozens of places that offer binary and trinary switches, often specifically intended for particular cars -- none of which ever include Jaguars. For our purposes, you can use a generic. You can get one from

Hot Rod Air, Inc.
9330 Corporate Drive, Suite 308
Selma, TX 78154
Orders: 1-877-693-3200
Tech: (210) 651-0040 Fax: (210) 651-0070
http://www.hotrodair.com/
E-Mail: sales@hotrodair.com

Once you pick a switch, you must connect it into the high pressure line. There are at least four ways to do this. One option is to purchase a "saddle clamp" that clamps onto the outside of a tube and then a pin is screwed down to puncture the tube underneath. GM dealers have such a saddle clamp, part number 15985307.

Another option is to purchase a tee that is fitted to the high pressure service port and provides a switch port and a new service port. Conveniently, these are available that screw onto the R-12 port and provide an R-134a port, so it replaces the high pressure port adapter. Make sure to get one that fits the pre-1976 R-12 high pressure port which is a 1/4" flare fitting. White Industries offers a suitable tee, part number 02638-SP. FJC also offers the correct tee, part number 2638. Hmmm, they seem related again.

As an aside here, several companies offer a selection of "service port extension hoses". These are hoses about a foot long that you screw onto a service port and leave in place permanently, and use the other end of the hose as your service port. The intent is to deal with service ports that the automaker chose to put in totally inaccessible locations. There are no such access problems on the XJ-S, the service ports are right up top -- but you might opt to use one of those service port extension hoses to locate your service port adapter tee and HPCO switch somewhere where the hood won't slam on it!

Another method for connecting your HPCO switch is with a tee that is installed at a hose connection. On the XJ-S, this would have to be installed at the right front corner of the engine compartment where the high pressure hose connects to the line to the condenser. The hose connects to the tee, the tee screws onto the condenser line. It effectively makes the hose a little longer, but that shouldn't hurt anything. Hot Rod Air offers such a tee.

A fourth method is a tee that is spliced directly into the high pressure hose. It'll require a crimping tool to install, but if you have a crimping tool it may be the cheapest option.

Pressure is a function of temperature in a refrigerant circuit, so in lieu of a pressure switch you could install a temperature switch. This might be easier as an add-on, since a temperature sensor can be strapped onto the outside of a tube rather than having to be connected into the line itself.

COMPRESSOR CYCLING SWITCH: Some automobiles have a "cycling switch" that turns the compressor off when the low side pressure gets too low. Pressure corresponds to temperature in a closed freon circuit, so what it's really doing is preventing the evaporator from getting too cold and possibly icing up. Since switching from R-12 to R-134a changes the pressure/temperature relationship, you need to adjust or replace this switch so that it cycles the compressor off at the correct temperature.

The XJ-S doesn't have a compressor cycling switch. Instead, it uses a Ranco thermostat that directly measures the temperature of the air coming off the evaporator and cycles off the compressor if this air gets too cold. So there is no need to worry about this when changing refrigerants.

CHARGING EQUIPMENT: It would make sense to describe charging equipment in the general section on the A/C rather than in this section on R-134a, but it's difficult to find R-12 stuff any more and you need a license to buy it anyway. The R-134a equipment is readily available to anyone in any auto parts store.

You will need a device to connect the cans of oil and refrigerant to the low side service port in order to charge it -- and you can't use the charging equipment that you used with R-12 because both the cans and the low side service ports are different with R-134a. Cans of R-134a have a little threaded nipple on top to connect to.

With R-134a, one basic setup is a brass valve that screws onto the top of the can with a little spike that punches a hole into the top of the can, and a short length of hose with an R-134a-standard threaded end that attaches to this valve and a brass quick-disconnect on the other end to connect to the service port.

There's also a similar device made entirely of plastic.

There is a device that attaches directly to the can and you turn the can over and jam it down onto the quick-disconnect port. No hose, no valve. I suspect you are not supposed to use this type to put refrigerant in the system, since you could easily introduce liquid refrigerant into the low pressure port. It appears that this type is chiefly used for such things as adding dyes or sealers to the system.

If you want to be more professional and careful about what you're doing, you want to have a "manifold" which is an assembly with three hoses, two gauges, and an assortment of valves. One hose connects to the low pressure service port, another connects to the high pressure service port, and the third connects to the vacuum pump or the freon tank or whatever you happen to be fiddling with. Once connected up, you just open and close valves to service the system. Very slick. And, perhaps more than the home mechanic is interested in paying.

There is a happy medium solution for the home mechanic. There is a package offered by Interdynamics, Model No. HGT-134A, that contains the short hose and can-tapping valve as in the basic charging kit described above. It also contains a 500 psi pressure gauge. And it contains an adapter: a quick-disconnect that connects to the high pressure service port and presents a low pressure service port to connect your hose to! That just seems wrong somehow, they went to all this trouble to provide different ports so you couldn't possibly connect the freon can to the wrong port and have it explode in your hand, and then they go and make this adapter that allows you to do it anyway! But as a practical matter it's a cheap way to use one hose to connect that gauge to either port. Just don't do anything stupid.

Note that the pressure gauge, being clearly intended for R-134a use, not only has pressure scales in psi and kg/cm^2 but also temperature scales in °F and °C. Pressure and temperature have a fixed relationship in a closed freon circuit.

This particular package does not come with a vacuum gauge. However, the pressure gauge is made with a 1/8" NPT connection at the bottom, and it comes in this kit with an adapter screwed onto it that allows the gauge to be connected to the R-134a hose fitting. So if you happen to have a vacuum gauge laying around, you can unscrew this adapter from the pressure gauge and screw it onto the vacuum gauge and hook it up.

CHARGING: Charging is fairly straightforward, and is described in the instructions that come with any kit. Note that the instructions will include putting a large can of ester oil in via the low pressure service port, but if you've replaced the compressor you should have already added 8.5 ounces of oil in liquid form so you will only be adding a small can at most at the port.

The guidelines on R-134a is to plan on using 85% by weight of the amount of R-12 the system used. The Jaguar V12 with the A-6 compressor uses 2.5 lb of R-12, so it should take about 34 oz. of R-134a. Buy three 12-oz. cans.

Many people conclude that since it takes fewer ounces of R-134a than it took in R-12, you're not supposed to fully charge the system with R-134a until there are no bubbles in the sight glass. This is incorrect; no gaseous refrigerant in the liquid line is a fundamental requirement of a properly functioning refrigeration circuit regardless of what type of refrigerant is used. The reason we use only 85% as much R-134a is because R-134a is less dense than R-12; the same quantity of fluid weighs fewer ounces.

There are warnings everywhere that the sight glass is not a reliable indicator of proper charge with R-134a. There are two reasons for these warnings. First, PAG oil will tend to fog over the sight glass under certain conditions, which means you won't be able to see any bubbles whether they are there or not. Obviously, if you planned on relying on the sight glass and neglected to keep track of how many ounces of R-134a you've been putting in, you're screwed. So warnings are in order: keep track of how much R-134a you're putting in, because the sight glass is not a reliable indicator of proper charge. You didn't think about it meaning it that way, did you?

Fortunately, the fogging problem apparently doesn't apply to systems using ester oil. It may apply to some of the stop-leak products offered for use with R-134a, though, so it's still a good idea to keep track of how much refrigerant you're putting in.

The second reason *does* apply. If the condenser is inadequate for use with R-134a and you don't install an HPCO, you will end up with a system that is either undercharged or overheated. Undercharged is better. So, while ideally the system will have an adequate condenser and run pure liquid in the liquid line, you may be compelled to undercharge the system and put up with the (considerable) reductions in performance in order to limit the high side pressures. A better idea would be to install a HPCO switch as described above and fully charge the system -- but if the condenser shortcomings are not addressed, it's going to be cutting off the compressor a *lot*.

Delanair MkII (up to 1987)

TRAINING MANUAL: Jaguar, back in the days of British Leyland control, issued a "British Leyland Service Division Dealer Training" manual, "Aid # S1002" on the Environmental Control System. Although it's described as intended for the "Jaguar XJ6, XJ12 Series Two", the same basic system was used in the pre-1987 XJ-S. This book is long out of print, but if you happen to find a dealer or mechanic with one you definitely want to have a copy made.

SCHEMATIC CORRECTIONS: This clarification applies to the "Air Conditioning" diagram in at least one early-80's edition of the owner's handbook as well as Figures 10.125 and 13.94 in Haynes manual 478/49015. There is a BU wire that comes from the left connector on the M1, M2, and High speed relay coils and eventually ends at the low speed switch (192D). Another wire, no color indicated but I'm betting it's black, comes off the left connector on the Low speed relay coil and wraps around the bottom of the entire schematic, clearly the ground for everything. At the top left corner of this diagram, it appears these wires are connected -- but they are not. A little Liquid Paper is in order to make this clear.

HEATER CORE REPLACEMENT: The heater core ("heater matrix" for you Brits) in the Delanair MkII has integral pipes that extend through the firewall, where hoses connect it to the engine cooling system. To get it out intact requires disassembling the entire dashboard and A/C system, including discharging the freon circuit.

Michael Neal recommends shortcutting the heater core removal to keep from pulling the dash apart. The instrument pod must still be removed, and dropping the steering column down is required. But total disassembly can be avoided by cutting the pipes and installing the new core using short pieces of hose with clamps. Neal is an official Jaguar mechanic and highly recommends this method; there is nothing wrong with using heater hose for such an application, and disassembly of the entire system is likely to cause further problems unless done by an experienced Jag mechanic.

Greg Price sends a detailed checklist: "To those who have to replace their heater cores and want to cut the pipes rather than disembowel their entire interior, the procedure is pretty straightforward with the following caveats:

1. You don't have to take the driver's seat out, but it might make a more comfortable working environment.

2. The steering column must be removed in order to make room for the heater core to slide out. The steering column is held up under the dash by four bolts. These bolts have spacers, washers, seating rings and a steel piece that holds the nuts. Before removing the steering column, take out the tach and speedo, then look inside with a flashlight to see where all of the little spacers and miscellaneous bits go. Take notes. As soon as you start to remove the four bolts, all of those bits bail out.

3. Take a Polaroid picture of the heater mechanism area before you start taking things out. If you can't buy or steal a Polaroid camera, draw a very detailed map of the area, and pay attention to what goes under or over what.

4. As you remove the screws and such, tape them to a sheet of paper in the order that they were removed. It makes the orderly reassembly that much more orderly.

5. Buy the best hose clamps you can find. Get those swedish jobs that you can torque down with an impact wrench.

6. Use silicone to seal the hose to the pipes.

7. Cover everything. Twice. Brass shavings fly everywhere when you cut the pipes (especially if you use a pneumatic cutoff tool). Silicone always ends up everywhere except where you want it.

8. Be mindful of the hazard light switch. It's easily mangled. I think mine will hold together (I hope).

9. Plastic wire ties are great for holding all of the excess wiring and plumbing up out of your way.

10. Don't drain your cooling system like the manual says. Pull off the heater hoses, plug them temporarily, then blow the remaining water out of your heater core with compressed air. Keep your face away from the outlet.

11. Watch out for the fiber optic line going into the ignition switch cover. Remove the switch cover and tape it up out of the way with the fiber line before you drop the steering column.

12. If your cruise control doesn't work, now is a good time to check the steering column wiring and speed set switch.

“The entire procedure took me about 3 and a half hours (including a short dinner break), which beats the hell out of disassembling the dash and console.”

STUB DUCTS: The stub ducts that the rubber ducts connect to are easily removable; just twist CCW. This can be really handy for getting to some things, such as the 12V terminals on the firewall. Richard Mansell says, “these can also be pulled off to get at the top of the A/C drain tubes.” To reinstall, just offer them up to the holes and turn around until they pop into place, then turn them CW to lock.

BLOWER FANS - INDIVIDUAL SPEEDS NOT WORKING: The four blower speeds are controlled by four relays built into a single unit that is located adjacent to the left side footwell; the footwell register and the small padded cover must be removed to get at it. If one of these four relays quits, one speed of the blowers no longer works, and the A/C system just skips over it from the next lower speed to the next higher speed and back. The result can be a little disconcerting, since the bigger change is speed is quite noticeable, and since it may be more change than necessary the system can end up cycling back and forth between the two speeds a lot when it would have been happier just staying at the middle speed. Even worse, if it happens to be the “low” speed relay that fails, the A/C compressor can be operated without a fan running which is not good on the equipment and may cause the compressor to kick in and out on its own thermostat trying to prevent iceup.

This four-relay assembly appears to be a common failure: this author has had three of the four relays inside it fail, and others report similar results.

I took the box apart and fixed it each time. The unit is tough to get out of the car, but once out it is a simple matter to bend the plastic edges back and pry open; you might even try bending the edges back and prying the base out *without* removing it from the car, since the base will carry all the important parts and you’ll simply leave the plastic housing in place. Be careful; the NW wires connecting to the terminal with the screw (and several of the components inside, if you don’t disconnect this wire before opening) are hot at all times unless you have disconnected the battery.

The coils are designed to be on continuously, so they don’t burn up; the problem always seems to be broken connections. The thin wires from the relay coils break off of the terminals, and soldering them back on makes it work as good as new. However, there is a theory that these long thin wires spanning considerable distances within this assembly are the cause of the problems; a vibration in the car, perhaps at a particular speed or engine RPM, may resonate these wires like guitar strings and break them off.

So, instead of just reconnecting them, fix the problem. On each coil, the skinny coil wire comes out of the coil and is wrapped a couple of times around a plastic lug on the side of the coil before running off to the terminal. Solder a larger gauge wire to the terminal and route this larger wire to the plastic lug on the relay and wrap it around a couple times, then solder the end of the coil wire and the new thicker wire together right next to the lug. Hence, the thick wire spans the distance to the lug, and the thin coil wire is well supported.

Alternatively, just replace the individual relays that go bad. Brian Sherwood "Found a portion of the fan control relay was inop, no fan on "low". Removed four wires from bad portion of relay block and plugged into a generic 12-volt relay with spade terminals; fan works fine now. Fan control relay is located in center console, LH side under heater unit."

The four relays are located at the four corners of the unit. The "low" relay, at the bottom right corner as you look at it, seems to be wired with four wires as Sherwood described. The other three relays, however, each have two wires going to them, plus there are two commons going to the whole set of three. A large NW wire provides 12V power to all three contacts to power the blowers. A small BU wire provides a common switched ground for all three coils. The signal to the relays comes via BY, BG and BW wires, and the power to the resistor pack and blowers is via larger U, R, and GS wires.

If the low relay fails, you can replace it with a standard automotive relay, such as those sold for driving lights; merely remove the four wires from the box and connect the B and NY wires to the coil and the NW and Y wires to the contacts, as Sherwood suggests.

If one of the other three relays fails, you can still replace it with a standard relay. Connect a wire from the BU wire to one side of the coil (without disconnecting the BU wire from the other relays on the board), and simply pull the BY, BG or BW wire off the terminal on the faulty component and connect it to the other side of the coil. Connect a heavy wire from the NW wire to one side of the contacts (again leaving it connected to the other circuits), and pull the U, R or GS wire from the terminal on the faulty component and connect it to the other side of the contacts.

Either opening the box and correcting the problems or replacing the relays with individual SP relays would probably save a lot of money; generic "driving light relays" will work fine are only a couple bucks each. It's likely to cause less trouble, too; most of the aftermarket generic relays are quite reliable. You certainly don't want to buy a replacement four-relay unit from Jaguar -- after all, the original one is causing trouble, and the replacement isn't likely to be any better. In fact, it might not be a bad idea to simply yank the entire block out of the car and replace it altogether with four generic relays at the first sign of trouble.

Note that British Leyland Service Division Training Manual S1002 on the Environmental Control System shows a separate low speed relay and a box containing three relays; since the manual is intended for the XJ6 and XJ12 Series Two, this probably describes an early arrangement. The wiring schematic appears unchanged, however, and the replacement of individual speed relays with separate units will work just as well.

BLOWER FAN RESISTOR PACK: Component #188 on the schematics. Physically, this unit is mounted in an opening high on the left side of the A/C system, above the heater core pipes. Access to the resistor pack is poor, to put it mildly. If it must be removed, it is suggested that the left side blower assembly be removed first. It is also suggested that a hole be drilled in a piece of structural sheet metal to allow a Pozidriv screwdriver to be used on the upper mounting screw.

The speed of the blower fans is controlled simply by connecting the various resistances in series with the blower motors. These resistor packs are installed in the airstream from the blowers so that the airflow will keep the resistors cool. If the blowers seize or otherwise fail to move air, the result is often a cooked resistor unit due to lack of cooling combined with the high current load due to the mechanical problem.

If one is really cheap or in a hurry, the unit can always be repaired using Nichrome wire from an old toaster or some such, or even by twisting severed wires back together. Do not use solder, as it will melt; all connections must be mechanically attached. Exact resistance values are unimportant, since being off a little will only make the fans run a little faster or slower than original. Note that this unit is so difficult to get to that it would be nice to make *real* sure it doesn't fail again.

BLOWER FAN RESISTOR PACK -- FUN WITH SCHEMATICS: Some A/C system schematics, including Fig. 10.125 in the Haynes, show the blower fan resistor pack (component 188) incorrectly. They show the GS wire to the fan motors themselves being connected to one end of the three resistances, as though all three resistances operate in series. In fact, the GS wire connects between the 0.85 and 0.425 resistances. In M1 speed, power is supplied to both ends of the resistor pack (Y and U wires) so that the 0.85 resistor operates in parallel with the 0.425-1.275 pair. In M2 speed, power is supplied to the R wire in addition, so the 0.85 resistor is now operating in parallel with the 0.425 alone.

The "Air Conditioning" system schematic in the ROM at the end of section 86 as well as Fig. 10.130 in the Haynes show the fan resistor pack correctly.

Also of note, the schematic in the ROM and Fig. 10.130 in the Haynes show one additional circuit by which the high speed position of the control knob will, via diode #D4, operate the M2 relay. Reason unknown; it almost appears to be a backup in case the high speed relay fails.

DEMIST DUCT VANE: The ROM, Section 82.25.21, step 35, says "Ease demist duct vane securing studs from screen rail and recover demist duct assembly." John Nuttall felt this was unclear, so when he finally figured out what it was talking about he provided the following explanation. Note that this applies to his 1977 XJ-S.

"Removal of this vane uncovers a screw which secures the unit to the car body just below the windshield. The main difficulty with the manual is that it does not make clear just what is the demist duct vane, and I don't think the official name is a very good description. It turns out that this object is a piece of vinyl covered rubber about 34 in (85 cm) long, 3/4 in (2 cm) thick, and 3in (8 cm) wide in the centre, tapering at the ends. Along its back face is screwed (with 13 screws) a plastic air deflector to direct air to the windshield. This vane fills in the gap between the centre of the fascia and the windshield.

"To remove the demist duct vane you must undo two screws placed vertically downwards at the ends. With the windshield in place it is impossible to do this with a conventional screwdriver. I was able to turn these screws with vise grips. The underside of the vane has two prongs about 17 in (44 cm) apart which engage slots in the unit below."

CONTROLS: Rob Reilly provides the following system description: "Outside air is drawn in through the grille in the center of the cowl between the bonnet and the windshield. Vacuum operated flaps on the fan motors close off this outside air under certain conditions and draw air instead from inside the car (known as the recirculating mode).

"From the fan motors the air goes through rubber branch hoses to the front chamber of the heater unit. Here *all* the air passes through the air conditioning evaporator and gets cold (if the compressor is on). Then there are four flaps controlled by mechanical linkages which can be seen on the right hand side of the unit. These control what percentage of the air passes through the heater core and becomes warm (if the water valve is open and the water is warm) on its way out to the vents.

"The upper front (meaning toward front of car) flap ("upper bypass flap") opens or shuts off cold air to the dashboard side vents, center vent, and windshield defrost vents. This air has *not* passed through the heater core. Clockwise is open, counterclockwise is closed, viewed from the right hand side. The center vent and windshield defrost vents also have vacuum-operated flaps.

"The upper rear flap ("upper heater flap") opens or shuts off warm air, which *has* passed through the heater core, to the same upper vents as the first flap. Clockwise is closed.

"The lower rear flap ("lower heater flap") controls warm air to the lower vents on the sides of the transmission hump and to the duct hoses going to the rear vents under the center console armrest. Clockwise is open.

"The lower front flap ("lower bypass flap") controls cold air to the lower vents. Clockwise is closed.

"On the left side is a vacuum actuator and linkage which, when the selector is on DEFROST, will be up (vacuum off) and prevents the bottom heater flap from opening.

"There is a servo motor on the lower right which operates some more micro-switches, vacuum line valves, and mechanical linkages, and is in turn controlled by the temperature setting and several temperature sensors through the amplifier and relay on the lower left.

"The left hand knob (temperature control) turns a variable resistor. The resistor should have a resistance of zero ohms at the 85 degree mark and 10,000 ohms at the 65 degree setting. There are three solder pins on this thing, one of which should not be used. If you had a high resistance in the circuit the unit would think you're asking for cold air and would turn the stepping motor to give it to you.

"The small device mounted on the lower tube of the heater core is a temperature-controlled on/off switch which disables the blowers until the water warms up." Actually, it limits the blowers to low speed.

CONTROLS -- VACUUM LOGIC: The following logic chart was graciously provided by John G. Napoli:

Jaguar Climate Control Vacuum Logic -- Representative of 1982 XJ-S HE

Compiled by John G. Napoli

	Control:	Vacuum Switch		Cam Switch		Vacuum Solenoid
	Item Controlled:	Screen Flap	Lower Heater Flap	Water Valve	Center Dash Flap	Blower Flaps
FULL COOL	Control Status:	On	On	Open	Open	Energized
	Item Status:	Closed	Open, and overridden by flap	Closed	Open	Closed
	Vacuum Status:	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
FULL HEAT	Control Status:	On	On	Closed	Closed	De-energized
	Item Status:	Closed	Open	Open	Closed	Open
	Vacuum Status:	Vacuum	Vacuum	No Vacuum	No Vacuum	No Vacuum
FULL DEFROST	Control Status:	Off	Off	Closed	Closed	De-energized
	Item Status:	Open	Closed	Open	Closed	Open
	Vacuum Status:	No Vacuum	No Vacuum	No Vacuum	No Vacuum	No Vacuum

Notes:

In FULL COOL, recirculation is enabled because the vacuum solenoid is energized.
A NORMAL A/C mode is therefore implied with the vacuum solenoid de-energized.

In FULL COOL, everything gets vacuum.
In FULL DEFROST, nothing gets vacuum (default system operation if system fails).
In FULL HEAT, only the items fed by the vacuum switch get vacuum.

The vacuum switch is attached to the right hand climate control knob (Positions: Low, Auto, High, Defrost).

The cam switches are part of the servo. The servo is mounted on the right of the climate control unit under the dash (next to the right hand occupant's left shinbone).

The vacuum solenoid is mounted on the left of the climate control unit under the dash (next to the left hand occupant's right shinbone).

Water valve is located on center of firewall in engine compartment.

Dashboard may have to be removed to access flaps. Always check operation of and adjustment of servo linkages when troubleshooting this system. There are two blowers (left and right). Check them both!

Some later XJ-S's may have a manual override enabled by pulling the right hand climate control knob out and turning. Reference to this feature was seen in a 1983 XJ-S Owner's Manual.

CONTROL MICROSWITCHES: The right side control knob has microswitches behind it that are often found to be the source of trouble. However, Ron Whiston points out that the problem is often not a failure of the microswitches themselves, but simply that they are incorrectly positioned relative to the cam; turning the knob doesn't move the switch enough to make it click. Even though the mount holes are not slotted and are not intended to provide any position adjustment, merely loosening all the mount screws and holding the switches inward while tightening them back down will often correct all problems.

TEMPERATURE CONTROLLER: Reportedly, the wirewound pot has problems. See Exotic Auto, page 707.

CONTROL LINKAGE ADJUSTMENT: The ROM describes an adjustment procedure that is unclear and covers only a couple of the adjustments needed. The illustrations are tiny and poorly labeled. Below is a procedure that should enable a more complete adjustment of the linkage. See Figure 26 and Figure 27.

While performing these adjustments, keep this concept in mind: The difference between a flap being fully open and 90% open is insignificant; there is a lot of airflow in either case, and the passenger will not be able to detect a difference. On the other hand, the difference between a flap that is fully closed and one that is slightly open is *huge*. Therefore, the objective of the adjustment procedure is to make sure that all flaps close fully, and how far they open will be of little concern.

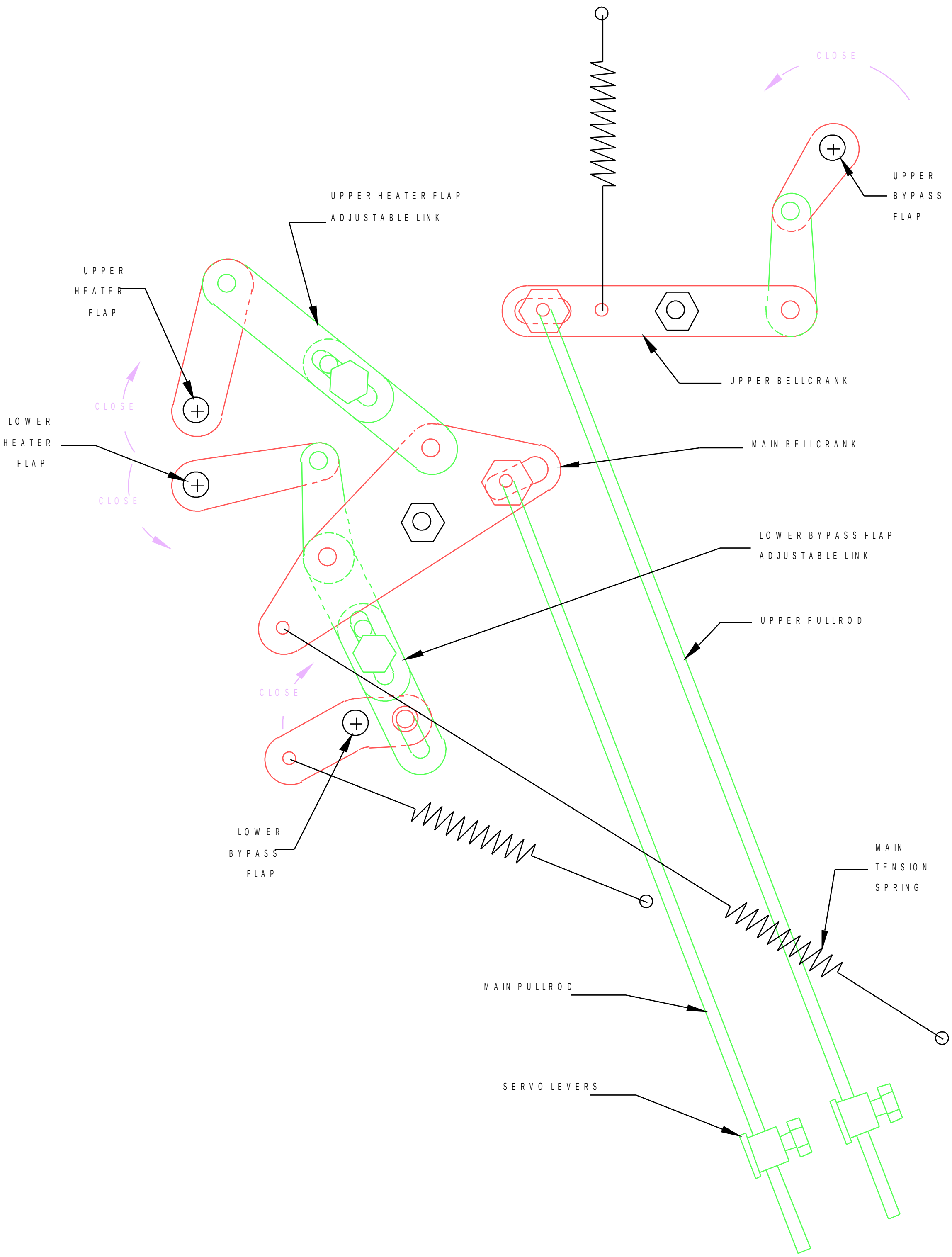


Figure 26 - Climate Control System Linkage -- Early MkII

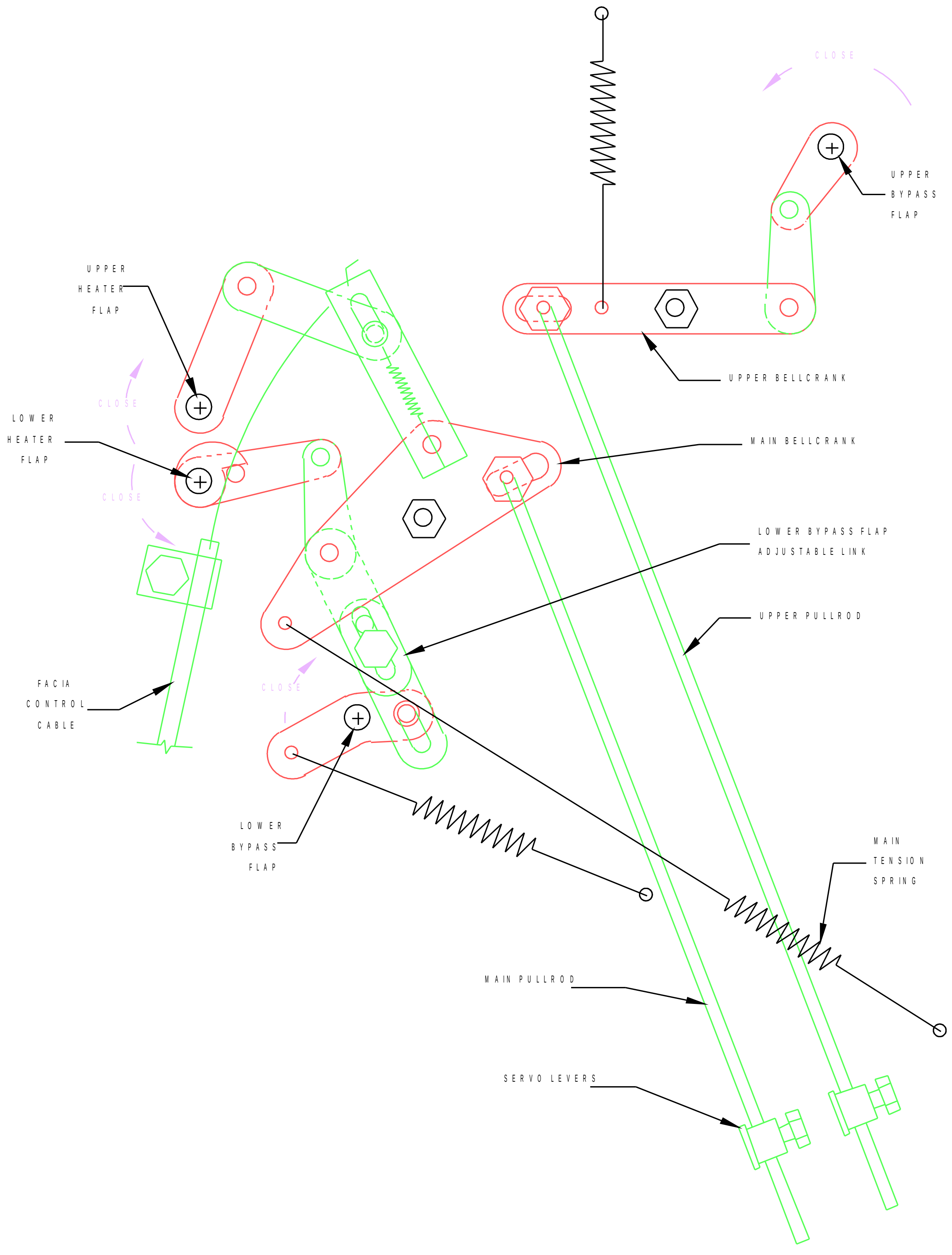


Figure 27 - Climate Control System Linkage -- Later MkII

1. Remove the glove compartment, the "underscuttle casing" (panel above the footwell) on the right side, and the

grille and padded panel on the right side of the transmission tunnel.

2. Remove the short steel duct that serves the footwell grille. Be careful not to drop any screws into the works.

3. Loosen the locking screw on the lower bypass flap adjustable link. Loosen the locking screw on the upper heater flap adjustable link if there is one; if the car has a facia temperature control (a slider under the stereo), it will not have an upper heater flap adjustable link as the facia control takes its place. Loosen the locking screws on both pullrods where they connect to the servo control levers.

4. Move the servo to the full cool position, which is where the levers on the servo are held at their most downward position. Note that the pullrods are normally held upward by the linkage springs; with the linkages disconnected, the servo levers will fall down regardless of servo motor operation. You must pull upward on them with your fingers to determine what position the servo is actually in. Note also that operation of the servo doesn't move the levers continuously from one extreme to the other, but rather goes back and forth somewhat; be sure the motor has moved all the way to the extreme position that holds the levers in the downward position before proceeding.

   To move the servo, disconnect the main electrical connector to the servo unit, which is a 13-wire connector in the same general area you're already working in. Connect 12V power across the solid purple and solid red wires; if the battery is connected, 12V power is available at the nearby fusebox, at fuses 2 or 3 (RHD cars) or fuses 13, 14, 15, or 16 (LHD cars) so it's a simple matter to run a jumper from the fusebox -- or simply from the cigar lighter, and connect the other wire to ground. If the battery is disconnected, a 9V transistor radio battery will also work well, running the servo a little slow but it gets there. To run the opposite direction, reverse the power.

5. Turn the main bellcrank clockwise until the lower heater flap is held firmly shut; it may be easier if the main tension spring is disconnected. Hold the main servo control lever up. Tighten the locking screw on the servo lever.

6. If the car has no facia control, hold the upper heater flap in the fully closed position (clockwise) and tighten the locking screw on the adjustable link.

   If the car has the facia control, move the slider to the full right position. Loosen the clamp holding the cable housing, and move the cable housing until the upper heater flap link forms a straight line. Lock the cable housing into this position.

   To check the operation of the facia control, move the slider to the left. The upper heater flap should fully close, and further movement should be taken up by the spring in the linkage.

7. Move the servo to the full heat position (levers in their highest position).

8. Turn the lower bypass flap to the fully closed position (clockwise). While holding this position, slide the adjustable link to its longest possible length and tighten the locking screw.

   The lower bypass adjustable link has a slotted opening to allow the flap to be farther closed than the linkage calls for. To check that this slider works properly, move the servo off the full heat position. Turn the lower bypass flap towards closed, against the force of its spring. The lever should move smoothly in the slotted hole. If it doesn't move smoothly the linkage is probably misaligned, causing it to jam. Determine which way the parts are misaligned. Take the lower bypass adjustable link apart by removing the locking screw entirely and removing the screw holding the lever to the flap. Once out of the car, carefully bend the parts to correct the misalignment. Reinstall, readjust, and check for proper motion again.

9. With the servo in full heat position, allow the spring to turn the upper bellcrank clockwise until the upper bypass flap is closed. Hold the upper servo lever up and tighten the locking screw.

10. Reassemble and test drive.

Note that on later cars there is a vacuum actuator above the left side footwell that holds the lower heater flap closed when the defrost is called for. Vacuum permits lower heater flap operation, lack of vacuum prevents it. To observe the operation of this actuator, it will be necessary to remove the underscuttle casing on the left side. There is no real adjustment necessary, however, since it is either on or off. Make sure there are no wires or anything obstructing its motion.

Note that the connection of the pullrods to the bellcranks is a nut-bushing that is fitted into a slotted hole on the bellcrank. The procedure above does not address location of the nut-bushing within the slotted hole. This position determines the sensitivity of the system; if the motion of the servo causes the flaps to move too much, the nut-bushing should be relocated farther away from the pivot so that the same amount of pullrod motion won't turn the bellcrank so much, and vice versa if the servo doesn't move the flaps enough. It is recommended that these nut-bushings not be tampered with. If their position is altered, the entire linkage adjustment procedure above should be repeated.

CONTROLS - RANGE PROBLEMS: Olov Carlsson sends this comment: "I had a problem with the temperature control knob being out of range. Even when I put it in the coldest position, the system wouldn't cool properly. It did work, however, which I determined by using the cigarette lighter and holding it under the interior temperature sensor. This sits in a hole that can be felt under the dashboard centre shelf. When doing this the system adjusted itself and cranked out wonderfully cool air.

"There is an adjustment for this on the amplifier unit. I turned it to the cold end position, but this wasn't sufficient to bring the temperature control knob properly on scale.

"My final solution to this was to connect a 10 kohm resistor in parallel with the external temperature sensor, which is mounted inside the right side external air intake. Careful analysis of the circuit diagram and the wiring allowed me to put the resistor alongside the internal temperature sensor. I connected a wire to the appropriate lead on the amplifier unit, the result being that the new resistor effectively was in parallel with the external temperature sensor. This one, by the way, did measure the correct resistance (the same as the internal sensor, when they both had the same temperature). This brought the adjustment on the amplifier unit into range making it possible to calibrate the temperature control knob."

TOO MUCH COOLING: Mike Morrin says, "If the system works properly for a while (10 minutes) and then drifts slowly towards full cooling, then the fault is likely to be in the plumbing to the in-car air temperature sensor. This is a reference to a couple of cases I have heard of where the rubber connector inside the dash had come adrift so that the air temperature *inside* the dash was being measured. There is no cold air supply inside the dash, just heat soak from the engine and heater unit, causing the measured temperature to creep higher and higher, and the A/C to pump full cold into the car."

TOO MUCH HEATING: Tom Bernett says, "Note that the function switch removes the supply from the temperature control circuit when in the DEF position, and this causes the system to move to full heating, so a faulty function switch can cause the system to stay on full heating. But, I was getting considerable air flow from the side and center vents when it was in full heat mode."

Mike Morrin explains: "Yes, because the function switch also has a vacuum valve which directly controls the demist flaps, and is independent of the electric circuit."

SERVO REPAIR: Mike Morrin says, "After cruising for an hour at about 70 mph. with the A/C on (of course), the system all of a sudden went to full heat. I fooled around with the temp selector and after several minutes it went back to normal operation.

"It turned out to be a faulty feedback potentiometer in the servo, so that the amplifier thought the system was on full cold, so was sending the system to full warm. To check this you need to leave a voltmeter connected to the feedback circuit (as per instructions) and see if the voltage goes the right way or the wrong way when the fault occurs.

“The actual fault on mine was that the feedback potentiometer is a wirewound type, and the wiper arm had worn through the wire right at the end of its travel. I did a quick fix by painting some silver loaded paint onto the end of the winding, and it has survived for 3 months so far, I expect another 10 years out of it.”

RELAY CHATTER: Mike Morrin, who owns a 1975 XJ-S, reports on “a tendency for the amplifier relays to chatter after moving the servo. An oscilloscope across the supply lines showed noticable spikes when the amplifier relays operated. I have managed to significantly improve this by fitting a 1000 uF 50V capacitor across the 12V supply close to the amplifier. The amount of relay chatter is reduced by about 80%. I can confirm that driving the car today, the operation of the servo system was smoother than previously.”

CONTROL AMPLIFIER REPLACEMENT: Aftermarket A/C control system amplifiers are available for those who either don’t wanna pay Jaguar prices or don’t expect that a new one of the same type will last any longer than the original did. See H. D. Rogers & Sons on page 712 or Welsh Jaguar on page 697.

CONTROL AMPLIFIER REPLACEMENT -- CHEAP VERSION: Mike Morrin suggests, “...a double pole switch (like a window lifter switch) can be arranged to drive the servo manually.” Simply connect 12V power through the switch to the red and purple wires on the servo connector; the two positions of the switch should provide power in opposite polarities. Label the button “cooler” and “warmer” or some such.

NAPOLI MOD: The idea of this mod is simple enough: provide a switch to enable operating the climate control system without the compressor when cooling is not needed. John Napoli says, “You are basically adding a switch in series to the inline fuse for the compressor located on the transmission tunnel near the air flap linkages.” The wire in question is a GN wire.

Note that operating with the compressor off will not only result in no cooling, but will eliminate the ability to dehumidify as well. In high humidity situations, you will probably need to turn the compressor back on to prevent window fogging and other humidity problems. You will definitely need it on if you use “defrost” mode to clear condensation on the inside of the windshield.

Also note that operation of the system in hot weather with the compressor off might cause the “Auto” mode to increase fan speeds, since it’s trying to cool and the servo is moving to ever more powerful cooling modes to try to lower the temperature. However, normally the occupants will want to switch the compressor on long before this happens. Even if it did happen, it’s simple enough to switch to “Low” mode.

There is a fuel cooler in the freon circuit, and shutting off the compressor will obviously result in a loss of fuel cooling. According to Roger Bywater, “the fuel cooler was added as an emission device, not because of fuel handling difficulties like vapour lock, although this could happen on early cars before the fuel rail temperature sensor was introduced. The high underbonnet temperatures of the V12 always resulted in a lot of heat being transferred to the tank with the recirculating fuel and I recall measuring over 60°C at the tank which means a lot of vapour can be given off. To pass a full EPA emission test for certification there are strict limits on the evaporative emissions of the whole vehicle (including adhesives, plastic mouldings, paint, etc.) and the fuel cooler eased this situation by reducing fuel vapour loss. This is why all cars for the USA market had air conditioning - they were not certified for sale without it. Also the convertible would have to have the compressor running continually because the air con would probably not be used with the top down.” Hence, the Napoli mod might technically be considered detrimental to the emissions control systems of the car. Note, however, that you would normally only switch the compressor off on days where the weather was cool anyway; presumably, the fuel needs cooling the most on the same days that you do, when you will have the compressor on.

The guys who have computers in their cars report that shutting off the compressor results in an instant fuel economy increase along the order of 2 mpg. As always, your mileage may vary, and in this case some of that benefit may deteriorate as the fuel in the tank gets warmer; warm fuel hurts engine efficiency. And if you roll the windows down, all bets are off; open windows are detrimental to aerodynamics, and if you're travelling at highway speeds the benefits of turning the compressor off and opening the windows may be a wash.

One final note: The stock system will already shut off the compressor under either of two conditions: 1) the air coming through the evaporator coil is too cold, or 2) the system is calling for max heat. Hence, the Napoli mod should not actually increase the heating capacity of the system; when max heat is needed, the compressor is off anyway. If this mod does noticeably improve heating performance, there is something wrong in the control system; I'd recommend adjusting the flaps per the procedure on page 535.

GARDNER MOD: The system is clearly designed with the intention that you will *always* have the climate control system on when driving; when the system control knob is turned to the "OFF" position, the fresh air/recirculation flaps are moved to recirc position, positively closing off the intake of fresh air. Tony Gardner's mod lets you drive along with the climate control system switched off and still have nice fresh air wafting through the dash vents. The Gardner switch removes the ground from the vacuum solenoid controlling the fresh air flaps, allowing the flaps to open and fresh air to enter the cabin.

The vacuum solenoid in question is readily accessable; simply remove the grille and pad on the left side of the console, and the vacuum solenoid is mounted just forward of the four-relay box. Simply disconnect the ground wire, and connect it through a switch.

The Gardner switch will hold the fresh air vents open regardless of whether the system is on or off, but when the system is on there isn't much point. During normal operation, the system almost always keeps the fresh air intakes open; the only time they are closed are during max cool and max heat, which are relatively rare. However, as noted above, the Napoli mod may cause the control to run to max cool far more often, so the Gardner mod may come in handy to use in concert with it.

For winter use, Gardner himself provides the following tip: "If the climate control is set to heat (to adjust the flaps) and then switched off, warm air flows through the fresh air ducts. The vent mod does not replace AC, therefore it actually works better in winter than summer." Note that when the system is switched off, the heater valve remains open for coolant to freely flow through the heater core; Gardner's idea of setting the temperature to full heat and then shutting the system off merely leaves the flaps in a position to guide the wafting air through the heater core. If the temperature is set to full cool and the system is shut off, the flaps will remain in a position to bypass the airflow around the heater core.

GARDNER/NAPOLI MOD COMBINATION: Tom Bernett was concerned about locating a profusion of switches in his XJ6. "If you combine both of these mods on the same switch (double pole, the circuits must be kept separate!) you can eliminate one of the switches and simplify operation. In one position the switch would make both the Gardner and Napoli circuits (just as in the factory configuration), in the other position the switch would break both circuits (invoking both the Gardner and Napoli mods). Here is the way this works under the 3 main operating modes of the A/C system:

> A/C System Off - The normal factory system configuration includes vacuum solenoid energized (fresh air flaps closed), and no power to compressor of course (except late XJ-S convertibles). If you open the combination switch (Gardner and Napoli circuits), vacuum solenoid loses its ground (fresh air flaps open). Napoli circuit has no effect since there is no power to compressor anyway. If you close the combination switch, the vacuum solenoid closes fresh air flaps (just like factory configuration), and makes the Napoli circuit (which has no effect since the A/C system is off and no power is available to the compresssor).
>
> A/C System On - Normal system configuration (except at full cooling) includes vacuum solenoid de-energized (fresh air flaps open), and power available to compressor. Opening the combination switch cuts power to the compressor (just like the solo Napoli switch), and has no effect on the vacuum solenoid which is de-energized anyway (except at full cooling, see below). Closing the combination switch allows power to

the compressor, and makes the circuit for the vacuum solenoid (which is de-energized anyway so there is no effect).

A/C System in Full Cooling - At full cooling the combination switch will be closed of course, so you'd have power to the compressor and the vacuum solenoid energized to close the fresh air flaps for recirc and max. cooling.

"As I said earlier, I'd rather not add another switch which isn't necessary and which requires additional thought and manual intervention (lessee... if I have the Gardner switch closed, should I open the Napoli switch, etc.?) It seems easier to say "I want fresh air only, open the combination switch with the A/C system off" or "I want everything but compressor, open the switch with A/C system on." or "I want normal operation, close the switch.""

GARDNER/NAPOLI MOD COMBINATION SWITCH: John Smith sends this suggestion: "The interior drivers lamp switch, the push on/push off switch next to the interior light switch is - you guessed it - a double pole switch. I have seldom used this switch for its intended purpose as it only provides minimal lighting.

"I removed the switch, and to give it a `genuine` A/c switch appearance I installed the letters`A/c` behind the switch window.

"To do this the switch must be carefully dismantled by drilling out the flaring of the small rivet and removing the rivet. This will allow the small side cover to be removed. Do this *carefully* because there are three springs and two copper contacts which will be loose inside and you need to note their position for reassembly.

"This will give access to the switch inner and allow you to gently prise off the front cover revealing the silhouette indicator piece of plastic with the lamp emblem. You will also see three small rectangular opaque plastic light diffusers. If you want a better looking and better lit switch - do not re install these. I also recoated the inside of the poorly painted white areas with liquid paper.

"On my bubblejet printer, I printed `A/C` using an 18pt Ariel bold font with white print and black background.

"I carefully scraped away the lamp emblem, leaving a small cleared rectangle to allow enough backlight through for the `A/c` label which I glued to the front over the scraped and cleared space. I sprayed the front with artist's clear fixing spray and reinstalled within the front switch cover and then reassembled the switch. Make sure you don`t put the `A/c` label upside down. The little red window is at the bottom and the green at the top.

"When refitting the switch side panel, make sure the hook on the piece of spring wire attached to this panel, engages in the in/out white plastic mechanism. A very small self tapping screw will replace the rivet.

"Wiring is as follows. Cut the connector wires about one inch back from the connector. Put the connector to one side. Get hold of the cut loom wires and join the the purple and the purple/ blue wires together. Tape off the ends of the black wire and the purple/white wire. These are not positive leads but it is best to tape them out of harm's way.

"Now the connector. Prise the connector cover open and relocate the brass terminal loop attached to the purple/blue wire from position 7 to position 9 alongside the purple wire. To check the wiring is correct, attach the connector to the switch and make sure there is continuity between the purple and purple/blue, and continuity between the black and purple/white when the switch is pushed in to the on position.

"To complete the wiring, hook up the vacuum (fresh air) wiring to the purple and purple/ blue wires and similarly, the A/c clutch wires to the black and purple/white wires. I soldered the joints and insulated them with heat shrink tubing to make a secure neat job.

"Reinstall the switch and it looks and works in a totally professional way."

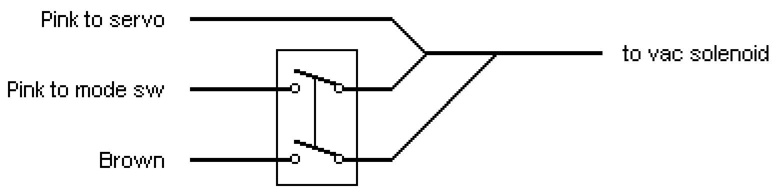
NAPOLI'S MOD TO THE GARDNER MOD (!): "Instead of wiring the Gardner switch to cut out the ground, wire it to apply power to the solenoid. Then, whenever you want recirc, regardless of the mode the climate control system is in, you can get it. You also preserve full Gardner functionality with the climate control off -- just switch off the switch." Essentially, the regular Gardner mod switch is OPEN/AUTO, while in this scheme it is OPEN/CLOSED -- complete manual control of the recirc flap.

SAWYERS MOD: The Sawyers mod is really another variation on the Gardner mod, providing improved control over the recirc flaps. It requires a two-pole switch. Craig Sawyers says it "does exactly what you want. Position 1, recirc under all conditions. Position 2, fresh air when mode = "off" and normal Delanair operation in any other mode switch position." Since "normal Delanair operation" means that the system is in fresh air mode nearly all the time but will go into recirc mode under the most extreme circumstances, the switch becomes a "fresh air/recirc" switch that the system has the capability of overriding when it really needs to in order to maintain temperature control.

"Unplug the pink connector at the solenoid (it has two pink wires going into it), and unplug the servo multi-way connector on the opposite side of the car. Now chomp *one* of the wires going into the solenoid female spade connector, and find out which one of the two wires you now have connects to the pink wire on the servo connector. That is the wire you *don't* want - the one you *do* want actually goes to microswitch C in the mode switch assembly, which you can't physically get to without dismantling the car. Note that you actually want a break in the *correct* pink wire - so you might have to resolder the one you just snipped, and snip the other one.

"Now take your two-pole switch and common up the wiper. Connect that common point to the vacuum solenoid end of the correct broken pink wire. Connect the NC (or NO) end of one pole to the other end of the pink wire. Connect the other NC (or NO) to the brown wire mentioned in my earlier post. Now plug both spade connections back onto the vac solenoid.

"Here's what the scheme described above looks like electrically:



"In operation, one switch pole interrupts the +12V feed that comes from the mode switch when in the "off" position. It is really identical to the Garder mod but with the switch in a different wire. The second pole of the switch is used to apply +12V to the solenoid when the mode switch is in any other position. So with both switches open, you get no +12V to the solenoid with the system "off", and the solenoid under servo control with the any other mode position (Gardner when "off", servo control in any other mode position). With both switch poles closed, you get +12V through the pink wire with the mode "off", and +12V from the brown wire in any other mode switch position (recirc no matter what). Just to complete the description, mode microswitch C takes a fused +12V from the fusebox and either connects it to the pink wire when "off" and to the brown wire in any of the other four mode switch positions."

BERNETT MOD: Tom Bernett explains his mod: "The Gardner mod opens the fresh air vents with the system turned off. My mod disables the fans and compressor with the system turned on. So I have fresh air and control of cabin temperature using the temp control knob.

"My mod requires switching open two circuits; one at the Water Valve Temperature Switch, and another at the feed to the Water Temperature By-Pass Switch in the servo unit (the brown wire at connector P2 near the servo)." Bernett describes how to test this operational mode by merely disconnecting two wires, so you can decide for yourself if you like it well enough to go ahead and install a switch:

1.) Remove the left hand console side casing and the underscuttle casing. The Water Temperature Switch is located above the black footwell vent. It's attached to a water pipe and has two connectors attached to it. One connector has two brown wires, the other has two brown w/ yellow stripe wires. Undo the connector with the brown/yellow wires.

2.) Remove the right hand console side casing. Find connector P2. It's located down low and aft. It's a circular white connector, maybe an inch in diameter with about 10 wires. Cut the brown wire between the connector and the servo unit. Cut it in the middle so you'll be able to connect to it later. Careful, don't cut the brown/yellow wire by mistake. You want the solid brown one.

"That's it. Try it out. Turn the ignition on and the mode switch to Auto. (If you have the Gardner and/or Napoli mods, switch those off) The servo unit should respond to the temp control knob, the blowers and compressor should be off, and if you're moving, fresh air, conditioned according to the setting of the temp control knob, will be flowing through the dash and footwell vents. Defrost position on the mode switch should still function.

"Why it works: The system is designed such that the heating mode is disabled (no blowers or compressor) until the coolant comes up to temperature. This prevents a blast of cold air in your face when you first start the car on a cold morning. After several minutes of running, the coolant warms up and the system clicks into action. This is controlled by the Water Temperature Switch. This switch closes when the coolant reaches 40°C/103°F and allows the system to operate normally.

"Now, just as you don't want a blast of cold air in a cold car, you do want a blast of air immediately when you start up a car that's been sitting in the sun on a hot day. This is accomplished by a Water Temp By-pass Switch and some fan switches in the servo unit. These are powered when the system is in cooling mode no matter what the coolant temperature is. So they override the above Water Temperature Switch. These switches are powered via the brown wire at connector P2.

"So, opening the circuit at the Water Temperature Switch disables the blowers and compressor in heating mode, and cutting the brown wire at connector P2 disables the blowers and compressor in cooling mode. In both modes the temp control knob, in-car and ambient temperature sensors, servo motor, fresh air flaps, etc. still function.

"All that remains is to come up with a convenient way of doing the above switching. I'm presently operating the mod with a double pole toggle switch. Opening the switch shuts down the blower fans and A/C compressor, but still keeps the fresh air flowing and the temperature control knob and servo unit functional. Close the switch and the system goes back to normal operation.

"I envision using this mod as my on/off switch. I'll leave the mode switch in Auto, and this switch open in all but extreme conditions. When I need max heat or A/C, I'll close my switch and the system will operate normally with both blower fans and A/C compressor."

Delanair MkIII (1987-On)

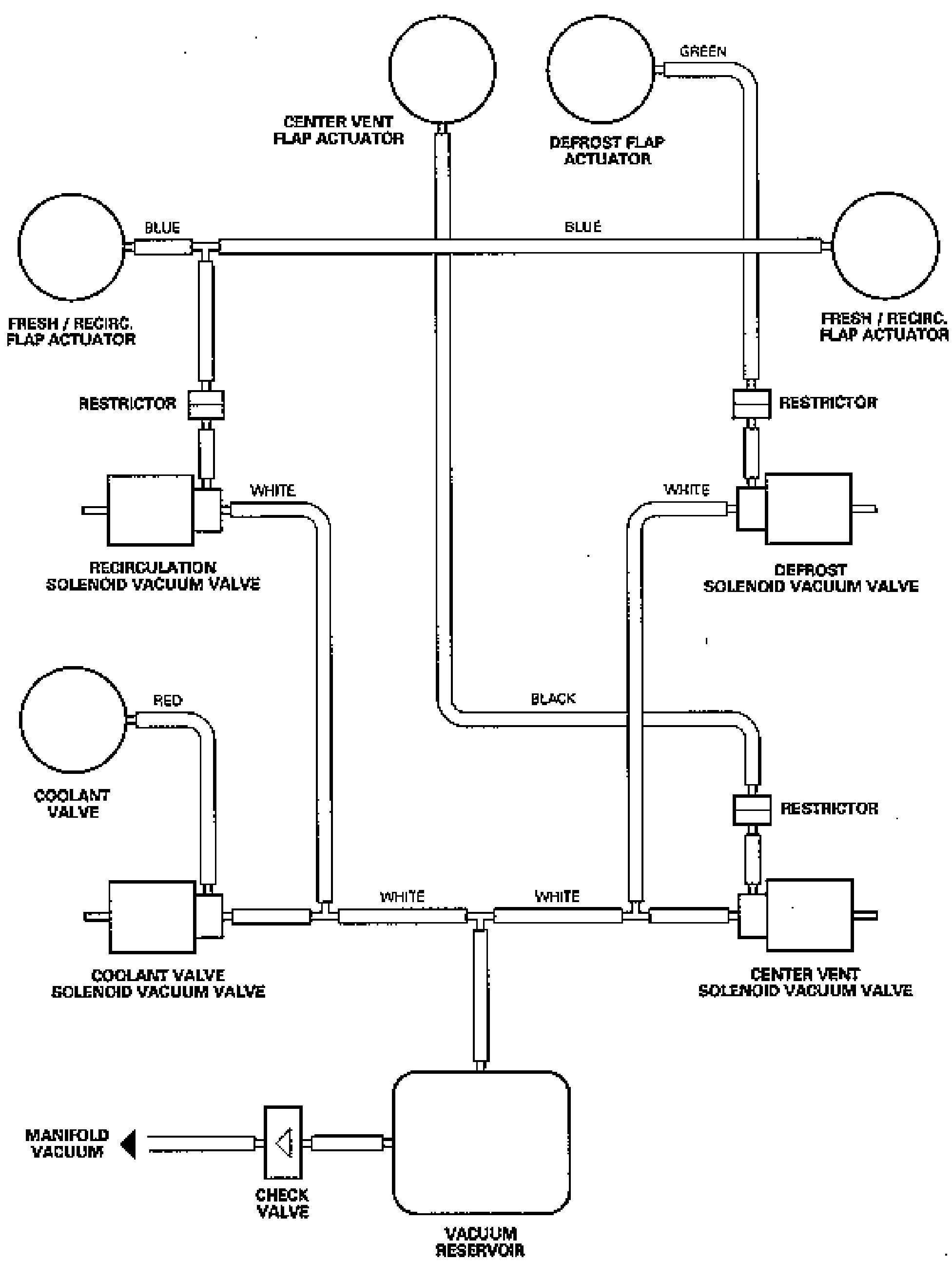
PARTS: Parts for the MkIII system are notoriously expensive. Per Hal Rogers, "the Delanair heater unit is made/supplied by Delanair of England. Many aftermarket companies have attempted to obtain parts directly from Delanair but they cannot sell directly because of contractual obligations to Jaguar."

PARTS CONFUSION: According to Technical Service Bulletin #8228, there is some confusion as to which A/C ECU goes with which water temp switch and in which car. According to their guide, the trick is to check the wires at the water temp switch on the left side of the evaporator case. If the wires to this switch are slate and black, the correct ECU is CAC 8032, the correct water temperature switch is JLM 763 (red), and the harness part number is JLM 1170. If the wires are green and black, the correct ECU is DAC 7601, the correct water temperature switch is JLM 2121 (black), and the harness is either JLM 10393 (all convertibles and 1992-on coupes) or JLM 10394 (1991-92 coupes). We all clear on that? Good.

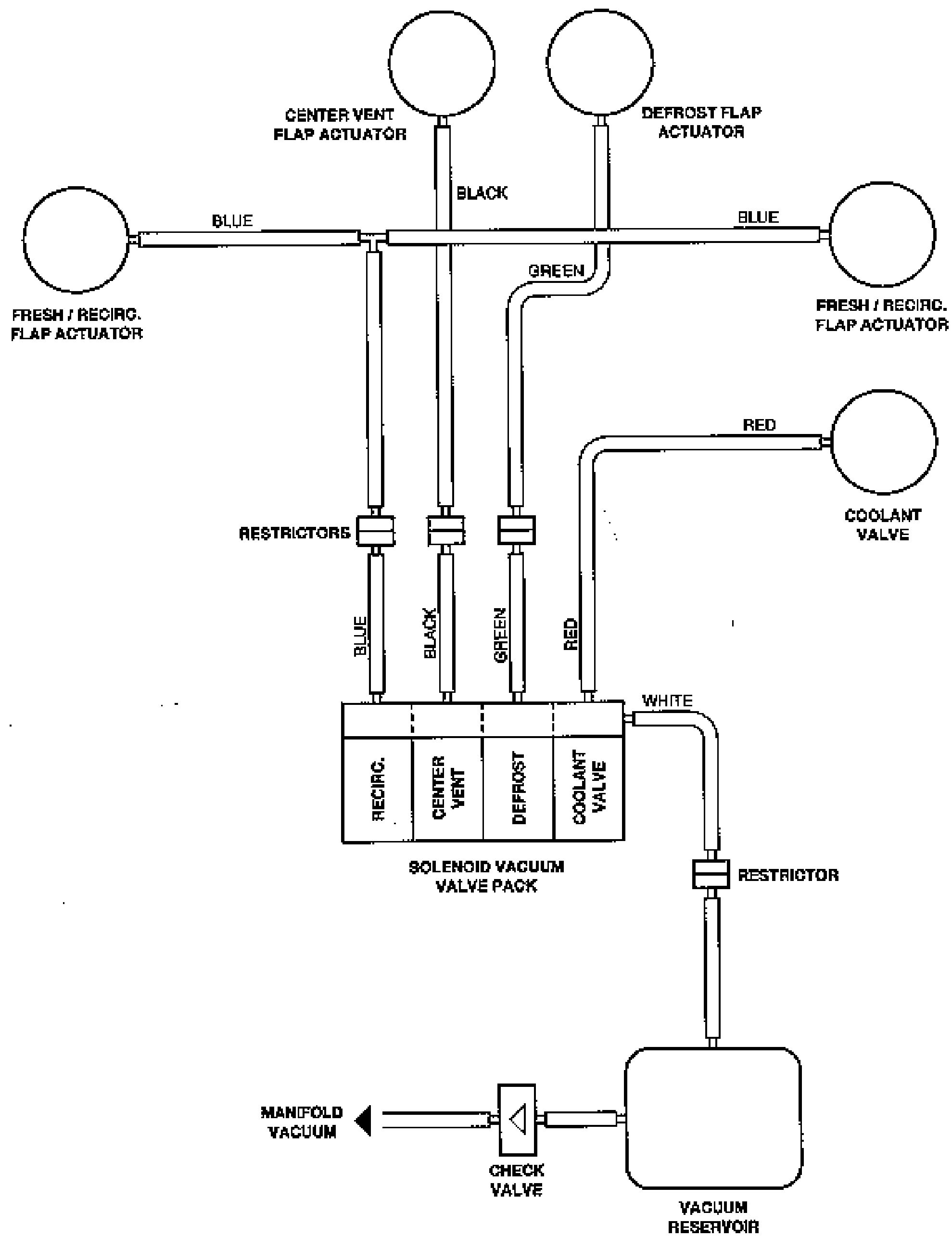
VACUUM SCHEMATIC: Finding a vacuum schematic seems to be difficult, so I have included two here -- courtesy of Victor Naumann.

Vacuum System

CLIMATE CONTROL VACUUM CIRCUIT: VEHICLES THROUGH 1993 MY



CLIMATE CONTROL VACUUM CIRCUIT: VEHICLES 1994 MY ON



BLOWER FANS: According to Randy Wilson: “Jaguar doesn’t sell the blower separately. They sell the complete blower unit: housing, motor, fan, and electronics! Yes, there are electronics buried inside that blower case. Plus, just to add a bit more, the right hand box carries the ambient temp sensor. There are also two relays inside the box.” The blower assembly is reportedly incredibly expensive.

BLOWER SPEED CONTROL REPAIR: Stefan Knappe saved himself a lot of money: “I noticed that the right fan (it’s got two, left and right) did not work except when the fan speed was set to max. I took the blower motor out, which is rather easy on the right side of a LHD car, finding a little solid state circuit located in the intake part of the fan. This circuit gets information from the A/C computer and regulates the fan speed unless the setting is to max, which actuates a little relay situated in the blower case too. I found out that the power transistor on this little circuit was blown. I went to the Jag service asking whether this is available seperately. But, you might have guessed it, the blower is only available as a complete assembly, being very expensive. So I went to an electronic store and bought a transistor equivalent to the type built into the fan-circuit (Texas Instruments #2N6284). I soldered it in, put the stuff together and the fan worked from that time on without problem.”

Martin Sellars adds, “Air con blowers: these devices contain an electronic circuit which gives speed control for all settings but “high”. This comprises a Darlington transistor 2N6284, a 68 Ohm 2.5Watt resistor, a 1N5401 diode and a small glass diode, probably 1N4148 or 1N914. All these parts are easily obtained cheaply from electronic component outlets (example; in the UK Farnell Electronic Components, +113 2636311, but ask for a catalogue to get the right order numbers). Blowers that won’t run at low speeds almost always have a failed transistor, but replacing that alone won’t always fix the fault. The resistor is there to protect the transistor from voltage spikes produced by the motor, so check the value and replace if it isn’t right (most hobby multimeters have an Ohms measurement feature). The small diode feeds the blower motor voltage back to the A/C computer, and has steel leads which corrode away, breaking the connection and preventing speed control from working. I replaced mine with 1N4004 types, which are much more rugged, more easily handled, and cost just a few pennies more. These diodes are fitted with their cathodes (marked by a bar on the body) towards the transistor collector (the steel case). The 1N5401 diodes are very rugged, and unlikely to need replacing. When fitting new diodes or resistors, don’t try to fit them inside the blower interior, like the originals, where they are prone to corrosion. Fit them on the solder side of the PCB (having snipped out the old parts) and then cover them with the original plastic flap using some tape.

“I also fitted new brushes to the blower motors, using power drill spares filed down to the right size (Kirby’s tip!).

“Inside the blower assembly is the high speed relay, which is also prone to dirt and corrosion. Standard car accessory shop units can be used here, but check the pinout - I think they are not standard, I had to rewire mine. Considering the cost of a new unit, changing the parts mentioned above gives “as new” performance at a tiny fraction of the cost.”

COMPUTER PROBLEMS WITH BLOWER CONTROL: Stefan Knappe cheated on this one: “Another problem I had on a friend’s car, on which one fan did not work. After checking the fan, I found that the A/C computer (located on the right hand side of the centre console, take cover underneath glove box out) delivered signal to one fan blower only, the other signal line being dead. Computer gone (at least in this respect). I asked for the price of a new one and decided immediately to go for another solution. Since I’m not so deep into electronics to repair this difficult thing itself, I had another idea. I cut the signal line which was dead and connected it (the line to the blower) with the good one for the other side. Both fans worked again. Risk was that the computer will be damaged on the good side due to higher current delivering two circuitries, but on the other hand the thing was already gone... This solution proved to be okay, since it still works and the repair has been done three years ago.

“Caution: Don’t check power output anywhere in the system with a lamp or bulb, use a voltmeter 10 MOhm impedance, otherwise you may damage the computer!!”

TEMPERATURE SENSORS: Martin Sellars says, “Temperature Sensors: the Delanaire system uses three, all are electrically identical. They measure ambient air temperature (mounted on the RH blower housing), in car temperature (above the glove box, behind a small aperture in the dash) and on the evaporator. These have three wires to them, power (5Volts from the ACC), ground, and the output wire. The output voltage is very closely controlled at 2.785V at 0°C and rising by 0.01V per degree C. So, a sensor at 20°C (about 68°F) should read 2.985V, and at 30°C (about 90°F) should read 3.085V, and so on. I found these can be measured reasonably easily with a standard 20k/Volt moving needle "hobby" type multimeter, at least well enought for fault finding purposes."

Richard Mansell quotes from a Jaguar publication on the changes for the 1992 model year:

> "The air-conditioning in car sensor now uses the motorised aspirator/sensor from the XJ6 allowing a more accurate reading of the true temperature of the cabin which will be less susceptible to drift or overshoot."

DUMB PROBLEMS: Martin Sellars: "My car showed very erratic operation of the A/C, sometimes OK, sometimes wrong settings (hot on hot days and vice versa!), sometimes no action at all. This fault might have been blamed on the computer - but in fact it was due to moisture coming out of the evaporator, and running down the RHS of the transmission tunnel onto the inline fuse holder that carries the supply current to the A/C computer. The contacts had corroded slightly, breaking the supply current, and giving intermittent operation of the A/C. A new inline fuse, plus fixing the drainage, solved the problem."

WHILE YOU HAVE THE BLOWERS OUT: Martin Sellars: "While the blowers are out, access to the evaporator is much easier. The four short tubes which couple the evaporator body to the rubber blower ducts can be twisted slightly and removed. This allows slight access to extract some of the gunge and detritus that blocks up the drainage system, causing wet carpets, rusty floors, and other problems."

HEATER CORE REPLACEMENT: Those who must replace the heater core should thank their lucky stars if they have the Delanair MkIII system. A major design feature of this system is the ease of replacing this core, a major task on the earlier cars. The Delanair MkIII system has bolt-on pipes for the heater core, eliminating the need for the "shortcut" pipe-cutting procedure devised for the earlier system. Also, Per Michael Neal, "The heater core is removable from the right side. There is a large piece of black tape, similar to electrical tape, that covers the access panel. Removal of the core is simple as unbolting the pipes, pulling the glovebox and access cover and removing the core." This eliminates the need for removing the instrument panel and dropping the steering column, as on earlier models.

HEATER CORE PIPE ATTACHMENT BOLTS: Per Julian Mullaney, "There was a problem of dissimilar metals causing corrosion of the bolts which attach the pipes to the brass core. The pipes and heater core are brass, the screws holding them together were steel. I guess stainless bolts would be better. You could replace them as a preventive measure."

HEATER CORE PIPE ATTACHMENT O-RING SEALS: Per Julian Mullaney, "The O-ring seal used at the connection point appears to be of a terrible design. A mechanic once told me that these O-rings always go first."

For anyone who doesn't think the resultant leaks would be a big deal, Mullaney adds: "This leak really screwed up a lot of stuff under there. The drips ruined the A/C amp, connectors, and my CD player."

Apparently Jaguar realized the seriousness of this problem. According to Michael Neal, "Jaguar has a gasket to replace the O-rings. It is shaped like the mating pipe of the heater core and is made out of a silicon/rubber type material." The part number for the gasket is JLM 759; you need two to do the job.

According to Mark Roberts, the "condensation deflector shield" being added to systems by Jaguar (see page 665) is actually a result of these connections leaking on radios!

HEATER CORE: Peter Cohen found this note: "When stock of this heater core is depleted use part number JLM 11343. The pipes that are bolted to the JLM 11342 must be removed and re-attached to the JLM 11343 because they have a different angle than the pipes on the JLM 11343. This mild modification is necessary because of the price differential between the JLM 11342 & JLM 11343."

Steve Gibson explains: "Both parts *are* still listed by Jaguar at the present time. The JLM11342 Heater Matrix was fitted to the XJ12 Series III 1985 onwards as well as the XJ-S 1987 onwards. The JLM11343 Heater Matrix was fitted to the XJ40 1987 to 1993. The JLM11342 is just short of being twice as expensive as the JLM11343 unit, so I should forget about "when stock is depleted" and if you have need of a replacement get the later unit and save yourself some money."

ELECTRICAL

COLOR CODING: In electrical diagrams, this book uses the same wire color coding scheme as Jaguar uses in their manuals. If two colors are indicated, the first is the base and the second is the stripe. If three are indicated, the third is a spiral stripe. The color codes are as follows:

N - browN (*not* neutral!) - usually 12V power

B - Black - usually ground

U - blUe

K - pinK

S - Slate (British for gray)

G - Green

Y - Yellow

O - Orange

R - Red

W - White

P - Purple

Jaguar also throws an L in occasionally to indicate a Light color.

If you want to know more about wire color codes, perhaps you should consult BS-AU7a, “1983 Colour Code for Vehicle Wiring”, British Standards Institution, 2 Park St., London W1A 2BS. Tom Bennett points out that an extract from this code is available on the WWW at:

http://www.dimebank.com/tech/LucasColours.html

This site also says you can get suitably color coded wire for harness repairs from British Wiring (page 706), British Pacific (page 706), and Narragansett Reproductions (page 707).

WIRING DIAGRAMS: If you’re going blind staring at the diagrams in the ROM, Michael Frank sends this tip: “Wiring diagrams in the following sizes (prices in British Pounds):

500mmx353mm	£9.95	+ £1.50 postage
594mmx420mm	£12.95	+ £2.00 postage
840mmx594mm	£19.95	+ £3.00 postage
1180mmx840mm	£34.95	+ £4.00 postage

Available for most classic Jags, with XJ and XJ-S available soon. The diagrams are laminated in plastic and color coded to match the actual wiring. The supplier is:

Classic Graphics
11 Springhill Grove
Stockton, Cleveland TS17 OYW
England

ELECTRICAL GUIDES: Short answer: You need one for your car, and you can download it from:

http://www.captainjaguarscathouse.com/Electrical_Reference.htm

If that doesn't work for you, you get the long answer: The repair manuals are sketchy at best when it comes to wiring diagrams and schematics; to make any sense at all of the wiring in your Jaguar, you'll need a separate publication. Jaguar offers booklets full of schematics for the electrical systems; these don't seem to have a title, but they are generally called "Electrical Guides".

One of these booklets says "Publication S 57", "Revised 7/88", and has a leaper on the cover. Inside, it has three sections: Series III XJ6, XJ-S through 1987 MY, and XJ-S 1988 MY. Each has its own table of contents. Hence, when you buy a copy of "Publication S 57" and tell the seller what kind of car you're buying it for, you probably won't get the entire booklet; you'll only get the section you need. Since the cover doesn't mention the models covered, you get a copy of the cover and one of the three sections and the impression that you have gotten the entire book. This isn't really a problem except that owners of pre-87 H.E.'s, '88 H.E.'s and Series III XJ6's all own "Publication S 57" and wonder what the other guy is doing with it.

Also: that second section may claim it covers "XJ-S through 1987 MY", but it lies. It only covers H.E.'s, so it really covers only 1982-88. The web site above lists "wiring diagrams" and other electrical info for earlier cars, but the publication known as the "Electrical Guide" didn't appear until the late 1980's. There is enough difference between the pre-H.E. and the H.E. that trying to use Publication S 57 on a pre-H.E. will cause more confusion than it clears up.

Richard Mansell provides a comprehensive list of Electrical Guides for the XJ-S:

S 57	XJ6 Series III, 1987 & 1988 XJS Electrical Guide
S 57/89	1989 MY XJS Electrical Guide
S 57/90	1990-91 MY XJS Electrical Guide
S 72/92	1992 MY XJS Electrical Guide
S 72/93	1993 MY XJS Electrical Guide
S 72/94 4.0L	1994 XJS 4.0L Electrical Guide
S 72/94 V12	1994 XJS 6.0L Electrical Guide
S 72/95 4.0L	1995 XJS 4.0L Electrical Guide (thru VIN 198334)
S 72/95 V12	1995 XJS 6.0L Electrical Guide (thru VIN 198334)
S 72/96 4.0L	1995/96 XJS 4.0L Electrical Guide (VIN 198335-on)
S 72/96 V12	1995/96 XJS 6.0L Electrical Guide (VIN 198335-on)

Mansell also reports that all of these are available on a CD from Jaguar, and it also includes similar documents for saloons. The part number is

S ELEC CD1

This author has the 82-87 section of S 57; it is a loose-leaf binder containing 25 pairs of figures. In each pair, the first figure is a schematic of a particular electrical subsystem, and the second figure (on the facing page) is a plan view drawing of the engine or car indicating where the individual components are located. Some of the illustrations are 8½" x 11" and some are larger fold-out pages. This is *very* useful information, but note that the publication does not include any text at all; no descriptions of how systems work, no troubleshooting info, nothing. Since the supplements to the ROM *do* include such descriptions and troubleshooting info, they are perhaps the more useful guides even though the schematics are not as clear and complete.

Peter Cohen adds, "...the S57/year wiring diagrams are put out by Jaguar Cars of North America, and would not cover RHD or be available in the UK. OTOH, they are just books, easy to ship (and light), and should be duty free. I'm sure Jag Services would post one anywhere if you paid by credit card."

Regarding the electrical guide for his '90, Mike Wilson says, "They now come with a Supplement that includes corrections for the following:

Fig 2.1: Added Diode to Neutral Switch circuit

Fig 2.2: Added Diode to Component location

Fig 6.2: Added Shorting Plug behind Fog Light Relay

Fig 11.1 & 12.1: Corrected the Titles for Coupe and Convertible

Fig 15.1: Ground Code Correction for heated rear window

Fig 20.2: Cruise Control, Resume switch and set switch locations reversed

Fig 22.1: Door Lock Terminal Identification added

Fig 25.1: Added Diode to EFI and Emissions diagram

Fig 25.2: Added Diode component location

Fig 6.1: New wiring diagram for Fog Lamps

Fig 20.1: New wiring diagram for Cruise Control

Both publications are numbered: S-57/90."

Jeff Strom mentions another source of electrical info: "The Mitchell manual is a publication of all the wiring diagrams for all vehicles. The older version that was printed had better information than the CD-ROM version out now. These are bought by shops and customer service folks that need the electrical information and not the mechanical information. Cost is in the $1200 range with quarterly updates, covers *all* cars and trucks."

JDS: Later Jaguars are fitted with connections for an electronic diagnostic system. A knowledgeable mechanic, who shall remain nameless here, sends the following words:

"JDS stands for Jaguar Diagnostic System. Basically it is a processor that ties into the serial ports in the car wiring. However good this may sound, it is no more than a glorified wiring diagram. It sends you down the circuit you are checking and you end up more often with a car that is torn apart and not fixed. All Jaguar dealers in the US were forcibly recommended to purchase one of these $23,000 units back in the late 80's."

"The new P.D.U. diagnostic unit which is supposed to be the new JDS is a self-contained unit that can be taken on road tests. Gen Rad is the manufacturer of both of these machines. The P.D.U., already dubbed as "Pretty Damn Useless", is a very complex unit. It uses CD-ROMs instead of 3.5 floppies. The screen is about 4" square, green display. It is a very difficult unit to use. The techs that have been to school for the P.D.U. still have very little understanding of it."

OPTICAL FIBERS: If the wire is solid dark gray, it may not be a wire; it might be an optical fiber. Illumination of the air conditioning control panel is via a single light bulb in a housing in the console, with the light carried by fibers to the various locations. This makes the whole panel dark with a single bulb failure, but it's a cinch to replace the bulb; just remove the ski slope (3 screws on early cars, see page 488 for later models) and replace the bulb inside the fiber optic unit within the console.

Don't cut those fibers; they're not easy to splice. They are a little brittle, so don't bend them too sharply either. They tend to get in the way when working on the radio, so be careful.

If you need to disconnect one from the fixture at either end, don't just yank. Insert a tiny screwdriver into the slot along the side of the socket and twist to spread it a little, and the fiber will come out easily. It has a little brass fitting on it with a lip. To put it back, simply press it in until it clicks.

Note that the sockets on the bulb housing are not all the same. If you open it up and look inside, you will note that some of the sockets feature a colored filter. Which socket used will determine what color light comes out the end of the fiber.

If you need to try to splice a fiber, Don Mathis of the Lightguide Media Department at AT&T Bell Labs says: cut the ends of your plastic fibers with a razor blade. This should give a very smooth cut. You need to butt the two fibers together while you epoxy them in that position. A "V-groove" works well. If you come up with a means of clamping the two fibers together mechanically, index match grease between the ends helps to decrease the loss. Silicone grease, clear, works well. Vaseline is not bad either.

If all else fails, Edmund Scientific has the fiber for approximately $.70/foot for 0.040" diameter. You can also get genuine Jaguar fibers from several mail order outfits, but they aren't cheap.

WIRE SPLICING: Making durable, reliable wire splices is essential to working on a Jaguar; there are a great many electrical circuits, they tend to be rather complicated, and the Lucas components cause enough trouble. When troubleshooting, it is important to be able to eliminate a previously-made splice as a possible fault.

First, it is helpful to have a pair of wire-stripping pliers around -- a *good* pair. A good wire stripper will remove insulation from the tip of a wire neatly, doing much less damage to the conductors than you can do with a razor blade, or your teeth, or whatever. However, a cheap wire stripper, especially one in which the stripping slots don't line up properly or are not sharp enough, can cut half the copper strands while removing the insulation.

When splicing wires together, the best way is to solder them -- if they won't be exposed to a great deal of heat, which may melt the solder. A soldering gun of about 140W capacity is recommended; soldering irons are intended for circuit board work, and do not work well doing wire splicing. On larger wires, an iron may not provide enough heat to make a secure connection. And, the intermittent nature of wiring harness repair makes the instant heating of the soldering gun a big help. Even the little light bulbs usually found on soldering guns tend to be helpful in automotive work.

If your soldering gun isn't heating like it should, loosen the nuts holding the tip and retighten securely. These are electrical connections (a soldering gun is a transformer that provides low voltage and high current through the tip to heat it), and they need to be *tight*.

Regardless of whether the solder used says "resin core", you should use a separate tin of resin flux. The first time you use it, you will know why this is recommended; relying on the resin in the solder doesn't work nearly as well. Do not use an acid flux; it is intended for copper pipe connections, not electrical work. And, before doing any soldering, always dip the tip of the gun in the flux and apply a little solder to the tip as it heats up.

Another workable splicing method, and the method to use when exposure to heat is a factor, is to use a crimp-on connector. If the crimp-on connector is the uninsulated variety, it may be possible to combine methods; crimp the connector to the wires, and then apply solder.

Crimp-on connectors can be purchased in automotive stores, often in a package along with other types of crimp-on terminals. Some of the connectors will have a built-in piece of insulation, while others are bare. Keeping a selection on hand is a must.

Most of the available electrical connectors work well, but there are a couple specific types to avoid. One to avoid is a tap connector that consists of a plastic device than is placed over an existing wire, a new wire is put in place alongside it, a slotted metal guillotine blade connector is squeezed into place with a pair of pliers, and a cover is folded over and snapped in place. While slick, this connector makes weak and unreliable connections, especially on unusual wire sizes.

Where possible, avoid the use of electrical tape. With age, it tends to harden, while the adhesive gets gooey. After some time, tape on connections can be found to have fallen off or slid up the wire, leaving the conductor exposed. If electrical tape must be used, it should ideally be stretched a little as it's applied; the stretch will pull it tightly around the conductors, helping prevent its coming loose anytime soon.

Please don't use friction tape. Electrical tape is solid plastic, while friction tape is black cloth. Friction tape is not intended for electrical work.

If you are connecting separate ends of wire or can slip something over the wire from an end elsewhere, the best insulation method to use is heat-shrink tubing. Heat-shrink tubing is available at some auto supply stores, hardware stores, and building supply stores, but the best place to buy it is at an electronics store. At the better electronics stores it can be purchased in 4-foot lengths and in a great variety of sizes. It also comes in various colors, including near-transparent so you can see how lousy your soldering job was.

Select a size of heat-shrink tubing slightly larger than the insulated wire, and cut a piece a little longer than your splice will be. Slide this piece onto one of the wires before you connect the wires together. After soldering, slide the tubing over the connection and use a cigarette lighter or match to shrink it down snugly. Heat-shrink tubing can also be used to insulate uninsulated crimp-on wire connectors.

CONNECTORS: Since the basic wiring connectors themselves are among the worst features of Lucas engineering, it is recommended that the owner keep a supply of Molex connectors (such as those sold at Radio Shack) on hand. When a connector is intermittent or is otherwise causing trouble, don't try to clean it up; simply cut the sucker off and install a suitable Molex connector in its place.

Some hardware or building supply stores carry a substance for preventing oxidation and corrosion of electrical connections. One such substance is called Ox-Gard, by Gardner Bender Inc. of Milwaukee; it comes in a 1 oz. tube and has the consistency of grease. Since Jag electrical connections tend to corrode, it is suggested the owner keep a tube of this stuff around and use it. The first place to apply it is on both ends of each fuse you can find.

Tom Wagner says, "I have a number of associates that actually grease the lamp socket base. They swear that it keeps the moisture out and prevents rust. I have no emperical data to confirm this and really don't have the guts to try an experiment. I have noted however that some cars (especially Fords) have a type of white grease packed into the connectors. Unfortunately every time I have seen this material it is because I have been replacing the device, so I don't know if the device has failed due to it or whether it is just a normal failure."

GROUNDS FOR COMPLAINT: This author has noted several places in the XJ-S where a ground connector is attached to the chassis with a bolt or screw that also holds a harness strap. The harness strap is plastic, and is held *between* the ground wires and the chassis. This is NFG for at least two reasons: First, it means that the only way the ground connection can possibly be made is through the screw itself, which is less than half as reliable as a properly seated ground connection. Second, since the strap is plastic, the screw simply cannot be tightened securely as that would only crush the strap.

The car has enough electrical problems. It is recommended that whenever such a ground connection is found, it should be revised. One method is to provide two separate screws, one for the harness strap and one for the ground. Be sure to scrape all the paint away under the ground connection before reinstalling it. Maybe a little anti-seize compound would help, too -- both in assuring a good electrical connection and in keeping the bare metal from rusting.

So far, such ground connections have been noted on the wheel wells just behind the headlight housings on both sides, and inside both doors near the hinge end.

MORE GROUNDS FOR COMPLAINT: Colleen Melton says, "the front subframe is grounded to the chassis through the ground straps (two straps, 1 from chassis to subframe, 1 from subframe to engine)." Mike Morrin responds, "You just made the light go on for me. I always wondered why my car has a ground strap with both ends bolted to the subframe. There is another strap from the engine to the chassis." Morrin had been driving around with an ungrounded subframe due to somebody arranging these straps incorrectly. There have been multiple reports of these straps being connected incorrectly or missing altogether.

Having the subframe ungrounded may have little effect, but having the engine ungrounded is a disaster. Check out the history of engine grounding problems through the throttle cable (page 269) and shift cable (page 324). Just go ahead and buy a suitable ground strap and install it in addition to the existing one. Convenient places to install a new strap include between a bolt on a front anti-sway bar mount bracket and anything on the bottom front of the engine on whichever side you choose -- power steering pump mount bracket, alternator mount bracket, whereever you find the right size bolt. Remember to provide enough slack for the engine to move around on its mounts without straining the cable.

SPADE TERMINAL INSULATION: In the places that the XJ-S has female spade terminals to connect to male spade lugs on a device -- such as on the starter relay at the right rear corner of the engine compartment -- the female terminals on the ends of the wires have a milky white plastic sleeve that snaps in place over the terminal to prevent accidental shorts. These insulators are guilty of misleading in two different ways: 1) When the terminal is pushed onto the spade lug on the device, the lug may enter the insulator between the flat side of the terminal and the sleeve rather than into the terminal itself. This may actually feel like it was inserted properly, and will usually provide a connection when tested -- but it will be intermittent, and you will have problems sooner or later. 2) When the connector is pushed onto the spade lug, the terminal itself may slip backwards within the insulator without being noticed. It looks like it's in place, but the terminal itself is actually only touching the tip of the spade lug, again making an intermittent connection.

A very workable plan is to take these insulators off and throw them away, and insulate the female spade terminals using heat-shrink tubing.

If you are installing new female spade terminals on a wire, it is suggested that you use two different sizes of heat-shrink tubing to insulate them. This works far better than the little plastic collars that come on crimp-on terminals, so it is suggested you rip the plastic collars off and use this method instead. This also allows you to solder the wire to the terminal after crimping for a more secure electrical connection. To insulate the terminals, take a piece of heat-shrink tubing about 1/2" long and a diameter that will fit over the wire itself as well as the crimp end of the terminal and slide it onto the wire before attaching the terminal. After crimping and soldering, slide this piece over the crimp connection and use a match to shrink it down onto the crimp itself, leaving just the spade terminal exposed. Then cut a piece of heat-shrink tubing of a diameter that will fit over the female spade terminal itself about 1/2" long and slide it on until the end is flush with the business end of the terminal, and shrink it in place so that it covers the terminal and overlaps the first piece over the crimp. The end result is a two-level insulation job that looks professional and even provides a measure of strain relief to the wire connection.

It's possible to do a similar two-level insulation job to a male terminal using a very short piece of the larger heat-shrink tubing, but it doesn't surround the terminal itself when disconnected, so unplugged terminals involve some risk of bumping into things and shorting. It works just splendidly when plugged in, though.

CONTACTS: Vince Chrzanowski of Baltic, CT restores old auto radios for a living. He recommends *Channel Master* COLOR contact Shield, Silicone Base, which is available at most electronic supply houses. Model 9101 is the 16-oz. can; model 9100 is a 6-oz. can of the same stuff. He claims many rocker switches, even many of those that appear to be broken, can be fixed by spraying this stuff through the cracks without even removing the switch from the panel!

Chad Bolles likes LPS 1. "It is greaseless and does not attract dirt and is made for elec systems." Tom Wagner adds, "CRC has a chemical for cleaning too."

Tom Wagner warns against confusing electrical contacts with connectors and using the wrong product: "My major concern is that folk will generically use contact cleaners without actually knowing that fuses and the like are actually connectors. Never, I repeat, *never* use a contact cleaner on them. They are for rotary switches and will do more damage than good. Often a cleaning with alcohol and a clean business card is all that is needed. There are chamois on sticks for cleaning VCR heads at Radio Shack that are excellent. Never use a Q-Tip, they will leave material behind. For pin connectors, clean all the dirt you can out and use alcohol followed by air to take any surface residue out. Then a simple repeat removal and insertion of the connector a number of times is often all that is needed. Stubborn cases usually require more drastic means. A typewriter eraser used gently is a very good burnisher. Round wood toothpicks can be used to clean the female part of sockets.

"Check for broken or cracked parts. They can also show where failures might be; the electronic circuits very seldom break down, but sometimes the plastic they are attached to allows the connections to fatigue, resulting in poor connections.”

SWITCHES: If you’re looking for generic switches to fit the existing cutouts in the console or dash panels, Craig Sawyers explains your problem: “The aperture is 22.5x30mm, and you will find that the vast majority of rocker switches are 22.5x27.2 (or very close). What you need is a switch specified as "European cut out", which is 22.5x30mm. Now I'm in Europe, and why these switches don't dominate the market is anybody's guess.”

ROLLER MICROSWITCHES: The microswitches on the throttle linkage and on the shifter look tricky with their little rollers and all. However, they are in fact a standard item, and are readily available at your local electronics store -- complete with identical rollers.

POTENTIOMETERS: Tom Wagner says, “There is another product for variable resistors like volume controls and air position sensors. It is a pretty good “stop gap” solution for intermittant radio controls and sensors, but has to be sprayed directly on the carbon track. It does work, have used it for years on noisy radio controls. Check the can and be sure that it is for controls not switches. In the old days we used “carbon tetrachloride” (just tapped the shop fire extinguisher), but that wrecks your liver and can actually be absorbed through the skin. Illegal and dangerous!”

ELECTRIC MOTOR LUBRICATION: Stefan Schulz and Chuck Johnson Jr. forwarded this procedure, originally from Chuck Johnson Sr., for oiling a “permanently lubricated” electric motor: “It is possible to lubricate a ‘permanently’ lubricated bearing by oiling the wicking that surrounds the bearing. To do so take a sharp awl (punch) and with a hammer punch a hole into the ‘bell’ shaped cover over the bearing housing. Do this through the vent holes in the motor and *not* in the end of the motor itself. The wicking is housed on the inside of the motor in a ‘bell’ shaped tin cover so it is easy to poke a hole in it. Then just take an oil can (I use a PLEWS oiler so I can get some volume in there but almost any oil can that can put some pressure on the oil will work), and ‘flood’ the wicking. This way you do not have to take the motor apart to get the bearing soaking in oil. After this you can periodically lubricate the bearing by just re-flooding the wick through the hole you have made. This technique works with all motor types, auto as well as small appliance and large appliance motors.”

The bearing cover that you are punching a hole in is very thin metal, much thinner than the housing of the motor itself. If you punch near the center, you may hit the bearing itself, and possibly damage or misalign it. Punch the hole near the outer edge of the cover; there will be nothing under there except the felt that’s supposed to hold oil.

Of course, some motors don’t have suitable vent openings, so you may have to open the motor anyway. This method still applies, though, since the bearing inside is almost always retained by a permanently-attached cover of this sort and oiling is almost impossible *without* punching a hole.

Another favorite item for applying the oil is a hypodermic syringe, preferably one with a fat needle. With a little luck, you can buy one in your area without being arrested for drug abuse.

Now that you have a procedure, you can oil motors periodically or you can wait until they seize up. Your choice. Do you really believe “permanently lubricated” means forever?

In the specific case of the XJ-S electric radiator fan motor, Schulz adds “the motor is of the “definitely no user serviceable parts inside, so do not open me” variety. Then again, you can open the thing by forcing the pry slots at the top and close it again be replacing the cover and punching down a bit more metal from the side. Look at one and you’ll see what I mean.” Of course, bending the metal back and forth regularly might result in needing a new motor sooner than not oiling it at all. In these cases, you might try a different idea: drill a hole through the housing itself, aiming for the same area adjacent to a bearing, and apply oil without disassembly. If it is important to keep water or dirt out of the motor, cover the hole with a piece of aluminum tape when you’re done.

WIRING HARNESS RENOVATION: Richard O. Lindsay sends this innovative method: "Tie the harness into position with tie-wraps thereby preserving all of the original bends and more importantly, break-out points. Remove all of the jacket leaving the wires only in position. This is a good time to clean and degrease all of the insulation. Then cut each wire, one at a time, about a foot or so back from the connector end. This cut should be well back into the jacket away from the breakout point. This allows you to splice in a piece of generic wire of the appropriate gauge and turn the original cut off wire around leaving the nice clean color-correct wire sticking out. The addition of a correct connector makes for a functional harness that, when vinyl wrapped, will look new and be color code correct!"

Dave Covert sends the following: "The cloth cover is not something you can really buy, but must send your harness to a shop and have it wrapped. The shop has a braiding machine that weaves 32(?) strands of cotton thread around the bundle. Sixteen strands in a clockwise direction, sixteen strands in a counter-clockwise direction. The cotton strands are usually black, but if your original harness had a colored tracer thread(s), send a sample along with the harness and the shop will switch some of the 32 strands out for colored strands to match the original tracer. The shop will also want you to mock up your harness with a few pieces of electrical tape to hold it in the proper shape.

"Cost is modest, and varies a bit from shop to shop. I had good conversations with two different shops, each with different pricing schemes. The first shop was Class-Tech of Bend, Oregon, 1-800-874-9981. The second shop was Harnesses Unlimited of Oreland, PA, (610) 688-3998."

If a complete rewrap isn't called for, Bruce Snyder sends these suggestions: "I've had a lot of success with the large sizes of heat-shrink tubing available at electronics suppliers. It's available in long lengths and a large variety of diameters, and looks quite nice when installed. Of course, you have to be able to slip it over the wires. The other thing that has worked well for me is the dry vinyl and cloth wrapping tape from Eastwood, and the cold shrink tape. These work very well, and have no adhesive to make that sticky mess we all love so well. These all take a little time to install, but look good, are durable, are considerable cheaper than a new harness and don't involve extricating the old harness for re-wrapping."

If your problems happen to involve the injector harness, read all about it under the EFI discussion starting on page 276.

RODENT DAMAGE: One of the members of the XJ-S online discussion group happened to mention that his wiring had been damaged by rodents, and it was simply *amazing* how many members responded with similar experiences! Apparently Lucas wiring, along with all its other shortcomings, is found delectable by rats! The problems usually seem to occur up in the V between the heads; it's probably a nice, warm, cozy spot for a rat to curl up in, and there's an assortment of tasty wires to chew on. Simon Gray reports, "I spent yesterday replacing spark plug leads, you guessed it, *mice*. It may have been a rat, either way it took one night to eat through four cables and totally ruin my day (I had renewed them three months ago)." They don't limit themselves to spark plug leads, either; there are also reports of chewed fuel injection wiring and ignition pickup wires.

Matt Dillon suggests, "My solution was to leave a cheap radio on in my garage all the time. Apparently the mice don't like the noise. My radio's been on for 2 years without any further rodent attacks. Until I started playing the radio, my cat was attacked twice!!!"

Perhaps you should get a cat to protect your cat, Matt.

MAIN 12V BUS AND TERMINALS: On most cars, the battery is in the engine compartment, so it is pretty obvious where 12V comes from and how to tap into it. On the XJ-S, however, the battery is in the trunk. There is a *serious* cable coming from the trunk along the bottom of the car and up to a post on the firewall, directly under the rear bolt attachment of the left side diagonal strut. From that point there is a short bus directly across to a similar post on the right side. Both posts actually mount in plastic insulators through the firewall, and protrude through on the interior side of the firewall to provide similar attachment points for electrical loads inside. Basically, everything in the car is powered from these two posts. Both ends of both posts are covered with rubber boots. If you need to tap into a 12V supply to power a new stereo or something, these posts are the place to connect to.

Note that there are *no* fuses in this supply; if you get a screwdriver between any metal on the car and one of these posts with the boot pulled back, you are gonna make some serious fireworks. It is *highly* recommended that the battery in the trunk be disconnected prior to fiddling with those posts.

The nuts on these posts -- both ends of both posts -- have a hex that is 0.525" (13.3mm) across. That's right, the only thing in your tool box that will fit is a pair of pliers! Craig Sawyers tells us these nuts are 1/4" Whitworth - 5/16" BSF wrench size, even though they are neither 1/4" Whitworth nor 5/16" BSF threads. See page 26 for help finding a wrench or socket.

If you're not interested in buying oddball tools, perhaps the easiest thing to do is to get the nuts off with pliers and then file the flats down until a 13mm socket will fit. Or, just replace the nuts with normal coarse-thread nuts; the post is 5/16" with 18 TPI, the same number of threads per inch as 5/16" SAE coarse thread, although the thread face angle and root details may be different. Brass nuts are recommended, even though the originals appear to be plated steel. If you're concerned about the perfect mating of threads, you might consider replacing the post in entirety, if you can find a piece of 5/16" brass threaded rod and a selection of nuts.

CONTROLLING INDUCTIVE LOADS: This book is not intended to be a primer on electrics, but in this case a review of some basics is warranted. Inductance is the characteristic of an electrical circuit that causes it to resist changes in current flow. If the current is zero and trying to get to 3 amps, it will take a little time to get there because of inductance; similarly, if the current is 3 amps and trying to get to zero, it will take a little time to get there, too. Inductance can be thought of as "inertia" of electrical current; it takes time to get it moving, and it takes time to stop it.

Inductance is a result of the relationship between electricity and magnetism. When current flows through a wire, a magnetic field is built up around the wire. Since the magnetic field is actually a form of stored energy, it takes some time to build up that energy, which means it takes some time for that current to get going. Similarly, when the current is cut off, the magnetic field remains briefly, but in collapsing attempts to maintain the current in the wire.

Once you understand the nature of inductance, you really don't need to have written data on components to know which ones have high inductance; it's the ones that involve wire wrapped around an iron core to form a magnet. Such loads are called "inductive loads", even though they always have some measurable resistance. By comparison, a light bulb is called a "resistive load" because it has lots of resistance and very little inductance. In an automobile, electric motors (fans, wipers, pumps, etc.), solenoids, and the A/C compressor clutch are inductive loads; ironically, the relays handling such loads are also inductive loads in themselves, although obviously on a smaller scale.

When you initially "turn on" an inductive load by closing a contact, things work well. The current is initially zero and builds smoothly to steady current flow. When you shut it off by opening the contact, on the other hand, things can get very messy indeed. The current in the inductive load attempts to continue flowing, but the circuit has been broken so it has no place to go. The dead-ended current results in a sudden spike in voltage between the leads to the inductive load, which means a sudden spike in voltage across the contacts. This spike has the opposite polarity of the power that was previously connected; if it was +14.4 volts, it is now negative volts, and it can be many times higher than 14.4 volts.

This spike is really quick. So quick, in fact, that a set of relay contacts opening that may look instantaneous to the human eye looks like a train slowly pulling out of the station to this spike. When the contacts first break open, the voltage will rise so quickly as to jump the gap long before the contact has time to move a couple of thousandths of an inch farther away. The result is arcing at the contacts as they open, which of course chars the surface of the contacts and wears them away a little each time. Some electrical switches and control devices actually have two separate contact ratings, one for resistive loads and one for inductive loads -- and the inductive load rating will always be lower, reflecting the additional stress of breaking contact with inductive loads.

Is this a problem? Well, you might want to think about that. If the contacts controlling the inductive load are in a standard relay in a place that's easy to get to, probably not; the contacts within a standard relay are often much heavier than called for and may last the life of the car, and if they eventually crap out a new relay costs $3. On the other hand, if the contacts are within something expensive and/or difficult to get to (the climate control system, for example), you might prefer that the arcing was avoided. The serious concerns arise when the loads are controlled by transistors rather than mechanical contacts; some of those electronic control boxes are astoundingly expensive, and reverse voltage spikes don't do them any good at all. Problems also arise when a single set of contacts controls both an inductive load and something with delicate electronic circuits; disconnecting the contacts can cause a spike from the inductive load to go zap the electronic circuits rather than jump the contacts.

Fortunately, controlling these reverse voltage spikes is really easy. All that's required is a diode, which is an electronic component that permits current to flow freely in one direction but blocks its flow in the other direction. Just wire a diode across the terminals of the inductive load; when the power is disconnected, the current flowing in the coil will simply come out one end of the coil, through the diode, and back in the other end of the coil. This provides a path for the residual inductive current to take without having to jump the gap at the contacts. The voltage spike is almost entirely eliminated, reduced to the gate voltage of the diode -- something less than one volt.

It is obvious which way to connect the diode; if you connected it the other way, it would form a bypass around the load when the power was turned on (and usually a direct short to ground, so your diode vaporizes in short order or a fuse blows somewhere). The symbol for a diode includes what looks like an arrow pointing in one direction; this is the direction that current will be allowed to flow from + to -. So, the diode will need to be installed around a load with the arrow pointing towards the +12V power source so current won't flow through it when the power is on. Some diodes are marked with a simple band at one end; this end should point towards the +12V power source.

Alan Heartfield says, "On modern cars with electronic circuitry, a diode should be placed around every inductive load, even relay coils. In fact, P & B and Bosch sell 'ice-cube' relays with the diodes built in. These are used as standard on most modern transit vehicles to protect the electronics. The diode doesn't only protect the switching device, but also reduces RFI (caused by arcs) and eliminates large reverse polarity voltages from migrating around the car, potentially (pun intended) punching pin holes in insulation and reducing the life of electronic parts."

So: would it be a good idea for owners to add such diodes to earlier cars that didn't come with them? Like they say about chicken soup: it couldn't hurt. Diodes are cheap; you can get small ones suitable for relay coils from Radio Shack for 25 cents each or so. The biggest expenditure on your part would be the time and effort to install them. For that reason, you might consider just buying the later design relays that Heartfield mentions and just swapping them out. Note that a basic relay will work no matter which way 12V is connected to its coil, but once a diode is involved polarity becomes important; you might want to check that the +12V connection is on the correct terminal before plugging in the uprated relays. If not, you'll need to reverse wires, which can usually be done by popping the 85 and 86 spade terminals out of the socket, interchanging them, and popping them back in.

If you decide to buy diodes, you're gonna want to know what to look for. Diodes seem to come with lists of specifications as long as your arm, but many of them are unimportant in this application. One specification that is important here is the Peak Inverse Voltage (PIV), which obviously needs to be higher than the 14.4V that the diode will be subjected to -- but it's difficult to find a diode with a PIV rating less than 50, so this isn't a problem. The continuous current rating is unimportant, this diode will never see a continuous current. The surge current rating needs to be at least equal to the continuous current draw of the inductive load it's attached to, but the loads on relays are some fraction of an amp while the larger loads may be a few amps, and the surge ratings on even tiny diodes can be 30 amps or more. All in all, it's hard to go wrong; just select some tiny diodes for the relay coils and something more substantial for motors and other loads, and they'll work fine.

Finding a suitable diode for the A/C compressor clutch is especially easy. See page 505.

If you will compare the electrical schematics of early XJ-S's with those for the 90's models, this is one of the changes you will note; circuits containing a diode and a resistor have been added around many relay coils. Why the resistor? That brings us to more electrical theory. The magnetic field built up within the inductive load is a form of stored energy, and sooner or later that energy must be dissipated. If a simple diode is wired across the load, then when the power is cut off the current will continue to flow around the circuit until the energy is dissipated in the resistance of the wire and the diode itself. This might actually take too long. Some inductive loads have relatively heavy wire and low resistance, and so may take some number of milliseconds to decay. This can have detrimental effects. In the case of a relay, the slow dissipation of the magnetic field may cause damage to *its* contacts as they slowly drag open instead of popping open as they should. In the case of fuel injectors, Roger Bywater says, "Some years ago we measured injector closing action which with injectors like those on the V12 normally takes about 1 millisecond. Putting a flywheel diode in slows the injector closing down to about 3 milliseconds which is why you never see diodes used that way on injector drive circuits."

If you install a resistor in series with the diode, the initial current flow when power is disconnected will be unchanged; it is still the same amount of current that was flowing when power was on. However, this current is now flowing through an additional amount of resistance, which means it is dissipating more energy. The current flow will drop off more quickly. Electrically, the way to envision this is that the current through the resistor results in a voltage drop across the resistor -- which means we have reintroduced the reverse voltage spike, only now hopefully at a tolerable level. Since the initial current is a fixed value, the higher the resistance, the higher the reverse voltage spike. The voltage then acts against the flow of current and brings it to a stop; the higher the reverse voltage spike, the quicker the current stops.

The ultimate case would seem to be an infinitely large resistance: leave the diode out altogether. Infinite resistance results in an infinite voltage spike, which in turn stops the current in zero time. Doesn't happen in practice, however. What really happens is that, at the instant the contacts break, the voltage spikes high enough to jump the gap. As the gap between the contacts continues to widen, the current continues to jump it (helped by the generation of ozone), until the energy has been dissipated in bridging this relatively large resistor. In other words, the energy stored in the inductive load has been used to vaporize a few molecules off the surface of your contacts. Meanwhile, the high voltage spikes haven't done any good for the insulation in the wiring, and it'll eventually start to break down.

So, you don't want too much resistance. If the resistance was about the same as the resistance in the inductive load itself, then the reverse voltage spike would be about 14.4V -- which the electrical system is clearly capable of handling without damage. In practice, you can always go with a resistance a couple times larger than that of the inductive load itself, since the wiring and components will be designed to handle much higher voltage than 14.4V.

Note that the amount of energy dissipated in the resistor itself is exceedingly small and brief. Like the diode itself, the resistor can be tiny. A 1/4-watt resistor or even smaller will do.

Keep in mind that installing a resistor with the diode only makes sense on inductive loads where it is important to quench the magnetic field quickly, such as on relays. It shouldn't be necessary on electric motors, since the momentum of the rotor will keep it rotating several orders of magnitude longer than the effects of inductance will last. Similarly, the A/C compressor clutch probably doesn't need to disengage suddenly, since it will spin for a bit when disengaged due to momentum anyway, and the coil releasing the engagement a couple of milliseconds more slowly probably won't make any difference.

Now, note that if the resistor is high enough ohmage and high enough wattage, you can leave out the diode and simply wire a resistor across the coil terminals! This will waste electricity, because whenever the power is on to the relay coil it will also flow through the resistor with no diode to stop it. The resistor now needs to be large enough to handle that current on a continuous basis rather than just the instantaneous spikes -- but resistors are cheap, so this is plausible. While a resistor with a low enough resistance to suppress the reverse voltage spikes on a large inductive load would waste a lot of electricity, a resistor across a relay coil could have high enough resistance that the wasted electricity could be considered insignificant. The scheme has the advantage of making polarity unimportant, so power can be wired to the coil and resistor in either direction without blowing out a diode.

Bosch appears to have adopted this strategy on later relays, building a resistor right into the base of the relay. One such relay, having a gray plastic housing and number 0 332 204 159, shows a device wired across the coil in the schmatic on the case but doesn't indicate what the device is; it's shown as a simple rectangle rather than a resistor or diode symbol. However, a dissected relay revealed that the device was a 630Ω 1/2-watt resistor. At 14.4V, this resistor would waste only 0.023 amps. Such a resistor would theoretically permit a reverse voltage spike of about 107 volts as connected across the 85Ω coil in the relay. Presumably, this spike is considered a reasonable balance; a lower ohmage resistor would permit a smaller spike but would waste more electricity. Using a diode would permit use of a lower ohmage resistor for a smaller spike without wasting any electricity, but requires care in connecting to observe correct polarity.

There are other ways to deal with reverse voltage spikes in inductive loads, including installing zener diodes (which will "clip" the voltage spike at a particular level) and capacitors (which will absorb the energy and then send it back through the inductive load, resulting in a resonance wave back and forth until the energy is dissipated by resistance in the winding). Craig Sawyers likes the zener diode: "This might actually be an improvement over the resistor, for the following reason. The reverse voltage is in direct proportion to the rate of collapse of current. With a resistor, the voltage drops as the energy is dissipated, giving rise to an exponential fall in current and voltage. With a zener, the current will collapse faster, because it will attempt to hold a constant voltage of (say) 36.7V until the current is truly minute (microamps).” Zener diodes are cheap, but a bit more difficult to find than simple diodes and resistors.

One application where the simple diode won’t do is on reversable motors, such as electric windows, electric seat adjusters, automatic antennas, and electric mirror adjusters; the diode will conduct when the motor is running one direction. One possibility is to wire in a resistor without a diode, as described for relays above; since most reversable motor applications are only operated for a few seconds at a time, the wasted electricity can be considered insignificant even if the current through the resistor is significant. You could actually put the diode back in if you want, just to eliminate the waste of electricity in one direction.

Perhaps a more esthetically pleasing solution would be to install two zener diodes, each with a zener voltage somewhat greater than the 14.4V that the motors run at, wired in series but arranged with opposite polarity across the motor terminals. Any voltage spikes that exceeded the zener voltage plus the bias voltage of the other zener diode (about 0.6V) would be clipped; otherwise, the pair of zener diodes would do nothing. Offhand, going to such efforts might not seem worthwhile; if you think so, please see the section on window switch problems starting on page 605.

There are a few specific inductive loads in the XJ-S you don’t need to worry about. One is the injectors. Bywater: “The old V12 D Jetronic amplifier has a 'snubber circuit' on each of the injector drives consisting of a 6.8 µF capacitor and an 11 Ohm resistor in series. This has the effect of softening the induced voltage spike but still allows the reverse voltage to build up to oppose current flow. It might be expected that this arrangement would promote oscillation but that does not seem to be of much consequence.

“The 6CU and later V12 systems have 47 volt Zener diodes which clip the induced voltage spikes. This is a good solution because it provides rapid build up of reverse voltage, protects the output transistor from an excessive voltage spike, yet does not provoke oscillation.”

Another non-concern is the fuel pump relay. Bywater again: “Both 6CU and 16CU have a protection diode on the pump terminal already. Failure is usually caused by either a dry joint or a component failure and has nothing to do with the relay.”

If you have the earlier solenoid type door locks, you don’t have to worry about them either. They are never connected to system voltage! They are operated by power from discharging capacitors, so their current drops off gradually as the capacitor discharges.

If you have an early car with the solenoid-park wiper motor, there’s one place you *do* need to install a diode. See page 623.

One final note: Even with diodes, resistors, zener diodes or whatever in the circuit limiting the reverse voltage spikes, it is still unwise to have a single set of contacts operating both an inductive load and an electronic device. Alan Heartfield: “The insulation will handle it, not being polarity sensitive, but if it finds its way back to any collector-emitter junctions, they will not handle any reverse voltage spikes. Neither will the input circuitry of many integrated circuits. And the effect can be cumulative. A semiconductor will deteriorate due to overvoltage and/or reverse voltage effects.” If you must have a switch or relay control both an electronic device and an inductive load, it is advisable to select a double-pole control device and use a separate contact for each.

Relays

RELAYS: There are relays all over the XJ-S. On the ’83, most are a Bosch 12V 30A SPST relay number 0 332 014 113, and are a small metal box with four spade terminals labeled 30/51, 85, 86, and 87. 85 and 86 are the coil connections, 30/51 is the common contact, and 87 is the Normally Open (NO) contact. The typical layout of these terminals is shown in Figure 39 on page 680.

These relays apparently conform to a standard, and are readily available at any auto parts store. Often, the aftermarket relays are labelled for use in controlling driving lights, and may be found among the driving light kits instead of under general electrical components. They are usually entirely black plastic, and they often have an integral mounting lug. And of course, an aftermarket electrical device is likely to be as good or better than a British original (although not all -- this author found a particular type relay made in Italy and sold at AutoZone that wasn't worth a damn, three in a row failed quickly).

If you are installing or relocating relays note that relays are not watertight, even when they appear to be. Bosch relays have a distinctive little hole in the bottom. Their durability will be greatly enhanced if you will install them with the spade terminals pointing downward, so that dripping water can't get in and any moisture that does get in can drain out.

Unfortunately, the XJ-S is covered with exceptions to the common relay description above. Following are descriptions of several components that *look* the same and will fit in the standard socket, but are *not* the same and exchanging may cause problems or even shorts.

FIFTH SPADE TERMINAL: Many relays have a fifth spade terminal centrally located in the base in the middle of the other four; Figure 39 on page 680 shows a terminal 87a in this location. When replacing relays, it is of considerable importance that the new relay has the same type terminal in this central location. Common designations for this fifth terminal include 87, 87a, and 87b -- and these are *not* interchangeable. In most cases, a relay with a fifth spade terminal can be used to replace a relay with only four, as the socket or plug will usually have a hole or slot for the unused spade to protrude through, and the basic four are nearly always the same regardless what the fifth terminal is.

SECOND 87 TERMINAL: Some relays in the XJ-S (and some of the aftermarket generic equivalents) have a second terminal 87 in the center of the base. This terminal is connected internally with the first 87; it merely serves as a second connection to the same contact. Although internally the same, one should be careful about replacing a relay with two 87 terminals with a relay having only one; the socket may have a wire that connects to the central spade, and it will not be connected if the terminal is not there. At this point, the solution is usually a simple matter of trading one relay with another to get a relay having both terminals where it is needed. It would also work to simply splice the wire going to the second 87 terminal into the wire going to the first 87 terminal.

SPDT RELAYS: The radiator fan relay, SRB411, has five spade terminals on the bottom, and the terminal in the center is labeled 87a. This relay is bright red -- Lucas' way of indicating "Hey, dummy, this relay is *different*!". A close inspection of the schematic on the housing shows that this is in fact a SPDT relay, and the 87a is a Normally Closed (NC) contact.

A SPDT relay might not be quite as common as the typical SPST relay, but it's close. Finding substitutes is not difficult, although a generic driving light relay won't serve here. If you don't wish to buy the Lucas original, you can look for a Bosch, Hella, or Potter & Brumfield. Per Bob Whiles, the part number for the Bosch is 0 332 204 105 and for the Potter & Brumfield is VF4-45F11; this author suspects Bosch numbers 0 332 204 109, 0 332 204 125, and 0 332 204 159 would work as well. Per Volker Nadenau, the Hella part number is 4RD003 520-13. All of these will plug right into the red socket.

DPST RELAYS: Some relays, including Bosch number 0 332 015 006 and 0 332 015 012, have an 87b terminal. This connects to a second NO contact. Note that this is not the same thing as having two 87 terminals; while the relays with two 87 terminals have both terminals connected to the same contact, this relay actually has two separate contacts. Here's the distinction: when the relay is energized, the same connections are made as in the relay with two 87's, but when unenergized, the 87 and 87b terminals are *not* connected to each other. In some instances, this may make no difference, and perhaps a relay with an 87b terminal can be used to replace a relay with two 87's, but be very careful replacing a relay with an 87b with a relay with two 87's -- something might backfeed through the 87 terminals on the relay and cause malfunctions.

In addition to variations in the fifth spade terminal, there are other variations among relays -- and things that look like relays.

EFI MAIN RELAY: On the Digital P EFI system diagrams, item #312 is the "main relay". This relay is mounted in the trunk near the ECU, right alongside of the fuel pump relay. Don't mix up the two relays; the fuel pump relay is a standard relay, but the main relay, Bosch #0 332 014 112, looks like a standard relay but it has a diode installed internally in series with the coil. This difference is clearly indicated on the little schematic embossed in the side. They also paint a colored diagonal stripe across the top to indicate it is unusual.

The purpose of the diode in this relay is reportedly to protect the expensive EFI system from boneheads hooking up the battery backwards. If the battery is connected backwards, this diode will prevent the relay from operating, so the ECU will not get any power.

In this case making a special relay was totally unwarranted; a normal relay can be used by simply adding a suitable diode in the wiring *to* the relay.

FEEDBACK MONITOR RELAY: On the Digital P EFI system diagram for the North American "Emission A" spec, item #355 is the "feedback monitor relay". In the Electrical Guide, it's called a "feedback inhibit relay" on the EFI diagrams and it's called an "inhibit relay" on the starter circuit diagrams. Whatever it's called, you're going to be very interested in this relay when you try to start the car and nothing happens; this relay must close for power to get to the starter relay nearby.

The feedback monitor relay is mounted under the black plastic cover at the right rear corner of the engine compartment, alongside the starter relay and the cold start relay. The feedback monitor relay is the one farthest forward on the author's '83, although there's no telling if that holds true for other model years.

The cold start relay is a standard relay, but the feedback monitor relay is anything but -- don't mix them up. On the feedback monitor relay, Bosch #0 332 014 411, the connections on the base are rearranged, with one of the coil terminals (#85) and one of the contact terminals (#30) being interchanged compared to standard relays. There is a diagonal paint stripe across the top to indicate it is unusual.

The feedback monitor relay also has a diode mounted internally in parallel with the coil to absorb voltage spikes and protect delicate electronics (see page 559) -- long before it became popular to provide such protection in most relays. In fact, that may explain why the terminals are rearranged -- to make sure nobody substituted a standard relay without a diode. Of course, the feedback monitor relay is illustrated in most Jaguar schematics as a normal relay; no diode shown. The schematic embossed in the side of the relay itself shows the diode clearly, and it is also represented in the diagrams in the Electrical Guide.

Even before such spike protection became common, there was never any need for a special relay here; a normal relay with a diode wired into the harness would have worked fine. Hence, if your feedback monitor relay is acting up (the starter fails to respond sometimes), it is recommended that you do *not* seek out the oddball relay to replace it. Rather, use a jeweller's tiny screwdriver or something similar to pop the 30 and 85 terminals out the back of the socket, exchange them, and pop them back in. Then plug in a common relay (there's even an unused hole in the socket for a fifth terminal), making sure to use a modern one with built-in spike protection -- usually a resistor rather than a diode, but either will work fine. If you want to make sure to protect the EFI ECU from someone later installing a relay without such protection, hardwire a diode into the harness. Of course, you might also want to stick a label inside the plastic cover over these relays explaining to Jaguar mechanics that this application no longer requires the oddball relay.

ELECTRIC FAN DIODE PACK: The electric radiator fan diode pack is the blue block at the left edge of the engine compartment that looks like a relay, but isn't. It's described on page 224.

As an engineer, I have to express an opinion here: the guy who decided it was a good idea to make several totally different and non-interchangeable components all fit in the same socket should be dragged away and shot. There is simply no excuse for this level of incompetence.

LATE MODEL RELAY PROBLEMS: Michael Neal warns: "I just wanted to advise the list of a known problem with late model Jags, roughly '93 and later. They have several Hella brand relays in various places for different components. Underhood usage of them seems to be the worst problem. The XJ-S and XJ6 use them extensively on everything from A/C clutch control to EFI main relays. Hella apparently came out with a replacement to "fix" the failures. They haven't been working. Whenever I have a strange problem come in, 90% of the time it's been one of these damn relays. Unfortunately I'm forced to replace them with what Jaguar provides so that's what they get. The relays are developing bad contacts and overheat, failure is usually intermittent. Most of these relays have a light blue case. You can troubleshoot them by pulling the relay and jumping between the 30 and 87 terminals."

Leonard L. Peake adds, "There is a Jaguar "Service Bulletin" in regards to all relays on 1993 cars that have a date code before "183" stamped on the side."

Gary Penovich says uppity relays cause fault codes. "To prevent it from happening again, you may want to replace the blue relay(s) with the updated black ones. You should at least pull *all* your underhood relays, spray the sockets with electrical contact cleaner, and buff the grunge off of the relay contacts with an emery board. I'll but they're covered in grunge and corrosion."

SHOPPING FOR RELAYS: Finding a parts store employee here in the Bubba Belt who even knows what a relay is, much less whether or not it is the configuration you need, can be a challenge; "What kinda car is that fer?" as he prepares to type on his computer terminal. Actually, the best place to look for relays is in a junkyard; just about all cars use relays for one thing or another. They are often hidden inside fuseboxes or other compartments. European cars often use Bosch relays. All European automotive relays seem to have a little schematic on the outside, so it is a simple matter to confirm whether or not a relay has the desired terminals. This author had no trouble finding relays that have the 87a (NC) terminal. If you need a relay with only a single 87 terminal and don't care what the fifth terminal is or even if there is one, almost any relay will work; they all seem to have the basic 87 terminal.

If you find relays from late model cars, the schematic on the side is likely to show an internal diode or resistor wired around the coil (between the 85 and 86 terminals). No problem; in fact, this is likely to be an improvement! See the discussion on controlling inductive loads on page 559.

Japanese cars often use relays with a totally different configuration, and sometimes they have no schematic on the case. They are very reliable relays, though, if you can figure out which terminal is which. The layout of the base prevents plugging the wrong type relay into the socket, and the case color indicates which type relay it is. Gee, some engineer there musta thought about what he was doing!

If all else fails you can go to an electronics store and buy a generic "ice cube" 12VDC relay and solder short jumper wires to suitable spade connectors to plug into the original socket. "Ice cube" relays are called that because they have clear plastic rectangular housings so you can see the innards; no schematic on the case required, you can *see* what the terminals are connected to! Ice cube relays may have as many as four sets of contacts, and they always have both NC and NO contacts on each one. If you buy a relay with more contacts than you need, just wire them all up to provide extra current capacity.

Starting Circuit

STARTER RELAY: Also called the "ballast resistor starter relay" in the Haynes repair manual. Item 194 on Jaguar wiring schematics. It is Lucas style 22RA, Lucas part number 33356 or SRB301, Jaguar part number C36611.

Most of the Jaguar schematics show this relay's internals unclearly or even as a simple box with five terminals and no indication what goes on inside. If you have a copy of Publication S 57, the "Electrical Guide", the relay is shown in painstaking detail in Figures 2.1, 3.1, 4.1, 24.1, 24.2, 24.3 and 25.1 -- incorrectly every time. The relay is shown as having only a single contact connected to terminals C1 and C4, while in fact there are two separate sets of contacts within the relay. C1 and C4 are not connected to each other when the relay is not energized. Also note that the C1 contact is heavier duty than the C4 contact, so even though schematically it appears you could interchange them, it probably wouldn't work long if you did.

If you're having problems getting your starter to respond, perhaps the first thing you should do is attend to the spade connectors that attach to this relay. See page 556.

Dick Broxon of Cincinnati reports that his '88 XJ-S would fail to start on damp mornings. It wouldn't even turn over, it would just click. It would start later, though, when things had warmed up and dried out. He removed the plastic cover from the relays under the hood on the right fender and sprayed them with a product called WIRE DRYER by *Snap*. He has not had a problem since. The starter relay, of course, is under the cover mentioned.

Moisture is not the starter relay's only problem. It often turns out to be the culprit in a car that won't start, or will fail to start *sometimes* and then work perfectly later. To test, take the relay out of the car and apply power between the W1 and W2 terminals; you can jumper from a car battery, or you can just poke a 9V battery down onto the terminals. You should get a click. Then connect an ohmmeter between C1 and C2, and check that the circuit closes when the relay is energised. On this author's relay, the resistance measured was random: less than 1 ohm one time, 25 ohms the next time, infinite ohms (open circuit) the time after that. Click that relay a few times to make sure it makes good contact every time. Note that clicking it a couple dozen times seems to clear it up so it makes good contact each time, but you probably shouldn't rely on it staying good at that point. If it doesn't seem to be making good contact the first few times, it probably won't make good contact the night you're out on a date with the girl of your dreams.

It may be that the contacts within the relay get a little charred. It is possible to take the relay cover off, clean it up, and reassemble. Unfortunately, this apparently doesn't work for long. Bill Farnsworth says, "I did that first. A couple weeks later I found myself in a parking garage, as the best dressed mechanic in Redmond, WA. bent over the engine compartment wearing a tux..." This author tried it too, with a remarkably similar experience to show for it.

Just replace the stinkin' relay. Your local auto parts shop can probably order it for you, and it'll cost you only about $60.

Ouch. OK, now we're looking for reasonably-priced non-Lucas substitutes.

STARTER RELAY SUBSTITUTE (OPUS): Ask any auto parts shop for a starter relay for a Chrysler -- apparently just about any Chrysler from the late 70's. The particular starter relay this author found was made by Wells, number CR620. This relay is electrically identical to the Lucas item; it's just cheaper and better.

The terminals are *not* labelled the same, of course -- and they are not arranged the same way on the base either, so you can't plug the wires on by location. Here's how to connect things up:

wire color	Lucas terminal	equivalent Chrysler terminal
BG	W1	I
WY	W2	G
WR	C1	EGR/SOL
N	C2	BATT
WU	C4	BAL

The Chrysler relay is physically pretty similar to the Lucas, but the mount bracket attached to it is different. You could just drill a new hole in your Jag and screw it down, but note that it'd probably last longer if it was mounted right side up with the terminals pointing down. This author noted that the bracket on the Lucas relay was tack-welded to the casing. I ripped it off, drilled some 1/8" holes in it and pop-riveted it to the bracket on the Chrysler relay. Then I bent the Chrysler relay bracket down 90°, which put it in just about the same configuration as it had been on the Lucas relay.

An alternative idea would be to open the new Chrysler relay (looks easy) and pop-rivet the Lucas bracket right to the case. The Chrysler bracket, which is held on by rivets, can be removed and discarded and the holes covered. Reassemble and install.

The Chrysler relay is also a bit larger than the Lucas -- which may entail some fiddling if you want to get that hokey plastic cover back over it. I managed to get the cover back on; it wouldn't go on the OEM mounting holes, but it wasn't too difficult to move it over a bit, drill two new holes and screw it down. The upper edge is now not as close to the wing as it used to be, so you can see a bit of the bracketry by peering down in between. But it looks OK.

An alternative idea here would be to simply fab up a new cover with a hair more space than the OEM cover. Just find a plastic box and start cutting sides off of it.

One other minor difference of note: The Lucas relay appears to be a sealed box, but the Chrysler relay has a tiny filtered vent on the side of the cover. Hmmmm.

Lucas starter relay: special order, sixty bucks. Chrysler starter relay: on the shelf, eight bucks. You decide. Wanna guess which one will be more reliable?

John T. Richardson found yet another substitute relay: "a Sorensen SR-17 relay, cost was $6 at Checker Auto Supply. While this is not an exact drop-in replacement, it does mount in the space available and anyone with a VOM can decide the correct wiring terminals. Mine has been in service for over a year with no problems."

If you want to get down to basics, the starter relay is nothing more than a 12VDC DPST relay with one high-current set of contacts. As with any DPST relay, you can substitute two SPST relays. You can, in fact, wire up two standard automotive relays together to do this job, one to send power to the starter solenoid and one to send power to the ignition coil bypassing the ballast resistor. A 30A rating on the one controlling the starter solenoid might be enough, or you might look for a relay with even higher contact ratings -- which will still be a sight cheaper than the Lucas starter relay.

STARTER RELAY SUBSTITUTE (CEI AND MARELLI): The Lucas CEI and Marelli ignition systems control the coil current electronically and therefore have no ballast resistor -- and therefore no need for a contact in the starter relay that bypasses a ballast resistor. Nevertheless, Jaguar continued to use the same Lucas relay; in fact, parts lists seem to indicate they used it throughout the production life of the XJ-S. So, you can still opt to replace it with the Chrysler relay described above for the OPUS cars. There are some wiring changes from the pre-H.E. so here's the connection chart for H.E. cars:

wire color	Lucas terminal	equivalent Chrysler terminal
WB	W1	I
WY, WU	W2	G
WR	C1	EGR/SOL
N	C2	BATT
WU	C4	BAL

The C4 terminal doesn't do anything on the Lucas relay, and the BAL terminal won't do anything on the Chrysler relay.

Not only is the C4 terminal still there, but the WU wire that went to the ballast resistor is still there as well -- at least on this author's '83. In fact, there are two WU wires; one is connected to the C4 terminal and goes nowhere; this is the one that used to go to the ballast resistor on the OPUS ignition system. The other WU goes to the cold start timer, but it doesn't connect to the C4 or BAL terminal; instead, it is connected to the W2 or G terminal along with the WY wire.

The G terminal on the Chrysler relay only has one spade, so while you're at the parts store you might want to pick up some of the doublers used to connect two female spade connectors to a single male spade terminal. Or you can simply make up a short jumper with two male spade connectors and one female spade connector all tied together.

So, you have a C4 contact that does nothing connected to a WU wire that goes nowhere. That leads us to another possibility in starter relays: a relay that doesn't have the ballast bypass contact at all. Again, a Chrysler relay fits the bill; just ask for a later year, somewhere in the mid-80's or so. Chrysler likewise had gone to electronic coil current control and done away with ballast resistors, so they deleted that contact from their relays. The terminals are the same as the chart above except there's no BAL. Just tuck that unused WU wire under something and forget about it.

Of course, once you've omitted the ballast bypass contact, you're really just dealing with a plain ol' SPST relay. *Any* 12VDC relay will work as long as the contacts are rated for enough amps. It's not known how many amps the starter solenoid pulls, but it's entirely probable that a regular 30-amp automotive relay would work. The W1 and W2 connections become 85 and 86, C1 becomes 30/51, and C2 becomes 87.

OTHER SWITCHES AND RELAYS INVOLVED IN STARTING: If you are trying to use the EFI wiring diagram in the ©1982 Supplement, page 19-1, or Figures 13.10, 13.12, or 13.93 in the Haynes repair manual to diagnose starter problems, you may be getting very confused. These diagrams indicate that the only thing that disables the starter relay is the "start inhibit switch" (on the shifter, also called a "neutral switch" or "automatic gearbox safety switch", item 75 on Jaguar schematics) via the "feedback monitor relay" (also called an "inhibit relay" or "feedback inhibit relay", item 355 on Jaguar schematics). Why is a starter-disabling relay called a "feedback monitor relay"? Judging from the diagrams it appears that the neutral switch on the shifter was originally intended to prevent starter operation in gear, but with the emission-controlled Digital P EFI it's also needed to switch the EFI from open-loop to closed-loop operation -- and the neutral switch only has a single contact. So, instead of adding another switch or providing one with more contacts, they installed this relay. Since the relay likewise only has a single contact, it is used to control the starter, while the signal to switch the EFI -- being very low current -- is taken *through* the relay coil. When the neutral switch is closed, the BG wire is grounded, the relay closes, and the EFI signal input sees 0V; when the neutral switch is open, the relay opens and the starter won't work, while the EFI signal input sees 12V in the ungrounded BG wire.

In the "UK & Europe" diagrams on page 19-2 of the ©1982 Supplement or Figures 13.9 and 13.11 in the Haynes, there's no such thing as closed-loop operation and therefore no switching it on and off, so the feedback monitor relay is omitted and the starter relay is simply grounded through the neutral switch. The starter wiring circuit on page 86-7 of the ©1982 Supplement shows this non-US layout with a simple connection from the starter relay through the neutral switch to ground.

According to *all* of the diagrams mentioned above, the inertia switch will not affect the starter operation. On the North American H.E.'s, though, the inertia switch *does* disable the starter. There is an error in the diagrams showing the North American - Emission A schematic: At the upper left in the schematic, there are six circles with numbers in them indicating where wires go to. The leftmost one has the number 38, indicating either Ignition Switch Pin 1 (which would be a Start contact) or Ignition Switch Pin 3 (which would be an Ignition contact). The fact that one number means both things indicates how screwed up things are here. The leftmost circle should in fact be labelled 250, as it goes to the same place as the fourth circle from the left -- to the Inertia Switch. On the Master Key, the second number 38 should be scratched through, since the only remaining circle with a 38 in it goes to Ignition Switch Pin 1.

It appears that, with the U.K. and Europe H.E.'s, the inertia switch will not disable the starter. There wouldn't have been a convenient way to do that without adding a feedback monitor relay, which otherwise wasn't needed.

The diagram for "Ignition, Alternator and Starter Systems" on page 86-7 of the ©1982 Supplement is likewise representative of U.K. and Europe cars but not North American cars. For North American cars, the BG wire from 11 (the starter relay) to 6 (the "Automatic gearbox safety switch", what everywhere else is called a neutral switch or starter inhibit switch) actually should be a WB wire from the starter relay to the feedback monitor relay (not shown), and the feedback monitor relay is in turn controlled by the neutral switch -- and the inertia switch (not shown).

There are other changes you can make to that diagram while you're there. On item 11 the upper right terminal is W2 and the lower right terminal is W1, and these are the coil terminals. The upper left terminal is C1 and the lower left is C2, and these are contact terminals -- and C4 is omitted from this diagram, which is just as well because it doesn't do anything. On item 7, the two terminals on the left are the coil and the two terminals on the right are the contacts. On item 4, the six terminals, clockwise starting with top center, are 4-3-2-6-1-5. On item 12, the wire connecting to the bottom terminal is WS/U, not WS.

The wiring is shown correctly for North American cars in Figures 2.1, 24.1, 24.2, and 24.3 of Publication S 57, "Electrical Guide".

STARTER SYSTEM TROUBLESHOOTING: MacDonald suggests the ultimate test to determine whether your starting problems are caused by something in the relays and wiring or by the starter itself: "Try bypassing the thick brown with the thick white/red wire at the starter relay. If the starter does not crank then it's your starter!" Or the heavy cable wiring from the battery to the starter.

If the starter itself is working and therefore you must have a problem in the wiring to it, the next thing to try is to disconnect the WB wire from the W1 terminal on the starter relay, and connect a ground wire to the W1 terminal instead. If the starter now works like it should, your starter relay is OK (or intermittent!) as well as the wiring from the ignition switch; you now need to be looking at the inhibit relay (under the same cover as the starter relay), the neutral switch on the shifter, and the inertia switch.

Starter

Jaguar provided a new design starter beginning in 1988 that features a gear reduction drive. This starter will fit earlier V12's, and is much smaller, much lighter, more reliable, and just all-around better. If you ever need to replace the starter, insist on the gear reduction model.

STARTER REMOVAL: Both the ROM and the Haynes manual list several steps involving the steering column. This must reflect RHD cars; you don't have to mess with the steering column at all in a LHD car.

David Johnson wants everyone to be aware that the upper bolt holding the starter in has a 12-point head, and therefore requires a 7/16" 12-point socket. The manuals simply say to remove the bolts. "You can't really see the bolt head even with a mirror. So because most bolt heads are 6 point, I tried for what seemed like days with several different size sockets." Note: Davide Frada says an 11mm 12-point socket worked on his 1980; 11mm is just a hair smaller than 7/16". There are some who claim it's a 1/2" 12-point head on early models. Whatever, it's a 12-point head; keep trying until you find the size that fits! Some have suggested replacing this bolt, either with a longer bolt with a regular head and a sleeve under it or with an Allen head cap screw, but really once you know it's a 12-point head it works OK as it is.

"Also I learned *not* to remove the transmission dip stick and tube. What a mess! I guess with the car up on ramps the fluid ends up being significantly higher than the bottom of the tube."

Doug Maury wrote up a lengthy play-by-play on removing the starter. I won't include it all here because it'd add several pages to this book, but I will include some key points:

The front end of the car should be placed on jack stands so that the crossmember is at least 18" above the ground. And don't forget to disconnect the battery.

The RH air cleaner, RF wheel, and RH downpipe all get removed. Turn the steering wheel all the way to the left.

Remove the starter heat shield and cable retaining clips. Disconnect the big cables from the solenoid, including the one from the alternator. An 8" extension and a deep socket are suggested here.

Maury suggests disconnecting the "ignition" wire (red and white -- the only small one to the solenoid) at the other end, up in the vicinity of the transmission dipstick, and leave it hanging from the starter as it comes out. Remember to put a wire onto the new starter before installation.

There are two bolts holding the starter in place: one that's obvious and easy to get to, and the hard-to-get-at one with the 12-point head described above. It's a good idea to leave the obvious one in place to hold the starter until you get the difficult one out. Disconnect the vacuum line to the modulator on the transmission. If you left the center section of the exhaust pipe in place and held it up with a piece of wire, you might want to unhang it at this point so you can move it around. Use of a couple of ratchet extensions and a swivel is recommended on that difficult bolt. Some prefer to keep the ratchet handle forward of the transmission mount while others prefer to use really long extensions and feed them through above the transmission mount to get a straighter angle on the bolt.

Once loose, the starter can be a tight squeeze to get out, but it'll come out with some twisting and finagling.

Maury suggests replacing all the cables and wires, since they'll have been well baked by the proximity of the exhaust system. Good advice, although obviously the new cables will soon be baked as well. Going with something with high-temp insulation would be good, but in the case of those huge cables the more likely tactic will be simply making sure they're not bumping anything that they could short out against.

Upgrading the cable to the alternator while you're in there is highly recommended, just in case you ever replace the Lucas alt with something that puts out serious amperage. See page 582. When Alex Dorne replaced the early heavy starter with the later geared starter, the original alternator cable was too short to reach the smaller starter -- another reason to replace that wire!

Dorne also fabbed a bracket to hold the original heat shield over that new smaller starter. "The bracket is installed on the end of the starter, held by the two nuts that hold the starter together."

Maury suggests you check the new starter before installing it, including checking the solenoid travel (see below). If there's anything outta whack with that rebuilt starter, you're gonna kick yourself for not checking it before installing.

SOLENOID TRAVEL ADJUSTMENT: Apply 12V to the solenoid connection and watch the pinion move. Check that the solenoid moves the pinion to the specified position so that a .005" feeler gauge will fit between the pinion and the thrust washer but a .015" feeler gauge will not. If it's out of spec, it can be adjusted by repositioning the eccentric pivot.

Roger Bywater: "If wrongly adjusted the solenoid can reach end of travel without the power contacts being properly made to complete the circuit to the motor. Because the power contacts can burn if not solidly home it is possible to get a marginal condition where the effects of expansion can allow it all to work normally when cold but not when hot. I suspect that a lot of starter motors have been condemned as failed when proper adjustment would have made them serviceable.

"Unfortunately the pivot adjustment faces the engine block so cannot be altered in situe. It is therefore a good idea to check the end clearance adjustment on any starter whenever removed or when fitting even a new one."

Hmmmm. Sounds like it might be a good idea to aim for the .015" end of that range.

SOLENOID TERMINALS: Walter Acker IV says, "There is one major design problem in the GM starter/ solenoid system. The problem is that the top stud that holds the main cable that goes into the solenoid is too short in that the unit does not have enough length to accommodate a split ring lock washer to keep it tight and reduce the amount of arcing that happens in this unit. The answer is to go to a local hardware store and purchase a small package of 3/8" "inside star" lock washers and use one between the nut and the Bakelite housing that is on the solenoid.

"I just checked my ROM and the starter system for the XJ-S uses this type of system also, but the size of the lock washer may be a slightly different size."

INTERMITTENT STARTING WHEN HOT: The symptom: the car will start every time when cold, but when hot sometimes the starter doesn't even budge. Phil Boylan says, "In my opinion you may be suffering from the infamous "starter heat-soak" problem that is common to vehicles with a GM-style starter solenoid mounted with the starter motor in the high-heat area near the exhaust manifolds. The heat weakens the solenoid electrically such that the relay does not actuate reliably when starting current from the ignition key switch is applied.

"I went through *two* Lucas starters (one rebuilt, another brand new -- $$$), replaced the transmission micro-switches, upgraded the battery and ground cables, plus a bunch of other desperation fixes that shouldn't have worked (and didn't).

"Finally, I bought a "GM hot start kit" for $29 that electrically bypasses the starter solenoid switch and adds a Ford style remote starter solenoid. I mounted the remote solenoid in a convenient location on the passenger side firewall. The factory solenoid stays put because it's required to actuate the starter bendix gear. All you're doing with the remote solenoid is re-routing the ignition and battery cables first to the remote solenoid and then on to the factory starter/solenoid terminals such that the high amperage relay switching occurs in the cooler location.

"That small, inexpensive mod completely solved my hot start problems and the symptoms have never returned. The remote solenoid also provides convenient access to the ignition circuitry instead of having to feel blindly under the engine manifolds.

"And since Ford now owns Jaguar it can be argued that the remote solenoid backfit is also correct in spirit. :^) "

STARTER SLOW TURNING: Mike Morrin: "Check that the engine grounding cable (underneath on the left hand side) is not loose or damaged. This is not particularly an XJ-S fault, but it was loose on mine, and I would have been really mad if I had pulled the starter before discovering it."

The fact is that lots of electrical gremlins have been traced to faulty grounds, a lot of them to this strap in particular -- see pages 269, 324 and 555.

Of course, when a starter is turning slowly, most mechanics will check the battery terminals for corrosion. On most cars, one cable goes straight from the battery to the starter solenoid and the ground cable usually connects nearby, so a bad connection would almost have to be at the battery. On the XJ-S, however, the power to the starter comes from the battery along the bottom of the car and up to the left side terminal post on the firewall, then over to the right side terminal post on the firewall, then down to the starter solenoid. Weak connections can therefore be at either terminal post on the firewall as well as at the battery. See page 558 for more on those terminal posts.

Alternator

If there is any indication that your alternator is having trouble (not charging, low voltage, etc.), you should have it attended to immediately. If caught soon enough, it can be repaired or rebuilt. If left alone, it self-destructs and a new one is required.

One indication your alternator has had it is that the alternator warning light stays on after the engine is shut off.

An automotive alternator can be more thoroughly checked using a VOM (preferably digital). Connect the VOM anywhere that will show system voltage -- the cigarette lighter is convenient. If the engine is turning fast enough for the alternator to produce adequate power, usually about 1500 rpm, the system voltage must be between 13.6 and 14.4 volts. If it is not, either the alternator is defective, or there's a problem with the connections to the alternator, or there is a huge load somewhere draining all the power, or there is a problem with the belt drive turning the alternator.

Even if the voltage is between 13.6 and 14.4 volts, there still may be a problem with the alternator, because it contains diodes that rectify 3-phase alternating current into the direct current the car uses. If one diode fails, it will still put out 13.6-14.4V, but far fewer amps. And the output gains a lot of "ripple", meaning it looks less like smooth direct current, it's got some large fluctuations in it.

ALTERNATOR EXCITATION: The field on the XJ-S alternator is excited through the "ignition" warning light (fifth from left on the author's '83, has a little picture of a battery), so if this light is burnt out or disconnected charging may be intermittent. According to Randy Wilson, "A common enough design. Lots of alternators will respond like this... some would never charge. Here's what happens: the alternator needs a signal to indicate the key is on, and a power source to boost itself into a charging condition... bootstrapping, if you will. This power requirement is low enough that a lot of alternators use the power flow *through* the charge light for this purpose. This is called the exciter. And, in reality, key on is not really an important condition to the alternator. You just don't want to be driving the exciter full time, lest your battery will go flat overnight. Once the alternator is charging, it becomes self-exciting, and no longer needs or uses this external power source (oversimplification). Thus the light goes out.

"The exciter is used to induce enough of an electromagnetic field to start the current generation. However, there is always some residual magnetism floating around in a used alternator. With this residual, the alternator can generate a little bit of current, if you spin them fast enough. In the case of Lucas (and others) the current needed to self-excite is fairly low -- low enough that the current from the residual magnetism can meet the demand. This usually happens at 2500-3000 engine rpm. And as soon as the alternator is up and charging, operation is as normal. You don't have an outside exciter source, but you don't need it any more."

Jaguar may have provided a fail-safe here. The electrical diagrams show a 100Ω resistor in parallel with the alternator warning light, which would seem to mean it would get some excitation current even when the bulb is burnt out.

ALTERNATOR TROUBLESHOOTING: Michael Minglin says, "I really like the factory manual's instructions for checking maximum amps output. Even If I could reach down there to remove the plastic cover, I could not see to connect a jumper between "F' and "-". My solution was to remove the alternator and attach wires from "F" and "-" and run them out of the back of the alternator, up the inside of the fenderwell, with a male and female connector on the end by the cross brace. Now to jump the regulator all I have to do is connect the connectors. I'm not sure it is worth pulling the alternator just to make these connections, but I will never put in another alternator without this modification."

If your alternator doesn't seem to be charging like it should and you can't find an electrical cause, don't overlook the mechanical problem described on page 91 -- especially if it's a later car with a Bosch alternator and a ribbed alternator belt, and especially if it's a convertible.

RELOCATING DIODES: An alternator contains a full-wave rectifier, which is an assembly of six diodes that convert the alternating current produced by the windings into direct current for powering the electrical loads in an automobile. Conveniently, these devices are built right into the alternator, so service is simple: just remove the bad alternator and install a good one.

Unfortunately, the heat inside the Jaguar engine compartment is not good for electronic semiconductor devices such as diodes. The alternator has a cooling fan and the diodes are built into a heatsink, but when it's hot everywhere in the engine compartment such efforts will do no good.

If you're sick and tired of replacing diodes (or alternators), one possible solution is to open the alternator up, take the diode assembly out, and relocate it to some remote location where things are cooler. You will need to provide a small fan to keep them cool (they generate a good deal of heat on their own!), but a 12V computer fan is cheap and workable. Craig Sawyers sizes the wires needed: "the current from each of the three phases to the diode pack will be around 1/3 of the total output current. In the US, this would be known as 12 AWG, in Europe $3mm^2$. The output cables to the battery post would have to be rated at the full 120A. A double run of 8 AWG ($8.4mm^2$) would do this nicely (it will handle 150A)."

Another nice feature of this mod is that you no longer need to use expensive Lucas diodes; you can buy a diode pack used to rebuild any generic alternator of comparable or greater amperage -- the GM ones are really cheap in the US. You could also opt to improve the alternator by using Schottky diodes, which have a lower threshold voltage and therefore rob the alternator of less of its power and generate less heat.

And don't forget: if you locate the diode pack somewhere convenient, it should be a *lot* easier to work on than the alternator, which is a real pain to get to.

LUCAS ALTERNATOR: From the introduction of the XJ-S until engine number 8S57571, it was fitted with one Lucas alternator or another -- 66-amp on the pre-H.E., 75-amp on the H.E. There are also reports of Motorola alternators on these cars, possibly even fitted from the factory. Bob Johnson says the number is A5000/12.

If you're interested, there is a performance chart for the 75-amp alternator at:

http://www.jag-lovers.org/xj-s/book/Lucas75Aalt.html

If a Lucas alternator seems to be charging intermittently (fully charging one minute, discharging the next as indicated by the voltage gauge) or has simply stopped charging but has no shorts or burnt wiring, it might be fixable by replacing just the regulator itself. This is much cheaper than replacing the whole alternator, and is easy to do by removing the plastic cover from the back of the alternator.

LUCAS ALTERNATOR REPLACEMENT: Below you'll find several pages on replacing the original alternator with a GM alternator. Most of these were developed to replace the Lucas alternator -- before Doug Harper broke this news: "My Lucas 75-amp alternator was suspect, took it to a rebuild shop to see what my options are. He ended up selling me a rebuilt 1995 Land Rover 110-amp alternator, #13697 Lister or CAE A2051, that was a direct replacement for the 75A Lucas, just bolted right in. Had to replace the pulley. Made by Marelli!! Using the Radio Shack 270-1509 lighter adapter to the volt meter trick I was getting 14.2V at 1000 rpm, engine sounded better. The Lucas when working was putting out 13.66 Volts. The needle now sits 1 bar above mid point, rock solid. 50% more power as a direct replacement, no bracket required, no messing."

"The unit has an internal fan, same hole locations for bolts, and appears to be volume-wise smaller. Beside the power out and sense lugs is a timing output pin for diesels (?) and a 12VDC secondary power source on some units. The first one they showed me had cracks in the metal housing where the regulator bolts connect, on all 3 bolts, one serious. The second one they showed me was perfect - well, almost, but no cracks. Make sure you want the crack-free units."

Frankly, if you're replacing a Lucas alternator for any reason, you'd be well advised to go ahead and upgrade to this Land Rover/Marelli alternator even if you don't need the power. It's one of those "couldn't hurt" kinda things.

You probably should upgrade the power cables as described on page 582.

BOSCH ALTERNATOR: Beginning with engine #8S57572, the XJ-S was fitted with a Bosch 115-amp alternator. This alternator is driven by a multi-groove belt instead of the V-belt found on earlier cars. Since the alternator is driven from the crank damper itself rather than from the pulley that bolts onto it, this change involved the replacement of the earlier crank damper C36013 with one with the multi-groove pattern, EAC9248 (replaced sometime thereafter with EAC9693 to fit a timing disk for the Marelli ignition). The pulley part number didn't change.

ALTERNATOR LOAD DUMP MODULE: Reportedly, the 115-amp alternators fitted to the late 80's XJ-S will not begin to charge until the engine has been revved up. Although not really a problem, it is somewhat irritating to see the charge light on when everything else seems OK. According to Michael Neal: "Actually, there is a fix for this. There is a device called an alternator load dump module that was fitted to the later XJ40's and XJ-S's with the high output alternator. Fitting the module will fix the problem. The load dump module will cause the alternator output to function properly at idle without having to raise the idle speed." The part number for the 115-amp dump module is DBC 5896.

NOISY ALTERNATOR BELT: If you have the later Bosch 115-amp alternator with the multi-groove belt, chances are that sooner or later you will have trouble with that belt squealing. Neither tightening the belt nor even replacing it will help for long. The problem here is a flaw in the design of the multi-groove pulley -- not just this one on the Jag, but basically with all multi-groove pulleys. The author discovered this design defect on his '84 Honda Accord (his '83 XJ-S has V-belts), but the problem has been confirmed on the later Jaguars as well.

V-belts and multi-groove belts work basically the same way: a V-shaped section of belt is wedged into a mating groove in a pulley, and the load is transmitted by friction. The wedging action is what provides enough friction to handle the load. A conventional single-V belt wears on the sides, making it narrower and therefore sitting deeper in the groove, so it needs periodic tightening. This works fine until the belt either breaks or is so worn that it sits in the bottom of the groove instead of wedging between the sides, in which case it will slip badly.

The multi-groove belts, unfortunately, cannot wear anywhere near that much before they begin to slip. In fact, after the pulley itself has a little wear on it, they cannot wear *at all* before they begin to slip -- the brand new belt will slip almost immediately. This is because the belt will contact the pulley on *top* of the ridges between the grooves and ride on these edges rather than wedging down into the grooves. Sitting up on these smooth edges, it can barely transmit any power at all without slipping. In fact, even when it's not squealing it's probably still slipping.

It is easy to confirm this is what's happening: look at the alternator pulley with a flashlight. If the top edges of those ridges are bright and shiny, you've found the problem. Usually, the inside surfaces of the V's are much duller, sometimes even rusty, indicating the belt isn't even touching them.

The fix is easy, too, except that it requires getting that pulley out -- which isn't easy. With the pulley removed from the alternator, mount it on something that will spin it (a lathe, or find a way to chuck it up in a drill if you don't have a lathe) and grind the edges of those ridges down. See Figure 28.

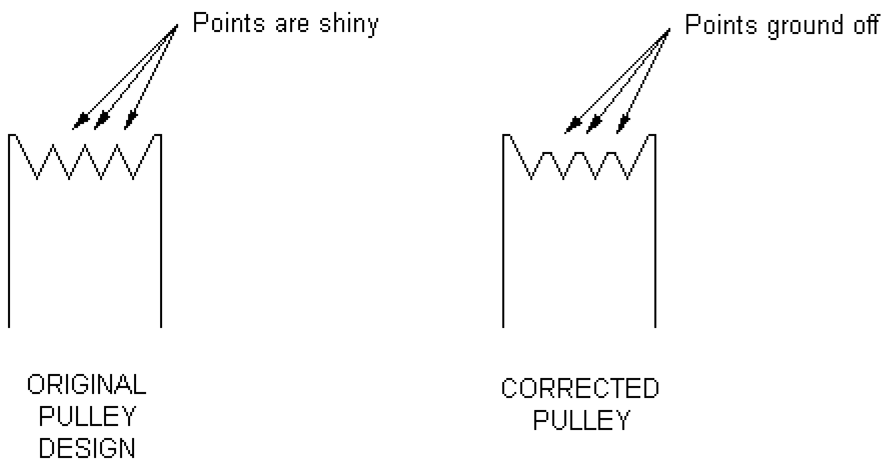


Figure 28 - Multi-Groove Pulley Correction

Don't worry about grinding off too much. Yes, you are reducing the contact area of the wedge area, but the fact is that once the belt is actually wedging rather than skimming around the ridges, contact area isn't a problem -- the multi-groove belt will easily handle all the load of the alternator and then some without complaint. Just make sure to grind the ridges down enough that they won't be a problem any more, even with a worn belt.

Obviously, the grooves on the damper pulley itself would benefit from similar treatment. It's not really called for, however; the larger diameter means that the belt generally won't slip on this pulley, even when it *is* riding on top of the ridges.

There is yet another possible cause of alternator belt squeal. See the report on failed crankshaft dampers on page 91.

RETROFITTING THE BOSCH ALTERNATOR TO EARLIER CARS: The alternator mount bracket EAC4181 was replaced with EAC9320 at the same time that the Bosch alternator was fitted. Perhaps the purchase of this bracket will permit the upgrade of the earlier cars to the Bosch unit. Since they all use internal regulators, the wiring connections should be fairly straightforward.

To deal with the multi-groove pulley on the Bosch, you can either purchase and install a new crank damper, or you can simply replace the pulley on the Bosch alternator with a V-belt type. Note that there *might* actually be some problem with this latter scheme; historically, alternators driven by a single V-belt never exceeded 60-70 amps or so. Larger alternators used two V-belts prior to the introduction of the multi-groove belt.

Scott Horner of New Zealand retrofitted the Bosch alternator to his UK-spec pre-H.E. XJ-S. "The Bosch alternator is bigger than the Lucas and Motorola in most dimensions. This meant having to drill out the original mounting bracket 'swing' (technical term!) hole, definitely needs to be done using a drill press. Trying to find a replacement pivot bolt with a larger diameter was entertaining; I eventually got a suitable bolt from a motorcycle store (but that could just be good old NZ and the complete lack of parts).

"The unit I got had a grooved belt pulley originally (although the Jaguar parts manual lists both grooved and V-belt) so I had to remove this and fit a normal V-belt pulley. The shaft size on the Bosch is larger than the Lucas and Motorola, so you can't use the original. I was lucky enough to be able to rummage through a collection of dead Bosch alternators, which all have the same shaft size, and found a suitable replacement, even down to the offset (so the belt lined up with the crank pulley).

"I was able to re-use the original power connectors on the back of the alternator (although I had to drill these out as well to make them fit)."

ALTERNATIVE ALTERNATORS: Regarding the whole general idea of replacing one alternator with another, John Napoli offers a viewpoint: "It is a good idea, IMHO, to go with a common alternator for your geography. Volts are volts, what you want is dependability and maintainability. A large Lucas infrastructure exists in Britain. In the US, a large infrastructure exists for GM stuff. The same can probably be said for other marques, but I have GM experience, and there is no shortage of ridiculously cheap GM components in the States!"

Alternators are rated according to the number of amps they can produce. There is no such thing as too many amps; since the regulator will limit voltage to a set value, an alternator with excess capacity will simply put out whatever is necessary to meet the load. The only reason to opt for fewer amps is to save money, since higher-amperage alternators generally cost proportionally more. A good rule of thumb, obviously, is to provide at *least* as many amps as the alternator the car came with was rated at. Before you decide how many amps are enough for you, you might want to read the sections on high-wattage headlights (page 656) and electric cooling fans (page 219) and think about whether you might add loads in the future. You might also think about whether you'll be considering a high-power sound system.

Note that in the old days when engines had carburetors and windows had cranks, a typical alternator might be rated at 40 amps or less. In modern automobiles with EFI and electric everything, the capacity of alternators has increased considerably. Meanwhile, the designs have become more efficient, so they don't appear any larger than their predecessors -- often smaller, even.

Any 12-volt internal-regulator alternator of suitable amperage would serve in the XJ-S if it could be mounted. Because they're cheap and plentiful in the US, several schemes have been cooked up for installing a GM alternator as described beginning on page 579. But first we'll tell you more about GM alternators.

GM ALTERNATORS: There are lots of varieties of GM (Delco) alternators, but for our purposes there are six basic "types" that we might consider for the XJ-S: The SI-10, the SI-12, the SI-15, the SI-17, the CS130, and the CS130D. All six mount basically the same way, which is *not* the same way the Lucas alternator mounts. This is why such a retrofit either requires the John's Cars GMALT alternator bracket or fiddling with the air pump bracket.

When talking about GM alternators, positions of the tensioner lug and the regulator terminals are defined by clock positions looking at the *rear* of the alternator with the pivot lug pointing downward (6 o'clock). Some GM alternators have the tensioner lug at 12 o'clock ("straight across"), some have it at 10 o'clock, some have it at 2 o'clock; the CS130 is available with tensioner lugs at 10 o'clock *and* 2 o'clock. The lugs (both pivot and tensioner) can extend farther from the centerline of the alternator on some models, termed a "long lug" case. However you decide to mount your alternator, you might want to drop into an alternator rebuild shop and review the lug schemes available to select a configuration that will fit best.

The regulator terminals can also be located in any of several clock positions, but who cares? Connect the wires to whereever they end up.

The SI-10 comes in amperages up to about 70, and can be rebuilt to put out over 100 -- but the shops don't recommend this and even refuse to do it. Apparently when this alternator is set up for high current it won't charge well at idle, and they get nothing but complaints from customers.

The SI-12 looks to the untrained eye to be the same thing as the SI-10 -- in fact, many of the parts are interchangeable, and one shop reported that they occasionally find rebuilds that have SI-10 and SI-12 parts mixed up in the same alternator. One visible difference is that the SI-10 has a metal fan blade while the SI-12 has a plastic impeller that looks like a solid disk with openings around the edge. The core parts of the SI-12 are much better than the SI-10, though; this alternator comes standard up to about 108 amps, and can be rebuilt to put out 140 amps -- a very common rebuild for folks that have high-power sound systems in their cars. It reportedly charges just fine at idle.

The SI-15 is physically quite a bit larger than the SI-10 or SI-12, and the SI-17 is difficult to tell from the SI-15. These typically can be had up to about 108 amps as well. A suitable unit can be purchased by going into an auto parts store and asking for an alternator number 70897. Note that if you're planning to hang the alternator off the bottom of the air pump bracket as described below, the SI-15 or SI-17 will probably not fit; it's too big, it might run into the chassis, possibly when the engine moves around on its mounts. Better to choose an SI-12, CS130, or CS130D alternator for such an installation.

When fitted with an internal regulator (the only configuration that should be considered for the XJ-S, since the Lucas is also an internal regulator type), all four of the "SI" alternator types above will come with three terminals. The big one is the main power terminal that is connected directly to the battery with heavy wires. The other two are 1/4" spade terminals numbered 1 and 2. You can buy a standardized two-terminal plug to connect to these terminals on a GM alternator at any auto parts store, but you can also use normal insulated female spade terminals. If you buy the standardized connector, they always seem to use a black wire for terminal 1 and a red wire for terminal 2.

Terminal 1 connects *either* to the indicator light on the dash *or* to a switched ignition power supply, depending on the alternator and the car, but apparently any of them will work connected to an indicator light. So, just connect this to the NB wire in the XJ-S.

Terminal 2 is a "sense" connection; the regulator will control the alternator's output to maintain a desired voltage (13.6V or so) at this terminal. The simplest method of connection is simply to connect it to the big terminal mere inches away on the back of the alternator, which will work fine; the Lucas alternator did this internally.

But this isn't the optimum configuration. The reason a separate sense connection is provided is so you can run a separate sense wire directly to the battery terminal; that way, the regulator will be sensing the voltage right at the battery, and will push the alternator's output a little higher to overcome the voltage losses in the cables between the alternator and the battery. Going all the way back to the battery would be inconvenient on an XJ-S, but it's not too difficult to connect this sense wire to the main power bus post on the firewall. Since the cable between there and the battery in the trunk is seriously massive, the losses there are likely to be minimal. However, the wiring between the alternator and that post includes some marginal size wires (unless you've upgraded them) so sensing beyond these losses may be beneficial.

Note that section 86.10.01(b) of the ROM describes a method for checking the losses in this line on the XJ-S; the same test will work with the GM alternator, regardless of where the sense wire is connected. The Lucas setup merely accepts losses up to 0.5V while the sense wire setup tries to overpower them, but in either case excessive losses in this circuit are not good.

There are also a few GM "SI" alternators that come with one more terminal for connection to a tachometer.

The CS130 is a newer GM design, used on most GM cars from 1987 into the early 90's; there is also a CS121, but it's hard to tell the difference, and apparently cars with fried CS121's are often advised to replace them with a CS130. The CS130 is physically smaller than *any* of the "SI" alternators described above. It has *two* cooling fans -- one external metal fan on the front, and another fan inside the housing at the rear. These alternators are rated at 85 to 105 amps in stock form, can be rebuilt to put out 140 amps, and charge like a sumbitch at idle. They are *all* internal-regulator type; apparently they assume you know that, because none of the books or catalogs tell you.

I know you don't think the physical size is a big deal, but let Arthur Blackwell improve your mind: "the alternator is *much* smaller physically and did not require dropping front suspension pieces to put in place."

The CS130 alternators come with some interesting variations in main power connections. Some have a basic stud, while others have a protruding rectangular block that a screw is run through crosswise. Whatever, it shouldn't be difficult to finagle a connection to the battery in the XJ-S.

The CS130 comes with a special regulator connector: a rectangular block with four pins in it -- one large one and three smaller ones. The big one is the sense wire, similar to terminal 2 on the earlier GM alternators. You don't need to connect it to the main power connection three inches away because GM has thoughtfully done that for you internally. Apparently, if you connect up a sense wire, it will override the internal sense connection. Hence, it is an *optional* sense connector; you can connect it to the main bus for optimum performance, or you can just forget about it and it'll work fine.

The small pin right next to the big one goes to the ignition switch on cars without a dash indicator light. The middle small one goes to a dash indicator light on cars so equipped. It's not known what the farthest small pin is for, perhaps a tach connector.

For clarity: you only need to connect up the main power cable and connect the middle small pin in the plug to the existing NB wire in the XJ-S to get the CS130 alternator to work. If you get the plug with the alternator from a junkyard, it's probable the plug will only have that one wire!

If you don't get a connector with the alternator, auto parts shops sell a variety of connectors to fit the CS130 regulator socket. You will need to get one from somewhere -- generic spade terminals won't work here. There are plugs available with four wires, one to each pin. There are plugs with only three wires. There are adaptors (short harnesses with a connector on each end) for retrofitting the CS130 into cars *without* dash indicator lights that originally had the earlier alternators with 2-wire connectors. And there are adaptors for retrofitting the CS130 into cars *with* dash indicator lights that originally had the earlier alternators with 2-wire connectors. Three out of these four will work on the XJ-S (you won't want the adapter for cars without dash indicator lights), so choose the cheapest one of the three. If it's the adapter you buy, just cut off the 2-wire connector and use the CS130 connector end.

If the CS130 in hand has the connections in an inconvenient position, the pulley can be removed with a 24mm socket and an impact wrench, then the case separated by removing the three bolts using an E8 Torx socket. Then the front case can be rotated to any of three positions and the bolts reinserted. Since the front case includes all the mounting lugs, this effectively rotates the rest of the alternator, including all the terminals on the rear end, in 120º increments.

Note that GM alternators can be fitted with either a single-groove pulley or several different widths of multi-groove pulley -- and of course most modern GM cars come with serpentine belts, so finding an alternator with a single-groove pulley in the junkyard might be difficult. The pulley from the Lucas alternator will *not* fit. However, finding a single-groove pulley for a GM alternator shouldn't be too difficult or expensive, and they can be swapped out in a minute.

There are some reports that GM alternators all have problems with the rear bearing. SI units came with a needle bearing, apparently a source of trouble. The CS130 comes with a ball bearing at the rear, a considerable improvement -- except that they used too small a ball bearing. The CS130 has also developed a reputation for lack of durability, apparently frying something in the electronics every 50K miles or so on the American cars they are fitted on. This being an American product, there are aftermarket fixes: J. C. Whitney (page 694) offers a "Quick Start 'Iceberg'" rebuild kit, 81xx5780U, which provides improved rectifier cooling and a larger rear ball bearing for the CS130 alternator. If you are paying good money for a rebuilt alternator from a reputable shop, you may want to insist upon such improvements at the outset.

J. C. Whitney also offers a kit, 81xx5781B, to convert the CS130 to 140 amp capacity. This is not necessary with a stock XJ-S, but if you've added loads such as an electric radiator fan or a big sound system, it's something to consider.

Besides the SI's and the CS130, GM also offers the CS130D, described on the Oakville Starter Alternator Ltd. "Tech Talk" web page: "The CS130D is the revised version of the CS130 and uses the same alternator connections although the connector has been slightly modified to reduce corrosion. Some GM vehicles as early as 1994 may have come equipped with this alternator. The joke in rebuilding circles is that the "D" in CS130D stands for "Different" because although the CS130D is supposed to be a close cousin of the CS130, internally they are totally "Different" - there are no interchangeable components. In reality the "D" stands for "Dual Internal Fan". The CS130 also had dual fans - one external (behind the pulley) and one internal (inside the alternator near the rectifier). In the CS130D, both fans are internal - there is no external fan behind the pulley. This is the easiest way to distinguish the two alternators.

"One of the new features on the CS130D is the alternator's internal temperature sensor. The regulator will sense the alternator's internal temperature and *shut the charging system down* if the unit reaches 280°F. The dash light will also come on. This of course will prevent overheating and prolong alternator life. This also means that if this alternator is overloaded (by a bad battery or an ear-bleeding stereo, etc.) it will shut off! No longer will roasted alternators be returned to us for warranty. The downside of this feature however is that diagnostic problems could occur. Imagine, a hot July day stuck in traffic - air conditioner is on full. Suddenly, the alternator stops charging and the idiot light comes on. The customer pulls off the highway into your shop and sits for 45 minutes before you can check it. When you check it you find that the alternator charges fine. The regulator had shut the alternator down after it exceeded 280ºF; once the vehicle cooled, the alternator started charging again. There is nothing wrong with the vehicle or the alternator."

In NW Florida in 1998, the price for a rebuilt GM alternator -- of whichever type -- was in the vicinity of $1/amp.

Actually a little less than that without core charge, but you might not wanna sell off your Lucas for the core value of a Delco so you may prefer to pay the core charge.

Michael Aiken points out that if your car came with the Bosch 115-amp alternator instead of the Lucas, you might be *reducing* your capacity installing a GM alt -- and the Bosch seems to be far more reliable than the Lucas, so you may not be improving reliability significantly either. Of course you can opt for a GM alternator up to 140 amps.

ALTERNATIVE ALTERNATOR INSTALLATION: A non-Lucas alternator won't simply bolt in where the Lucas alternator comes out, so you'll have to do something to mount it. The following sections describe several ideas for installing alternative alternators -- all of which happen to be GM alternators. But the same ideas might apply to other alternative alternator installations, even though details may differ.

GM ALTERNATOR INSTALLATION -- WHERE THE LUCAS WAS: One possibility involves making an entirely new bracket to fit whatever alternator you choose. However, the existing alternator mount bracket is rather convoluted and is involved in supporting the air pump as well, so it would be no simple task to fashion a replacement. It might be worth it, though; the cost of a new Lucas alternator would pay for a GM alternator *and* a very expensive custom-made bracket, and the *next* alternator replacement would be cheap.

Fortunately you can skip the fab work and just *buy* a new bracket. John's Cars (page 717) offers a bracket to fit a GM Delco alternator, complete with a suitable wiring connector. Their catalog number for it is GMALT. Michael Minglin says, "A little pricey, but well-designed and went in without any problems."

GM ALTERNATOR INSTALLATION -- HUNG OFF THE AIR PUMP BRACKET: It's possible to hang a GM alternator from the bottom of the air pump bracket instead of from the alternator bracket. The air pump bracket is steel and can easily be altered to hold a GM alternator close enough to the original position that the stock adjuster can be used. The attachment of the adjuster to the front of the engine is a block on a single bolt that can be loosened and repositioned to accommodate the new alternator position.

Jim Schultetus describes the method he used: "the original alt bracket was removed along with the alt and a rough dimension was taken from a reference point off the bracket to the alt pulley and from the front of the bracket to front edge of the original Lucas pulley. With these dimensions the CS130 was positioned next to bracket and two straps about 1-3/4 inches long were made of 1/4 in. steel about a inch wide with a 3/8 in. hole drilled in one end of each. These two straps then where bolted to the Delco alt and positioned on the original bracket tube of about a inch in diameter. Using the original measurements taken from the Lucas alt in original position I welded the 2 straps to the tube. Bolted bracket back to block, installed CS130 and used original tensioner setup and belt. Took about 1 1/2 hours."

Another variation on this idea would be to bolt or weld steel plates to the surface of the flanges on the air pump mount extending downwards, and drilling holes for a pivot bolt through them.

Here's another idea for modifying the air pump bracket to hold a GM alternator that doesn't involve welding: Drill a set of holes for a second pivot bolt, this set close (*very* close) to the bottom edge of the bracket and between the engine and the stiffening tube in the bracket. Swing a GM alternator from this pivot, spacing it back from the forward face of the bracket the proper amount to align the belt -- about 3/4". A "long lug" alternator (see GM alternator descriptions above) would probably fit best. The only problem with this idea is that the alternator probably won't be able to swing through many degrees between hitting the air pump bracket on either side of the pivot, so you'd need to select exactly the right length belt. A little filing here and there may permit a few more degrees of swing.

The Lucas alternator, using the GM alternator terminology, has the tensioner lug at the 2 o'clock position. Since the various methods of supporting the GM alternator from the air pump bracket position the pivot outward and upward from the original pivot for the Lucas, using a "straight across" (6:00 and 12:00) lug arrangement should put the tensioner lug in nearly the same position as original.

Don't just run a pivot bolt through the bracket and tighten a nut on the back side; you'll distort the sides of the air pump bracket. Insert the pivot bolt through the front flange of the bracket, through some spacers selected to provide belt alignment, through the pivot lug on the GM alternator, through a washer , through two nuts, through a washer, then through the rear flange of the bracket and into another washer and nut. First, snug up the rearmost nut, but don't overtighten it -- you don't want to distort the bracket. Second, tighten the nut just forward of the rear flange back against the forward side of the rear flange, so those two nuts are tightened down against each other with the rear flange in between. Finally, after adjusting the belt tension, tighten the forwardmost nut forward, pulling the alternator lug snugly against the forward flange of the bracket.

If your pivot bolt isn't threaded the entire length, you may need to add some spacers between the back side of the alternator lug and the nut that tightens down on it.

REPLACING THE AIR PUMP WITH A GM ALTERNATOR: If you happen to be using your car for competition or other applications where the air injection system is unnecessary, ripping the air pump out and putting a GM alternator in that spot to maintain tension on the A/C compressor belt makes sense. It looks especially attractive when you realize that the mount schemes are similar; a small GM alternator will fit right onto the air pump mounting bracket, you only need to add a few spacers on the pivot bolt behind it.

A short-lug CS130 alternator with a tensioner lug at 10 o'clock works just fine mounted on the air pump bracket in the OEM location, and does not interfere with the tensioner clevis, radiator hoses, or thermostat housing. A CS130D should fit just as well.

Alternators driven by V-belts, including the Lucas on the XJ-S as well as GM alternator applications using V-belts, generally use a 10mm wide (15 series) V-belt. The air pump and the air conditioning compressor on the XJ-S use a 13mm wide (17 series) V-belt. If you install a CS130 alternator in place of the air pump and driven by the same belt as the compressor, you need alternator pulley part number 24-1104. Other GM alternators probably need the same pulley. Unfortunately, you're not likely to find this pulley in a junkyard, but it can be ordered through any alternator shop for perhaps $15. This pulley is 3-1/4" in diameter, which is larger than typical alternator pulleys for 10mm belts, which means the alternator will turn slower -- which may have implications on charging at idle. That's tough; this pulley is this big for a reason, namely that a 13mm belt really shouldn't be bent any tighter than that.

From Bernie Embden's www site: "I was able to source a 3.25" wide belt pulley (1/2 inch) from Canton Racing Products. At $32.00 US, this billet aluminum pulley cost more that the alternator, but it does look good.

The tips of the cooling fan on the alternator might hit the upper corner of the front leg of the air pump bracket. To preclude this possibility, slip the pivot bolt through the air pump bracket with a washer under the head, mark a semicircle around the edge of the washer, and grind off the portion of the bracket outside this mark.

The pivot on the air pump is 3-3/4" long, but the pivot lug on a GM alternator is only 2" long. You can fill the extra space within the bracket with a stack of washers if you want. If you want a more professional appearance, drop into a bicycle shop; many 10-speeds use a 10mm rear axle and have spacers on the derailleur side of the rear wheel that will serve quite well here. Or you can get some more of the spacers used by Jaguar on the banjo bolt at the top right of the radiator; it's part number CAC4559. All of the spacers should go behind the alternator pivot; with it butted up against the front leg of the air pump bracket, the belt lines up perfectly.

The rear leg of the air pump bracket has a sleeve fitted where the pivot bolt goes through -- just like any other similar bracket. This sleeve is intended to be pulled through the bracket leg as the pivot bolt is tightened so that the air pump (or whatever) can be snugged up without bending the bracket itself. Make sure that your spacers are long enough that this sleeve is not pulled all the way through the bracket and the nut contacts the bracket leg itself. In fact, you might opt to push that sleeve rearward in the bracket before you start fitting spacers to give it more capacity to take up slack when tightening down the pivot bolt.

Unfortunately, the pulley on an alternator is smaller than the one on the air pump, which moves the portion of the V-belt between the crank pulley and the alternator up a little -- possibly right into the idler arm for the belt-driven fan. David Osborne didn't have a problem. "I did the CS130 alternator-in-place-of-air pump conversion with great success. The replacement (shorter) belt (Dynacraft 59017) successfully clears the idler arm by about 3/16 inch." Alas, others haven't been so lucky, and when you realize you've got interference there it can bring this pleasant little job to a screechin' halt.

To avoid this interference problem, it helps to mount the alternator with its centerline as low as possible. That's why you want a CS130; its small diameter keeps the centerline closer to the mounting bracket. You also most definitely want the short-lug version.

The 24-1104 pulley may also help with the interference problem. Using this slightly larger pulley will move the belt a hair away from the interference.

You'll need to figure out what length V-belt you'll need; with the CS130 alternator and 24-1104 pulley, the 59017 mentioned by Osborne above (or a 17590, same difference) works fine on the author's car with no belt-driven fan and hence no interference concern. Going to the long side helps with the interference problem, as swinging the alternator farther away to tighten a longer belt also moves the belt farther away from the idler arm. Going too long, however, will bring the alternator close to the side of the engine compartment and possibly cause a whack when the engine twists on its rubber mounts. That's another reason to choose a CS130; it's small size allows you to pivot it farther outward without contacting the fenderwell.

Once you find a belt length that works, John Napoli says, "Note the number (length) of the new alternator belt and scratch it into the fender of the car."

You might also find that going with a different length fan belt may help the interference issue by moving the idler arm out of the way. Of course, the *best* way to avoid the interference issue is to toss that belt-driven fan and idler hardware over the hedge and install an electric fan as described on page 219. As long as you're installing that big-amp GM alternator, why not put it to good use?

With a CS130 with the tensioner lug at 10 o'clock, the existing tensioner arrangement for the air pump will work just fine. If you use some other configuration and the alignment of the tensioner bracket gives you any trouble, take the tensioner bracket off the front of the right bank and replace it with the tensioner clevis formerly used with the Lucas alternator at the bottom right corner of the engine. This will require a 1/4" thick stack of washers under one end since the alternator tensioner clevis was designed to sit on an uneven surface.

See page 313 for removal of the rest of the air injection system.

REPLACING THE AIR PUMP WITH A BIG-ASS GM ALTERNATOR: John Napoli doesn't cotton to those newfangled itty-bitty alternators, he prefers the earlier clunkers. So he installed a "large case" GM alternator, which you can buy for a song since nobody else wants them any more. Mounted on the air pump bracket, the tensioner lug was too high and cocked the tensioner rod in the clevis on the front of the right bank. It also interfered with the right side radiator hose and thermostat housing. And the centerline of the pulley was so high that interference with the fan belt idler was a definite problem.

Napoli solved all these problems by making a simple plate to relocate the air pump mount bracket downward. "Take the steel bracket that supported the base of the air pump. Take a piece of flat steel or aluminum sheet (I used aluminum) about 5/32" thick (you want stiffness but too thick and you'll need longer bolts, and who needs the extra weight) to use as an adapter plate. The piece should be as wide as the stock air pump bracket and twice as long (high)." That plate will need to be 4" wide and about 5½" long. Of course, using a thicker plate and buying longer bolts (you'll only need two) will also work; the one thing you *don't* want to do is use bolts that are too short, since they are threaded into aluminum.

"The stock air pump bracket has four bolts that secure it to the side of the block (via an aluminum block bracket casting itself attached to the block with two large bolts). The plate you'll make will be drilled for six bolt holes, and is mounted sandwiched between the alternator (via the steel air pump bracket) and the block bracket. The upper two holes are used to bolt the adapter plate to the upper two holes of the block bracket. The middle two holes are used to bolt the air pump bracket and adapter plate to the lower two holes of the block bracket. The lower two bolt holes of the adapter plate bolt the air pump bracket to the adapter plate. Got it? Use the air pump bracket as a pattern for the bolt holes on the adapter plate.

“Bore a large hole in the top center of the adapter plate to clear the forward bolt that attaches the block bracket to the block -- once again, use the air pump bracket as a guide. Polish the adapter plate to a high gloss to add several miles per hour.”

REPLACING THE AIR PUMP WITH A GM ALTERNATOR -- OTHER IDEAS: If you’re removing the air pump and need to install a GM alternator to serve as an idler, you can hang the alternator off the *bottom* of the air pump bracket as described on page 579. The difference: with that installation, the air pump stays and the alternator is spaced rearward from the front of the bracket to align the alt pulley with the groove on the damper. But with the air pump removed you’ll want to install the GM alternator right up against the front of the air pump bracket so the pulley lines up with the A/C compressor pulley.

You might consider flipping the air pump bracket upside down. This will require drilling one large hole to clear the head of a bolt on the alternator bracket underneath.

ALTERNATOR POWER WIRING: After you’ve got your new alternator bolted in, you’ll need to connect the big power lug to the main power line to the battery -- which means either to one of the two posts on the bus on the firewall or to the post on the starter. The original alternator was connected to the post on the starter with two wires, but those wires may not be long enough to reach the new alternator location. David Osborne says, “An extension of the power cable from the alternator was required and a bubble-wrap Exide #6915608 6 gauge Quick Splice Battery Cable did the trick.”

The wiring from the main power connection on the alternator needs to be suitable for handling the rated output of the alternator *continuously* in an already hostile environment -- things are hot in there *without* any current in the wires! If you are replacing a 66- or 75-amp alternator with something over 100 amps, you will be loading the wiring and connectors with more current than they were intended to handle. You may find that the two large wires are *already* a bit charred at the back of the alternator.

If you install a more powerful alternator, you really should upgrade these power leads while you’re at it. Just replacing these two large wires with two larger wires would be tough, since they go through a conduit to the starter terminal; you basically need to pull the exhaust system from that side to work on it! Better idea: simply install an *additional* heavy wire from the main terminal on the alternator to the main bus on the firewall. Just route it along the right side wheel well, making sure to leave enough room for the wire to flex as the engine moves around on its rubber mounts. Joe Bialy provides some guidance on what size wire is adequate: “#6 gauge would be great, #8 is acceptable, #10 marginal. Three #14's are a wee bit better than one #10. Three #12's would work like one #8.”

The wiring from the starter terminal to the main bus and then all the way back to the battery is already more than adequate, of course, since it must handle starter current -- several times what alternator current will ever be.

Another idea: if you install an electric radiator fan with a control relay, you could run a wire directly from the alternator to the power input contact on that relay. That way, the fan (usually more than 10 amps) is powered directly through this wire, and the load in the other wiring is reduced accordingly. Of course, you can provide similar wiring to the OEM electric radiator fan relay and the headlight and fog light relays.

ALTERNATOR GROUNDING: Keep in mind that the full rated amperage of the alternator -- 66 or 75 amps with the OEM Lucas up to over 100 amps with the Bosch or GM alternators -- is expected to go through the bolts that hold the alternator to the side of the engine. Believe it or not, these bolts are not always up to the task -- especially if there’s a bit of oil, Loctite, or corrosion involved.

Rick Holland learned that there are reports of serious problems with grounding the GM CS130 alternator in particular. “Alternators supposedly were failing because of insufficient electrical grounds to the rear case of the unit. My *2nd* unit, a rebuilt from an outfit named "Columbia", said to install a heavy wire from the case to ground and cited a service excerpt allegedly from GM stating that a conductivity problem had been encountered with their "black oxide" mounting fasteners. The recommended fix was to install a heavy ground strap from the usually unused ground boss on the back of the alternator (heat sink side of case) to an appropriate clean spot on the engine. I used a basket weave ground strap with tinned ends." This is a cheap and easy way to make sure your alternator can send full rated current to the car -- *regardless* of which type alternator you have.

Also keep in mind that the same current must then get from the engine block to the chassis; see the comments on adding a ground strap on page 555.

Of course, even grounds that are not directly involved with the heavy current can cause flaky symptoms since they may effect the alternator's internal regulation. David Littlefield apparently had such trouble: "I found that my gauge showed "discharge" most of the time. For a long time, I ascribed this to just being another unreliable gauge.

"On my '88 there is a black plastic shield covering a bracket with some electrical connections on the inside of the passenger side (LHD) front fender, towards the back of the engine bay. I removed that cover and found a couple of ground wires connected to the bracket. I cleaned a goodly amount of corrosion off these connections and off the brass (?) screw that held the bracket to the chassis. Now, even at idle, the gauge shows "charge,". I wish I had figured this out earlier, it might have saved me the cost of a new battery and a new alternator. I'm convinced the old alternator died because of it, and it killed the battery, in turn.

"There was no indication that anything was wrong, besides the gauge reading low. Those of you that find your battery going flat overnight or similar symptoms may want to try this fix before removing the alternator. Or if you are replacing your alternator, be sure to clean up these contacts to keep from killing the next one."

CHARGING VOLTAGE AND TEMPERATURE COMPENSATION: Irrespective of Napoli's claim that "volts are volts", there actually is a design difference between British volts and Detroit volts -- or between early 80's Lucas volts and late 90's GM volts, anyway. Section 86.10.01(c) of the ROM describes checking the regulator in the Lucas alternator for holding output between 13.6 and 14.4 volts. When operating properly and within their load limits, the Lucas alternators seem to hold voltage near the low end of this range, around 13.6-13.7 volts. According to Michael Aiken, the later Bosch alternator behaves similarly; "My 115 amp Bosch on my 89 XJ-S charges at 13.67 volts measured at the battery."

It turns out, though, that the ideal charging voltage for the typical automotive lead-acid battery depends on the temperature of the battery; the lower the temperature, the higher the charging voltage needs to be to maintain a good state of charge. Modern GM alternators, including the CS130 this author installed, have "temperature compensated" voltage regulators inside, meaning that the charging voltage is varied depending on the temperature of the air surrounding the alternator. On the author's car, the CS130 charges at 14.3V when started cold and the alternator is at room temperature, and the voltage drops back to about 13.8V as the engine warms up. If the car ran hot, the voltage would probably get even lower.

Of course, the reason GM alternators include this temperature compensation is that they presume the battery will be seeing the same ambient temperature as the alternator because it's in the same engine compartment. But the battery in the XJ-S is in the trunk, so really you'd be better off *without* the temperature compensation. The original Lucas alternator evidently had no temperature compensation, but it charged at only 13.6V all the time; apparently it was designed for the battery to be in the engine compartment (as on Jaguar saloons and other cars using the same Lucas alternators) since it regulates at the voltage suitable for hot engine compartment temperatures. Since there are quite a few applications where the battery is installed in a cool location (marine applications, for example), perhaps Delco or others actually make a regulator that lacks temperature compensation; if you find one, opt for it. However, just installing the typical temperature-compensated GM alternator will generally work fine since the warmed-up voltage of 13.8V is still as high as the Lucas ever charged.

Combined with the sensing location difference discussed above, the installation of a GM alternator may result in the entire electrical system operating nearly a full volt higher than it ever did with the Lucas alternator in place. This has no detrimental effect since the electrical components were all designed to operate up to that voltage anyway, but it does make lights noticeably brighter, window motors zip quicker, blower fans blow harder, etc.

Don Neff says, "Jeep/Chrysler alternators also compensate for temperatures. My newer Jeep has a thermocouple under the battery to measure its temp instead of relying on the alt's temp. This alternator with remote temperature sensing might be a better choice for the XJ-S with its battery in the trunk."

Battery

When your battery needs replacing, you will find that the XJ-S uses an unusual battery -- and that Jaguar wants $$$$ for it. The Jaguar battery comes with an enclosed vent connected to a tube to route the vent out through the floor of the trunk. Batteries are normally in engine compartments which are well ventilated, and things still corrode right around the battery. A trunk is not ventilated at all, so the battery vapors will corrode the whole trunk. Harry Trafford reports: "the DPO let the Jag dealer in Miami install a new one. The dealer installed a standard Interstate mega-something and charged him $150 US for a $59 battery! The thing out-gassed into the boot and now I have a *major* rust repair job ahead of me. And no, the little red plastic Jaguar vent cover does not work. There are large rusted out areas up in the buttresses and along the boot area on either side of the lid, including the area between the rear glass and boot lid. The only thing keeping out the rain is the paint. Push a finger into any of those places and you'll be looking at the spare tire. We're not talking pinholes here."

Worse yet, batteries emit hydrogen gas when charging, so you run the risk of blowing the trunk lid off your car.

According to Randy Wilson, an Audi 5000 battery will fit with the addition of a half inch plywood shim. Audi put the battery in the passenger cabin, so it has similar venting provisions.

Wilson also reports that Interstate offers an add-on vent kit for their batteries. And there are some marine batteries with vent provisions.

Charlotte Hand reports that the make of batteries sold at Pep Boys, Pro Start, offers a "group size 34" battery for the XJ-S, complete with the proper vent provisions. There are apparently at least two to choose from, the cheapie and the high end.

Robbin Lewis says, "Sears now sells an "International" DieHard Battery that is an almost exact match to the original Jaguar battery, but at a much cheaper price. The only thing I had to do was move the 90 deg. fitting from the right side to the left... easy to do. Just swap the blank plug on the left side with the angle fitting on the right."

Delco Freedom batteries, as well as *some* Champion batteries, come with a flat top vent/cap assembly that has a vent opening on each end. Each is sort of a flat oval shape, but it is possible to connect tubing to them. Hopefully this is a trend among battery manufacturers; being able to remotely vent batteries is a plus, and it can't cost them much to provide the capability. Other Champion designs -- many of which are alongside on the same shelf, sometimes sharing the same part number -- have obscure venting, apparently coming out of whereever around the vent caps, and clearly impossible to properly seal.

A flat-top Champion model 78-2 fits the '83 XJ-S *perfectly*. It is a simple matter to fashion a suitable vent scheme with some 1/4" ID clear vinyl tubing and a plastic tee. This battery comes with an 84-month warranty, 24 month free replacement, 36 months free jumpstart, and is rated at 950 cranking amps at 32°F and 770 cold cranking amps at 0°F.

The catch? Model 78-2 is a side-terminal battery! The original top-terminal cable ends must be cut off and side-terminal cable connectors installed. They cost only a coupla bucks, the cost is no big deal. In truth, the XJ-S looks like it was designed for side terminals; there is precious little room for top terminals, requiring an unusually short battery height-wise. There's plenty of room on the front, however, and use of side terminals allows this full-size battery to fit under that plastic cover.

A more traditional design battery can be made to serve, but you must find a way to vent the fumes outside of the trunk. Find or make a cover to completely enclose the vents on the top of the battery (being selective when you buy the battery may help here), or an airtight container for the entire battery. Connect a vent tube and run it out through the floor of the trunk. B. J. Kroppe suggests "install a DIN cover over your battery. (DIN battery covers are found on BMWs and Mercs)."

With careful selection, the vent cover from the old Jaguar battery can be used on a generic replacement battery. Georges Krcmery says: "The EXIDE Mega-Cell # E42 50W has a rectangular slot around its filler caps which exactly matches the vent cover with only a slight adjustment: I had to cut off about 1 cm of the slot's lip to accommodate a similar widening under the nipple of the vent cover. It then snapped right into place. The battery is about 1/4" too wide to fit in the tray. Fortunately, the bottom of the battery has extra plastic on each side and it is possible to carefully saw off 1/8" on both sides to make it fit."

Michael Neal recommends an Optima battery (see page 707). This is a lead-acid unit but uses six separate coils instead of plates; it uses a gel electrolyte and is sealed, no vent required. "So far they have proven nearly indestructible." The Optima is not cheap, but reports are unanimous that it *is* worth the money -- it lasts so much longer than a conventional battery that its real cost is comparable.

David Littlefield elaborates: "Optima only sells two batteries for passenger cars, one with side posts (800U) and one without (800S). Either will work fine in the Jag, since the one with side posts also has top posts. These batteries are both red-topped; Optima also sells a yellow top battery that is designed for deep-cycle operation, such as in electric golf carts. You don't want the yellow ones." Optima also makes blue-topped marine batteries.

William Noorloos adds his experience with installing this battery: "...when I walked towards the trunk with the Optima in my hands it jumped the remaining 3 feet all by itself into position, and just sat there waiting to be connected! It's a total fit. 100% No fiddling. As a bonus the original Jag venting thing (Non-metallic British part *and* Lucas, but it has not broken yet) fits 100% over the Optima's 2 emergency pressure relief valves. So in the event of an alternator thinking it has to drive standard household appliances, and thereby blowing the battery, the (probably messy) inside of your expensive Optima will not end up in your trunk."

Whatever battery you use, you will want to reinstall the plastic cover over it. If you can make use of the original battery hold-down bracket, it may make life easier. With the Champion 78-2 described above, it would fit except that it blocks off the vents, and the tangs protruding downward on either end of the battery interfere with a built-in handle on the battery. Easy enough to cut the tangs off. The vents require a little more care, however; cutting enough of the bracket to clear the vents might render it two pieces! However, with judicious cutting, the top edge of the bracket can be notched all the way around the corner and part way down the side, leaving a portion of the side intact. If the height comes out too low it'd be a simple matter to put something *under* the battery to space the battery and bracket up enough to hold the plastic cover properly.

Alternative plan B is to forget the stock bracket and simply fashion a bar across the top of the battery. Longer J-bolts can be used, and two 1/4" holes made in the top of the original plastic cover. Then, after the battery is secured with nuts and washers, the cover can be installed and additional nuts -- real pretty cap nuts or threaded knobs, they show within the boot -- can be used to secure the plastic cover.

FYI: the battery compartment in the '83 XJ-S is 10 inches by 6-3/4 inches. The ideal battery height must be shorter than 8 inches, terminals included. The height to the flat top of the Champion 78-2 is 7 inches, and it fits with room to spare. It is *highly* recommended that you confirm the size of the compartment in your own car before shopping for a battery; the various documentation on what size battery to use, including those cute computerized battery selector displays, seem to be wrong more often than they're right.

One general observation about car batteries and warranties: There are some excellent $60 batteries out there with 60-month warranties (or longer). However, some $60 60-month batteries are actually a scheme to sell you a $40 battery every 3 or 4 years; it dies, you bring it in and complain, and they happily install another battery just like it and charge you the "pro-rated" cost based on how long it lasted -- about $40. If you think about it, you'll realize they could just as well claim the same battery is good for 20 years and charge you $240 for it -- you'd still end up bringing it back every three or four years and paying about $40 for a replacement. The only thing you're buying by paying more than $40 for the battery is the "hook" that convinces you to keep buying the *same* battery rather than trying some other make to see if it lasts longer. If you buy a 60-month battery and it dies without due cause in far less time, you might be well advised to simply write off that warranty and buy another make -- unless, of course, you don't mind having to replace your battery every 3 or 4 years.

There are some people who select batteries on the basis of cranking amps. The logic works like this: The car only requires a certain number of cranking amps to start, and almost any battery will start the car when new. However, as the battery ages, its cranking capacity diminishes with time, until eventually the battery will no longer start the car. The more cranking amps the battery has to begin with, the more it can deteriorate before replacement is required. This theory assumes a lot, including that different batteries deteriorate at comparable rates and that the battery doesn't suffer other types of failure such as internal shorts. As such, this theory probably doesn't apply to unusual batteries such as the Optima, but may be a fairly valid method of comparing conventional batteries.

But to this theory must be added another monkey wrench: In order to maximize cranking amps, the plates within batteries must maximize surface area, which is done by making them look like grids or screens rather than plates. With successive charges and discharges, these grids get more and more deformed (metal is etched away when discharging, plated back on when recharging, possibly in a different place than it was before), possibly reducing the cranking capacity faster than flat plates would. Also, the grids might fracture more easily with vibrations, causing internal shorts. There are so-called "rough service" batteries available that go the opposite route: they sacrifice cranking amps in favor of a rugged plate design that won't go to pieces if you install it in a truck and drive it across the Baja Desert.

BATTERY TERMINALS: If your XJ-S has the original battery terminals on the ends of the cables in the trunk, the 5/16" nuts used to clamp those terminals down on the battery posts require a 1/4" Whitworth wrench size. See page 26.

BATTERY HOLD-DOWN NUTS: Also Whitworth.

DEAD BATTERY PROBLEMS: If your battery is dead after the car sits for a few days, it's time to check for current flow when everything is supposed to be shut off. The standard method for doing this is to disconnect the battery and reconnect it with an ammeter in the circuit, and monitor the amps as you pull fuses one by one. The current with everything off should be in the milliamp range; if it's amps rather than milliamps, you need to find out what's being left on when the car is off.

Of course, the first thing you find out is that since the battery is in the trunk, the trunk lights are on while you're fiddling in there. So you've gotta shut off the trunk lights somehow to continue with the test. It is simply *astounding* how often the test doesn't find a problem -- because the problem was the trunk lights! The trunk lid isn't securely pushing the button on the switch, so the lights stay on with the lid closed. Or *sometimes* stay on with the lid closed, so sometimes the battery dies and sometimes it doesn't.

Craig Waterman fixed this problem by reinstalling the switch with a couple of washers under it to hold it up more. Others have fixed it by bending the bracket it's mounted on. The author went a slightly different route to address the same problem. On the '83, the flat metal surface on the inside of the trunk lid is supposed to be pressing that button. I purchased a set of stick-on plastic chair feet from a hardware store and stuck one on. Of course, now I have three spare chair feet left over. This fix can be viewed at:

http://www.jag-lovers.org/xj-s/book/TrunkLightSwitch.html

Then Stephen Edward Haley noted that on his '89, adding a chair foot isn't necessary because Jaguar already did. They didn't use a chair foot, of course; they manufactured a special part attached with two screws. Probably cost you half a month's salary from your local Jaguar dealer.

Note that the early cars didn't have this switch at all. They apparently had the more simplistic light bulb in the trunk lid itself with a mercury switch operating it. So, these cars don't generally have this problem with the trunk lights killing the battery.

TRUNK LIGHT CONTROL: On any modern automobile, the trunk lights have a little switch so you can turn them off when you don't need them. Jaguar forgot to provide that nicety -- but it's simple enough to add it. Just purchase a tiny toggle switch and mount it adjacent to the trunk lid switch and wire it into the same circuit. There's plenty of room there, and it's easy to find in the dark.

AVOIDING A DEAD BATTERY: Scott Jarvis suggests: "You can order a Battery Buddy from Outer Banks, (800) 682-2225, part # batbud. It mounts to the side of your battery and monitors the voltage. When the voltage drops below a set level, it automatically switches off to preserve the battery. You just reset a breaker and away you go! Many of the Boating catalogs should carry this and you may find a better price."

Kyle Chatman responds: "You can also try Priority Start from BLI International, Dept HR12, 17939 Chatsworth St., Ste. 521, Granada Hills, CA 91344, 800-780-8276. It monitors voltage drain when the switch is off and disconnects the battery if it gets too low."

Ned Blagojevic counters: "This is available in a kit form from Jaycar Electronics (Sydney), kit number KA-1739. The kit was published in Electronics Australia (Jan 92 issue). It connects to the accessory line and measures line voltage. If voltage drops to preselect limit between 10.9 and 11.9 it shuts off the flow. The kit includes a relay and specs."

Sears also sells a battery with a switch on it, so you can switch to a "reserve" and get started.

Fuses and Fuse Blocks

If your XJ-S is old enough to have glass tube fuses, take note: the UK uses a different definition of the rating for these fuses than the US does. The US rating is for how much current the fuse will carry without blowing; the UK rating is for the amount of current to blow the fuse within a certain time. The difference is about 2:1. Simon S. Johnson sends the following data: "...the source: a 1974 edition of "Buss Fuse Car and Truck List" which has on the back cover a section call "Foreign Car Fuse Replacement Data," -- foreign to the US, that is. It states that "English standards differ from US standards. This accounts for difference in ampere ratings." Then it provides a list:

English Type	Buss Replacement
50 amp	AGC 30
35 amp	AGC 25
30 amp	AGC 20
25 amp	AGC 15
20 amp	AGC 10
10 amp	AGC 7 1/2
5 amp	AGC 3

You may find that your fuses have a little paper label inside with *both* ratings; a Lucas rating (British) and a "continuous" (American) rating.

If your car uses tubular glass fuses and the ROM specifies an amperage, it's in the British rating; you will have to correct per the chart above to use the correct American fuse.

UPGRADING TO PLASTIC FUSES: Older XJ-S's have glass tube fuses, both in three main fuseboxes and in several inline locations throughout the car. Later cars have plastic fuses, a type found on many modern cars with the amp rating clearly marked on the top and color-coded as to amperage as well; these are called ATO/ATC fuses or "blade" fuses.

Now, there are those that will look at the plastic fuses and pronounce them “cheap” -- and they’ll be correct, they are certainly cheaper to make than the glass tube fuses. But don’t confuse “cheap” with “inferior” -- the plastic fuses are *much* better than the glass tube fuses. The small spade terminals make much more reliable connections with the fusebox than the metal caps on the ends of the glass tube fuses do. And even when the connections are working just fine on both, the plastic fuses cause less voltage drop in the circuit.

If you are new to Jaguar ownership, you’re probably thinking, “Yeah, right. The glass tube fuses worked just fine in all sorts of cars for many decades, they can’t be that bad.” If you feel that way, go ahead and skip the rest of this section -- but remember it’s here. You’ll be back.

While you’re pondering the superiority of plastic fuses over glass fuses in general, allow me to point out the superiority of generic fuse blocks over the OEM fuseblocks in the XJ-S. While the fuse blocks in most cars are something you never pay any attention to, the fuse blocks in the XJ-S are a known trouble source. This author had troubles with the #1 fuse location in the headlamp fuse block in my ’83, the fuse that serves the small electric fan and the horn. It seemed that every time I checked, this circuit was not working -- and I got to where I would tap the horn regularly to check. When it quit, usually the fuse itself had failed -- not blown, but rather had lost continuity within one of the end caps. Since the small fan was in fact a heavy-duty critter from a Mercedes, I thought maybe it drew too much power, so I went to a bigger fuse. No help, quickly failed again, again not by blowing but by coming disconnected internally. Went to a larger fuse still, and the fuse block itself started to melt and issue smoke! A fuse holder should *never* get hot -- it should either say cool or the fuse should blow. I decided there was too much resistance in there somewhere and abandoned this socket. I pulled that pair of wires out of the fusebox and connected them to a plastic 20A fuse. No further problems.

Unusual problem? Iain Burgess: “I had similar problems with the A/C blower fuse in the main fusebox on my XJ6. The plastic around the terminals that held the fuse eventually melted, for some reason, the contacts in the fuse box would heat up, regardless of whether the fan was blowing maximum or minimum. The fuse would eventually fall out and the blowers would stop working (Lucas's second line of defence??) The fuse never blew. Irrespective of the current draw, there seemed to enough resistance between the fuse and the contacts to generate enough heat to melt the plastic. I replaced the fuse a number of times, cleaned the contacts with contact cleaner, sand paper, you name it, but it still got hot. I fixed it like you did, replacing that section of the fuse box with an inline spade fuse - no further problems. None of the other fuses in the box were affected either.”

Donald Neff: “You are on the right track - the heat is caused by the resistance of poor contact. But as you know, since you cleaned the fuse tabs and holder sockets, it is not the fuse contacts. They are probably the best contact in the system at any time.

“I'll bet it is the wire-to-fuse holder connection. These are usually poorly crimped connections with no protective covering. They work fine when new, but deteriorate slowly over time. Eventually the wire collects a high-resistance coating of oxide between it and the metal of the fuse holder creating a hot resistor at that point.

“I cut the wire back to clean copper and pry the crimp open to remove the corroded section. After cleaning the crimp tabs I insert the clean wire, recrimp it and then *solder* it. The solder not only provides more surface area for current flow, it (crudely) seals the copper from oxidants. It has worked well for me for a few decades.”

Larry Lee talks about his 1979 XJ6: “The S2 fusebox can be the source of a variety of seemingly unrelated electrical failures, thanks to an interesting design. Several circuits are supplied by one wire from the battery in some cases. Electricity is supplied to adjacent fuse sockets through the ends of the fuses themselves. Corrosion can be a killer here. Be sure all of your sockets and the ends of your fuses -- particularly the ends on the "supply side" -- are clean. I had a glitch involving my A/C and wipers a while back that was caused by this.”

Walter Acker IV points out that it’s not that big a job to replace your old-style fuseboxes with new fuseboxes that use the better plastic fuses. Obviously, one method for upgrading to the later style fusebox would be to obtain the fuseboxes used in the later XJ-S. However, this might not be as helpful as one might expect. For one thing, the electrical stuff apparently changed rather significantly over the years, and the later fuseboxes are likely to have fuses for components and wiring that didn’t even exist in the earlier cars. Second, when Jaguar changed fusebox styles, they also changed the mountings, so you may have to do more upgrading than you planned just to get them installed.

The best and easiest solution is to use generic fuseboxes. In fact, Walter Acker IV and this author recommend basically the same type aftermarket fusebox in particular. One source is

Painless Performance Products
2501 Ludelle St
Fort Worth, Texas 76105
817-244-6212
http://www.painlessperformance.com/
Sales: 1-888-350-6588 sales@painlessperformance.com
Tech: 1-800-423-9696 tech@painlessperformance.com
or: +1 817-244-6898

This outfit offers several models of fuse blocks, with many having wires pre-attached and even pre-labelled as to which fuse serves what load, and some even have a relay for providing a switched source without loading up the ignition switch and existing wiring. But for our purposes, Acker recommends the part number 30002. This is a simple 4-fuse block, but it costs less than $8 and it has a clever arrangement by which you can assemble blocks together to form an 8-fuse block or a 12-fuse block or any multiple of 4. It also has no wires connected, just the terminals that snap into the box, preferred by people like Acker and myself who would rather terminate wires than splice them.

A tip on acquiring such fuse blocks: Painless recommends you buy from their authorized distributors, and one of their authorized distributors is AutoZone; they don't stock the Painless items, but will order them for you. But if you just walk back to the rack, you'll find the exact same 4-fuse block -- except that it's made by Conduct-Tite!, part number 115280, and sells for less than $4! Such a deal!

The terminals that are used in these fuse blocks come in a strip of four. Hence, if you're dealing with one common power source, you connect one wire and pop the entire strip into the block and go to work on the other four. If you are fusing four separate power supplies, you merely snip this strip of four into four individual terminals and wire each one separately and snap them into the block. However, Acker points out that you must be careful not to cut away too much of the strip. It is the breadth of this strip that prevents the terminal from passing through the block, so if you trim too much of it away you can end up trying to pull a fuse and getting the terminal and wire coming right out of the block with it. Just snip about a 1/8" wide section out between the terminals to avoid them contacting each other and leave it at that.

"But the OEM fusebox has five fuses." Well, you can use one of these 4-fuse blocks and add a separate inline fuse. A better idea, though, is to install two blocks and use the extra fuse locations as places to hold spare fuses -- or replace some of the inline fuses in the car such as the one to the radio or the one to the A/C compressor.

When done, be sure to use your computer to slap together a chart of your new fuse locations, print it out so it looks professional, and install it adjacent to the new fuse block for future reference.

ADDING INLINE FUSES: In the author's '83, the inline fuses consist of a little tubular plastic container with a wire in each end; when the two halves are twisted apart they reveal a glass tube fuse within, with a spring providing contact. These work OK -- but there's certainly no reason to use inline fuse holders of that type any more. Some modern Japanese cars use a type of plastic fuse called a JCAS fuse. A JCAS fuse is a little plastic box with a clear window on the top for viewing the condition of the fusible link and a pair of 1/4" female spade terminals in the bottom. So all you need to do is attach 1/4" male spade terminals to the ends of your wires, plug them into one of these fuses, and you have an excellent inline fuse arrangement.

JCAS fuses are available in 20A, 30A, 40A, 50A, and 60A ratings. They don't seem to be available in anything smaller than a 20A, but that usually isn't a problem; any serious short will blow a 20A before toasting any wiring, even fairly small wiring.

Instrument Panel

The illumination of the instrument panel is discussed on page 637.

VERTICAL VS. ROUND GAUGES: Earlier XJ-S dashboards have four small gauges that are rectangular and the needle moves vertically. When the bodywork was revamped in 1991, however, Jaguar went with a revised dash with all round gauges. According to Alan Akeister, "There is a company in the UK, however, who can convert older models to dials. They are called Autostyle Ltd." See page 714.

Unless stated otherwise, most of the tips that follow refer to the earlier style instrument cluster with four small vertical gauges.

INSTRUMENT PANEL REMOVAL: Section 88.20.01 of the ROM and Chapter 10, Section 69 of the Haynes manual describe how to get the instrument panel out. Note that both say you need to remove the underscuttle casing on the driver's side, but this really isn't necessary unless you drop something. Both manuals also mention having to disconnect the speedometer cable from the right angle drive, but they must be talking about early cars -- the '83 has an electronic speedometer, there is no cable.

INSTRUMENT CLUSTER SNAP-ON COVERS: At each end of the row of warning lights is a snap-on cover that hides the screws that hold the warning light lens assembly as well as the screws holding the entire instrument cluster in place. On this author's '83, these covers had distorted with age and lost their snappage, so they loosely rattled around in the openings. Shipping crates are often banded shut with 1/2" wide straps made of really hard steel, almost like spring steel; I cut a piece of that strapping about 2" long, bent it up 90º at each end, trimmed it a little to fit and inserted it between the retention prongs on the snap-on cover. The metal thus provided a backing spring pressing the plastic prongs back out to their original positions, restoring the snappage. Since I cut the ends just short enough that they didn't quite reach the end of the plastic prongs, the sharp edge of the steel dug into the plastic a little so the tension held the metal piece itself in place -- although it wouldn't be hard to add some double-sided foam tape between the center section of the steel and the back surface of the cover to make sure it doesn't go anywhere. My covers now hold themselves firmly and properly to the dash.

GROUNDS FOR COMPLAINT: There is only one ground wire to the instrument cluster; it's the contact on the smaller of the two harness connectors that is separated from the rest by an omitted contact. This single contact provides the ground connection for everything on the cluster -- gauges, indicator lights, illumination lights.

If you'll trace the conductor from the socket, you'll find that about an inch away it becomes a very narrow conductor indeed. Without having done any analysis of the load carrying capacity of that section of copper foil, let's just say that having all the 2.2W dash illumination lights on might result in a measurable voltage drop in this area -- which would screw up the gauge readings.

The fix is easy: provide an additional ground. Pick one of the several other screws on the flexible circuit that makes a ground connection, and attach a wire to it and connect it to ground behind the dash. Use of a spade connector will allow the instrument cluster to be removed and installed easily as before.

Instruments and Gauges

FLAKY INSTRUMENTS: There are four vertical gauges in the center of the instrument panel on most older XJ-S's, and they are unreliable -- not because they quit working altogether, but because they never seem to provide consistent readings. Brian W. Rice writes: "All gauges in my 85 XJ-S read low by 25% when I acquired the car several years ago. I did some tests by lifting No. 4 fuse and applying a variable voltage to the dead end from a power supply, making sure not to exceed 15 volts. With precisely 12 volts applied the voltmeter showed about 9V. The fuel gauge also only indicated 3/4 with a full tank of petrol." These problems are because the wiring *to* these gauges is a disaster, with at least *four* likely locations for poor connections on each lead to each gauge.

Even if you don't think you have a problem with the gauges, it is suggested you do a minor overhaul and cleanup of the instrument cluster anyway. It's really easy, anyone can do it, and it'll only take a couple hours even if you're really milkin' the job.

First, remove the instrument cluster from the dash -- see notes above. Second, remove five screws from the back side and separate the front cover from the rear housing of the instrument cluster. This will give you access to all the innards.

Now, if you have a VOM, you should be using it. Check the ohmage of each circuit from the socket where the wiring harness plugs in all the way to the brass nuts on the screw posts on the side of the gauge itself. Of course, these circuits should read zero ohms, or maybe some really small amount like 0.1Ω if you have a sensitive digital VOM. Basically, they should read pretty much the same thing you read if you just connect the leads of the VOM together.

You're likely to find some poor connections indeed. This author found circuits with more than 2Ω. That may not sound like much, but it's a *lot* for a circuit that isn't supposed to have *any* measurable resistance. Of course, if you don't have a VOM, just dive in and fix all the connections described below as though they are all bad.

The first likely source of trouble is the harness connectors themselves. The entire panel is wired with a clever flexible printed circuit, and the harness sockets are formed by folding portions of this flexible circuit into a hole and pushing the plugs in; the connections on the sides of the plug make contact with the bare copper on the flexible sheet. There's not a whole lot you can do here other than clean up the connections a bit (rub with fine sandpaper or the like) and perhaps apply some Ox-Gard to prevent further corrosion, but if some of the circuits are really messed up, here's a tip: places that do stained glass work use thin copper foil tape, and some of this tape might be usable to fix a damaged connection on that flexible circuit. Another idea is a hobby shop; places that sell stuff for model trains and the like sometimes sell copper foil conductors for sticking down on a surface and then painting over so there are no wires visible.

Each of the four vertical gauges is connected to the flexible circuit with screws with stainless steel wavy washers under the heads. Here's the second likely spot for a bad connection. If you're in a hurry, you might just loosen the screws a bit and retighten, since that will usually make a good connection for a while. For a more permanent solution, there are several suggestions. Besides polishing up the copper surface, you might consider replacing that wavy washer with something with a little more "bite". Basic steel is not recommended, though; this is one place you don't need rust. Some hardware stores sell bronze lock washers; if you find some in a suitable size, they'd probably work well. You'll need at least 29 of them. Alternatively, you might just take a pair of pliers to those wavy washers and make them *more* wavy. Rice makes another suggestion: "I was able to repair by soldering tinned copper wire to the flexible circuit board tracks being careful not to melt the plastic flexible board and fashioning the wire into circular washers to go under the terminal nuts thus establishing good contacts again." If you try this, you might want to go to the effort of removing the entire flexible circuit from the cluster so you can solder on it separately, avoiding the possibility of melting the plastic housing itself.

If you have trouble getting either of these first two type connections working reliably, you could just get PO'd, yank the entire flexible circuit and throw it away, and wire the entire cluster with wires with loop connectors and the like. Your biggest problem will probably be making connections to light bulbs -- and there are a *lot* of connections to light bulbs! You might consider applying a small strip of that copper foil tape on each side of each socket and install a self-tapping screw through it into the plastic to attach your wires to. You can dyke off the plugs on the harnesses and install generic Molex connectors to connect to your wires.

The screws for the gauges appear to simply screw into a tapped hole in the plastic housing. How can that make an electrical connection? Looking at the other side, each gauge is mounted on a small printed circuit board (this one's rigid) with three broad copper conductors. This PCB fits into a slot and is held in place with two small clips. When the screws are threaded in from the back side, the threads dig into the copper conductors on the face of this PCB -- that's correct, the third likely place for a bad connection. Of course, one possible fix here is to use a longer screw so it screws farther up the side of that PCB and contacts it with more threads; again, a screw that's likely to rust is not recommended, brass screws might be a good idea.

Remove the two or three connection screws and two clips on a gauge and lift it out. You will note that the gauge is mounted to the little PCB with three brass nuts and wavy stainless steel washers. This is likely bad connection number four; it may not appear as likely to cause trouble as the first three, but in fact on this author's car these nuts were the worst problem!

The fix for the last two types of bad connection is one operation. Remove the three brass nuts and separate the PCB from the gauge itself, being careful not to drop the small panel behind the PCB or a mysterious clip around one post that seems to do nothing but provide proper spacing. Set the gauge aside; if it's been working at all, it's not likely there's anything wrong with it. Polish both ends of each conductor on the PCB, then set it down on a flat surface and apply some solder. It solders really well. Build up a ring of "tinning" around each post hole, and tin an area at the end of each conductor for those screws to dig into. When cool, wipe away any excess resin and reassemble. You can easily do one gauge at a time so you don't mix anything up.

GAUGE REPAIR: All four vertical gauges are of similar design: two stationary coils at 90º to each other, and a heavily damped rotor. Automobiles have always used damped gauges; not only does it reduce the likelihood of damage from vibrations in the car, but gauges zipping up and down make drivers nervous.

Val Danilov reports, "Once I was sure that the oil gauge was faulty and not the sending unit, I pulled the gauge out of its housing by removing 3 screws from the back of the plate the gauge was attached to, as well as 2 metal clips. It's pretty much self-explanatory once you get to it. Once the gauge was out, in good lighting, you can see several hair-thin metal wires that run from the winding to 3 metal posts on the periphery of the gauge. The wires are soldered to the posts in such a way that they appear to be misplaced (as if they should extend farther to some other point), when in fact they are simply so small that you cannot easily see the points of attachment. When trying to move them with a tiny screwdriver, I found one wire which was loose. I used a regular soldering iron to affix the wire back on the post. Voilà! Problem solved.

"When the gauge is out of the instrument cluster, it is very easy to test it with a 12 volt supply by simply connecting one of the electrodes to +, while grounding the other electrode. Note: the gauge has 3 electrodes (nuts on the threaded ends of the posts), do not use the middle post. The post nearest the bottom of the gauge is ground."

85 MPH SPEEDOMETER: Regarding why some XJ-S's came with 85 mph speedometers, Randy K. Wilson says, "It affected 80, 81 and 82. It may also have been in during 83... not sure." This author's '83 has a normal speedometer -- but perhaps it was retrofitted.

David Berman adds, "It resulted from a regulation from the US National Highway Transportation Safety Administration (NHTSA) during the leadership of "safety-czar" Joan Claybrook, during the regulation-happy Carter administration. The purpose was to prevent kids from being enticed by the "century" mark. It was effective for the 1980 model year.

"The regulation was thankfully scrapped in 1983 as part of a regulation-reduction program of the first Reagan administration. Most non-US vehicles returned to "real" speedometers for the 1984 model year, but US manufacturers retained the 85 mph speedos, at least for their high-volume car lines, for a very long time."

If you don't like the 85 mph speedometer, it can simply be replaced with a normal speedometer from a different year. John Napoli says, "I did this on my car about a year ago. Bought a 160 mph unit from a junkyard. Installed easily and works great." Of course, the replacement speedometer will likely have a different odometer reading, and you'll just have to deal with that.

INTERMITTENT SPEEDOMETER: Several owners have reported on electronic speedometers that work sometimes, other times they sit at 0. Robert Louis Woodling says, "If the wires sag on the exhaust the insulation melts and the speedo stops working. The intermittent symptoms could be the beginning of insulation meltdown or a poor connection."

SPEEDOMETER/CRUISE CONTROL/TRIP COMPUTER/SERVICE INTERVAL COUNTER SIGNAL: That's right, the speed signal goes to as many as four separate places. This signal got to its destination by at least three different methods over the life of the XJ-S. The early cars had cable-driven speedometers and service interval counters; a cable came off a small angle gearbox on the side of the transmission, went to the service interval counter, and another cable went from there to the speedometer. Walter Acker IV says, "On my '76 XJ-S the cable driven service interval counter is behind the dashboard in the area of the radio." The cruise control had its own sensor on the front end of the drive shaft. Of course, there was no trip computer on these early cars.

The angle gearbox was apparently customized to utilize the same components with the GM400 that had been developed for use with the BW12; it not only provides a ratio change, but it also converts to a different type speedometer cable -- the threaded coupling is different, and the size of the squared section on the end of the cable itself is different.

Early 80's cars switched to an electronic speedometer that got its signal from a pulse generator that mounted on the very same angle gearbox. The mechanical service interval counter under the dash was replaced with an electronic service interval counter located to the trunk. The cruise control was altered to utilize the same signal, eliminating the need for its own sensor. The two wires that connect to the pulse generator are 12V power and signal.

The pulse generator changed part number in 1984 with the introduction of the trip computer. Ron Whiston says the differences are obvious, the color is different, the plug is different, but the dealer may still hand you the wrong one. It's best to take the old one with you when buying a replacement.

Peter Morris provides some suggested tests for this sending unit: "Check the transducer by getting under the car and pulling the unit, spinning the drive while someone verifies speedometer movement. This is not a conclusive test, however. If the there is no movement, another check, also performed under the car, is to disconnect the transducer, and connect a pair of clip-leads to the chassis-side connections. Clip one clip-lead to a heavy screwdriver and the other to a file. Drag the screwdriver across the file while someone watches the speedo. If there is speedometer indicator movement, then you can reasonably assume the wiring and connections to the speedo (and trip computer) are good. The next logical step would be to replace the transducer."

From VIN 134286 on -- the beginning of the 1987 model year -- the 1-wire oxygen sensors were upgraded to 3-wire oxygen sensors. This change eliminated the legal requirement for a service interval counter, so it was omitted. See page 292.

In 1988, the pulse generator on the transmission was eliminated in favor of a sensor on the final drive unit. While the transmission-mounted pulse generator was a shaft-driven device, this later unit has no moving parts; it is a simple pickup mounted adjacent to a toothed flange on the ring gear carrier inside the differential. The pickup does not produce a usable signal by itself, however; it's connected to a "speed interface unit" (so named to distinguish it from the "interface unit" used to process fuel injector pulses for input into the trip computer), and the speed interface unit in turn provides a signal to the speedometer, cruise control and trip computer. Doug Dwyer says "The speedo interface and diff mounted speedo transducer began with VIN 144263, about half way thru the '88 model year."

SPEEDOMETER SENDING UNIT 90° ADAPTER: John Shuck sends this report: "I've actually repaired these little expensive jobbies. Take apart the crimps and inside is a small square piece of metal that actually does the drive and is probably sheared. Now go to a speedo shop and have them square you a piece of speedo cable about 2 inches long. They put the round cable in a die.. hit it with a big hammer..bingo..square. Cut this to length with a die grinder and reassemble."

Another possibility might be to find the right size square key stock. Industrial supply houses usually have a good selection.

SPEED WHILE STANDING STILL: Technical Service Bulletin J85/28 addresses "Speedometer Needle Movement - Vehicle Standing". This TSB was issued in April of 1985 (shortly after the introduction of the trip computer) and the specified repair involves the trip computer, so apparently there was a spurious signal problem with the new speed circuitry for the trip computer. The cure is to pull the trip computer out of the dash and splice in a capacitor between the yellow wire on one harness connector and the black wire on the other harness connector. The capacitor is described only as "Lucas 60600903".

The yellow wire is the pulse signal to speedometer, trip computer, service interval counter and cruise control, and the black wire is ground. A capacitor installed in this way is simply a filter for spurious signals that may be affecting all four of those systems.

TACHOMETER ZEROING: Bob Gallivan reports that "my tach was out of whack, reading low ~ 750 rpm. Found that it can be zeroed in by a white plactic lever that sits ~ at the 6-10 O'clock position on the back of the tach face. While in the car it can be adjusted using some lock wire to pull the lever (up or down)." Note that Gallivan's car is an '84, and this author's '83 has no such plastic lever.

OIL PRESSURE SENDING UNIT: Many people confuse the two separate items on the XJ-S, both located at the top rear center of the engine, just below and behind the turntable. The smaller item is the warning light sender, and is a relatively cheap item. The larger part is the sender for the gauge, and it is more expensive and less likely to be available at a generic auto parts store.

The sending unit is a simple variable resistor. Jim Isbell says "I have opened up one from a series 3 XJ6 and found a mechanical diaphragm to wirewound pot contraption. It essentially acts as a variable resistor that shows high resistance at low pressure and low resistance at high pressure."

Mike Cogswell reports that earlier Jaguar senders were different than the later -- and they shouldn't be mixed. "Turns out that the S2 E-Types (and probably XJ-6s of the same vintage) used 80 psi gauges while the V12s used 100 psi gauges. The gauges are identical except for the markings, but the senders are different since they are the same resistance at different pressures."

FUEL LEVEL SENDER: Gregory Wells of Coventry West, Inc., says, "Regarding the fuel level transmitters, I trust everyone is aware that these are notorious for the floats becoming partially filled with fuel and thus giving a very false reading. In the last three years, I don't think we have changed a tank or transmitter without finding that the hollow float was partially full of fuel. I have seen people throw away the hollow plastic float and replace it with an appropriately-sized cork to eliminate the problem."

This author found some fuel in his float when lining the tank, but not much; perhaps 1/10 full. Still, it seemed the thing to do to do something about it, so I drilled a very tiny hole in one end, squeezed the fuel out, then plugged the hole with a #2 (tiny!) stainless steel screw. The screw was 1/4" long to begin with, but I cut it shorter so it was barely any longer than the wall of the float was thick. Then I coated the entire float with the same stuff the tank was being lined with; the tiny screw was backed out far enough to get some of the liner on the threads, then seated again.

I didn't expect this to make any difference -- but I was wrong. It made a *big* difference in how the fuel level gauge read. Previously, filling the tank resulted in the gauge reading on the F, perhaps a hair under. The level would drop fairly quickly to 1/2 full, then drop more slowly for the bottom half of the gauge. After draining and sealing the float, filling the tank resulted in the gauge reading quite a ways *above* the F, probably pegged. And it seems to move linearly from full to empty. Similar results have since been reported by Steve Holst and others.

Len Olsen provided an easier fix: go down to your local Ford dealer's parts department and ask for part number C0AZ-9202-B. This is a brass float that will fit the XJ-S sender with only minor spreading of the wire loop at the end of the arm. It also costs less than five bucks. It reportedly comes in packages of two for some reason, so how much you'll pay may depend on whether you can convince the Ford dealer to break open a package.

Peter Cohen adds, "For what it's worth, the second character is a zero, not the letter O. In Ford part number parlance, that is the first year that the part was used. In this case, probably 1990."

This is perhaps one of the easiest fixes on the XJ-S. Drive the car until the tank is nearly empty, then peel back the carpet in the trunk and remove the sender. Replace the float and reinstall.

Earl Huff says, "I replaced the fuel sender float on my 1985 XJ-S a few days ago with the recommended Ford float. The good news is that it was easy, all went well, and the gauge for the first time reads as it properly should. The puzzling part is that the original float appeared to be perfectly intact with absolutely no gas inside it. Does anyone have any idea why the new float made a difference? I guess there is really no reason to seek an answer to this being that the problem is solved. However, I would certainly advise anyone to go ahead and replace the float even if the old one looks fine."

Apparently Jaguar became aware of this problem and did something about it. Around 1987-88, the hollow cylindrical plastic float on the fuel level sender was replaced with a solid float that looks like a bicycle pedal. The Ford brass float won't fit -- but there shouldn't be any need to fit it.

Also note that the fuel level senders used in the H&E convertible are totally different, and the Ford float can't be used there either.

Another plausible method of improving fuel level sender performance would be to fit a weak spring to the arm. The spring should be weak enough that when you hold the sender in the same position it'll be in the car, the weight of the float will still overcome the spring and move the arm to the bottom of the stroke. But the spring should take *some* of the weight of the float, so when it sits on the surface of the fuel in the tank it sorta bobs on top rather than being nearly submerged.

VOLTMETER ACCURACY: If you're not sure to trust your voltmeter, Michael Minglin suggests "Pick up a cheap cigar lighter adapter, clip the leads and connect to a voltmeter. This will allow you to monitor the voltage, with reasonable accuracy, under different driving conditions."

If the voltmeter proves inaccurate, read the section on FLAKY INSTRUMENTS on page 591.

Fuel Guage: Hess & Eisenhardt Convertible

Mike Cogswell describes the system in the H & E convertible: "Each tank has its own fuel level sending unit. The upper unit is apparently the standard XJ-S tank unit. The lower one is similar, except the mounting plate is horizontal instead of vertical. The two gauges are wired in series. There is a small circuit board in the H&E harness that theoretically turns on the low fuel level light.

"My gauge is wildly inaccurate. Because they are in series I'm guessing that my top one basically hits bottom well before the bottom one starts to drop. As a result, my gauge is very non-linear." Another owner says, "My H&E gas gauge is like the stock market: sometimes up, sometimes down, always moving and seldom based on reality."

The low fuel warning light is no help. Paul Hackbart says, "It is as unreliable as the gauge, as the signal is derived from the gauge."

One suggestion that's been made is to disconnect the sender in the upper tank altogether and connect only the sender in the lower tank to the gauge. In theory, this would result in a full reading for the first 14 gallons after a fillup, and then linearly drop from F to E as the 11 gallons in the lower tank are consumed -- odd behavior, but perfectly usable.

Unfortunately, this presumes that the upper tank is used first, followed by the lower tank -- but the various idiosyncracies noted with this fuel system (see page 249) indicate this may not be a valid presumption. Indeed, part of the reason the gauge fluctuates so much may be due to the fuel draining into the lower tank and then being pumped back into the upper tank, so that both levels are fluctuating constantly and randomly.

Warning Lights

The sensors and circuits that operate the indicator lights are discussed here. The bulbs themselves are discussed on page 638.

IGNITION (ALTERNATOR) LIGHT: See page 572.

OVER VOLTAGE LIGHT: Yes, this is a different item than the alternator light. On the author's '83, the alternator light is the fifth from the right and has a lightning bolt on it. The overvoltage warning light is the fifth from the left and has a little picture of a battery on it. It comes on when the voltage exceeds some set value, around 15.6V according to Joe Bialy. In other words, it tells you when the regulator in the alternator has failed causing the alternator to overcharge. The voltmeter should confirm the problem.

Bialy provides some tests: "The OV unit looks like a big old time thermal blinker unit. It's mounted right by the main fuse panel on the driver's side, plugs into a three terminal socket. Take its R/B wire to ground and see the light come on bright. If you have a variable DC supply, break the white wire and feed it varying voltages to see it in action."

BRAKE WARNING LIGHTS: On the '83 XJ-S, the parking brake light and the warning light for low fluid in the reservoir are separate lights. Mike Morrin says, "On the earlier cars (XJ6 and XJ-S) they are different lights, but they both come on with the handbrake as the bulb test for the brake warning bulb. My recollection is that the circuit that drives them is shown incorrectly in the XJ-S manual."

HANDBRAKE SWITCH CONNECTIONS: Alan Baker provides some guidance: "To check the wiring, (mine's a RHD if that makes any difference), remove the black plastic cover at the base of the handbrake lever. The 3 wires on the micro-switch, starting from the front, should be black/white, then black/yellow, then black followed up at the rear by a ring connector earth. If the wires are switched, the warning light will remain on." You can look at an illustration of these connections in Fig. 9.22 in the Haynes manual.

BRAKE FLUID LEVEL SWITCH: The switch in the cover for the brake fluid reservoir is supposed to light an indicator on the dashboard when the level is low. The rubber cover over the connectors has a bump in the center. Pressing the bump forces the float downwards and closes the contacts, providing a circuit and bulb test.

Unfortunately, the switch is garbage and the indicator may never come on, or may stay on all the time. The float for the switch is a piece of cork, which rots, soaks up fluid and sinks, etc. The protective metal cover over the cork float gets full of junk and jams the float. The contacts within the switch are exposed to the air and fluid within the reservoir, and, despite evidently being silver plated, get corroded and fail to make a connection.

The cork is easily replaced with one from a wine bottle, and the metal cover's problems are solved by removing it and throwing it away. The contacts themselves can be serviced by using a tiny screwdriver to pry the switch assembly out of the top of the reservoir cover; don't lose the little metal sleeves that keep the contact screws from tightening down onto the plastic. But all such efforts won't solve the basic problem: you should not trust your life to that switch.

The Jaguar repair manuals indicate that either this switch or the pressure differential sensor will turn on the warning light, but after VIN 107981 the differential pressure sensor was deleted and replaced with a couple of simple fittings on the brake lines. So, the fluid level switch provides the *only* warning you are likely to get prior to actual brake failure. This switch therefore needs to be ultra-reliable, since it is rarely tested and failure to work when needed can be *fatal*. While it's easy enough to get it working with the procedures above, there's no good way to get it to *keep* working. The switch is crap, pure and simple.

The only truly safe solution is to replace it, lock, stock, and barrel, with something reliable. Something reliable was suggested by Walter Acker IV: the brake fluid reservoir from a Mitsubishi, which comes with the typical Japanese ultra-reliable floating-magnet switch built in. A suitable remote reservoir is used on several Mitsubishis, including the 93-96 Mirage 1.8L 2-dr, the Gallant 89-2/93, some later Gallants, and all Eclipses 90-99 and probably later. Basically, find a Mitsubishi in the junkyard and check!

If you happen to find a Mitsubishi with ABS, the reservoir is similar except that it has an extra part in it. Doesn't hurt anything; it will work too if that's what you find in the junkyard.

If you want a *new* reservoir, the part number is MB534534, and costs less than $40 from any Mitsubishi dealer -- but you'll have to order it and come back to get it when it comes in, they don't keep it in stock because it never fails. That part number includes the reservoir itself, cap, diaphragm, float, and switch, but not the mounting bracket nor the hoses.

The Mitsubishi reservoir actually looks very similar to the OEM Jaguar reservoir. The wires for the fluid level switch go to the bottom instead of the top, since the switch is magnetic and is actually *outside* the reservoir. Only the float -- with magnet -- is inside.

The mounting bracket used to hold the reservoir in a Mitsubishi is not readily usable in the XJ-S; it will be easier to fabricate your own. Joe Bialy says, "I mounted it in *exactly* the same place the old one was at. A simple "T" shaped piece of sheet metal bent 90 degrees to mount in the 2 existing holes. Then wrap a 3" hose clamp around the whole thing." This is an excellent plan; this author used it in my '83, but rather than a simple "T" I designed the bracket shown in Figure 29 to hold the reservoir a bit more securely.

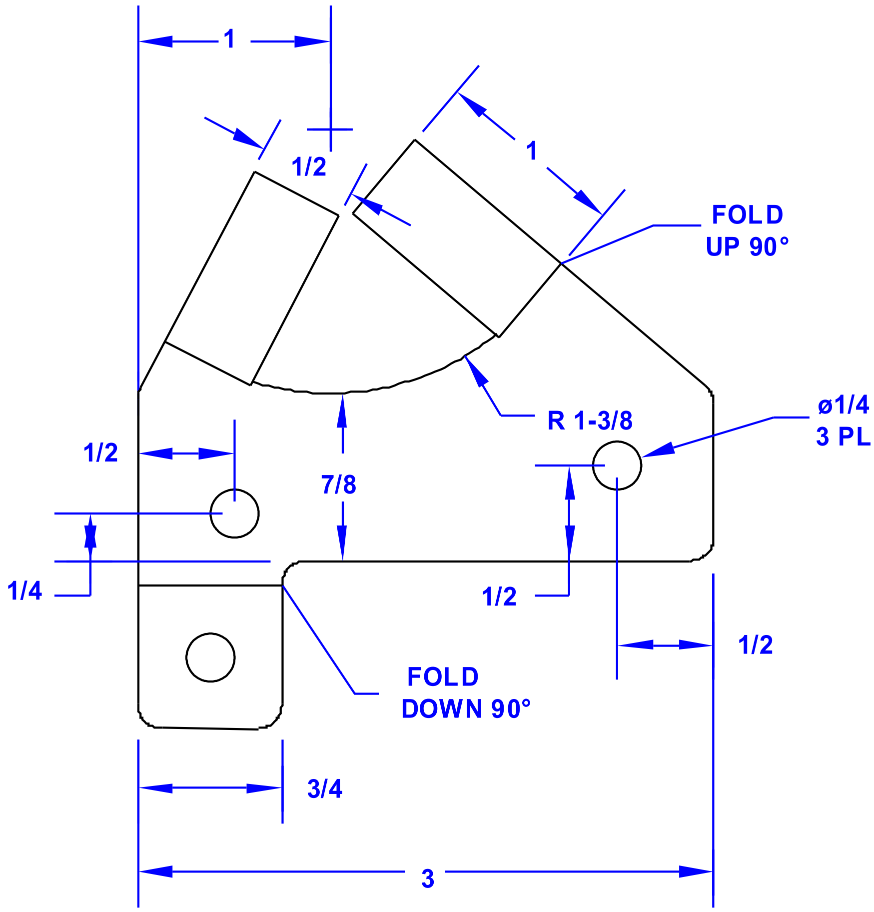


Figure 29 - Bracket for Mitsubishi Reservoir

If the MicroSoft gods are smiling down on us today, Figure 29 will print in actual size. So, just load a piece of sheet metal into the ol' inkjet and let 'er rip!

The bottom of the reservoir should be flush with the top of the existing support bracket, but the hose clamp will need to go around the reservoir about 1/2" up from the bottom; hence the two "legs" on this bracket being 1" tall. There is even a little ridge on the Mitsubishi reservoir -- it's actually the "MIN" level line -- that will neatly sit on top of one of these legs so it cannot slide downward.

The asymmetric design of this bracket serves to mount the Mitsubishi reservoir about 1/2" closer to the power brake booster than the original reservoir was. This provides more clearance to the throttle cable, as well as making it a bit easier to wrap your hand around the cap when unscrewing it.

The bent-down tab at the lower left in the diagram is simply to provide a place to fasten the wire connector down. If you wish, you can omit this tab and just slice the bracket straight across the bottom edge, and provide other means of fastening down the connector -- or just let it dangle. A generic strip of steel with 1/4" holes can be used by merely bending it 90° in the middle and mounting it under the same mounting bolt that holds the reservoir bracket itself.

The design shown above is for a LHD car. Those with RHD cars will probably need to make a mirror image of this bracket -- which means cut out the exact same piece, but bend the two mounting tabs down instead of up and the wire connector tab up instead of down.

The hose fittings on the Mitsubishi reservoir are 10mm, while the fittings on the Jag master cylinder are 1/4". You will need to devise a way to connect these sizes up. A 3/8" air hose will fit the Mitsubishi reservoir just fine. The simplest idea is to use two different sizes of hose with an adapter in between.

Another idea would be to take a short section of 1/4” red air hose and peel the red outer layer off, slide the black inner layer over the 1/4” fittings, slide the 3/8” hose over that, and clamp.

Another solution might be to purchase some 5/16” OD steel tubing and some 3/8” OD steel tubing, both of which are available at auto parts stores as pre-made fuel lines. Cut two 3/4” long sections from each. Slide a short piece of 5/16” tubing over the reservoir end of each one of the 1/4” metal tubes used to connect the OEM reservoir to the master cylinder, slide a short piece of 3/8” tubing over the piece of 5/16” tubing, and braze or silver solder both pieces in place. Then you can connect the metal tube to the Mitsubishi reservoir with short pieces of 3/8” hose, and you can connect the other end to the master cylinder exactly the way they were before. Be sure to check the braze jobs for leaks before installing.

Yet another idea would be to obtain a set of the plastic elbows that fit the Mitsubishi master cylinder and find a way to fit them to the Jaguar master cylinder. The elbows actually appear remarkably similar except for the fitting size and the fact that the Mitsubishi parts have a tab through which a Phillips screw is installed to make sure they don’t go anywhere. There’s no way to use that screw idea on the Jag, so the tab can either be cut off the elbow or just left there to hang off the side doing nothing.

The Mitsubishi cap is clearly marked to use DOT-3 only or DOT-3 or DOT-4 fluid only, plus some stuff in Japanese. If you wish, you can cut those markings off -- they are raised letters on a flat surface. Then you can print out a circular label with directions to use DOT 4 only along with a Jaguar leaping cat on a piece of peel-and-stick label material loaded into your inkjet, cut it out, and stick it down on top of this surface.

Connecting up the wires for the switch is not a big challenge. If you dyke off the connector from the Mitsubishi harness in the junkyard, you can just splice it onto the Jaguar harness (cutting off the spade terminals). Many junkyards don’t like you cutting harnesses, though. Still, this T-shaped connector must be a common shape, because many people manage to find one that fits. If you can’t, don’t fret -- the female spade connectors on the Jaguar harness will actually plug right to the Mitsubishi connector. It doesn’t matter which wire is connected to which terminal.

You can review this entire installation at

http://www.jag-lovers.org/xj-s/book/BrakeFluidReservoirFix.html

Besides having a level switch that will actually work when you really need it to, there’s another nice benefit of this reservoir replacement. The OEM Jaguar reservoir is vented by letting air into the fluid, but the Mitsubishi reservoir has a diaphragm in the cap. As the fluid level drops, this diaphragm moves with it, maintaining separation between fluid and air. As a result, the fluid will absorb much less air and moisture, and require bleeding less often.

Also, installing a Mitsubishi reservoir will solve problems with the OEM reservoir cap cracking.

MITSUBISHI RESERVOIR PROBLEMS: Ain’t this a kick in the pants! You go through the effort of replacing the OEM reservoir with the Mitsubishi, and find that it has problems too! Fortunately, its problems are not life-threatening and are easily corrected.

As mentioned above, the cap used on the Mitsubishi reservoir has a diaphragm built in to keep air away from the brake fluid. On Mitsubishis made before 1992, the cap itself has three small tangs inside and the diaphragm has three mating notches around the outer edge to prevent the diaphragm from turning around inside the cap as you screw the cap on. Unfortunately, what actually happens is that the diaphragm distorts at the notches while tightening, gets cockeyed, and loses the seal. Result: air is allowed into the brake fluid. In other words, when this thing screws up, it vents the brake fluid reservoir the same piss-poor way the Jaguar reservoir was *designed* to!

Mitsubishi’s solution was to redesign the cap and diaphragm, omitting the tangs and notches altogether. Who cares if the diaphragm rotates a little while the cap is being tightened? If you happen to find yourself with a reservoir with the old style distorted diaphragm, you can fix it by purchasing a new cap and diaphragm from your friendly Mitsubishi dealer -- but the two parts will cost as much as a new reservoir with cap and diaphragm! If you wish, you can purchase just the diaphragm and carefully cut away the tangs inside your old cap. The diaphragm part number is MB895813.

So, if you go scrounging in the junkyard for a Mitsubishi reservoir, you might want to check that the cap and diaphragm are the updated design without anti-rotation tangs around the edge. There should be only one notch, for venting the space *above* the diaphragm.

Interestingly, Mitsubishis have been sold in the US badged as Dodges -- and Dodge came up with their own redesign of that cap and diaphragm. Walter Acker IV found a reservoir in a Mitsubishi-made Dodge D50 mini pickup truck with a two-piece diaphragm: a rubber diaphragm with a hard plastic rim that snaps onto it. The hard plastic rim allows the cap to be screwed down on the diaphragm without distorting it. It also makes it easier to unscrew the cap later. Use of this diaphragm also requires a cap with no tangs in it.

You can review this diaphragm issue at

http://www.jag-lovers.org/xj-s/book/MitsubishiCapUpgrade.html

ALTERNATIVE MITSUBISHI RESERVOIR: Walter Acker IV went on to discover yet another type reservoir that can be used to replace the pre-ABS reservoir in the XJ-S. This one is also from a Mitsubishi, but from their pickup truck instead. The reservoir is rectangular rather than round, and is smaller than the round one, but will still work fine. The cap is black rather than the white one found on the round reservoir, and the reservoir Acker found doesn't have the problem with the tangs around the edge of the diaphragm -- but it's unknown whether that's simply because the one he found was a post-correction model or whether the pickup truck never had this design flaw in the first place. It still has 10mm fittings, so it will require the same hose adaptors described for the round reservoir above.

BRAKE WARNING LIGHT: Mike Morrin warns of another reason the brake warning light may seem to have failed in the "on" mode: "When I got my car, the warning light was on, but the handbrake adjusters (on the rear calipers) were seized. Fixing the adjusters put some extra tension on the cable, and the warning light switch then started working."

PARK LAMP FAILURE SENSORS: There are park lamp failure sensors in the trunk up behind the lip on both sides, as well as under the right side dashboard. The ©1982 Supplement says there is only one under the dash to serve the lights on the front of the car, but it lies; there are two, one serving the front right and one serving the front left. They all look the same: a small metal box with three terminals. The current to a light goes in one terminal and out another, heating up a conductor inside. When it gets hot enough, a bimetal strip bends enough to break the third connection to the dash indicator. This is why it takes a few seconds for the indicator to go out when you turn on the lights. If a bulb burns out, the reduced current doesn't heat the bimetal strip enough, so the indicator stays on.

If your dash indicator is staying lit for unknown reasons, the first thing to do is check that all the lights on the car are of the correct wattage; a lower-current bulb can fool the sensors. Then, find each sensor and disconnect the indicator wires (WS) one by one until you find which sensor is keeping the indicator on.

If one of the sensors isn't working right, they can be adjusted. There is a tiny screw on the box near the terminals, sealed with a drop of glue. When you're absolutely sure all the bulbs are working right, leave the lights on for a couple minutes. Turn the screw clockwise until the dash light comes on, then counterclockwise just until it turns off. Be careful not to touch ground with the tool used to adjust the screw.

An owner reports on a late model: "My 94 XJS gave me a dashboard indication of a bulb out but going around and around the car, all lights seemed to be working. This drove me nuts until I finally noticed the sexy little bulb that gives the headlight assemblies a little glow when the parking lights are on. It was working on the driver's side but not the passenger side. I didn't know it was even there and it has to be dark out to see it. Low and behold, I replaced the tiny bulb (standing on my head to do so) and all is well again."

The stoplamp failure sensor is different; see below.

The indication that a turn signal bulb has failed is that the turn signal dash indicator just blinks once, or not at all, while the functional bulbs on the outside of the car continue to blink properly.

STOPLAMP FAILURE SENSOR: The failure sensor on the brake lights works differently than the ones for the taillights because having the warning light come on for a few seconds every time you hit the brakes would be unacceptable. A brake light bulb failure shows up on the same dash indicator, though. With the ignition on, headlights off, handbrake applied, and the brake pedal pressed, the indicator should come on; if it does not, there's a bad circuit or bulb in the brake lights.

Colleen Melton says, "My '79 XJ-S recently had a mystifying, extremely aggravating problem. At random, the fuse for the brake lights (15A, #5 in fuse panel) & turn signals would blow. We isolated it down to the brake light circuit by deliberately not using the turn signals and waiting for the fuse to blow... At no regular interval, applying the brakes would cause the fuse to blow.

"After examining all accessible wiring and the bulb sockets, my husband concluded the problem was likely in the brake warning relay, located in the center console under the rear portion of the ski slope. He removed the 'relay' and opened it up. Sure enough, a blob of solder on the brake light input wire (14 ga green/purple) terminal was touching against the steel case of the 'relay'. Closer examination revealed the rivet holding the outer spade terminal to the inner solder terminal had loosened, allowing poor contact leading to high resistance producing heat, increasing resistance, leading to even more heat... This apparently got bad enough that the solder connecting the coils of wire wrapped around two reed switches (one for each brake light output) got hot enough to melt somewhat. In addition, a diode in the circuit was cooked by the heat.

"We have no idea what a replacement unit costs; my husband (electronics tech by profession) decided to repair this simple circuit. He cleaned up the dirty, overheated terminals, tightened (repeened) the rivet and soldered both terminals to the rivet. Replacing the diode was also very simple, nothing special about that component he said, any small rectifier diode would work there. Reinstalled the 'relay', everything works great. Brake lights are brighter than before (wonder why?), and the IP warning lamp comes on when it should (either or both brake lights disabled and brakes applied).

"For those interested, the XJ-S Parts Catalogue refers to this part as "Stop Lamp Failure Transmitter" P/N C.42291 (actually this is a better name than 'brake warning relay', which is how the ROM puts it). For anyone who knows which end of a soldering iron to grab, this would be a simple thing to repair. Aside from the aforementioned diode, there is a transistor, a resistor, and two wire-wrapped reed switches inside the can. All components could be easily replaced with like/similar items from any electronics store.

"In case of on-the-road failures, we made up a simple "Y" jumper with male 1/4" spade terminals at the three ends to connect the three green/pink wires together. This would bypass the transmitter and continue to allow the brake lights to work."

WARNING LIGHT TEST MODULE: In several of the wiring diagrams, it is item #324, labelled an "invertor". In Fig. 13.99 in the Haynes manual, it is item #1 and it's called a "Failure unit". In Fig. 22 in Section 86-22 of the Supplement to the ROM (same illustration as Fig. 13.99 in the Haynes) it is item #1 and called a "Warning light failure unit". Here's what this thing does: when the starter is energized, this thing provides a ground circuit for the brake fluid level warning light, the handbrake warning light, and the oxygen sensor warning light. As you're operating the starter, these warning lights should glow. This is to test the warning light bulbs themselves.

Trip Computer

VARIATIONS: The trip computer for US-spec cars has a different part number than trip computers used elsewhere. Since the Km/miles switch is readily apparent on all, Walter Petermann says, "It's probably due to the gallons. Inside the trip computer there's a jumper labeled 'imp'. All the trip computers (US) I've seen have this jumper missing."

SPEED SIGNAL: See the section on the speedometer signal on page 593.

TRIP COMPUTER FUEL MILEAGE: The CATALOGUE reports that erratic fuel mileage readings can be caused by a poor connection at the fuel injector resistor pack.

TRIP COMPUTER FUEL CALCULATIONS: Craig Sawyers: "One of the niggly things that didn't work was the fuel related aspects of the trip computer. Mileage, fine; clock, fine; fuel, nada.

"The trip computer gets its fuel signal from an "interface unit" mounted near the ECU. It is a plastic case, with four connections. Power (green) and ground (black), a line from the fuel injector feed for the resistor pack (yellow/green to pin 29 of the ECU) on the B bank, and a line that goes to the trip computer (orange). When you get the lid off this box (drill out four copper rivets), you find a more complex circuit than you expect, based around a quad op-amp and eight transistors. (Op-amp is short for operational amplifier. The "quad" bit just means that there are four of them in one 14-pin package.)"

"To cut a long story short, including tracing out the arcane circuit and rigging up a pulse generator to mimic the injector signal, the op-amp was history. The op-amp is a LM2902N, and is a generic part (the one that came out was Texas, the one that went back was Fairchild). I just bought mine from Farnell."

"Cost of op-amp, £0.29UK. Result, source of joy! I don't know what Jag would have charged me for a new one, but it certainly wouldn't have been within two orders of magnitude of 50 cents."

Is there a way those without pulse generators, oscilloscopes and the like could determine that the op-amp or even the entire interface unit is in fact their problem? "Not easy. The input signal is taken from the ECU, and is the injector drive to the resistor pack. This goes from 12V to 0V for the duration of the injector pulse. The output of the interface unit looks like a pulse-width modulated signal. Maybe the interface unit counts the pulses, and uses that to estimate the fuel consumption. I haven't gone into that bit of it at too much depth; working is working.

"Assuming that the other functions of the trip computer are OK, that power is present, and that a connector hasn't fallen off, I'd suspect the interface unit. Also given the low cost of the chip, and that everything else in there looks pretty bullet proof, I think I'd advise stuffing a new chip in (the right way round!) and see what happens."

The op-amp is soldered to the board. "The easiest way to get a chip out if you don't have a solder sucker is to use a small pair of cutters to snip each pin at the chip package itself. Then pull each pin out of the board separately with a small pair of pliers while heating the pad with a soldering iron."

Edwin Hyatt tried this fix. "Thanks to Craig, I now have a fully functional trip computer, having recently fixed the fuel consumption part of the display. The IC in the interface unit was the culprit, and at a cost of $1.29 at Radio Shack, it is by far the lowest cost repair to date. If the fuel related part of your trip computer is not working, this more than likely is the cause."

EXTRA CONNECTORS: The author's '83 has two 3-conductor connectors behind the dash in the vicinity of the top left corner of the glovebox, with blank-off caps on them. One is red with Y, O, and two G wires, and the other is black with P, RU, and two B wires; the P wire is from an inline fuse connected to an N wire. These connectors are apparently for the trip computer -- although this car doesn't have a trip computer. There are also connectors near the ECU in the trunk for connecting to the fuel interface unit, which likewise doesn't exist.

Electric Windows

There are reportedly three different types of window motor used in the XJ-S coupe: A Delco unit up to 1987, a different Delco unit 1988-89, and a Bosch from 1990 on. The early Delco motor has a large cylindrical housing, while the 1988-89 Delco unit has a smaller, more rectangular housing -- perhaps better described as a cylinder with two flat sides. Both of these are held together with a pair of long bolts.

The convertibles, of course, have another motor operating the rear windows, and apparently have different units in the doors as well.

Peter Cohen provides some part numbers: "The January 1987 - January 1989 parts book lists the non-convertible window motors as: Left: JLM975, Right: JLM974, and the regulators as Left: BCC5775 and Right: BCC5774. Convertible is listed as Motor: Left: JLM1496, Right: JLM1495, with the convertible regulator listed as Left: BDC5079, Right: BDC5079.

"The right side Delco motor that I removed had a paper label with the number 20060098 above the numbers 121 and 30P8 (the left side label was illegible).

Unfortunately, problems are reported with all types, even though none of them are Lucas. Some of the problems discussed below apply to all, and some apply only to particular units as noted.

ELECTRIC WINDOWS -- KEYLESS OPERATION: Some of us prefer the electric windows to be operable whenever we're in the car, not just when the ignition is on. If you share this preference, there is a "window lift relay" under the passenger's side of the dashboard that provides power to the windows whenever the ignition is on. All you have to do is remove this relay and connect the power wire directly to the wire to the windows, and the windows will operate whenever the buttons are pressed. Since the buttons are inside the car anyway, it's not exactly a security risk.

SLOW-MOVING WINDOWS: The early Delco windows always move slowly. This tip is from Leonard Berk: His windows operated very slowly, so he sprayed WD-40 down the frames without even dismantling the doors. The windows operate like new. Perhaps WD-40 isn't the ideal substance since the odor may be objectionable to some people, but it is worth noting that lubrication may be in order. Victor Naumann says, "Try not to use oil in the channel, it destroys the rubber. Silicone spray or graphite works OK. WD-40 is a great lube, but not for rubber, it makes it swell. Jag makes a very expensive lube called Glietmo, but I prefer silicone."

Paul Bachman says, "In my experience, lubricating rubber window guides is only a short term solution and seems to aggravate the sticking in the long run (gets gummy as it enevitably dries out). I have had very good success lubricating the guide rails on electric windows (including my 85 XJ-S) with graphite. It is difficult and a little messy to get it rubbed into the right places, but once in place it works for a long, long time."

On the author's car, one reason for slow windows was that the little roller that slides in the track at the bottom of the glass had gotten all screwed up -- see below.

John Himes talks "...about possible fixes to the drivers window not going all the way up without using their hand. On my 88 XJ-S, the problems was that one of the screws was removed by a PO, or had fallen out over time that mounts the window motor to the door & the others had become loose. The motor assy. would move when you raised or lowered the window. After tightening the screws & new lock washers (with the window all the way up so it would fit correctly), the window now goes all the way up & I no longer have the fingerprints on the window (inside anyway)."

John Setters reports: "Two problems caused my drivers side window not to close fully without assistance:

1. Window motor mounting had come loose.
2. The lift assist coil spring was binding on itself.

"Firstly remove the door trim panel - the hardest part! I found that I needed to close the window fully before tightening the motor mounting bolts. This is the way to assure correct positioning of the closed window. Do this by applying upward lift with your hand under the slide rail at the lower edge of the glass. Then tighten the bolts.

"Complete lift was hampered by lack of spring tension. Although well lubricated by grease too much friction existed. I applied spray CRC to the spring then operated the up and down movement to work the CRC into the spring coils. Heh presto it all works fine now."

John Napoli suggests adjusting the track at the rear of the window. There are two screws that hold this section of channel in place; one is under the door panel near the bottom rear of the door, and the other is clearly visible on the end of the door above the latch. The track is removable to facilitate replacing the glass. The bottom screw has a very large washer on it and fits through a large hole in the door sheet metal, so the track can be moved around quite a bit before tightening it down. The upper screw doesn't have as much room to move, but can still move a little. It is helpful to loosen both screws at the same time to fully investigate the range of possibilities.

Napoli also suggests "If you can't find an adjustment that solves the problem, replace the lining of the rear channel. Jag sells a replacement channel. I suspect that good old aftermarket channel felt can be installed in the old channel assembly." The problem with old channel felt is that the fur wears off, allowing the glass to rub directly on the rubber underneath. The friction is hence much higher than it should be.

If you have the early Delco window motors, once you have addressed all the possible problems listed above, your windows will still move slowly. The final solution is to install a relay control system; see below.

WINDOW/TRACK SEPARATION: John Napoli says: "I once had a weird window failure in my car. The PO had replaced the rear window channel on the drivers side. One day I lowered the window and *thunk* -- the window drops down out of sight. Opened the door up and found that the metal channel that the glass rides in had been pulled away from the glass. It was as if the glass had a positive stop on the way down. The motor kept on pulling the glass down after it hit the stop and pulled the arm off. Put it back together and it soon happened again. I solved the problem by taking the glass out, supergluing the arm to the glass (in the correct location!) and installing a sophisticated support that the steel arm would hit when the window was lowered. It was a carefully shaped chunk of 2x4. You need to glue the channel to the glass in addition to adding the stop because if the channel is loose on the glass it will eventually slide sideways and prevent the window from opening or closing properly. The glue locks the channel in position and the stop prevents the window from dropping too far and allowing the motor to pull the channel away from the glass.

ELECTRIC WINDOW REGULATOR DRIVE ROLLER PROBLEMS: The little roller on the end of the motor arm on one window in the author's '83 XJ-S was FUBAR. Basically, the shaft the roller turns on is attached to the arm like a rivet, and this attachment worked loose, allowing the roller to cock sideways and jam in the track on the window. As the motor forced it back and forth in the track, the edges of the sheet metal track chewed the plastic roller all to bits. No, you can't buy a new roller from Jaguar -- they want you to buy the entire window regulator mechanism. The '83 has the early Delco regulator, but all of the regulators have rollers of some type and may occasionally have similar problems.

For anyone with a lathe and some plastic stock, it would be a simple matter to make a new roller. Unfortunately, I don't have either. I went to a building supply store and looked through their collection of rollers intended for sliding closet doors, drawers, shower doors, etc. I immediately noted two concerns: 1) the roller in the Jag window was smaller than any of these; and 2) the roller in the Jag window has a sort of offset -- the bearing surface isn't in the center of the roller, but over to one side. In the Jag, the pin is shaped like the head of a flush head bolt, so that no part of the pin extends beyond the roller and jams into the track. Only a select few of the rollers in the building supply store had a similar feature.

I selected a package of "Closet Door Hardware" described as "No. 8544, 7/16" Offset Hanger Pr." and made by Door Products Inc.; I'm sure there are generic equivalents in just about any such store. This package contains two hangers intended for the top of a hanging, sliding closet door, each with a little roller to fit into a track. The 7/16" refers to how much the offset is, no importance here. In fact, the entire hanger is forfeit except for the roller itself. There are probably several other types of hangers, with various offsets, all using the same or similar roller. It is necessary to grind off a rivet flare to remove the roller from the hanger.

The roller acquired is the smallest I found, but still too large; it is about 20mm in diameter, while the Jaguar window roller is about 17mm. However, it was a simple matter to mount the new roller onto a 1/4" bolt, chuck it up in a drill, and grind off the outside edge until it was the correct diameter. This roller, along with the Jaguar original, is illustrated in Figure 30.

This roller also had the offset bearing, although it was not as long as the Jag original. When assembling, it was necessary to add a few washers behind it to space it out the same distance from the arm as the original had been. I made washers out of plastic so they wouldn't jingle. I also made sure their OD was small enough to not interfere with the window track.

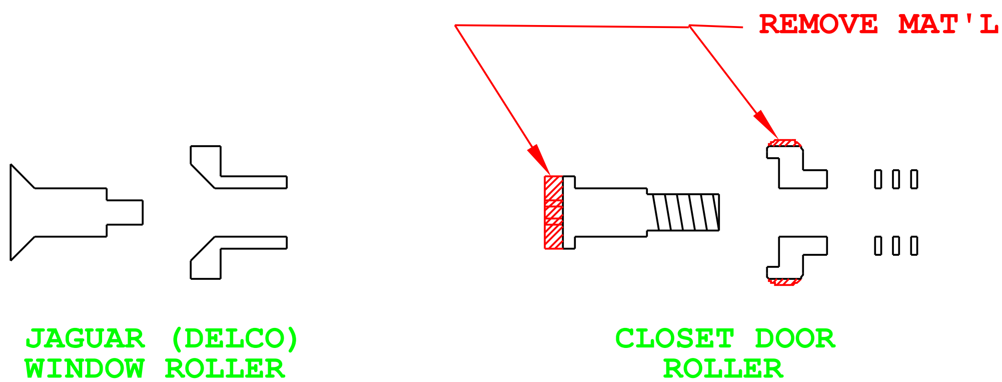


Figure 30 - Original Window Roller and Cheap Substitute

I also was able to find a shoulder bolt, or "axle" bolt, that I was able to modify for use. It was an Allen socket head bolt with a 1/4" diameter shoulder 3/8" long, and a 10-24 threaded end beyond that. If I had intended to use this bolt to hold the original Jaguar roller, I would have had to grind a taper on the bottom side of the head to match the tapered surface within the roller and allow the head to recess far enough into the roller so as not to protrude at all.

For this new roller, however, the problem was different. The new roller has a recessed opening for the head of the original pin that held it, but it's flat-bottomed, not tapered. There is therefore no reason to grind on the bottom side of the head, but the top side protrudes entirely too far -- this head is much taller than the recess is deep. So I had to grind about half of the height of the head off. This removed the entire Allen socket, leaving me no way to tighten it. So I cut a straight slot across the top for use with a screwdriver.

When assembling, I put the roller and the homemade plastic washers on this shoulder bolt, screwed on a nut, inserted it through the hole in the arm, and put another nut on the back side to hold it. When tightened up, this positioned the roller about the same distance from the surface of the arm that the original had been.

I chose not to install this roller in the original hole in the regulator arm. Instead, I drilled a new hole 1" closer to the motor itself, making the arm effectively 1" shorter, in hopes of improving the leverage the motor has moving the window. This worked perfectly, but since the arm is 15" long to begin with, this provides only a small percentage improvement in leverage. Still, it's easy to do, and every little bit helps.

Of course, the window motor and regulator assembly is an AC Delco; perhaps you can figure out what other cars it was used in and find a cheap replacement in the local junkyard.

ELECTRIC WINDOW SWITCH PROBLEMS: Reports of switch problems are more common with earlier Delco units. That may be partially because the cars are older or that there are simply more of them, but the early Delco system definitely suffers from overloaded switches. The switches are inadequate for the inductive load involved and the contacts get burned. Even though the later Delco and Bosch motors are physically smaller, they still move the windows at a good clip and probably draw a comparable amount of current; we'll probably hear more about switch problems in later cars as the years go by.

Bob Colson of the Jaguar Club of Southern Arizona points out that the window lift switches can be taken apart. First, remove them from the panel -- easiest to do by first removing the panel so you can push them out from behind. Then, by spreading the housing slightly, the rocker itself can be popped out. Then the parts can be cleaned up and repaired as needed. The two rocking contact plates are symmetrical but only one end of each gets worn, so the plates can be reversed to extend their life. The cruise control on/off/resume switch is constructed similarly.

Phil Patton adds: "Usually it seems the plastic things on the ends of the springs wear unevenly for some reason. When cleaning the switch replace the one from the left side to the right and vis-a-vis."

Another solution is to replace the switches with generic double pole/double throw self-centering rocker switches with better contact ratings. The difficulty here, obviously, is getting them to look right. Phil Patton sends this tip: "I have found a switch which is less expensive, IMHO looks much better, and I am positive will last much, much longer. This part fits the existing hole perfectly and has a small, coloured illuminated strip across it, making it easy to find in the dark. It is rated at 20 amps @ 12 volts and is (unlike the Jag switch) completely sealed so that dirt cannot contaminate the contacts. The part is GC number 35-3565 (green light) or 35-3570 (red light). They should be available from any decent size electronics parts house. The only modification necessary to use this part is to cut off the plug on the wiring harness and replace it with push-on lugs on each wire. If you don't like the light then just don't connect it."

Stephen Wood says, "I replaced the power window and power lock switches in my '76 XJ-S with '82-92 Camaro/Firebird units, $10 ea. new and they work great. I had to make a wiring jumper and a sub plate for mounting, but they function better than the Jag ones ever did."

A preventative measure may be to install a pair of zener diodes at each motor. See the treatise on controlling inductive loads starting on page 559.

Perhaps the best solution, and one that maintains the original appearance, is to install relays to operate the windows and operate the relays with the stock rocker switch. See below.

WINDOW CONTROL RELAY INSTALLATION: Both the dragging windows and the burned switch contacts are symptoms of the same problem: The switches are inadequate for the load. The high resistance, due to marginal, overloaded, or charred contacts, results in less than ideal power to the motor and causes the contacts themselves to fail often. This author measured the voltage at the window motor with the window trying to close, and it was less than 8 volts -- and dropping below 7 volts as the motor struggled. This operating voltage means the motor is only developing about 45% as much power as it would at 12V.

A set of window control relays will provide full battery voltage to the window motors, eliminating the losses in the wiring harnesses and switches. See Figure 31. Two SPDT relays will be needed for each window, an "up" relay and a "down" relay, and each will need to have serious contacts -- at least 10-amp rating. Since the current needed to operate the relays is minimal, the rocker switches should last forever -- even if they've already been abused and cleaned up a couple times.

The XJ-S comes with a relay referred to in the Jaguar literature as a "window lift relay"; all this relay does is turn off power to the windows when the ignition is off. I will continue to use that term when referring to that relay, and will call the new relays being added in the following scheme "window control relays". Try not to get confused.

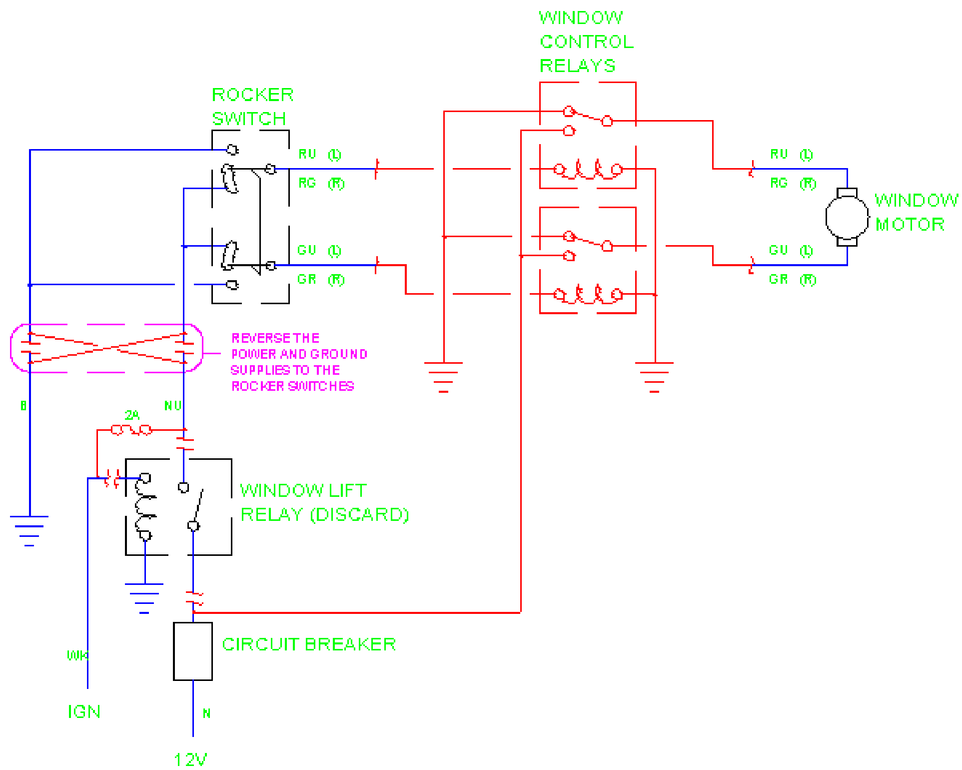


Figure 31 - Window Control Relay Wiring

Since window motors are permanent magnet motors, the direction they run depends on the direction of current flow. The wiring within the motor itself is *not* grounded. To run one direction, the switch grounds one motor lead and applies 12V to the other. To run the other direction, the same switch grounds the second lead and applies 12V to the first. The window control relays should be wired to do the exact same thing. In the wiring scheme shown, the normally-closed contacts on the relays ground both leads of the motor when the relays are idle, and each relay switches one lead to 12V power when energized.

A massive power wire -- 12 gauge or so -- must be routed to the window control relays directly from some heavy-duty source (any big, fat brown wire). You can toss in an inline fuse for safety, but it's probably a better idea to use the original thermal circuit breaker; it will do a better job of protecting the motor from overheating if the power is left on (somebody sets a book on the switch).

For the passenger's side window, it is quite convenient to use the existing 12V power source and circuit breaker for the windows, leaving the breaker mounted right where it is; just connect a new wire with a 1/4" spade terminal to the output side of the breaker and route it to the new relays.

For the driver's side, it may be preferable to just buy a new circuit breaker and power it from a lead to the fusebox; this would eliminate the necessity to run a heavy wire from the existing breaker on the passenger's side across the car to the driver's side. The original "Otter" circuit breakers are inordinately expensive and of unknown rating (apparently big enough to allow both windows to run at once, probably too big to properly protect a single window motor), but generic circuit breakers are available in auto parts stores in 10A, 15A, 20A, 25A and 30A ratings for around $5 each. The 10A should work for one window motor; this author used one and it has never tripped. All of these generic automotive circuit breakers are "thermal" type, as opposed to the electromechanical circuit breakers typically used in homes.

For the relays, 12V DPDT relays with 15-amp contacts from Radio Shack, cat. no. 275-218, will serve nicely. Since SPDT relays will do the job, wire both contacts together; two 15-amp contacts working together definitely should handle this job!

The sockets that Radio Shack sells for these relays are not recommended; buy a handful of 3/16” spade terminals instead. Radio Shack seems to only offer 3/16” spade terminals in a box with a lot of other connectors, and since you need 16 of them you’ll be buying a lot of boxes. If you go to an auto parts store, though, you may be able to buy a box with the correct “crimp-on” terminals alone. Even if the terminals come with plastic insulating collars, it is suggested you rip the plastic collars off and throw them away, solder the wires to the terminal after crimping, and insulate them with 3/16” and 1/8” heat-shrink tubing.

Since SPDT relays will work, automotive relays are another option -- if you can find some with an 87a (NC) terminal. Most of the relays sold in auto parts stores (usually for controlling driving lights) have two 87 (NO) terminals and no NC terminal, which won’t work. Suitable relays include the one used on the XJ-S electric radiator fan, SRB411, and all of its substitutes listed on page 224.

Another option would be to use two normal driving light relays (no NC contacts) instead of each SPDC relay. Rocking the button should operate both relays, and one should make the power connection while the other makes the ground. This wouldn’t make any sense if relays were priced the way they should be, but the fact is that you might find two driving light relays are *cheaper* and/or easier to find than one SPDT relay.

Automotive relays require 1/4” spade terminals, which are a good deal easier to find than the 3/16” terminals needed for the Radio Shack relays. Again, insulate them with heat-shrink tubing, 1/4” and 1/8” this time.

The relays can be located anywhere between the switch and the motor; simply break into the RG and GR (right side) or RU and GU (left side) wires from the rocker switch to the motor and wire in the relays as shown. Within the door itself is one possible location; in this case, a massive ground wire should be routed back into the car -- relying on ground contact through a door hinge is not recommended. Also, before closing the door up, it’d be a good idea to fasten the relays down (possibly with foam tape) and tie the wires down, and run the window up and down and operate all the latches to make sure the wires aren’t in the way of moving parts.

Another possible location is adjacent to the footwells; you can intercept the wiring near the door hinge by removing the kick panel on the side of the footwell just forward of the door (2 screws). There is a pocket that looks like it was made for these relays behind the kick panel. There is a door lock relay in the same space, but it isn’t taking up all the room. The wires from the door all go through this space, and there are a lot of them -- stereo speaker, electric mirrors, puddle light, door lock, and window. They are also plenty long enough, making it a simple matter to cut into the two window wires and install the relays. This location makes it unnecessary to have to route heavy 12V and ground wires into the door, or even to take the door panel off.

The relays can also go within the console if preferred, although that reuses a lot of the original wiring to the motors and reduces the potential benefits of installing really heavy power wiring.

It doesn’t make good electrical sense to use the existing circuit breaker to protect the wiring to the rocker switches and new relays, since that’s a heavy duty breaker and they are now a low-power circuit. Instead, provide an inline fuse to the rocker switches; a 2A or 3A fuse should be plenty to power the relays. Physically, this means that the NU line from the window lift relay to the rocker switches is disconnected from the relay and connected to a fuse instead.

Remove and discard the window lift relay, it won’t be needed any more; the window control relays themselves will accomplish its task. Unfortunately, the window lift relay doesn’t have a NC connection, so it cannot be reused as one of the four window control relays.

Where the power to the other side of the fuse comes from is a matter of preference. If you wish the system to work the way it originally did (windows won’t move unless the ignition is on), then connect the WK wire that originally controlled the window lift relay to the fuse, as shown in Figure 31. If, on the other hand, you’d rather the windows worked whenever you hit a button regardless of ignition, just connect the fuse to a constant 12V power supply -- and there happens to be one right nearby, connected to the input side of the circuit breaker.

A minor complication: One might assume that the window rocker switches are a center-off, DPDT operation, and the wiring diagram for the window circuits in the ©1982 Supplement is obtuse enough to let you go on thinking that -- but they are not. Each rocker switch is actually two individual SPDT switches, neither of which is center-off; both have NC and NO contacts. With the rocker in the center position, the NC contacts on both switches happen to be connected in such a way as to send 12V to both leads to the motor. Since 12V at both leads results in no current flow, the motor doesn't move. When you rock the switch, one of the two internal switches disconnects the 12V source and connects that motor lead to ground, while the other internal switch doesn't move -- hence, the motor runs. Figure 31 shows the switch schematically correctly, although it doesn't really indicate the actual physical operation properly.

All of this is normally just fine, except that all those leads are hot all the time. Something to keep in mind while working in the area, especially if you have bypassed the window lift relay so the windows are operational at all times with or without ignition (see page 603).

With the window control relay installation, however, these hot leads cause the relays to be energized when the windows are not moving. Rocking the switch causes one relay to *un*energize, and the system will in fact work just fine; the relays will just get warm. However, if you have wired the system so that the windows can be run with or without ignition (see above), the relay coils would be draining the battery when the car is parked. Ungood.

The solution is to exchange the 12V and ground connections to the rocker switch so that both motor leads are connected to ground when the rocker is centered -- just like you'd have expected Jaguar to do in the first place. You can make this change by cutting and splicing wires, but an easier way is to move the connectors around on the block connector that plugs onto the bottom of the rocker switch, putting the NU wires back where the B wires were and vice versa. If you have the switches with six round posts on the bottom, it is a simple matter to pop the connectors out of the block connector with a piece of 3/16" OD brass tubing (available at hobby shops); just insert the tubing into the round hole around the outside of each tubular connector, and it will compress the tangs on the sides of the connector itself and allow the connector to be pulled out the back side. Then they can merely be pushed back into the proper holes until they snap into place. If you have the later style switches you should be able to do something similar. Note that, for operating window control relays, the ground wires could simply be removed since they are not used.

Exchanging the power and ground wires may even be desirable *without* installing window control relays, since the windows will still run exactly the same way; you just won't have hot leads when working on the car any more.

When fiddling with all this wiring, rewiring, relay installation, etc., etc., trying to keep track of which circuit will move the window *up* versus which one will move the window *down* will drive you nuts. Instead, just forget about it. When you're all done and everything is working fine, if the button must be rocked the wrong way to move the windows, just turn the connector around on the bottom of the rocker switch. If you prefer, you can reassemble the console but leave the rocker switches hanging out of it by the wires; when you're ready to test it, just hold one rocker switch in your hand and push it one way or the other and note which way the window moves. Then turn the switch whichever way is correct and snap it into the panel.

This author has installed window control relays in my '83 XJ-S. I can report that the modification is a resounding success; the windows now zip up and down like they should. It is now clear to me that this is yet another modification that should be done by *all* XJ-S owners ASAP, before their stock window switches bite the dust from overload.

ELECTRIC WINDOWS -- EARLY CIRCUITRY: According to the ©1975 ROM, "Selections can be made on one switch at a time, the driver's switch over-riding the other panel switch", possibly to avoid overloading the circuit breaker. However, the ©1982 Supplement shows no such override and both windows on this author's '83 run at the same time. Randy Wilson says, "The SII XJ6, and early XJ-S, were set up in the manner your book describes. The switches are double pole, triple throw (down, pass-through, up). With this early system, you could only run one window at a time. And, if a switch failed such that the pass-through didn't work, all windows downstream also quit. Since the most used window, the L/F, is also first in the daisy-chain, it's not uncommon to see a SII with *no* working windows. This went away (all switches wired in parallel) with the SIII. I'm not sure exactly when the S changed over, but it was certainly by the time the H.E. was introduced."

If you have an early car and are having trouble with this system or these switches, the ideal solution might be to simply install the window control relay scheme described above and delete that daisy-chain nonsense. If your original switches can be made to work at all, they can be wired to operate the relays, and you will no longer be limited to one window at a time. Since you would be providing new and substantial power wiring to the window motors, there's no risk of overloading any existing wiring.

PRE-88 GEARS: Replacement gears are available separately. The motor/regulator assembly consists of a motor with a worm gear built into the output shaft, a housing that holds a gear/coupling assembly, and an arm with a gear rack. If your problems happen to involve that gear/coupling assembly, you're in luck! Chuck Sparks found out that the part is available in auto parts stores. It's called a "window lift gear kit", and it's made by Pronto, part number 42-90. It is described as applying to "any GM window regulator using a 46-spline, 12-tooth gear". It is described as fitting GM electric windows in cars and trucks from 1956-80.

There are no splines involved; there are two gears, a metal 12-tooth gear that engages the arm and a plastic 46-tooth gear that the worm gear drives. In between the two gears is a coupling assembly with a rather massive spring in it. All mounted on a short shaft. It's this entire assembly, both gears and the coupling mounted on the shaft, that comes in this kit. Cost is about $20.

A real cinch to install, too -- once you get the regulator out of the car. It's obvious, just take a cover off the housing, remove the old gear, install the new, reassemble.

PRE-88 WINDOW MOTOR REPLACEMENT: They are Delco, so you can get them from a Chevy in any junkyard in America, right? Apparently not. The window motors in the XJ-S are made by "Delco of England" and seem to be a little different than generic GM stuff.

Still possible, though. Don Lawton: "My Jag had the cylindrical Delco motors. I found that I was able to replace the motor/gearbox assembly with a Delco module off GM/Oldsmobile cars from around the mid-1980's. The unit is not the same as the Jag one, but the pinion has the same gear size; i.e. it fits the jag regulator sprocket. The unit also has a slightly different bolt mounting pattern, but a few minutes of work with a round file on the regulator plate enabled it to fit just fine.

"Another good point is that the passenger side GM regulator motor fits the driver's side on the Jag; i.e. you can get one that is less used and in good shape. The GM unit is slightly longer than the Jag so it sticks up a bit higher in the door, but tucks in nicely behind the mirror switches.

"I picked up several good GM regulator units from a local 'dig-it-out-yourself' auto wrecker for CDN $10 each, so I anticipate unstuck windows for the remaining life of my car!!"

Since the indications are that GM changed their window motor design in 1981 and Jaguar followed suit in 1988, it's entirely possible that a junkyard window motor from a pre-81 GM car would fit the pre-88 Jaguar even better -- maybe with no modifications at all. On the other hand, perhaps it's a good idea to upgrade to the later style motor.

1988-89 ELECTRIC WINDOW MOTOR FAILURES: On the '88-89 Delco units, the housing on the motor itself gets loose and jams the rotor, or lets water in. Victor Naumann says, "I have replaced a lot of motors that the back has fallen off of and water has ruined."

Steven Draper reports, "After taking the door apart, I noticed that the case on top of the window motor that holds the magnets is held on by only two bolts. The rear bolt had slipped some, and could not be tightened completely because of the soft metal. The bit of play between that casing with the magnets and the internals of the motor that spin about was enough to cause the motor to only work when you beat the side of the door. I inserted a slightly larger bolt with a nut on the bottom. I was able to put the new bolt in without taking the motor out. Believe it or not, the window now rockets up and down. If you've got a window that doesn't want to go up and down and tapping on the door helps, this could be your problem." If you can't find a suitable long bolt, consider threaded rod with a nut at both ends.

"It was interesting because the case had four bolt holes but the motor part with all the gears in it only had two holes for the case to attach to." It might not be a bad idea to put some aluminum tape or silicone sealant over the unused holes to keep water out.

"BTW, on the Delco motor, if you put the stator on reversed from how you took it off, the motor does the opposite of what the switch intends." Actually, this is probably true on *any* window motor. Might be a good idea to mark which way the case goes before disassembly, although you could conceivably just turn the switch around in the console.

1988-89 ELECTRIC WINDOW MOTOR REPLACEMENT: Peter Cohen reports, "'88's & '89's are known to have problems with the window motors. I have an '89 XJ-S and have replaced both window motors with the new style Bosch motors. I highly recommend them. The windows just zip up and down like they never did with the Delco motors. If you have an extended warranty, this should be a no brainer -- make them buy you the new motors. If the warranty company won't come through, sue their no good ass in small claims court.

"Some other insights into the window motor upgrade:

"1. When this upgrade first came out, it was only sold as a complete motor/regulator assembly. It is now available as two separate parts.

"2. When I bought my left side assembly a few years ago (about $325 then), two of the holes on the motor seemed not to line up with the holes in the black sheet metal panel in the door, & I had to drill new ones. This was not a problem with the right side, separate motor & regulator assembly which I bought in April, but I did have another problem: Both the regulator and motor shipped to me as right side were actually left side. The regulator assembly was in a sealed Jaguar package with the correct Jaguar part number for the right side. I took this to the local Jaguar dealer who cheerfully swapped it for a left side regulator, without my asking, and without asking where I got it. Being so successful with the regulator, I took the motor to another Jag dealer. Now, here's where it gets interesting. The motor came in a Bosch box, so I was a little nervous about trying to swap it at a dealer. I brought in the motor without the box, and again, the dealer swapped it without my asking. However, the number on the motor was different enough from the one I brought in that it wasn't just the difference between left and right. Also, the motor from Jaguar comes with 3 torx screws, and while the Bosch unit had no external wiring at all (just tabs to connect the wires), the Jaguar issue not only has the wires, but they are potted onto the motor. This leads me to believe that there is a standard issue Bosch motor that we can buy and adapt, even if Bosch won't sell the Jaguar number.

"3. There is a different type of plug on the Bosch motor (although still only 2 wire). You can cut & splice your old wires, or Jaguar sells a clean little adapter assembly to do it right. I have done it both ways, and both work. The adapter is $40, so you really have to want it."

"A few weeks ago, I found myself in a Mercedes repair shop, and noticed a window motor lying on the table. Dang if it didn't look exactly like the one I put in my XJ-S. Which leads me to speculate: How many other cars use the same motor? Audi? BMW? Volvo? Saab? Opel? A wrecking yard Bosch motor in conjunction with a new Jaguar window regulator may be just the ticket for replacing those crappy Delco motors without bleeding from the ears at Jaguar's price."

"The Bosch motor's drive gear has a different number of teeth, so the regulator gear of the Delco won't mate with it, thus the need to replace the regulator."

BOSCH ELECTRIC WINDOW GEAR FAILURES: On the 1990-on Bosch units, the gears strip. Matthias Fouquet-Lapar says, "I almost fell flat on my face when the workshop told me that the window motor for a '91 XJ-S was more than $800! They found a way to adapt the older motor type. They told me that there is some nylon drive gear which easily breaks and there is no good fix available, so they retrofitted the older type motor. It seems to require some major rework to the window mechanism though." Considering all the trouble Peter Cohen went to in upgrading his Delco motors to the later Bosch (see above), he probably doesn't want to hear that shops are doing the reverse.

Hugo Guerra reports that the window motors from a '76 fit just fine in his '90.

ELECTRIC REAR WINDOWS -- CONVERTIBLE: Trish Duffy says, "On the convertible, the two back windows automatically retract when the hood/top is lowered, and close when the hood/top is raised. These back window motors *can* burn out if the top raise/lower switch is held "on" for too long."

Larry Barnes says, “My 1992 convertible has a "Delco of England" window motor for the Rear\Side windows. I tried to order just the motor, but Jaguar wanted to sell me the whole shooting match (with regulator) for $360. I found a local motor shop the would rebuild the motor.”

There apparently are other problems with these windows, though. Andrew Corkan says, “I have a ’91 XJ-S convertible and the rear window, lowered automatically when the hood (convertible top) is lowered, stopped working. The window remained up, but otherwise the operation of the hood was not affected. I tested the usual, relay and fuse, etc...

“Following the Jaguar service manual, 1974-88, vol 4 page 76-11, I removed the rear quarter trim panel. I then removed the plastic motor cover. It is held in place by both adhesive and three plastic button fasteners. I missed one fastener and broke the thin plastic cover. I also unplugged the two motor wires.

“The failure was in the gearbox on the motor. The gearbox has a thin metal plate that covers a worm gear on the motor coupled to a plastic gear that couples to the window movement linkage. I removed the four bolts that hold the window linkage to the body. I lowered the window half way by hand and rotated the linkage to remove it from the recess in the body. (I did not remove the rear storage compartment or the hood lift linkage as stated in the service manual.)

“I don’t know why the gearbox failed. The gear box contains a rubber coupling consisting of 6 pie-wedge shaped sections that couple a three-pronged part on the plastic gear with a three pronged part on the metal shaft that runs out the back of the gear box. These wedges had popped out and knocked off the gearbox cover. It appears that the window motor is just run for a fixed amount of time and there is no switch to stop it, so maybe the rubber parts were just squeezed out when the motor stalled at the end of the travel. I saw no limit switches.

“I jammed the rubber back in place and replaced the metal cover and peened that back into place. When reinstalling the motor it is important to run the hood up or down so that the other window is in the halfway position (as per the service manual). This puts the window linkage in a position that allows access to all three mounting bolts for the gearbox. I repacked the gear box with general purpose grease, and added lithium grease to the linkages.

“It worked fine 6 times (up or down) last weekend. So far so good.

“The critical and possibly breakable part appears to be the plastic gear in the gearbox. All other parts are robust metal or easily cut rubber. If you find these gear boxes, keep the parts.

“The motor looked generic. If it fails it should not be too tough to find a substitute, just be sure you save the worm gear that is on the shaft.

“My time was 3.5 hours, mostly trying to figure out which screws to remove and how to remove the linkage. Next time it will take about 1 hour.”

Larry Barnes says, “I just got to repair the *left* rear window motor on "her" '92 Convertible. I also had this same problem with the *right* rear window motor. Dare I say it, "a design flaw"??? No, couldn’t be...

“Seems in the gear box (the flat lid pops off for easy access) there is a ring gear and a worm gear and a output linkage linked to the ring gear with a 1/4" flat/round rubber pad/shock absorber. Well, there are three little "ears" on the rubber shock absorber that will break off and, get caught in, and jam up the works (always with the window in the down position when you are 40 miles from home and it's pouring down rain). They seem to have no other practical use!

“The fix is: Remove the FOD, spin around 3 times anti-clock wise, and reassemble. Everything works great again...”

ELECTRIC REAR WINDOWS (CONVERTIBLE) -- ACCESS: Julian Mullaney says, “I was buggering about with my XJS Convertible rear windows which wouldn't work properly (just like everyone else's) and noticed that the panel that covers the motors is held in by several screws, one of which is behind the window glass. If the window ever gets stuck in the up position, or any position except all the way down, this screw would be utterly inaccessible, i.e. behind the glass. This means that the interior leather panel could not be removed and the motors could not be accessed at all. One would be truly screwed if this were to happen. I think I will leave these screws out next time. There are enough other screws holding the panel in place.”

Andrew Corkan responds, “It happened to me. I went to my basement and found a philips screwdriver tip, the kind you buy in packs of 6 for driving drywall screws with your electric drill. I then went to my local Service Star store and bought a strip of steel, 1/2 inch wide and 1/8 inch thick. I cut the philips part off the driver and drilled a hole in the strip of metal and brazed in the stub of the philips screwdriver into the hole. This gave me a right angle screwdriver, with a bend able handle, that was flat enough to get into the space. I could rotate the screw 90 degrees at a time and it took 15 minutes to get it out! If you do this be sure to file all the sharp edges off the metal; I then wrapped the metal in plastic tape to prevent damage to the leather. Before I replaced the screw I cut it off so it will only take two rotations to get out of the hole. Now that I think about it, maybe I will replace it with a hex head screw, easier to turn."

Electric Mirrors

ELECTRIC MIRROR DISASSEMBLY: Somewhere in the early 80's the outside mirrors changed. Alan Heartfield compares the '82 to the '85: "The '85 glass and backing frame will pop out of the housing, but the '82 will not. The backing frame is held to the motor with a screw behind the glass. However, the glass can be removed with careful use of a hot air gun."

Here's how the electric mirrors on this author's '83 were put together: The plastic rim was put into place, then the motor assembly was put in over it, and then three screws were put in through holes in the mirror platform to hold all that to the housing. Lastly, the glass itself was mounted on the platform with foam tape -- completely covering the access holes to the three screws.

Fortunately, you can easily see just how difficult it is to get to the screws before you even start. Run the electric mirror to the full up position, and pry it upwards a little more with a screwdriver and look under it. You will see two Phillips head screws. These two are not that difficult to get to. Run the mirror to full down and look between the top and the edge of the housing, and you should see the third Phillips screw dead center. This one's a real pain, since it's farther away from the edge than the lower two. Getting these three screws out and back in is the only difficulty with removing the motor assembly; if you can do that, the rest is cake. The mounting lugs on the motor assembly are open slots, so removing the two bottom screws and just loosening the upper one may work.

As long as you have the thing out, a couple of suggestions: First, the plastic rim may have flashing tabs around the edge of the inner rectangular opening, notably at the 3 o'clock and 9 o'clock positions. These tabs may interfere with operation of the mirror, and should be cut off. In fact, it isn't a bad idea to use a sharp blade to cut about 1/8" off the right side of this opening, enlarging the entire rectangle.

Second, the motor assembly mounts with three lugs, but there is a fourth unused lug that gets in the way during assembly. You may want to just cut this fourth lug off to ease reassembly. It does nothing for operation, though, so you also might just leave it alone.

Third, the bottom center portion of the plastic rim distorts, so the screws tend to pinch the mounting slots right on the edge rather than getting a secure grip. My solution for this was to attach a 1½" length of popsicle stick to the bottom center of the housing with a piece of aluminum tape. This holds the plastic rim up into the proper position while the bottom two screws are tightened.

Note that the motor assembly itself is also permanently assembled, by melting tabs. You'll have to grind them off to get it open, and then contrive some other method to hold it shut again.

The motor assemblies for the left and right sides are exactly the same, not mirror images or anything.

ELECTRIC MIRROR ADJUSTMENT SWITCHES: When the parts man at a Jag dealer was asked about these joystick switches, he had the part number memorized! We're talking *junk* here, and they charge $85 *each* for the two of them. Note that for '92 the joysticks were replaced by a fancy electronic adjustment scheme, and the following ideas do not apply.

Note: The mirror circuits are always hot, even with the ignition off. 12VDC won't electrocute you but it may cause burns or blow a fuse, so you may want to remove the appropriate fuse or disconnect the battery before working in this area.

Glenn Waterfield sends a description of how to rebuild the joysticks: "I was able to *very* carefully remove the pins holding the body of the switch together and strip down the pieces and clean the corrosion off them. To re-assemble the switch I did not want to try to reuse the metal pins that originally held it together since I will probably have to clean them again, so I found a tap just barely larger than the pin hole, a 4-40 I think, and carefully tapped the hole and put in three 4-40 nylon machine screws. If you try this I would recommend a clear work area with no carpet to drop the unbelievably tiny bits and pieces into."

If you'd rather just get rid of the junk switches, the following is a replacement scheme.

1. Make a flat rectangular panel to replace the original chrome escutcheon. You can make this out of anything you think would look good in your car -- chrome-plated steel, sturdy plastic, sheet metal covered with leather, elm burl, etc.
2. Go to an electronics supply store and buy four toggle switches. They need to be "mini" or "submini" ("micromini" will also work if you find any, but you need to drill smaller holes in the panel), "DPDT momentary center off". This means that they not only need to have three positions, but need to return to the center position by themselves when released. The current here is very low, a 3-amp rating will do. Once you find such switches, they should be only about five bucks each. Technically, a DPDT momentary center off rocker switch would also work -- if you can find one small enough to fit four of them in the car.
3. You may also want to buy some Molex connectors, such as Radio Shack catalog no. 274-236 and 274-226, to replace the hokey originals.
4. Mount the switches on your panel. The upper two should be mounted vertically and the lower two horizontally, since there will be one up/down switch and one left/right switch for each mirror.
5. A soldering iron or gun is required here. Connect wiring as shown in Figure 32. Note that each wire connects to two terminals.

If you'd like to see a photo of the author's installation, go to:

http://www.jag-lovers.org/xj-s/book/MirrorSwitch.html

It is also possible to use only two DPDT momentary center off switches instead of four by adding a DPDT switch (non-momentary) to switch from left mirror to right. With this selector switch, a center off position provides a "lock" so the mirrors cannot accidentally be moved; while not strictly necessary, it wouldn't cost anything, either type switch is readily available.

Glen E. MacDonald went this route. "Not wishing to junk the chrome escutcheon, I used the three switch alternative, ie. two of RS 275-637 (one each for vertical and horizontal adjustment) and one of RS 275-626 (to switch between left & righthand mirrors). I found that the former switches could be very tidily mounted where the original joysticks were (in the escutcheon) by utilizing suitable diameter caps from magic markers, pared for length and drilled to accept the switch. The mirror selection switch is small enough to mount unobtusively in the leading edge (front portion) of the escutcheon. It works like a charm and, in my opinion, looks quite professional!" Figure 33 is based on MacDonald's input for wiring these switches.

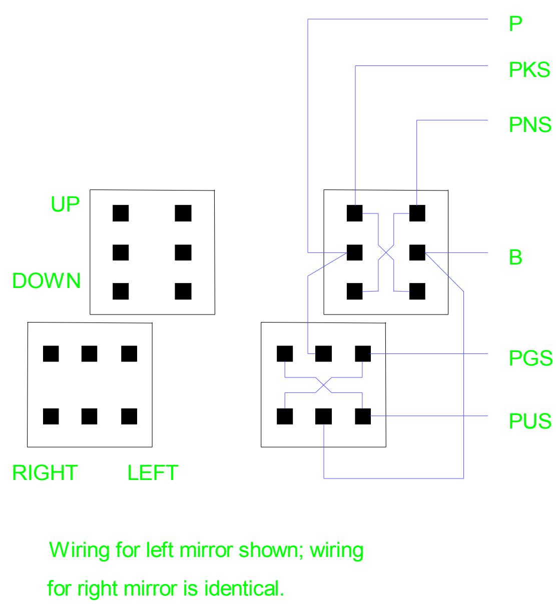


Figure 32 - Electric Mirror Switch Wiring

MacDonald cut the connectors off the original switches, and therefore the illustration shows the connectors and the wire colors from the original switches as well as the harness wire colors -- note that some mirror joysticks may have P wires instead of R.

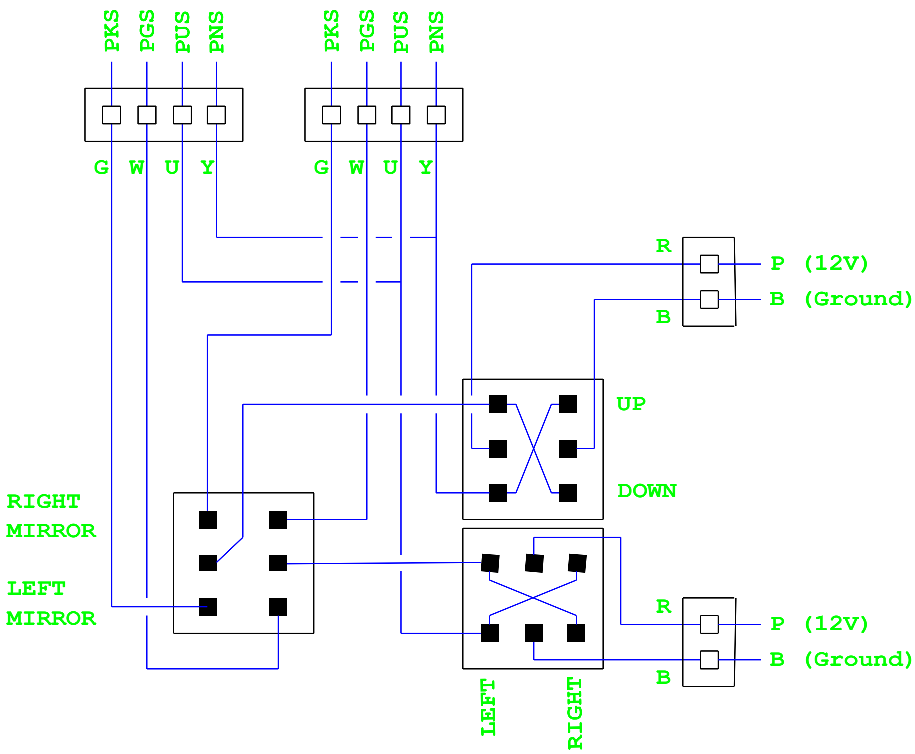


Figure 33 - 3-Switch Mirror Wiring

Note: the author's local Radio Shack claims they no longer offer the 275-637 momentary switches nor any acceptable substitutes, but similar switches are available at most other electronics supply houses. A suitable switch is made by GC, part number 35-018.

It may also be possible to utilize the mirror switches from some other car. More and more cars use electric mirrors these days.

Once your mirror control switches are operational -- original or replacement -- it would be a good idea to wrap some plastic around the assembly before installing to keep rain that gets past the window seal from getting into the switches and corroding the contacts.

Door Locks

There have been at least three different electric door lock schemes used on the XJ-S. The pre-H.E. had solenoid-operated locks powered through a pair of relays, one for lock and one for unlock, and controlled by a center-off rocker switch on the console. One relay is located on each side of the car within the footwells. It is this system that is described in Section 86.25.00 of the ROM. This system was apparently worthless from outside the car, but Mike Morrin says it isn't too difficult to add an aftermarket remote control locking system to it.

With the H.E. came a more automated version of the same solenoid scheme. Each solenoid had an arrangement of microswitches, capacitors, diodes and resistors added so that each solenoid could control the other solenoid. The relays that formerly were controlled by a rocker switch were now activated by a capacitor discharging through the coil. As a result, the rocker switch on the console was eliminated; moving either lock, either by the key from the outside or by moving the lever on the inside, would actuate *both* locks. This is the system that is described on page 86-23 of the ©1982 Supplement, although it also shows a boot lock that apparently didn't really exist until much later.

Finally, the solenoid type locks were replaced with motorized locks. The difference is readily apparent; before the change, the door locks operated with a clunk. After, there is a quick whirring sound as they lock and unlock.

Robert Warnicke: "If you care, some of the early saloons didn't have electric locks at all, or at least my '73 XJ12 doesn't."

Note that the Haynes manual is totally worthless on door locks.

If the locking system isn't working right, one obvious thing to do would be to remove the door panels and lubricate all the joints in the linkages and make sure they're all adjusted properly and moving like they should. Mack Kamna says, "As in the case with all lubrication, use the stuff sparingly. If you use excessive amounts, by giving the "grime" something to stick to, *you are creating the very thing that you are trying to prevent:* abrasion and thus wear of the parts." See also the note on the linkage clips on page 475.

There have been a couple reports of people getting out of their Jags while leaving the engine running, and when they closed the door they could hear the click as the car locked them out. The cause is unknown, but be forewarned. Also, see "Breaking In" on page 476.

MOTORIZED DOOR LOCKS: Julian Mullaney reports on the locks going nuts in his '91 convertible, apparently the motorized type: "All three solenoids went rapidly from lock to unlock for about ten seconds, even after I removed the key from the barrel!! This wouldn't stop until I replaced the key in the lock and forced it to stop oscillating. I almost expected it to blink its lights, start up, and drive away without me. Weird." Randy Wilson explains, "Nah, not weird. It's fairly common with that era XJ-S, and more than a little amusing to play with. On those cars, the power lock sensors are not position dependent; rather, they are motion dependent. What happens is a lock mechanism gets a bit stiff. You unlock the door, the sensor detects the motion and all drivers go towards unlock. The stiff mechanism causes the lock linkage to deflect a bit from the load. When the driver deactivates, the linkage springs back a bit. The sensor sees this motion as travel in the lock direction, and kicks the drivers into lock mode. Linkage deflects, drivers disengage, linkage springs back, sensor sees motion in unlock direction, drivers go to unlock.... repeat until end of battery. Or until you jam down on the linkage long enough to ride out the cycle.

"The cure is to remove both door panels and clean and lube the lock system. The gumminess is usually in the striker assembly."

Nigel Spratling says: "The door lock actuator is actually a sealed motorized unit made in Germany. I had a problem with mine and I took the unit out and very carefully cut it open along its seams. Once apart I took out the electric motor and carefully disassembled it by prying open the lock tabs next to the brush carrier. The motor is actually a Japanese Mabuchi 12volt device and they are prone to developing 'dead' spots on the armature when used infrequently (i.e., when used for a door lock). After extracting the brush carrier, I cleaned the brushes and also cleaned the armature contacts with some fine emery paper followed by washing with alcohol.

"Once the motor was reassembled I applied 12 volts to it to test it and it ran like a champ. I then reassembled the whole mechanism and refixed the two halves together with glue and duct tape (you can't see the lock mechanism inside the door, so duct tape is perfect ☺).

"The locks have been working perfectly for over a year since the repair and it cost nothing but time and patience. If it fails again I will buy a new Mabuchi motor from a hobby shop."

Considering the nature of Spratling's problem and solution, the motorized door locks might be yet another place where using the system on a regular basis might help keep it working longer.

BOOT LOCK: According to Mike Cogswell, electric boot locks were introduced in 1989 models. According to his dealer, they cannot be retrofitted to earlier models.

Note that the later cars with electric boot locks have a 3-position keyhole. This is explained in the owner's handbook, but who reads those things? If the battery is dead and you obviously need to get into the boot to do something about it, turning the key either left or right won't work; you need to turn the key to the middle position, straight up. Mark West says, "The lock has two functions. The first is to override the electronic lock, in case you want to keep a nosy valet out of your goods. The second is to allow you to actually open the trunk using the trunk latch without having to operate the door locking mechanism. When the key is turned to the middle position the trunk latch may be operated independently of the electronic locking mechanism. Using the key in this manner, you can open the trunk without unlocking the rest of the car. It's a time-saver if you haven't installed an auxiliary alarm system. If you *do* have an alarm, don't try this without disabling your alarm. It makes a very loud noise... kinda embarrassing in a shopping mall parking lot.

"It will only work with the larger of the two silver keys. One is the "valet" key and only opens the doors; it is smaller and has the concave butt end. The other key, which is larger and has a convex end, will operate the trunk lock, gas cap, glove box, etc."

KEY FOB LOCK: According to Mike Cogswell, the key fob security systems were introduced in 1989 as a dealer-installed option. Apparently these cannot be fitted to earlier models.

ALARM SYSTEM RESET: Victor Naumann provides a resetting procedure: "Each year is different; try disconnecting the battery, wait 1 minute. Reconnect the battery. If the lights flash and sounder beeps every few seconds you are halfway home. Have all your remotes, security looks for five signals. You must press each remote at least once and all of them for a total of five presses. The security should work then. If the sounder does not sound , you may need to disconnect the security backup battery next to the security ECU and the do the process."

Windshield Wipers

There have been three distinct types of wiper motor used in the XJ-S. In the earliest models, a Lucas wiper was used that incorporated a parking solenoid inside that pulled the wipers into a parking position that was beyond the regular wiping limit. Later models used a different Lucas motor that had no parking solenoid but ran the motor in reverse to park. Finally, around 1987 an Electrolux motor was introduced.

Note that Jaguar made a regular practice of replacing the early solenoid-park Lucas motor with the later reversing-park Lucas motor. They do *not* simply plug in, so Jaguar dealers were provided a "blue box" that allowed the earlier controls to operate the later motor.

BLADES: First, a clarification of terminology. "Wiper blade" means the entire apparatus at the end of the wiper arm. The little rubber strip that actually contacts the glass is called a "refill". Don't blame me, I didn't come up with this.

The OEM blades on the author's '83 were really garbage: a simple pair of levers with a spring at the pivot point. These were replaced with some Anco aftermarket units which are much better, having a multiple beam arrangement to distribute the load over the blade edge.

The OEM blades on the '83 have a pin protruding from the side of the center hinge that clips into the side of the arm. A perfectly workable attachment, but unfortunately largely unheard-of today. However, it was common enough at one time that some aftermarket blades came with little pins that would snap into the blade and allow it to be attached to these arms. This is no longer popular, but many auto parts shops still have a collection of these pins in a drawer behind the counter. After all, 99% of the customers buying replacement blades didn't need the pins and just tossed them over their shoulders on the way out of the store. Once you have a pair of pins, you're good for the life of the car; the pins won't wear out, so you can use them with whatever blades you ever install in the future. Most of the pins are steel, but some were stainless steel; if you're going through a box in an auto parts store, you might opt to keep looking until you find a pair of the stainless ones.

The OEM blades were both the same length, but when I was buying aftermarket Anco blades I installed a 14" blade on the driver's side and a 15" blade on the passenger's side. The 14" blade allows the driver's side wiper to park without contacting the A pillar. Also, having wipers of different lengths reduces the tendency to chatter -- which is one reason why many modern cars come with two different size blades from the factory.

The Anco blades held the edges against the windshield better and wiped better when it was raining -- but when it started to dry up, the wipers wouldn't park! The motor didn't have enough ooomph to move them. This led to a relay installation, as described on page 627, which fixed that problem.

Reportedly the OEM wiper blade design was changed shortly after '83.

WIPER MOTOR REMOVAL: Removing the wiper motor involves removing the entire intake grille assembly in front of the windshield. It doesn't look hard, but there may be trouble; the two fasteners closest to the windshield actually involve a rubber isolation mount, and trying to unscrew the nut may just rip the mount apart if you are unlucky today. Fortunately, it isn't too difficult to improvise a replacement mount scheme using a small bolt, a couple nuts, and a rubber grommet or two. It probably wouldn't be a good idea to rigidly mount the grille, though; Jaguar probably used the rubber mount for a reason.

WINDSHIELD WIPER MOTOR COVER: Under the grille, Jaguar provided a cover over the wiper motor to keep the rain off. If you're wondering where your original cover went, you need to read about water leaking in through the A/C system on page 466. This plastic part does not hold up in sunlight.

Providing a new plastic cover from Jaguar over the assembly would help for a while, but then it will just break up and plug the drains again. The aluminum tape suggested below is likely to be the prime protection for the motor in the long run. This author didn't even bother installing a cover and simply relied on the tape, painting it black so it would look OK from outside the car. It has worked for a decade.

Chuck Sparks suggests that you can buy a new cover and fiberglass it before installation to render it impervious to sunlight. Just coat it with resin, sprinkle on some loose fibers, and apply another coat of resin. Trim the edges up to make it look pretty, then paint it.

Jim Belkoff says, "John's Cars sells a replacement cover made out of genuine American plastic. I think it's worth the nominal cost." John's Cars is on page 717.

Chuck Roach says: "I went to my Jag dealer to pick up a new cover and the parts/service manager told me to forget it and just use an old one-gallon plastic bottle and cut it to fit and hold it in place with cable ties. Worked great. Will probably last as long as the original." I disagree; it's likely to last a good deal longer than the original.

Of course, you could probably fashion a cover from a thin piece of aluminum. Or find a metal can about the right size and shape and cut it out to make a metal cover. Or fashion a cover from a section of aluminum rain gutter. Or simply coat the motor with a layer of mastic. The possibilities are endless, just use your imagination.

WINDSHIELD WIPER MOTOR REBUILDING: The housing of the Lucas wiper motor is not waterproof, and it's sitting right under the grille, exposed to the elements. To protect it, Jaguar provides a plastic cover over the motor to keep water from falling on it. There are also two large drains from the wiper motor compartment out through the engine compartment and out into the front wheel wells that should prevent any standing water from accumulating in this area. Unfortunately, the cover is usually history (see above), the compartment drains are often plugged because that's where the cover ended up (see page 466), and the wiper motor has ceased functioning due to water damage.

If you have trouble with the wiper motor, it's not too difficult to rebuild. The ROM doesn't include any instructions for overhaul, but the Haynes manual does. Note that the instructions in the Haynes, including Fig. 10.101, don't accurately reflect the Lucas reverse-park motor found in the author's '83; perhaps they are more representative of the earlier solenoid-park motor.

Typically, a wiper motor "assembly" consists of the motor itself and the gearbox, with the gearbox integrated with one end cover of the motor. The instructions in the Haynes manual talk as much about getting the gearbox apart as the motor, but really you can usually tear apart one without disturbing the other. If it's the motor itself you wish to disassemble, it's a simple matter of removing two long screws. Note that the illustration in the Haynes shows the housing (it's called a "yoke" in the Haynes manual) as a single piece, while the author's '83 has a cylindrical case plus a separate end plate. Once the housing is off, the rotor can be removed by "unscrewing" it, allowing the worm gear to disengage without moving the wipers.

While apart, remove any accumulation of rust off the large cylindrical diameter of the rotor, the surface that passes very close to the magnets in the cylindrical can. You can use sandpaper; it's just iron. Use a phosphoric acid-containing rust treatment on this outermost surface to stabilize it and help prevent future rust, but be careful not to get the acid on anything else -- the wiring, the commutator, etc. Also clean all rust particles out of the cylindrical can, which will require some patience since they will stick to the permanent magnets inside so you must grab each particle to remove it. Masking tape is helpful; just stick it down and peel it off and it takes away a layer of the ferrous dust.

Clean up the brushes, which tend to jam when they've been wet for a while; make sure the brushes slide freely. If the brushes are worn (too short), replace them; there's no need to go looking for genuine Jaguar parts, just find any place that sells electric motor brushes (vacuum cleaner repair shops, starter/alternator shops, etc.) and buy some brushes that are a bit larger and file them down to fit. Carbon takes only seconds to file to size, although these will require some care since each brush has slots down the sides. The original brushes have brush, spring, brass guide and wire all bound together as one piece, but you can reassemble with separate generic pieces any way that forms a proper electrical connection. Note that the "third brush" in the Lucas wiper motor is a tad unusual in that it has one half of the tip cut away; make a similar notch on your homemade replacement.

If you're not up to that sort of work, Walter Acker says, "The brush plate is available from the dealer. It is normally a special order that takes time to get." Apparently, the same brush plate fits either the Lucas solenoid-park or the Lucas reverse-park motors.

Usually the best thing to do with the commutator, the segmented copper arrangement on the rotor that the brushes contact, is to leave it alone. However, if it's gouged, eroded, or otherwise in need of attention, the thing to do is to chuck it up in a lathe and file, grind, or otherwise machine the surface to clean it up, and then polish it as smooth as possible. Smoothness is good for brush life.

Use an ohmmeter to check for continuity at the commutator. There should be some continuity between any two segments, so you can check them all quickly by just connecting to any one segment and then check for continuity to each of the others from there. Also check that there is no continuity between a segment and the steel core of the rotor. If there's any segment that lacks continuity or a short to the core, you probably won't be able to fix it yourself; either contact a motor repair specialist for guidance or just buy a new wiper motor.

Lubricate the bearings with something that won't dry out and get gummy. Synthetic motor oil is probably as good a lubricant as you will find. However, take care not to get too generous with the lubricants at the commutator end of the motor; if the lubricants ooze their way onto the commutator, it'll screw up the motor and you'll have to come in here again and clean it up.

The most difficult part about reassembling a commutator motor is holding the brushes in a retracted position while you slide the rotor into place. Fortunately, on this motor the rotor goes in first and the case goes on afterward, which makes this task easier than on motors where it all must go together at once. Still, the fact that there are three brushes may make you run out of hands; you might use small pieces of wire to hold the brushes back during assembly.

If the long screws strip out of the threaded holes in the gearbox housing, you can install slightly longer screws and put nuts on the back side.

This being a worm screw drive system, there is a setscrew and locknut on the gearbox that contacts the tip of the rotor shaft. When assembling the motor, loosen the locknut and back the setscrew out a bit. After the motor housing is securely bolted into place, tighten the setscrew until it snugs up, then back it off a quarter turn and tighten down the locknut.

After reassembly, it wouldn't hurt to seal the top of the motor with aluminum tape (available where air conditioning supplies are sold -- it's used to seal ductwork) to help prevent water from getting in. You also might want to cover the center bump on the end plate; on the author's '83 there's a thrust insert behind the bearing that sticks out a hole -- it doesn't move, but it's not sealed. Don't cover the bottom of the motor; leave the openings uncovered on the bottom so that condensation drains out. And, of course, attend to the cover and compartment drain problems so you don't have a repeat of your troubles.

The solenoid-park Lucas motor, the reverse-park Lucas motor, and the Electrolux motor differ in detail, but the same type of repair and renovation should work on each.

WIPER MOTOR MAGNETS: Herman Green: "I took the motor apart and found that one of the magnets had come loose and had jammed the armature. The magnets are glued in with what seems to be some kind of silicone. Rust had crept under the bond and it gave up. I marked the location of the magnets with a file and measured the distance from the end of the housing to the top of the magnet, so I could put them back in the correct position. I also marked the magnets as to their location and orientation. If they're put in wrong, the motor will either run backwards or lock up. I then removed the magnets and cleaned them and the inside of the motor housing with a sanding flapper wheel in a drill motor. I then mixed up some JB Weld and glued them back in place. When gluing the magnets in, use a clamp of some sorts to snuggle them in tight. If not, you may not be able to get the armature back in! Once cured, I painted it with rustoleum to prevent further rust, and put it back together. Works great and should last a long time."

The author had the same problem. The white glue used is apparently just fine, Lucas didn't screw up there. The problem is water damage, due to the various water problems already noted -- lost motor cover, jammed compartment drains, etc. Eventually the motor case rusts behind the magnets, popping the glue loose.

Interestingly, the author's motor still ran with one magnet loose. The magnet is somewhat trapped between the case, the rotor, and the two long bolts holding the motor together. It can slide back and forth a little, but can't go anywhere. Apparently the motor just ran with the rotor rubbing on the face of the magnet without damaging anything. Of course, it didn't run well and occasionally it didn't want to start, which is why the overhaul was undertaken.

If you're as lucky and the magnets are intact, you can glue them back into place with JB Weld as Green described. If a magnet is neatly broken into two or three pieces, you can still fix it -- just glue the pieces together with JB Weld. If drop a magnet on the garage floor, though, it will probably shatter into hundreds of pieces; the magnets are made of ceramic. In this case, you'll be needing a new motor.

If only one magnet came loose, just put it back in directly opposite the one that's in there. If both are loose, you need to figure out where they go. Since the author has been in there, some specific guidelines for where the magnets go in the Lucas reverse-park motor are given on page 627; if your motor is the same, use those tips. If your motor is different, try the ideas below.

Since the magnets can't go anywhere, you should take note when taking the motor apart. If both magnets are loose, *immediately* stop what you're doing and mark which magnet goes in which side of the case. Installing them backwards will make the motor run backwards, and that means the reverse-park system will be trying to park when it's supposed to be running and run when it's supposed to be parking and the like; things will be all screwed up.

If you failed to note which magnet goes in which side, you might as well try the guidelines for the reverse-park provided on page 627; the chances of being correct are at least 50/50, perhaps better if Lucas kept the same magnet orientation from model to model. If you reassemble everything and it doesn't work right and you figure you've glued the magnets in backwards, there is one possible easy way out: remove the screws from the motor and rotate the entire case 180º and put the bolts back in. If there is an alignment notch or keyway, you may need to file a new one -- but the author's '83 didn't have any such devices, only an alignment mark. So you will be deliberately *not* lining up the alignment mark.

Other guidelines for magnet reinstallation: they should be equally spaced from each other within the case. When the motor is assembled, they should be aligned with the pair of brushes that are directly opposite each other. Obviously, the long bolts will end up between the magnets. Axially, the magnets should be centered over the core of the rotor, so with some careful measuring you should be able to locate them well enough.

If you only had to reglue one magnet, you know you really want to go ahead and knock the other one loose and reglue it while you're in there. I recommend against it. Shove on it a bit and see if you can get it to pop loose, but if it doesn't come off easily just reassemble the motor and forget about it. It's not all *that* difficult to get this motor apart and reglue it if it comes loose later. But if you get forceful trying to get that magnet loose, you're only too likely to break it -- and then you'll need a new motor.

WINDSHIELD WIPER PARK POSITION: On the author's '83, the wipers park to the left. Apparently some other cars have wipers that park to the right, but there doesn't seem to be any rhyme or reason to it.

The XJ-S wiper pivots are symmetrically located in front of the windshield, unlike any automobile on which an engineer thought about it for two minutes before designing it. As a result, the tip of one wiper bumps into the windshield frame when parked. Page 214 in the Haynes says to install the arms so the blades are parallel to the bottom edge of the screen when parked; that may work on the XJ12 but you really can't do that on the XJ-S on the side the wipers park pointing towards; the bottom end of the blade hits the chrome trim and the tip hits the A pillar. Avoiding these contacts requires positioning that wiper to park up high so it doesn't hit the frame; in the "Supplement for Later Cars" section, the Haynes actually provides an illustration with dimensions for positioning the wipers this way. Unfortunately, it looks stupid and obstructs the line of sight.

One way to improve this is to modify the wiper arm that points toward the A pillar to be shorter. This requires carefully unfolding the sheet metal where it is wrapped around the strut and drilling out the rivet just above the spring attachment. Then the strut can be cut about an inch shorter, drilled and bent to form a new spring attachment, a new rivet hole drilled, and then the strut can be reattached with a new rivet (a pop rivet will do) and the sheet metal re-crimped around the strut. A little flat black paint, and no one will know the original design was so poor. With the shorter arm, the wiper can be positioned much closer to the bottom of the windshield. Note that the shorter wiper will not reach as far toward the top of the windshield either, but this doesn't seem to pose a problem.

You can accomplish very close to the same effect by merely installing a shorter blade on that arm. A blade one inch shorter will pull the tip away from the A pillar the same amount as shortening the arm by 1/2". Unfortunately, it also reduces the area of the windshield that gets wiped. This may or may not be a problem for you.

Another improvement can be made by bending the arm slightly. The arm that parks over the other is cranked a little bit, but the one that parks pointing toward the A pillar is straight. Take that straight one, mount it in a vice, and crank it kinda like the other one. It's as difficult to bend as it looks; you're bending a flat bar the hard way, but the metal is soft and bends easily. This bend allows you to set this arm to park lower without the bottom end hitting the trim at the bottom edge of the windshield -- but it does nothing for the contact with the A pillar. So, it's a good plan to make *both* changes -- shorten the arm a bit and crank it a bit.

Another possible solution is to alter the wipers so they park on the passenger's side. In the case of the later Electrolux motor Stefan Schulz says this can be done by merely opening the motor gearbox and moving the park cam 180 degrees, but it doesn't look that easy on the Lucas motors. You will need to purchase Jaguar wiper arms that have the bend the opposite direction. Of course, after all this the wipers will still be just as obtrusive, but they will be aggravating the passenger instead of the driver.

Windshield Wipers -- Lucas Solenoid-Park

SOLENOID-PARK OPERATION: Mike Morrin reports on the early XJ-S wipers: "The wiper in question has a highly (over) engineered parking facility where on the parking stroke, the blades go an extra 5 degrees or so, which pushes them off the screen onto the chrome strip. In the parked position, the blades are on the glass for about half their length, and on the chrome strip for the other half. Definitely further out of the driver's field of view than where you would put them on a normal wiping stroke. The early cars had this feature; the pictures in the pre-HE parts book and the service manual both show the solenoid (although it is not labelled in the parts book and the service manual calls it a switch)."

The "Extract 3" wiring diagram in the back of Section 86 in the ROM and Fig. 10.128 and 13.96 in the Haynes manual include schematics for this system. The solenoid is not labelled, but it's the coil-lookin' thing alongside the motor.

Richard Dowling describes how it works: "In "OFF" position (park position) no power is applied to the motor or solenoid. In "LOW" or "HIGH" speed position +12V is applied to the motor windings through yellow (high speed) or red (low speed) wires." Note: the low speed wire from the stalk switch to the bulkhead connector is ULG and from the bulkhead connector to the microswitch it's blue. Inside the microswitch it does nothing but come out another terminal, and from there the low speed wire to the motor itself is red on Dowling's car, but in Fig. 13.96 of the Haynes it's BLG. Doncha just love Lucas wiring?

"As soon as the motor moves away from the park position the microswitch is closed and this maintains +12V on the "2" contact of the stalk switch." Note that Fig. 13.96 in the Haynes numbers the terminals on the stalk switch differently for some reason, with the terminal that gets 12V from the microswitch being number 1 instead of number 2.

"The motor shaft has a small worm which drives a large gearwheel. On the gearwheel a cam is mounted, and this cam has a pin which connects to a crank arm. The cam is concentric with the gearwheel in normal wiper arm motion. As the cam and gearwheel rotate the crank arm moves the wiper arms in an arc over the windscreen.

"When the stalk switch is returned to "OFF" position, +12V from "2" contact will both maintain the low speed motor winding energised and also energise the solenoid. The solenoid operation activates a catch to engage a spring loaded lever on the cam. This in turn forces the cam into eccentric operation on the gearwheel, which moves the crank arm over a longer stroke and thus activates the microswitch to open the "ON" contact and hence remove power from "2" contact on the stalk switch. The motor winding and solenoid are then de-energised and the wiper arms are in the park position.

"As soon as the motor starts up again the eccentric cam rotates to its normal concentric position on the gearwheel.

"The microswitch position is adjustable in a slot with a small screw to determine where it stops the crank arm. Opening the "ON" contact stops the motor which stops the crank arm.

"The microswitch body has 8 "faston" terminals, but only 2 terminals are effective. Those 2 are the common pole of the switch and the "on" contact. The other terminals are only for interconnecting wires."

Morrin: "It is nearly a good design, suffering only from the poor thermal design of the solenoid, and perhaps the parking switch should have been operated by a cam on the driven gear rather than by a switch on the sliding link thingy."

Note: the cars with the solenoid-park wiper motors did not have an intermittent mode. This may help explain the changeover to the reverse-park motor used later, since the solenoid-park scheme would probably not work well being parked every ten seconds or so.

WON'T PARK: Dowling: "Ever since I bought this car there have been times when the wipers would stop dead on the windscreen when switched off instead of parking. I know it is a problem with the switch fitted to the wiper gearbox. The switch is supposed to keep power on the motor until it reaches the park position." Unfortunately, since Jaguar took to replacing these wipers in entirety with the later reverse-park wipers; buying a new microswitch is likely to get more and more difficult as time passes.

"The overall wiper motor/gearbox is a fairly solid design and mine looks almost brand new after a clean up, oil and grease. Even the quirky solenoid that pulls in a ramp, that pushes up a latch, that forces the drive wheel into an eccentric orbit that then parks the wiper arms usually works. Strange but true - at least on my car.

“However, the switch gadget, which is a homegrown Lucas thing, is a pathetic cheap addition to what is a fairly good and expensive piece of machinery. I have pulled out the wiper assembly at least half a dozen times over the years to see if I could do anything to make it work reliably. It is not so easy to fit a microswitch in place of the Lucas POS, since you need a bracket to mount it and there is really no easy place to fit a bracket on the body of the wiper gearbox.

“I lopped off the top of the Lucas switch and exposed the little plunger in there which is operated by the cam on the slider in the gearbox. Luckily this leaves a hole in the Lucas item where you can put a miniature style microswitch. These are smaller than the regular size used on the throttle kickdown but not too hard to get hold of at US$3 a time. I made a simple bracket from aluminium angle and glued it to the Lucas POS.

“Drilled a couple of holes and mounted the microswitch. The microswitch has a short lever with roller and is pushed up by the plunger. Reasonably easy in the end.”

AVOIDING THE WON’T PARK PROBLEM: Regardless of whether you’re trying to preserve the original Lucas switch inside the solenoid-park motor or you’ve already replaced it with a generic microswitch as described above, you’ll see the value of reducing the stress on the contacts inside to help that switch last as long as possible. Its job is to break contact to not one but two inductive loads: the solenoid and the motor. As discussed beginning on page 559, inductive loads tend to cause charring on contacts when disconnected -- but it’s really easy to prevent this by adding a diode. You should add a diode here. Now.

When looking at the wiper motor assembly, there are two wires that go from the microswitch to the solenoid: one blue and one brown. This is a convenient place to add the diode: between the blue and brown wires, with the point or stripe on the diode towards the brown wire.

This isn’t the only place it could go. It could also go inside the car in the wiring to the stalk switch. It needs to be wired in between the RLG wire and ground, with the point or stripe towards the RLG wire.

Remember that even though you might be installing this diode in the wires to the solenoid, it’s not just spikes from the solenoid it’ll be absorbing; it’ll also be absorbing spikes from the motor, which is connected in parallel to the solenoid when the microswitch turns them both off. So, you need to make sure this diode is big enough to handle that job. As described in the section on installing such diodes, none of them ever need to be very big, but don’t put a really tiny one here.

Note: The relay installation described below will also help the microswitch last longer -- but it’s no substitute for installing this diode. The diode is probably more important to this switch’s life. Of course, doing both would be a good plan.

WON’T STOP -- CAUSE #1: Dowling: “If the microswitch is too far down its slot, or the switch contact does not open, the motor and solenoid stay energised and the wiper arm will not park. In fact the wiper will operate whenever the ignition is on. This is a very obvious fault and may burn out the solenoid if it is not fixed promptly.” By promptly, he means within a minute or so. As Morrin mentions below, if it won’t stop you need to move the stalk switch back to low speed position to avoid frying that solenoid.

WON’T STOP -- CAUSE #2: Morrin: “Unfortunately, a little bit of dirt or grease in the wrong place is enough to stop the solenoid pulling in all the way, which prevents the eccentric gear mechanism from pushing the wipers off the edge of the screen, which means that the parking switch doesn't get activated, which means that the wipers keep going and going and..... fried solenoid.”

The parking solenoid gets fried “because it is designed to be energised only while the wipers are switched off *and* are not parked. The designer thought that this period would be only a couple of seconds, and designed the solenoid with thermal capacity for about 30 seconds.

“If you do have an early car (pre H.E.) with this facility, if the wipers ever keep running after you have turned them off, then put the switch back into the ON position, or the solenoid will burn out within a minute or so. Remove the wiper blades if it stops raining.” Uhhh, it might help to shut the car off to do this. Once the wipers are in the trunk, you can start it back up and drive off with the wiper motor whirring merrily away. Alternatively, you might simply opt to shut off the ignition when the wipers are in the right place, and then remove the correct fuse before starting it back up. Fuse 9 should do it.

“If the solenoid has not melted, the parking function can probably be restored by carefully dismantling, cleaning and reassembling the solenoid.”

If the solenoid *has* melted: “I stripped off the old wire and built up the melted plastic core with epoxy filler, then filed it back to shape. The solenoid is wound with 0.16mm (0.0063") copper transformer wire. I didn't count the turns, but it does need to be neatly layer wound or you cannot fit enough turns to get the required magnetic pull.”

QUICKIE FIX FOR FRIED SOLENOID: Morrin: “I found that the parking switch is adjustable, and by trial and error found a position where the wipers would stop more or less at the bottom of the screen when switched off, even with the parking solenoid removed. This solution was almost perfect except that with the blades fitted so that they parked at the bottom of the screen, they did not wipe all the way to the passenger side of the windscreen.”

This quickie fix might even be considered an improvement. Per Morrin, the correctly-operating solenoid system “takes about half the period of a normal stroke to move the the wipers through the first 5 degrees, and you need to hold the switch for that period of time.”

UPGRADING TO LUCAS REVERSE-PARK: If you’re interested in upgrading an earlier car with the later wiper motor, Scott Horner describes “the little Lucas blue box modification - this plugs into the original wiring loom and fits into any tight spot under the dashboard. This was offered by Jaguar to make the windshield wipers park on pre-H.E. cars, when used in conjunction with an H.E. wiper motor.”

RELAYS: The pre-90’s XJ-S is notorious for powering high-current loads such as electric windows and windshield wipers through tiny contacts and long, skinny wires. The result is a 14V load that is trying to operate on 8V or some such, the rest of the voltage being lost in the controls and circuitry. If your wipers are dragging, the solution is to provide a relay scheme to provide solid power directly from the main power bus and use the original control wiring only to control the relays.

Dowling suggests there may be another good reason to install relays: to help the stalk switch last longer. It’ll also help the microswitch in the motor last longer. If either of those switches ever gives out on you, you’re gonna wish you had ponied up the ten bucks for relays when you first read this.

It’s very simple to install relays on the solenoid-park motor, only requiring two relays -- one for low speed, one for high. There are three wires from the microswitch to the motor itself. One of these is a ground wire; Dowling says that one is blue. For each of the other two, pull the spade connector off the microswitch and connect it to a normally-open contact on a relay. Connect the terminal on the microswitch to one coil terminal on the relay. Connect the other coil terminal on the relay to ground; that third wire on the motor is a ground, so you can splice into that or piggyback onto the terminal it connects to. Connect a stout 12V power lead to the other side of the normally-open contact.

Obtain that stout 12V power from the main bus on the firewall. You’ll need to provide a fuse within the engine compartment where it’s easy to get to, and then run the lead into the wiper compartment and install the relays in there somewhere they won’t get immersed when it rains.

The third wire from the motor needs to be a good solid ground. It might help a little to provide an additional reinforcement ground right there in the wiper compartment. Simply tie in another wire and screw the other end down to the body somewhere.

If you'd rather work behind the dash, these relays can just as well be installed in the wiring from the stalk switch. Merely cut the ULG and YLG wires and splice in the relays, using the lead from the stalk switch to power the relay coil and the contact in the relay to send solid 12V power on to the wiper motor. You can get the stout 12V power from the main terminal post on the firewall near the climate control system.

Windshield Wipers -- Lucas Reverse-Park

SCHEMATICS: The reverse-park wiper system is shown schematically on page 86-15 of the ©1982 Supplement to the ROM. Apparently the only place it's shown correctly in the Haynes is in Fig. 13.91 -- which is a wiring diagram for the saloon. Whatever, you can simply refer to Figure 35 below and ignore the relay additions to see how the car was originally wired.

WINDSHIELD WIPER CONNECTOR AND HARNESS: Once you have the grille out, you will find that the wiper motor plugs into a socket on a panel inside the grille compartment. Jaguar uses a really nice 8-conductor plug to connect five wires. You might find it helpful to know which wire on the schematics connects to which conductor on that plug. Figure 34 is an illustration of the connector on the panel in the author's '83, viewed as though you were standing on the engine looking at it. The circles represent brass posts.

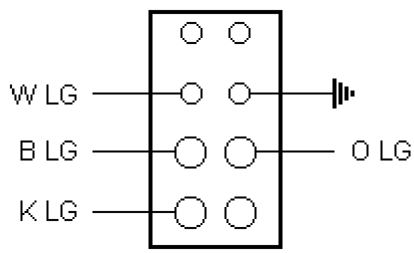


Figure 34 - Windshield Wiper Connector

Of course, the connector on your car may be different than the author's '83, so you might need to confirm those connections with a VOM. With the ignition switch turned to ACC, the W LG post should register 12V with the wiper switch in fast mode only. The B LG post should register 12V with the switch in slow mode only. The K LG should register 12V with the switch in intermittent/flick or off modes only. Turn the ignition off, and using ohmeter or continuity mode, you should get continuity between O LG and B LG posts in intermittent/flick and off modes only. Obviously, the ground terminal should register continuity to ground.

Also on the author's '83, there is a harness that starts with the plug that connects to this socket on the panel and plugs into the motor itself. At the motor end, it becomes evident that the wire colors in this harness do not correspond to the wiring schematics -- they are solid-color wires. And the plug is enclosed so you can't tell which wire goes to which connector by looking. It's not too difficult to determine which wire is which using a VOM, though:

Yellow	=	W LG
Green	=	Ground
Brown	=	B LG
Red	=	O LG
White	=	K LG

WINDSHIELD WIPER MOTOR DURABILITY: A design problem with the Lucas wiper motor is that the drive gears at the wiper arm shafts are plastic. Wear is a reported problem, and can be aggravated by operating the wipers on a dry windshield. It is suggested that the XJ-S owner use Rain-X or similar product on the windshield on a regular basis. This will make the water run off so the wipers need not be used as often, and it will also make the surface of the glass more slippery, so the wipers move more easily.

WINDSHIELD WIPER PARKING: If your Lucas reverse-park wipers don't park, you may be tempted to start tearing the wiper motor apart to work on the parking contacts -- but you would be forgetting that this is Lucas you're dealing with. As Mark Roberts found out, the problem is every bit as likely to be within the stalk switch. "Because the wipers would park in intermittent mode, I was skeptical about the problem being with the parking micro switch, but checked it anyway. Micro switch was fine. The problem was traced down to the stalk switch. In the off position, pins 5 & 6 (ULG & BLG respectively) are supposed to be shorted together, to provide a ground path for the motor. They are also supposed to be shorted when in intermittent mode for the same reason. On my switch, 5 & 6 were shorted in intermittent mode, but *open* in the off position...no ground, no work."

Dan Jensen provides more info: "There is a simple in-car test to determine if the switch is the problem. After turning the wipers off and having them stop midstroke, simply push down slightly on the stalk toward the intermittent position (but not the "locked" intermittent position). If the wipers park, it is the switch."

Jensen had this same problem on three different Jaguars! "Unfortunately, after disassembly of the switch in my '81, I could not come up with a successful way to repair it. The cause seems to be slow deformation over time of the plastic slide that supports the copper contacts in the switch. The slide is held against the stalk by a rather stiff spring that apparently leads to an inexorable depression in the plastic slide contact surface. At ~$100-125/switch, I will probably just live with the problem."

Tom Amlie says a new switch might not even fix it. "Ordered a new switch for $82. It was defective straight out of a sealed green box with the leaper on it. Took the old one apart. It has a flat plastic card with indentations in it. In the indentations are little pieces of copper. As the card moves in and out, the little pieces of copper are supposed to make and break connections as necessary. Trouble is, they are not anchored in any way and fall out. A few drops of crazy glue on the copper pieces and glued the thing together. Worked fine. This was my first experience with the "Prince of Darkness". I think you are too easy on Lucas in your book."

This author had the same problem and managed to fix it by disassembling the switch. Reassembly requires some ingenuity. A 2-1/8" length of 1/2" aluminum angle and two 1-1/2" #6 screws works well. Cut some plastic away on the back side of the switch, then lay the angle against it and insert the screws through holes in it and into the threaded mounting holes in the switch housing. The screws will protrude through the front, where you can use the ends to mount the switch back in the column with a couple of nuts and lock washers. The metal angle will help prevent the plastic housing from deforming and allowing the contact problems described above.

WINDSHIELD WIPER ARM MOUNT: The wiper arms are mounted on the shafts with a taper fit, held tight with a nut that is hidden by a plastic cover. The plastic cover can be simply swung up to reveal the nut, and if desired can then be pulled directly off; it just snaps into place. The nut really should have a washer under it; if not, the 8mm wavy spring washers described on page 27 will work well.

The base portion of the arm is made of aluminum, and a slight growth or wallowing of the tapered hole is an occasional problem. Contrary to expectations, this cannot be dealt with by merely tightening the nut further or stacking washers. The nut bottoms on a shoulder above the taper, and the arm remains loose.

There is a second result of this problem. When the nut pushes the arm too far down onto the taper, the bottom of the arm can pinch the rubber shield against the mount bushing and bind up the movement of the wiper. These motors have enough trouble moving as is, they don't need binding on top of it. After installing the arms and tightening down the nuts, grab the rubber shield between two fingers and try to turn it on the shaft. If you cannot turn it, it's probably binding.

These problems can be easily corrected. Cut a 1/4” wide arc from thin sheet aluminum (beer can for minor problems, old real estate signs if more thickness is needed) and roll it into a conical shim. Installed between the shaft and the arm, it will provide a tight fit.

MOTOR MAGNET REINSTALLATION: As mentioned on page 620, the permanent magnets have been known to come loose inside the motor casing. If the ceramic magnets haven’t shattered, it’s pretty easy to clean them up and reinstall them with JB Weld -- but you need to know where they go. Since the author has done this, the following guidelines should serve for anyone who owns a similar Lucas reverse-park motor:

On the author’s motor, the case is a simple metal cylinder 2-7/8” long, 3” in diameter, and open on both ends. There is a dovetail joint where the metal was stitched together to make a cylinder, but there’s no telling if that joint is located in the same place on all motors. There is a V notch at one end of the dovetail joint, and there are two small rectangular notches near the dovetail joint -- but none of these notches have any apparent purpose, so again there’s no telling if they’re in the same place on all motors.

The one thing that is reliable is a small alignment mark. It’s a straight line about 1/4” long, near the gearbox end of the case. It is meant to be aligned with a triangular alignment mark on the gearbox housing. Hence, the magnets need to be reinstalled properly relative to this mark.

The magnets should be installed 5/8” from the end plate end of the case. This results in them being 7/8” from the gearbox end of the case.

The magnets should be equally spaced from each other, and equally spaced on either side of the alignment mark.

Hold a magnet with the concave side -- the side that faces the rotor -- near the side of a compass. If the S point of the compass needle turns and points towards the magnet, set that magnet down and pick up the other one. You want the magnet on which the concave side attracts the N point of a compass needle.

Hold the casing in such a way that the gearbox end is up and you’re looking at the alignment mark. The magnet you’re holding should be installed on the side of the case to your right.

With a magnet in place in the case, you could remove the magnet, rotate it front-to-back, and put it back in in the same place and it wouldn’t look any different. Relax, it also won’t make any difference. The important thing is to have the correct magnet on the correct side of the case.

PITIFUL WINDSHIELD WIPER OPERATION: The performance of the early/mid-80’s Lucas wipers is really sorry. They behave as though they are “dragging themselves into the grave.” And switching from slow to fast speed makes so little difference you’d hardly notice it. This problem is similar to that causing the slow electric windows (see page 605), so a similar solution is recommended: a relay scheme should be incorporated to provide solid 12V power directly to the wiper motor without having to go through the stalk switch and the skinny wiring to get there.

Figure 35 is a schematic for installing up to three relays in the reverse-park Lucas wiper system. It should be noted that an owner can choose to install any one, two, or all three of these relays to improve his wiper performance. To explain: due to the way the control system works, both the 12V power and the ground connections go through the stalk switch and the wiring in between. It is probable that there are just as many volts lost in the ground wiring as in the power wiring. To improve any individual mode, one could install a relay to provide solid 12V power or one could install a relay to provide a solid ground connection, but for truly optimum performance one should install *both*. In Figure 35, Relay 1 provides one good connection for all modes; Relay 2 provides the other good connection for fast speed mode; and Relay 3 provides the other good connection for slow speed, intermittent, flick, and park modes.

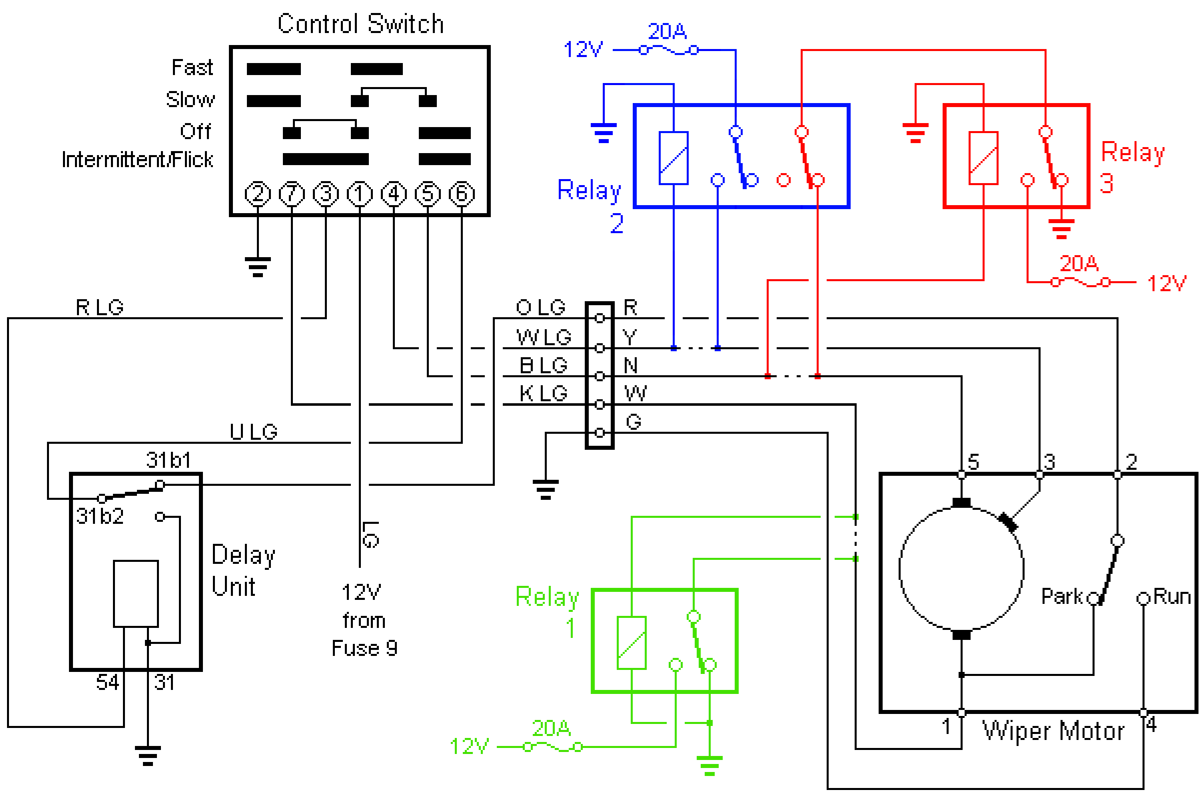


Figure 35 - Windshield Wiper Relays

Installation of all three relays should also make the stalk switch last longer, since it will no longer be carrying the heavy current.

Relay 1 and Relay 3 both must be SPDT relays (with 87a terminals -- see page 563).

Note that the second set of contacts in Relay 2 is really part of the Relay 3 scheme; if Relay 3 is not being installed, a SPST relay (common automotive relay) can be used for Relay 2.

If Relay 3 *is* being installed, two separate automotive relays with their coils wired together can be used for Relay 2 rather than trying to find a suitable double-pole relay with 20A contacts.

If Relay 3 is the *only* scheme being implemented, it will require two relays -- the one labelled Relay 3 and a SPDT wired as the right half of Relay 2 in the schematic, with the coil connected to the Y wire without breaking it.

Figure 35 shows a 12V power supply connected through a 20A fuse for each relay, but this is mainly for clarity and simplicity of illustration. In practice, a single 12V power supply should be run for all relays, and a single 20A fuse should be used; only one relay will be drawing current at any time. Note that the label on the fusebox may indicate a 35A fuse is needed for the wipers, but that reflects the difference between UK and US fuse standards (see page 587). If you are using UK-rated fuses, you should use a 35A.

In application, the power for the author's installation came from one of the main posts on the firewall, and a wire was run through one of the bolt holes originally used to mount the heater valve (which had been replaced and relocated -- see page 495). A couple of layers of heat-shrink tubing were applied around the wire at that point to protect it from rubbing inside the threaded hole. The ground wire was attached using a bolt threaded into the other mounting hole for the heater valve. Note that later cars have plastic nuts pressed into holes to mount the heater valve instead of the welded-on nuts on the '83, so the plastic nuts should be removed and a grommet and a bolt and nut should be used for the power and ground wires instead. If you still have the original heater valve in place, you could just drill new holes -- but, seriously, it would probably be a far better idea to spend the ten bucks on a new heater valve.

The fuse I used is a modern plastic type, and was located in the engine compartment to make it easy to replace if necessary. The relays themselves were installed within the wiper compartment, but far to the right and high up under the bodywork to protect them from rain.

There is a cable, DAC2644, that plugs into the bulkhead connector within the wiper compartment and into the motor itself -- see page 625. As a result, you can cut this cable and splice in the wiring to connect up these relays without fiddling with either the wiper motor itself or the wiring behind the dash; the only reason to open the door on the car is to turn the wipers on to test them out! The most challenging part of the job is getting the wiper grille out and back in when done.

Note that Relay 1 and Relay 3 will be energized when the wipers are off. This is not really a concern, however; relays are designed for continuous operation, the coils take very little power, and the relays will be deenergized when the ignition key is turned off.

Relay 3 only helps the modes where the wipers are supposed to be operating slowly. This may sound silly -- if you want more speed, just switch to fast speed! -- but in fact getting the slow speeds to operate smoothly and powerfully without the typical pitiful straining could be considered worthwhile. There's no danger of the motor running too fast; slow speed is provided by the design of the motor, so although it will be faster than the dragging OEM setup, it will still be slower than fast mode.

In fact, Relay 3 may be the *most* important scheme to install because it's involved in the wipers parking. Park is one of the slow modes that isn't helped with the high speed relays, so when the glass gets dry putting it in park may cause them to drag or even stop altogether without making it back to park position. This is really bad, because the power is left on in the motor.

If you install all three relays as illustrated, Fuse #9 in the main fusebox will no longer carry any serious current; it will be powering only the three or four relays you have installed and the delay unit. You can remove the 20A or 35A fuse and install a 3A fuse.

Windshield Wipers -- Electrolux

Beginning around 1987, the XJ-S was fitted with an Electrolux motor. This unit has metal gears at the wiper arm shafts, as opposed to the plastic gears on the Lucas. There are few reports of problems, so it must be a fairly reliable unit. Stefan Schulz says "The parts guy at my local Jag dealer says that it is *not* a drop-in replacement for the Lucas one."

If the Electrolux motor drags, adding a relay scheme may be helpful as it is with Lucas motors. However, somewhere in the late 80's or early 90's Jaguar (or Ford) realized the error of their ways and began providing relay schemes for heavy loads in their cars from the factory. Which happened first, and whether there's any such thing as a car with Electrolux wipers without relays, I don't know. If your Electrolux wipers drag, that might be an indication.

Windshield and Headlight Washers

These systems have changed considerably over the years. The pre-H.E. windshield washer is a simple tank with a simple, separate pump that draws fluid from a sort of dipstick tube inserted in the top of the tank. Both pump and tank are located at the rear passenger's side corner of the engine compartment. If that pump quits, a generic replacement such as those available at any parts store will work fine. The one sold by Wal-Mart, Wiper Mates #5101, also has the same electrical connector layout so the connector on the Jag wiring harness will plug right on. Polarity is important, but it is correct. Apparently there's some sort of standard for plugs on washer pumps.

On the H.E. up until VIN 110190 (mid-1983), the tank and pump are still on the passenger's side rear corner of the engine compartment but the windshield washer pump (DAC2403) is mounted horizontally and is attached directly to the bottom of the washer fluid tank itself. It actually screws onto the tank; the opening in the tank has a rubber grommet in it, and there's a plastic nut on the inside held in place by three rubber tangs on the grommet itself. The pump has a threaded inlet end and is installed by rotating the entire pump, screwing it into that nut and compressing the grommet.

When installing an aftermarket pump is a system like this, the recommended method of plumbing is to leave the toasted OEM pump in place and just tee the new pump into the line from it. Fine and dandy -- except that the primary failure on this author's pump was the shaft seal between the pump and motor, which allowed the fluid to drain through the motor and out the electrical connectors. Leaving it in place was therefore not an option, unless I could find a way to seal it. Didn't like that option anyway, so I removed all that junk and worked on connecting a pickup hose to the opening in the tank.

A suitable grommet can be found at the auto parts store on the rack of "PCV valve grommets". The one that fits a 1970-84 Toyota fits just fine. Next challenge: something to fit *into* this grommet. My choice was a PCV valve! They're cheap, so I just selected a plastic one, drilled the big end open and let the guts drop out, and plugged it in; it proved watertight. A 1/2" nylon tubing fitting would probably work too. Of course, the fitting on the other end is still pretty large, so stepping the hose size down to the 1/8" for the inlet of the aftermarket pump is still necessary.

Another option might be to jamb the hose itself into the grommet on the tank so the grommet seals against the outside surface of the hose. You could even feed the hose on into the tank and out the filler opening, then jam a fitting or a piece of brass tubing into the end of the hose to spread it a little larger and firmer than the bare end of the hose would be, then pull it back into the grommet until it "wedges" into place.

From VIN 110191 to VIN 148781, a different tank with a different type pump is used, but still in the same basic location.

Apparently, headlight washers were not available before 1982 or so. From their introduction up until VIN 148781, cars that have washers on the headlights have a single tank with two pumps. This tank still fits in the passenger's side corner of the engine compartment, but it is larger than the single-pump tank and has a more elaborate mounting scheme. The tank shown in the '88 Jaguar Parts Catalogue is labelled DAC2853, but Martin Hargreaves reports that the later Parts Catalogue (RTC9900CA) shows a tank number DAC4368. These two tanks appear exactly the same in the illustrations; the actual difference is unknown.

From VIN 148782 on, the tank (DAC4732/2) and pump is located in the compartment forward of the right front tire; this configuration is much more complicated, requiring a separate filler tube and cap and a special vent. Cars from VIN 148782 on with headlight washers have a similar tank (DAC4732/1) with two pumps.

From VIN 110191 on, the same type pump is used regardless of the tank configuration: DAC2876. This pump doesn't screw in like the earlier pump, but rather simply presses into a grommet. This is a common configuration; Alex Dorne says, "It is VDO part number V246 003, also found on:

Audi 100, '77-'92

BMW 3 series, '80-85

BMW 5 series, '82 - '87

Saab 99, '78 - '84

Saab 900, '78-'84

Volvo 300 Series (European) '82-'89

Volvo 400 Series (European) '87-96

VW Golf / Rabbit '81-'86

Most of these are prime wrecking yard material." Mike McLaughlin adds, "on my '85 XJ-S H.E. a Volkswagen Jetta pump ($20USD) is a drop-in replacement, both to the reservoir and the Lucas plug!" If a generic aftermarket pump is used, it should be easy enough to find a fitting that will plug into the same grommet and connect to a hose to the pump.

The saloon is apparently a different matter. The Haynes manual indicates the tank used with headlight washers is in the fender, and since the Haynes manual is ©1985 that means this move was made a few years before a similar move in the XJ-S. Also, the Haynes says it is installed in the left side fender, while in the XJ-S it went into the right side fender.

HEADLAMP WIPER/WASHER DIODE PACK: Read all about the electric radiator fan diode pack on page 224.

ACCESS TO WASHER TANK IN FENDER: Regarding the VIN 148782-on configuration, Michael Wilson says, "You have to remove the front stone guard to gain access. And trust me, it's much easier to remove the wheel to gain access!"

WASHER NOZZLES: According to Richard Mansell, the single-post windshield sprayer in the center of the air intake grille was replaced by two separate sprayers in mid-1987. These later nozzles are heated to prevent freezing. Jaguar didn't see fit to change the casting of the grille itself, so it retained a boss location in the center even though it wasn't drilled and had nothing installed in it.

Martin Hargreaves reports that the two separate sprayers changed again. "First later type has a plastic top which breaks easily when adjusting, and the hose attachment is straight (i.e. points down) and metal. This is DAC 4244. The newer type is metal at the top, and the hose attachment bends through 90 degrees and is grey plastic (possibly fitted over the original type fitting). This is DAC 6398. From my dealer DAC 6398 is UKP 28 plus VAT. Each."

Chuck Sparks says a large part of the problems with nozzles come from people using tap water in the washer system. After use, the water in the tip of the nozzle evaporates and leaves its minerals behind. In no time at all, the tiny passages are plugged. Really, folks, the $1/gal for washer fluid is money well spent.

WASHER SYSTEM CHECK VALVES: In some XJ-S's, Jaguar used inline check valves in the lines to the nozzles. Judging from the parts catalogs, this is related to the pumps used; the early external pump had one, the early H.E. screw-in pump didn't, the later push-in pumps did again. Maybe some pump designs didn't include check valves within the pump while others did.

They're easy to test; just remove them from the line and try blowing through them in both directions. They should feel wide open in one direction, totally plugged the other way. When they quit working, the only fix is apparently to replace them. Since they will have the same effect regardless of where they are in the line, you might consider relocating them; being plastic, they don't like sunlight and they don't like engine heat.

The check valves used on the pre-H.E., GWW504, are different than the check valves used on later cars, DAC2963. A check valve is a check valve; since both items fit the same type hose and handle the same type fluid, they logically should be interchangeable. Chuck Sparks claims the early design simply falls apart after exposure to heat or sunlight, so perhaps replacing with the later item is in order.

The early system with the dipstick hose pickup in the tank also has a check valve right at the end of that pickup. It's similar to the GWW504 except one side of the housing is missing so it can pick up fluid right into the check valve itself. Of course, you should still be able to substitute check valves; having an inlet that happens to be able to connect to hose shouldn't hurt anything.

WASHER FLOW RESTRICTORS: Although not shown in the parts catalogs, John Goodman insists there are flow restrictors in the lines to the nozzles on some cars. Even if they work OK when new, they may get plugged up and too restrictive as they get older. If you find them, you might consider simply removing them. "On some cars it's under the air intake grille so isn't easily spotted."

WASHER FLUID LEVEL WARNING LIGHT: The washer systems used in VIN 148782 on with the tank in the right front fender have a level sensor that operates an idiot light on the dash, presumably because it's not practical to simply look at the tank to make sure there's enough fluid in it. Michael Wilson says, "I just spoke with my local Jaguar dealer (Barrier Motors) this morning, and they told me that you can no longer purchase the "low level" sensor alone. It is now officially listed a NA (Not Available). Now, you must buy the entire reservoir bottle with the sensor built in. It does not come with the pump motor. Apparently you can utilize the unit off the old one. The entire assembly runs a whopping $155.00. Thats a lot of money to spend just to have an idiot light come on!"

WASHER MODIFICATIONS: John Goodman says, "Washers and wipers have improved over the years, but it was quite common in the early '80's to modify the washer systems on cars that were prone to greasy windscreens (my Jensen Healey was prone to this as the dirty air from under the bonnet would exit in front of the screen). We would take a small bore copper pipe from the washer pump and wrap it around the exhaust manifold or heater hose, connect a "T" piece with two lengths of small bore black nylon air hose routed through the body and taped to the windscreen wipers with numerous fine holes strategically directed. Add lemon juice to the washer water."

This author suggests wrapping that tube around the exhaust manifold wouldn't be good, since it would boil all the fluid away. Wrapping around a heater hose or pipe is a better idea; this would heat the fluid to near the same temp as the coolant, warm but below boiling -- and it might not heat it at all if the heater valve is closed, which would indicate a warm day. Might do wonders for clearing ice from the windshield -- or might just crack the windshield.

Light Bulbs

Light bulbs are discussed here. The taillight lenses and the like are discussed in the section on the body; see page 478.

If you can't find a bulb locally, you can order whatever bulbs you're ever likely to need from:

Lamp Technology, Inc.
1645 Sycamore Ave.
Bohemia, NY 11716-1729
1-800-KEEP-LIT
+1 (631) 561-1800 Fax: +1 (631) 567-1806
http://www.lamptech.com

BULB NUMBERING SCHEMES: Europe and the US use different schemes to number automotive bulbs, but a lot of the bulbs have equivalents. In Europe -- and in the Jaguar manuals -- light bulbs (and fuses) are specified by a three-digit number. Often, the manufacturer will be indicated by letters preceding the number; for example, a Unipart bulb may be number GLB 233, but it could be replaced by any bulb number 233. While the Jag manuals often indicate GLB numbers, I will endeavor to indicate only the three digit number in this book.

Here in the US, automotive light bulbs are typically packaged on cards in parts stores, clearly labelled by the US number and "12V" -- but no clue at all about what amperage or wattage they are. Sometimes, if you're real lucky, you'll find the candlepower -- but that's only loosely related to wattage. However, the parts stores will usually have a book behind the counter that gives complete data on the various bulbs available: voltage, wattage, life rating, candlepower, filament shape, etc. The only thing the books won't tell you is the European equivalent.

Of course, I try to actually be helpful in this book, so I will endeavor to give US equivalents to the European numbers where I have been able to figure them out. Note that some of the data below includes the wattage as listed on a specification sheet, often to two decimal places; rounding is definitely in order for general use, especially since the Jag bulb charts usually don't specify wattage closer than to an even watt.

The specification sheets also give rated voltages for automotive bulbs generally between 12.5V and 14.4V. On the cards, these are all called “12V”.

The Jaguar Parts Catalogue, August 1987, seems to take a more objectionable tack and lists only Jaguar part numbers for many light bulbs. There are no light bulbs in the car that were developed especially for Jaguar; all bulbs can be replaced with generic equivalents. Some that have been identified include:

Jaguar P/N	Euro equiv.	US equiv.
C9126	382	1156
C38966	286	
C43898	987	
JLM293	254	
JLM9587	207	
JLM9589	233	1893
JLM9590	239	11004
JLM9591	265	GE DE7576
JLM9592	273	
JLM9594	380	1157
JLM9598	411	H1
JLM9600	501	168
JLM9601	989	

See the specific application notes below to fill in those blanks for US equivalents.

MINIATURE BAYONET BULBS: Miniature bayonet bulbs are the flashlight-size bulbs with a cylindrical base with a pin on each side. They are sometimes simply referred to as “bayonet” bulbs -- including in the Jaguar bulb charts -- but this is technically incorrect, since “bayonet” actually refers to the larger bulbs of similar design such as most taillight bulbs. 13-14.4V miniature bayonet bulbs available in the US include:

NUMBER	WATTAGE
756	1.12W
1813	1.44W
1892	1.73W
1815	2.8W
1891	3.36W
1889	3.78W
1816	4.29W
1893	4.62W

All of the above bulbs are bullet-shaped; the glass capsule is about the same diameter as the base. For places where space isn’t a problem, there are also the following miniature bayonet bulbs with a larger spherical glass capsule:

NUMBER	WATTAGE

57	3.36W
257	3.78W
1895	3.78W
293	4.62W

The 1895's are sometimes available in colored versions.

If you visit a marine supply store, you will find an assortment of high-power miniature bayonet bulbs. In addition to reasonably-priced 12V5W bulbs, there are some atrociously high wattage bulbs with proportionately large glass capsules, up to 20 watts. There are also some halogen bulbs in 5W, 10W, 15W and 20W, some of which are a little odd-looking but they are all about the same physical size as the tiny bullet-shaped bulbs. Some of them aren't even labelled halogen, but rather labelled only for some particular application, a depth finder or something. Of course, you can tell they're halogen by the price. As a bonus, all of the bulbs sold at a marine supply store are corrosion-resistant for marine use.

FIBREOPTIC SOURCE BULB: This bulb is a miniature bayonet type. The bulb charts in the Jag manuals list a 254 or 989, depending on which book you look at, and describe it as 5 or 6 watt, again depending on which chart you believe. 254 is a festoon bulb, so that's wrong.

Note that 5 or 6 watts is high wattage indeed for a miniature bayonet; the 6 watt is higher than any in the chart above. Clearly, this particular application requires some serious light. Either the 1893 or 293 listed above probably fits the bill as 5 watts, meaning you'll get satisfactory light. If the various things lit by the fiberoptic source have always been too dim for you, though, a visit to the marine supply store may be in order; one of those 5W halogen bulbs might be just the ticket to liven up that dash. Going to much higher wattage than recommended would probably melt the fibreoptic unit housing, so don't get carried away.

SIDE MARKER BULB: In the US and some other countries, the lights on the front and rear ends of the car are required by law to be visible from off to the side of the car. The taillights on the XJ-S meet this requirement, since they wrap around the corners. The front markers are in the bumper, however, and therefore cannot be seen from the side. To meet the requirement, a separate side marker light is provided just forward of the front wheel on each side. On the SI/II/III saloons, the lights on either end don't wrap around the corners, so there are separate side markers on both ends.

The side marker on the XJ-S takes a miniature bayonet type bulb. The bulb charts in the Jag manuals list a 207 or 233, depending on which chart you look at, and describe it as 5 watt. This author's '83 was fitted with bulbs labelled 233 and 12V4W.

Several of the bulbs listed above would make suitable substitutes. If you don't really care how bright your side markers are, you can replace these bulbs with different wattage bulbs; however, you need to be concerned about whether the park lamp failure sensors work properly -- see page 600. These side marker lamps are monitored by the same park lamp failure sensors as the front parking lamps, and reduced wattage bulbs may result in bulb failure indications on the dash. If you wish, the sensors can be adjusted for the new current level.

Judging from the typical condition of the original bulbs, the corrosion resistance of marine bulbs might be helpful in these side markers.

A piece of 5/16" hose may be helpful in getting the side marker bulbs in and out.

CIGAR LIGHTER BULB: One bulb chart in the Jaguar repair manual says the miniature bayonet bulb for the cigar lighter (643) is 22 watt. I don't think so -- it should say 2.2 watt.

BAYONET BULBS: All the bulbs in the pre-1991 taillights and front turn signal housings are bayonet type, although some are single-filament and some are dual-filament. On the dual-filament bulbs, one pin on the base is positioned differently than the other to ensure you install it correctly.

REAR TURN SIGNALS, BRAKE LIGHTS: In the US, for these applications calling for the single-filament bulb number 382, use the 1156 -- very common, can be found in any auto parts store or Wal-Mart.

FRONT TURN SIGNALS: The bulb chart on page 04-3 of the ROM ©1975 calls for GLB 380, describing it as "Double filament - Italy only". It lies; it should say US/Canada only, Italy uses the single-filament 382. Among the electrical diagrams following Section 86 of the same book is another bulb chart, and this one describes the GLB 380 as 21 watts, when it should say 21/5 indicating that it is a dual-filament bulb.

In the US, for the dual-filament 380, use the 1157 -- perhaps the most common taillight bulb there is.

Another common -- and very similar-looking -- dual-filament taillight bulb in the US is the 1034. If you try to use 1034 bulbs in the XJ-S, the indicator on the dashboard may only light the first blink, or not at all, when you operate the turn signals. This is the bulb failure indication for the turn signals. Since the 1034 bulbs are lower wattage, the reduced current causes a bulb failure indication.

If you want brighter turn signals, J. C. Whitney (page 694) offers a 30/8W halogen 1157 bulb, catalog number 81xx0439B, that they claim is 50% brighter than the standard 1157.

TAILLIGHTS: In the US, for the taillights (smaller bulb on the outer corner of the taillight housing), use number 89 even though it's slightly more powerful (8W) than the 5W number 207 specified in the charts.

FESTOON BULBS: Festoon bulbs are the tubular bulbs with a pointed connector at each end. Here in the US, they are described as "SV8.5mm", 8.5mm being the diameter of the connector at the end. In addition to the wattage, you need to pay attention to the overall length measured from point to point. There are at least two different length festoon bulbs used in the XJ-S, 1.45" and 1.75". Sometimes festoon bulbs are clamped at the ends while other times they are held by the points; in some cases below, I mention which method is used.

BOOT LAMPS: The XJ-S used miniature bayonet bulb number 989 in the trunk up to 1982. From 1982 on it used festoon bulb number 239 (5W). The overall length of this bulb is 1.45". In the US, 11004 is a perfect replacement.

Note that the 1982-87 Hella boot lamp assemblies are not symmetrical, although they appear to be at first; the bulb itself is held closer to one side of the lens than the other. The lamp should be installed so that the bulb is held farthest away from the center of the trunk. This fixture holds the bulb by the points.

From 1987 on, the same lamp assemblies were used in the boot as in the interior.

INTERIOR LAMPS: The Jag bulb charts say the interior lights are either number 272 (10W) for early cars and 254 (6W) for later cars. Other sources offer 265 for cars up to VIN 100349 and 239 for VIN 100350 onward, corresponding to a change in the fixture itself. 265 is apparently 1.75" long, while 239 (the same bulbs as the boot lights '82-on) is a 5W bulb 1.45" long.

If you have an earlier car with 1.75" bulbs and want 10W replacements, you can buy GE bulb number DE7576. There are also bulb numbers 211 or 212 that will physically fit, but the wattage is unknown. 211 bulbs are also available in pretty colors, if you want to get tricky. 10W 1.75" festoon bulbs are also available in marine supply stores.

If you have the later fixtures and a 5W bulb will do, the 11004 will work. If you want to try a 10W, there is also a

11005 available -- but you might want to keep an eye on them that they don't melt the fixture.

The later lamps (all four corners of the interior use the same fixture) clamp onto the ends of the bulbs.

ROOF LAMP: The bulb in the roof lamp is supposed to be 10W, and is 1.75" long. The Jag bulb charts seem to leave the number column blank, but other sources suggest number 265 here. This atrociously expensive Hella fixture holds the bulb by the points. The GE bulb number DE7576 is a perfect replacement.

BACK-UP LAMPS: The books say the bulbs in the back-up lights are number 273, 21W. You can also find similar bulbs in 18W; close enough, especially if you replace both together. These festoon bulbs have a total length of 1.75". The glass portion itself is also much larger in diameter than the connectors, giving it a bulged look.

Either the 18W or 21W bulbs are hard to find in the US; you will probably need to find a place that specializes in import light bulbs. One alternative is the marine supply stores, which carry a 15W bulb the same shape and size. Or, you could substitute the non-bulged 10W 1.75" bulbs commonly available and call it a day.

LICENSE PLATE LAMPS: The license plate lights require festoon bulbs 1.45" long. The Jag bulb charts call for a 254 (6W), but other sources offer the 239 (5W) for this application. If 5W is acceptable, the 11004 bulb will serve. You can go up to the 10W 11005, but I'm betting you'll melt the lens.

CAPLESS BULBS: What the Europeans call a capless bulb is called a wedge bulb in the US. Capless bulbs have no base at all; the bottom of the glass capsule itself is formed into a flat edge and the wire conductors coming out of the capsule are wrapped around the edge.

The following is a chart of some US wedge bulbs, 13-14.4V:

NUMBER	WATTAGE	
658	1.12W	
160	2.66W	(long life)
161	2.66W	
158	3.36W	
184	3.46W	
124	3.78W	
194	3.78W	
196	3.78W	
558	4.29W	
192	4.29W	
193	4.62W	
168	4.90W	
175	8.12W	

Numbers 168 and 194 seem to be the most readily available.

There is another wedge bulb available in auto parts stores, number 3652. This bulb looks exactly like the bulbs listed above, but it's either a 5 watt short-life (only 700 hour) incandescent or a 5 watt halogen bulb, depending on which reference guide you're looking at. It does not say halogen on the package, but it does cost about five times as much as a 194. It definitely produces a *much* brighter, whiter light than a 194 -- this author can vouch for that. If it's really a halogen, it will probably last several times as long as a 194 -- perhaps the life of the car. And if it's really a halogen (and even if it's not), it'd be a good idea not to get fingerprints on it when installing.

Auto parts stores also carry a series of wedge bulbs that are physically much larger than the bulbs listed above but have the same wedge base. They typically have 3-digit numbers starting with 9, such as 921. These are much higher wattage than the small bulbs, up to 17 watts or some such -- you can check a catalog to find the wattage listings. Whether or not you can use one in place of one of the smaller bulbs obviously depends on whether you can physically fit it in the space, whether it will generate too much heat and melt something, and whether it will draw too much current for the circuit.

There is also a halogen capless bulb of this larger size. The number is 2040, and it's rated at 8 watts.

PUDDLE LIGHTS: The door edge lamps, also known as puddle lamps, are a 5W capless. They're not even listed in the bulb charts in the Jag books, but the Haynes manual says it's number 501. US number 168 is perfect.

The access is kinda neat; you remove one screw from the bottom, then slide the lens off rearward.

INSTRUMENT PANEL LIGHTS: The instrument panel illumination lamps are supposed to be a capless 2.2W, number 987. In the US, finding a 161 would be good, 160 would be better. Or, you could try something with higher wattage and hope nothing melts or burns up in there.

INSTRUMENT PANEL ILLUMINATION IMPROVEMENT: John Napoli suggests you disassemble the pod, and clean all the dust out of the warning light boxes and the like. "If you also want to improve lighting, remove the four green lenses. The instruments will be that much more brightly lit at night. You can probably also fit brighter bulbs, if you so desire."

Gordon Clefton made a less radical fix than simply removing the green lenses. "I removed each green lens (two screws), drilled five holes into the plastic, cleaned the plastic, and then replaced the green lens. The pattern was one hole at the end and four holes around the side. I am pleased with the results; the panel still has the Jaguar green glow, but all the instruments are very readable."

Yet another idea would be to remove the green lenses and install green bulbs. Green bulbs are commonly available in auto parts stores, which often have an entire aisle dedicated to dressing up cars with various colored lights. You can also visit an arts-and-crafts store and purchase some of the goop they offer to make stained glass designs -- pretty much whatever color you want -- and apply it directly to the bulbs.

Another method for making lights brighter would be to improve reflectivity. White paint helps, Liquid Paper works well, or you can apply small pieces of aluminum tape. For the illumination of the big gauges, there is an easy reflectivity improvement that can be made. The cowling around these two gauges, just outside the face itself as you're looking at it, is a single piece of white plastic that has been painted a dark grey on the surfaces that show. The reason they didn't just make it out of dark grey plastic is because the back side of this part that doesn't show is supposed to be white to reflect the light from the green-lensed illumination bulbs. Unfortunately, someone in the paint shop must not have understood this too well, because large areas of the back side of this part may be painted dark grey as well. So, take a piece of sandpaper and remove the dark grey paint from the back side, especially on the bevelled section surrounding the gauge. Or, if it's easier, you could just paint over it with white paint.

Keith Morris says, "If you will notice there is a cutout on the back plane of the large gauges that can accept another green lens and bulb setup. I obtained these extra lamps at my local Jaguar dealer and added them. They simply plug in - the electrical connections are present in the circuit sheet. The gauges are now brighter." This author's '83 has no such openings for additional bulbs, but Bob Gallivan says his '84 "has 3 extra holes for the lights."

Walter Acker IV went to further extremes and installed 900-series wedge bulbs: "The new bulb is #921, but you will be able to install the new bulb from the front only. The new bulb is too big to insert from the back, but can be installed from the front if you make sure to hold the sockets from the back with your finger to keep the bulb socket from pushing out the back.

"I found that the sockets pull on the copper part of the plastic board. When you have the plastic off of the back half of the dash cluster, if you chamfer the ends of the holes where the socket goes in very carefully you can reduce the pulling effect on the copper part of the plastic circuit board."

THIRD BRAKE LIGHT BULB REPLACEMENT: It may not be obvious at first, so John Himes sends this description for getting to the bulbs: "Feel or look on the underside of the cover; there are 2 black indentations on each side of the cover. Place your fingers on each of these, or you can also do one at a time. Press up on the indentation which is a sprung black square button that keeps the cover from rattling off. After your remove the cover, you have access to the bulbs. They are in gray plastic holders that you turn 1/2 turn to release."

THIRD BRAKE LIGHT RE-INSTALLATION: Apparently the things fall off. And apparently most glues don't work very well for putting it back on. Ray Schmitt says, ""GOOP" worked for me in that application. It's clear like silicon but stickier and sets up firmer. I had "Marine GOOP" on hand but I think the other types are much the same. Available at most hardware stores."

John Kjallberg says, "Try some window stop leak, silicone windshield and glass seal; this is flowable so look out for drips. You will have to support it for a day. I had no luck with other fixes."

INDICATOR LIGHT BULBS: The tiny bulbs used in the row of indicator lights at the top of the dashboard are "miniature capless", similar to capless but a bunch smaller. 14V versions are available at auto parts stores in the US in several different wattages:

NUMBER	WATTAGE
18	0.56W
73	1.12W
37	1.26W
74	1.4W
70	2.1W

Since the Jaguar bulb chart calls for a 1.2W, numbers 37 or 74 should make good substitutes -- but you also might consider varying the wattage bulb for your own preferences, like making the oil warning light real bright, less important lights dimmer, and the turn signals real bright so you can see them at all!

To get these bulbs in and out, it helps to have a pair of hemostats (a "roach clip" to you 70's potheads) with electrical tape wrapped around the jaws.

If you don't like the little pictures that are lit up by the indicator bulbs, Walter Acker IV points out that lots of cars use very similar rectangular colored panels for their indicators. So, you can pick up some panels at a junkyard, cut them to size, and install them in the Jaguar dash to change the way the indicators look. Acker's pet peeve is the turn signals, and he found that the indicator panels from a 1986 Isuzu Trooper II or a 1983/84 Mazda B2000 pickup truck were more to his liking. You can use this same idea to actually change what an indicator means; for example, you could do away with that trailer indicator and put in an indicator that the A bank of your Marelli ignition system has failed (see page 161), and put a red "Check Engine" panel on it with a really bright light bulb behind it.

TRIP COMPUTER SCREEN ILLUMINATION BULB: Robert Weiss-Malik found a replacement for the tiny light bulb that lights up the indicator screen on the trip computer: "I am happy to report that the bulb that I found at Radio Shack works just fine (so far anyways). The Radio Shack bulb is called a "bi-pin lamp". It is rated at 12 volts and 55mA. The part number is 272-1154."

Headlights

BRIGHTNESS: Jon Jackson and others point out that dim headlights may be the result of bad grounds. "On my '87 there is a ground under the hood to the left side of the radiator. There are several ground wires that go to this same point. Cleaned it up a bit and all is great."

HEADLIGHT TYPES: There were at least five distinct headlight schemes used on the Jaguar XJ-S over the course of its production life -- not including the fact that there were both LHD and RHD versions of many of these, if not all. In the US, four round headlights were used up through 1991, and oblong Carello headlights with plastic lenses were used from 1992 on. In Europe and most other markets, the XJ-S has been fitted with oblong headlights since its introduction -- but there were three different versions: Cibies with glass lenses and two bulbs per unit on the early models, Cibies with glass lenses and a single bulb per unit throughout the 80's, and finally switching to an E-code Carellos with plastic lenses at the same time the US cars switched to DOT-approved Carellos for 1992.

If you need to replace a headlight bulb, the Jaguar repair manual and the Haynes manual are both worthless; their bulb charts are all screwed up on headlights. In the sections on each type of headlight beginning on page 649, this book will tell you not only what type replacement bulbs are called for but also what substitutions and upgrades you might wish to consider.

HEADLIGHT REPLACEMENT: If you have the four round sealed beam headlights, obviously you are supposed to remove the faulty unit and replace it in entirety. In all four of the oblong headlight designs, however, correcting a burnt bulb means replacing a relatively small globe plugged into the back side of the reflector. On the pre-90's non-US cars with Cibie units this was a real pain because the entire headlight assembly had to be yanked out of the car in order to get to the bulbs. However, according to John Goodman, Jaguar addressed this sometime in the early 90's: "I just changed the front aluminium splash guards in the wheel arch behind the headlights. The part has been modified from the original one, it now has a removable access panel (which can be removed with the splash guard installed) to enable easy change of the headlight bulbs."

If you want easier access to the back of your Cibies, you can order the updated panels; "I just ordered one for a '89 XJ-S. I thought the parts guy had goofed, but he assured me this supersedes the old type." Unfortunately, this might not get you anywhere, since there is a stiffening panel behind the headlight and ahead of this wheelwell panel, and you might have to cut a hole in it to get to the bulb from behind. Goodman elaborates: "There is another "panel" behind the headlight, but this must be revised as well on later cars! It has a hand-sized hole stamped in it with turned over edge, either for strength or to avoid cutting one's wrist while removing the bulb holder. It is quite easy to fumble about and change the bulb if the wheel is turned in."

HEADLIGHTS USING REPLACEABLE BULBS: Whether your car takes H1's, H4's, or 9004's, keep your grimy paws off those little halogen bulbs. The oil from your fingers on the surface of the quartz capsule insulates it and prevents it from dissipating heat as it should. The result is that the bulb burns out very quickly, whereas normally these halogen bulbs will last considerably longer than a conventional sealed beam. If you accidentally finger the glass, clean the surface with some alcohol before installing.

There is one significant concern of headlight assemblies with replaceable bulbs: the owner may simply replace the bulb whenever it burns out, and neglect to notice when the housing itself is deteriorating, the reflector gets all rusty, or the lens gets broken. Since the reflector and the lens are critical to proper illumination, the conscientious owner will replace the housings whenever the performance is adversely affected.

PILOT LIGHTS: "Pilot" is UK-speak for the small bulbs within the headlight assemblies that are used to make the headlights glow when the headlights are not on. In the US, old VW Beetles used to have them, and many cars with the new composite headlamps have something similar. Daniel Stern says, "In most of the world, they're called "city lights". In the UK, they're referred to as "sidelights" (which is confusing, because they face *front*, not to the side.) This is the European equivalent of the US "parking" lamp. European-specs vehicles do not use amber parking lamps, but rather use white city lights."

The Jaguar repair manual variously describes their pilot bulbs as no. 15602, 4 watt, Osram miniature bayonet, or 223, or 233, depending on whose misprint you believe. This sounds the same as the side marker bulbs 233 (see page 634), but I haven't seen them personally and don't trust any of this literature any more, check the actual bulb itself before buying.

Vince Chrzanowski (who is using the Euro-spec Cibie headlights in North America) says "The pilot lamps I use are #1893. I use them in all my radio 12-volt applications because of their long-life rating."

Stern: "Note that city lights *are* a legal form of parking lamp in the USA and Canada. Parking lamps can be amber *or* white, and they are permitted to be nested with the headlamps. The latest XJ sedans use city lights rather than amber parking lamps."

Stern offers several advantages of city lights over the US-style parking lights: "If a headlamp ever malfunctions, oncoming traffic still sees you as a double-track vehicle. Plus, it makes your front turn signals much clearer because they now go "bright-off-bright-off" instead of "bright-dim-bright-dim" when the lights are on. Yep, another aspect of lighting that the Europeans got right and we didn't. City lights are especially useful if you have fog lamps. On foggy days, you can put on the city lights which will show other drivers very clearly where your car is, and switch on the fog lamps so you can see." Stern is presuming here that your fog lights are wired to be on with the headlights off, the only way fog lights are of any use, but this is technically illegal in most states; you're required by law to have the headlights on in fog so you can't see.

PROTECTING HEADLIGHT LENSES: If you have the Cibie glass headlights and don't like the idea of paying Jaguar for new ones, Griot's Garage (page 711) offers a way to protect them. It's a clear layer of vinyl that you peel-and-stick to the front of the lens and then trim around the edges. This is likely to be very effective, since even the slightest cushioning is likely to prevent most stones and the like from damaging the glass.

Griot's also sells a thinner version for fog lights and turn signal lenses, but claims the product is not for use on polycarbonate lenses. That leaves owners of the Carello lights out in the cold.

HEADLIGHT WIRING: The headlight and fog light wiring diagram on page 86-11 in the ©1982 Supplement contains just enough miscues to make it really difficult to follow. Mark the following to make it a little better:

- On the key, items 20 and 21 are the fog lamps at the front, and items 22 and 23 are the rear fog guard lamps. They could have been drawn more clearly, too, either showing the lamps or not rather than showing some and showing arrows to others. 20 and 21 should look like a matched pair, and so should 22 and 23.
- On the pre-1992 US-spec car, there are two LH main beams and two RH main beams, so items 8 and 10 should be doubled. This is not true for cars with oblong headlamps, however.
- There should be a capacitor shown wired between terminals 31b and 81a on the headlamp relay, item 4.
- On the US-spec car, the rear fog guard lamps, items 22 and 23, don't exist.
- On the author's 1983 US-spec car, the fog lamp switch, item 18, doesn't exist.

Note that the lack of a fog lamp switch makes it impossible to operate the front fog lights. Also, putting the headlamp switch into the #3 position (see below) activates the inhibit relay and therefore locks the headlights on low beam, but the power sent to the rear fog lights does nothing -- they don't exist. Sorry to report, this is not just an error in the schematics; this author's car was actually wired that way, and although it had front fog lamps from the factory there was no way to turn them on. It is, however, a fairly simple matter to move the RY wire from fuse #1 to fuse #6 to get the front fog lights to work when the headlamp switch is put into the #3 position. Be sure to leave the existing RU wire on fuse 6 to operate the dash indicator.

For owners of the US-spec car, Figure 36 is a replacement for the diagram, based on the author's 1983 H.E.

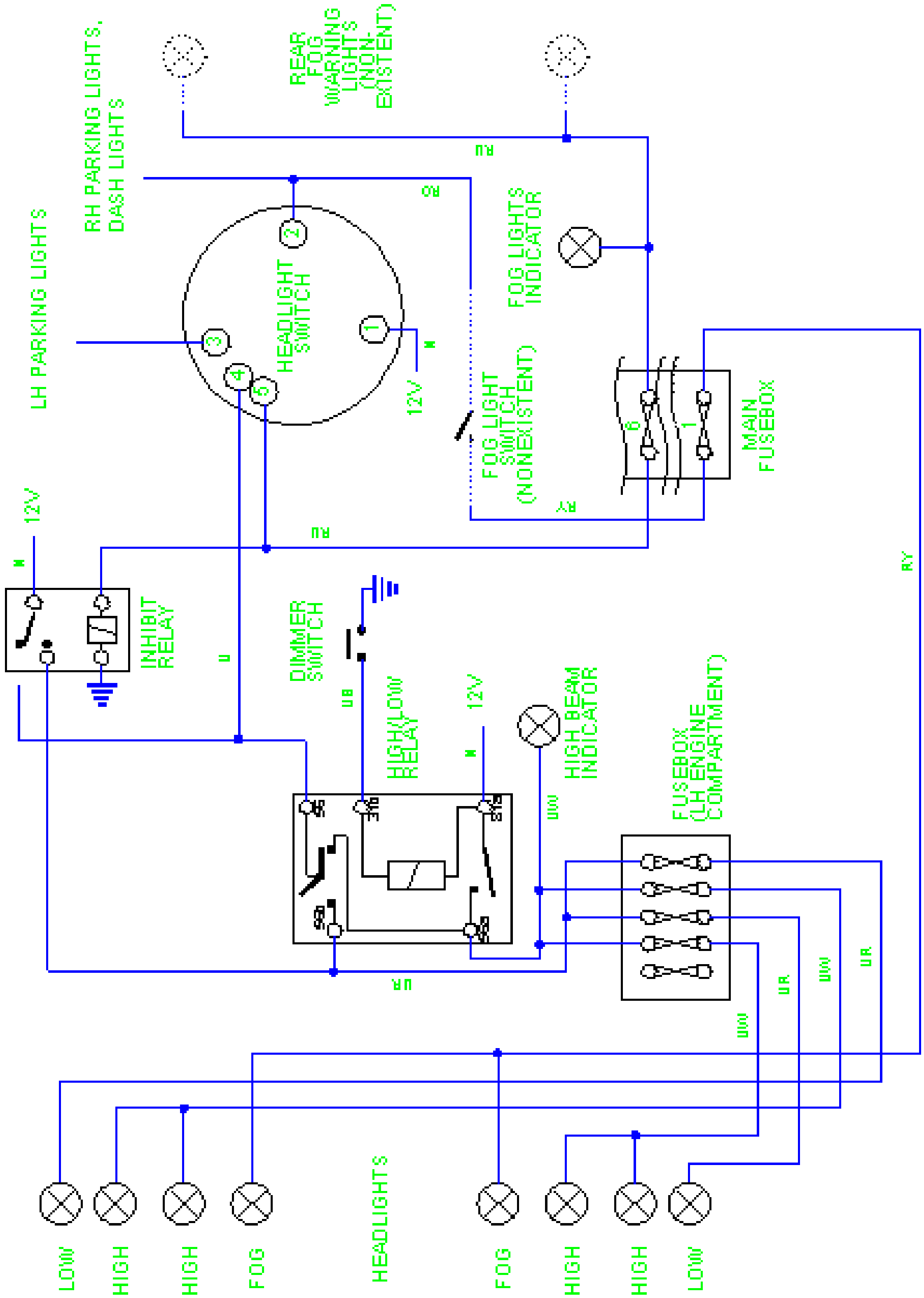


Figure 36 - Headlight and Fog Light Wiring

The headlight switch in the US-spec 1983 H.E. has five positions, three above and one below the off position. To get into the top or bottom position requires pushing the knob in while turning. The connections made in the positions are as follows:

3: 1-2-3-5

2: 1-2-3-4

1: 1-2-3

0: No connection

-1: 1-2

The -1 position, connecting only the dash lights and right side parking lights, apparently serves no intended purpose; as wired, all the parking lights come on due to backfeed through the bulb failure sensors. After a few seconds for the bulb failure sensors to warm up, the left side parking lights dim. If an owner wished, however, it would be a simple matter to rewire the right side parking lights to terminal 3 and use the -1 position to operate the dash lights only.

Other headlight switches are different, however. John Himes says that on his US-spec '88 the positions are:

Off

Parking lights only

Headlights

Headlights & fogs

Fogs only

John Goodman reports "On UK cars the fog/driving lights are operated on the rotary dash light switch.

1= side/park

2= headlights

3= head & fog/driving lights

4= side/park & only fog/driving lights

...and there is a push facility that works when in position 2-4 for the rear fog warning lights fitted in the rear bumpers."

HEADLIGHT SWITCH KNOB REMOVAL: To remove the headlight switch knob, you must depress a button in the shaft that is behind the surface of the dashboard and points down. To reinstall, you merely need to push the knob on, because it is shaped to slide over the shaft button and snap in place.

HIGH/LOW BEAM RELAY: Also known as the main/dip relay. In some manuals, the schematics of the high/low beam relay (Jaguar part no. C38616) show the components between connections 56, 56a, and 56b to be a normal set of relay contacts. This is *not* actually the case. This device is an electrically-operated rocker switch; when the coil is energized, the contact is switched from one side to the other, and remains there when the coil is de-energized. Next time it's energized, it flips back. Jaguar wants some serious $$$ for that relay.

Roger Homer reports that other cars use a similar relay. "The Headlight Relay is the same as the one on an early model Torana (General Motors Aust). They used the same high/low switching system, the relay I found is made by SWF (Germany?) part no stamped on relay is R200.867."

Ray Reynolds provides another report: "I found a compatible unit that dropped right in. I had to drill an extra mounting hole in the fenderwell to bolt the new relay in, but all the connectors plugged right in, and it all fit under the stock relay housing (with a little bending around of the headlight wires). The relay itself looks like a Potter & Brumfield, and was part #PBS89R from Micro Alarm (in Vernon, CA). It has 2 microswitches on top that do the actual power switching." Reynolds notes that this relay does not provide the pull-to-flash feature the stock relay does, but it would be easy enough to add a normal relay with the coils wired in parallel to provide this function. "Since the plunger is visible, you might be able to bolt another microswitch to the bottom of the relay so that it is activated when the relay is tripped for the flash feature."

If your high/low relay has given up the ghost and you can't find a reasonably-priced replacement, an alternate scheme using three conventional relays and a diode is shown in Figure 37. Note that wiring (and related contacts) indicated by heavy (red) lines must be suitable for headlight current, 30 amps or so. All other circuits are less than 3 amp. For the diode, a Radio Shack cat. no. 276-1661 will do nicely. Of course, you will need to figure out where to mount these relays; perhaps in the space behind the left headlights.

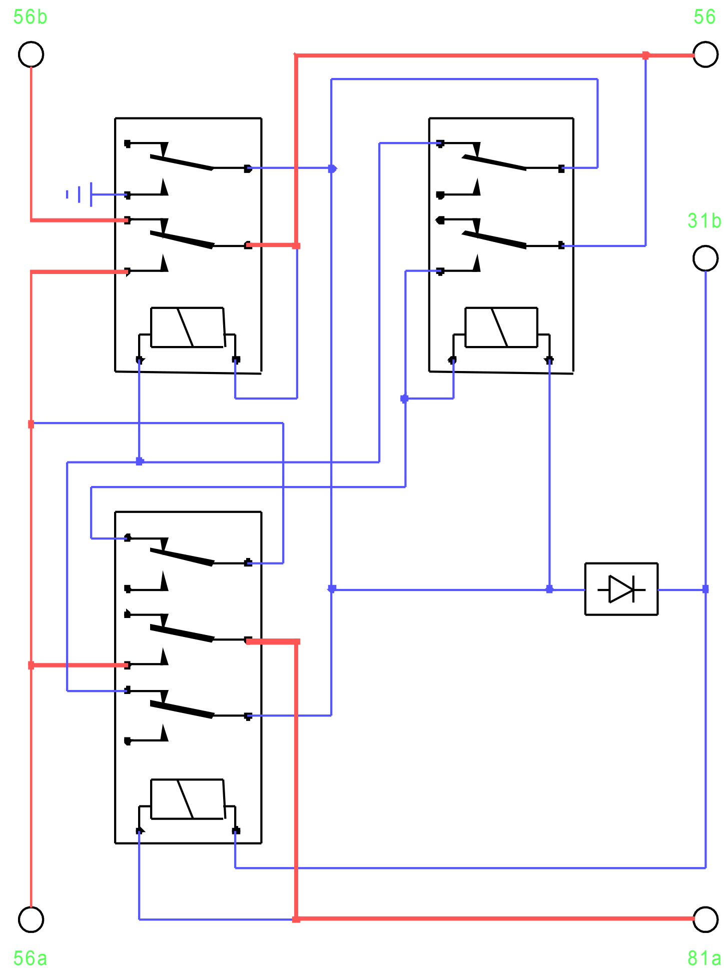


Figure 37 - High/Low Relay Replacement Scheme

As with any such circuit, a single multi-contact relay may be replaced by multiple single-contact relays by simply wiring the coils together. This may make sense here, allowing the use of SPDT 30-amp relays along with tiny "ice cube" DPDT relays instead of trying to locate DPDT or 3PDT 30-amp relays.

The only functional difference with this circuit from the original is that your headlights will always be on low beam when you first turn them on.

HEADLIGHT BUZZER: The XJ-S doesn't have one! What a cheap car. To add one is easy. You need a 12 volt buzzer such as catalog no. 273-055 from Radio Shack, and a rectifier (or diode) such as catalog no. 276-1661. For the buzzer you can also use any buzzer you've ripped out of a car, such as those pesky seat belt buzzers.

Connect one of the headlight wires to one end of the rectifier. Connect the other end of the rectifier to one lead of the buzzer. Connect the other lead of the buzzer to one of the ignition wires. Both of these wires are near each other under the dashboard -- from the headlight switch and the ignition switch.

A rectifier allows current to flow in only one direction. If you have wired it correctly, when both the ignition and the headlights are on, there is no current flow because both wires are at 12 volts. When the ignition alone is on, there is no flow because the rectifier stops it from flowing that way. When the headlights are on but the ignition is off, current flows and the buzzer buzzes. If the buzzer buzzes when the ignition is on and the headlights are off, reverse the rectifier.

Jan Wikström did it a different way: "Pulling the key out also operates the switch that controls seat belt warning etc. As my car doesn't have those, I've used it to operate a "headlights on" warning buzzer."

Connie Vloutely says, "I have been wanting to do this for a long time but could not find chime element suitable for automotive use. One that works on 12 Volt DC. I hate buzzers. I found one in the local radio shack store P/N RS-273-071."

HEADLIGHT UPGRADES: When you're driving your Jag down some desolate two-lane blacktop road at 140 mph on a moonless night, it's helpful to be able to see where you're going. Unfortunately, not all headlight systems are up to the task. If you have the US-spec four round headlights with the original sealed beam units in place, I suggest you slow down.

Even if you obey all posted speed limits, you will be amazed at what an adequate set of headlights will do for the pleasure and enjoyment of nighttime motoring. Where you used to have to squint and stare in hopes of seeing things in time to avoid hitting them, you can now sit back and relax. In fact, you may come to fully appreciate the advantages of nighttime driving, with the reduced traffic and cooler temperatures.

RELAY INSTALLATION: If you wish to improve the headlights on your car, the *first* thing you should do is install a set of control relays. This will improve the light output of the stock headlights, whatever type they are, and may just satisfy your need for better light -- and is a perfectly legal modification. If you decide to replace your headlights with something with higher wattage (as suggested on pages 653, 655, and 656) you will *not* be happy with the results unless you install control relays; the additional losses in the stock wiring due to the increased current flow will rob you of any increase in light output.

The whole idea of installing relays is to get as much of the battery/alternator voltage to the headlights as possible, since a small reduction in voltage makes a big reduction in light output on incandescent lights. Low voltage also causes incandescent lights to appear yellowish, which diminishes visibility even more.

Your objective, therefore, is to provide wiring that gets the power from the battery/alternator to the headlights with big fat wires and as directly as possible. Unfortunately, that wasn't the objective of the guy who designed the wiring for your car; his objective was to provide wiring as simply and cheaply as possible, and sized just big enough to keep it from melting. So, the stock wiring goes from the bus on the firewall down to under the dash, through the headlight switch, back to the front left corner of the car, through the main/dip relay and the headlight fusebox, then out to the four headlights -- all with wires that are barely adequate for the sorry headlights that came with the car.

A simple confirmation of the problem is to remove the headlights from their mounts while leaving them connected, start the engine, turn on the headlights and measure the voltage right at the connections on the back of the bulbs. The voltage there should be within a half a volt or so of the voltage measured between the terminal on the firewall and the chassis under the same conditions (headlights on, engine idling). If the voltage is much lower, the installation of relays will help the light output considerably. If you'd like to confirm where the losses actually occur, measure between different points along the line, starting with the terminal on the firewall and including both ends of each fuse in the headlight fusebox as well as the terminals on the headlights. If you measure the voltage between the terminal on the firewall and the power connector on the headlight, you will be measuring the *total* loss of the wiring system except for the ground circuits. You can also measure parts of this loss, such as between the fuse and the headlight, between the firewall terminal and the fuse, even across the fuse itself. If you measure the voltage between the ground connector on the headlight and the chassis of the car, you will be measuring the losses in the ground wiring (which are significant -- the ground wiring is inadequate, too).

If your voltage losses are too high, the solution is to disconnect the wires from the headlights and connect them to the coils of relays, run a massive power wire from the terminal on the firewall to the common contacts on the relays, and run substantial wires (with suitable fuses) from the contacts on the relays to the headlights. Thus you operate only these new relays with the original wiring, switch, and main/dip relay, and the serious current for the headlights themselves takes a much more direct route from the battery/alternator through the contacts in the new relays straight to the bulbs.

This mod only requires the locating of relays and running a serious cable from the terminal on the firewall to whereever the relays are; this author used a 4 gauge, but a 6 gauge cable would actually be enough. The relays should be mounted somewhere near the headlights to minimize wire length; perhaps within the boxes directly behind the headlights themselves. John Napoli suggests a big fuse in that cable, since the relays are likely to be located out at the front corner of the car and may be shorted by a relatively minor collision, and the shorting of such a major cable may cause serious problems.

Technically, you can do this whole job with only two relays, one for low beam and one for high beam, but it may be preferable to use two for high beam to keep from overloading the contacts on a standard 30-amp relay. Note that simply wiring two relays in parallel may not have the desired effect of doubling the contact capacity, since one will always close a millisecond before the other and thereby take all of the arcing load. A much better idea is to separate the wiring to the high beams and have each relay handle half the headlights. That way, each relay will only see half as much load, and if one circuit fails it only kills half your high beams rather than all of them.

Of course, you'll probably want to install a relay for the fog/driving lights as well.

Having four individual fuses on circuits that operate nothing but relays is definitely overkill. On the XJ-S, it makes more sense to continue to use the existing headlamp fusebox to serve the headlights themselves, so the relays should be wired into the circuits *before* the fuses. On the '83, the headlamp fusebox can be fiddled with by drilling out the two rivets that attach the mounting bracket to the fenderwell. The bracket isn't welded to the flange on the edge of the engine compartment, just folded over it. Removing the rivets allows the bracket to be lifted away, which in turn allows the fusebox itself to be turned over and the wiring rearranged. You can reinstall the bracket with a couple of screws, making it easy to work on in the future. Later cars have all sorts of variations in the fusebox in this area, but any of them can be altered as necessary.

Tip for those with the 4-headlight system: The existing wiring from the fusebox to the high beams on each side of the car is inadequate for both high beams, but it's good enough for one. So, one possibility is to run a new wire (about 12 gauge) to each side of the car with a new inline fuse for one of these high beams and reuse the existing wiring and fuse holder for the other high beam. The small wire from the 3-prong connector right behind the headlights to the headlight that's getting a new wire should be tied back into the other headlight at the socket, so that both of these skinny little wires are serving one headlight.

This type of reconnection requires popping the spade terminal out of the headlight socket, soldering the second wire to it, and snapping it back into the socket. Each spade terminal has a little tang on the back that holds it into the socket, so you need to insert a pointy object between the plastic and the terminal itself to depress this tang to remove the terminal. You will also want to bend this tang back into position before pushing the terminal back into the socket, so it securely snaps into place.

Of course, when done changing which fuse serves which headlamp you will probably need to revise the fuse sizes in the headlamp fusebox. It's easy enough to divide the wattage of each headlight by 12 volts to determine the amps that it will draw, and install a fuse suitably sized to serve.

On the other hand, it might be easier to forget all that fiddling with the original fusebox and wiring and simply remove the fusebox in entirety and throw it away and run wires directly from the relays to the headlights with inline fuses, and install an inline fuse for the electric fan. If your car is old enough to have the round tube fuses, this isn't a bad idea; those things make lousy connections and are always corroding and getting intermittent. The later style fuseboxes with the plastic fuses are better. You could, of course, install a generic fusebox that serves all your new headlight and fan wiring for a neat installation.

Be sure to provide adequate ground wires on the headlights as well. That's easy to do, by either adding additional wires or just replacing the ground wires entirely and connecting the new wires to a screw into the chassis, of which there are several handy right around the headlights.

While relay installation may involve a couple hours of fiddling, it is a very cost-effective improvement. The relays themselves typically cost less than five bucks each, and wire and fuses are also cheap.

RELAY INSTALLATION -- SIMPLER VERSION: Mark Barker provides a simpler method of improving the power supply to headlights on his web site. Rather than using separate main and dip beam relays as described above, Barker installs a single relay in the wiring *to* the OEM main/dip beam relay. “Unplug the thick blue wire in the middle of the dip/high relay. This now goes to one of the new relay's coil tags; the light switch only has to operate this relay now. Thick brown wire all the way from the main bus on the firewall, (under 14mm AF nut, using a ring tag) to one of the new relay's closing contact tags. Another short piece of brown wire from the new relay's other closing contact to the exposed tag of the dip/high beam relay the blue wire came from, using the appropriate crimps. Finally, a piece of black wire from the other coil tag to a nearby earth, using a ring tag.” Ed. note: actually, you might want to make that short piece of brown wire a short piece of blue wire to keep the color coding consistent.

This single-relay method is clearly simpler to implement than the multiple-relay method described above. Both methods eliminate routing the heavy headlight current through the headlight switch on the dash and out to the front of the car through the OEM wires, which is the portion of the circuitry where the lion’s share of the voltage loss occurs. The single-relay method continues to run the heavy current through the OEM main/dip relay and all the OEM wiring to the headlights beyond that, which unfortunately is still pretty skinny. Also, there’s no convenient way to divide the load for two relays, so if the total headlight load approaches or exceeds 30A it would be a good idea to find a relay that’s rated for higher current. Altogether, this option might be advisable only for those who want full power to stock headlights, while those intending to install high-wattage bulbs (especially four of them!) might be better advised to use the multiple-relay scheme above.

The single relay only closes once when the headlights are turned on, so the relay itself may last longer than the ones in the multiple-relay scheme that open and close whenever the driver switches from main to dip beam and back. The main/dip relay costs a *lot* more than a couple more generic relays, though, so the multiple-relay scheme may be cheaper in the long run due to increasing the life of the main/dip relay -- especially if high-wattage bulbs are used that exceed the rating of the main/dip relay contacts.

SO YOU ALREADY HAVE RELAYS: Sometime in the early 90’s Jaguar got wise and provided headlight relays from the factory. If you own such a car, you don’t have to worry about the headlight wiring. Right?

Maybe not. As discussed above, the purpose of installing relays is to provide the most direct connection to the battery/alternator possible using heavy wires to minimize voltage losses. The Jaguar factory relays may take the long routes through the dash switch out of the circuit, but that doesn’t mean they’re using adequate size wire. Daniel Stern says, “I have yet to encounter the vehicle with truly *adequate* wiring from the factory. Best I've seen is "passable", and that is rare.”

Wires to individual headlights should be 12 gauge, and wires that power two or more headlights should be 10 gauge or larger. Before you decide your wiring is fine, you might want to check what gauge wire Jaguar decided to connect those relays up with. If the wires from the main bus to the relay contacts and on to the headlights themselves is is still the 18 gauge stuff they use for nearly everything else, there is room for improvement there. You can either rip that stuff out and install adequate wire in its place, or you can simply add wires in parallel to the existing wires. And don’t forget the ground wires to the headlights.

Such work is likely to help the stock headlights considerably, but it is even more important if you decide to install high-wattage headlights.

UPGRADING HEADLIGHTS -- LEGAL CONCERNS (US): Before considering any headlight upgrades, it might help to know a little about the evolution of headlight laws here in the US. David Berman says, “In the 1920s and 1930s cars did not have sealed beams, they had headlamps with reflectors, lenses and replaceable bulbs similar to today. However, they had a serious problem with oxidation of the reflectors which dimmed the lights, and no amount of bulb replacement (which US drivers did regularly!) would help. Sealed beams were standardized in the US in 1939 and solved the problem entirely by eliminating the opportunity for reflectors to oxidize. They were such an improvement that sealed beam retrofit kits were made for earlier cars, even for the Ford Model A which had gone out of production in 1931."

By the 1950's and 60's, laws had been established requiring all cars in the US to have one of two types of sealed beam headlight systems: two 7" round headlights or four 5¾" round headlights. It was this requirement that ruined the appearance of the Jaguar XJ6/XJ12, designed to have two 7" bulbs plus two 5¾"; for the US market, the two 7" had to be replaced with 5¾" with a filler ring around them. It also is the reason the early US-spec XJ-S has two round headlights on each side instead of the "Euro-style" oblong single lamp assemblies.

DOT also limited the light output of headlights on both high and low beam. The headlights also had to have three little bumps on the front, used to check alignment. On top of all this were general prohibitions on more than four headlights or six head/auxiliary lights on a car.

Sometime in the 60's they prohibited glass covers over the headlights. This changed the appearance of the Jaguar E-type and the Volkswagen Beetle.

In the early 70's, they added two arrangements of rectangular sealed beam headlight systems to the approved list.

With the advent of energy conservation concerns, the automotive manufacturers were finally able to convince US legislators in the mid 1980's to drop the requirements for using standardized sealed beam headlights and permit the use of "composite" headlight assemblies in the name of better aerodynamics. These headlights have a lens/reflector assembly that was custom-designed for the car (and usually atrociously expensive), and the bulb itself is a smaller quartz-halogen item that plugs into the reflector from the rear. Berman: "Given the serious reflector problems in the 1930's and the dramatic improvement wrought by sealed beams, you could hardly blame the DOT for taking a long time to be convinced that the proposed new generation of reflectors wouldn't become oxidized and therefore the sealed beam requirement could be lifted."

Unfortunately, apparently the US DOT couldn't be convinced to legalize the *same* composite headlights that had been successfully used in Europe and everywhere else in the world for decades, so the US-spec cars got their own style of composite headlights. To this day, to be fully legal in the US, your headlight lenses need to say "DOT" on them. And most US-spec headlights seem to still have three little bumps for alignment even when the front of the headlight is sloped so some bumps are actually rearward from others. There are still limits on light output.

I dunno what DOT's priorities are, but it's obvious that they don't include providing good visibility at night or in rain. Not to put too fine a point on it, DOT-spec headlights *suck*. And just to show that this is not a "grass is greener" thing where everyone thinks people somewhere else have it better, John Warr from the UK says, "You guys in the US have to drive with the *most* appalling lights I have ever come across. To someone used to Euro lights, the first experience of US lights at night in the rain results in a puzzled driver standing in front of his hire car trying to work out what he has not turned on."

E-CODE: While the US DOT conspires to keep drivers in the dark, the European standards for headlights have evolved based on input from major headlight and driving light manufacturers in an attempt to provide truly excellent lighting. Headlights meeting these "E-code" standards are indicated with a capital letter E and a number with a circle around it on the lens. According to Daniel Stern, the number indicates the country in which the headlight was certified to meet the code.

There are E-code headlights designed to replace any standard sealed beam used in the US, and they always seem to have a distinctive pattern on the lens: there is a trapezoidal area between the center of the lens and the edge on the driver's side, with the fluting at an angle. These lights have a distinctive pattern on dip beam, sending light down to both sides and up towards the side of the road but *not* up towards oncoming traffic.

Before jumping in and upgrading your headlight system, you might want to check the regulations in your state. Or, you might wanna simply note how few citations are handed out annually for illegal E-code headlight assemblies and decide whether or not you wanna chance it. Stern says, "The fact of the matter is that back in the '70s when all cars had sealed beams, E-code lamps stuck out like sore thumbs. But today, with the proliferation of so many different headlamp designs, together with the elimination of headlamp inspections in at least 48 states, nobody knows or cares what kind of headlamps you're running." So, what's the bigger risk to *you*: getting a ticket, or being unable to see where you're going after sunset?

Stern also notes: "If you live in the US states of Oregon, Washington, Alaska or Massachusetts, or in the great nation of Canada, then E-code lamps are 100 percent legal."

Note that many of the "H4 headlights" sold by J. C. Whitney (page 694) are actually low-end E-code units and are described as "for off-road use." That is how they can sell headlights that are technically prohibited on public highways in the US; why the upper left cutoff on low beam would be helpful in an off-road application is never explained.

There are a couple other tricks that have been used; when "sealed beam" headlights were required, J. C. Whitney sold some "sealed beam H4" headlights; the rubber boot had been glued on over the bulb socket making the whole thing sealed. When the H4 bulb burned out, you just cut the boot away and put in a new bulb.

LEGAL CONCERNS -- JAPAN: The author is no expert on Japanese automobile regulation, but it is clear that there are some legal issues involving headlights. According to the H.E. Parts Catalogue ©1987, Japan-spec XJ-S's up to VIN 118583 (1986) used unique oblong headlight assemblies and unique headlight bulbs. From VIN 118584 on, Japan-spec cars used the same headlights as other RHD countries. Mike Morrin says, "Interestingly, the 1980 parts book shows the Japan market having US spec headlights (including LHD sealed beams!!) I presume the actual lamp units were replaced with Japanese ones on arrival in Japan." Maybe not; Japan reportedly got a lot of US cars shortly after WWII -- largely from American occupants bringing them over for their own use -- and apparently set up its specs to permit use of American LHD cars on its roads where people drive on the left.

Several people, including Daniel Stern, confirm that the pre-1986 Japanese headlights were really bad, comparable to the US sealed beams in their ineffectiveness.

If you have a pre-1986 Japan-spec XJ-S, you might want to consider upgrading it to the UK-spec headlights which are apparently legal there now. Or you can consider the other upgrades mentioned in the following sections, but be sure to check the local regulations first.

SOCKET MELTING: One possible problem with high wattage bulbs is melting of the plastic socket that plugs onto the back of the headlight. The solution to that problem is easy: remove the socket and install the spade connectors individually. One idea might be to push the spade connectors all the way through the socket and out the other side before connecting to the headlight; that way, the wires going through the socket would clearly indicate which spade connector goes to which terminal, but the plastic socket itself would remain dangling on the wires a few inches away from the headlight.

Four Round Headlights -- US through 1991

The four round headlights used on the US-spec XJ-S up through 1991are sealed beam halogens, available at any auto parts store. The outboard units (sealed beam 5¾" round halogen main/dip 35/35 watt[5]) are H5006, and the inboard (sealed beam 5¾" round halogen main 50 watt) are H5001. And yes, I have listed the correct wattages for these units, despite the various Jaguar literature listing the outers as 37.5/50 or 37.5/60. The non-halogen equivalents for the outboard position ("tungsten", number 4000) are 60/37.5 watt, but aren't recommended for anybody; you only find them in dark corners of auto parts shelves covered with dust. The corresponding tungsten sealed beams for the inboard position are number 4001, 37.5 watt, also not recommended.

[5] When listing wattages of high/low beam headlights, I endeavor to list the main beam wattage first, the low beam wattage second. The J. C. Whitney catalog often lists them the other way around.

FOUR ROUND HEADLIGHT IMPROVEMENT: If you have the four round sealed beam halogen headlights, your headlights suck -- trust me on this. Daniel Stern suggests that one quick and easy improvement might be to merely replace the outer high/low beam units with H5009's instead of H5006's. These are 50/40W instead of the H5006's 35/35W. Unfortunately, they are apparently pretty difficult to find. "I can supply a lot of "unobtainium" bulbs, but not H5009's." Another possibility may be the 50/50W H5812, "although now we're back to the theoretical, because H5812's aren't in current production."

If you actually want to see where you're going after dark, the sealed beams gotta go.

FOUR ROUND HEADLIGHT UPGRADE: The easiest, cheapest *and* most effective improvement is to replace the sorry sealed beams in the outboard position with far superior 5¾" round E-code units using H4 halogen bulbs. Not legal on US roads, but unlikely to draw the attention of Smokey. These assemblies can be purchased from J. C. Whitney for less than $20 each (H4 bulb included!) and will fit right into the outer (main/dip) headlight fixture with no modifications and no other parts to buy.

The standard H4 bulb is 60/55W, which is a significant boost over the 35/35W main/dip sealed beam halogens. But the chief advantage of the E-code units is that they have much better focusing patterns; on low beam, you can pull the car up to a wall and see that the pattern provides a distinct cutoff to the upper left (on LHD cars), while still providing plenty of illumination down and to the right. The result is that oncoming traffic gets blinded less on low beam, despite the higher power of the H4 bulbs.

H4 bulbs produce a brilliant white light. This is a wonderful benefit, even beyond the actual light output. Having everything in front of the car lit up with white light instead of the yellowish light of conventional headlights seems to make everything clearer.

With the legalization of composite headlights in the US come the "9003" and "HB2" bulbs. These are both exactly the same as the standard H4 except that they are DOT approved. All three designations are commonly available, and replacement bulbs can be found in the local auto parts store or Wal-Mart; H4's are sometimes sold as "motorcycle" headlight bulbs, and may actually cost more than the identical 9003's right next to them.

Note that this author has purchased a set of 5¾" round H4 units from J. C. Whitney, and the lights that arrived are labelled "Maxtel™ by JF", are made in China, and have "E3" in a circle on the lens.

Daniel Stern says that, as with anything else, you get what you pay for when buying E-code headlamps, and suggests you pony up for Cibie or Hella units rather than the J. C. Whitney no-names. "Genuine European E-code headlamps perform much better than the knockoff items, which often have counterfeit E-marks and actually haven't been tested or approved at all." This all may be true, but even the no-name E-code H4 units are a damn sight better than the sealed beams ever dreamed of being, so it all comes down to how much you're willing to spend for how much improvement you want.

FOUR ROUND HEADLIGHT UPGRADE #2: It may be important to some to know that, while the H4 hi/lo headlights fit perfectly, their external appearance may be slightly different than the original sealed beams. Where the sealed beam has a domed glass lens, the Maxtel has a "squared" lens with a shoulder that protrudes straight out of the retaining ring perhaps a quarter inch and then a very slightly domed front, nearly flat faced. You can take a look at these headlights mounted in the author's car at

http://www.jag-lovers.org/xj-s/book/H4Headlights.html

I think they're really pretty, but if you just get two for the outer high/low positions it might not be considered an ideal match for standard sealed beams in the inner two positions.

Good solution: get four, and use the exact same lights in the inner position by using only the high beam filament of the H4 bulb. The author did this, so you can see how it looks on the site above. If you are the type of person to keep spare light bulbs handy, you will only need to carry one type of H4 bulb to fit all four lights. And if a low beam filament burns out, you can just trade bulbs around and use that one for a high beam only.

Installing a high/low unit into the high beam (inboard) position will require cutting a relocated notch in the support ring behind the headlight. As you look into the hole where the headlight goes, the notch at the upper left is in the wrong place and a new one needs to be cut about a half inch clockwise. You can hold the new high/low headlight up to the fixture, fit the other two feet into the appropriate notches, and mark where you need to cut a new notch. Alternatively, you could just buy a couple new mount fixtures originally intended for the outer positions and mount them in the inners. The electrical plug will work fine as is; the two-connector plug will fit directly onto the three-connector H4 bulb and operate the correct filament.

FOUR ROUND HEADLIGHT UPGRADE #3: Instead of installing H4 hi/lo headlights in the inboard positions and using only the high beam filaments, you can replace the inboard sealed beam units with E-code high beam assemblies that use H1 halogen bulbs. H1 bulbs are also available anywhere that sells auto parts. H1 high beams have the advantage that, since the reflectors and lenses don't need to be designed to facilitate both high and low beam operation, they can be fully optimized for truly excellent high beam operation. Daniel Stern recommends this method: "H4 high beam: Lots of midrange fill light. Dedicated high beam: *Long*-range throw. It's best to have both types." Since the only advantages of using four H4's are minor (fewer spare bulbs required, perfect appearance match), he has a point; if you'd like more "midrange fill light", you can just upgrade the H4 bulbs in the outboard headlights (see page 656) rather than installing additional H4's in the inboard headlights. Plus, you don't have to modify the notch in the support ring to install the H1's.

Unfortunately, J. C. Whitney doesn't carry H1 high beam 5¾" round units, so you'll need to look elsewhere. Stern describes E-code 5¾" round units from Cibie and Hella: "The Cibie lamps are convex (dome) face lamps, like the original sealed beams. The Hella lamps are flat-faced." H4 high/low and H1 high beams are available from both companies. Stern goes on to note that the Hella H1 is truly flat-faced while the Hella H4 has an extending lip around the edge (similar to the Maxtels described above) so the two Hellas don't really match each other perfectly. "The difference in lens technique between the Hella H4 and the Hella H1 creates a difference in installed appearance between the two adjacent units. The Cibie H4 and H1 both use convex lenses of the same curvature. Whether this is of concern to you is a matter of individual taste.

"The Cibie H4 high/low units are equipped with city lights." Hey, there's an interesting possibility for modification of US-spec cars: disconnect the parking light filaments in the front turn signal bulbs and wire up pilot lights within the headlights instead. The pilot lights would be perfectly legal, but unfortunately they'd draw attention to the E-code H4 headlights which aren't.

"There is a potential design compromise in the Cibie lamps. The Cibie H4 weathershield can be installed in any clock position, so one must pay careful attention to putting it on such that the moulded-in word "TOP" is at the top, else risk water entrapment and shortened reflector life."

FOUR ROUND HEADLIGHT UPGRADE #4: John Goodman: "I would prefer the outer lamps to be the permanent dipped beam units as in the BMW's, i.e. The H1 single filament bulbs, because the reflector shape is different being solely designed for dipped use only, gives a better light pattern. This arrangement needs mods to the headlamp relays so they stay on when the inner main beam units are activated." No problem; a jumper between terminals 56 and 56b on the main/dip relay will do it.

Daniel Stern reports that Cibie produces a low-beam-only H1 E-code unit that will fit in the outboard position on the four-headlight XJ-S.

HEADLIGHT AIMING -- FOUR ROUND HEADLIGHT SYSTEM: A nifty feature of having four separate headlights is that you can get creative aiming them. The outer high/low units should be aimed pretty much as specified to ensure that oncoming drivers are not blinded. If E-code units are installed, this becomes both more important and more acceptable, since the E-code lights have a very sharp cutoff indeed; a little too high and you're blinding people, a little too low and you're not lighting the road very far ahead, but just right and you get excellent visibility for low beams.

Unfortunately, aiming the low beams accordingly will determine where the high beams end up, so you have limited options there. Fortunately, E-code high/low units seem to provide excellent high beam patterns when low beams are aimed properly -- as opposed to some US-spec sealed beams where you aim the low beams and the high beams are shining up into the trees or some such so you have to pick a compromise somewhere.

The inner high beam units have more flexibility. If it is presumed that they are never on when there are cars out there that may be blinded, you can aim them pretty much whichever direction you wish.

Of course, once again there are legal issues. Even though the high beams are only used when nobody is around but you, the US DOT still requires you to aim them the way they think they should be aimed. Again, this probably won't pose a problem in most areas; cops generally only issue tickets for poorly aimed headlights where someone is driving a car that's been crashed and one of the lights is aiming at the ground or off at 45º or some such. If you have vehicle inspections, though, headlight aiming is one of the things they typically check so you would have to aim the headlights the specified way before an inspection and put them back the way you want afterward.

FOUR ROUND HEADLIGHT REPLACEMENT: You can replace the four headlights with one or the other of the Cibie oblong headlight designs used in Europe (see below). Not legal in most US states, but will provide better lighting -- although not as much better as installing E-code H4 round units as described above. It's also likely to be considerably more expensive than the four round E-code units. Hence, the only real justification for going this route is if you happen to prefer the appearance of the Cibie oblong headlights.

Since the body panels are the same between US and Euro cars, this will be a bolt-in replacement -- but you will probably have to buy quite a few parts, including the mounting brackets that hold the headlights within the compartments and the trim pieces at the front.

Note that, if you get the Euro lights, you can also opt for the wiper/washer system for them, and even a *heated* wiper/washer system to prevent freezing of the washer fluid.

By replacing the four round sealed beams with far better headlights, we have vastly improved the lighting. If you *still* want better visibility you can add driving lights, but it's a better idea to opt for non-standard H4 or H1 bulbs -- see pages 653 and 656.

Cibies with two H1 bulbs -- non-US through 1980

The early non-US XJ-S has Cibie headlights with glass lenses and metal reflectors and uses two H1 halogen bulbs plus one "pilot" bulb on each side. This is the assembly shown in the Haynes manual, but John Goodman points out "The drawing of the XJ-S headlight bulb on page 198 (actually 197 in my book) looks like it was taken from a 1980 <UK> owner's handbook. But it's been edited to fit the page and you only have half the picture!!! What you are looking at here is a 1980 or earlier headlight, the bulb shown is a main beam single filament H1. What is not shown is an identical bulb which installs in an identical hole immediately underneath for the dipped beam."

Mike Morrin calls this early unit a "biode". "It is the term (probably trademark of Cibie) for headlight units with separate reflectors and bulbs for high and low beams. I think it is a condensation of "bi-reflector iodine". The term was widely used in europe back in the 70s, but I suppose not in the US as they were illegal there then. Back in the 70s, the British *always* called Quartz Halogen "Quartz Iodine"."

Morrin describes the early unit in more detail: "Low beam uses the back of the headlight shell (as per the later units). The high beam reflector is in front of this in the lower half of the unit. There is actually an adjusting screw which allows the vertical angle of high beam to be adjusted relative to low beam. The glass has CIBIE IODE in the centre of the casting. Most of the bottom half of the lense is clear, with fluting only directly in front of the high beam bulb. It is interesting that Cibie used Iode in the trademark on the lamp. I am sure that their after-market dual-reflector lamps of the same vintage were known as Biodes."

"The high beam has quite a narrow vertical spread, and really needs the low beam to be simultaneously lit up for close-in lighting. The early cars came already wired this way. The wiring diagram in my manual shows a dotted link across the low beam contacts on the relay.

"These are actually very good lights, except that they are very prone to oxidising of the reflectors."

H1 bulbs are typically 55W and have a small circular metal base with one straight side at a 45º angle to the single spade terminal pointing straight off the bottom. The headlight housing must have a suitable ground connection, since there is none on the bulb itself. H1 bulbs are readily available in auto parts stores. In Europe, the bulb number is 411. Note that the illustrations in the manuals seem to indicate that H1 bulbs have an external conductor around the outside of the capsule itself and entering in the front of the glass, but the bulbs actually for sale in the stores don't have this; all conductors are inside the glass.

HIGH-WATTAGE H1'S: The standard H1 is 55W, but 100W versions are available in most auto parts stores and J. C. Whitney sells 100W and 130W versions. A 130W H1 bulb is available at Wal-Mart for five bucks -- but not in the automotive section. It's sold in the sporting goods department. It's called "Night Blaster" A-709 and is described as a 12V spotlight bulb; only on the back of the card does it casually mention that it will fit any application calling for an H1 bulb.

CIBIE REFLECTOR DETERIORATION: The Cibie oblong headlights reportedly suffer from deterioration of the reflector, especially the early dual-H1 units. This deterioration kills the headlight effectiveness. Considering the cost of replacement units, many owners seek methods of renovating the reflectors in their otherwise operable headlights. It *is* possible to separate the lens from the reflector; there is a glue joint that can be cut through without too much trouble. However, Daniel Stern suggests that it'd be a better idea to just go ahead and spring for the replacement headlights: "Anyone who gets the notion that chrome plating will do the trick ought to know the reflectivity of the very finest quality chrome is 62 percent. Headlamp reflectors done properly have a reflectivity of 98-99 percent." Obviously, stuffing aluminum foil or aluminum tape in there isn't gonna cut the mustard, either! Stern also points out that doing a proper reflective coating application on a one-off repair of old units will usually cost more than just buying new units.

EARLY CIBIE REPLACEMENT: If you have the early dual-H1 units and need replacements, you probably should consider the later single-H4 units. A couple of owners have reported finding out that their cars had the dual-H1 on one side and the single-H4 on the other, indicating that a PO must have replaced one. Obviously, it can't be too difficult to replace one type with the other.

Another option is to replace the Cibies with the four headlight scheme as described on page 654.

Cibies with one H4 bulb -- non-US 1981-91

From 1981-91, non-US cars used Cibie headlights with a single H4 bulb and two pilot light bulbs on each side. Allan Charlton says the lights on his '78 have the circle-E symbol indicating E-code specification (see page 648). "It's E2 in a circle. The E2 also appears in a smaller circle with an A above, and in a small square with an A above (Actually, the A is so small that, in the poor light in my garage, it could be an R, but I think it's an A)."

H4 bulbs have a large circular metal base with three alignment tangs, one larger than the other two, and a 3-prong plug that will fit the same socket as a US-spec sealed beam -- three large (5/16") spade terminals arranged as three sides of a square. If your headlights use H4 bulbs, they are readily available -- or you can use HB2 or 9003 bulbs, which are exactly the same. In Europe, these bulbs are called 472. The French cars use a 476 for the yellow color.

SEALING NON-SEALED H4 HEADLIGHTS: H4 headlight assemblies are nothing resembling sealed; in fact, the back end is open enough you might consider it ventilated. To prevent moisture getting in and deteriorating the reflector, the assemblies include rubber boots that fit over the back end of the headlights. Note, however, that installing this boot will keep the assembly warmer; this doesn't normally pose a problem, but if you're using the big-wattage bulbs you might consider the tradeoffs between how hot the bulb gets and how big a problem moisture is.

Other cars, including Hondas, use rubber boots that appear remarkably similar on normal sealed beams. Perhaps one of these boots could be used when the original H4 boots are damaged or missing.

CIBIE REPLACEMENT: John Goodman reports from the UK: "Jaguar enthusiasts here actually change to the four headlamp system because of improved lighting available." Goodman isn't talking about installing the four crummy sealed beams used in the US; he's talking about installing four 5¾" round E-code units with H4 bulbs -- meaning the UK car goes from two H4 bulbs to four. He describes the kit from Jaguar, JLM 10357: "All 4 lights are the same and still use the H4 bulbs. A link wire supplied with the kit only enables the outer lights on dip. Could easily be wired for both pairs on dip, but would screw up the dim/dip and not sure if it's legal. Looks like it's been done this way for simplicity of owner installation. Although it remains a mystery why the genuine Jag kit did not have dedicated driving lights for the inner pair with H1 bulbs."

"If you have converted to four headlamps, the headlamp washer/wipers are now redundant, but you can utilise the additional separate pump for the headlamp washers (modify the wiring) to power one side on your screen washers, works well." Of course, this only works if you have an '88-on car with two separate nozzles -- or have added a nozzle in addition to the original single one.

If you convert to four round H4 headlights, you should read the section on that headlight arrangement starting on page 649. Just using the round sealed beam units that came in the US-spec cars would be a mistake.

UK DAYTIME RUNNING LIGHTS: There is a circuit in the mid-80's-on UK cars only that operates the low beams at reduced power to provide a running light-type illumination, apparently as a result of some law. Richard Mansell quotes "my owners manual which states: In the UK the headlamps are automatically switched ON in a dimmed dipped beam mode when the side lights are switched ON and ignition switch is in position '2'. This prevents the vehicle being driven with side and tail lamps only." John Goodman says it is "Controlled by a relay thingy by the headlamp fusebox (this on UK cars came in around '86 '87)."

Goodman continues: "It gets all screwed up if you try to install non-standard brighter wattage bulbs." Regarding the kits available in the U.K. to convert to the US-style four headlight system, he says "When I converted my previous XJ-S to 4 headlights the dim system still works because all 4 lights are the same and still use the H4 bulbs. All lights have dual filament bulbs, so 4 x 55w on main beam, however only the outer ones are ever wired up for dipped beam (not sure if this is a legal reason)."

If you happen to have such a UK-spec car and don't want to convert to four headlights, one nice option is the 100/55W H4 bulb from Wiko mentioned above. Since the low beam is still 55W, same as the stock H4's, the dimmed dip feature will still work as intended.

DOT-approved Carello -- US 1992-on

Composite headlights -- as opposed to sealed beams -- were finally legalized in the US in the name of energy conservation via improved aerodynamics, but that doesn't mean European headlights are now legal. After all, the US DOT couldn't possibly accept headlights that have proven excellent in Europe for decades. So, the 1992-on US-spec XJ-S has a new type of oblong headlights that say DOT on the lens. Emile A. DesRoches says the lights are made by Carello, and have plastic lenses with three little bumps for aiming. "The Carello light housings appear to be completely polycarbonate with reflectors of the same material plated and apparently epoxied to the lens in order to provide a leak free seal (no apparent O-ring, but it appears there's a ridge where the parts join). These things are very strong/resistant to scratching, etc. I've taken several stones without mishap and what appeared to be a nut or bolt at high speed (yes, I got to the track late and stupidly neglected to tape the headlights -- this from an SCCA tech inspector, yet). I expect it would be possible to separate the sections with use of the proper solvent."

Side note: per Daniel Stern, "Carello is a trademark of Magneti-Marelli SpA., Italy." That's right, the headlights are made by the same company that makes the ignition system! They have a plant in the UK, which is why the headlights are marked "Made in UK".

The Carello headlights come with a nifty adjustment scheme: the up/down and left/right adjusters are readily accessible from under the hood. There is no need to pull trim off or try to jam a screwdriver through narrow access slots to aim the headlights.

CARELLO BULBS: The US-spec Carello headlights are fitted with 9004 bulbs. These bulbs have a large plastic base with a fat O-ring and a D-shaped 3-terminal socket, and are 65/45W.

I will repeat: the US-spec Carello headlights use 9004 bulbs. I am *sure* of this. But if you start checking other sources, you're probably going to develop some doubts. Gary Penovich says, "Every website that I visited showed the USA spec 94MY using an H4/9003 lamp. The Osram/Sylvania website shows the incorrect fitting for a 94 as 9003." Hey, don't believe me -- but at least pop the access cover out of the wheel well and pull a bulb out and *look* at it before mail-ordering something you can't use.

CARELLO UPGRADES: When Jaguar was finally permitted to quit using those lousy round sealed beams, the headlights improved greatly, right? Daniel Stern says, "This is a tremendous, tremendous *retrograde* step in headlamp performance. The transverse-filament 9004 performs worse than many of the old sealed beams, even. The 9004 system is inherently *bad*. Poor luminance from the filaments, *huge* amounts of "noise" from 2nd-, 3rd- and higher-order filament reflections off the bulb walls, nearly impossible to control filament placement once the bulbs have been cycled on and off a few times, oodles of wasted light with transverse filament especially in rectangular or oblong reflectors...this junk was one of Ford's so-called "Better ideas" in 1983. Shame on them."

David Buchner describes the Carello headlights that came on his '94: "When you turn them on, you get a vague impression of some light." Buchner also owns an earlier XJ-S with four round sealed beams, and reports that the Carellos are "*much* worse." That's pretty bad indeed, since the four round sealed beams suck.

For a wattage boost (illegal on US roads), J. C. Whitney offers 9004 bulbs in 100/55W and 100/80W versions. Stern: "Badly-made 3rd-world overwattage 9004s (*all* of them...no reputable company makes such a product) have insanely high internal pressure and frequently turn into shrapnel grenades (hopefully inside a headlamp so the destruction is only to the bulb and headlamp...otherwise grievous injury can occur when flying hot glass hits flesh or eyes). *Vastly* increased glare for other road users and backdazzle for the driver...thermal damage to plastic headlamp parts...melted headlamp connectors (tiny contact pins in 9004 base). Brighter bulbs in bad headlamps don't make good headlamps...just bright bad ones."

Note that, as of this writing, this author has received several reports of use of 100W bulbs in Carello headlights and no reports of melted parts, but this nevertheless must be considered a try-at-your-own-risk idea. Unfortunately, Buchner tried high-wattage 9004's and reported that they had very little beneficial effect.

One very effective method of upgrading the US-spec Carellos would be to replace the units with the E-code Carellos (see below). Not legal on US roads, but not likely to attract attention and certainly a great improvement in lighting.

Another option would be to add driving lights. The driving lights should be wired so that you can leave them off and use the dimmer switch to switch from low beam to high beam and back, or turn them on and use the dimmer to switch from low beam to high beam plus driving lights. Then you can use the dimmer to switch back and forth between low and high beam in traffic situations where a car with good headlights would only need low beams, and switch on the driving lights when you're alone on rural highways and really need to see. And driving lights are perfectly legal.

The best fix may be to retrofit the earlier quad headlight scheme. Lee Murray says, "SNG Barratt has been advertising dual sealed beam conversion for facelift XJS'" and reportedly asking a pretty dear price for them. Apparently you don't need a kit, though; just get the headlight assemblies and chrome trim from an earlier car in a junkyard. Arnoud Bordewijk reports: "I had a go today and it's really easy: I deleted the center bracket on the ('89) headlights. The outer bracket on the ('95) car went to the trash as well. Basically the complete assembly bolts straight on: no drilling or weird stuff required. The only thing you need to take care of is the wiring but since the colours are the same this should be really easy. It took me about an hour to sort it out. The chrome really complements the champagne (dunno what the official name is) colour of the car: it looks like a million bucks (or 15 euros;)."

Remember that retrofitting the four round headlights won't help visibility if you just fit the standard sealed beams. To attain any actual visibility you'll want to install E-code headlights using H4 or H1 bulbs as described in the four round headlight upgrades starting on page 649.

E-code Carello -- non-US 1991-on

At the same time the US got the DOT-approved Carello headlights, other countries got E-code Carellos. These can be distinguished from the US-spec Carellos by a marking on the lens: "E11" in a circle. Also, the E-code headlights don't have the three little tits that DOT requires for aiming. Besides these minor appearance differences, there is a major difference: the E-code Carellos use H4 bulbs instead of 9004's. These units are reportedly far superior to the DOT-approved Carellos and probably don't call for much improvement.

If you need better lighting, consider the nonstandard H4's discussed below. You could also consider retrofitting the quad headlight scheme as described for the US-spec Carellos above, but perhaps the biggest reason to do that is if you prefer the appearance of the car with the quad headlights. Or, of course, you could add driving lights.

More Headlight Improvement Ideas

HIGH-WATTAGE H4'S: Of the five headlight schemes the XJ-S came fitted with, two used H4 bulbs -- and the discussions above suggest replacing the other three with systems using H4 bulbs! H4 systems provide excellent lighting -- but there is still room for improvement. One way to get better visibility yet is more wattage. J. C. Whitney offers H4 bulbs in 100/80W, 130/90W, and 165/100W. The 165/100W's are kinda pricey, but the others barely cost any more than standard H4's. You can even get the 5¾" round E-code assemblies from J. C. Whitney with the 100/80W or 130/90W's already installed for only an extra buck or two.

Also, Vince Chrzanowski reports that he found 100/55W H4's at his local electronics wholesaler: Eiko Order Code 01019-BP. Eiko products are distributed by:

> Wiko, Ltd.
> 10490 W. 164th Pl.
> Orland Park, IL 60462

And, no, he claims there is no typo, the name of the company is one letter over on the keyboard from the name of the product line.

Daniel Stern advises that "good quality European bulbs cost no more than Chaiwanese stuff from JCW or Wiko, and the wattage ratings on European bulbs are actually correct. The knockoffs are almost always quite a large bit lower than stated, never higher. This is not the case with European-made bulbs."

Note that the light output of incandescent light bulbs is not necessarily proportional to wattage; usually the higher wattages are *more* efficient. Suffice it to say that high-wattage H4 bulbs will definitely do the trick. On high beam the reflection from a brand-new road sign can be a little blinding. And when you flash at someone to move over, they move over!

Of course, nonstandard H4's are harder to find when one burns out -- but if you buy a spare or two, they don't take up much space in the trunk or glovebox. Or, you could just buy a normal 60/55W H4 from a local store to tide you over until you can get a new specialty bulb shipped to you.

HIGH WATTAGE HEADLIGHTS -- POWER SUPPLY CONCERNS: Since watts = amps x volts and automotive bulbs are 12 volt, a 100W bulb will draw over 8 amps and a 130W bulb will draw nearly 11 amps. Four 130W high beams will draw over 43 amps, or 29 amps more than the stock sealed beams did. You might wanna consider the capability of your alternator; the later XJ-S was fitted with a 115-amp unit, but the earlier ones had 66-amp or 75-amp Lucas units -- and you've still got electronic fuel injection, windshield wipers, A/C system fans, etc., etc. to provide power for. Still, this usually doesn't present a problem, perhaps because you can't use high beams too much due to oncoming traffic, there's usually no point to using high beams in the rain when the wipers are going, and since it's cool after dark the A/C fans are always on low speed.

You also need to consider the wiring and fuses. See the suggestions for installing relays on page 645.

BLUE BULBS: There are two distinct types of bulbs that can be referred to as "blue bulbs". The first one has a dichroic filter coating on the bulb that makes it appear gold. You have to hold the bulb up to the light and look through it to see why it's blue.

Are these bulbs a good idea? The answer is a clear and resounding no. In headlamp design, the bulb and the reflector/lens arrangement must be designed to work together, and in the case of halogen headlight arrangements that design is based on the bulb being clear and nonreflective. Introducing a filter coating does more than simply reduce the amount of light emitted (it is a filter, remember, its function is to absorb light); it also introduces a reflective surface within the system that causes light to scatter off in directions that the headlight designer was trying very hard to preclude.

There's no shortage of bad things to say about this crap, but the following excerpt from a NHTSA document sums it up pretty well: "These bulbs began to show up on cars and trucks in early 1998, shortly after the introduction of HIDs on more expensive cars. Having noticed this, NHTSA lighting engineers who regularly participate in SAE Lighting Committee meetings asked committee members to discuss the science, engineering, optics and other aspects of these new bulbs. Those engineers were mostly ignorant of the existence of those bulbs in the U.S. market. Upon being shown one of the suspect bulbs, all were surprised by the orange metallic interference coating that was present on the entire surface of the bulb capsule because they did not believe that it would allow a headlamp to perform properly. During that meeting, a test was performed on the bulb in a headlamp, comparing it to the OEM bulb for the headlamp. When set up in a photometry laboratory, the colored bulb reduced peak intensity in the seeing light area of the beam by two-thirds, markedly increased the glare intensity in the area where preceding and oncoming drivers' eyes are typically located, and the total volume of light emitted by the headlamp dropped by almost half. The beam emitted using the colored bulb, shining on a white measuring screen in the lab, showed a psychedelic array of colors, ranging from white near the hot spot to reds, greens, golds, blues and magentas, in vast areas of the beam. It was remarkably different than the performance of an OEM bulb. While the laboratory at which the meetings were held did not test the colored bulb/headlamp combination for compliance with FMVSS No. 108, the plot of its intensities showed that it was incapable of complying."

These things should be banned -- and they are. Daniel Stern: "Simply put: They are *illegal* in all of the US and all of Canada, Australia, Europe, Japan... A halogen or tungsten bulb that emits blue light is deemed a blue light, and is illegal on non-emergency vehicles in Europe, the US, and Canada."

The package on a set of Crystal Blue 9004's in a local store says they are DOT approved in small letters on the back of the card, but clearly warns on the front that they are for show car use only and that local laws should be checked before installing. The bulbs themselves say nothing at all. You don't need to check the local laws; they are illegal on the road -- *any* road. And while using Euro-spec H4 headlights in the US might not get the cops' attention, these bulbs are obviously and obnoxiously blue. They also increase glare on other drivers -- including cops -- so harassment from law enforcement can be expected to be constant and unceasing. As it should be.

NOT-SO-BLUE BULBS: The second type of "blue bulb" doesn't have the dichroic filter coating that gives the golden appearance, but rather a simple light blue tint on the glass. The objective is white light, not blue. These are a better idea than the golden bulbs described above. Stern again: "They come in 9004, HB2 (H4), 9005, 9006, 9007, all DOT-approved."

They're still not a good idea, though. Stern goes on to say, "The question of whether these filtered lights might be better has been tested by good researchers, and they find not only that any theoretical advantages vanish when the context of the study is actual driving tasks on actual roads -- that is, no seeing benefit -- but also there is a glare disbenefit with such filtration. Just say NO to blue-filtered lights of any kind."

It is this author's opinion that the popularity of blue-tinted lights -- other than with morons who care more about being "cool" than about safety -- is largely a result of the poor wiring in most automobiles, which causes headlights to operate at reduced voltage and therefore appear yellow and weak. Before considering any blue crap, please install relays or upgrade the wiring as discussed beginning on page 645.

YELLOW BULBS: Yellow is a legal color for headlights, with some areas permitting a yellowish shade of white while others permit downright yellow. This is for good reason; Daniel Stern says, "Until the mid 1990s, headlamps in France were required to produce yellow light. This was accomplished in one of several ways: yellow headlamp lens, yellow glass balloon in front of the bulb, yellow glass balloon as part of H4 bulbs, and dichroic filter coatings on halogen bulbs. This last method was the best, since it produced the required yellow color with very little loss in absolute light intensity. Yellow glass filters caused up to a 15 percent reduction in absolute intensity. In the mid '90s (1994, if I recall correctly) the yellow-light requirement was dropped for new cars in order to bring France into line with general European Community regulations. Yellow bulbs can still be had and used on pre-'94 cars, however.

"It's not directly apparent that yellow is a magically great color for lights. It's what happens when you subtract blue from an auto lamp. Blue is the shortest wavelength and, as such, scatters the most readily. When blue light strikes water (rain, fog, snow) it scatters in all directions and makes on-road vision very difficult. Blue also is a very difficult color of light to look at if it is at all intense...it stimulates the reaction we call "glare".

"So the French figured to remove the blue from the output spectrum of their vehicles' front lamps. The opposite of blue being yellow, the result was French yellow headlamps. There haven't been any recent comparitive studies, but yellow lamps always subjectively ranked as decidedly better in poor weather and lower in glare than white ones, and this matches my own experimental experience with fog lamps and headlamps that produce yellow light.

"One problem with this conclusion as applied to headlamps in France is that the dichroic technology came along very shortly before France rescinded the yellow-light requirement. Therefore, the lamps that were being compared with white lamps were almost universally yellow by dint of earlier methods (yellow glass) which reduced the absolute intensity of the beam, which may or may not have had a large part in reducing the glare. Because the requirement for yellow light no longer exists (though such light is optional in many countries) we probably will never know the vagaries of the answer to this question. Suffice it to say that yellow light makes a better fog lamp if you intend to use the fog lamp in poor-visibility conditions without any drawback in dry conditions, and modern dichroic techniques of "yellowing" the light take away some of the drawbacks (reduced amount of light) that used to be a problem with yellow lights.

“These days there are quite a number of dichroic (yellow-pass) lighting products on the market. There are bulbs with this coating, as well as auxiliary lamps whose lenses are so treated. There's nothing the matter with doing it either way (though my preference is for the coating to be on the bulb, because this makes it easy to switch between clear/white light and yellow light as desired).

“There are two commonly available levels of dichroic-filter coating strength on auto headlamp bulbs: A light coating which "skims" the highest-frequency blues off of the output spectrum, causing a yellow-tinted white light, and a heavier coating that blocks all of the blue frequencies from being output, causing the full-depth *yellow* light that we used to see in French headlamps. The deeper yellow tint is more effective at cutting through obscured environments (rain, fog, snow, dust), but the lighter coated bulbs meet international definitions of "white" light for headlamps. I've done considerable experimentation with various mixes of bulbs and my own preference for maximum visibility in bad weather is:

> -Lightly-filtered headlamp bulbs to produce legally-white light that gives considerably less glareback in bad weather
>
> -heavily-filtered fog lamp bulbs to produce yellow light that does not glare back at all in bad weather (full-strength yellow is legal in auxiliary lights)

“I like clear bulbs in driving lamps, because if you're worried about glareback, you're not using your driving lamps!”

So if the bulbs with blue dichroic coatings appear gold when you look at the bulb itself, what do the bulbs with yellow dicroic coatings look like? “The legal-yellow ones reflect a light purple, while the full-tint ("French") yellow ones reflect a deep blue.”

HIR: Howard Chu mentions another advance in headlights: “GE's HIR bulbs, which have a bulb coating that reflects infrared. This again allows visible light to escape unhindered, but keeps more heat in the bulb. The point here is that the filament glows because it's hot, so if you can keep more heat in the bulb, you can keep the filament glowing brighter with less electricity.”

“XENON” HALOGENS: Nathaniel Musselman found that Hella offers bulbs that look and work just like standard H1 or H4 bulbs except that they have xenon gas in them. They claim that the use of xenon gas improves light output and eliminates UV radiation that may damage plastic lenses and housings. You can visit Hella's web site at:

> http://www.hella.co.nz/

Daniel Stern says, “The gas mix in such a bulb does have a higher percentage of Xenon, but it's not exclusively Xenon. Also, the gas mix in the new type bulbs is under higher pressure. This allows the filament to run hotter, which produces more light. It's not a knock-your-socks-off improvement, but it is certainly noticeable.

“The newest types of bulbs all use this new gas mix formulation (which also is under a higher pressure). For instance, the H7 is one of the newest headlamp bulbs. All H7 bulbs have this newly-tweaked, higher-pressure gas mix, and the results have been good, with the H7 achieving a higher luminous flux (amount of available usable light) from a given wattage (55w in this case) than was achievable in a bulb of this general type with the old gas mix under the old lower pressure. So after a few years' experience with H7s, the manufacturers have moved to update the older traditional bulb types with the new gas mix under the new, higher pressure.”

"XENON" HIGH INTENSITY DISCHARGE (HID): Gas-discharge xenon lights, such as the strobe bulb in your timing light or camera flash, work by firing an arc through a tube containing xenon gas. HID headlights work similarly by providing a continuous arc to provide a continuous light. These lights have no filament; the arc travels through the gas itself to produce the light. The same arc provides high and low beam; the arc is physically moved from one position to another by application of a magnetic field, so the light doesn’t really turn on and off when switching between high and low beams but rather “moves”. The HID headlight system provides a purplish light and gives more light than halogen headlights for one third the wattage.

Daniel Stern: “HID headlamps, which have a bluish appearance, are legal. It's because they're not actually blue, they just appear more blue than the halogen lamps surrounding them. They are higher in blue and blue-green wavelengths, but this is specifically noted and approved in CMVSS108 and 108.1 (And, for US readers, in FMVSS108).”

J.C. Whitney (page 694) offers an HID conversion kit that will fit any headlight that uses H1, H4, or 9004 bulbs -- which, when combined with the earlier suggestions to replace the round sealed beams with H4 units, means you can fit them into *any* XJ-S. Cost is a mere $800 per kit -- and you’ll need two kits if you plan to do four headlights.

Worth it? Apparently not. Stern again: “There are many unsafe, illegal and noncompliant products on the market, mainly consisting of an HID ballast and bulb for "retrofitting" into a halogen headlamp. Often, these products are advertised using the name of a reputable lighting company ("Real Philips kit! Real Osram kit!") to try to give the potential buyer the illusion of security. While some of the components in these kits are sometimes made by the companies mentioned, reputable companies like Philips, Osram, Hella, etc. *never* endorse this kind of "retrofit" usage of their products.

“Halogen headlamps and HID headlamps require very different optics to produce a safe and effective -- not to mention legal -- beam pattern. It is not some great feat of upgrade engineering to put an HID capsule where a halogen bulb belongs, it is just plain foolishness. Some types of halogen headlamp bulbs (9004, 9007, H3) use a transverse (side-to-side) and/or offset (not directly in line with the central axis of the headlamp reflector) filament, the position and orientation of which is physically impossible to match with a "retrofit" HID capsule. Even those halogen headlamps that use axial-filament (9005, 9006, H1, H7) bulbs are not safely or legitimately "convertible", regardless of what kinds of clever products the junk vendors come up with.

“The most dangerous part of the attempt to "retrofit" Xenon headlamps is that sometimes you get a deceptive and illusory "improvement" in the performance of the headlamp. The performance of the headlamp is perceived to be "better" because of the much higher level of foreground lighting (on the road immediately in front of the car). However, examining isoscans of the beam patterns produced by this kind of "conversion" reveals *less* distance light, and often an alarming relative minimum where there's meant to be a relative maximum in light intensity. When you *think* you can see better than you can, you're *not* safe.

“It's tricky to judge headlamp beam performance without a lot of knowledge, a lot of training and a lot of special equipment, because subjective perceptions are very misleading. Having a lot of strong light in the foreground that is on the road close to the car and out to the sides is very comforting and reliably produces a strong *impression* of "good headlights". The problem is that not only is foreground lighting of decidedly secondary importance when travelling much above 30 mph, but having a very strong pool of light close to the car causes your pupils to close down, *worsening* your distance vision...all the while giving you this false sense of security. This is to say nothing of the massive amounts of glare to other road users and backdazzle to you, the driver, that results from these "retrofits".

“In order to work correctly and safely, HID headlamps must be designed from the start as HID headlamps. The only safe and legitimate HID retrofit is one that replaces the *entire* headlamp -- that is lens, reflector, bulb...the whole shemozzle -- with optics designed for HID usage. It *is* possible to get clever with available products, such as Hella's modular projectors available in HID or halogen, and fabricate your own brackets and bezels. But just putting an HID bulb where a halogen one belongs is bad news all around.”

ALTERNATIVE CONTROL SCHEMES: Besides upgrading the hardware in the headlight systems, there may be benefits to changing the ways in which the headlights can be operated. It would be possible to add dozens of schemes here, each complete with wiring schematics, thereby significantly adding to the poundage of this book. Rather than going that route, I have decided to merely put forth some of the more intriguing ideas that have occurred to me or have been sent to me, and leave it to the owner to figure out how to implement them if he so desires. Basically, any of them can be achieved with a switch or two, a couple of relays, and a couple hours of fiddling with the wiring.

John Napoli suggests rewiring the car so that the low beams remain on when the high beams are on, so all the filaments are putting out light. The early European headlamps with two H1 bulbs did this from the factory, and show how easy the rewiring is -- simply adding a jumper between terminals 56 and 56b on the main/dip relay. However, perhaps it should be noted that those early cars had separate bulbs for high and low beams, while later cars have both filaments within the same bulb. Overheating or early bulb failure might be the result. Hence, try this modification at your own risk.

If you have the 4-headlight system, Daniel Stern suggests you can go nuts with control schemes: "In a quad-round system, there are four holes and *six* filaments. Nobody ever said you have to have two matching pairs of lamps, or that you can't rewire the setup to create 3 beam distributions rather than just two (or even *five* if you're adventurous)." Just as an illustration, one of Stern's alternative setups is to provide three levels of light: standard low and high beams, plus a "mid beam" arrangement with the outer headlights on high beam but the inner headlights off. This setup makes good sense if the inner high beams are an H1 assembly with really long-range capability, and it only requires one switch and a relay. Using all four high beams will provide truly excellent visibility while you are alone on the road but the H1's can be turned off to avoid blinding another driver you are following at a distance while still keeping the outer headlights on high beam to provide good visibility at closer ranges. And since you have switched from four headlights to two, that guy thinks you have switched to low beam already and doesn't get mad at you for blinding him.

Fog/Driving Lights

FOG LAMPS -- DEFINED: In the US, fog lamps are yellow illumination lamps mounted low on the front of the car to provide visibility in foggy conditions. However, in some other countries, fog lamps are markers mounted at the rear of the car to enable other drivers to see *you* in foggy conditions. Naturally, Jaguar is only moderately helpful in keeping these two applications distinct in their manuals and schematics. In this book, "fog lamps" shall always refer to the yellow lights at the front of the car; when talking about the lights at the rear, the term "rear fog lamps" or something of the sort will always be used.

FOG LIGHT SHORTS: Jim McGuinn reports that he had an intermittent short circuit in the fog lights that he found was the rear of the bulb socket assembly arcing to the housing. A bit of electrical tape solved the problem.

FOG LIGHT KIT: While fog lights were standard equipment on XJ-S's for many years, Bill Kubida reports that somewhere around '93 they became an option -- and therefore Jaguar started offering an official fog light kit. "The addition of the front fog lights requires the addition of a suitable switch to the array of existing switches. For reasons known but to God and Jaguar, the addition of the single additional switch requires the following:

> a) removal of the switch block to the left of the trip computer which has a button for the rear screen heater and another for the rear fog lights. This switch block is then replaced by a new one having a front fog light switch and a rear fog light switch;
>
> b) removal of the switch block to the lower left of the steering column which has a button for the hazard warning lights and a blank-out plate. This is then replaced by a second switch block having a hazard warning light switch and another for the rear screen heater.

"I am certain that if we put a Cray IV to work on it for a couple of years a more complex system could be figured out, but personally, I doubt it."

AFTERMARKET FOG LIGHTS: If your car didn't come with fog lights, or your original fog lights met a curb, you don't really need to contact Jaguar; fog light kits are available everywhere, and any rectangular model can be installed under the front bumper and look fine on the XJ-S. It's a good idea to check on the availability of replacement lenses, since they are prone to damage. You might also check to see if the lenses are thick and substantial to resist all but the most powerful impacts. And you might check the availability of covers.

You might also wanna check the quality of the light and the pattern. As with most things, you get what you pay for. A good fog light will direct the light downward around the front of the car, staying under layers of fog if possible; a cheap fog light will leak light upward causing glare.

If cheap is what you're looking for, Wal-Mart and AutoZone offer "Blazer" driving/fog light kits. These sets are amazingly cheap -- barely more than the value of the H3 bulbs included. If you break a lens, the replacement lenses are for sale right next to the light kits on the rack!

If you're looking for good fog lights, the systems using the dichroic filters described by Daniel Stern on page 658 are the way to go.

When installing fog lights, be sure to provide a suitable ground connection -- directly to the base of the bulb itself, if possible.

FOG/DRIVING LIGHT BULBS: Fog lamps or driving lamps are usually fitted with either H2 or H3 bulbs. H2 bulbs appear to be mounted on a metal blade while H3 bulbs have a circular metal base with two notches, one rectangular and one semicircular, and a short wire attached with a spade terminal at the end. Both are typically 55W.

FOG/DRIVING LIGHT BULBS -- MORE POWER: 100W H2 bulbs are available from J. C. Whitney. 100W H3 bulbs are available at many auto parts stores, and you can get 130W versions from J. C. Whitney.

ALTERNATIVE CONTROL SCHEMES -- FOG LIGHTS: To see in fog, it is essential that the fog lights be the *only* lights on; main or low beams just cause glare. The simplest modification for US-spec cars would be to disconnect the RU wire from the inhibit relay, which causes the fog lights *only* to operate on the top position of the headlight switch. Once that change has been made, it would be just as well to remove the inhibit relay entirely as it serves no function.

A more elaborate idea for convenient fog light operation is to rewire the car so that you can put the headlight switch in one position and use the stalk switch to flick back and forth between low beams with fog lights and fog lights only. That way, when you come out of the fog bank, you can just flick the stalk to bring on the low beams for better visibility in clear air, and just as easily turn them back off when you encounter the next patch of fog. There's really no need to be able to get to high beams without putting the master lighting switch in another position, since whenever there's fog around you won't be driving fast enough to need high beams.

Note that you might need to check local laws here. At one time it was illegal in some states to drive at night with fog lights only, fog or not. Hopefully, more rational legislators have repealed such laws... what am I saying? There's no such thing as rational legislators, or the stupid laws wouldn't have been written in the first place! Maybe you can get by with a set of pilot lights; maybe the cops are stupid enough to think the headlights are "on" -- at least long enough for you to get past.

FOG LIGHT AIMING: Since you aren't that concerned with distance (you won't be driving that fast in fog) but you are concerned with curbs and the like, you may want to aim your fog lights a bit skewed -- each one aimed a few degrees to the side. Aiming them crosseyed accomplishes the same thing, just using the left light to illuminate the curb on the right side of the car. Whatever you do, though, don't aim them upward; ideally you want absolutely no light above bumper level, even 100 yards out.

DRIVING LIGHTS: Everyone knows that driving lights are white and fog lights are yellow. Many people know that driving lights focus light far ahead while fog lights spread it low around the front of the car. What many people seem not to know is that fog lights are mounted low on the front of the car, as close to the ground as possible, while driving lights need to be mounted high. Above the bumper at least; rallye cars mount them on the roof!

In other words, the lights mounted under the front bumper on the XJ-S really need to be fog lights. Fog lights will work great here; driving lights won't.

Of course, the reason you want driving lights is because you hate the looks of the yellow lenses. If so, here's a better idea: Install a set of modern fog lights with clear lenses and the dichroic filters right on the bulbs themselves -- which appear blue when the lights are off. These are better than the old yellow fog lights anyway.

Or perhaps you want driving lights because you can't see well enough with just the headlights on. This may be a valid reason if you have the US-spec Carello headlights, but with any of the other configurations of headlight on the XJ-S you'd be better off upgrading the headlights themselves as described in the earlier sections.

If you must install driving lights, kits are available everywhere. Perhaps the best place to mount them on the XJ-S would be within the upper grille.

As always, you get what you pay for; really good driving lights will provide a carefully-controlled pattern of light down the road, while cheap ones will just throw light everywhere and cause glare in rain and the like.

DRIVING LIGHT AIMING: How you aim driving lights will perhaps depend greatly on the light pattern they provide. If they project a tight beam, you'll probably want to aim them straight down the road to take advantage of that pattern. If they just provide a flood of light in the forward direction, though, you might consider aiming them crosseyed or skewed so they help illuminate the sides of the road in curves.

ALTERNATIVE CONTROL SCHEMES -- DRIVING LIGHTS: If the car is fitted with driving lights, it might make sense to rewire the XJ-S so that all the headlights and driving lights work at once. In fact, later US-spec XJ-S's came with a master lighting switch with an additional position that operates all six lights. It may be possible to retrofit this switch into the earlier cars. Or, you can simply rewire the "inhibit relay" scheme in the earlier cars, allowing high beams and driving lights to be used simultaneously; it might also be a good idea to add relays to prevent overloading any circuits.

With the options available for improving the headlights, there really is little reason to operate the driving lights simultaneously to get *more* light; you should be able to get plenty of light from the main beams. However, the driving lights might make excellent "cornering lights" if you aim them towards the sides of the road.

In many US states, there once were laws that prohibit there being more than four headlights on a car. Jaguar's intention for the inhibit relay was to prevent use of the high beams while the fog/driving lights are on, thereby making the 4-headlight US-spec car comply with the law. It is unknown how these laws have evolved now that the law requiring standardized headlights has finally been eliminated (thank God!). The owner is advised to check his state's current regulations before rewiring for all six lights to operate at once.

If your desired wiring scheme requires another switch, John Goodman points out that the UK cars have a different headlight switch which can be pushed in to turn on "fog lights" at the rear of the car; this push facility could be used for whatever your little heart desires, leaving your dash uncluttered with additional switches.

Horn

Steve S had his horns quit working, and found that the problem was a lack of ground connection at the steering column. There is a little copper spring that rides on the rotating shaft in the center of the column to electrically connect it with the outer casing -- but the outer casing may not be securely grounded! "I've run a separate earth from outer column to car body and everything's OK again.

"I couldn't find any proper earth wire from outer column to body; looked like Jag relies on the four bolts which hold the column to the body. I gave these 4 bolts an extra tweak but it didn't make any difference. I ran a 3" long wire from a convenient bolt head (looked about m4) on the plate on the front of the steering column lock mounting plate to a cluster of 4 black wires joining together at a 4 way bullet connector coming from the column stalk switch area."

Radio/Sound System

INTERCHANGEABILITY: Greg Meboe says, "During the 70's and 80's, the sedans and XJ-S's used the same radio, exactly. Until 1988 of course, when the radio in the sedan had a curved faceplate to match the new dashboard."

RADIO WIRING DIAGRAM: Greg Meboe adds, "On the top of my '84 cassette player which I removed to install the DIN radio, there was printed a nice wiring diagram for the color codes of the Jag radio circuit. I haven't been able to find this in the general manuals, and it's valuable information for anyone who is installing an aftermarket radio in their Jag."

RADIO REMOVAL: Steve Broady, regarding the late-80's radio: "Assuming your radio is a Blaupunkt made in Korea, you will need to cut a coat hanger into 2 pieces like a pair of U's to push into the front plate holes to remove radio from bracket. When you pull the radio out of the dash watch for ground strap on left side as bolt protrudes into bracket." Note that what Broady describes is actually a fairly common type of mounting, and the little U-shaped pokers are actually available separately at auto audio stores.

RADIO SECURITY -- REMOVABLE FACEPLATES: According to Greg Meboe: "The 86 Jags came with the removable-face tape deck, a design which has made radio repair/replacement outfits a lot of money due to its low service life. The face comes off to ward against theft, but the connectors for the face don't seem to cut the mustard."

Vince Chrzanowski, who repairs and restores old car radios, says, "The faceplates can't be repaired by ordinary mortals. The commonest failures are not in the LEDs, but in the surface-mounted integrated circuits which are hidden under mounds of epoxy. Additionally, the slide controls are among the most failure-ridden we've ever seen. But the faceplates *can* be purchased in repaired form. Our source for rebuilt faceplates is Southern Autotronics in Virginia (1-800-446-2880, usual disclaimers apply). The last time I purchased one, the technician indicated that they were in short supply. That was about two years ago.

"The 9500 series radio was, in my opinion, not nearly as reliable a radio as the so-called *lesser* 8600 series. After struggling for a few years to keep the 9500 alive in my '85 XJ-S (faceplate, tape deck and pc board failures), I opted for the 8600 and have been perfectly happy ever since. Actually, the 8600 is much easier to use and much safer to operate on the road."

RADIO SECURITY -- CODES: Somewhere around 1986, Jaguars came with a radio that had another security feature: if the power was disconnected, the radio would never work again unless the correct security code is entered. Presumably, people who steal radios won't steal one they can't use.

Of course, you can choose any repair procedure in the manual, and chances are the first step is to disconnect the battery. If you already went through this and your radio is now nonfunctional (or you have stolen such a radio), you apparently will need to contact your friendly dealer to obtain the security code. You may also need to provide a serial number that begins with "B" that is on the case of the radio.

If you would like to avoid the grief, reportedly there is a product on the market that can be plugged into the cigarette lighter. It uses a 9V battery, and will keep a small amount of power on the system while the battery is disconnected. It will supposedly keep the radio operational, stations programmed, etc.

CONDENSATION DEFLECTOR SHIELD: Apparently, either plugged condensate drains in the A/C system or leaking heater cores have a tendency to dump water on the stereo -- and some of those stereos ain't cheap! So, Technical Service Bulletin #8685 says essentially that a "condensation deflector shield" *must* be installed on all XJ-S vehicles prior to VIN 163790 whenever the mechanic is working in the area. The part number for the deflector is CBC 9193, and it appears to be *very* easy to install, requiring only 0.10 hours.

SPEAKERS: The '83 XJ-S comes with a decent sound system, except that it lacks tweeters. It is highly recommended that if your car doesn't have tweeters, buy some and add them. You can just add two in the front -- some people feel that only bass notes should come from the rear to give the impression that you are "facing the orchestra" -- or you can add one at all four corners to provide a complete surround sound. Just wire them in parallel with the existing speakers. If there are any induction coils in the line to the existing speakers (they are sometimes installed in an inline fuse holder), wire the tweeters in *before* these, so the induction coils serve the existing speakers only.

There are many types of tweeters available. The best kind are a 1" or smaller dome tweeter; some may have a dome made of plastic or even titanium, but either way they provide excellent high frequency sound and excellent dispersion. The size refers to the size of the dome itself, but nevertheless the entire thing is pretty small -- and they're usually fairly inexpensive as well. The sound from tweeters is pretty directional, so some tweeters come with a mount that allows you to aim them -- but even if you just mount them flush in the doors, the sound will be vastly improved over no tweeters at all. Be sure to get 4 ohm tweeters; the 8 ohm tweeters are intended for home systems. Dynamic tweeters will usually come supplied with a capacitor; wire the capacitor in series with the tweeter. This forms a filter that keeps the bass notes from being applied to the tweeter, which might burn it up.

Another good option is to go to Radio Shack and buy piezo tweeters, Cat. No. 40-1383. The nature of a piezo tweeter means that you don't care about ohmage or filtering, just wire them in. They're cheap, sound good, and are almost impossible to damage.

MAKING THE AFTERMARKET RADIO FIT: Greg Meboe provided some guidance on how to get a fancy new stereo to fit in my old Jaguar. "Your car is an '83, so it would have originally been fitted with a two-knob cassette player with manual pushbuttons for play, ff, rr, and eject. This radio was fitted from '82 to '84, inclusive. The metal facia panel (fibre-optic panel) which was fitted with this radio has a cutout which resembles a side view of a foot-long hot dog stuffed into a normal-size bun. Starting in model year 1985, Jaguar began to fit the more modern, rectangular faced radios which use a large, rectangular facia cutout. The fibre-optic panel fitted to 1985 and newer sedans and S's will therefore accommodate any modern DIN radio without modification. The radio mounting scheme for the Jaguar was the same throughout the years, so a person could install a 1985-on Jaguar radio in their pre-'85 car just by fitting the later style fibre optic panel." This panel is shown on the "Heating and Air Conditioning-Controls" page of the Parts Catalogue (besides framing the radio, the panel also holds the knobs for the A/C system). The part number of the 1986-on panel is DAC3418.

"For the structural mounting of the radio, modern aftermarket units seem to have a series of standard 8mm mounting holes on the side. I made up a set of steel brackets to fit these standard holes, and mount the radio in the fashion that Jaguar intended -- with the nylon push fasteners in the front."

BLOWING FUSES: Typically, the first time you crank up the volume on your high-powered aftermarket stereo system, it'll go silent on you. Sean Straw says, "There are three fuses associated with your stereo - the fuse in the passenger side fusebox (RADIO/CIG LIGHTER), the fuse on the stereo itself (well, any self-respecting stereo will have one), and one on the line between the two, which as the manual describes, should be in the console (actually, the Jaguar service manuals claim it is "behind the stereo").

“I'd installed a new stereo, and I had it turned up a bit, then switched to the cassette, and it just blinked out. After some probing around, I determined that it was the fuse between the stereo and fusebox, and located it roughly forward of the cruise control switch on the console (underneath the driver-side console ashtray). It will require that you remove the console veneer entirely.

“I found the fuse wiretied closely to a bundle, as well as electric taped over the fuse housing to another line (dunno why - I eliminated the tape when I was in there). I found a 2A fuse in there, but the manual calls for a 1A - both of which are odd, given that the stock Jaguar stereo had a 10A fuse on it -- fused to that same power input as the inline fuse is on (as versus the ignition/accessory input which tells the stereo to wake up). I checked with the local Jaguar dealership and he said there shouldn't be a problem for that line to carry 10A, so I switched the inline fuse to a 10A and the stereo works fine.”

Actually, the situation could use a little more explanation. The Haynes manual and the ROM seem to talk only of a “radio” and otherwise provide little info on wiring of the stereo system, but with almost any system there are actually two separate power supplies: a switched and an unswitched. The unswitched is connected to the battery at all times while the switched turns on and off with the ignition key. In the old days when things were simple, the unswitched line drew only a tiny amount of power, since all it did was maintain the settings on the tuner presets and the like; the switched line, which powered the amplifier itself, the tape drive mechanism, and anything else you didn’t want on when the car was off, drew the relatively heavy current. Hence, the switched line would be fitted with a 10A fuse or some such, while the unswitched line would get only a 1A.

Then the serious autosound buffs came up with the idea of installing huge capacitors in the power supply to a stereo system. These “stiffener capacitors” can range from 0.25 farad (already larger than most any other capacitor used anywhere by several orders of magnitude) up to 1.5 farad; the rule of thumb is 0.001 farad for each watt of amplifier power. These capacitors are typically about the size and shape of a 12-oz. beer can, and some stereo buffs connect up entire banks of them! Their purpose is to maintain a rock-steady voltage supply to the stereo when the stereo itself calls for a sudden surge of power, such as when a heavy bass note is hit.

The problem is that such capacitors cannot be on a switched line. In fact, installing them in a car requires some care in pre-charging through a resistor before connecting, or something will get fried. Once installed, they must remain in continuous connection with the battery at all times, and disconnecting the battery for servicing the car requires discharging and recharging through the same resistor when reconnecting. If installed on the switched circuit, the first time you hit the ignition key the contacts within the ignition switch would weld themselves into a handsome little glob.

As a result of these developments, the modern stereo systems have changed the standards. They still require a switched and an unswitched power supply, but in order to take advantage of stiffener capacitors and other power supply upgrades, the heavy current is taken from the unswitched line. The switched power supply now becomes merely a “signal” that the ignition is on, and therefore draws almost no power.

Obviously, if you remove an original deck that drew its amplifier power through the switched line and install a newer deck that draws its amplifier power through the unswitched line, the first thing that’s gonna happen is you’re gonna blow the tiny fuse that was originally intended only to maintain station presets. Straw’s dealer is correct, almost any circuit in the car will handle a 10A fuse without trouble, so you can merely replace the 1A inline fuse with a 10A to make your new deck work. On the other hand, you might opt to run a new heavy-duty power supply wire from one of the two main terminals on the firewall directly to your new deck to make sure it’s not starved for amps when you’re rockin’ out.

CD CHANGER ADDITION: David Brown sends this info on installation of a CD changer in the boot: “I believe all post-’88 cars are pre-wired. Depending on what year you have, a 7-pin DIN socket (that’s what we call it in the UK anyhow) will be found in different places in the boot (trunk).

“... a Clarion changer unit will plug straight in and you’re all set.

“For a Philips or Alpine unit, you have to disassemble the plug on your CD changer and rewire a couple of pins around. Basically you can *control* the unit as it is currently wired, but you would hear nothing. The head unit expects the sound signals to be traveling down some otherwise unused pins. Simple experimentation shows what they are.

"On my Philips unit, I had a DIN plug which carried the instructional/power signals and had separate phono/tulip plugs which carried the sound. I patched those sound signals back into the DIN plug at the 11 and 1 o'clock positions. You could find out which pins *should* carry the signal by half connecting the CD changer to the cars socket, such that the changer works but you can still see the pins. Then dab each pin with a phono cable until you hear the music come through. Then you'll know which DIN pins are expected to carry the sound signal."

If you have this connector, the stock Jaguar stereo includes controls to operate these CD changers remotely.

CD CHANGER ADDITION -- FM MODULATOR TYPE: If you have an earlier car that isn't pre-wired for a CD changer, you can still add one by getting the type that splices into the FM antenna. This is convenient, since the antenna on the XJ-S is in the trunk. Such systems inherently lack some of the high frequency response of a directly-wired CD player, but it'd be the rare individual indeed who could tell the difference.

Bill MacDonald says, "All CD changers have a gain control for the output to the FM modulator. The little silver box that has the antenna wires and data and power connections contains the modulator on older Sonys. New models of all brands seem to be building the modulator on the circuit board right inside of the changer. You can adjust the gain either by an adjustment that is made for you to adjust the gain on the box or open it up and you can adjust a universal gain or a single left and right gain. You are supposed to match the FM volume equal to the CD volume, but it's your choice.

"You can also adjust the frequency deviation and offset; a lot of radios are not tuned exactly as they should be and sound scratchy or "s" words sound horrible. Be very careful and use plastic adjustment tools and I only recommend this if you have patience and dexterity because you can also detune the carrier and pull it out of PLL stereo mode. But if you sit in the middle of a quiet car with no noise around you and relax and adjust the modulator with your ears you can tune it in to sound a lot better than what it was factory adjusted to."

HEAVY-DUTY POWER: If you're installing a whopper of a sound system, you might consider replacing the Lucas alternator with a GM alternator as described beginning on page 576. This would permit installation of a reasonably-priced 140-amp alternator.

If 140 amps isn't enough, you may want to note the idea of replacing the air pump with a GM alternator discussed beginning on page 580. While the intention there was to eliminate the original Lucas alternator, there's no reason this same modification couldn't be used to fit the XJ-S with *two* alternators. Connecting two alternators to a single electrical system is reportedly unwise, but providing two entirely separate electrical systems is reportedly a fairly common exercise in the world of high-power sound.

Antenna

TYPES: In general, two types of antenna ("aerial" in the Jaguar parts books!) were used in the XJ-S. Up through VIN 123280, a Merlin antenna DAC3542 was used; this is a remote unit in which the drive assembly is buried under a panel in the right side of the trunk, and a cable housing connects it to the mast. From VIN 123281 on, a Hirschmann antenna DAC3579 was used; this has a black plastic rectangular housing. It is not remote, the drive assembly is right where the antenna is.

Richard Mansell says "I have a feeling the XJ40 uses the same electric aerial as the later XJ-S's." Actually, not quite right; the XJ40 uses a Hirschmann antenna DBC5101, but this unit looks almost exactly the same except for the electrical connection. It even uses the same replacement mast.

ANTENNA VS. SPOILER: Richard Mansell: "When you have a boot spoiler it's a bit of a problem as the mast goes through a small hole in the spoiler!" John Goodman explains: "On the boot spoiler equipped cars there is an additional relay wired into the boot light switch. The idea is that when the aerial is extended, radio and ignition on, lifting the lid very slightly causes the boot light to come on and the aerial to retract (after the stupid 4 second delay)."

ANTENNA MAST LUBRICATION: Michael Minglin says, "Porsche dealers sell a small foil packet with an oil soaked swab inside. This is to lubricate the antenna shaft." Hal Rogers (see page 712) adds, "Jaguar also sells a similar lubricating pack as well. A number of Jaguar specialists (like myself) carry it. It is very inexpensive." Considering the wealth of information listed below on repairing the antenna, maybe this lubrication is a good idea.

MERLIN ANTENNA DRIVE WIRE REPLACEMENT: Steve Leamy says: "Some models use a plastic drive wire instead of metal; you can repair these with weed eater line but you have to remove the motor base and ant to service it."

Dan Jensen tried using 0.080" grass cutter line, and it didn't work. "The main problem was it was stiff enough when coiled into the tight end of the coil guide that it popped out between the guides and jammed. I think having a material that (a) is reasonably flexible, (b) is tough enough to stand repeated uncoiling and coiling, and (c) has an o.d. near 0.125 are all important. I see no reason why grass cutter string would not work, but the o.d. needs to be close to 0.125 in. Note that the original extend/retract cable has a small hole in the center, i.e., it is *very* thick-walled tubing vs. flexible rod."

"I also tried PTFE (Teflon), but it quickly failed due to the repeated flexing. Ultimately, I used 0.125 inch flexible polyethylene rod purchased from a local valve supply company. This has worked without problems."

MERLIN ANTENNA MAST REPLACEMENT: Hal Rogers of H. D. Rogers & Sons (page 712): "It does not have a replaceable mast, never did."

ANTENNA CLUTCH ADJUSTMENT: Steve Leamy sends instructions on adjusting the drive clutch, apparently on the Hirschmann antennas but perhaps applicable to all: "This repair covers ant that just won't quite make it up or down and still makes a clicking noise before stopping.

"You want to get to the side of the unit that looks like a cup and has a screw in the middle of it. Remove the screw and the cover and you will have now exposed the clutch drive for the ant. On the shaft in center you will find a locking nut which you will now back off 1 or 2 turns, now grip the metal clutch and tighten 1/2 turn. Retighten locking nut and prop unit up so you can test it. Turn key on and radio and ant will raise in 15 to 20 seconds, once ant reaches full height you should hear 3 bumps and ant motor should shut off. Turn key off and ant should go down completely and 3 bumps and motor will cut off. If ant still does not go full up or down adjust clutch in quarter turns until a full stroke is attained.

"On 88 and above XJ's I have found three different manufacturers of ant in the cars I have serviced the but all of them use some type of clutch system and can be fixed by resetting of the tension on it."

HIRSCHMANN ANTENNA MAST REPLACEMENT: While the Merlin mast is driven via a plastic wire, the Hirschmann mast is driven by a plastic strip with a row of teeth down one side. These teeth engage a drive sprocket inside the unit.

A repair kit is available for Hirschmann antennas, including the mast and the plastic gear rack. The Jaguar part number is DBC2200. According to Hal Rogers, "The mast is the same for some German cars."

John Goodman suggests: "Replace the mast the easy way!!!

"1. Undo mast securing nut on top of wing/fender(leave unit intact in car).

"2. Get helper to switch radio on, while you pull up on the mast, the motor will extend the mast right out of the car complete with nylon cable.

"3. Put new mast into hole, get helper to turn radio off, motor will pull new mast into hole, tighten securing nut."

HIRSCHMANN ANTENNA -- BROKEN DRIVE COG: Samuel J. Louw shares his experience on his '89 XJ-S with the Hirschmann antenna: "I tested it with the cover off and saw that the motor was driving the gear, but that the second gear driving the antenna was not turning. I took the two gears apart and found the plastic pin transferring the driving force from the drive gear via the internal spring to the antenna gear broken off. The first glue attempt was unsuccessful, but on second attempt I enlarged the hole, which the plastic pin already has, a bit and fitted a small self-tapping screw, together with some steel epoxy. Antenna is working fine now. Glue and screw just needs to be flush with the gears."

HIRSCHMANN -- OTHER FAILURES: Most automatic antennas have a motor with a worm gear on the shaft that drives a wheel connected to the spool that winds the mast up and down. The Hirschmann has a difference: instead of the worm gear being on the motor shaft, it's alongside the motor and there is a tiny toothed belt driving it. So, if the thing isn't working, it may be because this tiny belt has snapped.

ANTENNA REPLACEMENT: The original Jaguar antennas are incredibly expensive, even when the mail order shops put them on sale. If you're not real concerned about originality, you can replace either the Merlin or Hirschmann antenna and its delay relay with any of several antennas from J. C. Whitney or any local auto parts store for around $40. It won't have that 10-second delay before going down, but nobody's ever figured out what that's for anyway.

If you're replacing a Merlin, there are aftermarket antennas with remote drive arrangements available for a few more bucks if you'd like to locate the drive in the same place the original was. Hal Rogers of H. D. Rogers & Sons (page 712) says, "The unit that we sell which is a replacement unit, not exactly the original, and you may need a fitting kit as well...It replaces DAC3542 or DAC4090 Jaguar part number."

You don't really need a remote type unit, though; you can install a cheap replacement with the motor right on the bottom of the mast rather than remotely connected, so it's in plain view within the trunk. You can fashion a cute housing or cover around it if you wish. Typically, a remote drive antenna is used where space is a problem, but it's not a problem in the XJ-S; there's no telling why Jaguar selected the remote Merlin unit for its early models.

When selecting an antenna, always insist on one that is "fully automatic", meaning it raises or lowers automatically when the radio is switched on or off; the "semi-automatic" antennas are electric motor driven, but you must control them manually from a rocker switch installed somewhere. The difference is only a couple bucks, so it's not worth the effort to install and use a semi-automatic.

Also note that the ideal extended length for an FM antenna is about 31". Any shorter *or longer* will give less-than-optimum FM reception.

The aftermarket fully automatic antennas usually have two wires aside from the coax cable itself, one that should be connected to 12V power and one that should be connected to a signal wire from the radio. If you are installing a generic antenna, remove the original antenna along with the green delay relay attached to it. Connect the WK wire in the car to the signal connection on the antenna. Connect the NP wire in the car to the 12V connection on the antenna. If the antenna came with a fuse in the line you can include it in the circuit, but the XJ-S already has fuses in the circuits so you can just discard it if you'd prefer. If the antenna has a black wire, connect the black wire in the car to it; if not, make sure the housing of the antenna motor is grounded to the car, either by the mounting scheme or by connecting the black wire to it.

Also, both the original antennas as well as the aftermarket units have a drain tube to dispose of rain water that runs down the antenna into the housing; route the drain tube somewhere outside the car.

The antenna installation instructions also direct you to adjust the antenna trimmer on the radio. However, if your radio has an electronic tuner (digital display instead of mechanical needle), it probably has no such adjustment.

If you really like that 10-second delay, you can opt to keep the green relay in the circuit. Leave the WK and NP wires connected to the delay relay the way they originally were. Provide a connection from the NP wire to the 12V power connection on the antenna, which may require tapping into a line. Then connect a wire from terminal 4 on the delay relay (where the UW wire was originally connected) to the signal wire on the antenna. Tom Graham says, "The Jag relay spade connector we want will have voltage (battery) on it when the radio is on. Check this with a volt meter to chassis ground. Then turn the radio off, the voltage will drop off in about 15 seconds (this is how the delay works)." Note that terminal 5 on the delay relay, where the UR wire was originally connected, is not used in this scheme.

Miscellaneous Interior Stuff

SEAT HEATER: Later XJ-S's come with a seat heater, and apparently it lacks reliability. Stefan Schulz sends a description of the repair of this unit:

"The seat is connected to the car electrics through three different connectors, one for the seat belt logic (cable runs under centre console, pull carefully to expose connector), one for the lumbar pump, and one for the seat heater. The latter two are under the seat and can be accessed most easily by moving the seat as far to the rear as possible.

"Having disconnected the seat heater connector, check with a voltmeter whether it delivers power when the seat heater is switched on. If it does, the problem is somewhere in the seat. Remove seat.

"Turn seat upside down in a clean area. Locate the connector that connects the bottom seat heater in series with the one in the backrest. Pull it apart. Use an ohmmeter to figure out whether the bottom or the backrest heater is faulty.

"If the bottom heater is faulty, remove the black rubber cover from the bottom of the seat. See where the heater power supply wiring enters the bottom cushion ? Good. Carefully pull it apart at that point, exposing the top of a cheap and nasty heater element.

"Cut the top covering of the heater element to one side of the thermostat and flip it over to the other side to expose the thermostat element. Don't cut it away, you'll need to put it back later.

"There are three joints within the seat heater element. Orange/slate wire to thermostat, thermostat to heater element, heater element to black wire. Examine all three joints. Note that they get hot (hey, they're part of a heater) and are moved and flexed constantly. Solder joints should never be used in areas that get hot or which are under mechanical stress like the one these wires are experiencing. So what did the cheapskate Jaguar designers use? Exactly. The thermostat is cheap too, and its connection lugs will be badly oxidized.

"Take out the thermostat and subject it to the usual boiling water/ice water routine to test it. Check with an ohmmeter that it opens when in hot water and closes when in cold. Being more precise with a cheap part like that is a waste of time. If you find that the thermostat is faulty, you'll see that it is not a Jaguar part. Jaguar wants you to replace the entire heater and cushion assembly. But this 'stat doesn't do anything any other 45°C/12V/10Amp bimetallic 'stat wont do, so get a replacement from an electronics shop if necessary.

"Solder the thermostat back in, using weapons-grade solder wire with a high silver content and consequently high melting point. You did remember to dry and clean the connection lugs first, of course. Re-solder the third connection (heater to black wire) as a matter of course.

"Squeeze the thermostat back into the cushion, make sure that none of the heater wires touch it. Put back the top covering using *solvent-free* glue and a staple at the end. If you use glue containing solvent, you will find that that works the same way as the naturally occurring rot of the seat foam, only a lot faster - seconds instead of years. Use an ohmmeter to check the resistance offered across the seat heater connector now - it should be about 1.8 ohms.

"Refit all the other components by reversing the removal sequence. Put the seat back in the car and connect it

(remember the seat belt logic connector!)"

GLOVEBOX LIGHT: The XJ-S doesn't have one! What a cheap car. It's easy enough to install one, though. Just buy a suitable light fixture at your favorite auto parts joint, and install it in the top of the compartment just behind the latch. Wire it into the interior light switch just to the left, so when the switch is operated it will turn on both the right front interior light and the glovebox light.

In the author's '83, there is an unused 2-conductor connector hanging out of the harness directly above the glovebox -- you'll need to take the glovebox out to see it. The wire colors are R and B. This may have been intended to power a glovebox light at one time. The B wire is a ground, and the R wire comes from fuse #15 in the auxiliary fusebox -- which is the fuse to the right front parking and marker lamps. Hence, if a glovebox lamp were to be powered from this connector, the lamp would be on whenever the parking lights are on. If you don't like that, you would need install a glovebox door switch in the circuit so the lamp was off unless the glovebox was open.

There are other implications of using that connector. Any current drawn through it comes through the bulb failure sensor for the right front corner of the car. Hence, the increased current could fool the sensor into indicating that the bulbs are all OK when, in fact, one is burnt out. If you don't provide a glovebox door switch, you probably should readjust the tiny screw on the bulb failure unit to put its sensitivity back where it belongs.

To avoid getting confused by voltmeter readings, remember that bulb failure sensor has resistance in it. On the author's car, the voltage at that connector was about 10V while the battery was at a solid 12V.

Yet a third power source possibility is a dedicated power source with a switch -- a glovebox door switch or even just a manual toggle inside the glovebox. There are lots of solid brown wires in the area; all of them have 12V whenever the battery is connected, and all of them have enough capacity to handle a glovebox light with no sweat. The main firewall power terminal isn't too far away, but you'll have to remove the rubber duct to get to it.

CIGARETTE LIGHTER: Apparently, some XJ-S's were equipped with some sort of non-standard cigarette lighter. This causes two problems: first, when the element in the lighter quits working, it's hard to find a replacement; and second, it may prove problematic to plug accessories into the cigarette lighter hole. If you are having either of these troubles, the easiest solution is to drop by any auto parts store and buy a generic cigarette lighter and install it, and throw that hokey Jaguar one out.

WHERE IS LUCAS TODAY? "Lucas merged with the Varity corp in Sept. '96. Varity is what was left of Massey-Ferguson after it was chewed up along with Kelsey-Hays. The president of Varity is now in control of the new LucasVarity and it seems that he has no love for Lucas or the name. US automotive operations will cease in the next few months for Lucas and will only be represented by a company called AutoSpecialty which was just recently acquired and based in LA CA. which will market no Lucas product but will be owned by LucasVarity. AutoSpecialty supplies undercar and braking products. LucasVarity will continue for a while in Europe but a team is taking surveys at present for a new name for the merged company, and it won't be Lucas."

Cruise Control

PRE-1992 VS. 1992-ON: Richard Mansell quotes from a Jaguar publication describing the changes for the 1992 model year:

> "New cruise control: The V12 models now feature the Hella speed control system as fitted to the pre-92 MY 3.6 coupe in place of the AE Econcruise system. This gives more logical layout, more accurate control of speed, the addition of a cancel function."

As of now, this book only addresses the pre-1992 cruise control.

PRE-1992 CRUISE CONTROL: Thanks for the following procedures for troubleshooting the Jaguar cruise control system go mainly to Tom D. Graham.

CRUISE CONTROL DESCRIPTION: An electrical signal from the drive train tells the cruise control system how fast the car is going. On early XJ-S's there was a dedicated sending unit near the input flange on the differential. Later XJ-S's split a signal from the speedometer transducer on the transmission. On still later models, the speedometer transducer is built into the differential unit itself. See page 593 for notes on these senders.

The signal is processed by the cruise control electronic control unit. This ECU directs the amount of vacuum in the bellows unit and the bellows unit operates a cable to the gas pedal/throttle.

Within the bellows assembly are two solenoids, one which normally (cruise control off) vents the bellows to atmosphere and the other which normally seals off the vacuum line from the intake manifold. The "vent solenoid" is connected to the yellow/white and black wires, and the "vacuum solenoid" is connected to the yellow/white and yellow/black wires. When the control unit calls for speeding the car up, 12V is applied to the yellow/white wire, activating both solenoids. The vent is sealed and the vacuum line is opened, and the resulting vacuum within the bellows pulls the cable, applying throttle. The speed control unit modulates the ground connection of the vacuum solenoid to apply the proper vacuum to maintain a constant speed.

On the brake pedal housing is a switch that breaks the yellow/white wire whenever the brakes are applied, effectively shutting off the system and allowing the throttle to return to idle. This is actually a back-up feature; the power from the brake light switch is also sent to the speed control unit, which is supposed to drop the power to the yellow/white wire. Note that if the brake light circuit fails and doesn't put the cc into decel mode and the backup switch is the only thing that disables the actuator, as soon as the brake pedal is released the cc will resume and the car will accelerate.

CRUISE CONTROL RECALL: As the result of a recall, there is usually a blue solenoid valve installed in the vacuum line to the bellows unit. This device is designed to seal the vacuum line and vent the bellows unit in addition to the solenoids. It's mounted at the right front corner of the engine.

Of course, it might not be installed correctly. Dave Kautz says, "I've been fussing off and on with my cruise control, trying to figure out why it doesn't work. This past weekend I bypassed the little blue solenoid valve mounted at the front of the right-side cam cover. I believe this part was added as part of a retrofit as it doesn't show up in any of the documentation I have on the workings of the cruise control. Well, bypassing it didn't fix my cruise control but it did lower the idle speed several hundred rpm indicating to me that it was behaving as an air leak even it the de-energized state. It looks to be a three-way valve with the cruise servo side vented to atmosphere when the valve is (supposedly) closed so the air being drawn in was un-filtered - lovely... I mention all this as one more place to check when folks are chasing down a high idle problem. After hooking the vacuum line from the cruise control servo directly to the manifold tap it took more than a full turn on the idle "screw" to get the idle back up to 750 rpm."

Kautz's solenoid valve had been installed backwards, probably by a dealer mechanic performing the recall. It is a 3-way solenoid valve, but when de-energized it's supposed to connect the cruise control servo to atmosphere, not the intake manifold! And it's supposed to have a little filter on it so that even the cruise control servo doesn't get unfiltered air.

CRUISE CONTROL ADJUSTMENT: If the cruise control is adjusted correctly, when the set switch is pressed the system will maintain the speed the car was doing at the instant the button was pressed. If adjusted incorrectly, it will maintain either a higher or lower speed. Hence, the test procedure is drive the car on a straight and level road and press the set switch, allow the speed to settle about ten seconds, and press it again. If adjusted properly, it can be set over and over and still maintain the same speed. If incorrectly, the repeated sets will result in gradually higher or lower speeds.

If adjusted incorrectly, adjust the speed control unit until correct; it is a simple matter to have the speed control unit hanging under the dash (it is located above the passenger side footwell) and the necessary tools along for the test drive, and preferably an assistant driving. Although the repair manual describes a method of adjusting the cruise control, some of these units have no obvious adjustments. If you pry the box open, however, there are two adjustable pots on the circuit board. The one to adjust is the one in the corner, farthest from where the wires enter the box. NOTE: The adjuster is *very* sensitive; it is difficult to move it a small enough increment.

SERVO TROUBLESHOOTING & REPAIR: If you have an ohmmeter, unplug the connector to the bellows unit and check the resistance across the bellows solenoids, yellow/white to black and yellow/white to yellow/black. Each solenoid should register 25-30Ω.

Connect the black wire from the unit to chassis ground and the yellow/white wire to 12V using a jumper wire. You should hear a click. Disconnect the black wire from ground and connect the yellow/black wire to ground, and once again connect the yellow/white wire to 12V. You should hear another click. This verifies that both solenoids are moving.

Connect both the black and yellow/black wires to ground and the yellow/white to 12V to activate both solenoids, and suck on a hose connected to the bellows unit. You should be able to move the bellows. If you can't seem to suck anything, the vacuum solenoid isn't opening (or the hose is kinked or plugged). If you seem to suck air easily without accomplishing anything, either the vent solenoid isn't closing or the assembly is leaking.

The following comments apply to the older cruise control actuators that had a bellows that looked like a bellows, and a flat metal disk that the cable attached to. Newer cars use a different actuator, and some even attach directly to the turntable -- a no-no with the older throttle cable design.

This cruise control actuator can be disassembled easily. Remove one bolt at the front end and disconnect the throttle cable from the disk at the rear end (don't lose the little cable attachment thingy!) and remove it from the car. Then peel the bellows away from the disk the cable attaches to, and away from the solenoid housing the same way.

These units seem to have several common failure modes. The first and most obvious is that the bellows leaks around the edges where it snaps over the metal disks; even a small leak is enough to render the system totally inoperative. If this problem is suspected, it is a fairly simple matter to peel the bellows off at both ends, apply some silicone sealant, and reassemble. Another suggestion that's been made: use a clamp intended for a dryer hose around the edge of the bellows to hold it securely against the metal disk.

Another common problem is the bellows itself develops a tear or leak. You can easily check if the rest of the system is operational by patching the leaks, using a bicycle tire patch kit, tape, or whatever. It may not last, but it will tell you if the rest of the system is OK.

It has been suggested that using Son Of A Gun or some similar substance on the bellows may help protect the rubber from aging.

Gregory Andrachuk describes repairing another failure mode, sticky solenoids: after taking the bellows off, "I simply lubricated them *liberally* with Liquid Wrench (like WD40, but has Teflon). The cruise functioned *perfectly*..."

Yet another common failure is that the tiny rubber seats on the solenoid plungers fall off, and the solenoids no longer seal the ports. Bill Farnsworth went looking for why his cruise control quit working: "I took the bellows unit apart today to reseal it. Lying in the bottom of the bellows was a small thin metal disc about 5/16in. in dia. It had a slightly smaller thin rubber disc glued to one side of it. I took up the solenoid half of the bellows unit and gave it a close examination. Guess what was missing from the top of one of the solenoid plungers. Yep, that little tiny disc. So I glued it back on, sealed the bellows and the Cruise Control works again. If I just pulled the bellows off and tipped it over, the part would have fallen out onto the engine and I would never have known about the displaced disc."

After removing the bellows, the solenoids can be removed by prying them out of the housing to get at the plunger. If you've lost or damaged the rubber seat, use a hole punch on a bicycle inner tube to make a new one. Make sure the sealing surface is flat and smooth before reassembly.

It must be pointed out that a failure of a cruise control could be dangerous, although that would typically require the two openings to atmosphere to fail closed *and* the opening to vacuum to fail open -- highly unlikely. You should make repairs carefully, using a very reliable glue (such as JB Weld) to hold the rubber seat on the rod. Use of unreliable glue such as cyanoacrylate (superglue) is not recommended.

Robert I H Egerton adds some tips for putting the solenoids back in. “When I put em back they didn't work. Eventually I realised that the horseshoe-shaped bits of copper or brass under them are springs which hold the moving core down so you must ensure that they clip into the core when you put em back. I get my pension at Xmas so it took me some little time to suss it out .”

CRUISE CONTROL CABLE ATTACHMENT: Bill Trimble managed to lose the little part that screws onto the end of the cable to connect it to the bellows unit. “I took the car over to Rick the Mechanic's to see if he had any ideas, and sure enough he remembered that one of the local auto parts places had barrel connectors for hood release and choke cables. I bought one for a couple of bucks and we fitted it in about ten minutes, the only modification needed was to gently pry out the round end on the bellows side to fit the wider diameter of the new barrel connector. We also wrapped some safety wire around it so that if the cable slips out again, the connector won't fall out.”

Safety wire is tricky to get right here. Before trying to assemble this thing, take the tiny screw out of the barrel connector, push it through a tiny piece of cardboard, and screw it back into the barrel. That way, when your grip on the thing fails, the barrel will only drop 1/4” and sit right there on the loop instead of falling into the dark abyss. A washer would work, too, but it’d jingle with engine vibrations.

Another idea would be to tie a piece of string to the screw, and tie the other end to the bellows end plate itself. You could actually do that before taking it *apart*.

HEAT SHIELD INSTALLATION: There’s a heat shield attached to the bracket that wraps around the bellows and holds the cable housing. This heat shield should be underneath the bellows to protect it from radiant heat from the engine. Steve Wilke’s car had it on top when he got it. If your car has been similarly misassembled, you’ll want to correct it.

SERVO RELOCATION: To get that bellows assembly to last longer, it would probably be a good idea to relocate it somewhere cooler; this will not only keep the actuator cooler, but it will make working on the distributor easier. Ron Whiston relocated his to the area in front of the radiator, mounting it on the same bolt that holds the horns. He fabricated a new cable, similar but longer. He notes that removing the mount bracket, which is held to the back of the A/C compressor with the same bolt that holds the hoses on, will require recovering and recharging the freon circuit -- a lot of extra effort and expense. Therefore, he suggests you can either wait until you’re working on the freon system anyway, or you can fabricate a new bracket and abandon the original one in place until the opportunity arises to remove it.

BELLOWS REPLACEMENT: Jim Isbell says, “If you ever do this make sure you get the metal ring out of the center fold of the old one and put it into the new one which may not have the ring in it.”

SERVO REPLACEMENT: If you have to buy a new servo unit from Jaguar, be prepared to open your wallet a long way. You may find better prices if you shop around, though; Randy Wilson says “Those of us not locked in to the Jag parts distributing system, i.e. the independents, have an alternate source for this servos, plus we can get the bellows as a separate service item. They still aren’t cheap, as they come through a different British car parts network (RR!), but the servo is about half what Jag wants.”

CRUISE CONTROL TROUBLESHOOTING -- WIRING AND SWITCHES: To check the wiring, disconnect the wiring connectors at the speed control unit. The speed control unit is located just under the fuse panel above the passenger footwell. It has two electrical connectors, a nine pin connector and a single pin connector. Pull the connectors apart and perform the following checks on the wires going out to the car, not to those going into the speed control unit. Make sure that the bellows unit three wire connector is connected properly if it was disturbed by previous testing.

Connect one lead of a volt/ohmmeter (VOM) to a convenient car chassis metallic ground, and test to make sure you have a good ground using the ohm setting on the meter. The other meter probe will be used on the pin connectors. Unless stated, all measurements are made with the ignition off.

1) Set VOM to ohms and test the black wire; it should check as zero ohms, since it is a ground wire.

2) The yellow/purple wire is connected to the "inhibit switch" mounted on the gear selector; this switch opens to allow the cruise control to work only when the selector is in D. The same switch serves to allow the kickdown solenoid in the GM400 transmission to be activated only when the selector is in D. As a result, when the selector is not in drive, the wire is not truly grounded; it is routed through the kickdown solenoid in the transmission to ground, which is effectively grounded as far as the electronic circuits in the speed control unit is concerned. With the selector in P (or anywhere other than D), check that the yellow/purple wire reads low ohmage; it might not be zero, but it should be low. With the selector in D, it becomes open; check that it measures infinite ohms.

   If the console is opened, the physical operation of this switch can be observed. These type microswitches, complete with the rollers, are available at electronic shops.

3) The black/pink wire is connected to the set switch on the turn signal stalk. It normally reads as open (infinite ohms) but should indicate zero ohms while the set switch is pushed. See below.

4) The black/slate wire is connected to the master control switch just behind the selector lever on the console. It should read open (infinite ohms) when the switch is in either ON or OFF position and zero ohms when the switch is moved to RESUME.

5) The yellow/white wire connects to the two bellows unit solenoids through the brake-operated switch which acts as a backup to cut out cruise control when brakes are applied. It should read the 25-30Ω of the vent solenoid. When the brake pedal is pressed, it should read open. Note: the brake pedal switch intermittently shorting to ground is a known problem, so you might want to wiggle the brake pedal while here and see if you can get this wire to read zero ohms. If it does -- even for an instant -- read the section on fried ECU transistors below.

6) The yellow/black wire is connected to the vacuum solenoid. It should read 50-60Ω; this is because both solenoid coils are in series to ground referenced to this wire.

7) The yellow/orange wire actually connects to two different pins at the speed control unit connector. It is connected to the master control switch. Turn the ignition on, select a suitable voltage scale on the VOM, and check that this wire reads 12 volts with the switch in the ON position (center) and zero volts with the switch in the OFF position.

8) The green/purple wire is connected to the brake light switch. Normally, this wire should read zero volts; when the ignition is on and the brake pedal is pressed, it should read 12 volts.

9) The yellow wire to the single connector is the signal from the pulse generator mounted on the transmission. Pulses from this wire signal the cars' speed to the speed control unit. This pulse signal also works the speedometer, so if the speedometer is working it is likely that the pulse is also getting to the speed control unit. However, the presence of the pulse at this connector can be checked. Connect a voltmeter to chassis ground and the connector pin. Drive the car, and even at very low speed the signal will measure around 4 volts AC. And the voltage does not increase with speed.

SET SWITCH GROUND: The set switch on the stalk has a ground wire within the column that connects with other grounds. This wire has a nasty tendency to break off right where it attaches to the stalk, rendering the entire cruise control system inoperative. Any scheme that will provide a ground wire connection to the stem of the stalk itself will fix it. The broken wire can be spliced, or a new wire can be clamped onto the stalk just inside the column housing.

BRAKE PEDAL SAFETY SWITCH ADJUSTMENT: There are two different switches used on XJ-S's, but both need to be open when the brake pedal is depressed and make a connection when the brake pedal is released. One type switch is located on the brake pedal housing within the engine compartment, right next to the driver's side bonnet latch. It is threaded into the housing with a locknut. The locknut can be loosened and the switch screwed in or out until it works properly. The other type switch is located in the footwell, and its operation is obvious.

CRUISE CONTROL TROUBLESHOOTING -- SPEED CONTROL UNIT (IN CAR): If the bellows unit is OK and no problems are found with the cruise control wiring or switches, the only remaining component to check is the speed control unit. The tester shown in Figure 38 is simple to make, requiring only two flashlight bulbs, two resistors and some wire. It is also used for the bench test of the speed control unit.

Notes-

a) Length of the three wires is about three feet each.

b) The two bulbs are 3V flashlight type PR2.

c) The 33Ω and 22Ω resistors are 1/2 watt or larger.

d) The bulbs and resistors are soldered as shown.

e) Small alligator clips will help in connecting.

f) All components can be purchased from Radio Shack, about $6.

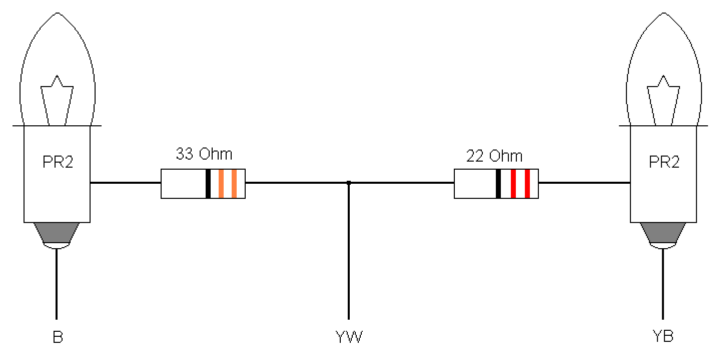


Figure 38 - Cruise Control Test Circuit

Mount this assembly on a piece of cardboard about 4 by 6 inches.

Disconnect the connector from the bellows unit and connect the three wires from this tester to their respective colors on the wiring harness (not to the bellows unit). The bulbs and resistors take the place of the two bellows solenoids so that we can observe the operation of the speed control unit. Route this assembly out from under the hood and use a windshield wiper to hold it against the windshield so you can observe the bulbs while driving.

Next go for a drive. At about 30-40 mph push the "set" cruise button. The bulb on the left (33Ω) should light but rather dimly and stay lit. This bulb is taking the place of the yellow-white solenoid that closes the bellows to the atmosphere.

The right bulb should light but flicker, and, as you slow down the bulb will light brighter, and as you speed up it will grow dimmer. This bulb is taking the place of the yellow-black solenoid that controls the vacuum from the engine.

If this bulb test circuit works, then the speed control unit and associated wiring/switches are good. If this test fails then the speed control unit is possibly at fault.

CRUISE CONTROL TROUBLESHOOTING -- SPEED CONTROL UNIT (ON BENCH): Bench testing the speed control unit is not complicated but you do need some experience working with electronic circuits. Essentially, what we do is connect up the speed control unit with power and grounds as it would be in the car, then feed it a pulse generation to simulate speed and observe its operation with the above two-bulb tester. Thus, to perform this bench test you will need:

1) 12V battery source
2) about 8 alligator clip leads, mini-size with boots
3) a sine wave frequency generator.

First, fuse the 12v battery supply with a 1 amp fuse; this will hopefully save you from any nasty smokings. The speed control unit should only draw around 1/2 amp.

Working with the speed control unit and its associated nine pin connector make the following connections:

1) Black/red and brown go to battery ground (negative).
2) Brown/black is not connected (simulating the inhibit switch in drive).
3) Brown/white is not connected (used only for "resume speed").
4) Brown/yellow is attached to a clip lead but left open (it is the "set speed" switch).
5) The two-bulb tester is connected, black to battery ground, middle wire to yellow/white, and outside wire to yellow/black.
6) Yellow and black/green are connected to positive 12 volts.

This completes the basic wiring of the speed control unit. Next a pulse must be sent into it via the single green wire connector to simulate the car speed. A simple sine wave generator that can put out 5 volts at 60 to 200 Hz will work. The generators' signal lead is connected to the green wire connector and the ground to battery ground.

With all connections in place and the signal generator set at 80 Hz, and 5 volts, touch the brown/yellow wire to ground for a second and remove it. This simulates pushing the "set speed" switch in the car. The two bulbs should light with the left one remaining steady while the right one changes its flickering as the signal generator frequency is lowered or raised. If not, replace the speed control unit.

FRIED ECU TRANSISTORS (SALOONS): One of the two switches on the brake pedal is a "last chance" safety feature for the cruise control system; it is connected between the system ECU output and the actuator itself, and when the brake pedal is pressed it positively disconnects power to the actuator no matter what else is going on. The switch in question is item #2 in the speed control schematic on page 86-13 in the ©1982 Supplement, and is connected into the YW wire between the ECU and the actuator. Hence, when you find the switch, it will have YW wires on both terminals. It doesn't matter which wire connects to which terminal on the switch.

The switch used in the XJ-S, C42525 or SMB420, is shaped like a bolt and is located on the left side of the pedal box inside the engine compartment. This type switch appears to have no problem. The troublemaker is DAC1895, used in the saloons. This rectangular switch mounts down in the footwell. Craig Sawyers helps identify it: "On the side of the switch I could easily see were the numbers 1533447, which isn't a Jag number, so it must be Lucas's code to hide the guilty." This switch may occasionally short the ECU output to ground, which causes a direct short which flows too much current and blows a transistor or two in the ECU. It's not terribly difficult to fix the ECU, but if you don't address the switch problems it'll just get blown again. Even if your cruise control is working, it might not be a bad idea to check the switch and make appropriate corrections to prevent trouble.

What to do about the switch? There are many possibilities, starting with merely replacing it with a new one. Bruce Segal says, "We got into the habit of always replacing this switch when replacing the ECU. Comebacks went way down."

Sawyers found this fix unsatisfactory. "Some dumb-ass designed the switch body out of steel, which is firmly earthed. So when the plastic button wears a little in its guide, the conducting end wobbles sideways and shorts to the case. When

I replaced my switch to cure this problem, I found the *new* switch could be coaxed to short by wobbling the plastic button. At that point I threw in the towel, pried the case off, and formed some thin card to fit around the inside of the case and prevent shorting once and for all. No problems since."

Another possibility, obviously, would be to replace the switch with something non-Lucas. It is a very simple switch, so perhaps a suitable substitute can be found. The contacts must be open when the button is released and connected to each other when the button is pushed. Make sure neither terminal connects to ground under any circumstances.

Another possibility would be to install a totally different kind of switch, perhaps in a different location. A microswitch with a long integral lever could be used, which allows the large motion of the pedal to reliably operate the switch. Just make up a little bracket to hold it where the pedal arm will hit it when it's in the fully released position.

Yet another idea would be to install a relay. You can connect the YW wires to the C and NO contacts of the relay, and provide ignition-switched 12V to one side of the relay coil and connect the other side to one terminal of the pedal switch. Connect a wire from the other terminal of the pedal switch to ground. That way, a short to ground in the switch would look just like the switch is closed, enabling the system but not hurting any components. Things would still work even if shorted when the pedal is pushed, because this is merely a safety feature; the primary means of entering disable mode when the brake pedal is pushed is via a 12V signal from the brake light circuit.

Finally, you could simply omit the switch altogether and just connect the YW wires together; as mentioned above, the system will still work normally since this is only a safety device. It's a rather important safety device, however, so this method is not recommended.

Once you have the switch problems corrected, you'll need to fix the fried transistors in the ECU. Segal says, "I've found that most of the time (except when you really need it) the cruise ECU's can be repaired by replacing two of the transistors inside. They are in the lower left hand corner of the board. The board is arranged so that the wiring harness comes off the left side. The transistors are labelled ZTX650 and ZTX750. They can be replaced by Motorola MPS650 and MPS750. Very easy and very cheap."

"The ECU part number is DAC4293. The older part number is DAC3672. The DAC4293 definitely can be fixed, I don't remember if the older one uses the same circuit." (Ed. note: The ECU in the author's '83 is DAC3134 and contains these same transistors.)

"The original transistors are Zetex ZTX650 and ZTX750. Digi-Key (http://www.digi-key.com) sells Zetex so these parts should be available through them. You can use ZTX750 and ZTX751 as well."

Walter Petermann adds, "I use ZTX753 for the power out to the yellow/white wire, and ZTX653 for the control signal on the yellow/black wire. They are rated for 2amps (6amps peak). Digikey (800 344 4539) stocks them at $0.78 under the above part #. They have a minimum order but I don't know what that might be."

ECU REPLACEMENT: If your actuator and bellows are OK but your ECU is toast and you're the kind of guy who tinkers with a soldering iron, "600 Low-Cost Electronic Circuits" by David M. Gauthier, ©1989, includes instructions for building a speed control unit using an RCA CA3228E IC plus four transistors and a handful of resistors and capacitors. The actuator shown in the schematic has the same arrangement of vacuum solenoid valves as the Jaguar actuator so this project should provide a usable replacement ECU. Presumably there are many other similar how-to books that include directions for making a cruise control unit.

SURGING WITH TURN SIGNALS: The author of this book may be the only owner who's ever had this problem, but I'll report on it anyway. Whenever cruising with the cruise control set and a turn signal was first turned on, the car would surge forward briefly. Then, after the EFI ECU was modified to provide better throttle response, the car would surge on each blink of the turn signals! Once the turn signal was cancelled, the car would return to its original set speed -- a clear indication that the problem was not due to a crossconnection between the set switch and the turn signal switch, since a "set" signal would cause the car to increase speed and *maintain* the increased speed after the signal is removed.

The problem was eventually traced to a poor connection providing power to fuse 5 and on to the turn signals and also, via fuse 17, the G wires powering the cruise control system. The high-resistance connection caused the voltage to fluctuate more than a volt at fuse 17 when the turn signal blinked on and off.

In this particular case, the problem turned out to be within the ignition switch itself; it was pried open and the contacts cleaned and the problem was cured. Theoretically, any bad connection along the way would have the same symptoms, such as corrosion at fuse 5.

CRUISE CONTROL REPLACEMENT: Larry Lee sends this description on how to replace the Jaguar cruise control system with a generic Dana unit: "The particular unit I installed was purchased from Sears, Model 318.20309. This model came with a turn signal lever that can replace an existing one (if no other switches are on it), but Model 318.20308 included a clamp-on control switch. Other than the control switch design, the two units are identical. The manual for this unit does not say "Dana" anywhere in it, but I recognized the system as very similar to other Dana units (also purchased from Sears, but marked "Dana Electronic Speed Control Kit 250-1000") I had installed on other cars as far back as 1978. There have been some changes over the years -- such as a change from two driveshaft magnets to one, and deletion of an inertial deceleration switch -- but all of them that I have seen are installed essentially the same way." Note: apparently Sears no longer carries these units, but they -- or something similar -- may be available elsewhere.

"The installation manual is quite complete and easy to follow. It includes an electrical schematic and a pictorial drawing that shows how the various components and cables connect. The cable plugs are all different, so improper connections are difficult to make.

Follow the manual instructions to install:

Driveshaft Magnet

Road Speed Pick-up Coil

Servo

Disengagement Switch & Valve Assembly (Brake Switch)

"Some judgment must be exercised when mounting the various components."

The Disengagement Switch & Valve Assembly mounts on the brake pedal. When the brake is applied, it breaks an electrical connection to ground, killing the cruise. Besides that, it also vents vacuum to the system, making doubly sure it is off. Considering the fact that the stock XJ-S already has a switch mounted on the brake pedal housing for disabling the cruise control, it may be tempting to discard the Dana unit, plug the vacuum dump line, and just connect the wire to the stock Jaguar switch. Note, however, that the Jaguar switch works the wrong way; it breaks contact when the brakes are released, and connects to ground when brakes are applied. Therefore, a relay would be required to use this switch. Considering the effort required as well as the reduction in safety due to lacking the vacuum dump, it's probably better to simply use the Dana parts.

The driveshaft pickup is normally mounted right behind the transmission. However, considering how difficult it is to get around the transmission mount on the XJ-S, it may be preferable to mount it at the rear end of the driveshaft adjacent to the differential. If possible, the pickup should be attached directly to either the transmission or differential in order to move with them on their soft mountings; if mounted on the surrounding bodywork, the transmission or diff -- and hence the drive shaft with magnets on it -- may move around relative to the pickup, possibly interfering with the signal.

The Dana kit Lee describes attaches only one magnet to the drive shaft. While he reports no noticeable balance effects from attaching the small magnet to one side, those who are concerned may easily add a dummy weight to the opposite side when installing.

Note that any cruise control servo should be attached to the throttle linkage in a similar manner to the original. On the early XJ-S, it may be helpful to unbolt the throttle pedal assembly from the firewall and lift it out to look at it. If the cable connection is relocated to the turntable at the top center of the engine, operation of the cruise control may cause the throttle cable to come undone or jam; however, later cars were designed to permit attachment here.

Locating the servo unit itself may be challenging. The original mounted just forward of the distributor -- and you are replacing it, presumably because it didn't survive the heat in this area. If the cable is long enough, the best place is probably out in front of the radiator. You could get creative and make up your own extra-long cable, or find a way to connect the end of the Dana cable to the end of the Jaguar cable and use both!

Whichever Dana kit is purchased, the control switch assembly won't look all that great in the XJ-S interior. Worse yet, the original set switch (on the turn signal stalk) and ON/OFF/RESUME switch (on the console) will no longer be used, leaving either unused switches or gaping holes where they once were. The following is based on Lee's method for using the original Jaguar set switch and ON/OFF/RESUME switch in place of the control switch that came with the kit. This will maintain the appearance of the Jaguar interior, but it requires the purchase of a relay. Note: the illustration shows the terminal layout for an automotive relay, but any 12V SPDT relay will work. If the an automotive relay is used, make sure it has the real 87a connector (normally closed contact). Many standard automotive relays, notably driving light relays, actually have two 87 connections and no 87a connections, which won't work. See the notes on the radiator fan relay on page 224.

Remove the 4-wire plug from the Dana control switch cable, and connect the Jaguar switches to the plug as shown in Figure 39. This sketch shows *only* the wiring that differs from the Dana (Sears) schematic in the area of the control switch; basically, the section of the Dana schematic from the four-connector plug onward should be replaced with this sketch.

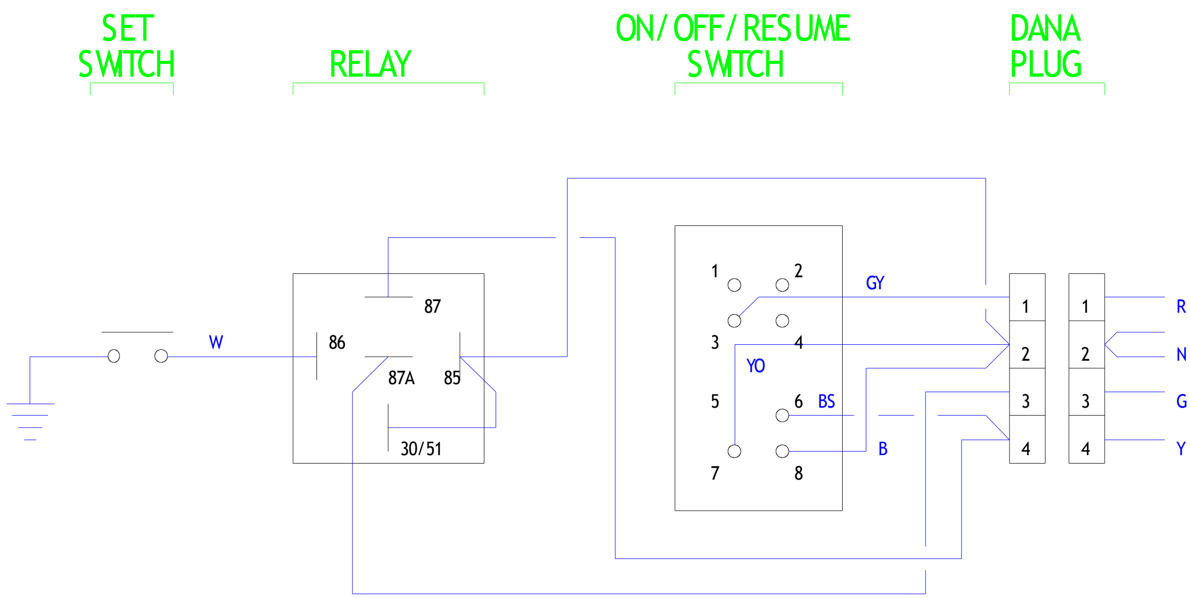


Figure 39 - Wiring for Dana Aftermarket Cruise Control

"How the Jaguar switch functions replace the Dana switch functions should be clear from the Dana schematic. The Jaguar switches are physically located in two places, but that makes no electrical difference. A good ground for the Set Speed switch is essential (as is a good ground for the Servo), but it can be located just about anywhere."

For clarity, Lee describes the operation of the Dana control switch that is being replaced: "It is a single piece that contains two separate switches, but they share a couple of wires. (For convenience, I'll refer to the wires by the numbers shown on the connector.) One is a momentary push button that is NC across wires 2 and 3. When pressed (SET/COAST), it opens between 2 and 3 and closes between 2 and 4. Actually, releasing this button is what engages the control and determines the speed setpoint. The second switch is a slide switch that has three positions. In OFF, no connections are closed. In ON, a detented position, wires 1 and 2 are closed. This same switch can be pushed momentarily (spring return) into RESUME/ACCEL position, which maintains the 1-2 closure and also closes between 1 and 4."

For those whose parts don't look exactly the same as those in the illustration, a description of the contacts made may be helpful. First, the relay: 85 and 86 are the coil connections, 30/51 is the common contact, 87 is the normally open contact, and 87a is the normally closed contact. On the ON/OFF/RESUME switch, placing the switch in the ON position connects contacts 3 and 7. Pressing the RESUME maintains the 3-7 connection and momentarily connects contacts 6 and 8.

"Once the unit is installed, the check-out procedure described in the manual should be followed without any changes. Use the electrical schematic to sort out any errors in the new wiring. Hopefully, this will not be necessary.

"The pictorial drawing in my manual showed one *unlabeled* adjustment screw on the Regulator." Note: the adjustment screw referred to here is on the side of the regulator box, to the left of the "Centering Adjust" screw. "It should be labeled 'Minimum Speed Adjust.' The manual describes how to make all set-up adjustments. I set the Minimum speed at 30 mph, which enables the unit to maintain a set speed anywhere between about 30 mph and 90 mph. Others may prefer a different range.

"Once everything has been tested and adjusted, push the Regulator and excess wiring up behind the underscuttle panel below the steering wheel. I have not found it necessary to fasten the Regulator to anything.

"One should now be able to enjoy miles of foot-off driving!"

Note that while this installation maintains the interior appearance of the Jag, the Dana cruise control does not work exactly the same; it has more features. First, the stock Jaguar set switch is just that, but with this Dana system it becomes a set/coast switch; if pressed and held when the system is engaged, the car will slow down, and a new cruise speed will be set when the button is released. Second, the resume position on the control switch becomes a resume/accel; if held down, the car will speed up.

One other issue: The original Jaguar cruise control system includes a switch on the shifter to ensure that the car is in D before engaging the cruise control. The Dana aftermarket cruise control lacks such a safety provision, probably because there is a built-in electronic control to prevent the engine from racing if the cruise control is engaged while in neutral; there is a step in the instructions for testing the regulator to ensure engine racing does not occur. The system also supposedly will not permit engagement below an established minimum speed, so engaging in neutral would evidently require attaining highway speed and then moving the shifter to neutral.

If the safety features that are good enough for Dana are good enough for you, the YP wire from the shifter switch may be simply abandoned. However, this same switch also ensures that the car is in D before sending power to the kickdown switch on the GM400 transmission. Therefore, the switch itself and the other two wires connected to it -- a LGW wire to the kickdown switch and a BW wire to the solenoid within the transmission -- must be left in place for the kickdown to function properly.

If, on the other hand, you insist upon restoring this safety lockout, another relay will be required -- a DPDT this time. A 12V power supply should be fed through the shifter switch to operate the relay. When in D, one pair of contacts on the relay should provide the same connection between the kickdown switch and the transmission solenoid that was provided before. When in any position other than D, a totally separate set of contacts should be wired in series with the disengagement switch on the Dana system.

STORAGE

This section provides tips for storing an XJ-S for extended periods.

GUMMY FUEL: Walt Osborn of Vintage Jag Works: “We have the third car in the shop this year with stuck valves. This is becoming more of a problem as people collect more cars than they can take care of. Some of the cars have been sitting for several years and the gasoline evaporates and leaves behind a syrupy varnish-like substance which gets on the valve stems in the cylinder head and causes them to stick in their guides. They stick in the open position, the owner attempts to start the car and/or turns the motor over with the starter, and the piston fouls the valve. Now the engine may start and run for a time and then start missing. The miss is usually a bent valve.”

FUEL STABILIZING: Fuel doesn’t store well, it goes “stale”. Fuel lines and other components may be affected by “varnishing”.

In the old days of carburetors, it was usually recommended to cut off the fuel supply and run the engine until the fuel lines and float bowls are empty. Unfortunately, this is more difficult to accomplish on an EFI system -- and may do more harm than good. The electric fuel pump is immersed in fuel, and running it for any length of time with air in it is probably not advisable. The worst thing for injectors is water, so condensation in empty fuel lines wouldn’t be good.

The local auto parts store sells fuel stabilizers that can be added to fuel. Before storing a car, add some fuel stabilizer to the tank and drive the car for a while to get it circulated throughout the fuel system. Gregory Wells says, “Sta-Bil is one brand and these things are almost always available at boat dealers, since they are highly recommended for use in boat engines stored over the winter.”

SOUR GASOLINE: Arthur Smith says, “I found a reference to "Sour gasoline" (gasoline which has developed peroxides). I found that enlightening since some of our British cars get stored for a period of time. The reference was to a certain special rubber with stabilizers added that could withstand the "Sour Gasoline". That makes me think that when one of our cars is stored for any length of time the "varnish" that forms will eat any rubber that is in the fuel system.

“The information came from a BF Goodrich pamphlet and the distributer said the special rubber is not available.”

ENGINE FOGGING: The auto parts stores sell aerosol foggers for preparing engines for storage. For the Jaguar V12, you will need two cans of aerosol fogger and three people. When ready to park it, take both air cleaner covers off and disable the ignition and EFI -- you can disable both in one move by disconnecting the white/slate/blue wire to the ignition amp right on top of the engine. Have one person stand on either side of the car with a spray can of engine fogger in hand while the third person holds the throttle open and turns the starter. A good blast for a few seconds in both sides at the same time. Turn off the starter and foggers at the same time, so you don’t run any fresh air through behind the fog.

When it comes time to drive the car again, it is generally considered a good idea to change the oil promptly. There may have been condensation during storage, which will contaminate the oil.

TIRES: The following was attributed to a Yokohama tech rep: “He recommended two methods for storing vehicles. First, inflate the tires to 65 psi and leave the weight of the vehicle on the tires. 65 psi? Modern tires will accept 65 psi for storage without damage. You just can’t drive on them at this pressure without damage. He did caution, however, that old stamped steel rims may not be able to take this pressure with out damage. His second recommendation was to keep the tires at the proper inflation pressure and to remove the weight of the vehicle from the tires (ie. put the car on jack stands).

"The tech rep stated the reason for these two alternatives was that all tires contain nylon (typically, the nylon covers the steel cords and keeps the steel cords from working their way through the tread). The nylon will develop a flat spot. The colder the temperature, the faster and more pronounced the flat spot will be. Jag owners in Edmonton, Alberta, and Bismark, ND should have first hand knowledge of this.

"A final recommendation, store the vehicle in a dark, well ventilated, cold room. Light (specifically ultra-violet light), temperature, and moisture will damage the vehicle finishes and rubber over time."

CAR COVERS: The general consensus is *not* to use car covers for long-term storage due to their adverse affect on ventilation. Car covers are apparently better left to daily use only.

BATTERY: Herbert Sodher hails from the cold North where people store their Jaguars all winter and drive less valuable vehicles in the snow. When stored that long, the battery in the XJ-S tends to go dead. The alternator, clock, and some stereos and security systems put a small drain on the battery when the car is parked. Jaguar recommends disconnecting the battery if stored more than a month, but that may be assuming too much about the condition of the battery and how easy the engine will be to start. And, disconnecting the battery requires resetting the clock, all the stations on the digital radio, and possibly some security stuff, all of which is a pain.

Sodher suggests the owner go to an auto supply store and purchase an on-board, fully automatic trickle charger and install it in the car. One called the Mity-Mite is made by Schumacher Electric Corp., is rated at 1.5 amp, and costs around $30. This unit is so small that Sodher attached it right to the front of his battery with Velcro, and the battery cover will fit over it (his battery is not the original -- it may require a different location for the Jaguar battery). It comes with eyelet connectors that can be connected directly to the battery terminals. Merely remove the nut on the clamping bolt from each terminal, put on the connectors, and reinstall the nuts. The unit comes with a one-foot power cord, just enough to feed outside the battery box. When parked for extended periods, merely run an extension cord into the trunk. The unit will automatically charge the battery as required, and won't overcharge it.

MODIFICATIONS

ROUTING WIRES, HOSES, ETC.: John Napoli says, "A really easy way to run wires or hoses or whatever across the firewall on an XJ-S is to go through on the passenger side (Federal models) access plate where the pedal box would be on a Brit version. To get to it, remove the windshield washer reservoir (under the hood on the passenger side). Now remove the bracket and the plate. Plenty of ways to run your wires through there! Note that there is another vacuum reservoir for the climate control system underneath, as well."

GARAGE DOOR OPENER INSTALLATION: Paul Bachman says, "I took my garage door opener and replaced the battery with a 9 volt regulator (about $0.50), and installed it inside the center console. Apparently, the entire wiring harness becomes an antenna, because the range actually increased (I expected it to be worse) when I buried the transmitter in a basically metal box. Sure is nice not to have that stupid transmitter in my way any more. I will install a third window switch between the two existing ones for the control.

"The 9 volt regulator (LM7809) is a very simple three terminal device in a large transistor package (TO-220). It is available or can be ordered at any electronics store for under $1. One terminal goes to ground, one terminal goes to a switched 12 volt (+) source (can be found at the cruise control switch) and the third will provide a regulated 9 volt source. The 9 volt source is connected to the (+) battery terminal or soldered to the appropriate place on the PC board of the transmitter. The (-) battery terminal is, of course, connected to any handy ground (same place as the ground on the regulator). If you can handle a soldering iron, it is quite simple.

"This project is particularly practical if you have a garage door transmitter with a case that is broken and needs to be replaced anyway."

WEIGHT REDUCTION/RELOCATION

The XJ-S is a heavy beast. Let's face it, it's a luxury car, not a performer. The best way to aggravate the Corvettes would be to pull about 800 pounds out of this car. If you can do without the electric windows, electric door locks, stereo system, 5 mph bumpers, air conditioning, back seat, spare tire, carpeting, sound insulation, etc., etc., then go for it.

Another popular way to reduce weight is to replace components with lighter versions. Chad Bolles has replaced the radiator with an aluminum model, the bonnet with a fiberglass one, the A/C compressor with a smaller model, and other mods. Effective but expensive.

When making weight reduction modifications, bear in mind that such mods will affect acceleration in the non-wheelspin realm by the proportion of total weight of the car; removal of 200 pounds will improve acceleration by 5% in a 4000-lb car. In conditions where the wheels spin, weight reduction in the front of the car will help slightly, weight reduction in the rear will hurt slightly. Weight reduction has almost no effect on top speed (other than how long it takes to get there). Weight reduction has a similar effect on maneuverability as installing bigger tires; it may be negligible if the present tires are adequate. Although it might feel different (and that alone may justify the modification), the actual timed performance may be insignificantly changed.

Also bear in mind that the springs, shocks and other components are designed for a 4000-lb car. If the weight reduction is significant, the car will effectively be sprung more stiffly and will ride higher. If the stock springs are cut shorter to bring the ride back down, it will increase the stiffness even more. All of this may be considered desirable in a car as soft as the XJ-S.

Weight reduction from points high on the car is preferable, since it will lower the center of gravity and make the car lean less in corners. It is even beneficial to relocate components lower on the car.

Weight reduction at the extreme ends of the car is also preferable, because it reduces the moment of inertia of the car. In other words, it reduces the car's tendency to resist beginning to turn when going straight, and its tendency to keep turning when beginning to straighten out. It is beneficial to relocate components from the ends of the car to more centralized locations.

If weight is removed entirely from one end, it can change the balance of the car. Since the XJ-S is obviously nose-heavy, it would be helpful to either remove weight from the nose or relocate components to the rear of the car.

Weight reduction on rotating parts, such as engine/drivetrain moving parts, wheels and tires, brake rotors, etc., can have a much greater effect on performance than general weight reduction throughout the car.

COLD WEATHER

ENGINE HEATERS: If you live where it gets cold and use your Jag in the snow, it is highly recommended that you invest in an engine heater. While preventing engine damage due to frozen coolant is the most obvious objective, those in the know point to many other advantages to engine heaters. They reduce engine wear because running a cold engine results in accelerated wear. They save fuel since a cold engine burns a lot of fuel. They save wear and tear on the Lucas starter. And they render the cabin heater operational much sooner.

The ©1981 handbook says, "Provision is made on the right-hand side of the cylinder block for the fitment of an engine heater element obtainable from your Dealer under part No. C34403 - 110 volt." Apparently the handbook lies. C34404 is the correct part number for the 110V heater element, but the Parts Catalogue indicates that it's installed in the lower radiator hose. There's no place in the block to put it.

Jaguar provides part numbers not only for the heater and the elbow it fits into, but the two halves of the lower radiator hose as well:

Heater element (110V)	C34403
Heater element (220V)	C30381
Elbow	C36996
Hose - radiator to elbow	C41103
Hose - elbow to water pump inlet	C41099

It's interesting that the elbow is just that; it replaces one of the bends in the single-piece lower radiator hose.

If you're not enthused about the Jaguar offerings, there are several types of generic engine heaters available in various wattages. There are heaters that replace a freeze plug, although that option probably wouldn't work too well on the Jaguar V12 due to the lack of freeze plugs in accessible locations. There are heaters that are installed in a radiator hose, some of which include a pump to circulate the coolant. There are heaters which attach to the surface of the oil pan, and there are dipstick heaters. Some heaters have thermostats to turn them on when it gets too cold, and some have timers that will warm the engine in time for you to drive it.

Of course, there are two schools of thought on the use of an engine heater. Some recommend having it on whenever it gets below a particular temperature. This makes sense if it gets *really* cold where this car is parked. Hopefully, if you have the proper anti-freeze mixture, you won't need to worry about this possibility unless your Jag is parked outdoors in the Arctic. If so, building a garage with gas heat might be cheaper than paying the electric bills on the block heater.

The other popular idea is to turn the heater on some amount of time before you're gonna need the car, thereby having it partially warmed up and ready to go. This will prove *much* cheaper than starting the car and letting it warm up, both in terms of cost of electricity vs. gasoline and in wear and tear on the engine.

In either scheme, remember that the Jaguar V12 is 700 pounds and it's made of aluminum which conducts heat very well. You're probably going to need the biggest wattage heater you can find. Or, perhaps a better idea, two heaters; perhaps one in the lower radiator hose and one in the oil pan.

There are some who claim that the dipstick heaters, especially high-wattage ones, can be harmful to the oil and result in accelerated breakdown.

Those who live in cold climates already know one method that is *not* recommended: build a campfire on the ground, then roll the car over it. Every winter some morons make the paper by burning their cars to the ground.

RADIATOR COVERS: Would you believe your car can overheat when it's freezing out? The answer is definitely yes. The radiator is designed to efficiently transfer heat to the incoming air. When very cold outside, the coolant in the radiator may be cooled to the point where it begins freezing, and a slush containing chunks of ice starts collecting at the bottom. When the chunks get big enough, they can plug up the hose taking the coolant back to the engine. Once the flow of coolant stops, the coolant in the radiator freezes even more solidly -- and the coolant in the engine overheats.

If it's really that cold, the best prevention is to block some of the air coming through the radiator. This is easily done with a piece of cardboard. You'll be amazed at how much blockage is necessary to restore proper operation; it seems you have to cover three quarters of the radiator.

If this proves to be a regular problem, there are actually products available that provide a radiator cover that is adjustable from within the passenger compartment by means of a cable.

OIL: Many winter drivers have found that use of synthetic oil helps with cold weather operation. Synthetic oil apparently does not thicken as much as natural oil when cold.

John Goodman: "A tip passed on to me many years ago was to put a waterproof thermal jacket over the oil cooler in the winter months (bit hard to get at in a Jag !)"

FROZEN DOOR LOCKS: You're freezing, and you can't get into your car! A revoltin' development. Jim Wood says, "There are little black boxes - somewhat near the size of your car door lock "beeper" - that has a little round rod that fits into your key opening and its sole purpose is to heat the key opening up & melt the ice - in just a few seconds - at least in New York's coldest weather so my sister and bro-in-law say - so that your key will turn and open the door lock. They've been using these battery-operated things successfully for *years*. They fit very well just in the palm of your hand. They're not very expensive either!!! I'd keep a spare battery in my pocket or purse tho just in case - *not* inside the glove box ..."

LPG

People in Australia and some other areas like to convert their gasoline-powered automobiles to run on Liquified Petroleum Gas (propane) because it winds up costing about half as much in fuel costs to drive their cars. A complete coverage of all the implications of such a modification would add considerably to the already hefty poundage of this book, but mentioning a few of the concerns is in order. John Fergus says, "I would recommend you get a copy of *Propane Fuel Conversions* by Jay Storer (SA Design Books); this will tell you in detail all you need to know.

Eric Vuurman describes an LPG system: "The conversion leaves the original setup *unchanged* and the car can run on both LPG and petrol. Changing from one to the other is a matter of turning a switch on the dash (while driving !). The LPG-unit basically consist of:

- Pressure-tank (50 - 120 liters)
- evaporation unit
- 2 shutter-relays to change from LPG <--> Petrol
- nozzle between air-intake and carburettors.

"LPG is loaded into the tank by an outside mounted filling cap, no mess, no smell or fumes in the car. During operation, liquid LPG flows from the tank to the evaporation unit under natural pressure. In this unit the LPG evaporates into gas. The unit is heated by the cooling sytem of the engine (LPG needs heat to change from one phase to the other). The gas flows from this unit to a special "nozzle" piece that is placed between the air filter and the carbs. The control of the gas flow is achieved by a combination of vacuum and throttle control. In this way the engine is fed with a mixture of air/lpg and the carbs do not need to add anything to it."

Stig Abrahamson describes the installation on his Daimler Double Six: "Gas is fed via a solenoid operated valve to the vaporizer which is located next to the brake servo. Gas is then fed via adjustable orifices to mixers located between the air filter and throttle bodies. The mixers are simple venturies and draw gas in proportion to the air flow through the throttle. Switching between petrol and LPG is simply done by switching off the main ECU relay and switching on the solenoid LPG valve."

Peter Cave says, "The simple venturi mixers that I have seen have all been mounted on the engine side of the throttle body."

COST BENEFITS: LPG costs less per gallon than gasoline, but that's only part of the story. There is less energy per litre in LPG, so your Km/litre numbers will reportedly drop by perhaps 10-15%.

Of course, you will also need to estimate the costs in additional maintenance (or reductions in maintenance!), and balance all of that against the cost of system installation. The cost of a professional conversion seems to be in the range of $2500US, but clearly you will need to check local sources for better estimates.

TAXES: A large part of the advantage of LPG is in the difference in taxation compared to gasoline. Since LPG is used to run stoves, heaters, and the like, it generally is not subject to "road use" taxes. As the LPG conversions get more popular, however, it can be expected that the governments will decide to close this particular loophole -- and eliminate much of the cost benefits you hoped for when you spent your money on the conversion! Governments may decide to start taxing all LPG or to find a way to tax only that used in automobiles, but one way or another they will get their cut.

SPACE: An LPG conversion takes up space in the car, already at a premium in the XJ-S. Eric Vuurman says, "The main disadvantage is the space taken by the tank." Peter Smith adds, "I imagine in the XJ-S the tank may restrict access to the petrol tank/spare wheel."

Even accepting the loss of trunk space, John Fergus says, "The main problem is finding room to place the converter. The converter may be known in the US as a vaporizer/regulator. Basically the liquid propane is warmed by the circulation of engine coolant and this converts the propane to a gas vapor. If it was allowed to vaporize without the heat it would freeze the lines. The LPG systems are very simple but there is really a space problem in the engine bay of the V12 XJS. One installer I spoke to recently said he puts it next to the brake reservoir on our right hand drive cars and the rest is fairly straightforward. I have yet to see a car under the bonnet to see how tight it is but I can't see that there will be enough room there."

SAFETY: Arguably a non-issue; after all, driving around with 20 gallons of liquid gasoline in a flimsy sheet metal tank isn't exactly the safest thing you can be doing, so having a heavy-duty pressure vessel containing a flammable gas may be considered an *improvement* in safety. Eric Vuurman says, "It is extremely safe. There are very simple but strict safety measures that apply to both the installation and the operation. LPG tanks will survive the most severe crashes and to date no report is known of any tank exploding after a crash."

POLLUTION: There are limited-production cars that are imported into the US in small numbers and meet the EPA requirements *by* converting to LPG! Stig Abrahamson says, "My car is a Daimler Double Six 1980 Series 3, Pre H.E. Digital P injection and the 10:1 engine. It started its life in Germany and was imported to Sweden in 1983. During that time Sweden had very peculiar emissions regulations shared only by Switzerland. A loophole made it possible to import cars and convert them to LPG. This is what happened to mine. The conversion was made with the sole purpose of getting it past the emissions test. I can have the engine running in my garage (door open of course) without feeling any odours apart from burnt oil dripping from various leaks.

"LPG in Sweden is now almost extinct. I happen to live close to one of the five filling stations in the country."

Where this author used to work at Pratt & Whitney Aircraft, the fork lift trucks used indoors ran on LPG to avoid indoor air quality problems. Honda has developed cars to run on LPG to meet the Very Low Emission requirements proposed for some areas.

Note also that LPG doesn't have any additives like gasoline does; it wouldn't be a good idea to put additives in a fuel that might be used to grille hamburgers.

POWER: Along with the reduction in Km/litre, there is also an estimated reduction in power of about 10% when operating on LPG. Many drivers claim they don't even notice.

Stig Abrahamson adds, "One advantage is that it has a sharper throttle response on LPG compared to petrol."

OPERABILITY: Eric Vuurman says, "LPG gives *instant* smooth engine running. Especially with older engines/carbs in a wet/cold climate this is a huge advantage. There is no need of mixture adjusting with (automatic) chokes or other gadgets when the engine is cold. Just start the car and it runs great."

IDLE: Stig Abrahamson explains: "In order to feed the engine a combustible fuel air mixture all of the air has to pass the mixers between the air filter and throttle. This makes it impossible to use the AAV since it bypasses the left hand throttle and thereby reduces the amount of fuel delivered to the engine as well as upsetting the balance between the banks.

"Solution to this was to plug the AAV and set the idle using the stop screws on the throttles and balancing them with a standard carburetor balancer. When this was working I had to find a way of increasing the idle when cold. My solution was to carefully adjust the throttle linkage and add a solenoid to the central butterfly and energize this via a small thermostat opening at 60°C and preventing the throttles from closing against the stop screws when the engine is cold. This gives me only one step in increasing the cold idle but it works reasonably well.

"Another minor problem was the PCV valve which also bypasses the throttle. I have strengthened the spring a bit to prevent it from opening at idle."

John Fergus counters, "I have often thought of blocking the AAV to see if this would give a stronger idle when cold but have not done so yet. My '78 XJ-S has no mods to the AAV or the PCV and it idles quite well in all circumstances. However I do find it necessary to start the car on petrol for the first time each day as the LPG does not fire up a cold engine as instantaneously. The one limitation is that it is not possible to get a high idle, e.g. more than 650 rpm, without opening the butterflies a little but I have resisted this as I still want to drive on petrol. Overall I believe the AAV operation seems to help the cold idle by somehow dragging the extra LPG past the butterflies. Perhaps the warmer weather in Australia doesn't place such demands on the cold start system."

OCTANE: LPG has gobs of octane, something like 110. Simply not a problem any more. However, it also has different flame propagation characteristics, which means that the ignition timing curves might need a little massaging to optimize performance. Peter Smith says, “There is a compromise to make between the two fuels because LPG requires more initial spark advance and less further advance than petrol, so usually the timing is set a few degrees advanced. There are a couple of aftermarket black boxes which will try to reduce this compromise and Mallory used to make a good one.”

ENGINE DURABILITY: As mentioned above, LPG has no additives. This concerns some people, and some even recommend that the car be run on gasoline on occasion to ensure that parts such as valve seats maintain a proper coating of whatever benefits the gasoline additives are supposed to convey. However, note that such advice may apply better to engines with soft cast iron heads without valve seat inserts than to engines such as the Jaguar V12.

Peter Smith says, “I have put more than half a million miles on LPG/petrol (dual fuel) cars and can tell you it's a better fuel for long life. Being dry, it doesn't wash the lubrication off the upper cylinder walls like petrol does. The plugs last longer although it needs a higher quality spark to ignite, so it won't like worn plug leads.”

Eric Vuurman says, “I have a 1969 Volvo 164 on LPG. It has been running for 345000 km without any trouble or major engine work.”

OIL: The oil manufacturers offer special motor oil for engines running on LPG. The reasons are uncertain, but most people with LPG conversions just use the oil and don’t ask questions. LPG is reportedly easier on oil; it comes out looking as good as it went in.

IGNITION: Stig Abrahamson says, “The LPG/air mixture acts as a better insulator than petrol/air which puts additional strain on the ignition system. I had a problem with the old coil and replaced it temporarily with a generic one, worked fine on petrol but not on LPG. The original works though...” This being the situation, those with Marelli ignitions might want to take note and make sure to do the “silicone squirt” to avoid catastrophic failures described starting on page 161. Of course, they should anyway!

DIAGNOSTIC BENEFITS: John Fergus says, “It is useful as a diagnostic tool when trying to isolate problems with the engine tuning as you can switch between petrol or LPG.”

CLOSED-LOOP CONTROLS: John Fergus (in Australia, where LPG conversions are big business) says, “There is a system available which consists of an 0_2 sensor and a control module whereby the module will allow a direct feed of extra LPG to each mixer via a small additional hose when the 0_2 sensor measures a lean mixture. Another firm does a similar system but instead of running extra gas when lean it controls the vacuum being sensed at the converter and makes the converter supply extra gas. All very simple and very effective and if the vehicle is a pre-H.E. without sensors then you end up with a computer-controlled fuel system better than the original Jag one.”

WHERE TO FIND HELP, PARTS, ETC.

This section of this book provides a listing of some mail-order outfits and the like, along with choice comments. Note that this is *not* intended to be anything approaching a comprehensive list; it merely provides contact info for some of the more commonly referred-to sources and a few sources that provide difficult-to-find stuff. Inclusion in this book does *not* imply endorsement of the firm by this author, nor does exclusion imply that a supplier is somehow unacceptable or substandard. In general, outfits that concentrate on local business -- as opposed to nationwide or worldwide shipping and support -- are not included here, but such outfits may very well provide the best support for your particular needs.

Many mail-order joints advertise in the Hemmings Motor News, so pick up a recent issue to get the latest info.

DEALERS: Any Jag dealer can provide a pamphlet listing all the Jaguar dealers in the U. S. and Canada. If you think about it, this is a useful pamphlet to have -- a dealer isn't always easy to find when you need one. Dealers will usually ship parts, so they are another mail-order resource. Remember, if the dealer is shipping from another state, you save on state sales tax -- which will help pay the shipping charges.

Some dealers have an 800 number, good only in their home state or local area. At least one dealer's parts department has such a number and does not publish it. If your nearest dealer is a long distance call, be sure to tell them it's long distance; perhaps they will invite you to call back on an 800 number. Be sure to have a notepad ready!

TELEPHONE NUMBER CONVENTIONS: Throughout this listing, I have endeavored to use a notation for phone numbers that is apparently common in Europe. The first character is a + which indicates that you must begin by entering an "international access code", which are digits you must dial in order to begin an international call, and which vary considerably depending on where you are calling from; here in the US, you generally must dial 011, while in the UK you must dial 00. In Australia, the international access code is reportedly 0011.

The next one or two digits are the "country code", followed by a space. The country code for the US and Canada is 1, for the UK it's 44, for Australia it's 61 and for New Zealand it's 64. A more complete listing of country codes is generally found near the front of any telephone directory.

What follows on a US phone number will be the 3-digit area code, in parentheses, and then the 7-digit phone number itself. For UK numbers, the area code and number are listed, but no parentheses.

Now, the idea behind listing numbers this way is to provide all the information necessary to call these numbers from anywhere in the world. However, it becomes the responsibility of the reader to interpret this information somewhat in order to make a call within his own country or local area. For example, a person in the US calling a US number should know that he can forget about the international access code and country code and merely dial a 1 (or any of an entire smorgasbord of long-distance access codes in this day of deregulation) followed by the area code and number. A person in the UK dialing a UK number should know that he can drop the international access code and country code but must add a 0 before the number. Obviously, those who actually live within a stone's throw of the place being called may be able to drop even more digits and make a local call.

The 800, 877, and 888 numbers are another matter. These are toll-free long distance numbers, but they reportedly only work from within the US. Hence, they are listed as 1-800-xxx-xxxx, the way they must be dialed in the US to work properly.

Some notes regarding phone calls to the UK: On August 5, 1994, exchanges in the UK changed. For the most part, the change was simply to add a 1 at the beginning of the exchange, although a few exchanges changed entirely.

Paul Garside sends this explanation of the phone number conventions in the UK (prior to the addition of the 1): "Major city (e.g. London, Birmingham, Edinburgh, Glasgow) phone numbers used to be of the format:

<2-OR 3-DIGIT CITY CODE> <3-DIGIT AREA CODE> <4-DIGIT NUMBER>

All other towns and villages in Great Britain used the format

<4-DIGIT AREA CODE> <5- OR 6-DIGIT NUMBER>

These are all generally 6-digit numbers now. The spaces are also shown as dashes. There is no significance to either, they are merely for ease of reading."

In the UK, a company's literature often lists the phone number including the beginning 0. Remember that when calling from other countries, this 0 should be omitted.

INTERNATIONAL CREDIT CARD USE: If you have a credit card, you will find this is one of the neatest features of owning it. Charging a foreign purchase to a credit card gets the seller paid in his native currency, and gets you the best exchange rate available automatically -- the charge shows up on your statement in your currency. The credit card companies can offer the optimum exchange rates because they don't have to keep a pile of foreign currency on hand to do so.

TAXES: Those who purchase parts within the European Union must pay a Value Added Tax (VAT) of 17.5%. However, orders shipped outside the EU are exempt from this tax. If you are ordering from elsewhere and someone tries to charge you VAT, they are trying to rip you off. According to Stefan Schulz, this is a common scam.

Before getting into the listings of retailers, some numbers of general interest to Jaguar owners:

JAGUAR CARS LTD.
Browns Lane, Coventry CV5 9DR (UK)
+44 24 7640 2121
The source!

JAGUAR UK
http://www.jaguarcars.com/uk/
Mainly info on current models, but genuine Jaguar parts and accessories can be ordered.

JAGUAR DAIMLER HERITAGE TRUST
Jaguar Daimler Heritage Centre
Browns Lane, Coventry CV5 9DR (UK)
+44 24 7620 3322 FAX: +44 24 7620 2777
http://www.jdht.com
or
C/o Jaguar Cars Limited
Browns Lane, Allesley, Coventry CV5 9DR
+44 24 7640 2125 FAX: +44 24 7640 5581
"The Trust is a subsidiary of Jaguar Cars Limited." Outwardly, this appears to be just a car museum adjacent to Jaguar's original facility, but in fact it's much more than that. It appears that JDHT is determined to do whatever needs doing for the owners of older Jaguars. Among other services, they offer "Genuine Jaguar Engineering approved parts for classic Jaguars..." In other words, they may be the *only* place to get the part you need. They have even posted notices in Jaguar World magazine asking for ideas on parts that need to be *improved*.

JAGUAR OF NORTH AMERICA
Leonia, NJ
+1 (201) 592-5200

+1 (201) 818-8500

JAGUAR CARS, INC. -- PUBLIC RELATIONS
Mahwah, NJ
+1 (201) 818-9770

AUTOSEARCH LIMITED
PO Box 2032
Westfield, MA 01086
e-mail: SCOTTMCCON@aol.com
"We have a database of all dealers and manufacturers that sell car parts at retail, wholesale, and discount. We know of every supplier of aftermarket, performance, restoration, new, used, replacement, nos, car care, audio, etc. in the country and can supply a list for any make, year or model. If interested please send $6.00 to the address above. We will send your list within one week of receipt. Please provide make, model, year and the general description of parts wanted."

NEW PARTS

BRITISH AUTO/USA
92 Londonderry Turnpike
Manchester, NH 03104
+1 (603) 622-1050 FAX: +1 (603) 622-0849
1-800-4-JAG-PTS
Apparently formerly known as British Auto Interiors, but has branched out to the rest of the car. Per Chip Weems: "They do their own direct importing, and in addition to interiors they are into fabricating a bunch of their own repro items. They are also a fairly large restoration shop, and when I've had trouble with installing some part, Tom will call in one of the mechanics to give me free advice over the phone."

BRITISH PARTS INTERNATIONAL
8101 Hempstead Road
Houston, TX 77008
1-800-231-6563
http://www.motorcarsltd.com
Franck Guilloteau says: "They apparently have an extensive stock pile of both new and used parts for models from early XK-E onwards with a comprehensive (250 page) catalog to boot. However, for prices you have to call, they are quite competitive."

BRITISH VINTAGES
645-D Tank Farm Rd
San Luis Obispo, CA 93401
1-800-350-JAGS or +1 (805) 541-5986

CATHOUSE SPARES

176 Liverpool Rd.
Enfield 2136
Sydney, NSW, Australia
+61 2-9747 2144 Fax: +61 2-9747 3212

Mark Jackson says this outfit sells locally-made stainless steel coolant cross pipes and header tanks to fit the XJ-S -- and for reasonable prices to boot. "Darn things are painted black - should have left them brushed SS!!"

CLASSIC COMPONENTS

Tower House, Teesside
International Airport, Darlington DL2 1PD (UK)
+44 1325 332505 FAX: +44 1325 332405

CLASSIC SPARES LTD/CLASSIC ENGINEERING

Unit 4 Brook Road, Britannia Road
Waltham Cross, Herts EN8 7NP (UK)
+44 1992 716236 FAX: +44 1992 788424
http://www.jagweb.com/classicspares

New and used parts, aftermarket parts, Jaguar-based kit and replicar support.

COVENTRY WEST, INC.

2101 Randall Road
Lithonia, GA USA 30058
+1 (770) 484-6500 FAX: +1 (770) 484-1419
1-800-331-2193
e-mail: sales@coventrywest.com
http://www.coventrywest.com

New, rebuilt, and used parts.

EAST COAST JAGUAR

802 Naamans Road
Wilmington, DE 19810
Tel: 1-800-475-9257 or +1 (302) 475-7200
Fax: +1 (302) 475-9258

Shameless bragging from the proprietor himself, John DiGiacoma: "New, used and remanufactured parts for all Jaguar models from 1940s to present. Many hard-to-find parts. Supplying restoration and repair shops and enthusiasts nationwide and abroad for more than 15 years. Water pumps, wiper motors and steering racks rebuilt. Brake parts re-sleeved. We are also a service shop with a very knowledgeable staff having over 20 years experience servicing, rebuilding and driving Jaguars."

ENGEL IMPORTS

5850 Stadium Drive
Kalamazoo, MI 49009
1-800-253-4080 or +1 (616) 375-1000

This is a Jaguar dealership. They will ship parts, and their 800 number is good country-wide. If they don't have the part you seek, they have access to a computerized system that theoretically will find it at any dealer in the US that has it.

EUROPEAN AUTOPARTS SPECIALISTS, INC / AUTO DOCTOR

23151 Telegraph Road
Southfield, Michigan 48034
+1 (248) 353-1592 or +1 (248) 355-2730

They have no catalog, but they can still get most parts to you as cheap as anybody. They have a $50 minimum order, however.

EXOTIC AUTO PARTS

Anaheim, CA
1-(800)-231-3588
+1 (909) 946-1809

AL HOGAN'S AUTOJUMBLE

Mansfield, Ohio
+1 (419) 524-1088

This is a business that specializes in buying out old stock from dealers. The owner Al Hogan is very knowledgeable about British car parts.

INTERNATIONAL SPARE PARTS

1-800-243-0073

J. C. WHITNEY & CO.

1917-19 Archer Avenue
P. O. Box 8410
Chicago, IL 60680
+1 (312) 431-6102
http://www.jcwhitney.com

The quintessential mail-order auto parts company. Occasionally they go into receivership and pocket your money, but most of the time they are acceptable. Very few Jaguar parts (oil filters, etc.) but they have a large selection of generic items. Once you get on their mailing list, you will never be lacking for scrap paper to light your fireplace. Brainless order-takers. You can call in the middle of the night. They will not tell you brand names.

A good rule of thumb: don't ever order the *cheapest* part available from J. C. Whitney. You may be shocked at how cheap some products can be. If there is a choice, choose what they would describe as "better" or "best".

Their catalog numbers generally have two numbers, two letters, four numbers, and a letter. The first two letters (3rd and 4th characters) vary depending on what catalog you're reading from, but the rest of the number stays with that part as long as they carry it. Hence, throughout this book, whereever a J. C. Whitney catalog number is listed, the 3rd and 4th characters are normally shown as "xx" -- you should fill in letters from the catalog you have when ordering.

JAG SERVICES

16820 South Lathrope
Harvey, IL 60426
1-800-842-0912
+1 (708) 331-9151 Fax: +1 (708) 331-9404

"He will call you back; he will have the part; he will know exactly what you're talking about; his price will be cheaper than the dealer; he will have genuine Jaguar parts; and he'll ship today."

From another customer: "I haven't been so satisfied with anyone's service for a long time. They really live up to their word, I always get everything when I am told I'll get it. Plus, they wreck many used Jags, and they only sell new genuine Jag parts in Jag boxes. Plus, I can't find any place that is cheaper, they have very reasonable prices, and know exactly what they are talking about."

JAGUAR ALL-PARTS
Berkeley, CA
+1 (510) 548-8748
Jaguar parts. According to Thomas Alberts, offers replacement antennas and antenna repair kits.

JAGUAR DENVER
1-800-426-4515
Lucas, Girling, Jag parts.

OLAF P. LUND & SON
2-26 Anthony Road,
Saltley, Birmingham B8 3AA (UK)
+44 121 327 2602   FAX: +44 121 327 6284
Free catalog.

MOTORCARS, LTD.
8101 Hempstead Road
Houston, TX 77008
1-800-338-5238 ext. 570   FAX: +1 (713) 863-8238
http://www.motorcarsltd.com
e-mail: info@motorcarsltd.com
Jaguar and Rover parts.

MOSS MOTORS
PO Box MG
7200 Hollister Ave.
Goleta, CA 93116
1-800-235-6954
New and repro parts.

NORMAN MOTORS LTD.
100 Mill Lane,
London NW6 (UK)
+44 171 431 0940   FAX: +44 171 794 5034
Worldwide shipping.

NOS LOCATORS
587 Pawtucket Ave.
Pawtucket, RI 02860
+1 (401) 725-5000
New parts, also fasteners.

Q.C.R. MOTORS LTD

Whitacre Road
Whitacre Road Ind. Estate
Nuneaton
Warwickshire CV11 6BU (UK)
+44 24 7638 5296 or 7632 5577 FAX: +44 24 7664 1211

According to Jaguar World magazine, this company was once known as the people who did bodywork on TWR and JaguarSport models, including the XJ220. Needless to say, they still take pride in their body shop. However, they have apparently taken on a new role: warehousing and distributing parts for older models that Jaguar doesn't want to be bothered with any more, most notably the XJR-S and other specials but also the earlier basic XJ-S. They not only have things like the molded bumper overriders, they also have the original tooling so if they run out they can make more. They also have the special mechanical parts for JaguarSport/TWR/XJR-S cars such as pistons, camshafts, 5-speed gearboxes, brakes, exhaust systems and wheels. The good news: Q.C.R. reportedly sells these parts cheaper than Jaguar ever did! But if you order your parts from Jaguar now they just buy from Q.C.R. and happily slap on their markup.

SNG BARRATT

The Heritage Building, Stourbridge Road,
Bridgnorth, Shropshire WV15 6AP (UK)
+44 1746 765 432 FAX: +44 1746 761 144
e-mail: barratt@barratt.co.uk
http://www.sngbarratt.com/

Searchable parts list, on-line ordering, etc.

TERRY'S JAGUAR

117 East Smith Street
Benton, IL 62812
1-800-851-9438 or 1-800-447-4587 (orders only)
+1 (618) 439-4444 (info) FAX: +1 (618) 438-2371
E-mail: FastCats@terrysjag.com
http://www.terrysjag.com

Free catalog with excellent photos of many items; good selection of high performance parts. Also, you can download an electronic catalog from their WWW site.

Kyle Chatman: "I recommend you buy from someone other than Terry's Jaguar because of their shipping policy. I had to wait two extra days and my wife and I had to rearrange our schedules so that an adult could be here to receive and sign for a brake rotor. UPS has a category of delivery that "means the driver must receive an adult signature and hand the package(s) to a person." I called Terry's today to explain that the restriction was causing me trouble and I was told that it was their policy and they would ship no other way. Even though you pay the shipping, they won't ship it they way you request. Terry's suggested I have the part delivered to my place of work. Oh yes, that's considered outstanding behavior in my office. Anyway, if you have a choice and don't have an adult at home all day, every day, I recommend you buy from someone else."

VINTAGE JAGUAR PARTS

Ray and Walt Osborn
1390 West Highway 26
Blackfoot, Idaho 83221 USA
+1 (208) 684-4767 or +1 (208) 684-3554
Fax: +1 (208) 684-3386
e-mail: General Information: ray@vintagejag.com
Sales: sales@vintagejag.com
http://www.vintagejag.com/

WELSH JAGUAR ENTERPRISES, INC.

223 North 5th Street
P. O. Box 4130
Steubenville, Ohio 43952
1-800-875-5247 or +1 (614) 282-8649
FAX: +1 (614) 282-1913
http://www.welshent.com/

Catalog available.

XK'S UNLIMITED

850 Fiero Lane
San Luis Obispo, CA 93401
1-800-444-JAGS (1-800-444-5247)
+1 (805) 544-7864 FAX: +1 (805) 544-1664
http://www.xks.com
e-mail: xksunltd@aol.com

Catalog available (a few bucks, refundable first order), full line of parts. Takes great pride in their restoration shop. Will restore individual components, such as resleeving brake cylinders in stainless. Offers a nice vented rear brake disk kit.

USED/REBUILT PARTS

ENGLISH SWEDISH CAR SPARES

Alpharetta, GA
1-800-241-1916

Per John Napoli: "Great selection of XJ parts."

JAGUAR HEAVEN

1433 Tillie Lewis Dr.
Stockton, CA 95206-1130
info: +1 (209) 942-4524
orders: 1-800-969-4524 FAX: +1 (209) 942-3670

Used parts recycler.

JUST JAGUAR

2/8 Cooling Road
Frindsbury
Rochester
Kent ME2 4RG (UK)
+44 634-296860 Fax: +44 634-294195

Patrick O'Keeffe says, “A contact that I have found very useful for their expertise and massive stock of second user parts.”

XJS BREAKERS

+44 1992 768007 or +44 1860 255700 (UK)

Ask for Alan.

SPECIALTIES

Interiors

A&B LEATHER & WOOD RENOVATION

1 Dampler Road
Coggeshall, Colchester CO6 1QZ UK
+44-137-656-1586

AUTO INTERIORS OF EUROPE

1790 E McFadden, Unit 107
Santa Ana, CA 92705
1-800-533-2886

KENT BAIN

1785 Barnum Ave
Stratford, CT 06497
+1 (203) 377-6745

Custom interiors, seat rebuilding and repadding.

G. W. BARTLETT CO., INC.

1912 North Granville Avenue
Muncie, IN 47303-2701
1-800-338-8034 or +1 (317) 289-1586
FAX: +1 (317) 289-1251

Interior and trim parts. Sells original specification Jaguar interior kits and components. Free catalog and material samples.

BAS LTD. JAGUAR TRIM SPECIALISTS
250 “H” Street, Unit 8110
Blaine, WA 98231
1-800-661-5377

BRITISH AUTO INTERIORS
See BRITISH AUTO/USA, page 692.

CERTAINLYWOOD
13000 Route 78
East Aurora, New York 14052-9515
+1 (716) 655-0206 Fax: +1 (716) 655-3446
info@certainlywood.com
http://www.certainlywood.com
Not a Jaguar specialist, but a good source of wood veneer.

CONNOLLY LEATHER LTD.
Wandle Bank
Wimbledon, SW19 1DW (UK)
+44 181 542 5251
If you will cut a sample of your original leather from under a seat and send it to these folks along with £37.80, they will send you a renovation kit containing lacquer, hide food, stockinette, and comprehensive instructions.

ALBERT CONSTANTINE AND SONS
2050 Eastchester Road
Bronx, New York 10461
1-800-223-8087 or +1 (718) 792-1600
FAX: +1 (718) 792-2110
http://www.constantines.com
Not a Jaguar specialist, but an excellent source of woods and veneers of all types, wood finishing supplies, etc. Free catalog.

CROFTGATE
UK
+44 1706 216096
Leather dye kits.

THE FINISHING TOUCH
Unit 17, Broadfield Lane Ind. Est.,
Boston, Lincs PE21 8DR (UK)
+44 1205 369239
Stainless steel door sill protectors.

BILL HIRSCH AUTO
396 Littleton Avenue
Newark, NJ 07103
1-800-828-2061 or +1 (973) 642-2404
FAX: +1 (973) 642-6161
e-mail: hirschauto@aol.com
http://www.hirschauto.com/

This outfit has original Connolly lacquer-based dye for the leather interior, as well as non-lacquer-based dye, leather crack filler, and Connolly Hide Food. They also offer products for etching and coating the inside of a fuel tank to seal leaks.

H. P. CO.
1079 Colonial Club Dr.
Harahan, LA 70123
+1 (504) 737-4691

Burled walnut dashboards.

JAGUAR INTERIORS OF ENGLAND
PO Box 47
Muncie, IN 47308
+1 (317) 289-9901

Carpeting and upholstery.

KELLER ASSOCIATES
PO Box 2833
Saratoga, CA 95070
+1 (408) 370-3705

Burl walnut dashboards.

LEATHERIQUE LEATHER RESTORATION PRODUCTS
PO Box 2678
Orange Park, FL 32067-2678
+1 (904) 272-0992 Fax: +1 (904) 272-1534
e-mail: lrpltd@aol.com
http://www.Leatherique.com

The owners of this business happen to own Jaguars -- they must have taste! Some of the pics on their www site actually show Jaguar interiors as examples, even though they may not be labelled as such. “We manufacture custom color match leather dyes for RR/B, MB, Jaguar, and many other autos. We work with museums, restoration shops, and do it yourselfers. We've been around for 30 years and have a well known product. Our Rejuvenator Oil restores strength and suppleness to leather and imparts a nice natural, new leather fragrance, without any fragrance additives.”

RAU RESTORATION

2027 Pontius Avenue
Los Angeles, CA 90025
+1 (310) 445-1128 Fax: +1 (310) 575-9715
wcrau@rau-autowood.com
http://www.rau-autowood.com

Specialists in automotive woodwork of all kinds. Besides offering restoration of Jaguar wood trim, they also offer walnut burl steering wheels made from original steering wheels and walnut burl cellular telephone casings. They will happily send photos of their handiwork. From such photos, it becomes clear that their woodwork is far better than the Jaguar original work, and in fact they offer to bleach and yellow the new veneer "to look more like the old finish" for a small additional fee.

Body

BRIT-TEK

New Hampshire
+1 (603) 437-1584

According to Bruce S. Murray, this is a US distributor of Waxoyl, a popular rustproofing substance. "You need a spraying kit; or you can use your wife's garden sprayer."

CAR CARE SPECIALTIES

P.O. Box 535
Saddle Brook NJ 07663
Phone: +1 (201) 796-8300 Fax: +1 (201) 791-9743
E-Mail: carcaresp@aol.com
Owner: Larry Reynolds

28 page catalog. According to Gene Halaburt, "They sell high quality car care products from 3M, Black Again, Harly Products, Lexol, Masury, Meguiar's, Oil Flo, One Grand, P21S, Porsche Car Care, Ritz, Sonax, Surflex, Tony Nancy, Wurth and Zymol. The first 16 pages give a detailed description of products and prices, and the remaining pages offer excellent advice on 1) washing cars 2) Tire/Rubber and Vinyl Treatment, 3) Care & Feeding of Leather/Vinyl, 4) Paint Chip Repair, 5) Paint Cleaning, 6) Protecting Finish, 7) Care & Feeding of Wheels, 8) Repairing Damaged Wheels, 9) Engine Cleaning, 10) Care & Feeding of Convertible & Soft Tops. The advice Larry gives is very "hands on" and practical - showing pluses and minuses of products and techniques."

COTECH - Eric H. Slabaugh
1805 Little Orchard Street #100
San Jose, CA 95125
+1 (408) 977-0400 or +1 (408) 977-0820
"Coating Technology for the Auto Restorer". According to Andrew E. Kalman, this outfit can refinish chromed plastic parts: "Their process is *not* a chroming process. Rather, they vacuum-deposit aluminum on the stripped part and then spray a clear polyurethane over it.

"I inspected several parts (hubcap, grille, taillight cluster) and was suitably impressed. The finish on these parts was very nice - perhaps not as "hard" looking as chrome, but very reflective, with a bit of depth, and extremely uniform in their color. Basically, it looks like polished aluminum with a protective clearcoat on it. They generally do plastics and pot metals, in aluminum, gold, copper or titanium nitride.

"XJ-S headlamp buckets are $75 each, grilles $120. This seems to compare favorably with new parts. 50% down at time of order. He quoted me 3-4 weeks. It's cheaper if you deliver the parts pre-stripped (they get charged $45 to strip the grille, for instance)."

BARRY HANKINSON, LTD.
15 Copse Cross St.
Ross-On-Wye, Herefordshire HR9 5PD (UK)
+44 1989 565789 FAX: +44 1989 567983
Trim kits.

INDUSTRIAL PLATING COMPANY
Frank Aguilar, President
San Carlos, California
+1 (415) 593-1046
A small company that does mainly industrial plating for the surrounding Silicon Valley high-tech firms. They do all plating to military specs. Supposedly base their prices on the actual effort involved rather than the cost of new Jaguar parts, so are much cheaper than most. Unclear on whether they will actually do business by phone and mail; best to call and ask nicely.

INTERMARQUE AUTO PARTS
Houston, TX
1-800-666-8700
Parts and sheet metal.

MARTIN E. ROBEY SHEET METAL ENGINEERS
Pool Rd, Camp Hill Industrial Estate,
Nuneaton CV10 9AE (UK)
+44 24 7638 6903 FAX: +44 24 7634 5302
http://www.martinrobey.co.uk/
The *manufacturer* of Jaguar body panels!

METRO MOULDED PARTS, INC.
11610 Jay St.
P.O. Box 48130
Minneapolis, MN 55448 USA
1-800-878-2237 or +1 (612) 757-0310
FAX: +1 (612) 757-2803
e-mail: sales@metrommo.com
http:// www.metrommp.com

According to Tom Carney, a supplier of body seals and gaskets with any extensive line of Jaguar-specific items. “Not just weather stripping but a lot of other stuff like stabilizer bushings, air filter to carb gaskets, window channels, headlight gaskets, etc. etc.”

PENINSULA IMPORTS
3749 Harlem Rd.
Buffalo, NY 14215
1-800-999-1209 or +1 (716) 833-3000

Body and rust repair panels.

PII DISTRIBUTING
PO Box 27358
Houston, TX 77227-7358
1-800-231-5836 or +1 (713) 975-6272

Genuine Jaguar parts, sheet metal.

TOWER PAINT
Custom Spray Can Dept.
1-800-779-6520

According to Mark Wentworth, this place “will put *any* paint into a spray can. I got the paint codes from my ’67 122S and my ’80 245, called them, and they sent me 12-ounce cans of the right match. They also provide an *exact* matching service if you can ship them a part, like the fuel filler door or some such item. If you are afraid that the “spray bomb” will not yield good results: I can’t tell the factory job from the spray can (They use a very nice nozzle).”

Restoration/Rebuilding

WHITE POST RESTORATIONS
White Post, VA 22663
+1 (703) 837-1140

Antique auto restorations. Will resleeve brake cylinders with brass liners.

IMPERIAL MACHINE CO.
621 S. 112th St.
Lincoln, NE 68520
+1 (402) 488-9450

Resleeves brake cylinders in stainless steel. Credit cards not accepted. You must enclose a check with the master cylinder including shipping cost.

KIRK'S AUTO REFITTERS
3019 Mississippi Ave
Davenport, IA 92506
1-800-547-5747
According to Zahid Ahsanullah: "His work quality is superb and he seems to know a lot of new and used parts vendors out there. He will meet or beat any price you can quote him. I like to support small businesses and he's on my good list."

THE EASTWOOD COMPANY
580 Lancaster Avenue
Malvern, Pennsylvania 19355-0714
1-800-345-1178
http://www.eastwoodco.com/
This is a mail-order outfit specializing in automobile restoration tools and products. They also carry Colourtune, a device to allow viewing the combustion through a spark plug hole.

GAS TANK RENU USA
12727 Greenfield
Detroit, Michigan 48227
e-mail: DanRenu@aol.com
http://www.gastankrenu.com
A product to line fuel tanks.

MOYER'S FUEL TANK RENU - Joseph H. Moyer or Sandra Lee Moyer
2011 Western Avenue
Greensburg, PA 15601
1-800-328-9550
e-mail: slmoyer@westol.com
http://www.gas-tank.com/
Gas tank repair and restoration specialists. Mail order operation; you ship them your tank, they renovate it to much-better-than-new condition, and ship it back to you. Guaranteed to never rust.

VICARAGE (USA-Holland-UK)
USA: +1 (305) 444-8759 FAX: +1 (305) 443-6443
e-mail: vicarage@ix.netcom.com
http://www.vicarage-jaguar.com/
"Restoration & enhancement specialists"

Exhaust

BELL SILENCER MANUFACTURING -- Roy Gibbons
Phillips Lane, Old Town,
Swindon, Wiltshire
+44 1793 619234 FAX: +44 1793 532946
Stainless exhaust systems. Part of Bell Silencer Services Limited, Swindon.

DICK AMES
608 Ft. Williams Pkwy
Alexandria, VA 22304
+1 (703) 370-3097
Stainless steel exhaust systems.

BORLA INDUSTRIES
Oxnard, CA
+1 (805) 983-7300
Stainless exhaust.

COVENTRY S LTD.
6406 85th Place
New Carrolton, MD 20784
1-800-537-4146
Stainless exhaust systems.

STAINLESS STEEL MUFFLER CORP.
3032 Genesee St.
Buffalo, NY 14225
+1 (716) 893-2116
Stainless exhaust systems.

Electrical

LUCAS AFTERMARKET OPERATIONS, PARTS AND SERVICE
UK
+44 121 506-5000

ASOM ELECTRIC
1204 McClellan Dr.
Los Angeles, CA 90025
1-800-424-2766 or +1 (310) 820-3720
FAX: +1 (310) 820-5908
email: asomelect@aol.com
"We are an auto electrical rebuilding shop, dealing mostly in Lucas and Bosch. We rebuild electrical components including starters, alternators, generators, regulators, fuel pumps, wiper and window motors. We have a large supply of Lucas parts in stocks, including many discontinued pieces. We have been in business for 36 years."

BARLEY CREEK ENTERPRISES/JAGUAR
869 Pioneer Drive
Lebanon Junction, KY 40150
+1 (502) 543-2932
According to Robert Woodling, "Jaguar radios were manufactured by AutoSound Inc. (ASI) from 1981-86 model years. ASI went out of business in 1986. All the parts were purchased by Mike Lanham of Barley Creek Enterprises/Jaguar. Mike will repair these radios for a *very* reasonable price."

BECKMAN -- Bob or Donna
+1 (919) 381 2700
Repair ECU's.

BRITISH CAR SERVICE
Tuscon, Arizona (USA)
+1 (520) 882-7026
www.britishcarservice.com
Rebuilds distributors.

BRITISH WIRING INC.
20449 Ithaca
Olympa Fields, Il 60461
+1 (708) 481-9050
Per Lauren Pratt, "For individual wires of nearly any size and color code and terminals, boots, etc."

BRITISH PACIFIC LTD
3317 Burton Avenue
Burbank, CA
1-800-554-4133

CLASS-TECH
62935 Layton Ave.
Bend, OR 97701
1-800-874-9981
Dave Covert says "If you need a harness wrapped.. I would recommend you give these guys a call..."

COVENTRY ENGINEERING
9500 SW Martha St
Tigard, OR 97224
+1 (503) 620-9482
Wiring harnesses.

DEL CITY
2101 W. Camden Road
Milwaukee, WI 53209
1-800-654-4757 Fax: 1-800-431-1293
http://www.delcity.net
Wire, high-temp wire, connectors, relays. Can provide stripes and spiral stripes. Has branches around the US.

EXOTIC AUTO
Myrtle Beach, SC
+1 (803)-236-9005
Johnny Vaught reports on an A/C system fix: "One of the most common problems on the cars is the temperature controller, and specifically with one component, a wirewound potentiometer. Exotic Auto persuaded a company to reproduce the pots and now offers a cleaning, rebuilding and calibration service for the modules."

GLOBAL METRICS, INC.
Belmont, CA
+1 (415) 592-2722 or 1-800-227-9981
Supplier for the Bosch fuel injector harness plugs.

MAGNECOR
+1 248-669-6688 Fax: +1 248-669-2994
http://www.magnecor.com
Makers of spiral core spark plug wires. Offers a custom set for the Jaguar V12.

NARRAGANSETT REPRODUCTIONS
Box 51
Wood River Junction, RI 02894
(401) 364 3839

NISONGER INSTRUMENT SALES & SERVICE
570 Mamaroneck Ave.
Mamaroneck, NY 10543
+1 (914) 381-1952 FAX: +1 (914) 381-1953
According to Walt Morris and Rob Reilly, this outfit does a good job refurbishing gauges.

OPTIMA BATTERIES
San Jose, CA
1-800-292-4359
http://www.optimabatteries.com
Unusual sealed battery with gel electrolyte. Excellent warranty, but more importantly an excellent battery! Call for a

local dealer, or visit an Interstate battery dealer.

RHODE ISLAND WIRING SERVICE
P O Box 434
West Kingston RI 02892
1-800-241-1955 or +1 (401) 789-1955

Per Lauren Pratt, "For a special harness of your design that is any length, wire size, color code, or any combination thereof, along with any terminal and connector or boot, and loomed in whatever color and pattern you may wish. They will even re-loom your harness in the original colors and pattern."

DANIEL STERN LIGHTING
http://www.danielsternlighting.com/

Supplier of automotive headlights and tech knowhow.

THE WIRING HARNESS COMPANY
UK
+44 1332 810052

Per Craig Sawyers, "When Lucas stopped braiding looms, the proprietor (Peter Newall) bought their braiding machine and the database. So he can re-build any harness that Lucas used to do to original specs. They have just done a superb job for me by re-building all the engine and engine bay looms on my V12 Saloon to as-new condition."

Steering/Suspension/Final Drive

APPLE HYDRAULICS
715 Route 25A
Miller Place, NY 11764
1-800-882-7753 or +1 (516) 744-9627

Rebuilds Armstrong, Girling shocks.

ATLANTIC ENTERPRISES
221 Strand Industrial Dr.
Little River, SC 29566
1-800-654-7565 FAX: +1 (803) 399-4600

Rebuilt steering racks, steering pumps, seal kits, polyurethane rack mounts.

QUALITY JAGUAR/CONCOURS WEST INDUSTRIES (Michael Bontoft)
306 Dwight Rd.
Castle Rock, WA 98611
+1 (360) 274-3373 Fax: +1 (360) 274-3376
http://www.cwiinc.com

Formerly in Costa Mesa, CA. This firm specializes in Jaguar rear suspensions. For those of you who are unaware, the Jag IRS has been *the* item for hot rods for 25 years. From this catalog, you can order Jag rear ends chrome plated, cadmium plated, powder coated, narrowed (to fit wider wheels), with different gear ratios, etc, etc. You can even order an entire IRS with no original Jaguar parts, including a final drive unit that uses Ford 9" differential parts; this assembly was featured in the September 1994 issue of Street Rodder. The company also offers front suspensions, high performance differentials, and aftermarket bushings.

R.E.S. (Rear End Specialists) (Jim)
26489 Ynez Rd. Ste.c-143
Temecula, Ca. 92591
+1 (909) 693-5340 Fax: +1 (909) 699-1836
na617@aol.com

"R.E.S. specializes in rebuilt suspension components. We offer the following services: rebuilt differentials, ratio changes, rebuilt hub assemblies, rebuilt brakes, rebuilt complete rear suspensions, and differential parts, all at exceptional prices."

SPEEDWAY MOTORS
300 Van Dorn
P.O. Box 81906
Lincoln, NB 68501-9896
+1 (402) 474-4411 FAX: 1-800-736-3733

This is a mail-order outfit for hot rods. Since the Jaguar rear suspension is popular among the hot rod crowd, the catalog offers such things as finned aluminum final drive covers, nylon radius arm bushings, brakes, shocks, etc.

UK AXLES
Unit 20, Wyvern Way,
Uxbridge, Middx (UK)
+44 1895 272464 Mobile: +44 860 702801

Axles, differentials, ratio changes. Overseas enquiries welcome.

Wheels

THOROUGHBRED MOTORS / Rodney Dessberg
2035 Cornell Street
Sarasota, FL 34237
+1 (941) 955-5960

Rodney specializes in wheels. He does a good business putting aftermarket wheels on Jags and keeping the stock wheels, and therefore has an incredible selection of stock wheels to unload at good prices. He also does other work with Jags and other neat cars.

BRITISH WIRE WHEEL
1650 Mansfield St
Santa Cruz, CA 95062
1-800-WIRE WHEEL or +1 (408) 479-4495

Dayton and Dunlop wire wheels, tires. *The* place to go for correct reconditioning of your JagWires. Please see comments on page 403!

DAYTON WHEEL PRODUCTS
115 Compark Dr.
Dayton, OH
+1 937-461-1707 Fax: +1 937-461-1815

PRISTINE
South Milton Keynes (UK)
+44 1908 282628
Refinishes alloy wheels.

Miscellaneous

AAPAK
1845 North Grand Avenue
Phoenix, Arizona 85007
1-800-832-5544
+1 (602) 254-1116 Fax: +1 (602) 252-5065
http://www.aapak.com
Air conditioning stuff.

BARNHILL BOLT CO. INC.
2500 Princeton NE
Albuquerque, NM USA
1-800-472-3900 or +1 (505) 884-1808
http://www.barnhillbolt.com/

BRITISH TOOLS AND FASTENERS - PHILIP BROWN
2030 Andre Ave.
Los Osos, CA 93402 USA
http://www.britishfasteners.com/mm5/merchant.mvc
boltnut@ix.netcom.com
1-800-587-0475 FAX: (805) 528 0358

BRITISH TOOL COMPANY
891 Houseman NE
Grand Rapids, MI 49503
Whitworth tools. Also makes special factory tools originally made by Churchill in England. Will buy unused or obsolete tools for British cars. Has an engineer on staff and a machine shop, will design and make large or small items for special projects.

JOHN FARRELL
57 D Alder St.
West Babylon, NY 11704
1-800-454-7977 or +1 (516) 454-7977
Chiefly an E-type specialist, but can provide the square-cut O-ring seals that are needed between halves of the front brake calipers on the XJ-S.

GRAINGER

1-800-CALL-WWG

http://www.grainger.com

Industrial supplies. 350 locations in the US, Canada, Mexico and Puerto Rico.

GRIOT'S GARAGE

3500-A 20th Street E.
Tacoma, WA 98424
1-800-345-5789

Tools and automotive accessories. According to Rob Westcott, "Beautiful stuff if you have really deep pockets." Free catalog.

HITCH-WEB

Southern California
1-800-300-4067 (orders)
+1 (818) 787-3186 (info) (8-5 Pacific time)
http://www.hitch-web.com
e-mail: info@hitch-web.com

Offers a trailer hitch to fit the XJ-S. Specifically, a DaLan Class 1 Receiver #DA247272~C4620, rated at 200 pounds tongue weight and 2000 pounds towing capacity.

McMASTER-CARR SUPPLY COMPANY
PO Box 440

New Brunswick, NJ 08903-0440
+1 (404) 346-7000 or +1 (330) 995-9555
Fax: (404) 349-9091
http://www.mcmaster.com
atl.sales@mcmaster.com

A supplier of industrial stuff. Can order online. Will accept credit cards. Catalog weighs about 20 pounds.

METRIC & MULTISTANDARD COMPONENTS CORP.

120 Old Saw Mill River Road
Hawthorne, NY 10532
1-888-966-MMCC (1-800-966-6622)
New York:
1-800-431-2792 Fax: +1 (914) 769-5049
Chicago:
1-800-221-4469 Fax: +1 (630) 655-9062
Dallas:
1-800-527-5177 Fax: +1 (972) 870-1154
Atlanta:
1-800-444-9560 Fax: +1 (770) 935-9511

Obviously a source for metric stuff, but the "multistandard" includes British standards like BSPP.

NORTHWEST TRANSMISSION PARTS
6347 Fair Ridge Road
Hillsboro, Ohio 45133
+1 (513) 927-5366 or +1 (513) 442-2811 or 1-800-327-1955
"An excellent source of parts for all automatic transmissions including specialized items for Jaguar BW transmissions."

GUNSON LTD.
Pudding Mill Lane
London E15 2PJ (UK)
UK source for ColourTune, a device that can be screwed into a spark plug hole to watch the combustion and determine if the mixture is correct.

PEGASUS AUTO RACING SUPPLIES
1-800-688-6946
Hylosil and Hylomar sealants.

H.D. ROGERS & SONS - Hal Rogers
3418 Barksdale Blvd.
Bossier City, LA 71112 US
+1 (318) 742-3651 FAX: +1 (318) 742-5044
e-mail: hdrsons@iAmerica.net
http://www.hdrogers.com
"I try to offer very competitive pricing on original equipment and reproduction (aftermarket) parts. I can also offer many factory Jaguar packaged products at discounted prices too (just not as discounted as other items). Most of what I stock is mechanical, hydraulic, electrical, accessories, books, manuals (not stocking much body/trim but can s/order).

"I directly import parts in many instances and can even special order directly out of the UK should some need it. I can supply virtually any currently available part as well as lots of old NOS pieces too."

"We sell an excellent aftermarket a/c amplifier unit for the XJ (original part number is C45402). The unit comes with a 5 year warranty. We import the amplifiers from Australia. They are quality pieces and are not common in the USA. Other USA suppliers offer aftermarket amplifiers too but I believe ours is the best one for the money." They also sell antennas and antenna repair kits.

VALEO CLIMATE CONTROL
New Road
Ammanford
Dyfed.
South Wales SA18 3ET
+44 1269-3131 Fax: +44 1269-591269
or
HEOL-Y-MYNYDD
Gorseinon
West Glamorgan
South Wales SA4 1XX
Tel: +44 1792 898855
According to Alan Akeister, took over Delanair, makers of XJ-S climate control system.

PERFORMANCE/MODIFICATION

ADDCO

715 13th Street
Lake Park, FL 33403
1-800-338-7015

Addco makes anti-roll bars for anything with four wheels, and at reasonable prices. They offer a 7/8" bar for the rear of the XJ-S and a 1" bar for the front. They evidently based their offerings on the pre-1982 XJ-S (which came with a rear bar), because both bars are intended to replace existing bars, not install where there was none before. As such, the rear anti-roll bar kit does not include links and other parts that will be necessary on the 1982-on car. Also, both bars are much stiffer than stock; they don't offer a soft rear bar to complement the stock front bar. They have now been informed of the error of their ways, and perhaps they will respond with a from-scratch kit as well as a more limber rear bar for the 1982-on XJ-S.

AJ6 ENGINEERING/Roger Bywater

60 Henshall Road, Bollington,
Macclesfield, Cheshire SK10 5DN (UK)
Tel/Fax: +44 1625 573556
aj6eng@jagweb.com
http://www.jagweb.com/aj6eng

This outfit offers all kinds of aftermarket inlet systems and various EFI system modifications and improvements for both V12 and 6-cylinder XJ-S's. Of note, they will fix faulty ECU's on an exchange basis for reasonable prices. They also offer EFI diagnostic equipment. Jeffrey Gram says they can "rebuild any 6CU or 16CU to either low or high CR, with or without catalyst and that we should take care not to pay too much for an ECU, AJ6 has loads on stock."

Richard Mansell reports: "The AJ6 website lists the following acceleration figures for the various mods they sell.

	40-60	60-80
Standard	6.7	6.9
Super Enhanced ECU	5.0	5.76
+ Large Throttle kit	4.5	5.45
Full Plus Torque kit	4.1	4.94

This author has corresponded with Bywater at length, and will add the following personal recommendation: Roger Bywater worked in the engine development department at Jaguar when the V12 was being developed. He left Jaguar in the late 70's to form AJ6 Engineering. There probably is no higher authority on the Jaguar V12 to be found.

ARDEN AUTOMOBILBAU GmbH

Untergath 175, D-47805 Krefeld (Germany)
Ph: +49 2151 37230 FAX: +49 2151 372323
http://www.arden.de
arden@arden.de

Exclusive alloy wheels, wood trim including a wood rim steering wheel with airbag, wind deflector for convertibles, suspension and body styling mods. Most spectacular offering is an XJ-S estate car (station wagon). They also make an XJ-S with a back seat. Steve Gallant says, "Arden is the only Jaguar-only dealer in Germany and is a TUV-approved 'tuner'. They manufacture all kinds of specials, including a coupe version of the XJ-S without the flying buttresses (looks kinda like the convertible with its top up - very attractive - see it in Skilleter's book on XJ-S's)."

BURL DESIGNS

Formerly AUTOSTYLE BY PAUL BANHAM
Unit 14, Castle View Business Estate, Gas House Road,
Rochester, Kent, ME1 1PB (UK)
+44 1634-840530 Fax: +44 1634-844424
http://www.jagweb.com/burl_designs/index.html

According to Alan Akeister, can convert older dashboards to the later style round dials, and add extra wood inserts to dash facias, around heater and radio controls, and to ski-slopes (the area around the shifter). Veneer refurbishing and replacement veneer pieces. Body styling kits, bumpers, spoilers, etc., even an entire kit car called an XJSS. Hardtops for convertibles.

Note: There has been a report of difficulty dealing with this outfit; shoppers are advised to check the dispute resolution policy on their credit cards before ordering, especially with overseas orders.

Also note that some customers have complained that veneer pieces didn't match as well as they had hoped, even when a sample of the original had been sent to Autostyle. The usual complaint was that the Autostyle veneer was darker than the original.

B&M RACING AND PERFORMANCE PRODUCTS

9142 Independence Avenue
Chatsworth, CA 91311
e-mail: bmperf@pacificnet.net
http://www.bmracing.com

Not a Jaguar specialist, but offers high-performance parts for the GM400 transmission. Free catalog.

HARVEY BAILEY ENGINEERING

Ladycroft Farm, Kniveton, Ashbourne
Derbyshire DE6 1JH. (UK)
+44 335 346419 FAX: +44 335 346440

According to Jeffrey Gram, "Handling kit for Jags consist of revalved Bilstein or Koni dampers and stronger anti-roll torsion bar and rear torsion bar. Very good results with 23% uprating of the rear spring rate." Also offers a front cross brace for the XJ-S convertible as well as a "rear anti-tramp frame".

BAKER PRECISION BEARING

2865 Gundry Ave.
Long Beach, CA 90806

Distributors of the Oberg Filter, a bypass oil filter system which employs a reusable, ultra-fine stainless steel filtering element, and uses an adapter plate for simple and straightforward installation either in place of, or in addition to, the spin-on filter.

ROB BEERE RACING SERVICES

Unit 1 Priority Mill, Charter Avenue,
Coventry CV4 8AF (UK)
+44 2476 47 33 11 FAX: +44 2476 47 33 22 Mobile: +44 860 675001

Lightened flywheels, hot camshafts, other high-performance engine and suspension parts.

CLASSIC ENGINEERING

Unit 4, Brook Road, Britannia Road,
Waltham Cross, Herts EN8 7NP (UK)
+44 1992 788967

Offers a kit to install the 1992-on structural cross-bracing to a 1988-1991 XJ-S convertible.

CONVERSION COMPONENTS, LTD.

17 Victoria Street
Waihi, New Zealand
+64 7 863 8509 Fax: +64 7 863 6354
sales@conversioncomp.co.nz
http://www.conversioncomp.co.nz

Offers three different 5-speed transmission kits for the V12 XJ-S: one using the Toyota Supra transmission, one using the Toyota 'Big' Supra transmission from the 3L Twin Turbo Supra, and one using the Tremec. On the Supra transmissions, the shifter location is modified to 390mm from the engine face, much closer than on any stock Supra transmission.

COOPERCRAFT

Westwood, Broadclyst
Exeter EX5 3DH (UK)
+44 1404 822100 FAX: +44 1404 822102

Aftermarket brake calipers, and some modified rear brake cylinders.

DEE ENGINEERING

Costa Mesa, CA
+1 (714) 979-4990

Makers of "ProThane" urethane suspension parts, including anti-roll bar mounts, end link assemblies and individual bushings, shock absorber mount bushings, bump stops, tie rod end boots and coil spring dampening inserts. Some of their parts are sold by J. C. Whitney.

Their "B" style anti-roll bar mount bushing and bracket will, with a little trimming on the corners of the urethane bushing itself, fit the rear of the XJ-S very well; for a 9/16" bar, the part number is 19-1127, and for a 5/8" bar it's 19-1128. It does not appear that any of their anti-roll bar mounts are well suited to the front end of the XJ-S.

Thanks to Thomas Alberts for this info.

DELLOW AUTOMOTIVE PTY LTD

37 Daisy Street
Revesby, NSW 2212 (Aus)
PO Box 43 Revesby North 2212
+61-2-9774-3873 fax: +61-02-9774-4783

Per Michael Frank, these are specialists in installing Toyota Supra 5-speeds in Jaguars. They will sell a kit either with or without the transmission itself, and will ship worldwide. "The kit includes bell housing, clutch, pressure plate, rear crossmember, speedometer cable, pushrod, yoke, and clutch fork, etc." "They also supply a "Qik-Shifter" which reduces shifter throw by 50%."

DOUBLE S

UK

According to John Goodman, these makers of stainless steel exhaust systems "...make a large bore sports system for the XJ-S. They also make stainless steel headers as well, though they are not cheap they were prepared to sell direct, which at the time was priced significantly lower than the prices quoted from the Jag tuning companies (cuts out the middle man !).

"Apparently the headers are a pig to fit because you have to jack the engine up one side at a time, but when installed there are no clearance problems other than they won't fit LHD cars. The big bore system fits either the standard front pipes or the headers (may be different versions)."

British Auto/USA (page 692) distributes Double S products in the US.

ELECTROMOTIVE INC.

14004-J Willard Road
Chantilly, VA 22021
+1 (703) 378-2444
http://www.electromotive-inc.com

This company offers aftermarket electronic fuel injection and ignition systems suited for the XJ-S.

EREBUNI CORP.

+1 (718) 387-0800

Per Brian Schreurs: Offers body styling mods.

FASTERJAGS -- Brian Welker

214-769-4555
7715 Robin Road
Dallas, TX 75208
http://www.fasterjags.com

BOB GREENE DEVELOPMENTS

Unit 9, West Court, Buntsford Park Road
Bromsgrove, Worchestershire B6O 3DX (Birmingham area, UK)
Ph: +44 1527 873716 / 832453 FAX: +44 1527 575403

Offers vented rear brake rotor kits. Jeffrey Gram: "For the front there is a bigger disc kit with 4 pot aluminium calipers for 15" wheel: 12" disc, 2 thicknesses: 28 or 32 mm; 16-17" wheels, 13" disc; 17-18" wheels, 14" disc (full race version).

HYPER

Unit 7, Stationfield Industrial Estate,
Kidlington OX5 1JD (UK)
+44 1865 842557 FAX: +44 1865 842558

Several different body styling changes including spoilers and a wide-body conversion. Split-rim alloy wheels, manual and automatic gearbox conversions, exhaust systems. Agents in South Africa, Hong Kong and France.

JAGUAR SOUTH - Chad Bolles
306 Valcour Road
Columbia, SC 29212
+1 (803) 798-3044 FAX: +1 (803) 798-4512
e-mail: jaguar@bbs.clynx.com

Bolles has a great deal of experience in racing and high performance work, and also has a great many contacts for buying hard-to-find stuff or having special things made. He has made many more radical performance mods to his own street XJ-S than those suggested in this book, and is building an XJ-S dragster using the V12 engine.

Bolles can provide a few choice items for reasonable prices, such as a V12 crank with an 80mm stroke that uses Chevy connecting rods and an adapter plate for connecting a Chevy bellhousing (auto or manual) to the 5.3 engine.

Also reportedly can provide genuine Churchill Jaguar special tools at excellent prices, depending on the current pound/dollar exchange rate.

NOTE: This is one of at least two firms in South Carolina named Jaguar South.

JAGUARS THAT RUN
P.O. Box 66
Livermore, CA 94550
http://www.jagsthatrun.com

Specialists at putting Chevy V-8 engines into Jaguars, pickup trucks, etc. Also offers manuals on doing the job yourself, including "Jaguar V8 Conversion Manual" by Mike Knell.

JEG'S
751 East 11th Avenue
Columbus, Ohio 43211-2695
1-800-345-4545 FAX: +1-614-299-4444

A supplier of Chevy aftermarket stuff. Free catalog.

JOHN'S CARS, INC.
800 Jaguar Lane
Dallas, TX 75226
1-800-866-5247 or +1 (214) 426-4100
FAX: +1 (214) 426-3116
e-mail: conversions@johnscars.com
http://www.johnscars.com

This place is best known for Chevy V8 conversions for Jags. Still, their catalog contains some useful stuff such as an improved design steering rack mount, as well as several tidbits of helpful information. They also have a good assortment of used parts. "Our replacement parts (poly rack bushings, poly trans mounts, A/C hoses [R134 compatible], PS hoses, etc.) are engineered beyond OEM specifications and all carry a lifetime warranty."

JUST JAGS
Rycroft Villa
24 Proffit Street
Walsall, West Midlands WS2 8AZ (UK)
+44 1922 637779 Mobile: +44 831 506722
e-mail: justjags@yahoo.co.uk
http://jagweb.com/justjags/index.html

Body styling components. Offers bumper covers, a "boot infill panel" that replaces the boot plinth and provides a smoother appearance around the licence tag, and a boot lid spoiler with an LED 3rd brake light built in. If you're in a country that requires rear fog guard lights, the bumper covers have no in-bumper provision for them. There is reportedly carbon fiber involved, as opposed to the simple fiberglass of some other products.

K & N ENGINEERING, INC.
P.O. Box 1329
Riverside, California 92502
1-800-858-3333 or (951) 826-4000
UK: Phone: +44 (0) 1925-636950 Fax: +44 (0) 1925-418948
email: uk.sales@knfilters.com
http://www.knfilters.com/

Manufacturers of low-restriction permanent air filters consisting of a layer of oiled fabric sandwiched between aluminum mesh.

KEISLER AUTOMOTIVE ENGINEERING & ELECTRIC -- Mr. Shafi Keisler
Knoxville, Tennessee USA
+1 (423) 982-8198 phone/fax
E-mail: skeisler@icx.net
http://www.keislerauto.com

A selection of well-engineered performance and upgrade parts for the XJ-S. Offers a 5-speed manual transmission conversion kit based on a Tremec TKO unit, with bellhousings to fit either the 5.3 or 6.0 engine. Also offers a 5-speed kit for the 4.0.

RON KELNHOFER
8219 W. Bradley Rd.
Milwaukee, WI 53223-3286
Phone: 414-355-7441 Fax: 414-355-4901
E-mail: rkelnhofer@wi.rr.com

Offers improved banjo bolts, half moon seals, and timing chain tensioner access plugs.

KOENIG SPECIALS GMBH
Flösserfasse 7
D-8000 München 70 Germany
+49 89/724970
Telex 528145 koevm d
Telefax +49 89/7238813

Phil Stuart: "I have a König (Koenig in the US) modified XJS. This includes body modifications, engine mods, interior mods and suspension mods." Stuart notes that the engine mods included nitrous oxide injection and sodium filled titanium valves. "My car is registered here in Canada as a Koenig Wildcat, not as a Jaguar XJ-S."

TREVOR LANGFIELD
Doncaster, England
phone: +44 1302 834343
"High Power Nitrous" systems.

LISTER OF NORTH AMERICA
1912 Granvill Ave.
Muncie, IN 47308
1-800-338-8034
High performance accessories.

LYNX MOTORS INTERNATIONAL LTD.
68 Castleham Road
St Leonards on Sea, East Sussex TN38 9NU (UK)
+44 1424 851277 Fax: +44 1424 853771
enquiries@lynxmotors.co.uk
http://www.lynxmotors.co.uk
Makers of the Lynx Eventer, an XJ-S made into an "estate car" -- or what we Americans would call a station wagon. Hatchback and all.

MOTEC
http://www.motec.com
Manufacturers of aftermarket EFI systems. Per Ken Wallace, "This appears the ultimate. Quite expensive."

PAECO IMPORT PARTS
2400 Mountain Drive
Birmingham, AL 35226
1-800-326-6401 - orders only +1 (205) 823-7278 - Everything else
According to Michael Neal: "They offer a wide range of performance parts and machine work as well as complete engines. The Jag V12 is available up to 532 hp with their stage 4 engine. Their solid copper gaskets may be worth checking out. Paeco claims they are virtually blow-out proof."

PURADYN FILTER TECHNOLOGIES, INC.
3020 High Ridge Road
Boynton Beach, FL 33426
1-800-488-0577
+1 (407) 547-9499 FAX: +1 (407) 547-4025
http://www.puradyn.com/
PURADYN EUROPE LTD.
Centrax, Shaldon Road
Newton Abbot, Devon
TQ124SQ, England
+44-1626-52251 FAX: +44-1626-56592
Produces a package for maintaining clean oil; includes a bypass filter and a heater to boil away contaminants.

RED LINE SYNTHETIC OIL CORP.
3450 Pacheco Blvd.
Martinez, CA 94553
+1 (510) 228-7576

Makers of a product called "Water Wetter" that supposedly will improve cooling efficiency. Included in their line of synthetic lubricants is a product called MTL (Manual Transmission Lubricant), an oil specifically designed for synchros. They also make synthetic transmission fluids. According to Dean Gosselin, "Red Line puts together a nice package of technical data which they mail for free upon request."

SUMMIT RACING
Akron, Ohio
+1 (330) 630-3030
http://www.summitracing.com

High performace parts for Chevys and the like. Getting a free catalog is compulsory, even for Jaguar owners.

CLIVE SUTTON
14 Kingsbury Trading Estate
Church Lane, London NW9 8AU (UK)
+44 181 200 4455FAX: +44 181 200 4094

Offers a handling package for the XJ-S, as well as other "enhancements". Also is a dealer for AJ6 Engineering products.

TCI
One TCI Drive
Ashland MS 38603
+1 (601) 224-8972 FAX: +1 (601) 224-8255

High performance GM400 transmission parts.

TILTON ENGINEERING
+1 (805) 688-2353 Fax: +1 (805) 688-2745

Bellhousings, lightweight flywheels, heavy-duty starters (for difficult-to-start souped-up engines), multi-plate clutches, etc. for the Jaguar V12. Per John Napoli: "Their stuff looks very good -- I've seen it on a number of race cars -- but it is a little pricey."

TOTAL SEAL, INC.
11202 North 24th Avenue, Suite 101
Phoenix, Arizona 85029
1-800-874-2753

Makers of a unique type of piston ring that provides a much better seal than conventional rings. These rings are very popular in racing.

TURBO ACTION
1535 Owens Rd.
Jacksonville FL 32218
+1 (904) 741-4850 FAX: +1 (904) 741-4853

GM400 high performance parts.

W.L. WHITE (Bill)
1013 Ferry Road
Christchurch, NZ
Phone/Fax: +64 3-3321546
For the Jaguar V12:

7.5 liter overhaul kit (HE & Pre-HE) which has to date been supplied as short engine (on exchange basis) but can be supplied as partially assembled kit. All kits are supplied with cast alloy deepened & gated sump.

8.4 liter under development.

Deepened and gated alloy sump kit available separately.

Induction Systems:

12 Throttle Body 95º manifolds (45-48mm) for XJ-S. Length = 220mm from port face.

Four plenum cast alloy 45mm interior parabolic manifolds designed primarily to take advantage of "pressure wave" or sonic supercharging theory, but will also function as high flow manifold for larger engines.

Four plenum injection manifold available for V12 E-Type and can be used as "low profile" arrangement for other purposes.

High flow single plenum manifold to run larger engines with standard layout. This alloy casting has the same runner design as four plenum manifolds.

Complete tuned engines can be supplied if required with management systems to accommodate fuel requirements and prevailing emission standards.

Management Systems that embrace M.A.P., T.P.S. (or combination), multi coils, advance curve manipulation and oxygen sensor open- and/or closed-loop operation. Oxygen bas parameters are adjustable.

"Also of interest, he will be working on a 6.5l - 7.0l diesel version of the Jaguar V12. He estimates around 200 hp and envisages it will be used for marine applications."

Mike Morrin talked with White, and reported that "Bill has got most of the parts ready for his quad cam V12; he has (typically) done a very thorough job, involving new castings for the timing cover and each end of the 'turned' XJ40 head. I presume this will become another standard conversion."

ZYTEK SYSTEMS
London Road
Bassets Pole
Sutton Coalfield
West Midlands B75 5SA
+44 121 3232323
http://www.zytek.co.uk/
Makers of fancy electronic control systems for automobiles -- including the engine management system used on the XJR-S.

ACCESSORIES

JAGUAR MOTORING ACCESSORIES
606 N. Milpas St.
Santa Barbara, CA 93103
+1 (805) 966-7158 FAX: +1 (805) 564-4118
Has Mini-Mag flashlights engraved with the Jaguar logo, Jaguar Christmas ornaments, many other accessories.

TS IMPORTS/MOTORING EXTRAS
+1 (419) 384-3022 FAX: +1 (419) 384-3272
Orders only: 1-800-543-6648
Key fobs, T-shirts, patches, etc.

PUBLICATIONS & PERIODICALS

AMAZON.COM
http://www.amazon.com
The world's biggest and most famous bookstore.

AUTO BOOK CENTER (formerly HYDRO-E-LECTRIC)
45-A Morton Station Road
Charlton, MA 01507
+1 (508) 248-0850
1-800-448-6244
According to John Horner, carries "Shop manuals; parts books (a great resource); sets of service bulletins; also owner's manuals for most Jags. The shop manual, parts manual, and Borg-Warner transmission manual were all good quality full size reprints. The reprints are spiral bound, which is very practical for an owners manual. Also, the quality of printing is quite good with all diagrams very clear and readable."

ROBERT BENTLEY, Publishers
1734 Massachusetts Avenue
Cambridge, MA 02138
1-800-423-4595 or +1 (617) 547-4170
http://www.bentleypublishers.com/
Jaguar factory shop manuals, parts catalogs, and driver's handbooks.

BOOKSPEED
16 Salamander Yards
Edinburgh EH6 7DD (UK)
(+44) 0131 467 8100 Fax: (+44) 0131 467 8008
http://www.bookspeed.com/
Source for an extensive collection of Jaguar books and manuals.

CLASSIC MOTORBOOKS

729 Prospect Avenue
P.O. Box 1
Osceola, WI 54020-0001
1-800-826-6600 Overseas: +1 (715) 294-3345

The actual company name is Motorbooks International, and they publish books under this name. Classic Motorbooks is one of their retail divisions. They are not affiliated with the UK or Australian companies with similar names.

HAYNES PUBLICATIONS INC

861 Lawrence Drive
Newbury Park, California 91320 (US)
+1 (805) 498-6703 Fax: +1 (805) 498-2867
e-mail: info@haynes.com
http://www.haynes.com

Source of the Haynes workshop manuals.

HAYNES PUBLISHING GROUP

Sparkford Nr Yeovil
Somerset BA22 JJ (UK)

HEMMINGS MOTOR NEWS

Box 100
Bennington, VT 05201

KELSEY PUBLISHING LTD

PO Box 13
Westerham, Kent TN16 3WT UK
+44 1959 541444 Fax: +44 1959 541400
e-mail: jagworld@aol.com

Publishers of *Jaguar World* and *XJS Bulletin* magazines.

MOTORBOOKS INTERNATIONAL

See Classic Motorbooks, above.

MOTOR BOOKS

233 Military Road
Cremorne 2090
Sydney, New South Wales, Australia
+61 2-9909-1144

Stefan Kjellberg: “They seem to have a good selection of Jag manuals & books.”

EWA & MINIATURE CARS USA, INC. (Eric Waiter)
205 Route 22 East
Green Brook, NJ 08812
Orders only: 1-800-EWA-4454 (1-800-392-4454)
email: ewa@ewacars.com
FTP: ftp.ewacars.com/pub/ewacars
http://www.ewacars.com

The US distributor of *Jaguar World* and *Jaguar Automobilia Collector* magazines, as well as a lengthy list of other British automotive magazines. Also issues a quarterly listing of automotive scale models, books, handbooks and manuals, general autobooks, videos, even books about models!

MODELS

It is not likely you will find a model of the XJ-S in your local K-Mart. However, if you find a hobby shop that will special-order models, Hasegawa makes several XJ-S models including some models of XJ-S race cars. Hasegawa model CA-1 is a 1:24 scale stock street model. This is apparently a model of the Japan- or UK-issue car, as it is right-hand drive, the wipers park to the right, and it has the European style single headlight units. For those of us who haven't built a model in 20 years, the price causes sticker shock: about $25. But it is remarkably detailed and accurate, including a complete interior with all gauges, switches and pedals, and an engine accurate enough for you to learn where things are you can't see in your engine compartment. The rear suspension is complete with individual shock absorbers. The wheels are the older 5-point domed alloy style. The tires are rubber and actually say "Pirelli P5" and "215/70VR15" on them.

JAGUAR MODEL WORLD
P.O. Box 40,
Hornchurch, Essex RM11 3LG (UK)
FAX: +44 1708 475993

All the obscure Jaguar models you could possibly want.

MODEL EXPO, INC.
Dept. HMN33, P.O.Box 1000
Industrial Park Drive
Mt. Pocono, PA 18344
1-800-222-3876

Dealer for Burago die-cast metal models, 1:18 and 1:24 scale.

TOYS FOR COLLECTORS
P.O. Box 1406
Attleboro Falls, MA 02763
+1 (508) 695-0588

$5 catalog.

EXOTO TIFOSI

+1 (818) 305-1358

According to Mike Plechaty: "Models in various scales of just about everything ranging in price from $16.95 to $25,000, or so. The catalog is 268 pages 8-1/2x11 format complete with b&w photos & costs $7."

EWA (see listing under Publications, page 724)

INTERNET SOURCES

There are many valuable Jaguar-related resources on the Internet. In addition to the sources described below, e-mail addresses and WWW URL's have been included in the listing of sources where applicable.

Please note that many functions on the Internet are case-sensitive; typing capital letters in commands, addresses, or the like when lower-case letters are required (or vice versa) will often result in failure. Always enter addresses and commands *exactly* as they are written.

Author of this book: See flyer page at the front for e-mail address.

Walt's Jaguar Tip of the Week: You can subscribe to receive Walt Osborn's free tips by writing to ray@vintagejag.com.

Discussion lists: If you have access to Internet e-mail, you can join a "list". A list is a system by which an e-mail message is forwarded to everyone on a mailing list automatically. Such a system facilitates group discussions, with everyone's questions, comments, and expertise being read by everyone else. There are thousands of such lists, covering almost any conceivable topic from camels to rock groups.

Most lists have one address to send messages to the list members, and another address to send subscription requests or other administrative stuff. Some systems are fully automated, requiring a specific format subscription request. If you're having trouble, most lists have an "admin" that can be contacted by addressing a message to the same address as the list itself preceded by "owner-"; for example, you can contact the admin of the xj-s list by addressing your message to owner-xj-s@jag-lovers.org. Please remember that admins are typically volunteers.

All of the lists described here are free of charge; the term "subscribe" means merely to add your own e-mail address to the distribution list, and is not meant to imply that you need to write a check or anything.

Most lists also offer a "digest" option in which all the messages are saved up for a specified time and then sent as one long message. There is no less text involved; "digest" doesn't mean it's edited or shortened in any way, just that it's all put into a single message. There is no value in this unless your Internet Service Provider charges on a per-message basis or some such.

Also note that many lists have alternative methods of subscribing that make use of the World Wide Web; just surf to a site and sign up for a list by simply filling in a few blanks. The jag-lovers lists mentioned below have such an option; just visit

http://www.jag-lovers.org

and sign up for the lists of your choice online.

When you first subscribe to a list, you will automatically be sent an introductory message containing instructions on how to unsubscribe, "netiquette", how to find FAQ's, etc. Please read the guidelines carefully before jumping in and offending all the other subscribers.

Note that most -- possibly all -- of the lists run on the jag-lovers server are set up so that they will not accept a message for posting from a non-member; if you want to post a question, you must subscribe first. It's easy to do, and you can always unsubscribe shortly thereafter just as easily.

Here are some lists that may be of help to the Jaguar XJ-S owner:

xj-s: A list specifically intended for Jaguar XJ-S enthusiasts can be joined by sending a message to:

majordomo@jag-lovers.org

with the words "subscribe xj-s" or "subscribe xj-s-digest" in the body of the message. Note that the "Subject" header is ignored, the command must be in the body.

To send messages for distribution to the group, address them to:

xj-s@jag-lovers.org

An opinion from this author: if you own an XJ-S, it is *highly* recommended that you find a way to subscribe to the xj-s discussion list and to search the list archives. If necessary, buy a computer and learn how to use it. It is no exaggeration to claim that the benefits of list membership will most certainly pay for that computer in short order.

v12-engine: A list specifically intended for Jaguar V12 enthusiasts can be joined by sending a message to:

majordomo@jag-lovers.org

with the words "subscribe v12-engine" or "subscribe v12-engine-digest" in the body of the message.

To send messages for distribution to the group, address them to:

v12-engine@jag-lovers.org

In general, it's a good idea for owners of V12 XJ-S's to subscribe to *both* the xj-s and v12-engine lists, and post questions relating to the engine on the v12-engine list and questions relating to the rest of the car on the xj-s list. Owners of XJ12's should sign up for the v12-engine list plus the "xj" list, which is where SI/II/III XJ6's are discussed; between the two lists, they should be able to obtain answers on the various parts of their cars. Owners of 6-cylinder XJ-S's should sign up for the xj-s list plus the "modern" list; the modern list includes XJ40's, so the AJ6 engine is commonly discussed there.

There are several other Jaguar-related lists at this same server. To obtain a complete listing, send a message to that same majordomo address and type "lists" in the body of the message. Or, visit the WWW site mentioned above.

british-cars: Another list, intended for enthusiasts of all British cars, can be joined by sending a request to:

british-cars-request@autox.team.net

Messages to be distributed to the group can be sent to:

british-cars@autox.team.net

They mostly discuss MG/Triumph/Healey/Rover etc., but Jaguars are included occasionally.

LIST ARCHIVES: Discussion lists will usually maintain a set of archives, so that "newbies" can read the discussions that have occurred in the past -- thereby minimizing the need to dredge up old topics again. For most lists run through a majordomo, you can obtain an index of the archives by sending a message to the majordomo address with the words:

index <listname>

in the message body, where <listname> is the name of the particular list you're interested in. Once you have received the index, you send another message to the majordomo with the words:

get <listname> <filename>

The filenames will usually indicate a date, so you can tell which archive you're getting. Since you don't have to wait for someone to write back with a reply to your question, quite often downloading the archives and doing a search of them for keywords will find an answer *faster* than just posting a question to the list.

Some lists also maintain a file called "CONTENTS" or some such. If found and downloaded (using the same "get" command described above), it provides a much better way of finding the particular archive you need, since it includes information on the topics covered rather than just the date.

If the list in question maintains a web site, web-browsing capability can make searching list archives much easier than fiddling with the majordomo. Just visit the site and follow directions.

Note that the jag-lovers site includes archive browse and search facilities, and this is the *only* way you will get to visit their archives. It requires a sign-in, primarily to verify that you understand the legal ramifications of using info found there.

USENET NEWSGROUPS: Don't confuse discussion lists with UseNet Newsgroups; the functions are similar but not the same. With a discussion list, messages posted to a central server are forwarded to every e-mail address on a subscription list. With newsgroups, messages are posted to a newsgroup, and various "news servers" all over the world periodically obtain copies of all the messages in particular newsgroups for review by users who have authorized access to that news server. When you first connect to a news server, you can obtain a list of all the newsgroups it carries, which may be as many as 30,000 -- yes, being able to automate a search will be helpful! Once you select a newsgroup you're interested in, you can obtain a list of all the subject headers for all the messages currently posted to that newsgroup. Then you can select which messages you actually want to download and read. Messages are automatically deleted after some set amount of time to prevent the system from loading up with obsolete messages. There are usually no archives kept.

The news servers are supposed to be local to minimize data transfer over the Internet; messages are distributed automatically to all news servers carrying that newsgroup during periods of low traffic. Users are usually only authorized to use a particular news server that is associated with their ISP. If that news server doesn't happen to carry the newsgroup the user is interested in, he has to complain to his ISP to see if he can convince them to start carrying it.

There is special software available for viewing newsgroups, although modern web browsers often include a newsgroup viewing utility. If you use them a lot, a software package such as News Xpress is recommended.

At this writing, there are no known Jaguar-related newsgroups. There have been discussions about starting one, though, since they handle heavy message loads better than discussion lists.

FTP SITES: An FTP (file transfer protocol) site is a location on the Internet where directories of files can be accessed and downloaded to your own computer. On automotive-related sites, such files will often include collections of Frequently Asked Questions (FAQ), pictures (GIF and JPEG files), lists of parts and service suppliers, and other items of interest. Almost all FTP sites allow logging in as "anonymous" and entering your own e-mail address as a password.

Some systems provide Internet e-mail but don't provide access to FTP sites. For such situations, a system has been established wherein access to FTP files can be accomplished via e-mail; files are "mailed" to your address. To get instructions, send e-mail to:

server@ingr.com

with "/HELP" in the body of the message. The server will automatically send you the help file with further instructions.

british-cars: This group maintains a collection of files on an FTP site:

triumph.cs.utah.edu (155.99.208.4)

The british-cars files are in directory /pub/sol/, with picture files in directory /pub/sol/Images/.

WORLD WIDE WEB: If you have WWW-browsing capability, the number of sites of interest to Jaguar owners seems to grow every day. The "address" for a WWW site is called a URL, and it begins with http:// followed by a server name and perhaps a subdirectory and filename.

Also note that, in this Word 97 document, URL's have been formatted as hyperlinks -- which makes them blue and underlined. It also means that, if you are viewing on a computer with a properly-installed browser, you can merely point-and-click on one of these hyperlinks and it will automatically start the browser and take you to that site. Of course, if you're reading this book on paper, it's just a pretty blue color.

Some URLs of interest to Jaguar owners:

Jaguar: Jaguar has its own WWW site:

http://www.jaguarcars.com

jag-lovers: The jag-lover's discussion lists maintain a site on the WWW:

http://www.jag-lovers.org

The jag-lover's site contains links to just about everything else on the WWW pertaining to Jaguars. Archives for the jag-lovers.org discussion lists are browsable and searchable. This author also maintains a recent update to this book, along with a collection of photographs relating to things discussed in the book, at the jag-lovers site.

DealerNet - The Virtual Showroom: DealerNet can find Jaguars for sale in your area:

http://www.dealernet.com/

Alldata: Alldata maintains a list of the Technical Service Bulletins (TSB's) on many cars, including Jaguars, and provides access for a fee. They maintain a page on the WWW and allow users to see what is available for their car as well as provide trial access. Their WWW page is at:

http://www.alldata.tsb.com

Michael Minglin points out that there is an online ongoing discussion of air conditioning issues at:

http://www.aircondition.com/wwwboard/index2.htm

Kirby Palm's Home Page: Includes a guide on proper Jaguar etiquette:

http://www.nettally.com/palmk/

INTERNET RELAY CHAT: IRC is a special application of the Internet that requires WWW browsing capability *plus* special IRC software. Suitable software can be downloaded from several places on the WWW, including

http://www.mirc.co.uk

With IRC, usually you log into one of several IRC networks (all of which reside on the Internet) and join in on real-time discussions with other people who happen to be there at the same time. Each network offers a huge selection of "chat rooms" to choose from, each dedicated to a specific topic; if you want, you can apply to get new chat rooms created.

The jag-lovers discussion list has set up its own chat room, but it is *not* carried by the various IRC networks. Rather, it is available *only* via the jag-lovers server itself. The standard IRC software can be used, but it's also possible to join in from the jag-lovers web site using an interface available there. The IRC software is more convenient, though, so if you get into the chat habit you probably should go ahead and download it.

This, of course, is not exactly the busiest chat room on the net. In general, the subscribers to the lists post a message declaring a time that everyone is to meet for a chat. Most other times, this chat room will be totally empty.

CLUBS

The scope of this book includes assisting the Jag owner in getting in touch with his local club. However, it is not practical to list all the Jaguar clubs in the US or the world. The list for the US alone is about 50 pages, and since it already exists, it would be redundant to attempt to establish a second listing.

Jaguar Clubs of North America (JCNA) maintains the list of clubs in the US. To obtain a copy of the list, as well as other Jaguar club info, contact:

Jaguar Journal
P.O. Box 220
Stormville, NY 12582
+1 (201) 818-8500

or:

Jaguar Clubs of North America, Inc.
555 MacArthur Blvd.
Manwah, NJ 07430-2327
+1 (201) 818-8144 FAX: +1 (201) 818-0281

If there is no local club near you, you can join JCNA "Membership-At-Large" (M-A-L). Contact:

Jaguar Clubs of North America, Inc.
National Office
Nelson Rath
+1 (502) 245-5827
e-mail: nnrath@prodigy.net

For club info in the UK, contact:

Jaguar Enthusiasts' Club Ltd.
Thelma Brotton
Stoneycroft, Moor Lane, Birdwell
Barnsley, South Yorkshire, S70 5TZ
+44 (0)1226 740754 (9am to 9pm) Fax: +44 (0) 1226 293581
Mobile: +44 (0)374 125765

Actually, JEC can provide some parts -- such as a longer banjo bolt for the back end of the tappet blocks. Accept credit cards, will ship worldwide.

Jaguar Car Club
Barbary, Chobham Road, Horsell,
Woking, Surrey GU21 4AS
+44 1483 763811

Membership secretary: Jeff Holman.

And, just because Willem Noorloos was nice enough to provide the information, here are the three clubs in the Netherlands:

Jaguar Daimler Club Holland, Rotterdam, F. Verbrache, 010-4821212

Jaguar Drivers Club, Aalter, J. v/d Elst, 09 374 11 71

Classic Jaguar Club Z-Limburg, Heerlen, A. Wolfs, 045-5229965

HERITAGE CERTIFICATE

You can obtain the production records on *your* Jaguar. Quoting from the application form: "A JDHT Heritage Certificate is a Certificate which gives all the relevant information on your car taken from the original records. It will confirm the original build numbers and colour scheme, give the dates of build and despatch, as well as the original destination of the car. Where recorded, the name of the first owner and the original registration mark are also included on the Certificate."

You must provide a photocopy of your registration or some other proof of ownership or existence of the car.

Contact:

Jaguar Daimler Heritage Trust, Archive Department
Jaguar Cars Ltd.
Browns Lane, Coventry CV5 9DR (UK)
Phone: +44 24 7620 2141 or 2743 Fax: +44 24 7640 5581

From Brian Sherwood: "I recently sent for a certificate for my '84 XJ-S from JCNA, trying to confirm that several pieces of optional equipment were factory or TWR options.

1. You have to send them all the eng/trans/body/VIN numbers- they will "verify" them (?).
2. Took six weeks to receive reply.
3. Certificate does not say anything about optional equipment. Doesn't even say what dealer initially sold the car.

"Unless you have a collector's class early car (XK, etc.), save your money for parts."