



3/3b ... loosen the oil pan drain plug ...



3/3c ... and allow the oil to drain.

the plug up against the oil pan. Once the last thread has come free, remove the plug quickly to avoid having used oil running down your arm - **Warning!** Remember it will be quite hot.

4 Leave the oil to drain. Meanwhile, remove the oil filter using a commercially available oil filter wrench. There are numerous types of wrench available, including versions for use with socket set drive bars. The filter is located on the side of the block, just to the rear of the alternator. Access is not too easy - you will have to work around the alternator and the engine mounting, so it is impor-



3/4 Use a strap wrench to loosen filter ...

tant that the wrench you use will work in the confined space available. If you need to buy a wrench, we suggest you purchase it from your Mazda dealer, or at least ask where they got theirs - that way you'll get one that works.

5 Place some rag below the filter to catch any oil spillage, then loosen the filter with the wrench and remove it by hand - **Warning!** The oil may be hot. Carefully clean around the mounting face with clean rag, and while you're doing this, remove the oil dipstick and wipe it clean. Once the old oil has drained fully, clean the drain plug and oil



3/5 ... then unscrew and remove by hand.

pan threads, then screw the drain plug in by hand. Tighten the plug to 21-41 Nm (3.0-4.2 m·kg, 22-30 ft·lb). Now fit the new oil filter. Smear some oil on the sealing gasket, then screw it in place and hand tighten only. (Never use a wrench to tighten a filter - you will either damage the threads or find it impossible to remove when the next filter change is due).

6 Add the fresh oil slowly. After about 3 liters have been added, start checking the level using the dipstick. Take care not to overfill the engine - if you do you will have to drain off the



3/6 Refill the engine with oil - don't overfill!

excess. Refit the dipstick and filler cap, start the engine and let it idle for a few minutes, then switch it off and allow it to stand for a further minute or two. Recheck the oil level and top up if required - the oil level will have dropped slightly as the oil filter filled.

4. DRIVEBELTS (EXTERNAL) - INSPECTION, REPLACEMENT & ADJUSTMENT

1/1, 2 & 2/1.

INSPECTION

1 The drive belt arrangement varies from model to model and is dependent on the options fitted (power steering and/or air conditioning). Note that the camshaft drivebelt is dealt with separately, later in this chapter - in this section we are dealing with the external V-belts or V-ribbed belts. The checking and adjustment is similar for all configurations.

2 Start by examining the belt carefully for signs of wear or damage. Excessive wear is often due to incorrect adjustment, but eventually all belts wear out and must be replaced. Indications are obvious scuffing or fraying of the belt structure. In

time, the belt material will begin to break down and cracking will begin to form on the working area of the belt.

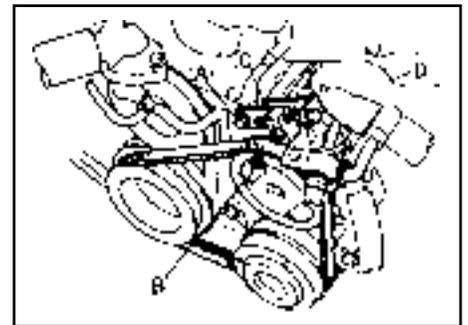
3 Traditional V-belts work by being pinched between the pulley faces and must be tensioned correctly to achieve sufficient grip. Eventually, wear on the working faces of the belt may allow the belt to bottom out in the pulley groove. Any belt that gets this worn can never be made to work properly and will slip even if excessive tension is applied.

4 V-ribbed belts are thinner and wider in section, using a number of smaller V-sections working in corresponding grooves on the pulley face. They rely on their greater surface area to achieve grip, and are generally more flexible and less prone to cracking. Make sure that they sit on the pulleys correctly - it is easy to fit them so they are displaced by one rib either way.

REPLACEMENT

5 Regardless of the type of belt used, if you find signs of wear or damage, fit a new belt right away - don't wait until the belt breaks in service. The basic configuration is a single belt driven from the crankshaft and running around the alternator and water pump pulleys. Where either power steering, air conditioning or both are fitted, you will need to remove this belt first to gain access to the alternator belt.

6 Where power steering only is fitted a second, outer, belt runs from the crankshaft up around the power steering pump. Refer to the accompanying line drawing. Slacken bolt (A) and



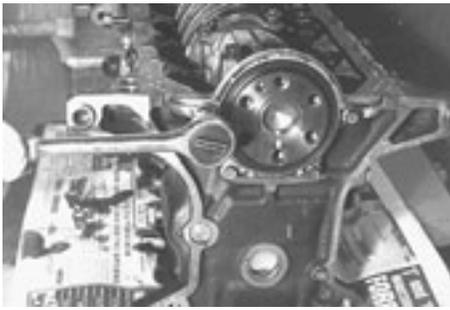
D4/6 DRIVEBELT ARRANGEMENT (POWER STEERING & AIR CON).

nuts (B) and (C). Back off the adjuster bolt (D) and remove the belt.

7 If the car has power steering and air conditioning, a longer outer belt is used to accommodate the extra pulley, but the removal procedure is essentially the same as described above.

8 If the car has air conditioning but no power steering, the belt runs around an idler pulley, occupying the position normally used for the power steering pump, and then around the air conditioning pump. On these vehicles, slacken the locknut at the centre of the idler pulley, then back off the adjuster bolt and remove the belt.

9 Once the outer belt, where fitted, has been removed, you can remove the inner alternator belt. Slacken the alternator mounting bolts positioned above and below the alternator body. Back off the



7/83a Unscrew bolts ...

been removed the housing can be pulled away from the cylinder block. If necessary, gentle leverage can be applied by inserting a screwdriver between the rearmost main bearing cap and the back of the seal housing.

CONNECTING ROD (BIG END) CAPS, CONNECTING RODS & PISTONS REMOVAL
 84  The connecting rod caps are marked across their joint with the con-rod by Mazda - our engine had a V-shaped device stamped in it. This is fine to tell you which cap goes with which rod, but won't tell you which rod and cap come from which

bore! We recommend that you use a center punch to mark each connecting rod and cap with an appropriate number of dots to ensure that they remain a pair and are installed on the correct crank web. Note that the cap and con-rod ID marks should be stamped on the right-hand side of the units. Note: before removing the connecting rod caps, it would be a good idea to check con-rod bearing side clearance.  3/8/50.

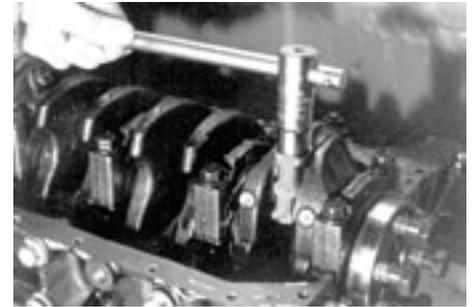
85  Each connecting rod cap is retained by two 14 mm nuts which should be slackened alternately and progressively. Once the nuts have been removed each cap can be lifted off of the con-



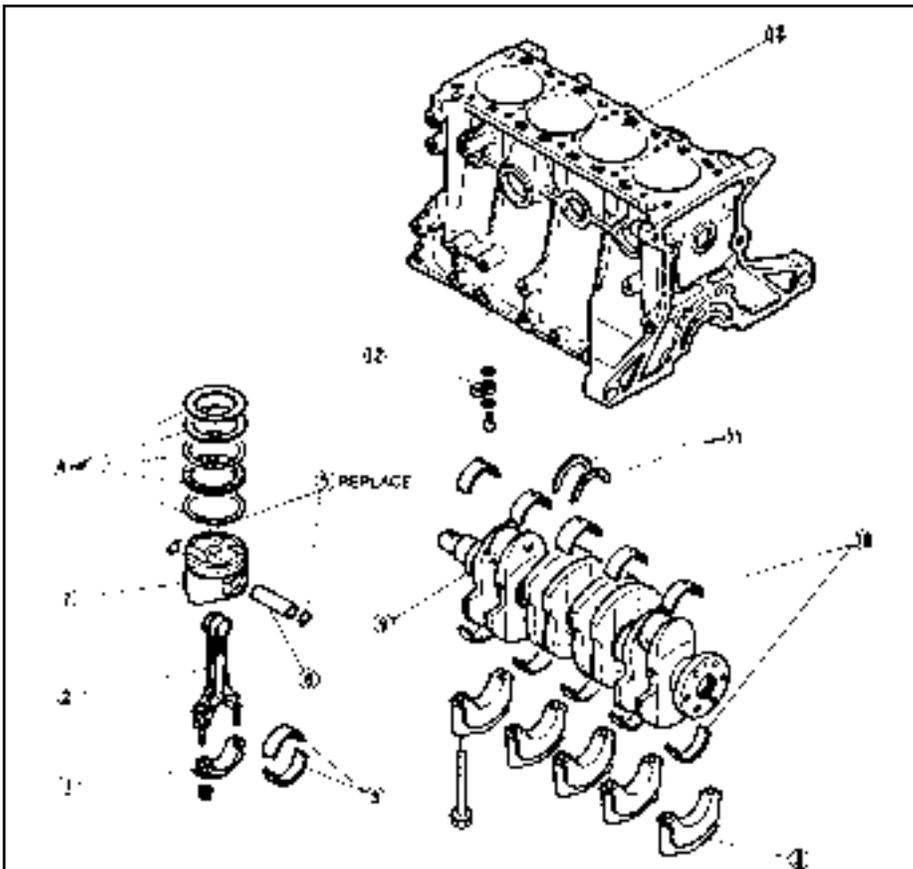
7/83b ... and lift seal housing away.



7/84 Mark conrods and caps.



7/85a Unscrew cap nuts ...



D7/84 CYLINDER BLOCK INTERNAL PARTS

- 1 Connecting rod (big end) cap. 2 Connecting rod. 3 Connecting rod (big end) bearing shells. 4 Piston rings. 5 Piston pin clips. 6 Piston (Wrist/Gudgeon) pin. 7 Piston. 8 Main bearing caps. 9 Crankshaft. 10 Crankshaft (Main) bearings. 11 Thrust washers. 12 Oil jet, sealing washers & banjo bolt. 13 Cylinder block.



7/85b ... and lift caps away.

rod studs: if its bearing shell sticks to the crankshaft gently lift the shell off and keep it with the correct cap. Note: it's easier to rotate the crankshaft if the flywheel bolts are lightly screwed back into the crankshaft rear flange and then a screwdriver can be inserted between the bolts to lever the crank around. **Caution!** Make sure the con-rod studs don't scrape or gouge the crank journals as the crank is rotated.

86  Note: if there's a ring of carbon around the top of the bore, above the piston's travel, scrape it away with a sharp-edged tool - this will make piston removal easier. Each piston and con-



7/86 Withdraw piston and conrod from bore.

MAZDA MIATA/MX5

dogs with a little engine oil. Set the drive dogs to match the slots in the cam and then slide the angle sensor into position: if it won't go home with a little to-and-fro twisting, then pull it out and rotate the drive spindle 180 degrees and try again. Once the drive dogs engage the rear of the camshaft, push the angle sensor body fully home against the rear of the cylinder head and loosely install the retaining bolt.

131  If you marked the relationship of the crank-angle sensor body to the cylinder head, realign the marks and tighten the 12 mm lock bolt to a torque of 22 Nm /2.2 kgf m/17 lbf ft.



9/131 Align marks and tighten bolt.

132 If you didn't mark the setting of the crank-angle sensor, then set it in mid position and follow the ignition timing adjustment procedure:  5.

IGNITION COIL & HIGH-TENSION LEADS INSTALLATION

Note: If you intend to install the engine and transmission as a single unit, consider leaving the fitting of the coil unit until after the engine is back in place, otherwise you'll find that the coil unit hits the engine compartment firewall/bulkhead because of the acute angle taken by the engine/transmission assembly during installation.

133 Fit the coil assembly in position on the back of the cylinder head and replace the two 12 mm headed bolts which hold the coil bracket to the top rear of the cambox cover. There is a further 12 mm bolt underneath the coil assembly and this, too, needs to be installed. Tighten the bolts to a torque of 22 Nm /12.2 kgf m/17 lbf ft.

134 For the moment leave the HT leads and connectors loose on top of the cambox.

135 If necessary, turn the whole engine so that you can work on the right-hand side.

ENGINE MOUNTING BRACKET (RIGHT-HAND) INSTALLATION

136 The bracket is retained by three 14 mm bolts which are of three different lengths. The shortest bolt should be at the front of the bracket in the lowest position and the longest bolt in the topmost position. For the moment leave the top bolt loosely threaded, but tighten the two lower bolts to a torque of 50 Nm /5 kgf m/36 lbf ft.

OIL PRESSURE GAUGE SENDER UNIT INSTALLATION

137 The oil pressure gauge sender unit screws into a threaded drilling on the right-hand side of the

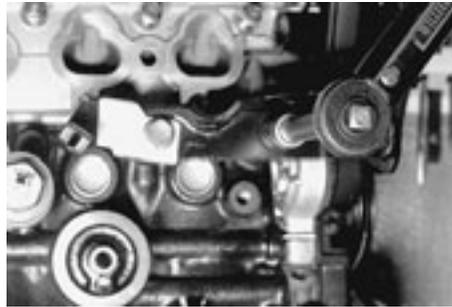
cylinder block immediately adjacent to a core plug and just slightly above, and to the left of, the oil filter boss.

138 Using your fingers screw the sensor body into the drilling. Do the final tightening with a 17 mm crescent wrench bearing on the hexagonal section of the sensor just above the threaded stem.

Caution! Do not try to tighten the sensor by using the hexagonal section just below the electrical connector blade.

ALTERNATOR BRACKET INSTALLATION

139  Position the alternator bracket at the

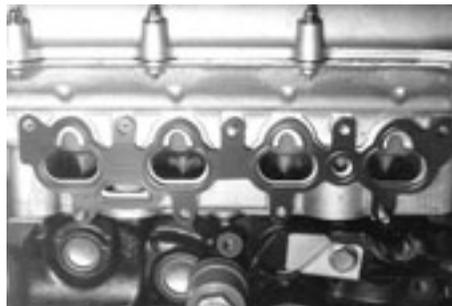


9/139 Torque tighten bracket bolts.

front right-hand side of the cylinder block, just beneath the cylinder head, and install the two 17 mm bolts. Note: don't forget the clip which is located under the head of the rearmost alternator bracket bolt. Tighten the bolts to a torque of 50 Nm /5 kgf m/36 lbf ft.

INTAKE MANIFOLD & SUPPORT BRACKET INSTALLATION

140  Fit a new gasket over the three studs projecting from the side of the cylinder head. Note that the gasket must be fitted so that the portion

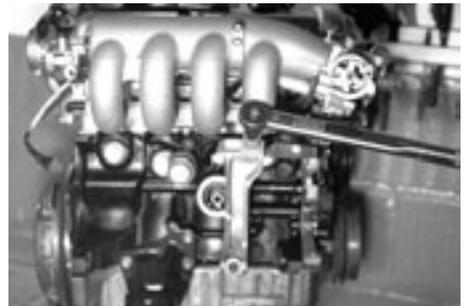


9/140 Fit new manifold gasket.

which surrounds the water jacket opening between intakes three and four is correctly positioned. No gasket cement is necessary if the sealing faces of cylinder head and intake manifold are both thoroughly clean and free of all traces of old gasket.

141 Gently slide the intake manifold into position over the three projecting studs and secure by fitting and finger-tightening the three 12 mm nuts.

142 Fit the six 12 mm-headed manifold retaining bolts, some of which are tricky to install although there is access between the individual manifold tracts. All the nuts and bolts should be tight-



9/143 Torque tighten support bracket bolt.

ened in three stages using a sequence that spirals outward from the center bolts. Note: you'll need a universal joint and extension bar to tighten the two bolts closest to the pillars supporting the fuel rail. Tighten all nuts and bolts to a final torque of 22 Nm /2.2 kgf m/17 lbf ft.

143  The manifold support bracket is secured by two 14 mm bolts, the longer of which goes at the top of the bracket. Tighten the bolts to a torque of 50 Nm /5 kgf m/36 lbf ft.

FUEL INJECTORS & FUEL RAIL INSTALLATION

144 Fit the four new insulating seal rings into the fuel injector apertures in the manifold flange. Fit the two locating collars in the tops of the fuel rail support pillars. Feed the fuel feed and return pipes down between intake tracts one and two and three and four. Tuck the wiring loom injector connector blocks out of the way and carefully lower the fuel rail into position, gently feeding each injector's nose into its port. It will seem a bit of a fiddle, but with a little gentle maneuvering and pressure you'll find that the fuel rail suddenly slips into place and you can guide the injectors home. Make sure that neither the insulator rings nor the rail locating collars are knocked out of position during this process. As soon as all of the injectors and the fuel rail sit down into their respective seats, install the two 12 mm headed bolts that secure the fuel rail to the support pillars on the intake manifold. Tighten the two 12 mm bolts to 2 Nm /2.2 kgf m/17 lbf ft. **Warning!** Do not overtighten - a damaged rail, insulators or seals could allow fuel leakage.

145 Reconnect the vacuum hose from the valve on the rear of the fuel rail to the adjacent stub at the top rear of the intake manifold.

146 Connect the four terminals of the injection system wiring loom to the blue male connectors on each injector. Start at the rear end of the engine with the shortest spur and move forward to the second shortest, and so on - an audible click indicates the connection is properly made.

AIRVALVE INSTALLATION

147  Fit the airvalve to the side of the intake manifold, having first checked that its rubber seal is still resilient and intact. Tighten the four retaining bolts with an 8 mm wrench/spanner or socket, using modest finger pressure only.

148 Once the airvalve has been installed, reconnect the small diameter coolant pipe that comes

8

SUSPENSION
&
STEERING

1. INTRODUCTION

The Miata/MX5 is equipped with fully independent suspension front and rear. The suspension on all four wheels is of the double wishbone type. The suspension wishbones are carried on rubber bushed pivots supported on the ends of transverse subframes, or crossmembers. The lower pivots are adjustable using eccentrics, permitting adjustment of the caster and camber angles. This system provides servicing adjustment, as well as allowing for the application of nonstandard geometries for competition purposes.

Suspension is provided in the form of double-acting gas charged shock absorber struts, around which are mounted coil springs. Body roll is controlled by front and rear torsional stabilizer bars (anti-roll bars).

2. WHEEL ALIGNMENT - PRELIMINARY CHECKS

➤ 1/1, 2.

1 As we mentioned above, Mazda have built in comprehensive adjustment facilities for the suspension and steering. This does not mean that you need to adjust the suspension on a regular basis - the adjustment facility is there primarily to allow the correct standard alignment settings to be restored after new suspension parts have been fitted or as wear occurs. Mazda put in a lot of work developing and optimizing the car's suspension geometry, and departure from the standard settings will normally cause more problems than it solves.

2 It may be, however, that you need to apply different settings if you intend to use the car in competition, where ride comfort can be ignored in favor of optimum handling. Also, the fitting of nonstandard suspension parts may call for revised suspension geometry - if this is necessary, then consult the supplier of the parts for detailed setup instructions.

3 When checking wheel alignment, it is assumed that the tires are in serviceable condition and correctly inflated, that the wheel bearings are within specification and that the steering joints are unworn. The car should be checked on smooth, level ground. Note that the fuel tank should be full, the engine coolant and oil levels should be normal, and the spare wheel, jack and tools should be in their normal positions in the trunk. There should be no luggage or occupants in the car.

4 In addition to normal hand tools, you will need some sort of alignment gauge. It is possible to check and adjust toe-in using a simple beam-type tracking gauge of the type sold by most automotive tool stores. We feel that most proprietary tracking gauges would work on the Miata/MX5, but we cannot be certain of this - we suggest that you check that the proposed gauge will work on the car before you disturb any alignment settings. We also describe a simple checking method which only requires accurate measurement between lines made on the tires - this is Mazda's official checking method.

5 Checking and adjusting camber and caster

angles is a little more complex. The adjustment procedure itself is not too difficult, but since adjustable suspension of this type is relatively rare on road cars, you may find a suitable gauge difficult to source. Given that you will only rarely need to check and adjust these settings, you might consider this alternative. If you need to disturb the suspension settings, for example, due to the need to teardown the suspension for other work, you can mark the current settings during the teardown, and simply return them to the marked positions during installation. This method may not be 100% accurate, but it will be close enough to allow you to drive the car - slowly - to the nearest tire specialist or Mazda dealer, who will be able to fine-tune the settings if necessary. We detail the adjustment procedure below for the benefit of owners with access to the necessary equipment, and who are familiar with its use.

6 Before starting the geometry checks, bounce the car on its suspension a few times to check suspension efficiency and to settle the car in its normal position. When you push down on each corner of the car, it should bounce back up and settle quickly - excessive bouncing indicates wear in the suspension units and this should be investigated and rectified before proceeding.

7 You now need to measure and note down the exact distance between the fender brim and the center of each wheel. The difference in height on each side of the car must not exceed 10 mm (0.39 in). The rear of the car should sit slightly higher than the front - but this must not exceed 10-30 mm (0.39-1.18 in). If you find a discrepancy during this check, you should look at the suspension springs, which may have become permanently compressed through normal wear. Note also that wear or deterioration in the suspension pivots can cause height irregularities.

8 Before you start work on caster or camber angle checks and adjustments, we strongly recommend that you first spray releasing fluid or WD40 onto the suspension cam bolts, so that subsequent adjustment is made easier. There are two of these to each wheel, at the lower wishbones, where they attach to the crossmember. Similarly, if you need to adjust toe-in, clean and lubricate the ball joint threads after sliding back the dust boots. You can just about get to the required areas without jacking the car (but take care not to get the fluid on the brake parts).

3. WHEEL ALIGNMENT - CHECKING & ADJUSTMENT

➤ 1/1, 2.

FRONT WHEELS, TURNING RADIUS

1 Having carried out preliminary checks (➤ 8/2), place the front wheels on a turning radius gauge and measure the maximum steering angle by turning the steering from lock to lock. Measuring from the straight ahead position, each wheel should move inwards by $37^{\circ} 23' \pm 2^{\circ}$ and outwards by $32^{\circ} 32' \pm 2^{\circ}$. If adjustment is required, slacken the clip which secures the dust boot to each tie rod end (if



1990-91 Mazda Miata/MX5

13

PERFORMANCE
TUNING

1. INTRODUCTION

In this chapter we take a brief look at the mechanical tuning possibilities for the Miata/MX5. Like any other car, it is perfectly possible to improve the performance of specific mechanical areas by adding aftermarket equipment. Inevitably, though, there is a price to be paid in terms of financial outlay and in loss of flexibility.

The Miata/MX5 is a pretty well-developed vehicle designed for a specific purpose, unlike the average sedan which is compromised to a much greater extent; the sedan needs to be all things to all owners. Inevitably, this means that it turns out pretty bland. The Miata/MX5, on the other hand, is a sports roadster pure and simple, and this clear definition has allowed its designers to tune the standard car for this specific role.

The singular nature of the Miata/MX5 is what makes the car a delight to drive; it doesn't need to be good at lugging five people and their luggage or towing a trailer, so it makes no attempt at this. Instead, it concentrates on moving one or two people with little or no luggage in the most enjoyable way it can.

It also scores over its European predecessors in terms of refinement and integration. The application of 90s' technology to the classic roadster concept, backed by a serious R&D budget, has resulted in a degree of harmonization undreamed of a decade or so ago - no flaking chrome or occasional electrical functionality here. The car works as a package; the engine, transmission and suspension parts complement each other to a high degree, and this means that adding aftermarket parts presents a real risk of making the car worse instead of better.

That said, the Miata/MX5 is an individual car, and the individuals who buy them will invariably hanker for even more individuality - the large aftermarket which already exists around this car underlines this demand. If you want to uprate your car our advice is to think carefully about exactly what it is that you want to achieve, read all you can on the available conversions and modifications and get as much independent advice as you can. This way, you'll end up with a *genuine* improvement.

One other point. The engine in Miata/MX5 form is configured as a pure sportscar power unit. It is designed to be able to take 6500 rpm shifts when you are really looking for its maximum power: if you habitually shift at 5000 rpm you're losing 21 horses ...

2. TUNING PARTS - SOURCES

1 There are many potential sources of tuning parts and accessories for the Miata/MX5 including Mazda. A few items may be obtainable from auto parts stores, but in general you will need to deal with a specialist supplier. We don't propose to attempt to list all the Miata/MX5 specialists worldwide - there are too many of them, and we have no intention of getting into a situation where we appear to be recommending (or omitting to mention!) suppliers who we have never had dealings with.

Where we mention specific suppliers, they are major players in the Miata/MX5 world who have helped in the preparation of this book by supplying us with information about their products. We have included some addresses at the end of the book.

2 We suggest that you start out by joining an owners club. Of these, the biggest and best is undoubtedly the Miata Club of America, staffed by people very close to the development of the Miata, and whose excellent publication, *Miata Magazine*, carries a wealth of reviews and advertisements for the latest Miata goodies. We would rate this as the definitive source for all things Miata, and as such, warrants membership wherever you happen to live in the world.

3 There are other national and local clubs catering for the Miata scattered around the world. Our suggestion would be to start off with the Miata Club of America, and then to track down and join any local organization. A list of known clubs appears at the end of the book.

4 Other sources for Miata parts and accessories will be found in the general motoring press, which is also a good source of reviews of aftermarket products. Check for product reviews at the newsstand - if a Miata-related part is reviewed in a particular issue, you'll almost certainly find various suppliers advertising.

5 Talk to other Miata owners about any proposed modification or improvement. If you can track down another owner who has done the same or a similar modification, you'll pick up a lot of information which could save you unnecessary time and expense when you do the work on your car. Other owners will also have opinions about suppliers, tuners and specialists. If this is on the basis of personal experience, take note. If it is one of those 'this happened to a friend of a friend' type stories, take it with a pinch of salt.

6 Finally, be wary of modifying your car in any way if it is under warranty from Mazda. Unauthorized changes may invalidate your warranty, even if not directly responsible for some later failure. Obviously, Mazda-approved or supplied add-ons should not have this effect.

3. TUNING - IMPORTANT CONSIDERATIONS

1 Before you start bolting on performance parts, give some thought to the effect that they will have on the rest of the car. As we mentioned earlier, the stock Miata is a well-balanced car. This means that items like the tires, brakes and suspension complement the standard engine. If you bolt a turbocharger to your Miata, you will upset this balance; the stock suspension, brakes and tires may no longer be adequate for the improved power output. A substantial increase in the engine's power output will put additional strain on all driveline components, especially the clutch. Uprated after market clutch kits are available from several sources.

2 You should discuss these considerations with your proposed supplier. If the supplier knows and cares about what he is doing, he will be happy

