A jackshaft chain drive transfers power from the countershaft sprocket to drive a fluid pump to produce a two-wheel-drive dirt bike.

4. While frequently checking fluid level in the master cylinder and topping it off as necessary, repeat Step 3 until the fluid coming out of the tube is clean and clear and without bubbles.
5. Remove the hose, snug down the bleeder valve, top off the master cylinder, and replace the master cylinder cap.

The Hand-Pump Method
A brake bleeder tool will speed up your brake fluid change. Use the following method to change your oil with the tool.
1. Connect a collection tank between the pump and a hose attached to the bleeder valve.
2. Remove the master cylinder cap. Be prepared to constantly replenish the master cylinder with brake fluid during the bleeding process.
3. Loosen the bleeder valve a half turn and use the vacuum pump to slowly pump the fluid through the brake system. Don't forget to replenish the master cylinder.
4. When the fluid coming out of the bleeder valve looks clean, clear, and free of bubbles, stop pumping and snug down the bleeder valve.
5. Detach the pump from the bleeder valve, replenish the master cylinder, and replace the master cylinder cap.

BRAKE SYSTEMS
TROUBLESHOOTING

PROBLEM: The brakes drag when they get hot.

SOLUTION: The brake fluid could be saturated with water. It's best to change the brake fluid twice a year.

PROBLEM: After only 15 minutes of riding, the rear brake pedal has no free movement and the brakes are very sensitive.

SOLUTION: The brake pins could be bent or have divots that cause the pads to drag against the disc. The heat is transferred through the caliper piston and into the brake fluid. The water in the fluid boils and expands, and that causes a lack of free movement at the brake pedal. Check the brake pins and change the fluid.

PROBLEM: The brake lever or pedal pulsates when the brakes are applied.

SOLUTION: The disc is bent and is pushing the piston back into the caliper. This force is transferred into the pedal/lever, making a pulsation for every revolution of the wheel. Replace the disc because it cannot be repaired.

PROBLEM: The front brake pads wear on an angle.

SOLUTION: The front caliper carrier bracket is bent; replace it.

PROBLEM: The brakes make a squealing noise.

SOLUTION: The discs and pads have a thin film of glazing on their surfaces. The glazing could have occurred from leaking fork seals, power-wash detergent, or chain lube accidentally sprayed on the disc. Medium-grit sandpaper can remove the glazing from the surface of the discs and pads. Afterward, clean the discs with brake cleaner—never with a detergent.
CHAPTER ELEVEN

TUNING TIPS FOR HONDA DIRT BIKES

1990–2004 HONDA CR80/85
FLAWS: fork damping
FIXES: Emulator valve

This bike hardly changed between 1987 and 1995. The engine is excellent, a design far ahead of its time, but the chassis and the suspension are archaic. The swingarm on the early models was stamped sheet metal that was clipped together. Later, Honda changed to a conventional, welded design. The forks are simple oil-orifice, damper rod type. This suspension setup is the single biggest hindrance to an aspiring mini racer. The biggest problem with the CR is the spring rate of the forks and shock. Pro-Acidion makes a selection of aftermarket springs, calibrated accurately. Ask a suspension tuner for recommendations on both front and rear spring choices based on the rider's weight, height, and ability. Heavier or taller riders will need stiffer springs, for obvious reasons.

FORKS
Riders who use the front brakes hard will need stiffer fork springs to prevent the front end from diving abruptly in braking bumps. These are damper rod, not cartridge, forks. There are two ways to change the damping rate: either change the viscosity of the oil (SAE 10 weight) or vary the diameter of the hole in the damping rod. Changing the oil level will change the bottoming characteristics of the fork but not the damping. In 1994, a new product became available for CR forks called the Emulator valve, made by Race Tech. The valve improves the damping of the compression and rebound circuits, emulating the effect of cartridge forks. The valve costs just over $100 and is easy to install. The Emulator valve fits between the fork spring and the damper rod of each fork leg.

SHOCK
When the low-speed compression damping is too soft, try adjusting the clicker to between four and six clicks out.

BIG WHEEL SUSPENSION
Most riders will benefit from stiffer springs on both ends. Companies such as Race Spec and Pro-Action specialize in hard-to-get springs for minis. The rear shock needs more compression damping because the longer swingarm causes the shock’s shaft speed to be slower. Also, the rebound damping is too stiff. Try adjusting the clickers to remedy these problems.

CYLINDER
The port timing of the stock cylinder is okay for most riders. For expert riders, I suggest widening the right rear transfer port to 17 mm, the same width as the corresponding left rear transfer. The exhaust port can be raised to a maximum height of 25 mm, measured from the top of the cylinder. The boost ports that connect the intake to the transfer ports can be enlarged to 12 mm. These mods will help top-end power. Chronic head gasket leaks are common on all CR80s. The problem is not the head or gasket, it’s the top of the cylinder. The surface has imperfections all around the stud holes and the water ports. Fix this problem by removing the studs, and then lap the top surface of the cylinder on a flat surface using medium-grit sandpaper.
Always use a gasket scaler on steel Honda head gaskets.

BUILDING A SUPERMINI FROM A CR EXPERT
The CR80/85 Expert was introduced in 2001. It features bigger wheels and extended wheelbase to make the bike competitive in the supermini and 125-cc classes. The maximum displacement limit set by the AMA for the supermini class is 105 cc, achievable only with changes in the bore size, not crankshaft stroking. Wiseco makes a 101.5-cc piston and gasket kit. This kit requires boring, porting head mods, and electroplating. If you’re strictly looking for more low-end power for women racers or trail riding, then simply boring and plating the cylinder will be ideal, but you still have to modify the head for piston clearance. For expert riders, the porting changes have to be extreme to take advantage of the top end. I suggest widening the exhaust port to a chordal width of 49 mm, raising the exhaust to 24.7 mm, raising the center transfer to the same height as the other transfers, and opening up the boost ports to 12 mm. The head must be modified as follows: enlarge the diameter to 52.5 mm and set the squish band angle to 10 degrees with a recess depth of 1 mm.

2000–2003 HONDA CR125
FLAWS: weak powerband
FIXES: V-Force reed valve, exhaust valve modification
After being accused of having an antiquated engine with a high-maintenance exhaust valve system, Honda made a bold change in the top end of the CR125. The cylinder is nearly identical to the RS250 road racer design. There is a new exhaust valve that has only three main parts. The valve varies the effective stroke, port time-area, and duration. Overall, Honda made a good decision to update this model. The new top end has a lot of potential. Many of the parts from the 2000–2002 models interchange. The crankcases and cylinder were changed in 2003, and that engine is very peaky with hardly any low-end power.

BEST VALUE MODS
ENGINE: V-Force reed valve, porting, 12-tooth sprocket, steel clutch plates, exhaust valve mods
SUSPENSION: springs for your geared weight
CYLINDER MODS
The 2000 and 2001 cylinders have a lot of potential. The exhaust port and valve can be modified in a number of different configurations. For more top-end power, raise the exhaust port to 28 mm from the top of the cylinder. Also drop the outer edges of the exhaust port 5 mm. The ports on the 2002 and 2003 models are actually too big. If you're looking for more low to midrange power, switch to the Wiseco 755MO5400 piston kit from an RM125. The timing height is higher, which retards and reduces the timing and duration of the ports. The cylinder head will need to be modified for piston clearance. On a lathe, cut the squish band to a recess gap of 0.060 in./1.5 mm. Use a blend angle of 20 degrees and narrow the squish band to 0.0235 in./6 mm.
EXHAUST VALVES
There is a new exhaust valve with only three main parts. The valve varies the effective stroke, port time-area, and duration. It's a great design except for the shape, which is easily tuned. Honda did us a favor by making the valve halves so large and restrictive. The valves can be ground to different profiles. In stock form, the valves don't allow for enough blow-down timing from 4,500 to 8,000 rpm, prior to when the valves flip wide open. A simple way to advance the exhaust valves is to make a bushing for the stop pin to limit how far the valves close. A bushing with a 5-mm diameter, placed over the top of the original stop pin, is ideal for most riders. The 2002 and later exhaust valves have blow-down ports that achieve the same thing as the bushing on the stop pin. The valves also have labyrinth channels for better sealing at low rpm. The 2002 valves fit into the 2000–2001 cylinders.
CRANKCASE MODS
The 2000 CR cylinder has a gross mismatch with the crankcases. The cylinder hangs over into the cases, partially blocking the flow. If you’re looking for more top-end power, the cylinder ports should be ground larger to fit the cases. If you’re looking for strictly low-end power, apply epoxy to the cases to blend into the cylinder ports.

MX World clutch with easy access cover.
REED VALVE
The V-Force 3 brand of reed valve gives a big gain in low to midrange power. Modifying the intake manifold for use with a V-Force reed valve is a fairly difficult task. You have to remove the two rubber wings that normally extend into the stock reed valve. The Honda manifold doesn't use a gasket because it has a molded O-ring instead. I use a two-step process to remove the rubber wings. Start by clamping the manifold in a vise but not on the O-ring surface. Use a hacksaw to saw off the wings within 1/8 in. of the base. Then use a Moto-Tool with a sanding drum to polish off the remaining material.

GEARING
Install a 12-tooth countershaft sprocket with a stock rear sprocket to make second gear more usable and virtually eliminate the need for first gear.

EXHAUST MANIFOLDS
Honda changed the exhaust manifold and exhaust port duct shape on every model of CR125 from 2000 to 2003. All the manifolds interchange, but the 2002 stands out as the best design for getting more low to midrange response. The main differences are the length and D-shape to the inside diameter.

1998–1999 HONDA CR125
FLAWS: weak top-end power
FIXES: Cometic base gasket and head mod

The 1998 CR125 was a great evolutionary design leap. With an aluminum frame, five-speed gearbox, and a new exhaust valve system, Honda came under criticism from the motorcycle press for switching from a six-speed to five-speed. The frame follows the same concept as the CR250, and has proven reliable and rigid. The five-speed gearbox enabled Honda engineers to widen the gears, making the tranny more reliable. Earlier models tend to break first gear, which is part of the main shaft. This failure occurs most often when aftermarket clutch plates are installed with stiffer springs. The new HPP exhaust valve system cures a twofold problem related to performance and reliability. The new HPP eliminates blowby over the valve and prevents a worn valve from contacting the piston.

BEST VALUE MODS
ENGINE: Cometic gasket, bigger carb. CR250 air box
SUSPENSION: Pro-Action revvalving

NEW HPP
The new exhaust valve system solves a number of maintenance and performance problems. The new valves feature an L-shaped guide rail that prevents the valve from contacting the piston after it wears. The new design seals properly in the closed position for more compression and better low-end power. Some of the magazines claim that the bike
doesn't have enough top-end power, which is due to the lower exhaust port height of the new HPP valves. The effective stroke is longer and the compression ratio is lower so that the engine can run on pump gas.

**CYLINDER**
The cylinder porting and casting quality are excellent. All you need to do is experiment with the cylinder height. That involves swapping base gaskets with different thicknesses. Cometic makes base gaskets in the sizes of 0.010, 0.020 (stock), and 0.039 in. If the thinnest gasket is installed, the engine's powerband will shift down the rpm scale—good for tight stadium racing. There is no head modification needed. However, if you install the thickest gasket, you'll need to modify the head. If you really want to get the cylinder ported, here are some guidelines. Widening the exhaust port will only cause the valves to snag the ring. The transfer ports can be raised to 41.25 mm for the front set and 42 mm for the rear set for more top-end power. Grind the valve guides on an angle so the port height measures 28.5 mm from the top of the cylinder to effectively raise the exhaust port.

**HEAD**
The head's gasket surface can be turned down as much as 0.024 in. (0.6 mm) to raise the compression ratio to compensate for the Cometic 0.039 base gasket.

**EXHAUST PLUGS OR VALVES?**
The HPP valve system maximizes the powerband by adjusting the time-area of the exhaust port to the engine's rpm. If an engine is to be tuned for maximum top-end power and the application can sacrifice some low-end power, exhaust valve plugs are the best choice. On dirt track motorcycles and shifter karts, I install plugs because the engine is used in a narrow, high-rev range. Boyesen Performance manufactures the aluminum exhaust plugs. The plugs are installed in place of HPP valves. The exhaust port height can be raised to 28 mm, measured from the top of the cylinder. That will really make the engine rev. By removing the exhaust valves, you can also remove the power valve governor that drives off the crankshaft to reduce drag and friction on the crank and yield extra horsepower.

**CARBURETOR AND AIR BOOT**
The 1998 CR can gain more top end by installing the intake setup from a CR250. A Keihin PJ38 carburetor with the air boot from a 1998 CR250 will boost maximum airflow through the engine. A carb from a 1990–1996 CR250 will fit the best. The baseline jet settings for that carb are 58 Slow jet, 1468 Needle P-2, 170 Main jet. The Honda part number for the needle is 16012-KS6-004. The 1999 CR125 already uses the larger air box but still needs the larger carburetor.

**1990–1997 HONDA CR125**

**FLAWS:** carb jetting off, clutch fades, rings dent easily

**FIXES:** richen jetting, install steel clutch plates, lace-up Excel rims

The CR is regarded as the best 125 of the early to mid-1990s. These models have had their share of problems, but overall this is the most reliable 125 cc motocross bike. Simple problems such as carb jetting can be adjusted with just a needle and main jet change. The clutch performs better with steel plates and frequent oil changes. The stock rims are very soft and dent easily when riding in rocky conditions. It's best to replace them once they are dented with Excel rims.

The CR engine can be modified to be a better enduro bike or have the raging top-end power for GP motocross. Whatever type of dirt riding you do, the CR125 can be modified to suit your riding demands.

**BEST VALUE MODS**

**ENGINE:** 1468 needle for carb, RAD valve, 53-tooth rear sprocket

**SUSPENSION:** stiffer fork springs

**SUPERCROSS OR ENDURO POWERBAND**
If you want to increase the low-end and midrange power of your CR125, these modifications are the hot ticket. These are great for supercross, where you need quick bursts of power, or enduro riding, where mellow power is better for navigating snotty trails. These modifications are also well suited to lower level riders. The bike will be easier to ride with the sacrifice of some top-end power.
Aluminum CR frames need wide glide plate protection for the bottom frame tubes.

**HPP VALVES**
The exhaust valve guides of the 1993 to 1997 models are manufactured with such a high opening that, when the valves are closed, the exhaust gases can pass over the top of the guides. For more low-end to midrange power, install the exhaust valve assemblies from the 1999 CR125. These parts are very expensive at about $150, but they really help the low-end power. Honda part numbers: left 14700-KZ4-000; right, 14600-KZ4-000.

**HEAD MOD**
The 1990 and 1991 models have domed pistons and hemi-shaped combustion chambers. The 1992 model was the first year of the flat-top piston design. Never mix heads and pistons on the earlier and later CRs or you may damage the engine. The 1990 and 1991 head can be improved by turning down the face of the head 0.028 in. or 0.7 mm. Then thesquish angle must be cut at a 10-degree angle with a deck height of 0.020 in. or 0.5 mm. On the 1992 and later models, the spark plug thread in flush to the combustion chamber. The top of the spark plug lug should be turned down on a lathe 1 mm. The compression ratio and squish band width are good, so no other modifications are necessary.

**REED VALVE**
The Boyesen RAD Valve makes a tremendous difference in the low and midrange of the powerband and is a must for enduro riding.

**EXHAUST PIPE**
The best pipe for these engine mods is a Dyno-Port low-end pipe.

**HIGH-REV POWERBAND**
The stock engine peaks at about 10,500 rpm. To be competitive in the national championships or GP's, the engine must have a powerband that starts at 5,500 and peaks at 12,500 rpm. Modifying the CR for that extra elusive 2,000 rpm is very expensive and requires total engine disassembly and special machining.

This is a parts list of the engine components and an explanation of how they are tuned to work together: 1992 CR125 cylinder 12110-KZ4-860; 1991 head 12200-KZ4-730; 38-mm PJ Keihin carb; aftermarket pipe and silencer; carbon fiber reeds.

The 1992 CR125 cylinder has more aggressive exhaust and transfer port timing than the 1993 and 1994 models. You can use the 1993–1996 HPP valves, but you need to switch to the domed piston and head. The domed setup enables more efficient cylinder scavenging at high rpm. The carbon fiber reeds are less prone to fluttering, and the larger carb is needed to boost the rpm peak of the engine.

**CRANKCASE MODS**
The cases must be machined for a larger intake port with better flow up to the transfer ports.

**REEDS**
Use carbon fiber reeds instead of the stock reeds, which start to flutter at about 10,700 rpm. The carbon fiber reeds produce excellent top-end power without fluttering at high rpm.

**PISTON AND HEAD**
The domed piston has a slight advantage at extremely high rpm. Use a Wiseco Pro-Lite and the 1991 head.

**CR125 CARBURETOR JETTING**
Here are some specs on a starting point for carb jetting. The specific gravity is different between North America and Europe, so European jetting specs need to be slightly richer. American carb jetting for 36-mm PJ Keihin using 93-octane pump gas with a pre-mix ratio of 40 to 1: air screw 1.5 turns; slow jet 58; needle 1468; main jet 168. European specs for unleaded premium petrol with a 40 to 1 pre-mix: air screw 1.5 turns; slow jet 62; needle 1468; main jet 178.

Baseline carb specs for a 38-mm PJ Keihin are one step richer on the slow and main jets using the 1468 needle.

**CR CLUTCH TIPS**
Never install stiffer clutch springs in a CR. The clutch is designed to slip when the gears engage on upshifting. This helps reduce the impact on the transmission. Stiffer clutch springs could accelerate wear on the transmission because of the increased load. Steel clutch plates wear slower and don't contaminate the gear oil. However, they do increase the drivetrain inertia, just like a flywheel weight. The heavier steel clutch plates will help you hook and stay in control on slippery, hard-packed tracks, but the bike will feel a bit slow to respond in deep sand or where you have good traction. The additional weight of steel clutch plates can make the bike a bit easier to ride as well. When the stock clutch basket wears out, replace it with a Hinson racing clutch. The Hinson clutch basket is made of better material and hard-anodized with Teflon.

**1985–1989 HONDA CR125**

**FLAWS:** left-side crankshaft seal leaks, clutch plates wear out

**FIXES:** replace seal often, install Barnett steel plates

Honda perfected the 125 in the late 1980s. Here are some general things to pay close attention to or modify for better performance.

**BEST VALUE MODS**

**ENGINE:** 53-tooth sprocket, 1468 carb needle

**SUSPENSION:** shock revvalving, stiffer fork springs
GEARING
A good baseline for gearing on all models should be 13/53 for motocross and 12/52 for supercross and enduro. Adjust by single teeth on the rear for slightly different tracks and conditions.

CARBURETOR
A 36-mm carburetor works best using these jetting specs: 58 slow jet; 6 slide; 1468 needle; and 168 main jet (very slightly according to elevation and extreme air temperature differences).

CRANKSHAFT
The left-side crankshaft seals wear out quickly because the left-side cover is flimsy. Replace the seal often; otherwise, the piston could overheat and seize on the exhaust skirt. The 1987 model's crankshaft was updated to a stronger design. The new connecting rod uses a 15-mm pin, so you must change the piston with the crankshaft. Both parts are standard on the 1988 model.

CYLINDER INTERCHANGE
The 1989 cylinder is Nikasil-plated and it will fit the 1987 and 1988 models (which are not plated).

CLUTCH
Replacing the aluminum clutch plates with steel plates makes the clutch last longer and doesn't hurt performance. Never install stiffer springs in the clutch of a CR125 because it will cause the first gear drive to fail. First gear wears quickly on these bikes normally, and it is part of the clutch shaft, so it is expensive to replace.

REEDS
Honda doesn't make replacement reeds for its bikes; use Boyesen reeds.

ATAC SYSTEM
The exhaust valve on the 1987 to 1997 models can be damaged on installation. The right-side valve end has a flat machined on it, and if you tighten the actuator lever too much, it can round the flat edge. This causes the valve to hang open and raise the exhaust-gas temperature at high rpm, eventually causing the piston to seize.

SHOCK
The rear shock can be modified for better handling on the 1985 to 1988 models. These types of shocks use straight shims. The rebound valve stack has two transition shims, one in the middle and one closest to the piston. Put both transition shims between the number 26 and 27 shim from the piston. After this, the shock will handle square-edged bumps much better.

2002-2004 HONDA CR250
FLAWS: reeds chip, powerband short
FIXES: V-Force reed valve, porting for midrange and top end
Back to the future—that's the theme of the 2002 and later CR250 engine. This case reed design traces its roots to the late 1980s, when it was used in a dual-sport bike for the Japanese market. Many people think that the 1992 to 2001 engine was a superior design, including factory rider Mike LaRocco, who continued to use the old engine for two seasons after the new engine was released. The biggest innovation on the 2002 model was the electronically controlled RC power valve system. The 2002 and later models suffer from a narrow powerband concentrated in the center of the rev range. Installing a top-end pipe helps the over-rev, but the main problem with the powerband is in the cylinder porting.

CYLINDER
The RC valve design changed in 2003 because the original valves had gaping pockets on the sides and roof of the exhaust port duct. The 2002 to 2004 cylinder's exhaust port can be raised 0.060 in./1.5 mm. In order to get the widest powerband, the cylinder needs to be turned down by 0.030 in./0.75 mm and the cylinder head's recess squish gap needs to be machined by the same amount to ensure the proper piston-to-head clearance.

REEF VALVE
The stock reeds are prone to chipping. The V-Force reed valve is much more reliable because it distributes the load to double the sets of reed petals.

1997-2001 HONDA CR250
FLAWS: piston and ring design, secondary coil
FIXES: Wiseco piston, replace coil when misfire starts
The 1997 model was the first generation of advanced ignition systems. The traction control concept of monitoring rpm changes versus time is good, but Honda missed the mark on the 1997 model. It needs a steeper advance curve in order to give the powerband a hard-hitting midrange, for which previous models were famous. The 1998 model has a slight change in the cylinder head and the ignition. The 1999 model has a different cylinder with porting that is a bit too mellow for most riders.

A few mechanical problems have surfaced with time, including failure of the ignition coil and the piston ring. When the top coil fails, the engine starts misfiring and then loses spark completely. The piston ring tends to spin around the ring groove after the centering pin works loose from the piston. The best solution to these problems is to keep a spare top coil in your toolbox and replace the stock piston often or switch to a more durable Wiseco piston.

The 1997 model was the first year to use the aluminum frame. By 2000, Honda changed the frame at the front down tube and lengthened the swingarm. Some of the problems on early models involved clearances at the motor mounts and head-stands. That could easily be fixed with shim washers to take up the gap. Lengthening the swingarm helps the handling on the 2000 models. Handling on earlier models can be improved with revalving.

The 2001 model has the best 250-cc engine built by any motorcycle manufacturer—a strong lower end and tranny with a new cylinder casting featuring reinforcements in critical areas such as...
the intake skirt. The port timing is on the radical side and the bike is faster than most riders need. Honda switched to a Mikuni carburetor for the 2001 model. The jetting is extremely rich and requires leaner jets on the pilot, needle, and main jet. For more information on engine mods, check out the next section on the 1992 to 1996 models.

BEST VALUE MODS

ENGINE: Wiseco Extreme Lite piston, Cometic thin base gasket
SUSPENSION: revalving

SECONDARY COIL
The 1997 CR250 has a problem with a bad batch of secondary coils mounted on the left side of the frame that connect to the spark plug. High-rpm misfire and hard starting are clear symptoms of a faulty coil. Eventually, the coil fails completely and the engine loses spark. In 1998, Honda cured the problem with a better quality coil.

CARBURETOR
In 1997 and 1998, Honda used an electronic carb that monitored rpm with a black box; the system was sensitive to a couple of problems. The wire connector was located on the outside of the frame and was prone to water seepage. The black box was sensitive to electrical noise; it's important to use a resistor spark plug to reduce the interference. Lean bogging in the midrange during hard acceleration is a symptom of a faulty coil. If this happens, disconnect the wire connector and install a richer jet needle, such as a .368.

1992–1996 HONDA CR250

FLAWS: chain and sprockers wear, cylinders break, rear suspension kicks
FIXES: loosen chain tension, install 1999 cylinder, revalve shock

There is hardly any difference among the engines used from 1992 to 1996, and the modifications listed will apply to the previous models. The focus of the engine mods is to make the CR easier to ride for motocross riders and even better for enduro riders.

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interchangeable among the 1992 to 2000 models. The 1995, 1996, and 1999 cylinders are the best because of their smaller exhaust and intake ports. These cylinders have the best timing combination and the most sealing surface area for the rings. The 1999 cylinder has extremely small exhaust ports and smooth power delivery; it works great to tame down the 1997 and 1998 models. However, many people complain that the 1999 model is flat on the top end. For the 1999 model, I recommend raising only the sub-exhaust ports to 39 mm, measured from the top of the cylinder. The smaller intake port doesn't hinder performance and is stronger to reduce piston skirt wear. The cylinders with the smaller intake port are easier to install because the rings are less likely to pop out of the grooves when sliding the cylinder down on the piston. Apply epoxy on alternate sides of the separating bridge for more crankcase compression. This also changes the flow pattern up through the transfer ports and into the cylinder bore. Flow shaping is also performed on the rear transfer port window exit angles. This cylinder will peak at 7,500 rpm and works great with the stock pipe, stock or spark arrestor silencer, and intake system. To attain the optimum compression ratio and exhaust port time-area on the 1992 to 1994 model cylinders, the cylinder base must be turned down (0.5 mm) on a lathe. The transfer ports must be raised to 58 mm, measured from the top of the cylinder.

**FLYWHEEL WEIGHT**

The flywheel weight is the final component to tune. Tuners normally overlook this component. Dave Warson, who teaches riding schools in England, thinks that flywheel weights make the power delivery easier for most riders to handle, especially junior and vet motocross riders or trail riders.

**SWINGARM**

The 1992 CR250 has a problem with cracks forming in the swingarm. You can gusset the swingarm for additional strength. The biggest cause for a cracked swingarm is too little chain slack. Take care when adjusting the chain; it's better to be a bit loose than tight.

1990-1991 HONDA CR250

**FLAWS:** Leaky air boot, carbon-seized HPP valves, fork debris

**FIXES:** Seal boot, chamfer HPP valves, Eibach springs and Pro-Action preload cones

Honda CRs need the intake manifold modified by having the stuffers hacksawed off. Take care not to strike the molded O-ring surface with the saw. It's best to leave a little material to finish with a sanding roll and a Moto tool.

These bikes are very reliable but have some handling problems that are easily fixed. The engines produce good torque, but the exhaust valve system is difficult to service. Here are some fix-it and tuning tips for these models of CR250s.

**BEST VALUE MODS**

**ENGINE:** Carb jetting, flywheel weight

**SUSPENSION:** Aftermarket springs, Pro-Action cones

**HPP VALVE MODS**

The HPP valves are prone to carbon seizing. See the recommendations on exhaust valve servicing in Chapter 6.

**CARBURETOR JETTING**

Here are some jetting specs when using a 40-to-1 premix ratio with 93-octane unleaded fuels and an NGK BP7ES spark plug: 55 slow jet; 1369 needle in the third position; and a 175 main jet.

**AIR BOX SEALING**

The air boot-to-air box flange must be sealed on the older CRs. The best sealer to use is weather stripping adhesive because it isn't fuel-soluble. Never use silicone sealer because the fuel will deteriorate the sealer and allow water and dirt to enter the air box.
To install a new Hot Cam on a CRF450, you have to use internal snap ring pliers to remove this retaining clip. Next, the cam and bearings must be shifted sideways out of the Unicam carrier.

CYLINDER TUNING
There are some simple modifications you can perform to the cylinder with just a file. Remove the casting flaws around the boost ports for smoother flow through the intake, and match the HPP valve guides to the exhaust port. This is a critical area of the cylinder because even a small mismatch can cause a shock wave that effectively blocks the exhaust port. Other more difficult mods include raising the transfer ports to 58 mm from the top of the cylinder, turning down the cylinder base 0.5 mm, and narrowing the rear transfer ports as listed in the paragraph for the late-model CRs.

HEAD MODS
The top of the spark plug lug must be turned down on a lathe 3 mm to allow the spark plug to thread down flush into the combustion chamber. This modification improves throttle response and reduces spark plug cold-fouling.

FLYWHEEL WEIGHT
The CRs benefit from a flywheel weight. Sixteen ounces is the standard size that companies such as A-Loop or Steahly use for their products, although they will have several options available. In general, heavier weights are better for enduro and off-road, while lighter weights are geared toward motocross or supercross. For novice and intermediate riders, the heavier weights can work very well. Power delivery is a bit more manageable and low end is greatly improved. The bike will be easier to control, yet deliver the same amount of horsepower.

Steahly makes thread-on flywheel weights. This product threads onto the fine left-hand threads on the center hub of most Japanese megaport rotors. Normally, the threads are used for the flywheel remover tool. Thread-on flywheel weights can only be used if the threads on the flywheel are in perfect condition.

BIG DISPLACEMENT KITS
If your cylinder's plating is worn and needs to be repaired, consider a Wiseco oversize piston kit. Wiseco offers 265-cc pistons. The kit requires modifications to the exhaust valves.

IGNITION TIMING
Advancing the ignition timing gives the CR more midrange hit in the powerband. Normally, Honda stator plates aren't adjustable. To make the plate adjustable, you need to file the plate 1 mm at the lower bolt hole. This will enable you to rotate the stator plate clockwise to advance the ignition timing.

CRANKSHAFT SEAL
The left-side crankshaft seal is prone to failure. Honda redesigned the seal in 1992. The seal fails because dirt and water enter the ignition cover. Boyesen Engineering makes an aluminum cover that seals properly. If your CR bogs at low rpm, the seal is probably blown and needs to be replaced.

FUEL TANK INSERT NUTS
The fuel tank insert nuts are square-shaped and pressed into relief in the plastic fuel tank. When the scoop bolts are overtightened, the insert nuts tend to spin in the tank when the bolt is removed, making it impossible to remove the radiator scoop. The solution is to remove the insert nut and bond it back in place with epoxy. Removing the nut will be difficult. I use an impact wrench to spin the bolt while using a large flat screwdriver to pry off the scoop just behind the insert nut. Take care not to puncture the fuel tank. Once you remove the scoop and insert nut, grasp the square insert nut with a wrench or channel lock pliers and remove the bolt.
Apply a dab of Duro Master-Mend epoxy to the insert nut and the relief in the fuel tank. Press the insert nut in place for about 15 minutes.

**FORKS**

These cartridge forks have the early model valve design with a small-diameter piston. They are prone to clogging up with metal debris. The forks have to be disassembled and cleaned often. The main sources for the metal debris are the springs and the spring preload cones. The springs have a coating that flakes off. The preload cones are made of steel with sharp-machined edges. The cone fits into the spring and aggravates the flaking problem. Use Eibach fork springs, which are powder-coated with a flexible material that doesn’t flake off. Precision makes an aluminum preload cone that doesn’t wear or vibrate like the stock steel cone. Performing these two modifications will save you money in fork oil changes and improve the bike’s handling.

Some suspension companies offer hard-anodizing for fork parts. On bikes produced after 1989, most fork parts come hard-anodized from the manufacturer. Hard-anodizing prevents the aluminum parts from wearing prematurely. This service is to repair slider tubes on the 1990 and later CR250 models.

Many companies make aftermarket base valve kits for cartridge forks. These products improve performance through changes to the piston design and the valve shim stacks. If you are going to the expense of installing a base valve kit, make sure that the fork springs are matched to your riding weight, skill level, and the base valve kit. Race Tech provides a tuning manual with its Gold Valve products. The tuning manual provides guidelines on spring rates and valving changes for a variety of rider profiles.

**2002–2004 HONDA CRF450**

**FLAWS:** weak valvetrain, suspension valving

**FIXES:** Kibblewhite Black Diamond stainless-steel and titanium valvetrain kit, suspension revalving

Building a 450-cc four-stroke for motocross was a brilliant first effort for Honda. This bike is a careful blend of traditional XR reliability with a Formula 1 edge. Innovations such as separate oil cavities, automatic decompression, and low-cost, modular replacement parts are the benchmarks that Honda challenged its competitors with. Overall, the CRF450 is a great bike with tons of aftermarket accessory choices. In 2002, the bike needed aftermarket triple clamps with more offset, so Honda incorporated the design changes for the 2003 model. As with most Honda models, the engine parts interchange easily.

Considering that the 450 is 1/10 of a Formula 1 auto racing engine, it’s pretty reliable for a dirt bike. Some minor problems nagged this engine with valvetrain issues. Here are some of the details about OEM parts and the best choices of aftermarket accessories for this popular bike.

**VALVETRAIN**

The valvetrain on a four-stroke dirt bike engine consists of the intake and exhaust valves, springs, collets, retaining clips, tappets, shims, camshaft, and cam chain. The CRF450 requires frequent maintenance of the titanium intake valves. The valve seat area tends to form a cup shape when the valve springs sack out with use. The valves bounce off the valve seat, causing the hard oxide protective coating on the valve to wear off. The solution is to install stainless-steel valves with dual-rate springs.

Start by removing the rocker arm cover. The decompressor must be adjusted every time the exhaust valves are re-shimmed.

**HIGH-COMPRESSION BIG BORES**

The piston needs to be replaced between 50 and 100 hours of use. Wiseco makes high-compression piston kits for the stock bore and 3 mm over stock.

**CAMSHAFTS**

The 2002 camshafts is considered a peaky cam for a high-rpm powerband. The 2003 is a torque cam. Hot Cams makes aftermarket cams of similar high- and low-rpm choices.
TUNING TIPS FOR HONDA DIRT BIKES

These Summers Racing Concepts fork braces improve the stability for the traditional line of XRs, which use conventional forks.

AIR BOX MODS
The factory recalled the original 2002 air boxes for sealing problems. PC Racing makes a positive seal kit for the air box and filter. It's intended for use on the 2002 model and can be applied to the later models.

CHAIN TENSIONER TESTING
The 2002 and 2003 cam chain tensioners are prone to failure. Replace them with a 2004 tensioner. Test an old tensioner by squeezing it in your hand. Try to make the plunger retract by wiggling and squeezing it together. If you can make the plunger retract, the tensioner needs to be replaced.

WATER PUMP
Water pump leaks are common with the 450. Always replace the shaft and bearings along with the two seals. Make sure the seal spring faces out toward the impeller; it's a common mistake to install it flush and backward. Take care when installing the right-side engine cover. The water pump drive hub is rectangular and must fit precisely in the crankshaft.

1990–2001 HONDA CR500
FLAWS: abrupt powerband, headshaking
FIXES: lower compression ratio, stiffer fork springs
The CR500 hasn't changed much in the past five years, and there is a lot you can do to this bike. The engine hits abruptly and riders complain that it is hard to ride on slippery surfaces. Here are some mods that will help the engine pull smoothly from low-end and rev our further.

BEST VALUE MODS
ENGINE: DEP sport pipe and silencer
SUSPENSION: fork springs
CARBURETOR
A 39.5-mm Keihin PWK carb will add 3 horsepower to the top end and make the engine pull cleanly off the low end. Suzuki sells an aftermarket PWK or you can use a carb from a 1992 and later KX500.

CYLINDER HEAD
You can turn the head on a lathe to reshape the transition between the combustion chamber and the squish band. Set the rotor angle to 25 degrees and cut into the squish band, starting 15 mm from the edge of the chamber. Install a projected nose spark plug such as an NGK BPR5ES.

CYLINDER
The hook angles of the rear transfer ports should be filled with epoxy so the transfers are aimed at each other instead of toward the exhaust port. The narrower the port, the smoother the low-end power. The minimum chordal width of each rear transfer port is 10 mm. Raise the exhaust port 1.5 mm and widen the two ports 4 mm on each outer edge. The steel sleeve will be rough from the original manufacturing process and should be machined to the aluminum casting. Polish the port edges with fine-grit sandpaper to improve piston and ring life.

Monitor the bore of the cylinder for out-of-round wear and taper wear. I have had the best luck running oversize Wiseco pistons, set to 0.004-in. piston-to-bore clearance.

EXHAUST SYSTEM
Pro-Circuit, FMF, and DEP Sport make excellent pipe and silencer combinations for the CR500.

The XR400 has some issues with loose head studs, especially when a 440 big bore kit is installed. This heavy-duty stud kit improves the longevity of the air-cooled XR.

FORK SPRINGS
Riders who weigh over 170 pounds may want to switch to a stiffer spring rate (23–25 pounds). If bottoming and head-shake occurs frequently, that is a sign that you need stiffer fork springs and to raise the fork oil level. The highest fork oil level is 120 mm, for the minimum air space and highest pressure.

FLAWS: soft fork springs, magneto covers leak, air boot leaks
FIXES: stiffer fork springs, Boyesen magneto cover, seal air boot
The big CRs went through an amazing design evolution in the late 1980s. The suspension went from drilled passageways and squirming fork oil to upside-down cartridge forks and a rear shock with technology rivaling an Ohlins. The CRs changed more in five years than they had in the 12 years since their inception. There are many innovative products built by European and American companies that bring the mid-1980s CRs into the 1990s. The 1986 and 1987 models share the same exhaust valve system and are easy to control. However, the HPP system requires frequent service. Here is a survey of the products and mods for these timeless motorcycles.
BEST VALUE MODS

ENGINE: 1369 carb needle, chamfer
HPP valves, T-vents in carburetor
SUSPENSION: fork springs, check linkage bolts

CR250 EXHAUST VALVES
The earlier models (1984–1985) have a butterfly valve linked to a can at the exhaust manifold to increase the volume of the header pipe at low rpm and boost the low-end power. The butterfly valves are prone to carbon buildup, which locks the valve in the open position and reduces the top-end power of the engine.

SUSPENSION
Honda had problems determining the proper fork-spring preload on the early cartridge forks. The proper amount is 5 to 15 mm, although Honda used as much as 30 mm on production bikes. The best fork spring rates to use are 0.40–0.41 kilogram for the CR250 and 0.44 kilogram for the CR500. The Race Tech Emulator valve is about the only aftermarket accessory that you can use to improve the handling of the older CRs. It’s the closest thing to a cartridge fork.

LINKAGE
The suspension linkage and the floating rear drum brakes of the 1985 and 1986 models are also trouble points. The 1988 CR250 had chronic problems with bent rear-shock-linkage bolts and Honda redesigned the parts and added flanges to the heads of the bolts. The part numbers for the new bolts are H/C 2976678 and H/C 2976686. The CR linkage requires careful attention and frequent lubing. A seized linkage can put an enormous strain on the frame, causing everything from cracks in the frame to leaks at the head gasket.

REAR WHEEL
In 1989, Honda redesigned the rear hub to be lighter. It was too weak and often shattered. Honda had a recall campaign in Europe but not in America. The 1990 hubs look similar to the 1987 hubs with a conical taper, compared to the straight diameter hub of the 1989 model. Tallon makes an excellent replacement hub that is far stronger than the stock hub.

ERGONOMIC CHANGES
Bolt-on parts for the rest of the chassis include wider foot pegs, stiffer seat foam, a skid plate to protect the frame, and a cable to prevent the rear brake lever from rearing off the beams.

ENGINE
The only real change to the CR250 in the late 1980s was the switch to water cooling. The air-cooled models suffered from detonation, and the cylinder head had to be modified to lower the compression ratio and narrow the width of the squish band.

SPARK PLUG
The best spark plug heat range is an NGK BP7ES.

CARBURETOR PROBLEMS
The carb’s fuel-inlet needle and seat wear out quickly because of the vibration, causing the engine to flood when the bike is dropped. Change them every season.

SILENCER
The later model CR500s suffer from chronic breakage of the silencer core. The silencer needs to be packed often; otherwise, there is nothing to protect the core tube from vibration.

REED VALVE
In 1986, Honda put a plastic insert in the reed valve to stuff the dead air space and boost the velocity. FMF sells aftermarket “reed stuffers.” Boyesen reeds are a good investment because the reed stop plates block the cylinder’s rear boost port. Boyesen reeds are more responsive than original Honda reeds and they don’t require the stop plates.

CARBURETOR
Jetting for the 1986 to 1991 models burning 93-octane pump gas with a premix ratio of 40 to 1 should be 55 slow jet, 1369 needle, and 172 main jet. Take care setting the float level and replace the inlet needle and seat every year. Changing to a modern T-vent system for the carb is also beneficial. In this way, if you ride through mud, your bike won’t vapor lock (mud splattered up under the bike blocks the carb’s float bowl vents).

IGNITION SYSTEM
The ignition systems require frequent maintenance in the form of cleaning the inside of the flywheel. The dirt and water that get drawn in from the plastic side cover break down the coils, corrode the flywheel, and wear down the left-side crankshaft seal. Boyesen Engineering makes aluminum side covers that seal better than the stock plastic covers. They also function as a heat sink to transfer damaging engine heat away from the ignition. Ignition coils and spark plug caps tend to break down on the CRs.
AIR BOX
The air boot flanges on the CRs tend to leak after you pressure-wash the bike with strong detergents. Seal the air boot with weather stripping adhesive, available from auto parts stores.

HONDA XR TUNING
WITH SCOTT SUMMERS AND FRED BRAMBLETT
Honda XRs are used for everything from play riding to hare scrambles to desert racing. They are perhaps the most bulletproof and widely used dirt bikes on the planet. Although enduro and trail riders have been using XRs for decades, Scott Summers, one of the best off-road riders in the sport, put a No. 1 plate on the flanks of an XR600 several times in the 1990s and has demonstrated that XRs are capable of much more than just plunking down trails or crawling through the woods. He and his mechanic, Fred Bramblett, are not the typical rider–mechanic duo. They are motorcycle innovators. They've devised some interesting innovations for the XR line of Hondas. They've tested just about everything possible for XRs. Whether racing the Baja 1000, the ISDE, or cow trailing through the deep woods of Kentucky, they know the setup that works best.

ENGINE
Air Filter
Clean the air filter and the air box after every ride. Check the filter for excess oil buildup near the point where the crankcase vent enters the air box. If the rings are worn, crankcase oil will flow up the vent and into the air box and coat the filter. This can cause a rich fuel jetting condition.

Oil and Filter
Change the crankcase oil after every two rides and the filter every other oil change (four rides). Check the wire mesh screens that are mounted in the bottom of the frame and in the crankcase. If you ride a mud race and have to fan the clutch often, the fiber clutch plates can start to disintegrate and pollute the crankcase oil. The particles will become trapped in the wire mesh filters. You should clean the filters at least twice each year.

Lube the Cables
Lube and adjust the clutch and throttle cables. Remember that the clutch cable free-play will be reduced as the clutch plates wear.

Valve Adjustment
The XRs don't need frequent valve adjustment, but keep in mind that the valve lash will be reduced as the valve and seat wear. Check and adjust the valve lash every 200 miles or after every fifth riding weekend.

CHASSIS
Chain and Sprockets
Clean the chain and sprockets after every ride, and lube the chain and check the free-play. Inspect the sprockets for chipped teeth caused by rocks. Check the alignment of the rear chain guide. Sometimes rocks or ruts can bend the guide, causing it to push the chain out of alignment with the rear sprocket, which can cause the chain to derail.

Keep It Greased
The XRs have grease zerks mounted in the swingarm and linkage pivots. You should grease the zerks after every other ride for two reasons: to force water and dirt from the bearing cavity and to lube the bearing. Fred Bramblett fits grease zerks to the neck of the XR frame to provide grease to the steering head bearings. The zerks are mounted to the frame and the races are notched to allow the grease to enter the bearing. Grease the steering head bearings every four rides. That may seem frequent, but consider that the XR holds the crankcase oil in the frame. When the oil gets hot, the frame temperature rises and the grease in the steering head bearings can melt and disperse from the bearing.

Spokes
Because the XR is a fairly heavy dirt bike, the spokes require frequent attention. Check them after every ride and don't be tempted to over tighten the spokes. That can crack the rims.

Brake Fluid
Change the brake fluid after every four rides. Use DOT 4 fluid.

DAMAGE CONTROL
The XR models are well-developed bikes that are extremely reliable. Crashing is one thing that all dirt bikers do from time to time. The rider–mechanic team of Summers and Bramblett have come up with a line of products that help make the XR more resistant to crash damage. Their products are available through Summers Racing Concept (800-221-9752).

Foot Levers
The shift and brake levers are reinforced to prevent them from bending but are also designed to break off clean in a crash to minimize damage to more expensive components. For example, the shift lever is designed to break clean at the shift shaft during really hard impacts. That way, the shift shaft doesn't bend or damage the crankcases. A stainless-steel cable wraps around the end of the levers and connects to the frame to prevent tree branches from wedging between the side covers and levers. The cables also serve to prevent the levers from snaring in deep ruts.

Wire Protectors
The Summers team noticed a common problem with XRs—the wires and rubber
plug that exit from the right-side engine cover get snared by branches and yanked out of the side cover. This allows the crankcase oil to leak out of the side cover and eventually cause catastrophic engine damage. The guys developed an aluminum guard to protect the wires from tree branches. The guard just bolts on to a few of the side cover’s mounting screws, and silicone seal is applied to further insulate the wires.

Chain Guard
The original chain guard should be modified to allow the chain to derail downward if the chain is forced off the sprockets or breaks. It is possible for the chain to bunch up and break the crankcases with the original guard design.

Fork Brace
A special fork brace was developed for the conventional cartridge forks used on the XR650L, XR600, and the new XR400. The brace reduces the front wheel deflection when riding over rocks or over large boulders.

XR PERFORMANCE OPTIONS
If you are considering bolt-on performance parts or high-performance services for your XR, consider your riding demands and the type of terrain that you ride on. There are a myriad of products available for the XR designed to suit a wide variety of applications.

Cooling Systems
There are two ways to improve the cooling systems of air-cooled engines: welding additional fins to the head and cylinder or installing an oil cooler. The oil cooler is the most efficient setup for reducing the engine temperature. The weld-on fin setup is commonly used on desert racers that run at high speeds where there is more free air available to take advantage of the additional fins. XRs Only and Ballard Cycles sell the weld-on fin kits. Lockhart makes an aftermarket oil cooler, or you can adapt the OEM oil cooler from the XR250 to the XR600.

High-Compression Piston
Wiseco makes an optional high-compression piston for the XR600. Higher compression pistons are generally more beneficial for slow-speed woods riding or high-altitude riding.

Carburetor
The stock carb works great for woods riding, and many riders prefer a larger 41-mm carb for desert racing. The White Bros. 41-mm carb kit gives an increase of about 4 horsepower and 6 miles per hour. However, the larger carb sacrifices the slow-speed throttle response that is important for woods riding over muddy or rocky terrain.

Head Pipe
There are three types of head pipes: straight, tapered, and oversized. All OEM head pipes are straight. The XR head pipes are available in two different lengths that effectively widen the powerband at low rpm with a sacrifice in peak power. The Summers team uses the tapered head pipe marked by Yoshimura. A tapered head pipe improves scavenging efficiency and reduces pumping losses because the pipe draws out the exhaust gases rather than relying on the piston to pump out the cylinder. Typically, tapered head pipes can cause odd jetting problems, but Fred Bramblett says that he hasn’t experienced any jetting problems with the Yoshimura pipe. Tapered head pipes work best with OEM cams or those with slightly retarded exhaust timing. Oversize head pipes are generally used in conjunction with big bore kits or for high-rpm applications such as desert racing or DTX.

Tailpipe
There are two types of tailpipes: straight-through silencers and spark arrestors. Some riding areas and racing organizations require the use of spark arrestors on off-road motorcycles. Check the rules before you purchase an expensive aftermarket tailpipe. Straight-through silencers provide the right flow characteristics and resultant back pressure to produce maximum power over a wide rpm band. Spark arrestors have a series of baffles that prevent particles of combustible gases from exiting the tailpipe. The Summers team uses the Yoshimura tailpipe for closed-course racing.

Camshaft
The Summers team uses the stock XR cam for bare scrambles and enduro racing and the HRC cam for desert racing. The HRC cam has a higher lift and longer duration. Most aftermarket cams offer 2 to 4 degrees of duration over OEM cams. Increasing the duration generally improves peak power, but changing the overlap of the intake and exhaust has a more dramatic effect on the powerband. Decreasing the overlap improves low-end torque with a sacrifice of peak power, while increasing the overlap improves peak power with a sacrifice of low-end power.