

ALL ABOUT

2-stroke cylinder & head mods

P O R T I N G

By Greg Hall

To the average Joe, porting is wholesale hogging out of the ports with a Dremel tool. It's raising the exhaust port and then milling the head to increase compression, resulting in a power increase at the highest rpm and a nonexistent midrange.

This story will *not* show you how to port. We are suggesting you keep your hands in your pockets and leave your cylinder with the professionals who have demonstrated that their cylinders are doing the job for professional racers. Instead, read on and learn what porting really is, how it can improve performance and what to look for from a porting specialist.

CYLINDER & HEAD MODIFICATIONS

Exactly what is "porting"? Loren Duncan of Duncan Racing, with over 3000 ported cylinders to his credit, is qualified to answer that question.

"The correct term is 'cylinder and head modification,'" he tells us. "One should not be done without the other. The definition has two parts. The first is the modification of the time that the ports are going to open and close during the 360-degree cycle and the angles in which those ports are going to feed the gases and the air in and out of the cylinder."

The second is having the skill or talent to perform 'porting.' It is like painting. It's an art form. You either have it or you don't. Part A without part B is no good. If you have seen a ported cylinder by a top-notch professional, it is a work of art. It's beautiful." Definitely not for the backyard mechanic, eh?

It used to be when you purchased a two-stroke engine, the factory shop manual included specs for port timing. With this information you could "match" ports. Today, without those specifications, "matching" ports has come to mean checking to see all the ports are equal. To make them equal,

or matched, it may be necessary to remove any casting flaws or "slag." A lot of cylinders today, right from the factory, are so clean that you will find little to do.

Before you raise the exhaust port, decking the cylinder and raising compression will generally make any motor run better. However, this is the point where the professionals float to the top and the backyard wannabe porters sink to the bottom. The amateurs don't know where to go from here nor why what they did works, if it happens to. Unless you understand exhaust duration, roof angle, port timing of your five transfer ports and intake timing—among other topics—let a professional do it.

PORT TIMING

One term you are likely to hear bandied about is "port timing." This is the *exact* moment when each port is uncovered by the piston during its 360-degree cycle. You have heard about adding additional base gaskets to change the port timing. Installing an additional base gasket will raise all the opening points (roofs) of the ports by 0.020", but remember that the base of the port also went up 0.020". So it's a Catch-22 situation. It's better to change the port timing by porting where *all* the port timing factors can be controlled—and, no, you can't use double head gaskets, either. This lowers compression and is a Band-Aid solution to changing the deck height, as we will explain.

One factor the average backyard porter doesn't understand is this: when you raise the exhaust port, the engine's cranking compression actually goes down! Why? If the port is higher, the piston must travel farther up the cylinder to close it. Therefore, there is a shorter distance for the piston to travel from that point until it gets to TDC (top dead center). The shorter the distance,



Loren Duncan of Duncan Racing says that porting is an art form. If that's the case, that makes Loren Michelangelo.

the less volume there is to be compressed and the lower the resulting compression!

DECK HEIGHT

Now do you see why a true porting professional requires head mods, in addition to cylinder mods? You should also give your proposed piston and head gasket to your tuner. To obtain an accurate picture of the head volume, your tuner will need the head gasket. Its thickness will have a direct effect on the volume. The piston is included because the deck height (position of the piston in relationship to the top of the cylinder at TDC) must be measured. You certainly don't want the piston to be above or below the deck at TDC.

However, when you do the deck height you also have to measure the position of the top of the piston at BDC (bottom dead center). At BDC, the piston's top must be at the base of the

is a downside. When the piston starts down, it compresses the fuel/air mixture in the crankcase. When the piston exposes the transfer ports, this pressurized mixture is forced upward through the transfers to the cylinder. If you are using a reed spacer, the mixture is in a larger area than normal, so it can't be compressed as much. Therefore, the pressure is lower and the fuel/air mixture will travel more slowly through the transfer ports and into the cylinder. As a result, the cylinder doesn't fill as well. The only time a reed spacer is useful is when the reed cage position actually blocks a port. Positioning it farther back helps the port flow better.

A piston change can result in a power increase under certain circumstances. You must make sure the cylinder's deck height is correct for the new piston. The exhaust skirt must be completely covering the exhaust port at TDC. If it doesn't, the intake charge that is under pressure in the crankcase is blown out the partially open exhaust port, then out the exhaust—along with your power "increase"! You would be surprised how many "experts" never check for this.

GOING BACK

What happens if you purchase a used racer and want to trailride it? Can

a "radical" port job be reversed? According to Loren Duncan, there is really no such thing as radical porting.

"To the consumer, a radical port job is all top end," Loren says, "and that's just not the case. Porting is either done correctly or incorrectly. The same amount of work goes into a low-end, midrange and a high-rev cylinder. When I'm done, there is no more that can be done to it."

For amateur porters, porting for top end is as basic as raising the roofs of each port, which raises the rpm but may render the remainder of the powerband unusable. Also, there's another cost of doing this. As a general rule, a low-rpm cylinder can be transformed into a high-rpm cylinder, but the reverse is not possible. There are exceptions, though. Before you recycle that aluminum cylinder, check with a professional.

Your exhaust pipe plays a larger part in determining what type of power your engine produces than the type of porting it has. An exhaust pipe controls how the spent gases are removed and at what rpm range they are removed the most efficiently. If you want more midrange from a motor ported for top end, you can install a mid-range pipe successfully, though not optimally. The pipe will prevent the

motor from developing that top-end horsepower the cylinder was ported for, if that's what you want it to do.

PICKING A PORTER

What should you ask your porting professional when you want a porting job done? According to Duncan, it's not what you should ask, but to pay attention to what the porter asks you.

"You walk into a shop to get a port job done," Loren explains. "If the porter doesn't ask what you're going to do with it, where you're going to ride it, what type of pipe you're going to use, what kind of fuel you're going to use or what type of carburetor you're using, then pick your cylinder up and get out of that shop as fast as you can! You will have no idea what you're going to get!"

It's up to the porter to find out what the customer wants out of his engine. The customer is not qualified to know exactly what he wants, because he is not a professional. This is why there must be a detailed Q&A session before the customer lays out \$400-\$500 for a full-on port (head and cylinder modification) job.

Select your porter carefully, or you may be spending your hard-earned dollars to buy a new cylinder to replace the one butchered by a Dremel-happy motor mangler! □

PORTING

transfer ports for maximum efficiency. Why? How efficient do you think your engine will be if the fuel-laden air is trying to enter the cylinder through transfer ports that are partially shrouded by the piston—because your "expert" didn't set the height of the transfer ports' bases first? If this step isn't done properly, then everything done later is going to be off.

Although the most impressive power increases are tied to the modification of the exhaust port on most motors, there are exceptions. It just depends on the individual motor, what you want to do with it and how well a job the designers did in the first place.

INTAKE SPACERS

An intake spacer will increase intake volume, which is good. However, there

FOUR-STROKE PORTING

SUCTION STILL MATTERS

● Beside the obvious differences, what is porting like for a four-stroke? Well, compression is always controlled by the piston crown height in an overhead cam engine (the motor layout of the vast majority of four-stroke ATVs). The four-stroke portsman is primarily concerned with getting the most flow with the least resistance down the intake tract, around the open intake valve (which may need to be contoured for best flow), and into the cylinder.

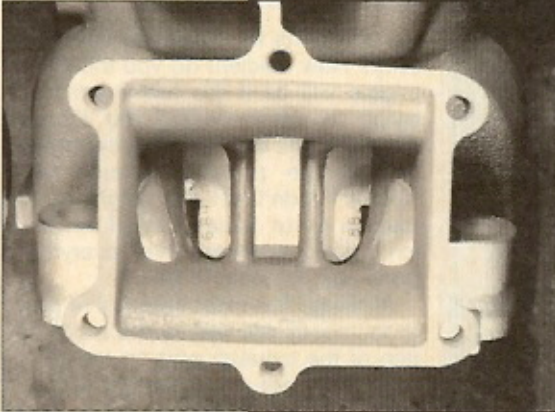
Once inside the cylinder, the head and piston must be shaped to create added turbulence to this flow, which ensures complete mixing of the fuel and air and promotes complete combustion. Then, on the exhaust stroke, the exhaust port must be contoured to provide as little impedance as possible so the spent gases can exit out the pipe. This process creates a suction that aids in filling the cylinder with fresh mixture, just like a two-stroke.

Porting on a four-stroke is mainly done to increase airflow at high rpm. Port jobs on a four-stroke have little effect on performance at low and mid rpm. It is also critical when going to a larger bore. If you get a bigger piston, but don't work the ports, the air will not flow as it should. Also, it allows more fuel into the combustion chamber and it helps cool the piston.

Just as you would with a two-stroke, leave four-stroke porting to experienced professionals—unless you are a gambling man. ●

BEFORE

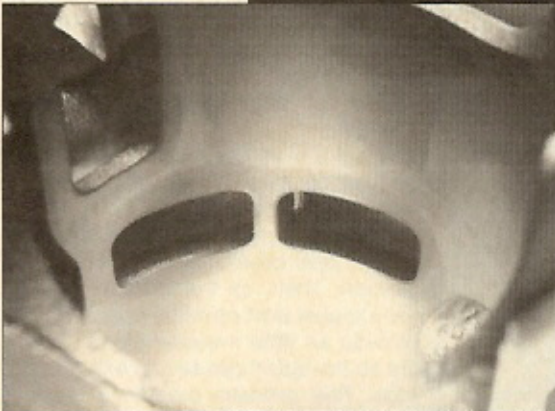
AFTER



On the left are the stock TRX250R intake ports, looking inward from the reed cage. Note how these same ports are shaped and the bridging is knife-sharpened for better flow on a Duncan Racing-ported 250R cylinder (right).



Looking upward from the crankcase, here are the transfer passageways on a stock TRX250R (left). The right photo shows a Duncan Racing-ported 250R cylinder. The contouring of the bridgework increases flow.



This is the piston's view (left) of a stock 250R's transfer ports. Duncan Racing has put a different roof and base on the port opening (right).



Looking from the top of the cylinder, here are the stock 250R exhaust ports (left). The right photo shows the changed port contour, plus the roof and base location on a Duncan Racing-ported TRX250R cylinder.