Rebuilding that Motor

I have observed threads and related threads on the GMCnet Forum with interest, so I'd like to weigh in on this. I will qualify the following by saying first that this is my *opinion* only and not intended to criticizes or offend anyone. *JMHO* That's all!!

I will also qualify myself a little by saying that my undergraduate degree is in Industrial Arts Education with a concentration in auto mechanics, and I taught Auto Mech. for several years in the Milwaukee schools. At the same time I worked at a Hot Rod shop, where I did all of the balancing work for them and a fair share of the long block assembly. Learned more there about auto engines in a year and a half than I did in 4 yrs. of college. Since then I have done mechanic work as a second job out of my garage and other businesses for 40 yrs. Over the years I have done countless rebuilds on all forms of motors from lawnmowers to garden variety grocery getter cars to "AA" funny cars. Domestic and Foreign.

Now.... what have I learned, and observed over the years about rebuilding.

The basic principles of rebuilding apply regardless of the motor or size or brand. There is nothing mysterious or special about any particular motor. They are all basically the same. 1.6l's, 3.8l's 302's, 318's, 327's 454's 455's...500's...all basically the same with a few individual peculiarities. A Mondello motor does not insure power and reliability... *unless* you are going to race it. Racing motors require some rather specific modifications to make it last under the extreme conditions that racing motors are subjected to. It's all about the finish line not how it runs 50K from now.

Now... this next statement is not based on fact...just my observation and experienced opinion. The more you modify a motor...away from the original design the less reliable it is likely to be. Generally speaking the factory design's motors to get well past the warrantee period. So, standards and tolleances at the assembly line are closely watched. That stock motor is really put together right. If they didn't, imagine the money and business they would loose to bad reputation. They also build for "worst possible senerios"...the guy that never changes the oil, because he is going to trade it at 50K anyway. So a certain amount of durability is essential.

Incredably, the least troublesome rebuilds that I have done, were the "quick and dirty" ones. Motors that I did for friends that just did not have the money to "do it right". Often those rebuilds were done *in* the car and were rebuilt because the motor was loosing power, and burning a lot of oil. Often this rebuild included no more than cleaning up the pistons to accept a new set of rings, and then just doing a quick hone on the cylinder walls with a medium stone so that the rings

would break in properly. If the valves were not burned and looked OK, they were reinstalled without grinding and a new set of valve guide seals were installed. Main and rods were plastigaged and if within specs, just put back together without changing or doing anything to them. Then new gaskets....button it up...do a couple of quick oil changes to get the crap that will settle to the pan out, and drive it. Got quite a few of those out there with lots of miles on them. Haven't had a comeback yet. (Knock on wood)

When you pull the motor apart, always number the rods, and get it back together the same way it came apart. If you are pulling the heads for a valve job, punch holes in a piece of cardboard, number the holes and keep the pushrods in order, so they go back to the same lifter and rockarm. You are less likely to have lifter problems if you do this...though I'm of the belief that lifters should be replaced on any rebuild.

I have found that if I can reuse the old pistons, rods, crank, and cylinders *without* machining of any kind, I have fewer problems on the whole. I figure...if it lasted the 80-100K without breaking, it's going to last another 100K.

If the cylinders have a .003 (I've actually done it out to .005 taper...I do not recommend this) or less taper, cut the upper ring ridge, and hone a good 45* cross hatch with a non-rigid medium hone. Hone *only enough* to cut the glaze. Don't get carried away, to much clearance and you will end up with piston slap. Clean the bore with a rag soaked with 5w30 oil. Use as many new clean rags with oil as it takes to wipe it down until you don't see honing material on the rag. You have to keep in mind at this point that when a cylinder has a .003 taper, it usually is not worn evenly all around the cylinder. You will find that generally there is more wear 90* to the pin or on the thrust sides of the cylinder walls. This will make them oval shaped. (sometimes called "square" instead of perfectly round.) The reason you must consider this is, if you choose to do a quick hone and replace the rings with a "square" cylinder, it will take perhaps 5-10K miles or more for those rings to wear into the shape of the cylinder. While this is happening you will notice some blow-by...usually in a spotted air cleaner where the breather from the valve cover attaches to the air cleaner. Just gotta put up with it till it wears in. If you don't like the blow-by, the only alternative is to have the cylinders bored and replace the pistons...preferably to .030.

Someone...somewhere...a long time ago said that it does not matter where you put the ring end gaps....that they will "float" and "find" their own seat. BS!! Ring end gaps stay where you put them. It makes sense to me to place the end gaps as I did when we built racing motors. Never put the gaps at either of the thrust sides of the piston (90* to the pin). That's where the most combustion chamber pressure will be. Place the top ring... 90* to the thrust side and directly over the pin. Second ring...180* from the top ring over the other side of the pin. Top oil

ring rail...30* from the pin on the compression side of the thrust. Bottom ring rail...180* from the top oil ring rail. The ends of the center section of the oil ring can be anywhere as long as it is not within 1" of the top or bottom ring rails. This is an easy thing to do, doesn't cost anything accept a little more attention to detail, will probably help control blow-by, and help keep your compression consistent.

If you are running a low RPM street motor, *don't* cross drill the crank. If you do, and the bearing clearances are on the high side, and especially if you have a high volume oil pump, you will push so much oil through the bearings that to much oil could get thrown on the cylinder walls. So much so that the rings won't be able to handle it, and you will end up burning more oil. I have seen motors that burned a lot of oil because the rod bearings were worn out..not because the rings were bad. If you do cross drill a crank, your rod clearances better be less than .001. IMO it is worth taking a grinder to the oil holes in the crank and flairing them out a little to assist the oil getting to the bearing surface. If you do this make sure you clean the crank throughly before assembly.

Balancing a motor is not worth the money if the motor is going to be run at 5K or less....*unless* you are changing parts of the rotating assembly. Balancing is not necessary up to about .040 overbore. If you change to "special" after market pistons .040 or more, or to after market rods, it *is* a good idea to balance the rotating assembly.

Now for a comment about the block and heads. Some in the business feel strongly that everything in the block needs to be perfectly parallel and in alignment. In the "perfect" racing world, this is certainly true. So they spend a lot of money and time machining the deck of the block so that it is in in perfect alignment with the crank. When you start doing this type of machining...which by the way is part of the infamous "Blueprinting and Balancing" procedures ...when you start doing these things, you open up a whole new ball of wax. Machining the deck changes the deck height ...where the pistons are at TDC in relation to the deck of the block. This should only be done after first sizing each connecting rod first...making sure that the distance from C/L of pin to C/L of crank on the rods are all the same. You also have to make sure that each of the 4 crank journals are exactly the same offset relative to the crank main bearing C/L, and the crank has to be perfectly straight, and set in a perfectly straight line bore. Then you do a trial assembly and measure deck to piston height to determine what metal has to be removed from where. Now think about all of the machining that has to be done here, at what cost, and the possibilities of mistakes. For what little gain you get in a MH motor, it ain't worth it. Many also feel that heads need to be *perfectly* flat. Most of the time I don't even check them for flatness. If they came off the motor without a blown head gasket...they are good enough to go back on just the way they are. In rare cases where I do

check them, I lay a known streight edge corner to corner across the head. Unless they are noticeably off...leave it. In rare cases where I do try to correct a problem, I've been know to use a large mill file to touch up some areas. When you start shaving heads, you change to many other things. Suddenly now the valves are closer to the pistons, you change the preload on the lifters because the valve train is now closer to the cam, you change the volume of the combustion chamber, raising pressures putting more stress on the headgasket, and it changes where the intake manifold will sit in the heads, meaning that you may have to machine the intake manifold to get the ports and bolt holes to line up. Why do all of this??? This is what head gaskets are for....to take up those imperfections. A good set of head gaskets and proper torquing of the head on assembly can easily make up for the lack of perfect flatness of a head or block deck.

Head work including porting, polishing, and CCing, is *IMO* a waste of time and effort on mostly street stock motors. It is very time and labor intensive. If you have the resource to do it yourself and want to be anal about it, go ahead...ain't gonna hurt anything...but the money spent for the little HP gain is not there. It is worth knocking off any nibs in the combustion chamber that might heat up and lead to preignition.

It is not always necessary to replace the cam. Mic it...if it is within spec, it's Ok to re-use. Even if I don't replace the cam, I always replace the lifters. Anytime I've had problems with collapsed lifters, it was because I tried re-using the old lifters. There is something about letting them collapse the first time (which can happen during a rebuild) that destines them to collapse again. Not worth the trouble to not replace them. *Always* use "cam lube" on assembly. If you don't have the equipment to "degree" a cam, or don't know how, don't worry about it. The little HP gain you get from it is not worth paying to have it done. Besides, you will never notice the little gain it on a 12000lb MH. On the other hand, if I had degree'd the cam on my 500 when I rebuilt it, maybe I'd have discovered that I used the wrong markings on the Cloyes timing set I bought....and probably wouldn't have bent 5 pushrods and 4 new SS valves....Oh well...s*^t happends.

Of all of the mods you can do to a motor...if you must do mods, dollar for dollar, an after market cam, designed for the purpose you've intended, gets you the most for your money. The problem is, when you change cams, in order to make the most of that cam, and retain some assemblance of reliability, there are many parts that must be changed with it. Lifters, springs, retainers, keepers (to match the new valves). Installed spring height must be closely attended to. A change in valves and/or a valve job (three angle if you can) will change the stem height of the valve. If you follow that through the valve train, it changes the preload on the lifters. So preload must be carefully monitored, and adjusted accordingly.

Now if you really want to take advantage of that extra lift and valve timing from that new cam, headers and a decent induction system (intake manifold) are next.....$$$$$$. Everything you do now takes you further from the reliability that was built into that stock motor. Every modification takes you further into the chaos factor.

There is a tendancy to want the motor to look really good on finished assembly. But be carefull of what you do to things like your valve covers, oil pan and other such things. A friend, buiilding a motor for his 350 powered pickup, sand blasted his pan and valve covers to get them clean enough for painting. Apparently he did not get all of the blasting material out from under the baffles in the pan and rocker covers. The sand took out the motor in the first 15 minutes of running....NEVER sandblast those parts or anything that might be associated with the internal workings of the motor.

It is not necessary to be "surgically" clean on assembly. No, don't expect an engine to last that has been assembled in a sand storm, but be as clean as you can reasonably expect to be in the garage you are using for the rebuild. Pull a plastic bag over it when you aren't working on it. AGAIN...be as clean as can reasonably be expected, but, there is no need to be excessively anal about it. Any little particles that get into the rebuild will wash down into the pan, and filtered out on their first pass through the filter. Before starting the motor the first time, and preferably while still on the engine stand, run the oil pump with an electric drill until you have good oil pressure. This allows you to check and verify initial oil presure and check to make sure that all of the oil gallery plugs were put in.

IMO, it is not necessary to go through an extensive break-in procedure. You do need to use dino oils for the first 5000 miles with the first change at no more than 500 miles. But I just drive them normally. If I have to go on the highway for a long trip, I set the cruse and go. If I need to drive it around town, I just drive as I usually do...including sticking my foot in it once in a while.

IMO, the old Big Block motors get along best with the heavier weight racing oils. Personally I wouldn't run anything less than 20W50 racing oils (unless your rod and main clearances are at or below .001) Again...just my personal preferance.

Several have asked me what is considered a safe RPM redline to be for the 455, or Caddy 500 for that matter."

It depends on a lot of things. But generally, I would look at the HP and torque curves, and set the Red Line conservatively at no more than 400 RPM above the RPM that max HP is achieved. On the 455 and 500 stock motors, this max HP is

around 3800 RPM. To me that sets the Red line at 4000 to 4200 RPM. If you look at the 455 "Koba Motor" built by the Coop at this web site:

http://www.gmccoop.com/images/Koba_motor_headers.jpg

Max HP with their "Kryptonite cam" is at 3900 RPM. That motor also has lot of other mods. So I personally wouldn't run it at more than 4400. Notice that they didn't post testing above 4137 RPM. That cam is designed for it's torque at our driving speeds, so that cam probably falls on its face after 4100...which is OK...who needs it anyway. If that cam was available for the Cad 500 when I did my motor, that cam would have been my first choice. BTW, I have talked to Jim Bounds about just that. For those of you building a Cad, Jim has said to me that he will make that profile available on a Cad core. Contact him for details.

Keep in mind now....the above is all JUST MY HUMBLE OPINION, *and* my relatively informed, off the cuff, back yard mechanic, gut level, eyeball it up and guestimate, way of doing things....that's all...

Larry Weidner
78' Royale w/500 Caddy
Menomonie, Wi.