Lean Engine Heat

We have a local customer that has had little success with optimizing his engine output. This bike is a 124 TC and has all the good parts in it; Baisley Hybrid heads. T-man 650 cams. Feuling pump and plate, name brand 2-1 exhaust pipe and a 48 Mikuni with a D manifold. It uses our cylinders with a 30 degree piston to match up to the Baisley heads.

This engine never made the right power. The bike had been professionally dyno tuned, but with mixed results (low 120s). The dyno operator had struggled to get the engine happy without complete success. The owner's only complaints were the low power output and an occasional puff of oil out the pipes.

We were just planning to use him as a case study and plug the bike into our dyno and put a good tune into it. We have a Stuska engine dyno equipped with Depac Data acquisition. We can measure Torque and Horsepower but what is much more valuable is the temperature thermocouples, in the exhaust pipes and under the sparkplugs. The ability to monitor the exhaust and cylinder head temperatures makes timing and jet changes much easier. When we tune a complete bike we remove the rear wheel and capture the swingarm with our dyno frame. The rear chain or belt then turns our dyno directly with no tire to drum interface problems or heat build-up.

First problem and change of plans: We started up the bike before installing on the dyno and WOW. It sounded like it had a loose wrench lying on the front piston. The owner had not mentioned any noises but this was serious stuff. A bore scope down the front cylinder showed damage so the top end came off.

On teardown these things were found:

1 Badly scuffed front piston. Rear piston OK but a lot of debris damage.

2 wrong intake manifold (real short) which resulted in an intake leak

3 vacuum port on back of carb had no plug on it. (another leak)

4 165 main…very small

5 sparkplugs protruding ¼" into the chambers.

6 air cleaner had an adapter on the bell mouth of the carb that was undersized and limiting airflow.

The list goes on and I won't go any farther but the interesting thing is was this bike was running on the road! A large engine, even when sick, still can produce enough power that the owner does not suspect any problems are occurring.

The engine was repaired; bore job with new pistons, oil pump serviced etc and the engine was flushed including oil tank.

The bike was installed on our dyno and the heat cycles were performed. The jetting was left unchanged as it came to us (165 main). The ignition timing was looked at closely as this is a source of many of the problems we see. We want to see the timing in the 26 to 32 degree range and 30 is a good starting point.

After the heat cycles were done we loaded the engine lightly to simulate cruising. At this time it became apparent the engine was rapidly overheating even while doing almost no work. Exhaust gas (eg) was 1345 front and 1309 rear Cylinder head (ch) were 320 f & 343 r. This mismatch of the hotter head combined with the cooler exhaust is a sign that the engine is lean. This engine would do what I call a slow bake and show rapid ring and cylinder wear. If you start @ this temperature while cruising and then ask the engine to accelerate and do real work it will hurt itself.

Since more fuel was called for, we started jumping the jet sizes up. In the whole process we ended raising the needle jet to cool the cruise range and we worked our way up the main in jumps of 165 (starting point) to 180,190,200 and finally a 210. We wanted to record the temperature and HP levels at all these points but THIS IS NOT RECOMMENDED. In this series of pulls we saw exhaust temps over 1500 and rear cylinder head temps of 450+. These relatively small main jet jumps took the engine from "real lean hot" to nuclear meltdown hot at about the 180 main jet size. We were flirting with death here but with our data acquisition we could abort any run/pull when the conditions warranted it. Out in the field you should always make large jumps in your fuel curve to get to the safe rich side and then lean back down to happy. Working up from lean will throw you in a place were you can hurt your engine very fast. IT IS AIR COOLED.

When we got the jetting up and the power was @ an acceptable level we could have quit, but the rear cylinder head temperature was still higher than normal. We were leaving some on the table. This engine had a 2 into 1 with 1 5/8 primary tube which is much too small for a 124. We installed our dyno proven mule exhaust which is a set of Cycle Shack 2' staggered duals and made a pull. The exhaust temps dropped almost 200 degrees and were very even front to rear. The cylinder head temps dropped over 100 degrees and the HP jumped almost 20 higher at 6000 RPM. We are now looking @ a 140+ rear wheel HP bike with drastically cooler temperatures.

I think this is very educational in the fact that it shows the temperatures involved in a miss-tuned air cooled engine. We actually don't see this very often on carbureted engines but it is a HUGE problem on the fuel injected ones. Pistons hate stoichiometric correct air fuel mixtures and leaner is even worse. If you point your oxygen-acetylene cutting torch at a temperature sensor and adjust it for the highest temp you have found stoichiometric.