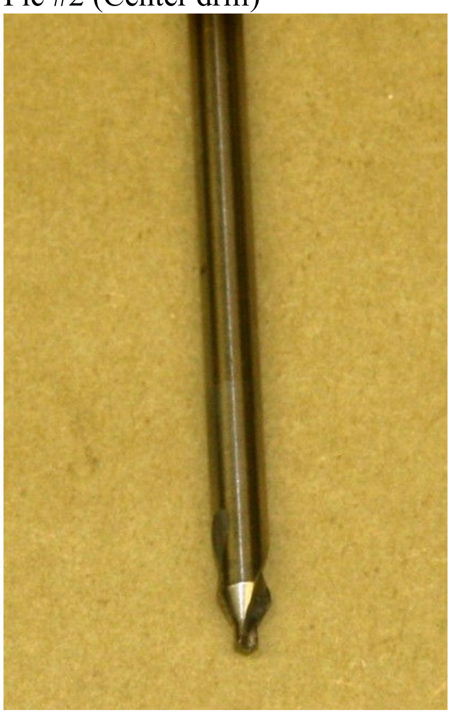
After receiving an email from a prospective customer which stated "If I have all this computer equipment why does it take so long" I thought this may be a good time to explain a little more in depth about the machining process. Firstly, a large number of the parts on my engine are from castings, which means that special jigs must be made to hold each casting in the exact same position. This is very difficult, because of shrinkage, flashing, casting gates, and casting risers. Keep in mind this must be done of each casting and in the case of the block there are 9 surfaces that all need to be precise or other parts do not fit or align. Greatly simplified some people have the impression that you put a block of metal in the machine, push a button, wait, and a finished engine comes out the other end. What the CNC process does is to insure that all pieces will be exactly the same. Can you imagine if every piece had to have additional work done to make them mate. It would be impossible to have replacement parts available, to say nothing about the astronomical amount of time it would take. Another good example is the heads. Altogether there are approximately 75 holes in each head. Of this, 38 holes must be drilled and taped 2-56. Just in cast you may not be familiar with what I am talking about picture # 1 puts everything into perspective and shows the difference between a ¼ -20 bolt and a 2-56 screw. To keep everything accurate, each hole must first be center drilled, drill the exact size, then threaded if necessary. Once again, a center drill has a very rigid body and a short drilling end and can be seen in picture # 2. If a tap is broken, the piece is not discarded but rather a special machine called an EDM (Electro Discharge Machining) is used to literally burn out the tap. This is so accurate that the pieces of the tap can be removed without destroying the threads – and no you cannot just drill out the tap as some people may think. When machining the heads I was in the process of tapping the holes for the valve covers and unfortunately broke three taps and it was not in the same place every time. Upon further examination of the program, I discovered that instead of being Y-.301, I had accidentally put in Y-.310. There is only a difference of .009 or about the thickness of three human hairs. Not very much, but certainly enough to break a tap! When you consider there are 75 holes and each may have as many as 3 operations, the chance for an error is very evident. Also before each drilling operation the surface of the casting must first be machined flat. If you are following me so far, add to the equation when the head is rotated in the indexing fixture, the X, Y, and Z coordinates also change. The machine must be told where to go and if a tool is not retraced far enough or soon enough, then the chance for a "crash" is very possible. Such is the case in picture #3, or as what I call a "Conley screw-up". Unfortunately I had not set the Z offset correctly and the center drill, tried to go completely through the head. Needless to say it was pretty ugly. You can easily see when you have a very long program with over 5,200 bytes of code and you are off just one digit, thing get real bad, real fast. This is why I try to write most of the programs during the day, when I am more alert, or at least try to be. On a positive note, it is pure poetry when everything works as planned. I truly hope this brief explanation is helpful and explains why it takes so long to get a part machined properly and to exact dimensions.

If any of you are still awake, I just wanted everyone to know that all the heads are totally machined and ready for the final process. Pictures #4 -#7 shows each finished surface of the head. After extensive testing and evaluation the new and improved combustion chamber is visible in picture #7. This design helps with "valve shrouding" and "flame travel".

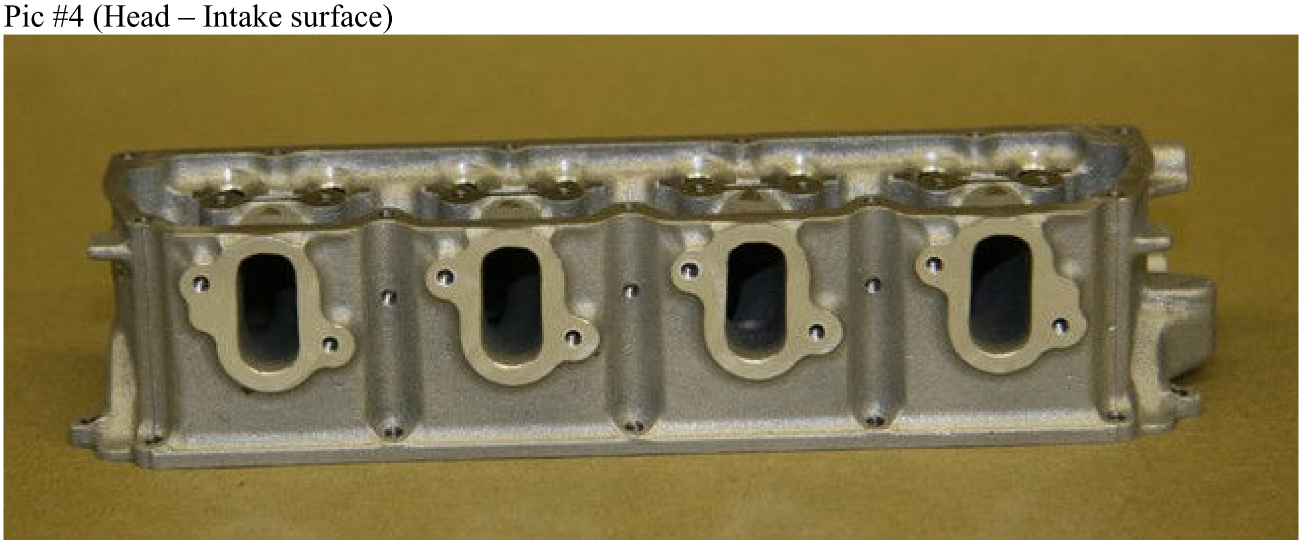
Pic #1 (2-56 screw on left ¼ - 20 bolt on right)

Pic #2 (Center drill)

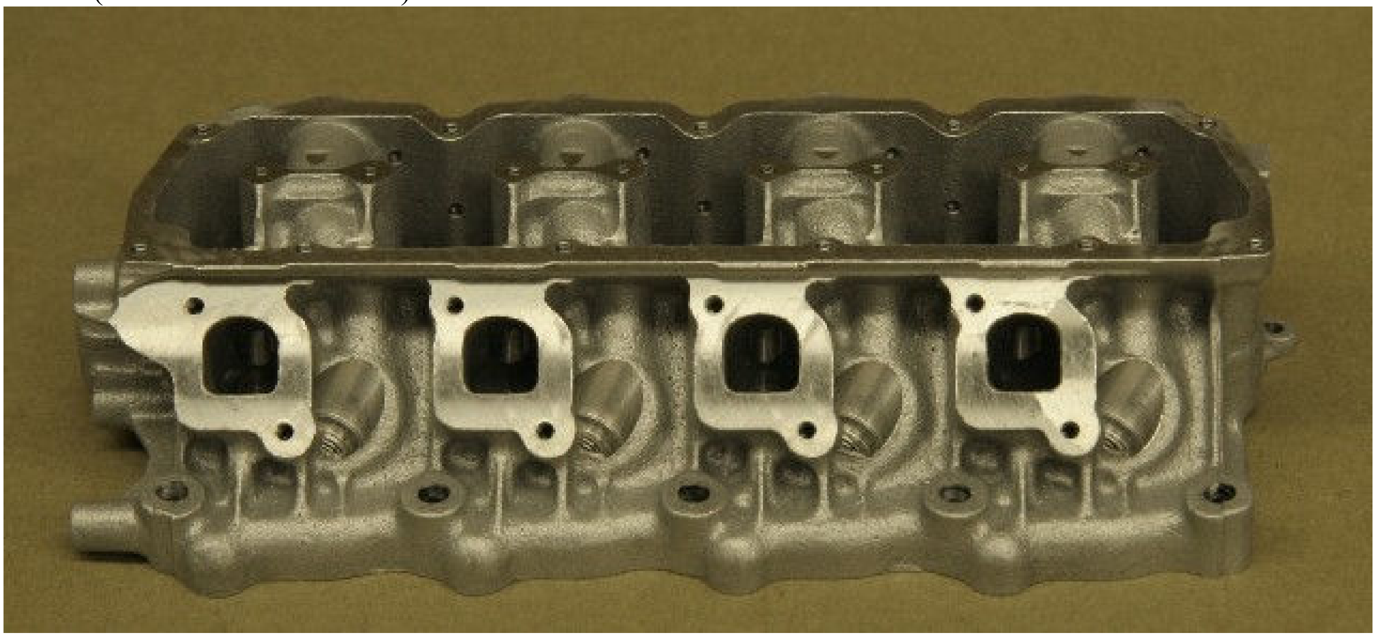


Pic #3 (Conley screw-up)

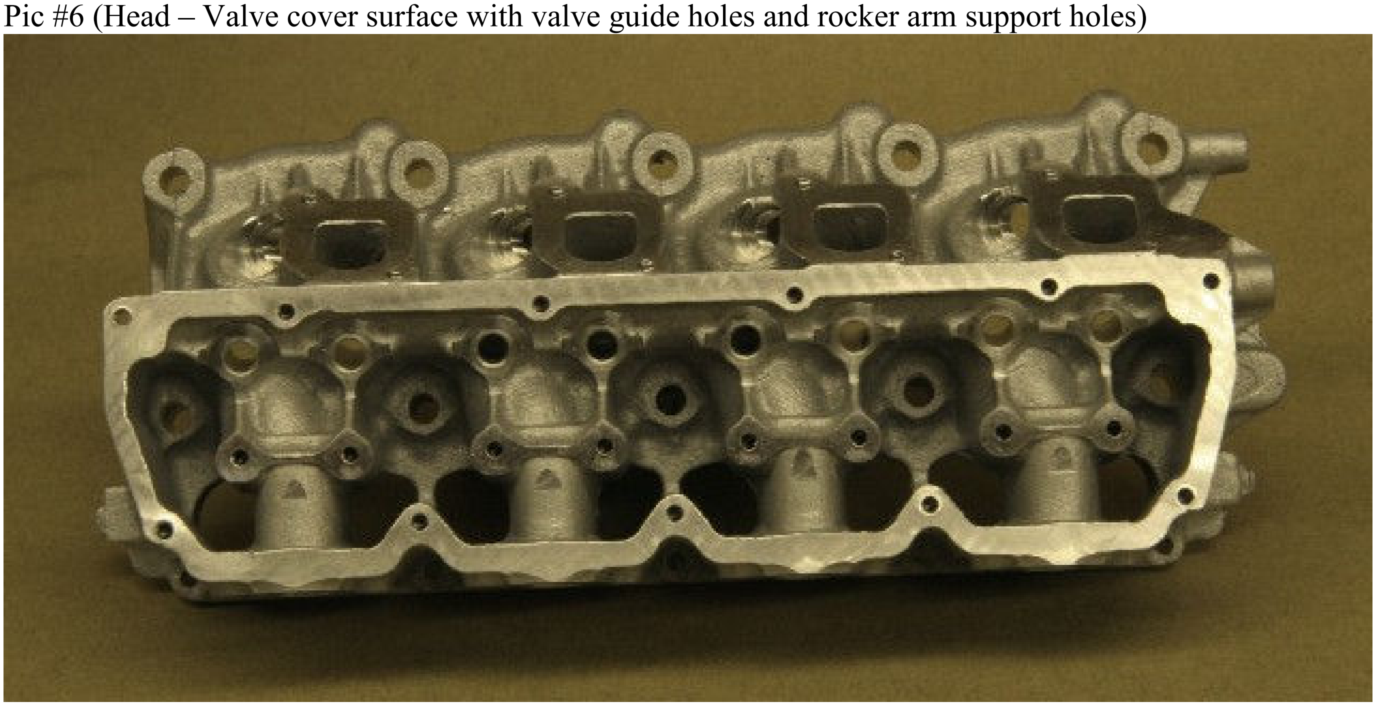
Pic #4 (Head – Intake surface)



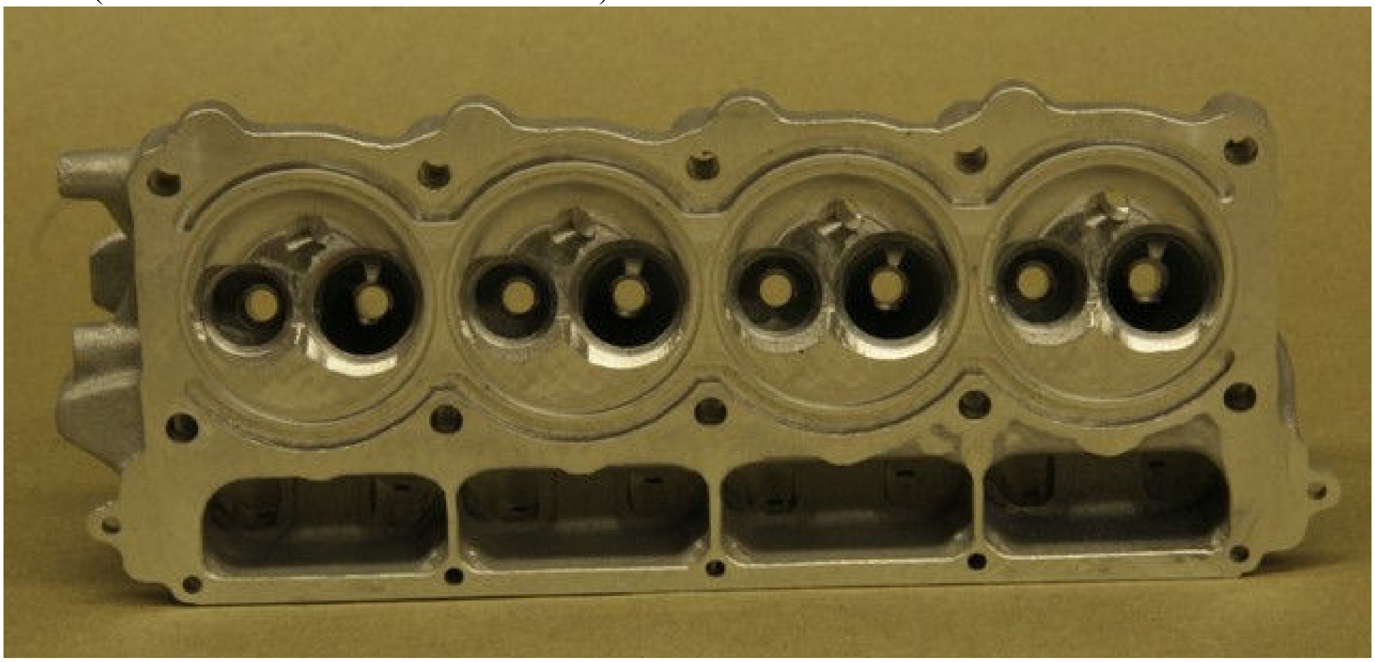
Pic #5 (Head – exhaust surface)



Pic #6 (Head – Valve cover surface with valve guide holes and rocker arm support holes)



Pic #7 (Head bottom and combustion chamber)



Pic #8 (Head bottom – better view of improved combustion chamber shape)