Rebuilding My 750 Veloce Engine: Part 2

Part 1 was mostly about improving oil flow so that the engine wouldn't kill itself when working hard. Unfortunately nobody will notice that work, but that's the point. Rebuilding the upper end, where the business happens, is more fun and usable. I can't imagine anything terminal happening there. As for any four-stroke engine, this is where you can make a powerful difference, not just with money, but with your time and a few special tools.

Mark Donahue's first and simplest "Unfair Advantage" was a solid but loose block under a fresh cylinder head (or two for him). He was a terrific development engineer and racer. Here is a link to my book review (https://www.enjoyclassiccars.com/books.html).

This is probably too basic, so I'll be brief: "Work" moves the "mass" of a car. In our engines, it is the push on the crankshaft at the right time that is the torque which starts the motion. However, it takes power to accelerate it. Power includes consideration of the time the work is done. Imagine the performance difference between a bus vs. a motorcycle. The business of a bus is all torque. It can jerk a lot of people into motion but it can't keep them pinned in their seats. A motorcycle is all about power. It is designed to rocket away with you. A diesel runs out of breath at 2500 rpm. Most motorcycle engines couldn't pull much mass but they are terrific accelerators, happily revving at least 3x higher than a diesel.

Overview

An internal combustion engine is fundamentally an air pump which sucks air and atomizes fuel, then triggers explosions to do work. Each bang creates a lot of exhaust. How quickly that exhaust gets out of the way to prevent polluting the quality of the next intake determines the power the engine can produce to speed up its work.

Much has been learned about timing, turbulence, scavenging and monitoring since our jewel's engine was designed a lifetime ago. Optimal timing of the ignition and valve motion, the quality of the fuel/air mixture and its motion during ignition, burning it all, and maximizing the quantity ingested, have been advanced by experimentation and technology. Not all of this is practical for us. But our engines can benefit from some of that.

In Part 3, I'll do my best to write a brief explanation about valve motion and timing and of course ignition timing. But this time, I'll start with the piston and end with the cylinder head. Our 750 piston's bore size, or diameter, is 74 mm – four working with the standard 75 mm stroke crankshaft displace 1290 cc. As I stated in Part 1, my goals were to boost torque, improve the durability and the civility of operating my 750 Veloce engine with original gearing on streets. I hoped to improve its civility with a little more torque easily installed the old school way making it bigger, a modest decrease of compression ratio, a modern camshaft design, and a better mixture control at idle. I eventually reached my goals with equal measures of luck and determination.

The Pistons

I shopped Mahle, Cosworth, and Ilmore for custom pistons with a clever dome designed to cause turbulence for a faster and more complete burn. However, the cost was too high – about 6 times the price of a set from Wiseco. I reasoned that their high revving motorcycle engines are more like ours than high displacement V8s with much bigger pistons, the target market for J&E, another obvious and reasonably price choice.

Most 750 Alfa owners don't start with a Veloce spec engine – still they enjoy an upgrade to 1400 cc

My original plan for increasing torque is on the left but I installed four of the pistons and pins on the right

displacement for driving on streets because the driver can always use more torque more often and with less effort than more power. And now the popular choices don't cost much more than standard pistons, and boring old sleeves saves the cost of buying new ones.

The photo shows one of the new 77 mm pistons that I bought – forged and machined by Wiseco in Ohio for Centerline in Colorado. The old one is a lightly used and original 78 mm, 9:1 compression piston for a 1600 engine. Long ago, when restoration was much more dependent on recycling and repairing, I intended to use these to install more torque. A friend who works for Mahle offered to check and coat them. That option is too radical for me now because boring liners to 78 mm weakens the bottom of the liners so much that I would have to use epoxy and semi permanently cement them up to an inch deep at the bottom my block's water jacket.

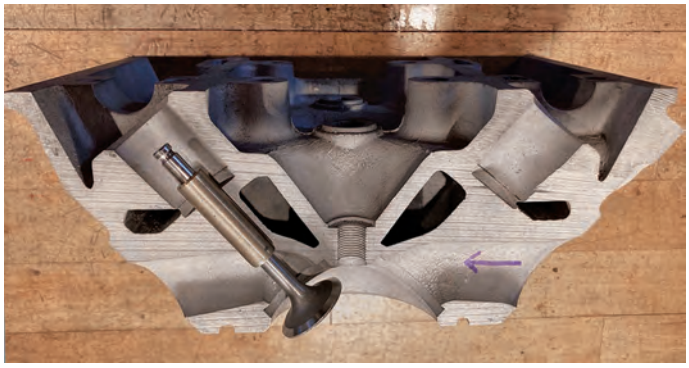
Compared to those cast by BORGO, Wiseco's forged 77 mm pistons are 20 percent lighter and cost about 50 percent more. That also buys 15% lighter pins because they have tapered holes. Tapered hole pins shed more unnecessary mass. And since I forgot to mention it before, my Carrillo connecting rods are 10% lighter than Veloce rods, but rods have more rotating mass than work sapping reciprocating mass. Their strength is more consequential and well worth the cost in in my "over square" high revving jewel.

The Head

Increasing displacement increases compression. Even if I were able to rebuild my used-up cylinder head, my Veloce was already pushed past the limit. When a head is "decked" too often or too much, the seat of the intake valve will be nicked. But, lucky me, that was the second problem the normale cylinder head (borrowed from my 80 hp Sprint's original 750) would solve. The proper Marelli starter would be happier. A worthy mission for us would be a campaign to rescue and preserve 750 normale cylinder heads. I suspect there are many more used up Veloce heads like mine that should be retired.

Alfa's major achievements in bringing the 750 engine into production were in the design and casting of the major components in aluminum and the now "classic" DOHC configuration with hemispherical combustion chambers that can accommodate big valves. Yes, Jaguar did it first, but conservatives there used a very heavy cast iron block.

The photo of the sectioned cylinder head clearly shows the very direct path for breathing in and out intrinsic in Alfa's cross-flow design. Very little improvement can be carved. I thought about the projection of the intake valve



Cross section through the cylinder head

guides and probably should have reduced and narrowed them but I didn't because Mike Sperry didn't for the Stage 4 1600 head on the SS engine in my Sprint. Only for his last gasp Stage 5 level of development does he do that.

It is useful to keep in mind that the first obstacle encountered by the air entering the engine is the throttle plate and its shaft, even at wide open throttle. Only if it is necessary to work on streamlining those too, then the protuberance of a valve guide might be consequential.

This might look scary but it is fun and satisfying to perfect the shape and sealing of valves

The photo illustrates my work on improving the second greatest obstacle to very fast air and gas exchange – the valves and their seats. Much gain has been found by shaping more narrow seats than the factory did – and at a 45-degree angle instead of 30 degrees – because that angle flows and seals better. And this seat should be positioned and sized on the valve with additional 30

and 60 degree angle cuts on either side, If necessary, a 15-degree surfacing shave should be used to assure there are no edges, nor more than a 15-degree corner encountered by the air flow. A greater angle creates unwanted eddies, which are standing waves that constrict and impede flow.

Overview of my favorite tools for enhancing engine performance

I find that I can cut very good valve seats with a couple of these cutters (shavers is more like it) that incorporate tiny file blades as shown. My aim is for 1 mm wide seats close to the margin of the intake valve and 2 mm wide seats a little farther away from the margin on exhaust valves. Perfect results can easily be produced by wearing magnifying reading glasses with good lighting. Apply ink with a Sharpie marker to the seat, then file some seat material off manually, using a deep socket and a T handle. The final touch is to lap the finished surface with fine valve grit, wipe both surfaces clean, mark the valve, then flick it onto the seat to hear the sound of a perfect seal. Some machinists recommend using gasoline to check the seal of valve pairs on their seats. I don't because Neway cutters are much more consistent and neater than old school powered grind stones that need constant dressing. Also, easily overlooked is the backside of valves. My exhaust valves had a pronounced edge between the curvature from the stem and 45-degree seating surface. This was easily remedied in my lathe, but a drill press and a hand grinder would be good tools too.

Late last century, a new "best practice" for seat cutting emerged. Its called an interference angle. Typically a 45-degree angle on the valve closes on a 46-degree cut on the seat. The benefit was much higher seating pressure (same force on smaller area), which is higher on a line than on a ring. That's good for test numbers from high volume production. I don't buy it because, for us, exhaust valve heads can't transfer enough heat to a line and I don't like waiting for "whenever" a seating ring forms. And our engines don't have self-adjusting hydraulic lifters. Our hobby doesn't have to be efficient.

Most of us have heard the term "porting and polishing." That term was much in vogue when our engine was conceived. Well, don't waste time polishing. Some surface texture is desirable because it reduces laminar flow which causes "wet walls." The wet part is incombustible fuel that could have been put to work by turbulence. A little porting is still useful, but Alfa's DOHC design is basically already perfection.

My porting tools for smoothing alignment. Not shown, but important, is my simple dial-in and plug-in speed controller commonly used with wood routers.

The Gaskets

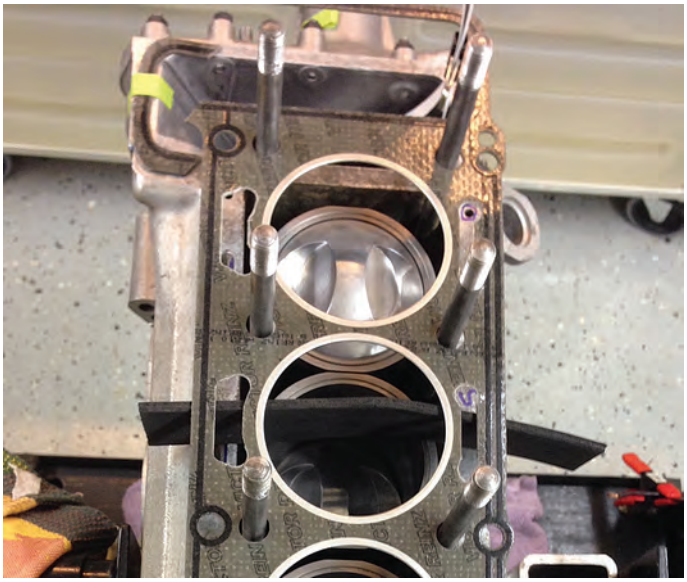
An obvious improvement to be had is fettling the usual mismatch of alignment at the gasket surface between the intake manifold and head. If there is any movement possible between the two when engaged by the studs, find the best alignment possible and clamp with nuts to hold in place. Next, find a location near each end on the flanges for drilling small holes through the flange and into the head about 5 mm for inserting temporary alignment pins to guide final assembly (even two nail shanks will do). Then use a stiff bent wire and/or forceps, with the felt removed from an old marker, to highlight where on the interface some aluminum must be ground away to eliminate edges and smooth the alignment. Unfortunately, this is awkward for the Solex downdraft manifold. However, the effort will pay off handsomely by increasing the rate of flow. The gasket must be similarly trimmed to eliminate any protrusion. Increased flow leads to better volumetric efficiency, which increases torque AND especially power.

A more complex gasketing issue is specific to 750 series engines – the limited choices for the head gasket. I had purchased a 750 specific copper "sandwich" style

version long ago because they are “old school” and familiar to me. But as I learned more and was warned by several Alfa specialists with years of experience, that they’re OK only for race engines I started to pay attention. For long term use I’d have to accept high maintenance because they become messy leakers.

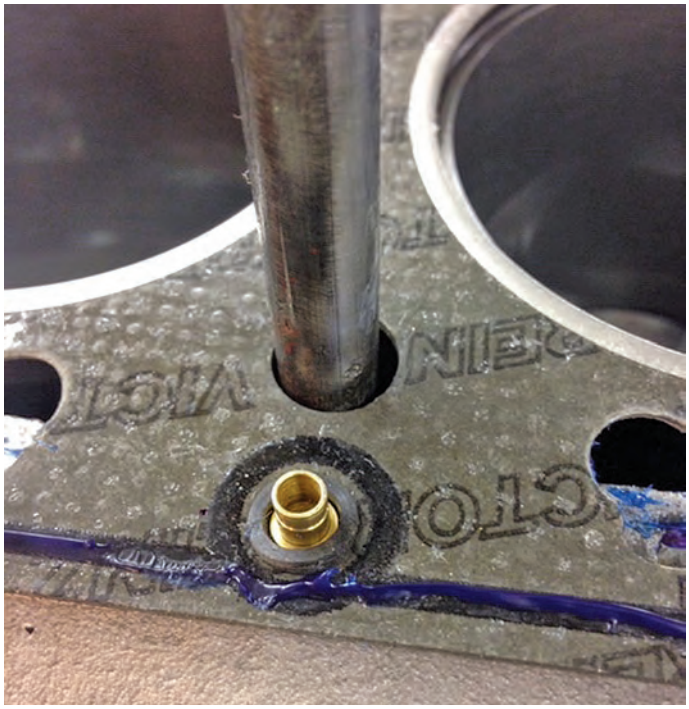
Then I watched Claus Menzel modify Victor Reinz head gaskets for the 101-1300 to fit the shorter chain box of the 750 engine. Sealing that location is not a challenge. You can shorten it to fit by cutting with a chisel on at angle. You can then splice with sealer. It is not risky as shown in the photos below.

Adapting the best head gasket to fit the 750’s shorter chain box is not difficult



I don’t know of a head gasket made for cylinder liners bored out to 77 mm pistons. The best fit is the gasket for the 78 mm bore 1600 cc engine – with fire rings displaced only a half millimeter on top of the thick end of the liners. I had previously v-grooved their tops to emboss more seal into the copper of my old head gasket. But when I learned that Trail Auto – our local independent Alfa Romeo service shop that is famous for insisting on OEM parts from AFRA – also uses Victor Reinz gaskets because they cause less trouble, I finally shelved the copper gasket that I brought home from Germany in my luggage.

Containing combustion is the job of the fire rings with the stretch from torque on the nuts at the top of the head studs. Preventing water and oil leaks are ancillary but vital too. I put a bead of blue sealer across the top of the gasket behind cylinder 4. Now they recommend applying a thin coat of Permatex Gray sealant on both sides of the rear one inch of the gasket. I’ve been happy using Würth DP300. My gasket in the photo below left is temporarily propped up about an inch above the block. Notice also that I opened up the water passages to the cylinder head. I used the head as my guide.



The little details that might or might not reduce insignificant but annoying oil leaks.

I used extra measures to mitigate oil leaks from the six holes which supply the cam bearings. Instead of “split pins” and “O” rings, I chose machined brass tubes, with a shoulder slightly thinner than a compressed gasket, and square section “O” rings used in GM V8 valve stem seals. And based upon tests conducted in Wisconsin that demonstrated 750 head studs easily hold 60 lb. ft. of torque, I increased my torque about 10 percent to 50. And to eliminate a stuck head problem long after I’m gone, I wiped white lithium marine grease on the head studs and their holes in the head.

Additional Reading

For additional information about 750 valves, see “Heads You win” and “Breathing deeply” by Michael Payne, in

GiuliettaLetta Issues #80 and 81, Winter 2003 and Spring 2004. Also, Dave Mericle in Los Angeles wrote a comprehensive series about his 750 Spider restoration for European Car. These were reprinted in our Giuliettaletta. His articles in 2002 are relevent and comprehensive, though dated.

Our Register's online archive for all Giuliettalettas is in the Resources tab on our website's home page. An additional and bespoke password for access will be supplied upon request. I'll look forward to spending more time using it's search function and start from the beginning. You can too!

Next Time

The working title for Part 3 is "Timing to Make it Work is Everything." My Marelli distributor is simply as Claus Menzel wanted it to be, but it is still on probation. I'll mention other options with some discussion. The most challenging subject of all is valve motion and timing. Camshafts are our "black boxes." I encountered a last minute fiasco with my choices. But now there is simulation software! My cam grinder used it to sort most of the variables. Plus, my DCO3 carburetors had been severely abused. One of the repairs is likely responsible for the excellent idle I now enjoy.

Peter Pleitner
