
HARDENED VALVE SEATS – TO USE OR NOT

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Editors Note: This article is a follow on to the "Saving An Original '63 340 HP Engine From Extinction" article in the last edition of the Signal Seeker. It was initially an email by John to Joe Chip in response to a question from Joe regarding how his engine was being rebuilt.

On your engine the valve seats in the heads were so beat up because of the worn out valve guides that the machine shop had to put hardened valve seat inserts in the heads. I normally don't like to do that if I don't have to, but in your case we had to put them in just to save the heads.

Most machine shops put in the hardened valve seats, but I attended a number of Society of Automotive Engineers (SAE) seminars and tech session in the last 1970's and early 1980's on just this topic. Both SAE and the gasoline companies independently concluded, after much research that hardened valve seats in cast iron heads aren't required, and in some instances can actually be more of a risk than not putting them in.

A little background on the concept of hardened valve seats: In the early 1970's the government forced the gasoline companies to remove lead compounds from gasoline to protect the environment from poisonous lead emission from the tailpipes. Lead compounds had been in long time use as the primary method to increase gasoline octane to prevent engine knocking in high compression engines.

One of the other advantages of the lead that was served to lubricate the valves and valve seats. So in the mid-and-late 1970's there was a great deal of concern in the media and technical circles that the lack of lead would cause increased valve seat wear and pounding by the valves, resulting in a problem called "valve seat recession" (basically letting the valve head pound itself into the valve seat enough so that the valve enlarges the seat in the head, thus moving itself slightly upward in the head toward the spring and away from the piston, which over time can damage the head.

So both SAE and the gasoline companies did literally hundred of studies to determine if "valve recession" could occur, how fast it would happen, and under what engine conditions. A key element to remember in all of this was that the gasoline companies, when they removed the lead compounds, had done extensive amounts of research and ended up replacing the lead with sulfur as the lubricant (which is still in today's gas -- occasionally you've probably smelled the rotten egg smell when you're behind another car -- that's sulfur dioxide).

All the studies showed the same thing. Namely that valve recession using unleaded gas was essentially non-existent under any realistic engine operating conditions, including even the most severe of racing conditions. Only if the engines were at high temperatures and run nearly flat-out for the equivalent of thousands of hours was there any detectable recession, and then it was generally minor. Remember, this applies to cast iron heads like yours, not aluminum heads which do require hardened valve seats because the aluminum is much softer than cast iron.

But the interesting secondary conclusion by the SAE and gas companies at the time was that the installation of hardened valve seats, while certainly eliminating any possible occurrence of valve recession under any conditions including those most extreme ones, does introduce a slight risk that a hardened valve seats can actually fall out of its pocket (if it wasn't perfectly installed or if the engine overheated). Additionally, use of those inserts can actually result in cracking the thin metal area in the heads between the intake and exhaust valve. If

the valve seat falls out, the engine gets destroyed, and if the metal between the two valves cracks then the head has to be replaced.

Both SAE and the gas company studies concluded that the sulfur compounds did a great job replacing the lead, that the use of hardened valve seats with unleaded gas is realistically unnecessary, and that their use introduces a slight risk of failures that would damage the engine. They also concluded that those risks are significantly greater than the risk of valve recession, which as I said only occurred in their tests in very high mileage engines run continuously at high RPMs for very long periods of time (not the kind of thing most restored Corvettes, or any other engine for that matter, would ever do).

So, while I did use the hardened inserts in your heads just to save them at all, I don't normally do that on street cars unless specifically requested by the customer (in which case I generally try to talk them out of it). My own 1966 327/350HP Corvette engine had well over 210,000 miles on it when I rebuilt it, and the original valve seats were still in good shape, needing only the usual re-grinding. Today it has almost 250,000 miles and is still doing fine. I've rebuilt many high mileage street and racing Corvette and other motors with no signs of valve recession from the unleaded gas, just as SAE concluded.

I just don't do it if I don't have to. It's usually unnecessary and it's normally just an extra cost at the machine shop -- except where I need to save original heads like yours, or in racing engines with very high valve spring pressures such as with high-RPM high-lift solid roller racing camshafts.

Of course, this doesn't apply to aluminum heads. They're different and do require hardened valve seats of some kind.

This is probably way more info than you wanted. If I haven't bored you to death with all this and you need any more info, let me know.