REBUILDING THE GM LS1 STROKER

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Say the name Arnie "Farmer" Beswick and many an old Pontiac fan will nod and share a story or two about Arnie and his legendary GTO, the Tameless Tiger. About two hours down the highway in Illinois, Jim Riskovsky, owner of Turbo Connection in Edwardsville, IL, is learning to tame his own tiger, his 2005 Pontiac GTO.

Jim started out modifying his new 2005 GTO before the factory paint had dried. A supercharger, headers, exhaust and higher ratio rocker arms pushed the stock shortblock to its limits putting down in excess of 715 hp and 625 ft.lbs. of torque. But, when you have a shop named Turbo Connection, you can't have your shop's project use a supercharger!

So, with a clean sheet of paper, Riskovsky decided to design a platform that would make a tremendous amount of horsepower, while retaining reliability, drivability, and fuel economy. The goal was to reach 1,000 hp at 14-15 pounds of boost while running on race gas, and achieving 850 hp on 92 octane pump gas on 10 pounds of boost. Quickly, it was determined that this should be a ground-up design, starting with a solid foundation and building from there.

The Heart of the Beast

The first decision on the design was what block to use. The stock engine in the 2005 GTO is a 364 cid (6.0L) GEN IV V8 that is used in a myriad of GM vehicles from GTOs and Corvettes to various truck platforms. The specifications for the stock engine are shown in **Chart 1**, page 3.

There were immediately two concerns for this new boosted platform. First, the hypereutectic pistons in their stock form would not be reliable under the cylinder pressures at maximum boost levels. A suitable forged piston would be a much more reliable choice. Our second concern was that past tests have shown cylinder liner creep in the stock block configuration when subjected to high boost or high levels of nitrous oxide. Therefore, a cast iron block would be a more suitable choice. In terms of block availability, the least expensive choice would be to use a GM 6.0L iron block (GM p/n 12572808) commonly known as the LQ9 block which is 3.98″ bore, 9.240″ deck, 2.56″ mains, 6-bolt mains. This block can accept up to a 4.030″ bore, and can be purchased new from GM or found in late model trucks in scrap yards. These blocks have proven to be very

Block	Cast aluminum/iron sleeved	Camshaft	.500/.500 gross lift 200˝/ 203@.050˝
Bore/Stroke	4.00 x 3.62 (101.6 x 92 mm)	Static CR	10.9:1
Mains	6 bolt, Cross-bolted main caps	Connecting Rods	Powdered metal steel
Crankshaft	Nodular iron	Pistons	Hypereutectic Cast aluminum
Deck	9.240˝	Mains	2.56˝
Head Bolts	4 per cylinder		

Chart 1 *The GTO's stock engine was good, but not good enough for Jim Riskovsky.*

Block	Cast iron	Bore/Stroke	Up to 4.250˝ x 4.500˝, 4.400˝ spacing
Mains	6 bolt, dowel located, LS7 main caps	Deck	9.26 / 9.70
Head Bolts	6 per cylinder, machined up to 1/2˝ studs	Mains	2.56˝
Bore Spacing	4.400˝	Lifter Bore	.842˝ machined to 1.060˝ bushed
Oiling	Wet or Dry sump capable, priority mains	Tranny Mount	Adds 7th hole to match SBC patterns also

Chart 2 *The Chevy LSx aftermarket block, when stroked and boosted, was expected to be much more powerful.*

stable and can be safely stroked to 414 cid with an aftermarket crank.

In March 2007, with the help of Warren "The Professor" Johnson, GM Performance Parts introduced a cast iron, Gen III/IV aftermarket block known as the LSx (GM p/n 19166454). There were many features with this block that made it appealing to our boosted application including the capability to go as large as a 4.25˝ x 4.50˝ bore stroke combination, six head bolts per cylinder, priority mains oiling (as opposed to top end priority on the stock block), and the better main caps from the LS7 motor. This made the decision easy, and the LSx block was chosen for the base and a displacement of 427 cid was planned (see **Chart 2**, above).

Rotating Assembly

Based on the goal of 1,000 hp, Riskovsky had to focus on making a bullet proof bottom end, with the goal of 75,000 miles minimum before a rebuild. The foundation of the rotating assembly is based off of the Eagle Specialty Products 1,500 hp kit for the LS series engines. This consists of forged 4340 chromoly crankshaft with 4.000˝ stroke and 6.125˝ forged 4340 chromoly H-beam rods with ARP 3.5˝ bolts. Flat-top JE Pistons were custom designed for this particular turbo application to give a final static compression ratio of 10.7:1, with dual pin oilers and full floating wrist pins. Swain Tech GoldCoat Ceramic Armor Ceramic Thermal Barrier was applied on piston crowns and PC-9 Solid Film Lubricant on the skirts. The ring package consists of Total Seal 2000 Series Gapless Rings, 1/16˝, 1/16˝, 3mm tool steel top ring, gapless second, and a STD tension oil ring.

The entire block, although it is delivered machined, was deburred, line bored and honed. Calico Coated CL77 rod and main bearings were used. When assembled, clearances were established as follows:

- Rod bearing .025˝;
- Main bearing .027˝;
- Wrist pin .0008˝;
- Upper ring gap .028˝;
- Second ring .020˝; and
- Piston-to-wall .006˝.

Many people questioned the high compression numbers, especially for a turbocharged car. Past builds revealed several things that lend themselves to the goals for this project. First, there is a space limitation for mounting twin turbos on the GTO, and there is limited availability of larger turbos for this application. Second, the camshaft selection for this particular application is mild, which makes it much friendlier in terms of boost.

Along with power, we have found that we can achieve better fuel economy as well as lower exhaust emissions by carefully selecting the compression ratio. Furthermore, this vehicle's fuel system was redesigned to allow the engine to run on gasoline, E85 or methanol.

Cylinder Heads and Valvetrain

Not since the advent of the legendary "fuelie" head has GM snuck in such a performance head as the L92 cylinder head. The comical thing is that this head is predominantly used on trucks and SUVs! The lineage of the L92 cylinder head can be traced right back to the infamous LS7 cylinder head that is powering the newest Z06 Corvettes. It sports the wider intake ports as compared to the standard LS2 cathedral ports, and has both revised intake and exhaust runners.

If this was back in 1960, we'd be getting these heads out the back door at the GM test facility. Thankfully, the production numbers make these cylinder heads extremely affordable.

For our application, we kept the stock valve size on both the intake (2.165″) and exhaust (1.585″), and CNC ported both ports and decked the heads slightly to achieve phenomenal flow characteristics for a stock casting. Tests have shown that increasing the valve sizes on a bore of 4.125″ or less starts to shroud the valve and kill flow.

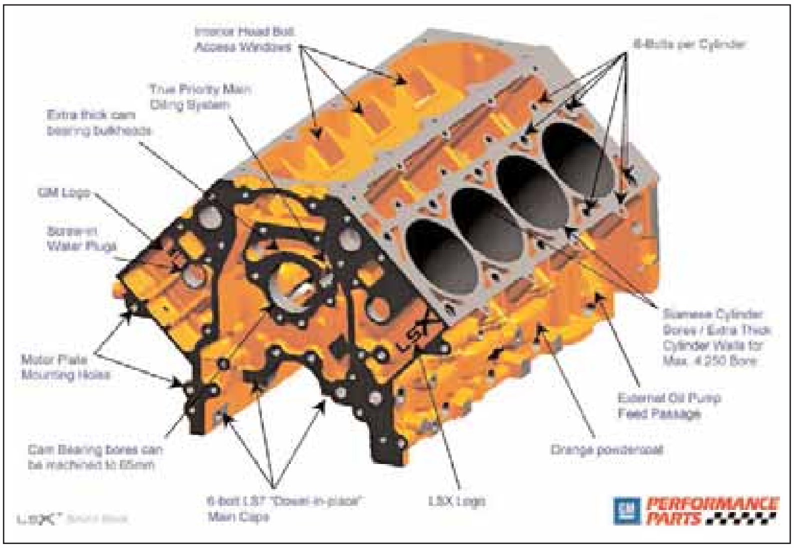
The stock rocker arms on the intake side (1.7:1 ratio) were kept, while the exhaust rocker arms from the LS7 engine were used (1.8:1 ratio). If you look at the flow ratios, you'll notice that our ratio has dropped in comparison to the LS1/6/2 cylinder heads. Thus, we can use the higher exhaust rocker ratio to help cheat the airflow a bit (see **Chart 3**, page 6).

To match the new port shape of the L92 engine, the stock LS2 intake could not be used. The stock intake that comes with the trucks that are equipped with the L92 cylinder heads is typically too tall for the shorter cowls on GTOs, Corvettes and Camaros. Thus, the L76 intake has to be employed. Although it appears to be identical looking on the outside as the LS2 intake, the ports are developed to optimize the square ports on the L92 heads.

Camshaft

Camshaft choice is probably the number one problem that people run into, and many times, the wound is self-inflicted. As we all know, a camshaft is more than just a Saturday night cruise sound maker; it can make or break an engine for performance, economy and drivability. Too many customers install the biggest camshaft possible without thinking about the engine as a whole.

For this design, Riskovsky chose an off-the-shelf LS7 stock camshaft from the Z06 Corvette. The specs of the camshaft are 211/230 @ .050 120 lobe separation angle (LSA), .558(1.7)/.588 (1.8). The camshaft was installed at 5 degrees retarded. By installing the camshaft retarded by five degrees, the dynamic compression was dropped from a risky 8.2:1 down to a boost-friendly 7.65:1. This also allowed the shape of the power curve to be shifted higher, which favors this setup due to the fact that it will make gobs of torque down low, but due to the smaller turbos, may run out of breath on the top end.



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Feeding the Beast

All this horsepower is created thanks to a pair of APS 20G Garrett 3582 dual ball bearing turbos. The pressure for the turbos is fed through stock exhaust manifolds that were coated with Jet-Hot 2000 series coatings. As tests proved out, these turbos are a bit undersized and are running out of airflow for this engine at upper rpms. Right now, APS is working on developing a set of larger turbos that will fit this application that should supply an additional 200 hp.

Spent exhaust gasses are fed out through a complete stainless steel exhaust system main from Stainless Works for the GTO. Decibel levels are very close to factory levels at idle and while cruising.

The stock fuel system on the GTO was not up to par when trying to support the horsepower levels that this combination puts out. The decision to move the fuel system to a return style system fed by twin 255 lph fuel pumps, connected by eight lines going to a set of aftermarket fuel rails. Attached to these fuel rails are eight 74 pound per hour Mototron high impedance injectors driven by the factory ECM.

	Stock L92		CNC Ported L92	
Lift	Intake	Exhaust	Intake	Exhaust
0.2	153	114.4	135	116
0.3	225	147.2	199	158
0.4	276	170.3	262	190
0.5	309.6	183.1	316	222
0.55	323.2	186	334	233
0.6	332.2	189.5	345	241
0.65	327.7	191.1	356	249
0.7	330	192.6	368	250
0.75	317	195	377	252

Chart 3 *The differences between the stock and CNC-ported L92 cylinder heads are dramatic.*

Since the car was designed to run on pump gas, two additional alcohol injection kits by SMC Enterprises were installed with the sprayers sending either ethanol or methanol directly into the throttle body. The alcohol system supplements the existing fuel system due to its spraying once in boost. The alcohol fuel curve is tuned by monitoring boost levels and the speed and flow of the pump is regulated accordingly with the controller.

So why choose alcohol as a supplemental fuel? First, alcohol-based fuels typically carry an octane rating from 107 to 115. This extra octane gives our fuel mixture a bit more resistance to detonation, which on a forced-induction vehicle, is very important due to our significant increase in cylinder pressures.

The second and more critical aspect of using alcohol is understanding its effects on the internal combustion engine. The secret lies in the Latent Heat Vaporization and Auto-ignition of alcohols.

If you've ever poked around an alcohol fueled engine equipped with carburetors, you probably noticed that the intake runners are iced over during idle, especially if equipped with a large overlap camshaft. Furthermore, while monitoring the engine parameters, you probably noticed that the engine runs quite a bit cooler when using alcohol. What causes this? Well, you've probably experienced this phenomenon on a daily basis. Put a bit of water on exposed skin, then gasoline, then alcohol. The alcohol, as it evaporates, will feel the coolest, followed by gasoline, then water. This is all thanks to the Latent Heat Vaporization property of liquids.

Physics dictates that a certain amount of heat is required to convert a liquid to gas. This additional heat is expressed as the Latent Heat Vaporization value. Using the values from **Chart 4** (below), ethanol requires about 250 percent of the heat to change to a gas, and methanol requires about 340 percent of the heat. So, in effect, the conversion from liquid to gaseous state will draw heat from the combustion chamber. We know that gasoline will drop the chamber temperature about 40 degrees F, therefore, ethanol will drop the temperature roughly 100 degrees F while methanol will drop it roughly 135 degrees F. Thus, at these Stoichiometric values, we see a significant drop in temperature of the air/fuel mixture.

Notice, too, how much lower the auto-ignition temperature of alcohols are as compared to gasoline. Again, detonation and pre-ignition are the enemy of a forced induction application. By mixing alcohols into the fuel mixture, we are, in effect, helping to raise the auto-ignition temperature of the heterogeneous fuel mixture and adding a significant safety factor to the setup.

	Gasoline	Methanol	Ethanol	E85
High Heating Value (BTU/lb)	18,700-19,100	10,260	13,160	14,021
Latent Heat Vaporization (BTU/lb)	140	474	396	359
Boiling Point (Liquid -> Gaseous state) ° F	100-400	149	172	164
Stoichiometric Ratio	14.7:1	6.45:1	9.01:1	9.765:1
Octane (R+M/2)	86-93	115	113	106-109
Energy of Stoichiometric Mixture (BTU/ft3)	94.8	94.5	94.7	94.7
Auto-ignition Temperature ° F	495	867	797	630

Chart 4 *How do you determine which fuel is best for your vehicle? It all comes down to the numbers.*

Controlling the Beast

The key to taming this tiger is the computer control that GM graced the vehicle with from the factory. For the 2005 GTO, the E40 ECM controls all engine management, and if equipped, a TCM controls the automatic transmission in concert with the ECM. For this application, all of the factory sensors were left in place with the exception of the MAF (mass air flow) sensor. The MAF sensor was removed due to the fact that the increased airflow from the turbos was "pegging" the meter. In other words, the MAF was not calibrated to see that much airflow and thus we were hitting its ceiling as far as reading.

Inside the GM computers, there is a volumetric efficiency (VE) table specifically tailored to each vehicle setup (**Chart 5**, page 8). Unfortunately, this table doesn't reflect mechanical VE. This table is more of a fueling table based on a combination of air mass, temperature, and pressure.

The VE table is referenced by both rpm and load (MAP). The problem is that without a MAF sensor, the ECM must calculate the airmass. Luckily, we have other sensors that allow us to calculate the airmass, so, GM actually calculates the VE by using the following formula:

VE = gram/cyl*charge temperature/MAP

Thus, by factoring the sensor values from the intake air temperature (IAT), the engine coolant temperature (ECT) and the manifold air pressure (MAP) sensors, as well as the cubic inches of the engine, the ECM will determine the airmass.

Since the basics of the engine have radically changed from the stock configuration, a lot of time is spent within the VE table establishing the new fueling curves. Since we continue to have our stock HEGO (O_2) sensors in place, we use the values from them to drive our fueling requirements to a stoich value of 14.7:1.

Unfortunately, there is no magic bullet to derive these values. It is simply done by doing drive cycles either on a load dyno or on the road to balance each cell within the table.

With a goal of 1,000 hp, a bulletproof bottom end was required. A high-quality rotating assembly was the place to start.

Handling Boost Fueling

The VE fueling table reveals that it stops at 105 KPA, or roughly right at atmospheric pressure. Thus, the stock configuration does not understand boost situations. To remedy this, the stock 1bar MAP sensor is replaced with a genuine GM MAP sensor from a Saturn ION. What this allows is a MAP sensor that has a range up to 2.5 bar. Thus, it can read well in excess of the 14 lbs. of boost that this engine will eventually see.

To allow this new MAP sensor to track, we used HPTuners software to modify the ECM with a custom patch to expand the VE table to accommodate boost. This table, (**Chart 6**, page 8) now allows the VE fueling calculations to track up to 22+ lbs. of boost.

One thing that you will notice is that as we increase boost, we don't increase fueling that much. This is due

The L92 cylinder heads have a performance lineage, even though they're seen predominantly on trucks and SUVs. For our application, they were the perfect addition, once we CNC ported both ports and decked the heads slightly.

Manifold Absolute Pressure (kPa)

Engine Speed (rpm)	15	21	26	32	38	43	49	54	60	66	71	77	83	88	94	99	105
400	534	745	1007	1065	1124	1182	1227	1267	1295	1324	1364	1406	1426	1358	1461	1663	1686
800	794	965	1217	1281	1346	1410	1453	1497	1543	1571	1598	1616	1611	1542	1663	1897	1925
1200	958	1150	1291	1386	1452	1502	1546	1583	1614	1639	1660	1676	1727	1631	1743	1976	2000
1600	1097	1378	1563	1670	1736	1781	1819	1850	1878	1904	1930	1948	1949	1815	1919	2169	2194
2000	1438	1870	2034	2157	2219	2273	2319	2325	2368	2400	2435	2452	2457	2259	2367	2666	2695
2400	1503	1925	2072	2180	2248	2307	2352	2383	2407	2449	2486	2512	2535	2317	2416	2713	2739
2800	1675	2020	2158	2256	2299	2351	2390	2438	2459	2500	2526	2551	2604	2376	2470	2764	2782
3200	1967	2248	2392	2469	2485	2536	2580	2638	2650	2697	2706	2733	2749	2530	2653	2988	3020
3600	2117	2325	2448	2560	2616	2660	2701	2727	2750	2771	2813	2827	2851	2610	2724	3059	3088
4000	1958	2160	2278	2358	2402	2438	2471	2488	2504	2520	2547	2559	2596	2369	2468	2768	2793
4400	2120	2301	2382	2486	2535	2600	2627	2656	2666	2690	2721	2723	2727	2494	2601	2920	2947
4800	2075	2265	2372	2478	2531	2589	2616	2633	2643	2667	2691	2694	2724	2482	2581	2892	2917
5200	2030	2229	2362	2469	2527	2577	2603	2610	2620	2643	2661	2664	2685	2446	2543	2850	2874
5600	1985	2194	2351	2460	2523	2564	2590	2586	2597	2620	2632	2635	2645	2410	2506	2808	2832
6000	1940	2158	2341	2452	2519	2550	2576	2563	2573	2597	2602	2605	2606	2374	2468	2766	2789
6400	1895	2122	2330	2443	2514	2535	2561	2540	2550	2573	2573	2575	2566	2338	2431	2724	2747
6800	1850	2086	2320	2434	2510	2519	2545	2517	2527	2550	2543	2546	2527	2302	2393	2682	2704

Chart 5 *Inside the GM computers, there is a volumetric efficiency (VE) table specifically tailored to each vehicle setup. Unfortunately, this table doesn't reflect mechanical VE, but instead is more of a fueling table based on a combination of air mass, temperature, and pressure. The VE table is referenced by both RPM and load (MAP).*

to the addition of the alcohol that is added from the SMC kit when under boost. If this kit was not present, then the fueling numbers would continue to grow as demand increased under boost.

We are also able to bias our airmass calculations more toward the IAT readings on a boosted car. This is beneficial if we see that we are experiencing heat soak within the intercoolers, and thus are putting the engine in jeopardy of inducing detonation. By adjusting the bias more towards the IAT, we can ensure that we are reading the increase in air temperature and making adjustments automatically to our fueling calculations.

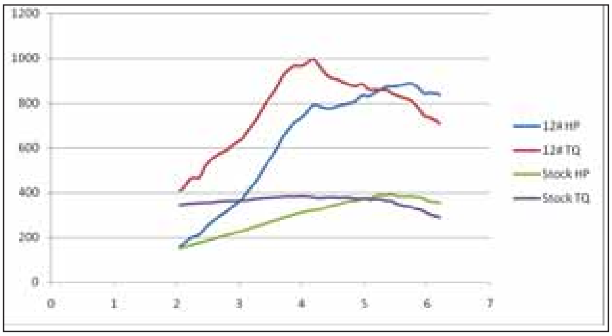
Controlling Spark

The basic table that controls the spark advance in the ECM is tracked by both engine rpm and cylinder airmass (**Chart 7**, page 9). The benefit of doing the table like this is that since we are using the MAP sensor in calculating our airmass, we will automatically detect boost/non-boost situations. Therefore, without any modifications, the stock tables from the factory are able to handle up to 22 lbs. of boost!

Now we can have the best of both worlds; we can have proper timing under non-boost situations to achieve drivability, economy, and emissions considerations, and we can retard timing automatically based on boost levels and rpm. That means we don't have to run any external boost retard boxes.

Furthermore, the default program for the ECM has two timing tables: a high octane and low octane table. Since we still have the factory knock sensors active, we will automatically reduce timing in the event that spark knock is detected, and slowly blend the two timing tables together to achieve a safe condition in real time.

This blending will come into play if you have instances of getting a bad tank of gas, or have other mechanical issues. If the knock situation removes itself, then the ECM will slowly adapt back to running purely off of the high octane tables. Thus, the ECM will constantly be monitoring conditions to ensure that the engine stays together for a long time.



This graph shows the stock GTO dyno numbers and the latest dyno numbers for this configuration at 12 pounds of boost.

Manifold Absolute Pressure (kPa)

Engine Speed (rpm)	105	110	114	119	124	128	133	138	143	147	152	157	161	166	171	175
400	1863	1803	1721	1589	1251	1270	1289	1307	1325	1344	1362	1380	1399	1417	1436	1454
800	2134	2067	1973	1788	1435	1456	1477	1498	1519	1540	1561	1583	1604	1625	1646	1667
1200	2188	2121	2024	1834	1472	1493	1515	1537	1558	1580	1602	1623	1645	1667	1688	1710
1600	2243	2174	2074	1880	1509	1531	1553	1575	1598	1620	1642	1664	1686	1708	1731	1753
2000	2359	2286	2182	1917	1511	1534	1556	1578	1600	1622	1645	1667	1689	1711	1733	1756
2400	2388	2313	2208	1940	1529	1552	1609	1597	1619	1642	1664	1687	1709	1732	1754	1777
2800	2523	2405	2243	1970	1553	1576	1612	1622	1645	1668	1690	1713	1736	1759	1782	1805
3200	2510	2402	2252	2076	1638	1662	1689	1711	1735	1759	1783	1807	1831	1855	1879	1903
3600	2581	2511	2396	2211	1743	1768	1794	1820	1845	1871	1897	1922	1948	1974	1999	2025
4000	2580	2481	2367	2252	1808	1834	1861	1887	1914	1941	1967	1994	2020	2047	2074	2100
4400	2707	2623	2502	2380	1910	1938	1966	1993	2021	2049	2076	2104	2132	2160	2187	2215
4800	2669	2586	2467	2348	1884	1912	1940	1967	1995	2023	2051	2078	2106	2134	2161	2189
5200	2629	2548	2431	2313	1857	1884	1911	1939	1966	1993	2021	2048	2075	2103	2130	2157
5600	2590	2510	2395	2279	1829	1856	1883	1910	1937	1964	1991	2018	2045	2071	2098	2125
6000	2562	2472	2358	2245	1802	1828	1855	1881	1908	1934	1961	1987	2014	2040	2067	2093
6400	2513	2435	2323	2211	1774	1800	1826	1853	1879	1905	1931	1957	1983	2009	2035	2061
6800	2474	2397	2287	2176	1747	1772	1798	1824	1850	1875	1901	1927	1952	1978	2004	2029

Engine Speed (rpm)	180	185	189	194	199	203	208	213	218	222	227	232	236	241	246	250	255
400	1472	1491	1509	1528	1546	1564	1583	1601	1620	1638	1656	1675	1693	1712	1730	1749	1767
800	1688	1709	1730	1751	1773	1794	1815	1836	1857	1878	1899	1920	1941	1962	1983	2005	2026
1200	1732	1753	1775	1797	1818	1840	1861	1883	1905	1926	1948	1970	1991	2013	2035	2056	2078
1600	1775	1797	1819	1842	1864	1886	1908	1930	1953	1975	1997	2019	2041	2063	2086	2108	2130
2000	1778	1800	1822	1845	1867	1889	1911	1933	1956	1978	2000	2022	2045	2067	2089	2111	2134
2400	1799	1821	1844	1866	1889	1911	1934	1956	1979	2001	2024	2046	2069	2091	2114	2136	2159
2800	1827	1850	1873	1896	1919	1942	1965	1987	2010	2033	2056	2079	2100	2121	2136	2151	2166
3200	1927	1951	1976	2000	2024	2048	2072	2096	2120	2144	2168	2192	2208	2222	2229	2235	2242
3600	2050	2076	2102	2127	2153	2179	2204	2230	2255	2281	2307	2332	2336	2336	2336	2336	2336
4000	2127	2153	2180	2206	2233	2260	2286	2313	2336	2336	2336	2336	2336	2336	2336	2336	2336
4400	2243	2270	2298	2326	2336	2336	2336	2336	2336	2336	2336	2336	2336	2336	2336	2335	2336
4800	2217	2245	2272	2300	2328	2336	2336	2336	2336	2336	2336	2336	2336	2336	2336	2335	2336
5200	2184	2212	2239	2266	2294	2321	2336	2336	2336	2336	2336	2336	2336	2336	2336	2335	2336
5600	2152	2179	2206	2233	2260	2287	2314	2336	2336	2336	2336	2336	2336	2336	2336	2335	2336
6000	2120	2146	2173	2199	2226	2252	2279	2305	2332	2336	2336	2336	2336	2336	2336	2335	2336
6400	2087	2113	2140	2166	2192	2218	2244	2270	2296	2322	2336	2336	2336	2336	2336	2335	2336
6800	2055	2081	2106	2132	2158	2184	2209	2235	2261	2286	2312	2336	2336	2336	2336	2335	2336

Chart 6 *The VE fueling table shown in Chart 5 reveals that it stops roughly at atmospheric pressure. Thus, the stock configuration does not understand boost situations. A genuine GM MAP sensor from a Saturn ION has a range up to 2.5 bar. Thus, it can read well in excess of the 14 lbs. of boost that this engine will eventually see. This table now allows the VE fueling calculations to track up to 22+ lbs. of boost.*

Another timing issue that we have to address is inlet temperatures from the turbo. As we heat soak the intercoolers, we have to be aware of the engine's tendency to knock under hot air-charge temperatures. Within the ECM is a table that allows us to add or retard timing based on the readings coming from the IAT sensor, which is monitoring our intake air temperature.

Chart 8 (below) is built from IAT temperature and cylinder airmass, which tracks boost. The table reflects that as our intake temperatures increase, we automatically will reduce timing to ensure that we don't put the engine into a spark detonation state.

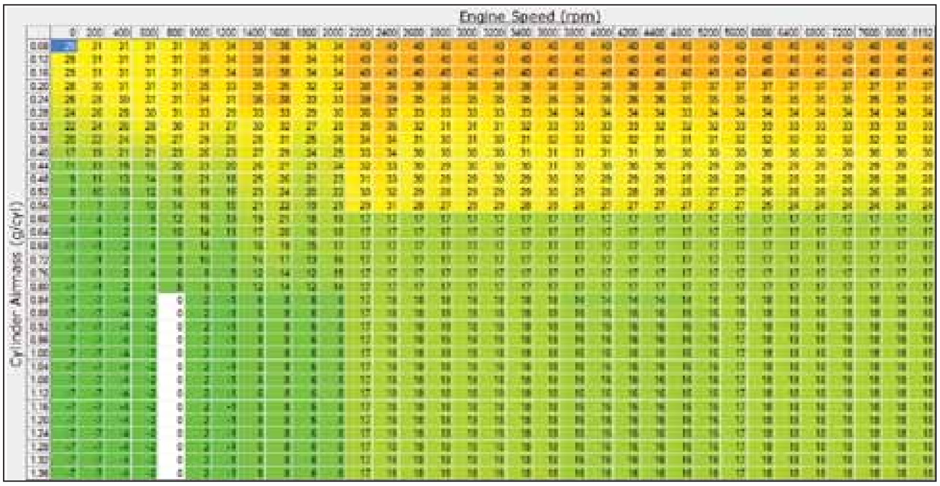


Chart 7 *The basic table that controls the spark advance in the ECM is tracked by both engine RPM and cylinder airmass. The benefit of doing the table like this is that since we are using the MAP sensor in calculating our airmass, we will automatically detect boost/non-boost situations.*

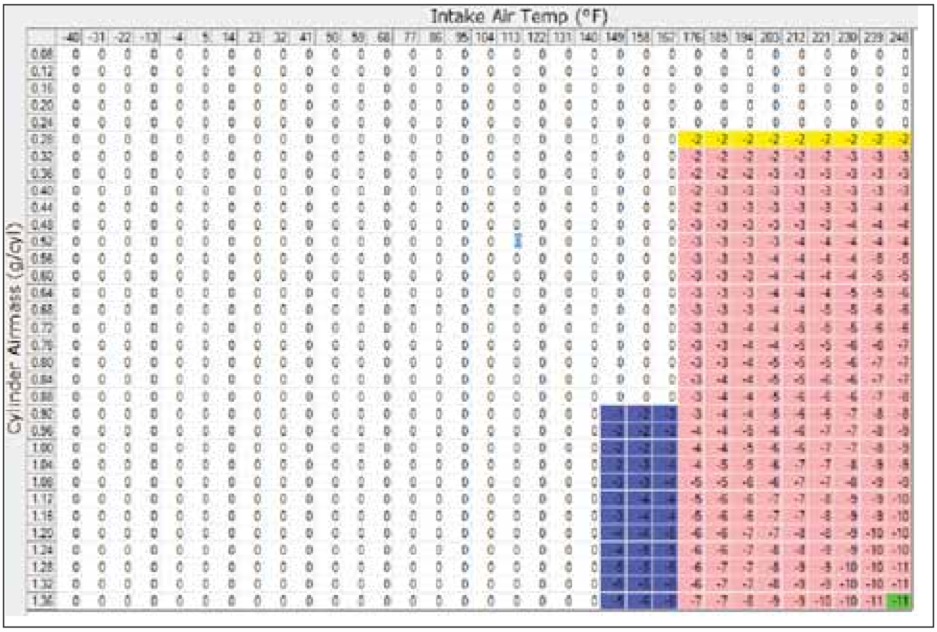


Chart 8 *This chart is built from IAT temperature and cylinder airmass, which tracks boost. The table reflects that as our intake temperatures increase, we automatically will reduce timing to ensure that we don't put the engine into a spark detonation state.*

The Results

What Riskovsky has created is blending old school racing technology along with modern day ECM computer controls. The result is an incredibly powerful car under boost situations, yet, a car that is as drivable as it was in its stock form.

Economy and drivability were main goals with this project. To date, the car can consistently bring down 30 mpg on the highway cruising in 6th gear at 70 mph. Thanks to the stock Z06 camshaft, valvetrain longevity and durability is not an issue.

The cam selection also helps to reduce the exhaust noise to near stock levels.

Unless someone was aware of what lurks under the hood, they would never suspect this GTO lays down almost 1,000 ft.lbs. of torque. The dyno numbers for the current configuration are shown on page 8, and the graph shows the stock GTO dyno numbers and the latest dyno numbers at 12 pounds of boost. Once the new, larger turbos are delivered, Riskovsky expects another 150 hp added to the current numbers.

So, if you are out cruising in Southern Illinois or in the St. Louis area, and you come across a stock looking red GTO, just beware that you may have this tiger by the tail! **EBTG**

About the Author

Keith McCord *is president of McCord Consulting Group in St. Louis, MO. He's a "gun-for-hire" for various OEM and aftermarket companies to design products, parts, CNC code and process improvement. Keith also writes custom ECMs for GM and Ford vehicles.*