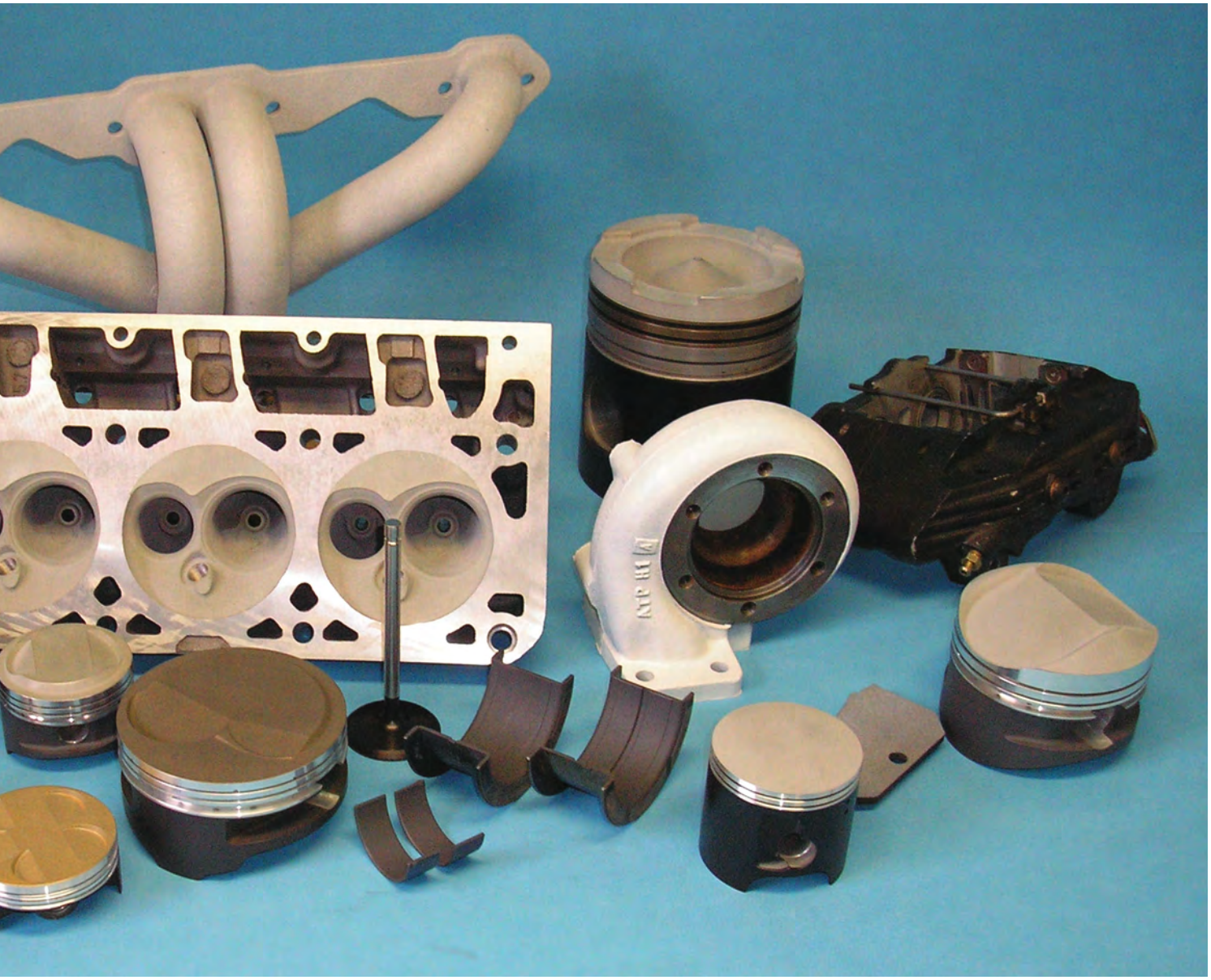
BY **RICHARD TUCKER**

What Should I Expect From Coating My Engine?

Internal engine and exhaust coatings are so widely depended on now that the questions, "Do coatings work?" or "Will it flake off?" are obsolete. Now people just want to know, "What should I realistically expect from coating my parts?" Swain Tech Coatings has always been the leader in engine and exhaust coatings. By developing specific coatings to improve internal engine and exhaust parts and professionally applying the coatings in a controlled environment, Swain Tech has earned a reputation for quality coatings with durability that is unmatched. Through the years, we have seen small coating shops start up with inferior materials and inflated claims. Some of the inferior materials are so basic they are sold as "do it yourself" coatings. These inferior materials tend to fail in service and the inflated claims cannot be delivered on. Both leave the customer feeling like they have been bitten by the old snake oil. Swain Tech's professionally developed and applied coatings have been on the track and in the field-tested for over 30 years. The following is an independent, unbiased test that was conducted in cooperation with Circle Track magazine. The purpose of the test was to give engine builders and performance enthusiast a realistic presentation of power gains that should be expected with quality coatings on a high performance motor.

Circle Track sought out a shop that has an ongoing race program. Wayne's Mail Order Engine Parts has an ongoing test program for small-block two-barrel Chevy Late Model Sportsman engines making them a good fit for this test. Ross pistons, Crower rods, Cam Dynamics camshaft and lifters and other reputable parts were used. To be sure this was an "apples to apples" comparison all initial clearances were carefully measured and noted on the assembly of the uncoated parts. After assembly, the engine went through normal break in procedures on a test stand. After break in was completed, the motor was bolted to the dyno for 6,500 rpm pulls. The motor was tuned to achieve its best power and the results were recorded. Maximum power was 318 horsepower at 6,000 rpm and peak torque was 305 at 3,500 rpm. All involved were happy with the initial uncoated results and felt the motor would perform well in the real world where the car needs to pull hard out of corners and reach maximum power at the end of straight away.

After the dyno pulls, the motor was torn down and components were sent to Swain Tech to be coated. Thermal barrier coatings on pistons and heads are where the biggest power gains are achieved so



those were coated first. We coated the combustion chambers; exhaust ports and piston domes with our TBC ceramic thermal barrier. Piston skirts were coated with our Poly Moly low friction coating to reduce wear, attract lubrication, and provide a solid film of lubrication if the oil film goes away. We also coated the rod and main bearings to improve the wear life of the bearings and journals. The bearing coating provides a back-up form of lubrication to prevent catastrophic failure if you lose oil pressure or oil film. Though the coatings will add a slight film thickness, it would be unusual to need to make a clearance provision for any of the coatings.

Typically, oil-shedding coatings will not make a measurable power difference unless the motor is turning over 6,500 rpm. Despite the fact this motor was expected to make peak power near 6,500 rpm where the oil shedding coatings were not likely to make a measurable power difference, we coated the rods, crank counterweights, oil pan and timing cover with oil shedding coatings to illustrate that the coatings are permanent coatings and that they will survive in a race motor

After coating, all parts were measured again and the motor was reassembled placing all parts in their original positions to eliminate the possibility of performance differences due to new or different parts. Reassembly confirmed that the coating thickness was thin enough that clearance provisions did not need to be made.

After reassembly, the motor bolted to the same dyno in the same shop the initial pulls were recorded on. The results were exactly what you would expect based on years of Swain Tech's independent dyno test on every type of motor from a basic 5 horse Briggs & Stratton Motor to motors that are found at the top levels of circle track, drag and road racing. With over 30 years of testing, we can confidently state you should realistically expect a 2-5% horsepower and torque gain on a motor with coated pistons and heads.

With no modifications other than the coatings, the dyno pulls clearly showed the torque and horsepower curves were much better. Both curves were fatter in the lower rpm ranges where it will improve the drive off corners, and both curves were flatter as well. Peak horsepower was up 2% from 318 to 324 horsepower and peak torque was up 5% from 320 lb/ft to 335 lb/ft. In the heart of the curves, these numbers were even more impressive. At 4,500 rpm, torque was up 7% from 298 lb/ft to 319 lb/ft. At 5,500 rpm, horsepower was up 6% from 302 to 320 horsepower. Most engine builders will take full advantage of the coating by

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Four cylinder motors are a great fit for coatings. With turbos, high compression ratios and high rpms, these motors really benefit from thermal barrier and friction reducing coatings.

making jetting (or mapping), timing, and lighter weight oil for maximum power gains. However for this test, we wanted to document and publish the gains that are achieved if the only modification was coating the engine. If the proper tuning adjustments were made to take full advantage of the coatings, these results would have been even more impressive.

This unbiased and independent test confirms exactly what a Swain Tech engineer would tell you to expect from a motor coated with Swain Tech's coatings. It is important to remember that power gains are just part of the purpose of coating pistons and heads. In addition to making more power, parts are protected against burning, run cooler with more tensile strength and are protected from scuffing, seizing, galling and sticking. Rings, pins, rods and the entire bottom end will run cooler with coated pistons. Head and coolant temperatures are lowered with cylinder head coatings.

No other modification will offer more value for the investment. Is there any modification other than Swain Tech Coatings that will improve both power and durability at any price? For about $750 a typical V-8 can have pistons, heads and headers coated (the coatings that add the most power). A typical 6 cylinder would be about $550 to have pistons, heads and headers coated and a typical 4 cylinder would cost about $450. This is value that is hard to beat.

If you are involved in high performance motors, you owe it to yourself and/or your customers to have your parts coated with Swain's thermal barrier and friction reducing coatings. The technology is proven and the benefits are unmatched by any other performance enhancement. Twenty years ago, coatings were new enough where a wait and see attitude may have been warranted. Now, a wait and see attitude will put you behind what the competition is doing.

An Introduction to Performance Coatings

A cost-effective way to improve performance and reliability

High performance does not come without its price. That price often is reduced reliability in the form of damaged internal engine parts. However, high tech, high performance engine coatings can now improve performance and reliability. Best of all, there are no trade-offs, no downside to the benefits coatings provide. It's a win-win situation.

Heat is necessary for power; engines operate by converting thermal (heat) energy into kinetic (movement) energy. But, heat also takes its toll on metal, often melting lightweight parts like aluminum or alloy pistons. For these reasons pistons were traditionally the weak link in the drive train. That doesn't have to be the case today. Lightweight aluminum and alloy pistons can be coated with thermal barrier and friction reduction coatings to ward off the reliability nemesis called heat.

A .002" ceramic thermal barrier coating (TBC) protects piston domes. TBC™ holds heat inside the combustion chamber where it can power the sled, rather than dissipate through the piston to weaken or burn the metal. TBC also protects parts from high temperature oxidation and reduces heat transfer by spreading the heat over the entire coated surface. This encourages proper flame travel and eliminates hot spots. Less heat conduction through the wrist pins and rods keeps the crank and bearings cooler, too. And, the coating is thin enough that no clearance provisions have to be made.

Friction between the piston skirt and cylinder wall is reduced with a tungsten-molybdenum disulfide polymer matrix

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Swain Tech's White Lightning™ exhaust coating is the best insulating and most durable exhaust coating available. If you have a heat problem, White Lightning™ is for you.

coating. This material, which we call PC-9™, has an extremely low coefficient of friction. Applied .0008" thick to piston skirts, the durable coating reduces scuffing and friction caused by piston movement.

Standard aluminum pistons can expand too much when subjected to high heat, and this expansion can cause them to seize. This does not happen with coated pistons because the thermal barrier coating reduces heat transfer. As an added benefit, carburetor jetting or fuel mapping can be safely leaned down to achieve better performance.

Pistons coated by Swain Tech Coatings can usually be identified by their white domes and dark gray skirts. TBC Thermal Barrier Coating is white and PC-9 friction reducing coating is dark gray. However, Swain Tech StealthCoat™ has the same color and texture as piston metal. StealthCoat is for racing classes in which stock appearing parts are required. And, GoldCoat™, a special .003" thick Swain Tech thermal barrier coating for nitrous and turbo charged engines, is gold in color.

The energy that creates horsepower comes from the heat of combustion. Adding nitrous oxide to the fuel/air mix greatly increases the intensity of the energy-generating heat in a combustion chamber. When that heat reaches certain intensity, it can melt pistons and other engine parts. GoldCoat protects pistons from heat damage, actually extending engine life while boosting power.

Pistons are the most popular coated parts. However, high tech coating of other parts will increase power and reliability even more. TBC applied to heads, enables the engine to convert more heat to power. Coating the entire combustion chamber surface area (piston top and head recessed chamber) improves combustion efficiency, resulting in higher horsepower. A Black Body Emitter (BBE) heat radiating coating applied to the outside of intercoolers.

Exhaust systems, coated with White Lightning, keep exhaust gases hotter longer, improving the scavenging effect. White Lightning is a unique exhaust system coating. The white, .015" thick, three layer thermal barrier coating keeps heat inside the pipe, which increases exhaust gas velocity for more efficient heat extraction.

A good looking, rust free exhaust system, coated with White Lightning, also contributes to an increase in horsepower – as much as three percent.

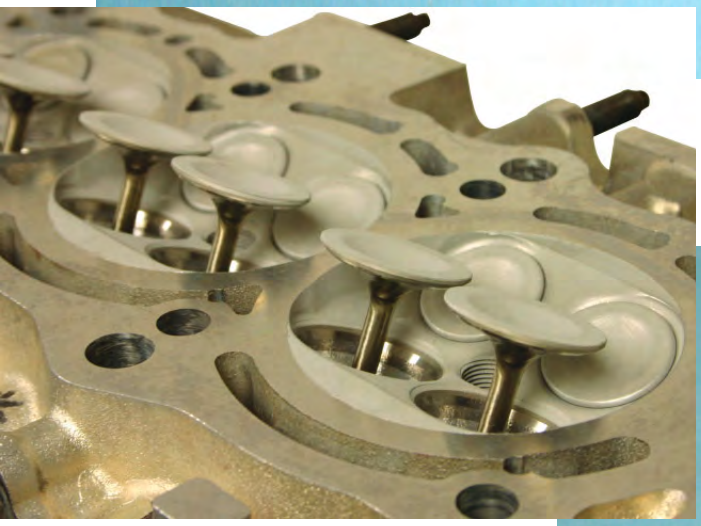
White Lightning is unequaled; it is a true, permanent ceramic thermal barrier, not a hi-temp paint like other coatings. The coating reduces under-cowl temperatures, increases gas velocity and makes turbo charger systems perform better. This textured white coating can also be painted without affecting its thermal properties.

Many snowmobile performance engine builders offer Swain coatings as standard or as recommended options. Do-it-yourself engine builders can have their parts coated as well. Pistons are sent to Swain's the factory, coated and returned, usually within 1 to 2 weeks.

Engine coatings are low cost insurance in anybody's book. A failed racing engine can be costly and eliminate you from the race. Advanced coatings are extremely beneficial in the quest for more power, speed and reliability.

Why coat a two-stroke piston?

Pistons are the highest stressed and the most critical part of an internal combustion engine. This is especially true for a two stroke motor. The four cycle piston only sees heat from combustion every other stroke, and in between, it has a full stroke to be cooled by the fresh incoming air. To further aid cooling, four stroke pistons are often cooled on the underside by oil spray and runs in a



Coatings on pistons, combustion chambers and valves are the internal engine parts that will provide the greatest power gains.

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cylinder with no ports to interrupt the rings. The two stroke piston sees the heat of combustion on every stroke without the benefit of a cool intake stroke or oil spray. Also, the two stroke cylinder is full of ports that attract heat, especially on the exhaust side where the hot gases flow directly over the crown on their way out of the cylinder, building even more heat in the cylinder near the exhaust port. This extreme heat can burn the little lubrication that the piston skirts see. This is why the piston is the weak link in the two stroke motor.

Despite extensive research and design improvements from the major two stroke manufacturers over the years, piston failure remains a nagging problem. How do you extend the life of pistons? Simply put, COATINGS. Swain Tech Coatings is the original high performance coating company. They have been developing and applying high performance coatings for over 20 years and are widely recognized as the industry leader. Swain Tech applies their ceramic TBC to the top of pistons, holding heat in the combustion chamber where that heat can be used to power the motor, rather than dissipate through the piston where it can weaken and burn the piston. This allows the piston to run much cooler and stronger. Piston skirts are coated with PC-9, a low friction/anti-seize coating to reduce frictional loses and piston sticking.

To further improve the thermal efficiency of the two stroke cylinder, Swain Tech often applies TBC to the domes of the heads and the exhaust ports, keeping the heat where it is needed to make power and out of the areas that lead to failures. Expansion chambers are often coated with Swain's White Lightning exhaust coating to keep exhaust gases as hot as possible, allowing the motor to breathe better. White Lightning is the only true performance exhaust coating available. This three layer ceramic coating keeps a tremendous amount of heat inside the pipes to improve scavenging.

To get most life and performance out of your two stroke motor, Swain Tech's high performance coatings are the most economical and beneficial modification you can add.

In the early 1970s, asphalt modified racer and ceramic engineer Dan Swain developed a ceramic coating system for pistons and heads for racing engines. In addition to coatings which improve the power and durability of high performance engines, Swain Tech also offers a variety of coatings for industrial applications that help fight wear, corrosion, friction and heat. Richard Tucker has been with Swain Tech for over 10 years. You may contact him via e-mail: rtucker@swaintech.com.