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September 2003

ENGINE BUILDER

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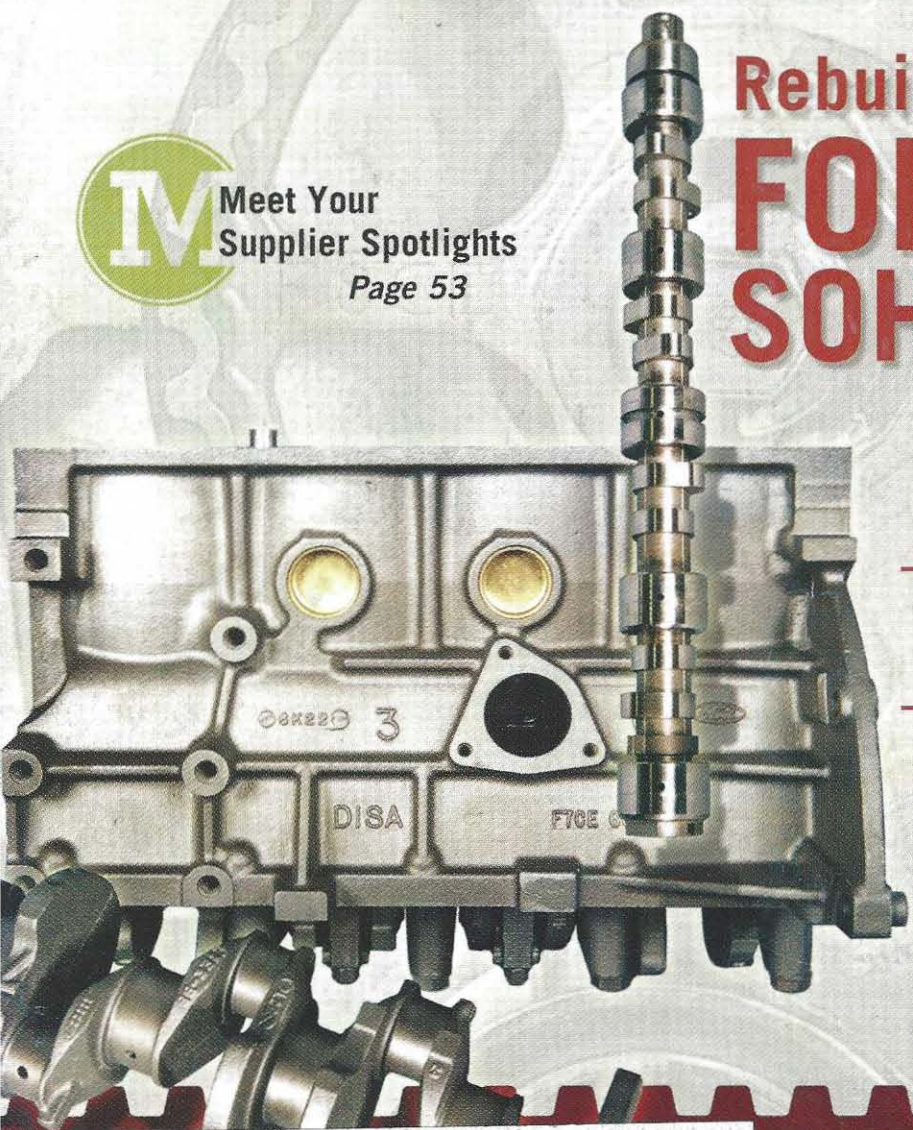

Rebuilding the FORD 2.0L SOHC Engine

Meet Your Supplier Spotlights
Page 53

Aqueous Engine Cleaning Options

Alternative Uses for Engine Building Equipment

Piston Rings and Cylinder Sealing

Also:

- PERA Core Corner
- AERA Profit Center
- Around The Block

ton and ring sets that are found in many production engines today were considered racing parts less than a decade ago, so it's logical to assume such things as "gapless" rings and exotic coatings may be in OEM engines before long.

Keith Jones of Total Seal Piston Rings says eliminating the end gaps in the compression rings can improve horsepower by as much as 10 percent depending on the application. "Our gapless rings have been very popular with racers, but we also have conventional rings, too, and offer both types with various coatings."

"We have steel rings down to 0.6 mm size in both gapless and conventional designs. Our 'Diamond Finish' rings are manufactured to within 50 millionths of an inch flatness and parallelism, with a finish that is typically 4 Ra microinches or less. This allows tighter assembly tolerances for better performance."

Jones says Total Seal's most popular face coating material is "C23," which has a coefficient of friction of 0.1 (three times better than moly) and won't flake off like plasma moly. It also works well with hard blocks and nickel silicon carbide-lined cylinders. Total Seal also offers a "C72" titanium coating, "C33" chrome nitride coating and conventional moly coatings as well, plus a "D47" side coating for the top and bottom of its steel Diamond Finished rings to reduce groove friction and microwelding.

"We're the Burger King of piston rings. We'll do rings anyway a customer wants them," says Jones.

The key to choosing a particular ring design and coating, says Jones, is to identify an engine's primary function in life. If an engine is a street/strip application, chances are it will spend 90 percent of its time on the street. For this kind of engine, street rings would work better than an all-out racing ring. Of course, it all depends on the compression ratio and whether the engine has a blower, turbo and/or nitrous oxide (in which case racing rings would be better).

Diamond stones cut fast and have a long tool life. But since they're more aggressive than silicon carbide they create more tear outs and other unwanted residue. Be sure to follow up with another operation afterwards to final finish the cylinder surface.

"If you don't know which type of rings to use, call us and we'll help you figure it out," says Jones.

Vern Schumann of Schumann's Sales & Service, Blue Grass, IA, says ring selection for performance engines depends on three things: compression ratio, the type of fuel (gasoline or alcohol), and horsepower. Schumann says plain cast iron rings should never be used in an engine that burns alcohol because alcohol cuts lubricity. Coated rings are a must with alcohol.

Gas nitrided steel rings manufactured from coil wire are best for turbocharged and blown engines, says Schumann, and especially those that run nitrous oxide for an extra power boost. He says nitriding penetrates into the surface of the metal and alters its chemical makeup. Because of this it can handle thermal shock much better than any add-on facing material and won't flake off under load.

"One of the biggest misconceptions that's out there is that moly faced steel rings are racing rings. Welded moly steel rings work great on the street but won't hold up like nitrided steel top rings," says Schumann. "Nitrided rings are stronger, provide better heat transfer, and won't flake from thermal shock. In five years, I think most racing engines as well as many street performance engines will be running nitrided rings instead of moly."

Schumann explains that the different coil steel wire used in rings provides different tensile strengths. "The coil steel wire we use in our rings has a tensile

strength of over 200,000 psi with zero porosity. Other alloys commonly used to make moly rings are typically 50,000 to 55,000 psi. Ductile iron, which we recommend for the second ring if the compression ratio is over 11 to 1 or the engine makes more than 400 hp, is rated at 70,000 to 80,000 psi. But ductile is typically two to eight percent porous, which reduces heat transfer and cooling. Ductile iron must be used with a coating, otherwise it smears the cylinder walls."

Schumann says the biggest mistake any engine builder can make is to use cheap rings with racing pistons. The rings should be steel or ductile iron so they don't fail. Otherwise they are likely to break, and when that happens you can kiss the piston and the motor goodbye.

Cylinder Bore Refinishing

As a rule, engine builders should follow the cylinder bore refinishing guidelines by the ring manufacturer. But like every other aspect of engine building, opinions differ as to what techniques work best in any given situation.

Federal-Mogul's Gabrielson says a "plateau finish" is the optimum bore finish for today's moly-faced rings. A plateau bore finish is what all types of rings eventually produce when they are fully seated, so the closer the bore can be prefinished to a plateau-like condition the less the rings and cylinders will wear as the engine breaks in, the better the rings will seal right from the start, and the longer the rings will last.

For moly rings, Gabrielson recommends a two-step honing process: first hone with a conventional #280 grit silicon carbide vitrified abrasive, then finish by briefly touching the bores with a #400 grit stone or giving them several strokes with an abrasive nylon honing tool or brush.

If the cylinders are honed with diamond, Gabrielson says to follow up with finer grit diamond, a fine-grit vitrified abrasive or a brush to finish the bores. Diamond stones are fast and long lived, but they are more aggressive than silicon carbide and create more tear outs and other undesirable residue on the surface. Because of this, a rough diamond honing procedure should always be followed up with another operation afterwards to finish the surface.

Equally important is bore geometry. Gabrielson says engine builders have to be especially careful about oil control on late model engines. He says the block should always be honed with torque plates if the manufacturer recommends doing so to minimize bore distortion that can cause blowby and prevent the rings from sealing properly.

"The bores have to be straight and round. Make sure you keep the Ra finishes within factory specifications, too, which is typically in the 10 to 15 Ra range on many late model engines."

Jeff Welsh with Peterson Machine Tool says #220 grit sil-