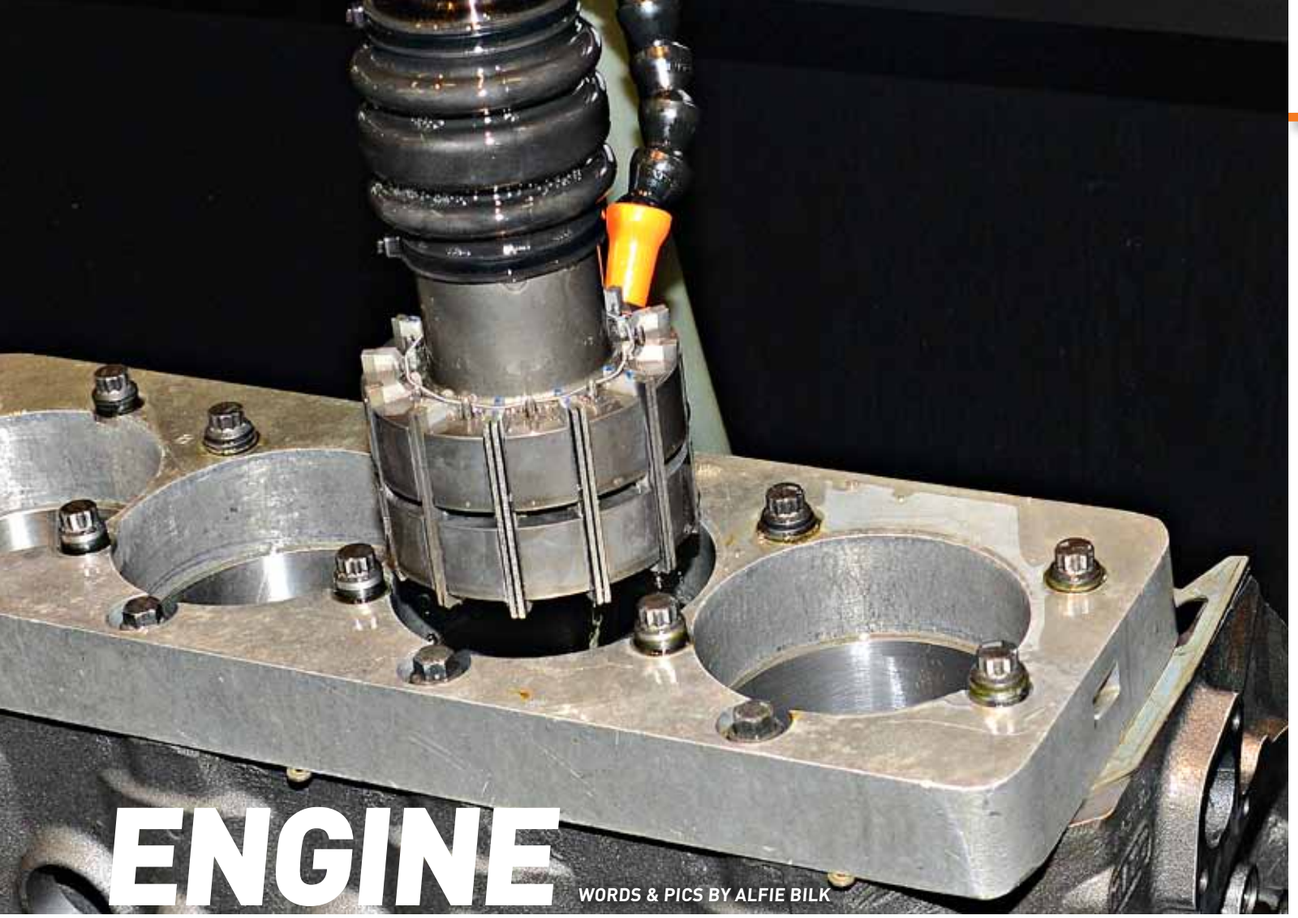
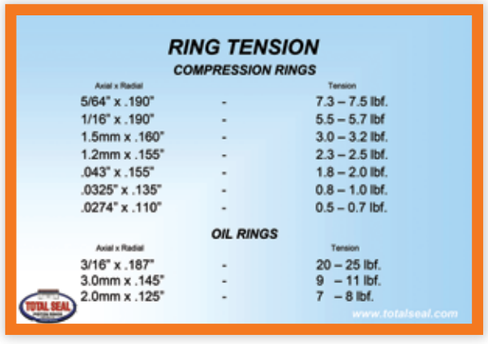


ENGINE BLOCK HONING

WORDS & PICS BY ALFIE BILK

ENGINE BLOCKS HAVE CHANGED, SO HAVE CYLINDER HONING PRACTICES. HERE'S HOW TO APPLY NEW PROCEDURES AND GAIN POWER.

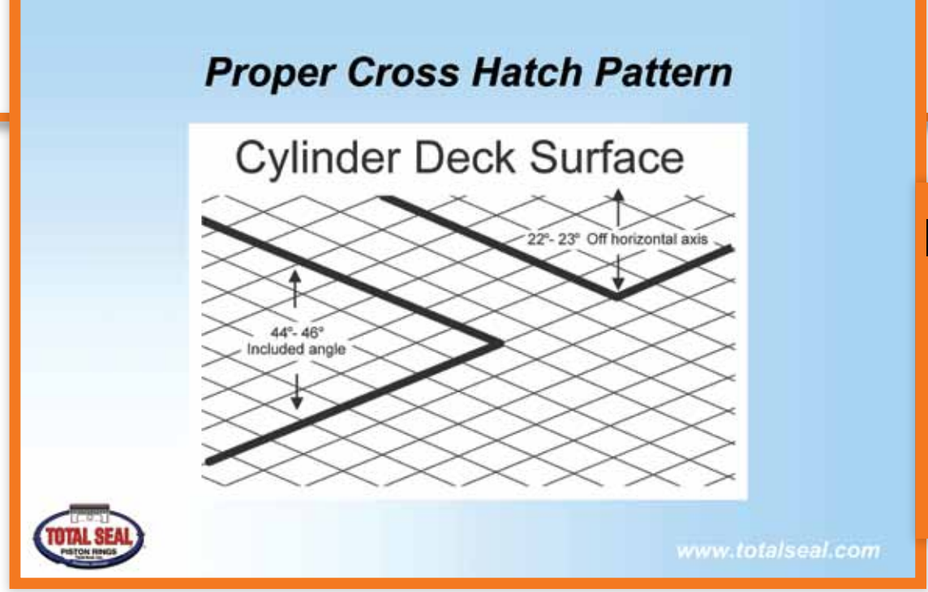


In the past two decades the metallurgy in engine blocks has changed—and not by a small amount

Cylinders are now much harder and with modern honing practices they accommodate rings that are much thinner, lighter, and lower in tension—often with exotic coatings.

In addition lubricating oils have been modified significantly to reduce friction and viscosity. All of this has contributed to new power generated by the engine block, but to take advantage of it, new honing procedures have to be adopted. The techniques employed for the past twenty years are rapidly becoming unsustainable.

Compare the production finish and standards of the engine cylinders of modern mass-produced automobiles. Yesteryear's GM, Ford and Chrysler were typically rated at 18 to 22Ra. Today's GM LS, Ford Modular and Chrysler Hemi engines measure 8 to12Ra. But that's not all; the car factories anticipate further reductions to 6Ra in the near future.



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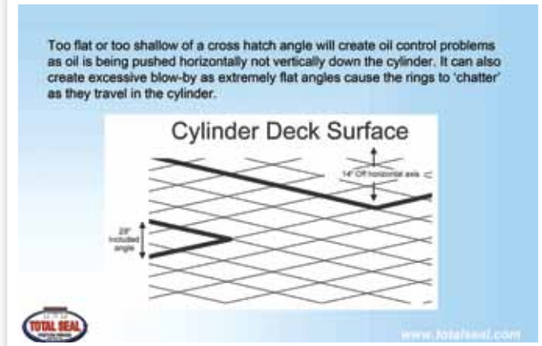
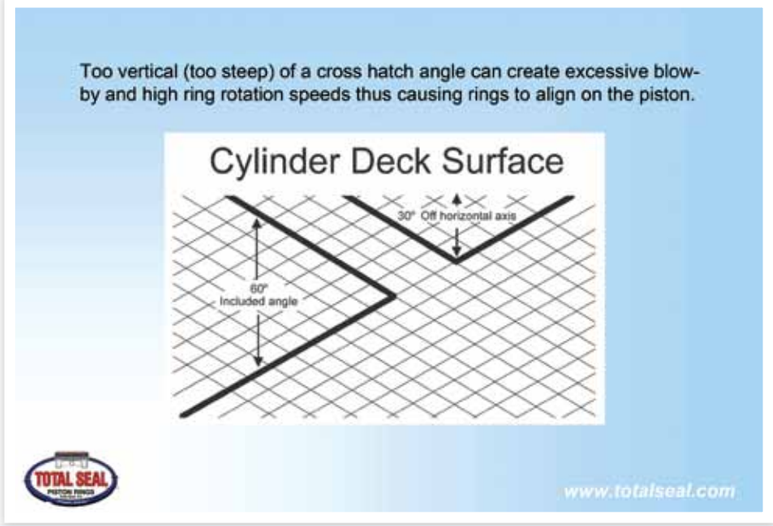
MODERN CYLINDER HONING IS CONFIRMED BY MEASUREMENTS: RPK, RK AND RVK

Harder engine blocks and affordable profilometers—the devices that precisely measure the surface finish of the cylinders—have changed honing procedures immensely and with it our understanding of oil retention and ring seal. Even the measuring standard Ra (arithmetic average of roughness) is becoming obsolescent, being replaced by three more effective standards: Rpk (Peak roughness); Rk (Core roughness) and Rvk (Valley roughness found below the core roughness).

"Almost always," says Tom Boucher of Boucher's Racing Engines, "people are honing much rougher than they think. When you have a rough bore it retains too much oil for modern light-tension low-drag racing rings and they cannot seal correctly and consequently burn oil because of inadequate honing." On the other hand, if oil retention is insufficient metal-to-metal scuffing occurs. Thus the objective is to have just the correct amount of oil retention in the cylinder walls after the ring scrapes it down—and this is achievable with a profilometer. Though no one can advise the correct honing stone—because there are too many variables—they can stipulate the surface finish for which you are aiming. Alas, without a profilometer, which is now affordable for most pockets, it would be impossible—akin to porting a cylinder head without a flow bench.





COMPARING HONING NUMBERS: PRO STOCK, NASCAR, TOP FUEL AND OTHERS

NHRA Pro Stock drag racing cars use compression rings of around 0.7mm (0.027in) thick that generate 0.5ft-lb of tension, while the oil control rings produce 3 to 6ft-lb of tension. Light and with little capacity to scrape away oil, the film retained in the cylinder wall is modest. Typical cylinder bore finish readings of Pro Stock or Comp Eliminator, or NASCAR engines are as follows:

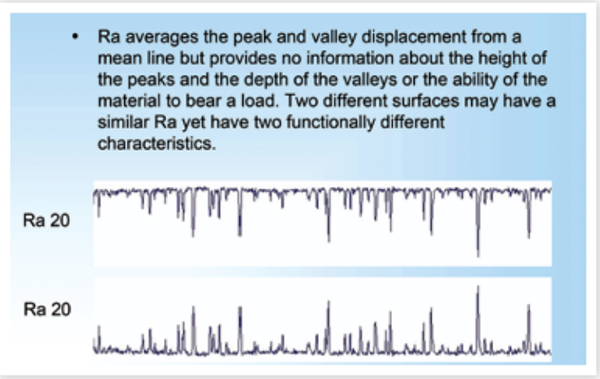
Rpk 4 to 6; Rk 18 to 22; Rvk 18 to 32.

In striking contrast Top Fuel engines, which endure extremely high temperatures and cylinder pressures, use 1/16th to 2.5mm (0.062in to 0.95in) rings that generate 5.5 to almost 10ft-lb of tension. Their cylinder bore finishes have a rougher hone, measuring Rpk 15 to 20; Rk 45 to 55 and Rvk 55 to 75. These honing standards applied to a Pro Stock engine would probably have oil entering the

headers when it started! For further comparison, Sprint car, Dirt Late Model, and Super Comp drag engines use honing finishes between Top Fuel and Pro Stock: Rpk 8 to10; Rk 25 to 30; Rvk 35 to 40.

It's of little significance that in Pro Stock there can be some light metal-to-metal scuffing. But in Top Fuel, where gallons of nitro methane are poured through the engine, protecting the oil film from being washed away is priority. Rings ride on a film of oil—known as a moderate boundary contact layer—and if the oil film is lost, so too is the ability to seal the ring to the bore. Inevitably, hot gases escape past the rings, the oil film evaporates on the cylinder walls and a sad fate known as "black death" is the grim reality.

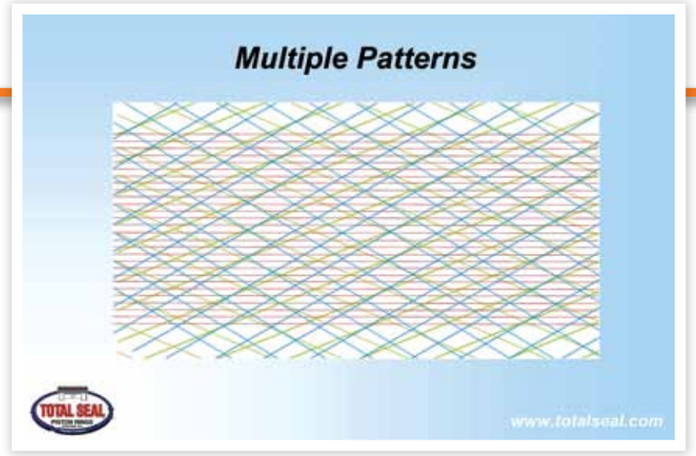
To counter this condition, lots of oil is retained on the cylinder walls of Top Fuel engines not just to act as a ring seal it but also to keep the parts cool. Top Fuel oil control rings are big and generate 25 to 28ft-lb of tension with lots of scraping capability.



contributed much lighter drag than previously. Of course, we now know lighter-drag rings require a different hone finish—the normal hone that had suited the 5/64th and 3/16th combinations was no longer effective." Today these engines have much smoother cylinder finishes with much less oil retention on the cylinder walls, but at that time they could consume a quart of oil every 1,000 miles.

FACING A SIMILAR CHALLENGE

In some ways, today's cylinder preparation is reminiscent of yesteryears' racing pushrod. Trend's Bob Fox discovered that a heavier pushrod represented the way ahead at a time when engineers wanted lightness. A decade later lightweight, deflecting pushrods had become obsolete. Similarly, at one time only NASA could afford a decent profilometer, which prevented our race engine builders from demonstrating their true brilliance. Now these sophisticated measuring devices sell for under $2,000—even available on E-bay—so inevitably like the stiffer pushrod, exacting honing practices will become the new standard. ■



CORRELATION BETWEEN CYLINDER WALL PREP, OIL RETENTION AND RING SPECS

Back at the cylinder wall, they speak of a plateau finish. This is the surface on which the ring makes contact and it should be flat and smooth. But in between each plateau or peak there is a valley. And it is here where things change for Fuel engines, alcohol motors and big blower engines. In fact, any high-powered race engine with significant cylinder pressures requires greater valley depth.

Perhaps a more interesting comparison relates to today's hot rod engines and those from the past. The stock, small-block Chevrolets of the 1970s and '80s used 5/64th compression rings, which produced around 7ft-lb of tension while the oil control ring made around 20ft-lb. In contrast, the compression ring of a modern LS engine makes around 2ft-lb of tension and the oil control ring around 7ft-lbs. As a result the new, lighter tension rings have less drag and less oil is retained on the cylinder wall. Unlike the racer who is seeking power increases, the original equipment manufacturer's principal interest in cylinder wall finish is motivated by the prospects of lower tailpipe emissions and better fuel economy.

Interestingly, in the early days of the LS Chevrolets, GM encountered oil burning troubles. "At that time" says Keith Jones of Total Seal, "they as well as Ford with their 5 liter engines and Mod motors, had adopted 1.5 x 1.5 x 3mm ring packages, which