

Tools, Tools and More Tools, Part 2

by Greg McConiga

Editor's Note: As an auto service professional, you're obviously more than a little familiar with the subject of tools, and, for many of you, collecting them is almost a passion. Fine, but what you use in your day-to-day career, no matter how high-quality, is necessarily different from what you need for high-performance work, in this case engine building. The following will help acquaint you with the types of tools you'll probably end up buying, as did Part 1 in the October issue of HOT ROD Professional. To quote Greg from the introduction to that article, "... the more you learn about high-performance engine building, and the more you know how to do, the more tools you'll need to support your activities. . . . you'll have to allow for a savings and purchase model that will support your career trajectory."





Cam Lobe Checking Tool

The plunger of this tool is reversible, as is the body. There is a flat tappet end and a roller end on the plunger, and the body fits common GM and Ford lifter bore diameters. If I run into an application that this won't fit, I just use a lifter and a dial indicator to do the same job.



Combination Squares

These are must-have tools for layout, measurement, squaring things up, and setting ring depth while you're grinding and fitting piston rings. There are so many uses I can't even think of them all. I use them every day -- can't do without them.

Valve Spring Height Micrometers (Opposite Page)

Your spring testers will give you spring tension at all heights on the spring along with the bind length. Use the height micrometer to set the installed height for the seat pressure that you need. Simply install them between the spring seat insert and the retainer, screw them tightly in place, and read the distance between seat and retainer. Shims can then be used to adjust the installed heights to your specification.



Cast Iron and Aluminum Burrs

The narrow fluted burrs are for cast iron and the wide fluted burrs are for aluminum. In a pinch, you can spray the narrow fluted burrs with WD-40 and work slowly and they'll do aluminum. Just remember to keep them lubed because once they load up with aluminum they are miserable to clean.

Header Spark Plug Tools

No explanation needed. If you've ever tried to get plugs in and out from around a set of large tube headers, you'll know exactly what these are and why you need them.





Parts and Systems Trays

Cleanliness and organization. There's nothing else to say. Available through CV Products, they are something you should not try to do without.



Plain Calipers

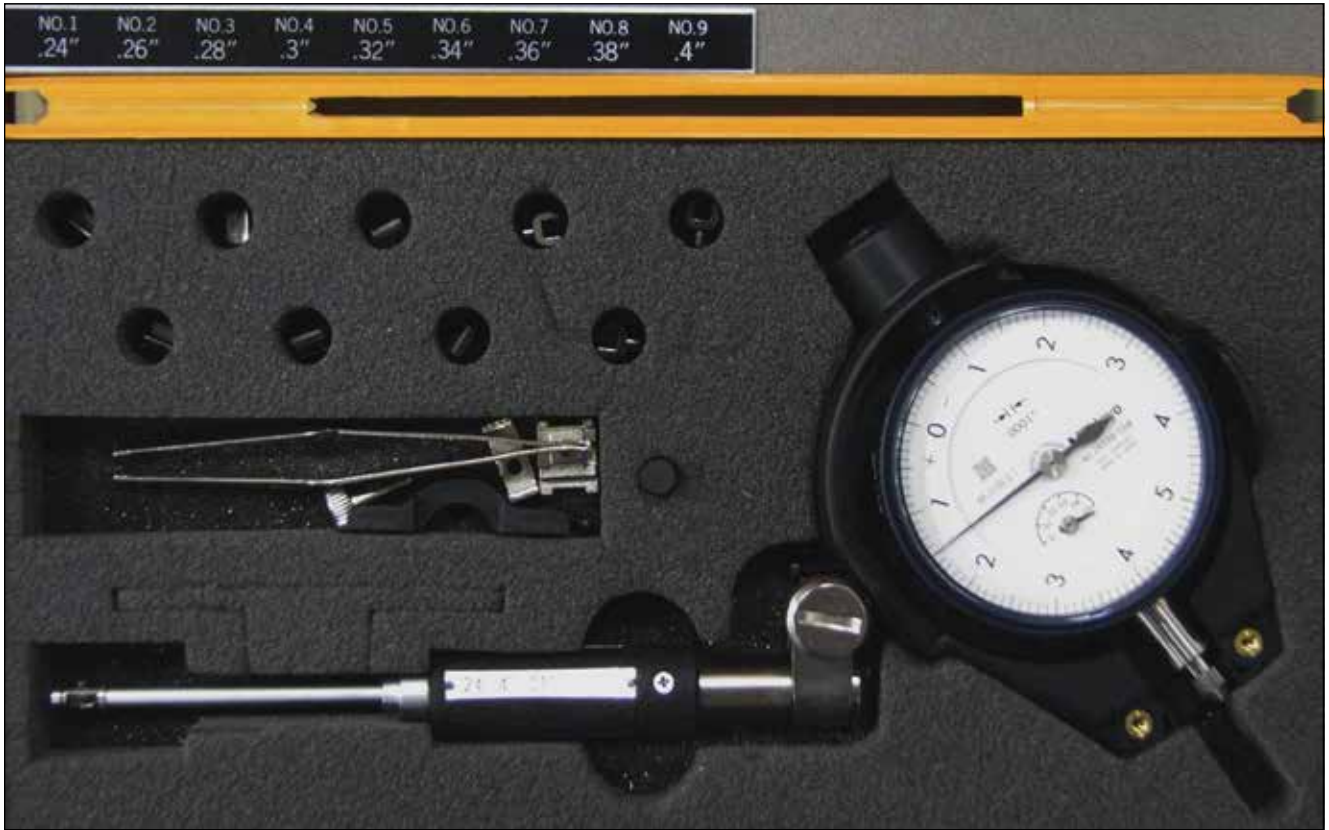
Useful for transferring measurements or roughing in a piece on the mill or lathe, they are also good for checking material thickness. Pictured are outside wide clearance calipers, hermaphrodite calipers, inside calipers, and narrow clearance outside calipers. These Starret calipers have a very nice feature in that you can lock the reading and then release one leg so you can remove them and close them back to the exact opening and read the measurement. That's what that extra nut is for on the leg of the caliper. It releases one leg without changing the measurement.

Bore Gauges

Investing in a full set of 1/10,000 in. reading dial bore gauges isn't for the faint of heart, but if you're going to check your guides, lifter bores, cam bores, cam bearings, main bores, main

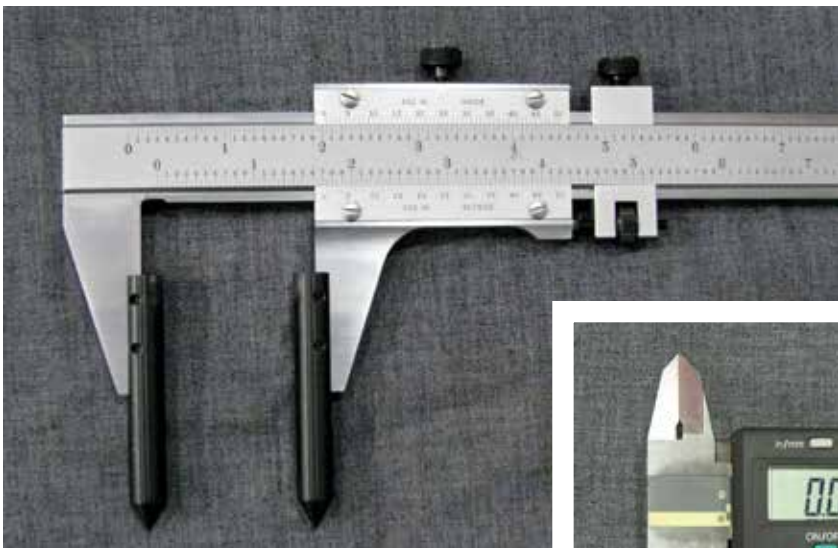
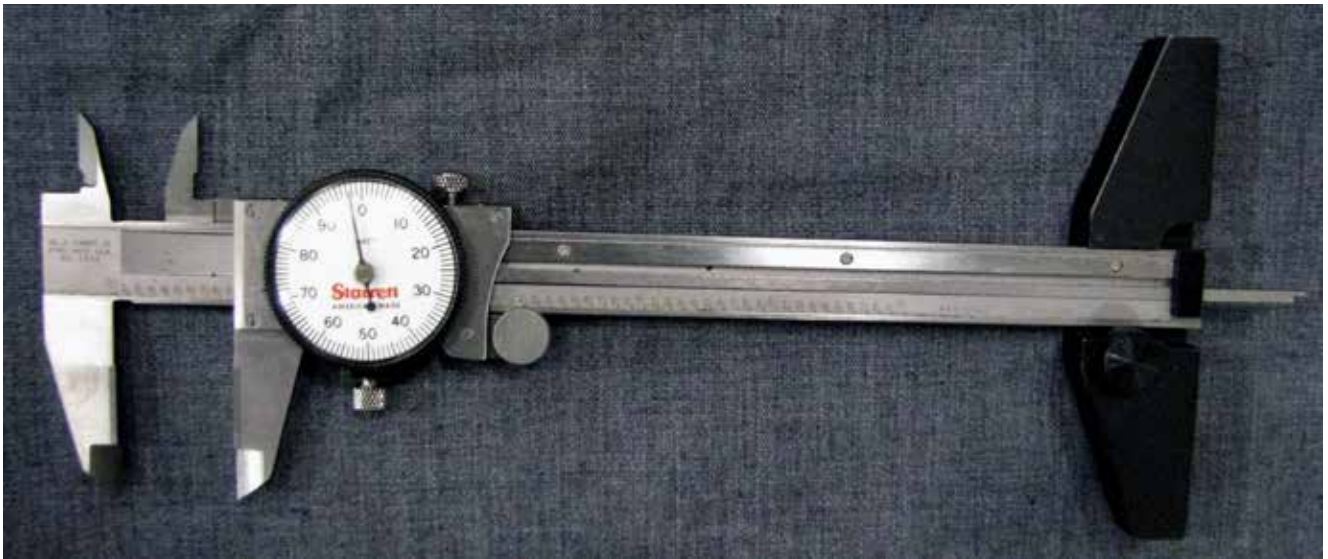


bearings, rod bores, rod bearings, cylinder bores, or any other hole that needs to be round and straight, you're going to have to have them. Plasti-gage has no place in a professional engine builder's arsenal. Most of it has sat on the shelf for so long that it's not even usable -- you'll know when it's brittle and the color has bled out into the paper it comes in. It's junk.



Dial, Vernier, and Digital Calipers

Calipers come in three major configurations: dial, vernier, and digital. I've pictured just a few of the accessories that are available -- there are others. The dial type reads out each .100 directly and the body of the caliper shows the inch and tenth of an inch divisions. The digital versions are nice because they read out directly. The vernier scale reads like any other vernier in that the marks that line up represent the reading. In this case, 1.742 lines up best on the outside (lower) scale. Make sure you check the accuracy of your calipers periodically by using your gauge blocks as a standard. You can stack gauge blocks to get a longer calibration length.





Micrometer Stand

(Above) Another must-have. It keeps your body heat from affecting the accuracy of the micrometer and it's invaluable for setting up your dial bore gauges. It's a third hand that makes your life a lot easier.

Reading Tenths

(Below) The marks on the thimble and the barrel are the standard graduations you see on every micrometer. The additional lines that run lengthwise along the barrel make up a vernier scale that reads out in ten-thousandths of an inch. Carbide faces are the only way to go for long tool life.



Thread Micrometer

(Above) I mark each rod bolt with its location, measure each using this Mitutoyo thread micrometer, then record the overall length of each bolt prior to assembly. The pointed ends of the micrometer fit into the stretch measuring dimples of the bolt. If a bolt remains stretched after removal it's discarded. Rod bolts, valve springs, rings, bearings, spark plugs, engine oil, oil filters, gaskets, and seals are all consumable parts of a race engine.



Dial Indicators

Indicators come in a lot of types. There are lug back, direct, and indirect reading and a lot of face sizes to choose from. The two inch is mounted in the bridge flanked with a one inch and a six inch. If you've got a good eye, you can interpolate between the ticks and come up with readings within a few ten thousandths of an inch.



Spring Cup and Washer Pickup Tools

Ever try to recover those washers or valve spring cups from an oily engine? The oil sticks the washer down as if it were glue. Rare earth magnets embedded in an aluminum handle make short work of it.



Piston Stuffers

(Right) These aren't a lot of money individually, but at about \$50 each they add up when you have to buy one for each engine bore size that you work on. They are the only way to load pistons and rings into a block.



High-Pressure Valve Spring Compressor

Another great tool by Buxton Engineering. This is without a doubt the best tool I've ever used for removing racing valve springs, and there is a bunch of adapters to fit nearly any application. Even valve springs that measure 450-500 lbs. seat pressure are easily removed. Yet another must-have.



High-Tech Compression Gauge

Compression gauges are another one of those tools that I've had several of over the years and accuracy has always been a question. This is a homemade unit, using bits from Snap-on and an Ashcroft 500 pound $\frac{1}{4}$ percent of scale accuracy gauge. Make sure if you try to replicate this that you spec the gauge correctly. It has to be tolerant of some pretty serious transient pressure surges. I was on a quest to verify my dynamic compression ratio software accuracy when I built this. The software is dead-on, by the way. That will become more important to you later when you're trying to build performance pump-gas engines and you're trying to find the upper compression limits you can run.



SPI Squares

(Left) There will be a number of times during a build that you'll need to confirm that parts are aligned or square with one another. A small machinist's square set like this is just the ticket.

Testing Valve Springs

Valve springs need a lot of love. They are some of the most highly stressed and failure prone parts of a performance engine. I use a Buxton for balancing the springs by measuring all the inners and outers and matching the lower reading inners with the higher reading outers. They are then tested on the Compuspring after cycling them through five or six bind cycles, then the spring output is printed. All the springs for this application were between 271 and 280 lbs. on the seat. The open pressures vary a bit more in part because this cam has different lift on the intake and exhaust and because the rate per inch varies a bit from spring to spring.



Compuspring Software, Power Technology, Stillman, CA 415-881-7777

2 - Results of Measured Intake or Exhaust Valves
 A.100 - Intake Valve Lift (Valve Fully Open)
 C.400 - Exhaust Valve Lift (Valve Fully Open)
 S.410 - Valve Retention Threshold

VALVE #	INSTR	VALVE	SEAT	INSTR	SEAT	INSTR	SEAT	INSTR	SEAT
INTAKE 1	276	1.830	762	1.128	1.070	0.058	688		
EXHAUST 2	271	1.830	768	1.137	1.080	0.057	616		
INTAKE 3	278	1.842	733	1.138	1.095	0.043	629		
EXHAUST 4	275	1.830	724	1.131	1.085	0.046	647		
INTAKE 5	271	1.840	728	1.136	1.040	0.096	649		
EXHAUST 6	276	1.830	724	1.132	1.075	0.057	655		
INTAKE 7	274	1.825	724	1.126	1.046	0.080	655		
EXHAUST 8	276	1.830	737	1.126	1.046	0.080	672		
INTAKE 9	272	1.840	733	1.147	1.075	0.072	672		
EXHAUST 10	276	1.830	742	1.126	1.045	0.081	640		
INTAKE 11	276	1.835	748	1.142	1.075	0.067	711		
EXHAUST 12	273	1.835	738	1.131	1.045	0.086	650		
INTAKE 13	277	1.835	730	1.137	1.080	0.057	659		
EXHAUST 14	279	1.820	745	1.116	1.090	0.026	682		
INTAKE 15	280	1.810	752	1.117	1.090	0.027	682		
EXHAUST 16	276	1.830	755	1.126	1.090	0.036	647		
INTAKE 17	271	1.840	740	1.147	1.070	0.077	677		

Testing Valve Springs (Cont.)



Modified ARP Bolt Stretch Gauge

Never torque rod bolts, always stretch them whenever you can. I have run into manufacturers who want you to torque their bolts, but in my mind that sounds like a no-confidence vote for their own product. Stretch must be accomplished in one pull -- never pull, measure, pull, measure, and so on as you'll only ruin the bolt. Don't forget to re-apply lube on the threads and under the bolt head before the next tightening attempt.



Scales

The big scale is handy for finding the assembled weight of your engine. You can measure over 150 lbs. by placing one end on a block the same thickness as the scale bed and the other end on the scale, and then swapping ends and adding the results together. The 3000 gram scale is used for weighing pistons, pins, rings, bearings and other small parts. Note the precision test standards that are used to calibrate the small scale.





LMS Valve Adjuster Tool

Makes adjusting the valves a snap. It's a calibrated clicker-style torque wrench that snaps over at twenty pounds-feet.



Ring Grinder and Switch Box

This variable speed unit uses a diamond grinding wheel and a flat turntable to mount the ring perfectly perpendicular to the grinding wheel. A dial indicator tells you exactly how much material you've got left to remove. I didn't like snapping the little toggle switch on this unit on and off, so I built a switch box to put in series with the grinder. If my switchbox fails, new parts are as close as the nearest big box hardware retailer.

Degree Wheel

(Right) A degree wheel and a good pointer is essential to finding TDC and degreeing in the cam. Every racing engine builder has one. The larger the diameter of the degree wheel the more accurate it is.



Thread Chaser Kit

(Below) Every hole, every bolt, every threaded fastener must be checked. New block, old block, new part, or old part -- check them all. I promise you it'll save your hindparts one day. ■



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