

Workshop

TAKING EXTREME MEASURES

If you are seriously into engine work on British or American classics you'll need some accurate machinist's measuring tools that measure in inches, because all of the specs in the old manuals are expressed that way. Of course, you can calculate metric conversions, but that may lead to a lot of trouble and confusion. Besides, conversions can be tricky when you are dealing with such tiny measurements as 1/1,000 of an inch.

You see, 1/1000" or even less in some cases, can make the difference between whether an engine develops piston slap or seizes in the first 20 minutes of service. Also, a mere thousandth of inch can mean the difference between whether an engine can hold oil pressure at its rod and main bearings or whether it will slowly pound itself to bits.

Making such precise measurements may sound difficult, but it really isn't. Not if you have the right tools and know how to use them. I'm talking about micrometers, calipers, dial gauges and a good machinist's straight edge. Nothing fancy. These items can be a bit dear if you buy them new though, so we suggest you purchase them from retired mechanics or machinists, or find them at second hand tool stores.

Calipers

They're great for quick measurements and are completely adequate for most measuring jobs. They are easy to read, easy to use and very versatile. One set of blades measures inside dimensions and the other measures

outside dimensions. This would be the only tool you'd need for most purposes provided you didn't ever need to take measurements any finer than 1/1000 (0.001") of an inch. But occasionally you need to get closer than that.

Micrometers

When you must make truly precise measurements, you need micrometers, both inside and outside. Many are accurate to finer than .0003", so they are the last word in precision when measuring crankshaft journals, cylinder bores and camshaft lobes. And yes, even .0005" can be critical. For example, even on larger engines such as Chev small-block V8s, if the clearances at the piston skirts are more than .0025, the pistons will need to be replaced.

Large, multi-task micrometers are available that use screw-in extensions, but most machinists don't think much of them. They are inconvenient to use, and the possibility of error due to their components being screwed together is significant. Proper mikes only measure within a one inch range. The smallest and most versatile is the 0"-1" micrometer, but you'll also need a 1"-2", 2"-3", 3"-4" and a 4"-5" for measuring large diameter items such as pistons.

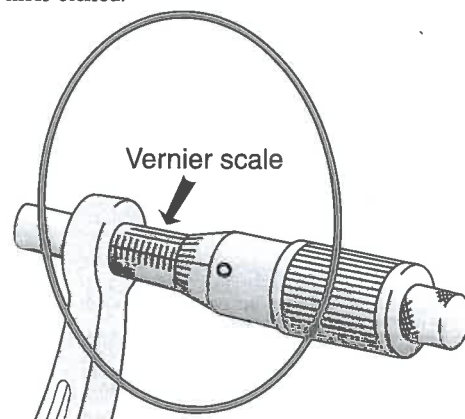
The digital alternative

Many mics come with vernier scales etched into them, but reading such scales can be a little confusing until you get used to it. In recent years, digital micrometers and calipers

have been developed that are easier to read. But digital measuring tools are more expensive and are hard to find used. They can also become a crutch that will limit you to using only digital tools. It's a little like learning to drive on an automatic and never mastering the art of shifting a standard transmission. Also, digital tools require batteries, and when they go dead, the tools are useless.

Learning to read

A precision screw inside the thimble of each micrometer is what makes precise measurements possible. This screw has 40 threads per inch. Thus one full turn on the thimble will close or open the micrometer 1/40 of an inch. And the decimal equivalent of 1/40 of an inch is .025". There are also 40 lines etched.



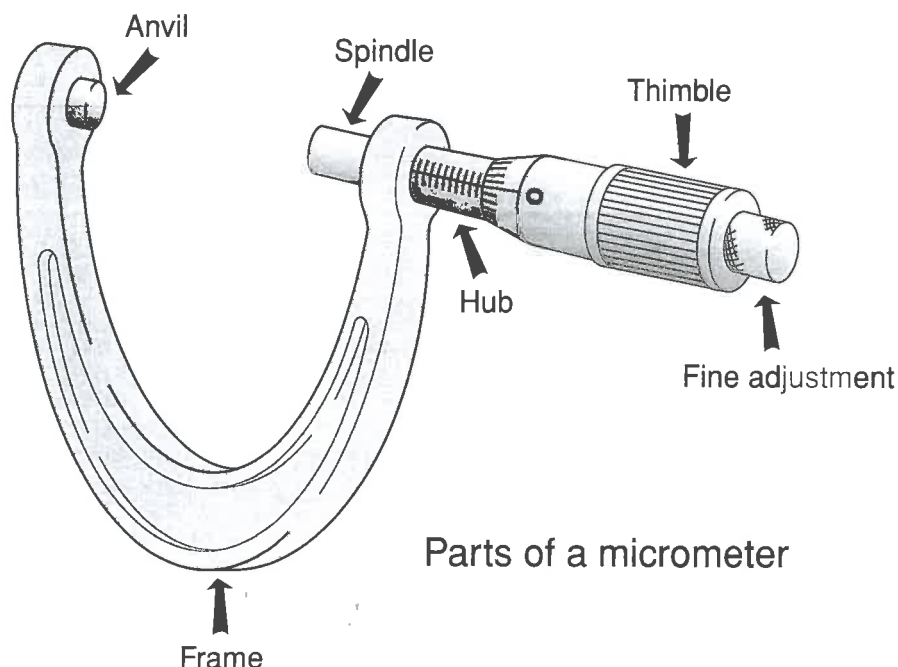
The scale in our illustration is shown here as if it were unwrapped from around the hub and thimble and placed flat on a table. In reality, you will have to rotate the instrument slightly to read the entire scale.

Adjust the thimble to a bit larger than the item to be measured, then turn the fine adjustment slowly until it clicks. Make sure the item to be adjusted is not slightly cockeyed between the thimble and anvil, then begin reading the scale.

Notice the lines on the hub. In the case of our diagram the thimble has moved out beyond the 2 mark but not quite to the next mark beyond it. Note down the number, which is 0.2000.

Next note the number on the thimble which most closely aligns with the line on the hub. In this case it is 22 or .0220.

Finally, find the line on the vernier scale that exactly lines up with one of the marks on the thimble. In this case it is the 3 line. This translates to .0003 or three ten-thousandths of an inch.



Barrel =	.2000
Thimble =	.0220
Vernier scale =	.0003
Total reading is	.2223

Precision micrometers can be purchased second-hand for a lot less than new, but you must verify their accuracy before you purchase them. Second hand shops often have used machine tools and will sell them for a fraction of their original cost, but make sure you get good ones, not cheap Chinese junk.

Also, make sure you pick up a set of measuring standards, which are little bars of steel ground to precise length the micrometer is intended to measure. If, when you check a prospective micrometer purchase with its standard, the lines don't line up exactly, don't buy the micrometer. Yes, you can have a used mic recalibrated by a pro, but that could cost more money than the used micrometer.

Measuring standards are also important to have so you can develop a feel for the micrometer. Most mics have a fine adjustment on the end of the thimble that will click when you have the right tension, but it is a good idea to learn to measure the measuring standards first in order to get the feel for the device. If you tighten a mic too much you can ruin it, and if you adjust it too loosely, your dimension will be too fat.

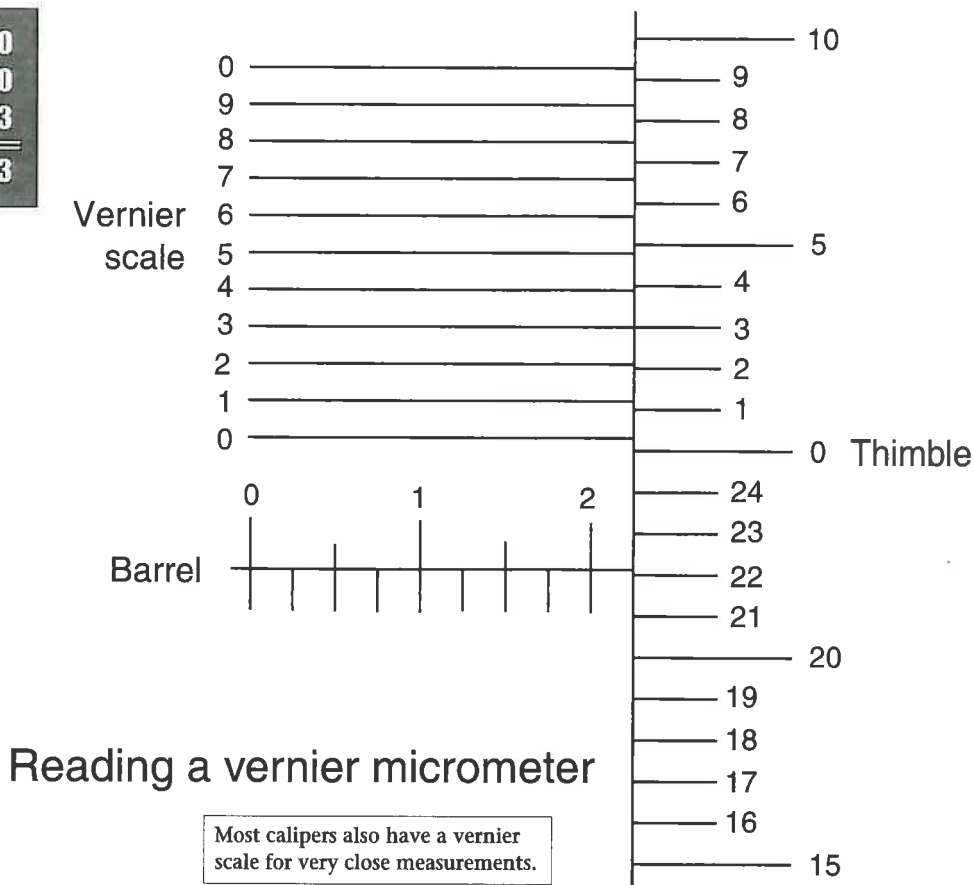
Dial indicator

A good dial indicator is virtually indispensable for careful engine work. They are the ideal tool for timing cams, determining valve lift, checking piston-to-deck clearances, crankshaft end play, and flywheel runout. You'll want a dial indicator that has at least an inch of travel and is marked off in .001" increments. When you purchase your dial indicator, be sure to pick up a good magnetic base as well. You'll want one with a minimum 90 pound pull so it will hold firm to the part on which it is placed.

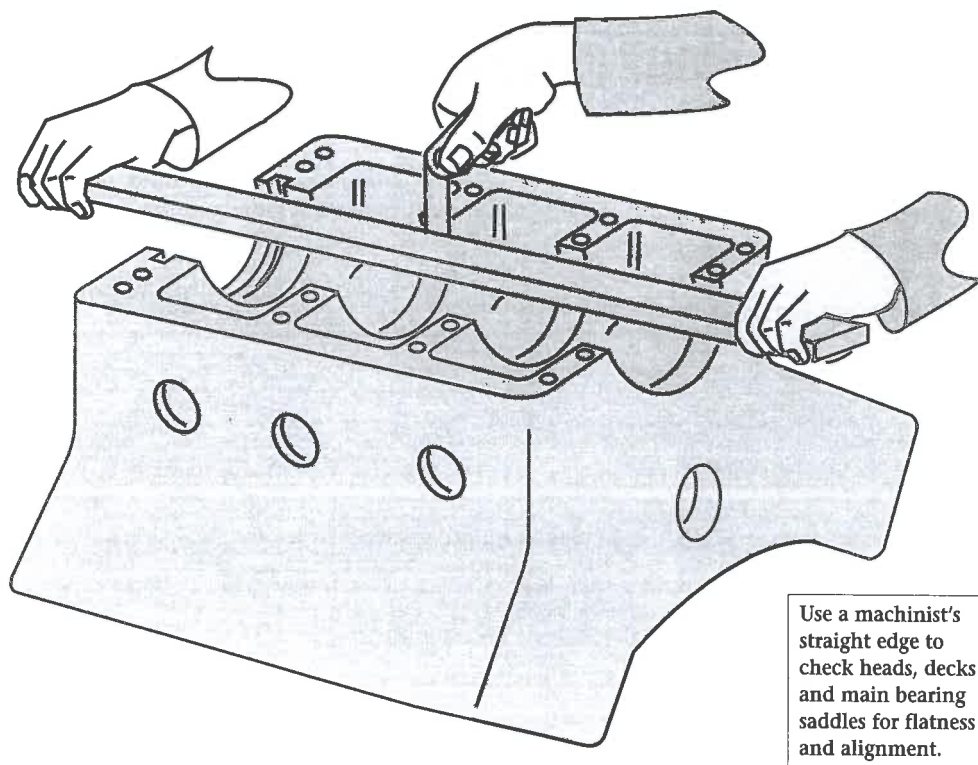
Machinist's straight edges

These are great for checking flatness of heads and decks. They are also great for determining whether an engine needs its main bearing journals align bored or not. Don't be tempted to use an ordinary straight edge because it may not be straight enough to give you an accurate reading.

You don't need all, or even any of these tools to build a classic engine, but the fewer measuring tools you have and know how to use, the more you will



Reading a vernier micrometer



need to depend on your machinist to tell you what is required, and the more you will have to trust that the job was done correctly. If you have ever had to pull a freshly overhauled engine out and tear it down again because the pistons didn't

fit, it wouldn't hold oil pressure, or because it developed an ominous knock due to something not fitting correctly, you can appreciate that checking a few measurements is no big deal by comparison. ■