Those Wonderful Spacer Blocks, version 2.1
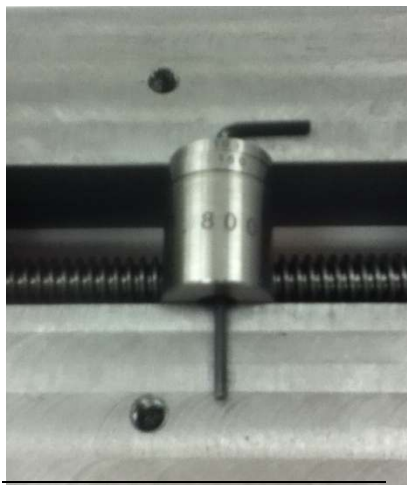
By R. G. Sparber

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I was able to buy a 36 piece spacer block set for around $40 during a past sale at Enco. This set enables me to make thicknesses between 0.150″ and about 3″ in steps of 0.001" within an accuracy of around ± 0.0001″ per block used.

If you have a gap to measure, it is a simple matter of finding a set of blocks that just fit and then increase the stack by 0.001″ and verify it does not fit. You then know the gap to within ± 0.001″.

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If you have a caliper of questionable accuracy but decent repeatability, you can use a stack of spacer blocks to measure within the resolution and repeatability of the caliper.

For example, my Harbor Freight® caliper has a resolution of $\pm$ 0.0005″ and excellent repeatability. I can measure an unknown with the caliper and then select a stack of spacer blocks to give me the same reading. Adding up the spacer blocks tells me the value of the unknown to within ±0.001″.

By using a sine bar, you can set angles very accurately with a stack of spacer blocks. The smallest angle that can be set using a 5″ sine bar is the arcsine of $(\frac{0.001″}{5″}) = 0.011°$. Going up by 0.001″ gives an angle of 0.023°. See below for how to set a height of 0.001″.

Of course, you can also use these spacer blocks to verify the accuracy of any caliper or micrometer you may have in your shop.

The spacer block set has blocks that increase by 0.001″, 0.010″, 0.100″, and two equal to 1.000″. The trick is to know how to select them to create the desired thickness. Without a strategy, you can go crazy trying to set a wanted height.

Let me first just show you how I build a stack 1.234″ tall. Then we will go through the logic.

I want   1.234″.
Pull: 0.104″   so   1.130″ left
Pull: 0.130″   so   1.000″ left
Pull: 1.000″   so 0″ left

Note that I work from the smallest number to the larger number and subtract each block from the running total as I go.
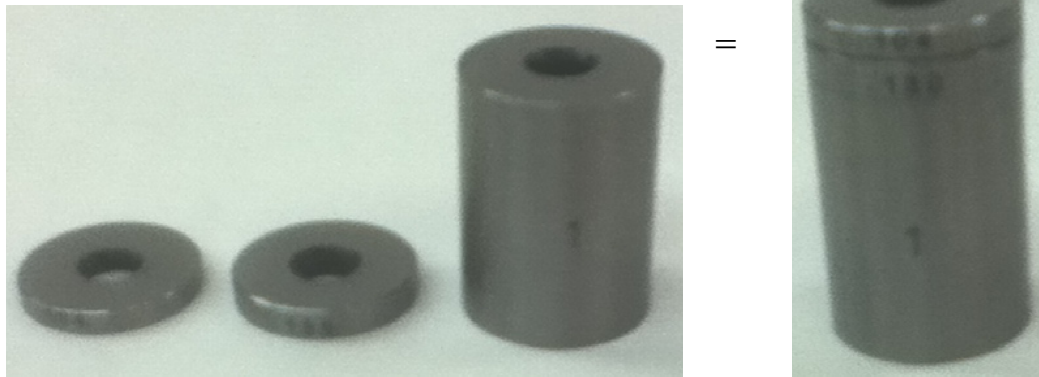

Here is the logic:

Say you want to select a stack of spacer blocks of value 1.234.

1. Start with the smallest non-zero number (4).
2. Find a block with that number in that position (0.104).
3. Subtract the thickness of that block from the value you want (1.234 – 0.104 = 1.130).
4. Go to the next larger non-zero number of what is left (3)
5. Find a block with that number in that position and zero in the previous position (0.130).
6. Subtract the thickness of that block from the value you have left (1.130 – 0.130 = 1.000)
7. Find a block with the next larger non-zero number of what is left (1)
8. Find a block with that number in that position plus zeros in the previous positions (1.000)
9. Subtract the thickness of that block from the value you have left (1.000 – 1.000 = 0)

With this approach you can create thicknesses as small as 0.150″.
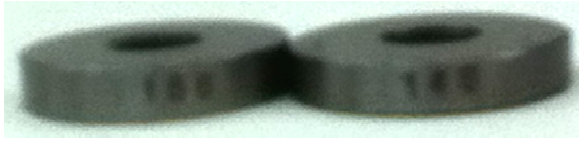
If you want to go smaller, you can place one block next to another and look at the difference. For example, say you want a step of 0.001″. Just pick a block from the 0.001″ group plus the one that is 0.001″ thicker. I could take the 0.103″ spacer and the 0.104″ spacer to get my 0.001″ step. Want a step of 0.003″? You could take 0.103″ spacer and the 0.106″ spacer.

After you have selected the spacer blocks, the mating surfaces must be very clean. Any swarf caught between blocks will throw you off. Use mineral spirits to clean the surfaces and then wipe it off with a lint free cloth. Press the blocks together and you are done.

After use, coat the blocks with a light machine oil to protect them from rust.

With my set, any given block is accurate to ± 0.0001″. In the worst case, stacking two blocks gives an overall accuracy of 2 times the accuracy of one block or ± 0.0002″. I typically have no more than 3 blocks so the overall accuracy in the worst case is ± 0.0003″.

Another way to figure the overall accuracy is to apply something called root mean squared[2]. For the case of my 3 blocks, RMS gives me an overall accuracy of ±0.00017″ or about ± 0.0002″. So we are mucking about with 0.0001″ in my hobby shop. I care about this degree of accuracy when checking my best caliper but for most work, assuming an accuracy of ± 0.0001″ per block is fine.

I welcome your comments and questions.

Thanks to William Abernathy for editing this article. English is my second language. I don't have a first one ;-). Thanks to Larry Rudd for finding a glaring error in the claim related to range of values attainable in a single stack.

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[2] See http://en.wikipedia.org/wiki/Root_mean_square