

Stacking Gage Blocks, version 2.3

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This article addresses how to stack gage blocks to produce a desired height. It does not deal with how to care for the blocks, where to use them, nor much of error analysis.



In most cases, a Grade B, 81 Gage Block set² is overkill for accuracy in a hobby shop. A Spacer set³ is probably all that a hobbyist will ever need. Yet I was able to buy a used gage block set for half the price of a new Spacer set.

This article presents a procedure that lets you stack gage blocks with minimal arithmetic. You will give up some accuracy but still be ahead of spacer blocks.

If you want the minimum number of blocks and therefore best accuracy, see Marv Koltz's excellent site (<http://www.myvirtualnetwork.com/mklotz/#misc>) and download the program SPACEBLK.

But first, let's tour the set. It can be broken into four sub-sets.

¹ You are free to distribute this article but not to change it.

² Accurate to ± 50 millionths of an inch per block with minimum step of 0.0001 inches.

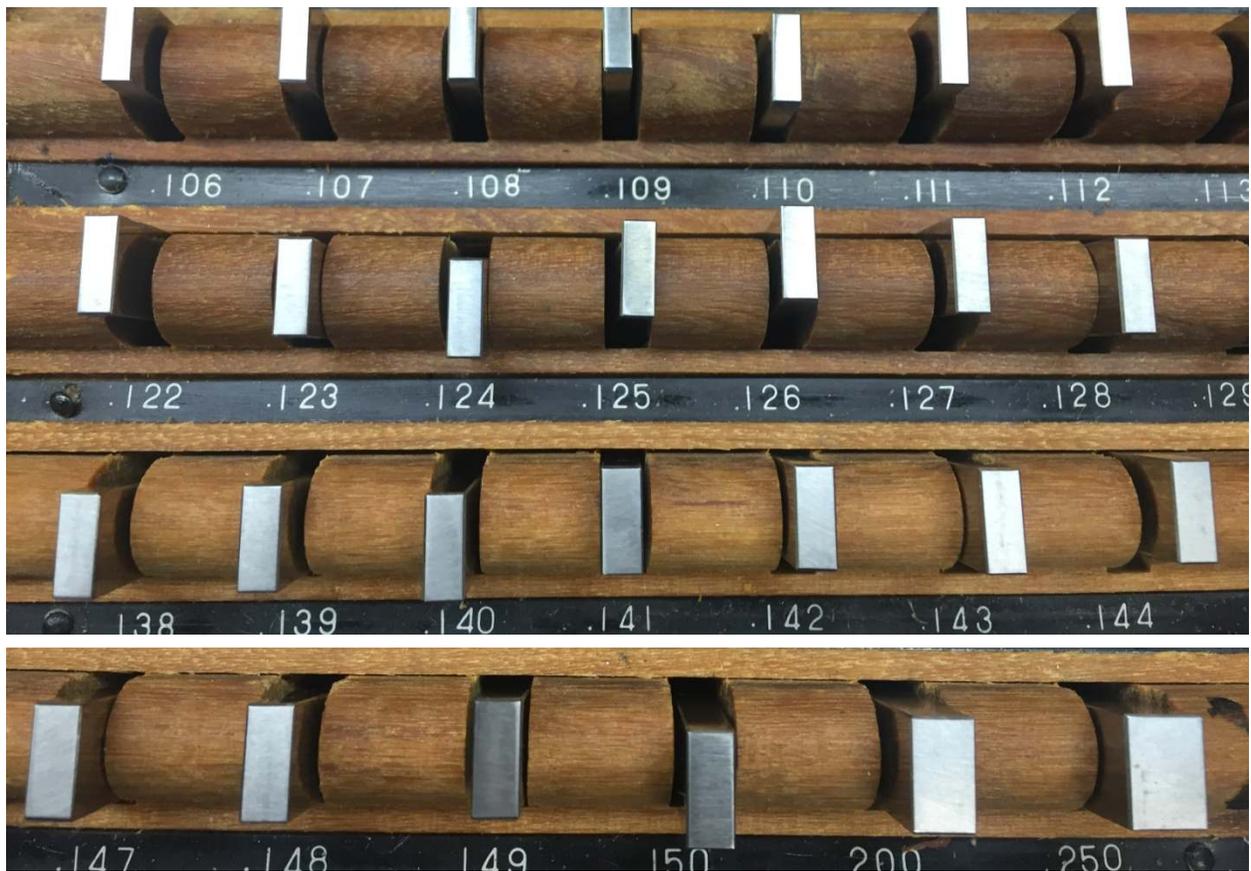
³ Accurate to ± 100 millionths of an inch per spacer with minimum step of 0.001 inches.



Starting at the upper left corner, we have the thinnest block at 0.050 inches. Then starts a sub-set that goes from 0.1000 to 0.1009.



After 0.1009 is the second sub-set which starts at 0.101.



This second sub-set increments by 0.001 inches. It takes us to 0.149 inches.



The third sub-set goes from 0.150 to 0.950 in steps of 0.05 inches.

The fourth sub-set contains 1.000 to 4.000 in steps of 1 inch.

Error

The most pessimistic way to estimate error is to deal with *absolute worst case*. This means simply summing the worst case error for each block.

One block has an error of ± 50 millionths of an inch. If you had a way to perfectly measure its thickness, you would see that it was somewhere between 50 millionths of an inch undersized and 50 millionths of an inch oversized.

Three blocks have an absolute worst case error of ± 150 millionths of an inch. Four blocks get us to ± 200 millionths of an inch. That is ± 2 tenths. So if you are thrilled to be within half a thou, you can forget about gage block error.

Now, on to the procedure!

Selecting Gage Blocks using Minimal Arithmetic

Overall rule: if a digit is 0, skip it.

For building **a.bcd**e I move from right to left:

1. Add 0.1 to **e**, select block
2. 0.1 to **d**, , select block
3. 0.1 to **c**, , select block
4. Take **a.b** and subtract 0.1 for each block selected. Select the needed blocks.

Examples:

Build 1.2345

1. **e** is 0.0005 Select **0.1005**
2. **d** is 0.004 Select **0.104**
3. **c** is 0.03 Select **0.130**
4. **a.b**: selected **3** blocks so $1.2 - 0.3 = 0.900$ for the last block.
Worst case error is ± 0.0002 inches.

Build 1.2502

1. **e** is 0.0002 Select **0.1002**
2. **d** is 0 so skip
3. **c** is 0.05 Select **0.150**
4. **a.b**: selected **2** blocks so $1.2 - 0.2 = 1.000$ for the last block.
Worst case error is ± 0.00015 inches.

Build 1.7523

1. **e** is 0.0003 Select **0.1003**
2. **d** is 0.002 Select **0.102**
3. **c** is 0.05 Select **0.150**
4. **a.b**: selected **3** blocks so $1.7 - 0.3 = 1.400$ so pick **0.400** and **1.000** for the last blocks.
Worst case error is ± 0.00025 inches.

Acknowledgements

Thanks to Marv Koltz for opening my eyes to the complexity of finding the minimum number of blocks. Thanks to Nelson Collar for shaking up my thinking. Thanks to John Herrmann for improving clarity in the block description.

I welcome your comments and questions. It is possible the procedure does not work correctly for specific stack heights. Let me know and I will correct it.

If you wish to be contacted each time I publish an article, email me with just "Article Alias" in the subject line.

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