Gage Blocks

Gage blocks were developed as a length standard evolving from the need to be able to have comparative measurements. Hundreds of years ago there were many different units of measure that were not based upon any agreed upon standard. The arguments that arose made obvious the need for accepted standards. Metrologists have used gage blocks for almost one hundred years and their basic design has remained the same for almost the same amount of time. Gage blocks typically come in two styles, square or rectangular and in three types of material. Steel, Tungsten Carbide or Ceramic. While steel are the leas expensive, they are the least durable. Tungsten Carbide are more expensive but have far greater wear characteristics. Ceramic Gage Blocks are the most expensive however they will not rust and have excellent wear characteristics. Unfortunately, Ceramic Gage Blocks are more brittle than Steel or Tungsten Carbide. When specifying gage blocks, please take these characteristics into consideration. Most companies use gage blocks as their masters thru which they obtain traceability to NIST. Please see our traceability section for details on traceability. Gage blocks are manufactured to the US Standard B89.1.9 or the formerly applicable Federal Standard GGG-G-15-C. The new B89.1.9 standard became effective in January of 2003. While it may seem that the new B89.1.9 specification has a significant wider tolerance, there is an important difference in the standards. The size tolerances of the new B89.1.9 standard applies to all the points on the gage surface not just to the reference point. The new B89.1.9 gage block grades are as follows: Grade 00, Grade 0, Grade AS1 and Grade AS2. Many people still use the even older Federal specification grades of AA and A whose use has been discontinued. Please see the Table One and Table Two for the old and new tolerance comparisons.

TABLE ONE	**B89.1.9 Grade 00**	**B89.1.9 Grade 0**	**B89.1.9 Grade AS1**	**B89.1.9 Grade AS2**
Thru .050 in.	+4 / -4	+6 / -6	+12 / -12	+24 / -24
Thru .400 in.	+3 / -3	+5 / -5	+8 / -8	+18 / -18
Thru 1.000 in.	+3 / -3	+6 / -6	+12 / -12	+24 / -24
Thru 2.000 in.	+4 / -4	+8 / -8	+16 / -16	+32 / -32
Thru 3.000 in.	+5 / -5	+10 / -10	+20 / -20	+40 / -40
Thru 4.000 in.	+6 / -6	+12 / -12	+24 / -24	+48 / -48

TABLE TWO	**GGG-G-15C Grade 0.5**	**GGG-G-15C Grade 1**	**GGG-G-15C Grade 2**	**GGG-G-15C Grade 3**
Thru 1.000 in.	+1 / -1	+2 / -2	+4 / -2	+8 / -4
Thru 2.000 in.	+2 / -2	+4 / -4	+8 / -4	+16 / -8
Thru 3.000 in.	+3 / -3	+5 / -5	+10 / -5	+20 / -10
Thru 4.000 in.	+4 / -4	+6 / -6	+12 / -6	+24 / -12

Notes on old or other standards

While GGG-G-15C has been superceded, it is expected that industry will probably continue to use those specifications for some time. GGG-G-15C was originally effective March 20, 1975.

Federal Specification GGG-G-15B was effective from November 6, 1970 thru 1975 and GGG-G-15A was used from 1964 thru 1970. The 15B and 15C Grades used the same nomenclature. However, the 15A Specification had the following grades specified: Grade AAA, AA, A+, A and B.

It is also not uncommon today to see the reference grade of "Toolroom" which typically means the gage blocks tolerances are + / - Fifty millionths (.000050").

Notes on Gage Block Usage

Gage blocks are precision measuring tools and need to be kept clean. Gage blocks are stacked, or wrung together to obtain a specific size. A common 81 piece gage block set is designed so that you can stack any size from .1000 thru 4.000 In increments of .0001" by stacking no more than four blocks together. The trick to selecting blocks from the box is to eliminate the right hand figure or digit of the size you are looking for and then work your way to the left. An example would be like this: Target size 1.7849 First eliminate the 9 by choosing the .1009 block

Balance = 1.6840

Second eliminate the 4 by choosing the .1340 block

Balance = 1.5500

Third eliminate the 5 (yes I know, it originally was an eight but your options for second digit are 0 or five so you work it out that way, it really isn't hard. Or you can buy a simple piece of software to figure it for you) by choosing the .5500 block.

Balance = 1.0000

Fourth eliminate the 1 by choosing the 1.0000 block and you get: 1.0000 + .5500 + .1340 + 1009 = 1.7849

Wringing gage blocks together can best be accomplished by practice and using this procedure:

1. Clean with mineral spirits and lint free rag.
2. Place another clean dry lint free rag on a flat surface like a surface plate and drop two small drops of very light oil (like a CRC 3-36 Technical Grade Oil) on one area of the cloth.
3. Rub the clean block's measuring surface on the oil and then on a clean area of the rag using a figure 8 motion to clean off any excess oil. Slide the Gage Block on to the other Gage Block (or wringing block) similarly prepared and rotate the top block 90 degrees and then

back to the matched position.

Note that dropping or abusing gage blocks is bad. If a burr raises on the surface of the block there are Gage Block conditioning stones that may be very gently used to remove the burr.

Temperature

Gage Blocks grow as temperature increases. The amount this will affect your measurements is contingent on the type of Gage Blocks and amount of temperature change. Gage Steel that is made of 52100 steel has a coefficient of expansion of 6.4 microinches per degree F increase in size. Other materials have different expansion rates. Standard Gaging temperature is 20 C or 68 deg F. While these amounts seem small, they can grow quickly depending on the size of the part you are measuring. Don't forget to consider temperature because some materials, like aluminum have extremely large coefficients of expansion.

Recalibration

While each company specifies their own periods for recalibration a guideline that many companies use was stated in the GGG-G-15C standard as Grade 0.5 and Grade 1 as Annually Grade 2 as Monthly to Semiannually and Grade 3 as Monthly to Quarterly.

Substitution of Grades for new Standard

ASME B89.1.9-2002 appendix B has the following suggested replacement grade table:

GGG-G-15C	1	2	3	N/A
B89.1.9-2	00	0	AS-1	AS-2