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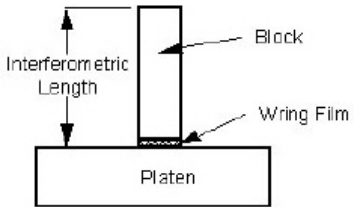
Wringability and Gage Blocks

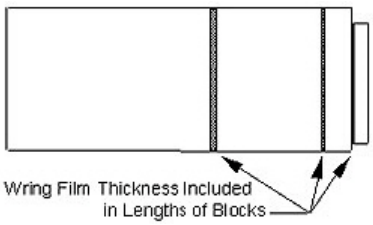
By Dave Friedel, General Manager of Starrett's Webber Gage Division

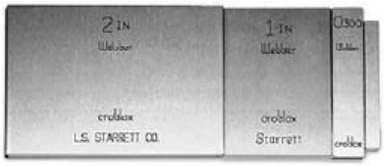
Wringability is an important property of gage blocks. In fact, gage block specifications recommend replacing blocks that have lost their ability to wring. Not everyone uses gage blocks in wrung combinations, but wringability is a test on the integrity of the surface condition of the gage block. Gage blocks that don't wring may give erratic and unreliable results.

The fact that gage blocks wring is incorporated into the lengths of the blocks themselves. Gage block length is defined as an interferometric measurement when the gage block is wrung to a flat platen. This includes one wringing film in the defined length of the gage block.



This definition is very useful. When gage blocks are assembled in combinations, no additional correction factor for wringing films needs to be added to the length of the combination.





Wringability itself may be defined as the ability of two surfaces to adhere tightly to each other in the absence of external means. (They are not magnetized or clamped together.)

Wringing requires two smooth, flat surfaces with surface finishes of 1 microinch AA or better. For gage blocks, it becomes difficult to wring surfaces if the flatness starts to exceed 5 microinches. The sources of the forces holding gage blocks together are thought to come from:

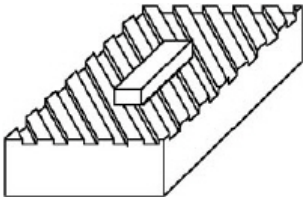
1. 1) Air pressure from the surrounding environment as the air is squeezed out when the blocks are slid together.
2. Surface tension from oil that remains on the gage blocks or water vapor from the air acts as a glue to hold them together.
3. When two very flat surfaces are brought into such close contact with each other, this allows an interchange of electrons between the atoms of the separate blocks, which creates an attractive molecular force. (This force will remain even in a vacuum or if no oil or water is present on the blocks.)

The last two sources are thought to be the most significant.

Preparation of Gage Blocks Prior to Wringing

Make sure that the blocks to be wrung are free from nicks and burrs. It is important that all nicks and burrs be removed BEFORE attempting to wring blocks together because a burr on one block may damage the surface of the other block.

Blocks may be checked for burrs with a gage block stone before wringing. A gage block stone with serrated grooves is recommended because it gives a better "feel" for nicks and burrs that catch the edges of the serrations. Badly nicked surfaces will click as a nick passes along the serrations.



Helpful Hint: *Gage block stones may pick up foreign material that may embed in the grain of the stone. These foreign particles may scratch the blocks. Gage Block Stones should be conditioned before use. This may be done by lightly rubbing the surfaces of two stones together in a figure-eight pattern. Clean the stones with kerosene before use.*

Stoning Gage Blocks

Stoning Gage Blocks Will stoning a gage block change its size? The answer to that question is No . . . and Yes. It depends largely on the condition of a block. A block in good condition will not be affected by light stoning. The purpose of stoning is to remove portions of the block that have been raised above the true gage surface by nicks or scratches which can contribute to more variation during calibration or large readings. Stoning will remove this small amount of raised material. Repeatability of readings is improved, and sizes appear to be truer to their original tolerances. Blocks will wring together better.

1. Stoning is to be performed only on used gage blocks where the surface finish may be degraded by scratches or small nicks.
2. Make sure the stone is clean and dry--free from any dirt or abrasive compound. Abrasives on the stone may lap the block and significantly alter its size.
3. With a light amount of pressure, stroke the block across the serration two or three times. (Forward, back, and forward.) It is not recommended that more than light pressure be used unless necessary to remove nicks and burrs.
4. Listen and feel for nicks and burrs that might be present. If the block glides easily across the stone without a scraping sound or clicking or jumping across the serration, then stop. Flip the block over, and repeat on the other side.
5. If nicks and burrs are detected, repeat the procedure but not more than twice more. The pressure may be increased each time as needed to try to remove the nicks and burrs. Use not more then seven strokes per session.
6. If repeated attempts are unsuccessful at removing the burrs, examine the block for damage. It is not likely a block would be wringable in this condition

Rusted Gage Blocks

The condition of rusty blocks may be greatly improved by stoning the blocks after the stone has been wetted with kerosene. While this may temporarily improve the utility of the block, this will not permanently remove the corrosion or halt its advance.

1. Take a cotton swab and dampen it with kerosene.
2. Wipe the stone with the dampened swab. A film of kerosene should be seen on the stone, but the stone should not be dripping wet.
3. Stone as before, using whatever pressure is necessary. It may be necessary to be quite aggressive to remove the corrosion.

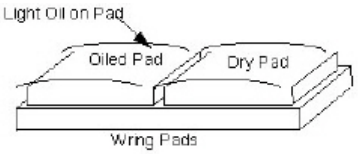
Stoning Pressures

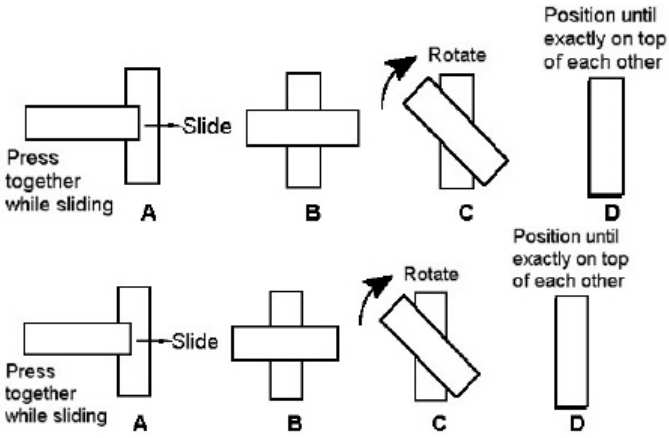
Light Stoning: 1 – 1.5 lbs
Medium Stoning: 2.5 – 3.5 lbs
Heavy Stoning: > 6 lbs

1. If the corrosion cannot be removed after repeated tries, then the block is considered to be damaged.
2. Keep the stone dampened as the kerosene evaporates.

Wringing Gage Blocks

1. Make sure that blocks are clean.
2. Wipe the surfaces of the blocks to be wrung gently across the oiled Wring Pad. (See figures below.)
3. Wipe these surfaces on the dry pad, removing as much oil as possible.
4. Slide the surfaces of the blocks together as shown. Apply pressure while sliding the blocks. The blocks should slide together without any feel of bumps or scratching, and should adhere to each other strongly after being rotated into place.





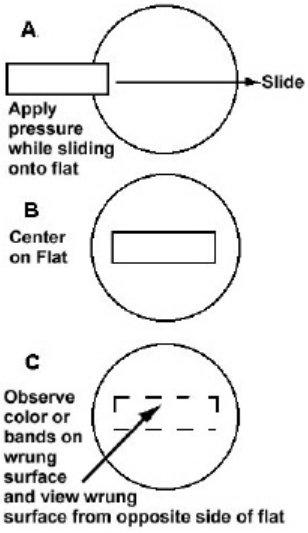
Testing Wringability of Gage Blocks

There is a formal test for wringability as described below. This test may be done by the user of the blocks, and does not require a laboratory to perform the test. This test is only usually done if a problem with a block is suspected.

To test gage blocks for wringability, a 2 Inch Diameter, Reference Grade (1 microinch flatness) Quartz Optical Flat should be used. A Double Sided Flat is recommended if more than 40 blocks are to be tested. (A double-sided flat does not add to the accuracy of measurement. It provides a second wringing surface if the first surface becomes scratched while wringing blocks to the flat.)

1. As before, prepare the blocks for wringing.
2. Wipe the surface of the Optical Flat gently across the oiled Wring Pad.
3. Wipe the surface of the flat gently across the dry pad.
4. Slide the test block onto the flat as shown. Apply pressure while sliding the block and flat together.
5. Observe the surface of the gage block that is wrung to the Optical Flat from the opposite side of the flat. Repeat this step as necessary to ensure a valid result.
6. Interpret results:
    1. For Federal Grades 0.5, 1, and 2, and ISO Grades K, 00, and 0, no color or oil should appear on the face of the flat.
    2. For Federal Grade 3 or ISO Grades 1 and 2, the surface shall not have less than 80% colorless wringing area.
7. Repeat for the other surface of the test block.

This test (at right) may be difficult to apply to gage blocks that are not almost perfectly flat. This includes thinner gage blocks that are less than .100" or 2.5 mm thick, which are not usually, flat in their free state. This includes most gage blocks in metric sets.



Wringability is an important property of gage blocks, but is fortunately a quality that can be controlled and monitored readily by the user of the blocks. With proper use and care, gage blocks will provide long, reliable, accurate service.

David Friedel is General Manager and Quality Assurance Manager of the Webber Gage Division of the L. S. Starrett Company. The Webber Gage Division specializes in the manufacture and calibration of gage blocks. Mr. Friedel has been active with the American Society of Mechanical Engineer's B89 Codes and Standards Committee for twenty years, and is the current chairman of the B89.1.2 Working Group for Measuring Gage Blocks by Comparison Methods.

The L.S. Starrett Company
121 Crescent Street, Athol, MA 01331
Telephone: (978) 249-3551 Fax: (978) 249-8495