Sieves: Making the Grade, Part 2

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Now that you have had plenty of time to read "Making the Grade Part 1" and familiarize yourselves with sieve-related terminology, literature, and requirements, we will explore sieves a bit more in depth. In this article, I will explore the values in Table 1 of *ASTM E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves*, explain the check requirements, and discuss sieve use in conjunction with mechanical shakers. I will also share some creative tips for repurposing your out-of-service sieves.

A Valuable Discussion

You may have noticed that *ASTM E11* Table 1 has a *lot* of information in it. Contrary to appearance, the values listed in columns 1 through 15 are not arbitrarily thrown together. The Standard Designation (Column 1) is the official reference for fractionations. There were several classification systems developed over the later 19th and early 20th centuries. The Udden-Wentworth scale, developed in 1922, and phi (Φ), developed by Krumbein in 1934, are two examples. The U.S. Standard (ASTM) sieve designations are those listed in ASTM E11. To view a correlation between Wentworth, U.S. Standard, Tyler, Φ, and other physical properties of particles, see the U.S. Geological Survey's Gradation Correlation Chart.

Standardizations and Checks

Sieve opening checks

To fully conform to the requirements of *AASHTO R 18*, you must maintain and check your sieves. I will get to maintenance a little later. For now, let's concentrate on "checks." You may have received a nonconformity during an AASHTO re:source on-site assessment that stated something along the lines of "Calibration, standardization, or check records were not presented for X, Y, and Z." Or, maybe it said something like "The calibration, standardization or check records presented for X-Y-Z equipment did not include measurements of critical dimensions." Maybe you are saying, "Yes, I have gotten that note! What's with all the verbiage?!" Don't worry. Whether you "calibrate", "standardize", or "check" something depends on the particular piece of equipment. For individual sieves, you always need to *check* the openings. For sieves sized No. 4 and greater, you must use a readable measuring tool to perform this task. (I will get into what I mean by "readable measuring tool" later.) Regardless of whether you have an in-house check procedure, or you reference *ASTM E11*, you must record the actual measurements of the required number of openings. Refer to your in-house sieve check procedure to confirm how many openings to measure and record. As I said in my previous article, make sure you are following *your* procedure – the AASHTO re:source assessors will be checking!

When you are taking your sieve measurements, you should compare them to columns 4 and 5 in Table 1 of *ASTM E11*. Column 4 (±Y Variation for Average Opening) shows you the maximum allowable tolerance for the average openings for all of your measurements. Column 5 (+X Maximum Variation for Opening) shows you the maximum allowable deviation for one opening before that sieve must be placed out of service. For example, if you measure ten openings on your No. 4 (4.75 mm) sieve, and the average of those ten openings is 4.85 mm, without any of them exceeding 5.16 mm (4.75 mm plus 0.41 mm), then you may keep that sieve in use. If the average is 4.85 mm, but you have even one opening exceeding 5.16 mm, then that sieve must be removed from service.

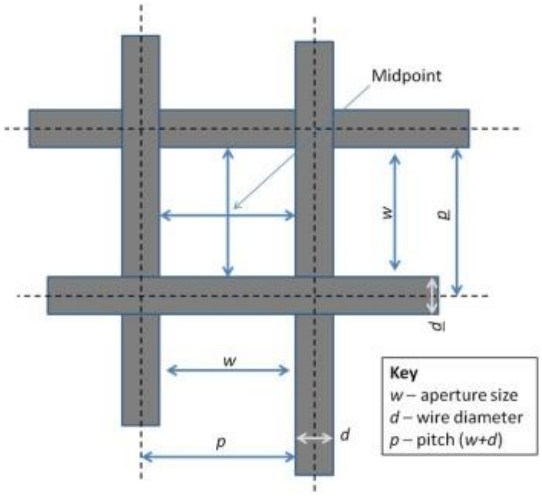
(1)	(2)	(3)	(4)	(5)
Sieve Designation		Nominal Sieve Opening (in.)	±Y Variation for Average Opening	±X Maximum Variation for Opening
Standard	Alternative			
millimeter		inches	millimeter	millimeter
4.75	No. 4	0.187	0.150	0.41

Excerpt from ASTM E11

Typically, you will not find a sieve where just one opening is that far out of spec. Why? Because the openings (or apertures) are connected! Have you ever walked through a screen door? Me neither. Maybe your cat has. Well, if you look at the screen afterward, there is usually a wide open hole, surrounded by other deformed areas.

How do I measure?

You may wish to try the method that AASHTO re:source assessors use to measure sieves No. 4 and larger. First, identify which screen you are measuring and what the required dimensions are. Have a pen or a friend ready to record. Hold the screen upside down, and, using the internal measurement side of your vernier calipers, measure the midpoint of the designated number of openings. Apply enough pressure so that the calipers are held snug, but



not so much that you will deform your sieves or damage your calipers. This is the hard part: read the measurement while holding the calipers in place. For right-handed people, this means reading the numbers upside down on many models of calipers, so try standing on your head. Record all measured dimensions.

For sieves with mesh finer than No. 4, you may perform a visual inspection. Some people prefer to use a magnifying device, such as an eye comparator, or loupe.

To use one of these devices, hold the eye-side of the comparator all the way up to your eyeball. Carefully bring the screen closer to the opposite side of the eye piece until the two come in contact. You should also perform a visual check to make sure that the finer openings aren't clogged with material.

In addition to checking the individual openings, you may also perform an acceptance test based on *ASTM E2427, Standard Test Method for Acceptance by Performance Testing for Sieves*. For this type of analysis, you will need an inspection or calibration sieve, as well as a compliance sieve. (For more information on inspection, calibration, and compliance sieves, see "Making the Grade Part 1." You will also need reference material which you can purchase or prepare yourself. AASHTO re:source sells extra proficiency samples XPS that can be used for this purpose.

To standardize a sieve or sieve set, you are essentially comparing the performance of a set of high-precision sieves to the set you would use on a daily basis. For the majority of the labs we encounter, this might not be a worthwhile option, as it can be costly and time consuming without providing much information vital to day-to-day operations. This type of analysis might prove useful to a much larger facility, if the organization wanted to see how sieves in difference testing sections compared to each other. Also, a third party may perform this type of standardization if questionable testing results occur.

So, did you just check your mechanical shaker, or did you standardize your sieves? If you verified that the timer is functioning properly on the shaker and established a shake time for your aggregates, showing that there is sufficient separation of particles without causing them to degrade, then you have just checked your mechanical shaker for sieving sufficiency. If you compared reference material gradation results using a set of high precision sieves and your normal-use sieves, then you have just standardized your sieves. Remember, you still need to perform an annual check of the sieve openings.

Readable Measuring Tools

If you have actually been reading this article or have read Part 1 of this article, you may have noticed that I mentioned that you have to record measured data. *AASHTO R 18* specifically requires that measured data be recorded on equipment records. For this reason, you must use a tool that can accurately measure the sieve openings. The vast majority of people performing in-house sieve checks will use a set of traceable vernier calipers for this purpose. You may also use an eye comparator with a scale attached for finer sieves.

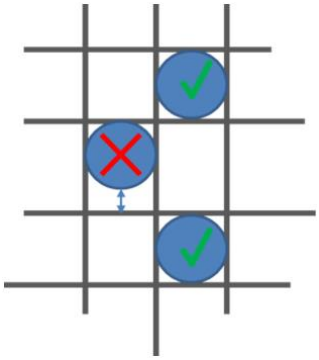
Go-No-Go Gauges

For those of you who don't know what I'm talking about, a go-no-go gauge is very similar to a ring-sizer. It's either a wand-like or stepped gauge that you insert into the openings of your sieve. If the sieve wires fall between the designated lines of the gauge, it is designated either "go" or "no-go." Using these is a quick way to determine whether your sieve openings meet the specifications.

A Go-No-Go Gauge is Similar to a Ring Sizer

Unfortunately, the go-no-go gauge is a no-go for checking sieves. There are several reasons that the use of a go-no-go gauge as a means of checking sieve openings is not sufficient to meet the requirements.

- These devices only tell you whether a sieve opening is good or no good based on the scale used on the gauge. You have no way to write down the measured dimension, which, as I have said before, is a requirement of *AASHTO R 18*. If your doctor asked you how much you weighed, would you tell him or her your pants size? Maybe you would look in your closet to find the largest and smallest pair of pants you own and report that you are somewhere between a 38 and 42, or an 8 to 12, depending on the brand. Telling your doctor the size clothes you can fit into does not give him the information he needs, which is your actual weight.



- The go-no-go-gauges are not an acceptable means by which to perform your annual sieve checks because of the likelihood of encountering a non-square opening. In Figure X, you can see that in the course of checking three openings, the opening with the red X does not register as being out of spec. The narrowest part of the gauge would measure the narrowest part of the opening, and not account for variability in a rectangular-shaped opening. While the diagram is an exaggeration, this could very well happen, and you would have no idea that you have an opening that is far too large to be acceptable.

Hand Sieving vs. Mechanical Sieving

Sieving by hand can be an efficient way to quickly separate a sample to obtain a certain size material, but is it really the way you should be performing your gradations? While it is allowed in *AASHTO T 27* and *ASTM C136*, it may not be the most repeatable method. Depending on the type of work you do, you may be performing dozens of gradations a day. Not only would your arms get tired from all that shaking, but there is a chance that the sieving adequacy requirements might not be met. If you are going to choose manual agitation over mechanical, keep in mind that holding a sieve stack at the top, and shaking it back and forth using the pan as an axis point, will likely result in falsely low numbers on your finer screens. This is because the coarser screens at the top are traveling much farther during agitation than the fine mesh screens that are probably only wobbling. If you use this method, make sure to perform a one-minute hand-check on each sieve to ensure adequate sieving, as specified in *T 27* and *C136*.

A mechanical shaker can save time and provide more consistent results, as long as it is being used properly. Ideally, you should establish agitation periods for different types of aggregate if you experience a variety, and ensure that you actually adhere to them. Those of you accredited for ASTM C1077 (Aggregate) should already be adhering to this requirement. If your shaker is supposed to be anchored to the floor or counter, make sure it is. Also, keep up with regular equipment maintenance as required by *AASHTO R 18*.

Regardless of whether you hand-sieve or use a mechanical shaker, you should always refer to Table 1 in *AASHTO T 27* and *ASTM C136* for the maximum allowable amount of material retained on the screens.

Goodbye is Not Forever – Go Green!

Just because you can no longer use a sieve for testing doesn't mean you have to toss it in the trash. These days, there are tons of things you can do to reuse and recycle! Sometimes you will have to cut the screen out and just use that part, or only use the frame. Here are a few ideas:

- Sell them to a metal recycling facility.
- Remove the screen and use it as a drain cover to keep rocks and jewelry out of your pipes.
- Use the removed screen as a baffle on a hot plate to prevent localized overheating or burning.
- Affix large screens to your wash bowls to aid in the decanting process. Cut out a semi-circle so that it fits the shape of your wash bowl, then weld or glue in place.
- Go panning for gold or play in the sand at the beach.
- Keep leaves and rodents out of downspouts.
- Use sieves as dividers in the oven to keep samples separated, or use them as carrying trays when removing samples from the oven.
- Attach a handle to a coarse screen and use it as a comb to work moisture through soil and sand, or to scarify compacted surfaces (where specified).
- Use a whole sieve to keep track of your tools while working on a car or painting.
- Use large, deep sieves as garbage cans.