

An answer the age old conundrum...

Is a .5-micron diamond paste 25,000 or 60,000 grit? And why both answers are correct!

I spent a goodly amount of time recently trying to put some reason behind why various manufacturer's report differences in diamond paste grit size ratings when they have the same micron rating.

*For those unfamiliar with abrasives (ie, sandpaper, stones, pastes, etc.) they're typically spec'ed using a "grit" rating. Historically, grit size is equivalent to the "size" of the wire mesh screen used to sieve the abrasive particles, size being the number of wires in a linear inch of the screen. (E.g., 60 mesh has 60 wires each direction in a square inch and is the size commonly used in kitchen faucets, an 80 mesh has an opening which will barely pass a human hair.) All abrasives are made up of varying sized particles that fall within a size range... for example, a 100 grit stone might be made up of abrasive particles that pass through a size 100 mesh but do not pass through a 120 mesh (remember, the smaller the number the larger the hole in the mesh). For large grit sizes (e.g., for mesh numbers <240), the sieving process actually uses a wire mesh screen-like process. But for the grit sizes we're interested in (>1000), the sieving process is much more exotic since we're dealing with micron-sized particles.*

We already know that different parts of the world use different standards, but a micron is a micron, right? So why the conflict? Well, I found lots of information which pointed to nothing specific that we could hang our hat on. I found the usual references to JIS, CAMI (which is now apparently part of UAMA, so don't be surprised if you start seeing references to that), etc.

On [www.madchem.com](http://www.madchem.com) I found the statement "DIAMOND MESH EQUIVALENT - refers to micron size grading as performed by the National Institute of Standards and Technology (NIST)", and a chart which includes columns for both "mesh size" and "diamond mesh equivalent". I've highlighted two particular entries...

| RECOMMENDATIONS FOR USE  | MICRON SIZE | MESH SIZE | GRIT SIZE  | MICRON RANGE | OPTICAL POWDER NUMBER | DIAMOND MICRON-MESH EQUIVALENT | MICRON RANGE |
|--|-------------|-----------|------------|--------------|-----------------------|--------------------------------|--------------|
| Finest finishes for work of the highest precision.                                     | .25         |           |            |              |                       | 100,000                        | 0-5          |
|  | 5           | 25,000    |            |              |                       | 60,000                         | 0-1          |
| Final finishing; high surface refinement.  | 1           | 14,000    |            |              |                       | 14,000                         | 0-2          |
|  | 3           | 8,000     | 1,200      |              |                       | 8,000                          | 2-4          |
| Light cutting; final finish on many materials.   | 5           | 2,500     | 1,000 (7)* | 2-20         | 5.0                   | 3,000 (6)                      | 4-8          |
|  | 9           | 1,700     | 900        | 3-25         | 9.5                   | 1,800                          | 8-12         |
| Medium to fast cutting; uniform scratch-free finishes; final finish on some materials. | 12          | 1,200     | 800        | 5-30         | 12.5                  |                                |              |
|  | 15          | 1,000     | 700        | 7-32         | 14.5                  | 1,200                          | 12-22        |
|  | 18          | 900       | 600 (16)   | 9-35         | 17.5                  |                                |              |
|  | 20          | 800       | 500        | 10-40        | 20.0                  |                                |              |
|  | 25          | 600       | 400        | 10-45        | 22.5                  |                                |              |
| Fast cutting; matte finish, pre-finishing  | 30          | 500       | 320        | 14-60        | 25.0                  | 600                            | 22-36        |
|  | 40          | 400       | 280        | 20-70        |                       |                                |              |
| For roughing, stock removal, grinding, etc.  | 45          | 320       |            |              |                       | 325                            | 36-54        |
|  |             | 280       |            |              |                       |                                |              |
| Low grade finish.  | 60          | 240       |            |              |                       | 230                            | 54-80        |
|  | 65          | 220       | 220        | 20-100       |                       |                                |              |
|  |             | 180       |            |              |                       |                                |              |
|  | 90          | 150       | 150        | 35-140       |                       |                                |              |
|  | 100         | 120       | 120        | 50-165       |                       |                                |              |
| *Numbers in parentheses give more precise micron numbers where needed.                 |             | 125       | 100        |              |                       |                                |              |
|  |             | 80        |            |              |                       |                                |              |

MadChem Table

I spent some time on the NIST website but gave up... their site is so large that you seemingly have to what/where you want to go to be successful. So I don't know what context to apply to the NIST statement. I do know that NIST both

1. defines measurement/testing methodologies, and
2. produces measurement standards which you can use to calibrate the measuring tools/devices.

For course abrasives it's economical to sieve to reasonably close tolerances... for example:  
100-grit = 149 - 125 microns

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But, as the particle size gets smaller, it not only becomes increasingly expensive, but technically challenging to maintain such close tolerances. Here's a chart I found on the [www.inlandlapidary.com](http://www.inlandlapidary.com) site.

| Diamond Grit Size Designations, Approximate Particle Sizes, and Counts   |  |   |  |   |  |
|--|--|---|--|---|--|
| The diamond grit designations for diamond lapidary tools actually represent a range of diamond particle sizes used to manufacture that designation. For example a 150 grit diamond wheel is actually a 140/170 grit wheel made up of diamond crystals ranging in size from 105-88 microns or .004-.0036 inches in diameter.  |  |   |  |   |  |
| Inland lists grit size for all their diamond products by the standard US convention of labeling after the larger size diamond. For example, an Inland 60 grit diamond wheel is made from diamond grit size 60/ 80 range. If you are used to seeing a single number grit size, all you need to do is find the range which that grit falls into and then use the lower number of that range for the comparable Inland diamond product. |  |   |  |   |  |
| USA Grit Size (mesh)   | Inland Equivalent                      | Size - Microns (range)                        | Size - Inches (range)                    | Number Particles in One Carat (approx)        | Comparable to these Grits                            |
| mesh is the number of wires per inch in a screen mesh  | listed grit on Inland diamond products | 1 micron = $3.93700787 \times 10^{-6}$ inches | 1 inch = 25,400 microns                  | 1 carat = 0.2 grams<br>1 gram = 5 carats      | commonly found grit sizes in lapidary wheels & drums |
| 8/10   |  | 2380-2000                                     | .093-.075                                | 4,2-7   |  |
| 10/12  |  | 2000-1680                                     | .075-.066                                | 7-12  |  |
| 12/14  |  | 1680-1410                                     | .066-.055                                | 12-20   |  |
| 14/16  |  | 1410-1190                                     | .055-.047                                | 20-33   |  |
| 16/18  |  | 1190-1000                                     | .047-.039                                | 33-57   |  |
| 18/20  |  | 1000-840                                      | .039-.033                                | 57-97   |  |
| 20/25  |  | 840-710                                       | .033-.028                                | 97-160  |  |
| 25/30  |  | 710-590                                       | .028-.023                                | 160-282                                       |  |
| 30/35  |  | 590-500                                       | .023-.019                                | 282-460                                       |  |
| 35/40  |  | 500-420                                       | .019-.016                                | 460-770                                       |  |
| 40/45  |  | 420-350                                       | .016-.014                                | 770-1,334                                     |  |
| 45/50  |  | 350-297                                       | .014-.012                                | 1,334-2,080                                   |  |
| 50/60  |  | 297-250                                       | .012-.010                                | 2,080-3,240                                   |  |
| 60/80  | 60 grit                                | 250-177                                       | .010-.007                                | 3,240-10,400                                  | 60   |
| 80/100   | 80 grit                                | 177-149                                       | .007-.006                                | 10,400-17-140                                 | 80   |
| 100/120  | 100 grit                               | 149-125                                       | .006-.005                                | 17,140-20,920                                 | 100  |
| 120/140  | 120 grit                               | 125-105                                       | .005-.004                                | 20,920-49,400                                 |  |
| 140/170  | 140 grit                               | 105-88  | .004-.0036                               | 49,400-82,400                                 |  |
| 170/200  | 170 grit                               | 88-74   | .0036-.0030                              | 82,400-140,000                                | 180  |
| 200/230  | 200 grit                               | 74-62   | .0030-.0024                              | 140,000-252,000                               | 220  |
| 230/270  |  | 62-33   | .0024-.0012                              | 252,000-384,000                               | 260  |
| 270/325  |  | 33-44   | .00123-.00173                            | 384,000-660,000                               | 275  |
| 325/400  |  | 44-37   | .00173-.0015                             | 660,000-1,120,000                             | 360  |
| 400/500  |  | 60-40   | .00236-.00157                            | 1,120,000-1,580,000                           |  |
| 500/600  |  | 60-25   | .00236-.00098                            | 1,580,000-2,046,000                           |  |
| 600/700  | 600 grit                               | 37-22   | .00146-.00087                            | ~2,046,000                                    | 600  |
| 700/800  |  | 36-20   | .00142-.00078                            | ~9,503,000                                    |  |
| 1200   | 1200 grit                              | 18-12   | .00071-.00047                            | ~1.696*10 <sup>7</sup>                        | 1200   |
| 1800   |  | 12-8  | .00047-.00031                            | ~1.696*10 <sup>7</sup> - 2.62*10 <sup>8</sup> |  |
| 2200   |  | 10-6  | .00039-.00024                            | ~7.86*10 <sup>7</sup>                         |  |
| 3000   | 3000 grit                              | 8-4   | .00031-.00016                            | ~2.62*10 <sup>8</sup>                         | 3000   |
| 8000   |  | 4-2   | .00016-.00008                            | ~2.05*10 <sup>9</sup>                         |  |
| 12000  |  | 3-1   | .000120-.00004                           | ~2.05*10 <sup>9</sup> - 6.2*10 <sup>10</sup>  |  |
| 15000  |  | 2-0   | .00008-0                                 | ~6.2*10 <sup>10</sup>                         |  |
| 60000  |  | 1-.25   | 4*10 <sup>-6</sup> -9.84*0 <sup>-6</sup> | ~ 6.2*10 <sup>10</sup>                        |  |

Inland Table

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Lets use Inland's data for 8,000, 15,000 and 60,000 grit sizes. I've tabularized it below:

| mesh  | micron range | average (*) |
|-------|--------------|-------------|
| 8000  | 4 - 2        | 2           |
| 15000 | 2 - 0        | 1           |
| 60000 | 1 - .25      | .625        |

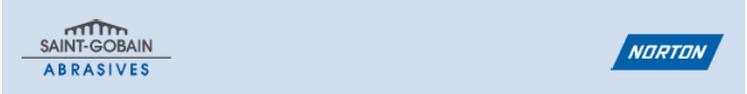
(\*)calculated by me

Example Inland Data

Now, **my hypothesis** as to why manufacturers grit specs differ for the same micron-size...

1. According to the Inland Lapidary chart above, US manufacturers spec according to the **larger** of the size-range of particles.
2. A chart I found on the [www.grindwellnorton.co.in](http://www.grindwellnorton.co.in) website (which I believe is the Norton subsidiary in India) contains the following which implies that the European (FEPA) convention is to spec to the **average** particle size.

## GRINDWELL NORTON LTD.



Grit Size of Abrasives depends on the average particle size of the abrasives. Different grading systems are prevalent and manufacturers generally use the US Standard Mesh Size or the European FEPA Size.

The Norton grit size is similar to the US Standard Mesh. In India, the FEPA system is preferred. A comparison of the different grading system of abrasives along with the average particle size is given below.

| Norton Grit Size |     | U.S. Standard Mesh | European (FEPA) Size | Japanese (JIS) Size | Average Particle Size (Inches) |
|------------------|-----|--------------------|----------------------|---------------------|--------------------------------|
| Diamond          | CBN |                    |                      |                     |                                |
| 16               | -   | 16/20              | 1182                 | -                   | 0.046                          |
| 24               | 24  | 20/30              | 892                  | 20                  | 0.033                          |
| 36               | 36  | 30/40              | 602                  | 30                  | 0.023                          |

GrindwellNorton Excerpt

Hence, using the Inland Example Data above, lets look for a “**2-micron rated**” size product:

- If we use the **US method**, we need to find the entry with 2 as the largest grit in the range... it's the **15,000 grit** product.
- If we use the **European method**, we must look for a range whose average grit size is 2... that's the **8000 grit** product.

So, the bottom line is that **the micron rating from some companies is the largest particle size in the abrasive and for others it's the average particle size**, depending on what spec conventions they're using.

And, before we get too cocky about all this, most manufacturing processes create a non-linear distribution of particle sizes within the range... e.g., there might be more/less larger particles than smaller, so the average is not necessarily the midpoint of the ranges that I've used as examples above. Hence, it's very difficult to compare product from different vendors even when you know the particle size range.