Grit rating systems in sharpening stones

Sharpening stones made of naturally occurring rock formations have been used for sharpening weaponry and tools for hundreds and maybe thousands of years.
In the later century manmade or artificial sharpening stones have been used for barbering and carpentering but never has the natural stone been completely replaced.
One of the obvious advantages of a manmade stone is its reliability and the definite assertion of the size and homogeneity of the particles being used for the sharpening stone and therefore the reproducible cutting edges they produce.
Nowadays there is hardly any artificial stone that does not come with a grit rating.
The system behind this number -the evaluation methods being used- or simply the meaning of this number more often than not remains unclear.
It is believed that information for some popular manufacturers about their grit rating system is available, even though hardly any *official* information is to be found.
There have been efforts to evaluate grit diameters and capture them in a grit rating system.

There are just as many approximations as there are systems. The particle size within a given system of particles can never be given as a single number. One can only hope to find an average or a size distribution. Particles within a system (like a powder or a sharpening stone) never are 100% unisized but vary in shape and size. Theoretically one has to use spectroscopic measuring devices like REM and look at each and every particle in the system measure its diameter and build the average and size distribution by hand.
This would be statistically sound but impracticable.

Fortunately there have been many efforts to build an approximation that is almost as good as counting each and every particle in the system. Almost all of them rely on a single simplification:
All particles in the system are of spherical shape

There is a reason why this simplification is so powerful. A sphere is the only geometrical object that can be fully described by only one single number: its diameter.
But how to find an equivalent diameter to a non spherical object?
Any given geometrical object can be described as a spherical object by use of hydrodynamic radius.

You can measure the Volume (for example) of a cubic object by:

$$V_{cubic} = Length \cdot Width \cdot Depth$$

Now theoretically you could take this Volume (for instance V_{cubic} = 3cm³) you just measured and convert it to a spherical object:

$$V_{cubic} \Rightarrow V_{Spherical}$$

$$V_{spherical} = \frac{4}{3} \Pi r_{hyd}^3$$

This equation gives you the hydrodynamic radius of the equivalent sphere.
Now this works in both directions because the hydrodynamic radius relates to the real radius of any given shape with the same volume. The hydrodynamic radius is the result of many measurements like the dynamic light scattering method -especially useful for dispersions and emulsions, see appendix for an example- or the sedimentation analysis.
All these measurements to some degree investigate the behaviour of the diffusion coefficient or Brownian motion which relates to the hydrodynamic radius like this:

$$R_H = \frac{k_B T}{6\pi\eta D}.$$

For more information on the hydrodynamic diameter the reader is referred to the literature about Stokes Law and the Stokes radius.

This is the background for high quality assessment of (micro) particle size distribution.
Other systems like Mesh refer to a sieve or mesh with a given opening per inch of mesh.
Of course it is impossible to actually sieve particles below 1µm, so here extrapolation is necessary.

All of these systems have many failures if used for describing abrasive particles.
None of these methods make a statement of the actual shape or real particle size.
The real meaning of grit rating systems is to simplify a size distribution to a single number that assures a certain quality standard. As mentioned above there are always particles smaller and larger than that of the average. The distribution or divergence is not accessible to the buyer and may vary from manufacturer to manufacturer even if the **same** grit rating system is being used!

Conclusion:
Grit rating systems according to Mesh, JIS or AINSI are not of absolute value for the interested buyer. There are several other things that have a large impact on the quality of a sharpening stone. Things no grit rating system takes into account.
It is advisable to compare grits from different manufacturers only if there is no other option. Therefore no grit comparison will be made here.

Appendix:

This is an example of a bimodal size distribution of a polymer dispersion measured with a Zetasizer Nano. Peak one shows the dominant particle size with 332,7nm.
Looking at the peak itself it becomes evident, that 332,7nm is the average size,
but there are particles much smaller and much larger present.