Classification of Granular Materials and Approximate Slot Size for Naturally Developed Wells

Name	Millimeters	Inches	Sieve Size	Slot Size (inches)	Slot Size (mm)
Boulders	>300	>11.8	>12"	>0.100	>2.5
Cobbles	300 - 75	11.8 - 2.9	12" - 3"	>0.100	>2.5
Gravel - coarse	75 -19	2.90 - 0.75	3" - 3/4"	>0.100	>2.5
Gravel - fine	19 - 4.8	0.75 - 0.19	3/4" - 4	>0.100	>2.5
Sand - coarse	4.8 - 2.0	0.19 - 0.08	4 - 10	0.100	2.5
Sand - coarse to medium	3.3 - 1.8	0.13 - 0.07	6 - 12	0.090	2.3
Sand - medium	2.2 - 1.3	0.09 - 0.05	8 - 16	0.070	1.8
Sand - medium	1.8 - 1.0	0.07 - 0.04	12 - 20	0.050	1.3
Sand - medium	1.3 - 0.5	0.05 - 0.02	16 - 30	0.030	0.8
Sand - fine	0.5 - 0.2	0.02 - 0.008	30 - 70	0.015	0.4
Sand - fine	0.2 - 0.08	0.008 - 0.003	30 - 200	0.007	0.2
Slits and Clays	<0.08	<0.003	<200	NA	NA

Grain size classification is based on USCS and slot selection is based on well construction using natural development and average grain sizes.

Limestone- a sedimentary rock composed mainly of calcite. Looks similar to sandstone but will bubble when exposed to a weak acid.
Sandstone- is a sedimentary rock composed mainly of sand-sized minerals or rock grains.
Siltstone- is a sedimentary rock which has a grain size in the silt range, finer than sandstone and coarser than clay stones.
Shale- any of a group of fine-grained, laminated sedimentary rocks consisting of silt and clay-sized particles.
Clay Stone- is a fine-grained sedimentary rock composed predominantly of hardened clay particles. Basically lithified muds and oozes. Ex. Slate
Ochre- refers to several forms of iron oxide and is a type of clay or sandy clay mineral.

Sand / Slot Size Gauge

Gauge	Name	Natural Development Slot		Filter Pack	Filter Pack Slot	
		inches	mm	sieve	inches	mm
	Gravel	0.125	3.2	3/8" - 3/4"	0.250	6.4
	Sand - Coarse	0.100	2.5	4 - 3/8"	0.160	4.1
		0.080	2.0	3 - 6	0.120	3.0
	Sand - Medium	0.060	1.5	4 - 8	0.090	2.3
		0.040	1.0	6 - 12	0.070	1.8
	Sand - Fine	0.020	0.5	10 - 20	0.040	1.0
		0.007	0.2	20 - 40	0.018	0.5

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Hardness Definitions

- **Cemented-** Once drilled the hole will stand open without collapse; refers to sandstone or other consolidated formations
- **Consolidation-** Hard enough the bit needs to turn cutting into the formation as opposed to raising and dropping the bit. Similar to cemented-not as tight
- **Dense /Stiff-** Refers to clays/shale; can be broken with fingers
- **Hard-** Difficulty drilling but cuttings can be broken with hammer
- **Loose-** Bit can be washed through the formation without rotation, cuttings have no consolidation
- **Soft-** Bit penetrates into the formation by raising and dropping, will not wash through without rotation
- **Very Hard-** Bit won't penetrate without pull down