

ASTM C144 Sand Gradation Requirements <sup>§†</sup>		
Sieve Size	Percent Passing	
	Natural Sand	Manufactured Sand
4	100	100
8	95 to 100	95 to 100
16	70 to 100	70 to 100
30	40 to 75	40 to 75
50	10 to 35	20 to 40
100	2 to 15	10 to 25
200	0 to 5	0 to 10

<sup>§</sup> Not more than 50% shall be retained between any two sieve sizes nor more than 25% between No. 50 and 100 sieve sizes.

<sup>†</sup> If an aggregate does not meet the gradation requirement limits, it may be used if the mortar meets the property specification of ASTM C270.

**Figure 2-13** ASTM C144 requirements for masonry mortar sand. (Copyright ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Reprinted with permission.)

Sieve Size	Amounts Finer Than Each Laboratory Sieve (weight %)				
	Fine Aggregate			Coarse Aggregate	
	Size No. 1	Size No. 2		Size No. 8	Size No. 89
Natural		Manufactured			
1/2 inch	—	—	—	100	100
3/8 inch	100	—	—	85 to 100	90 to 100
4	95 to 100	100	100	10 to 30	20 to 55
8	80 to 100	95 to 100	95 to 100	0 to 10	5 to 30
16	50 to 85	70 to 100	70 to 100	0 to 5	0 to 10
30	25 to 60	40 to 75	40 to 75	—	0 to 5
50	10 to 30	10 to 35	20 to 40	—	—
100	2 to 10	2 to 15	10 to 25	—	—
200	0 to 5	0 to 5	0 to 10	—	—

**Figure 2-14** ASTM C404 requirements for masonry grout aggregate. (Copyright ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Reprinted with permission.)

Figure 2-15 illustrates the range and distribution of particle gradation that are acceptable under ASTM C144, from the coarsest allowable gradation to the finest allowable gradation, with the ideal gradation shown in the middle. Both the coarse and fine gradations have a void content much higher than that of the ideal gradation. Many commercially available sands fall out-

side of ASTM gradation requirements for mortar and may have void contents even larger than those shown. Such shortcomings may be corrected by the addition of the deficient fine or coarse sands.

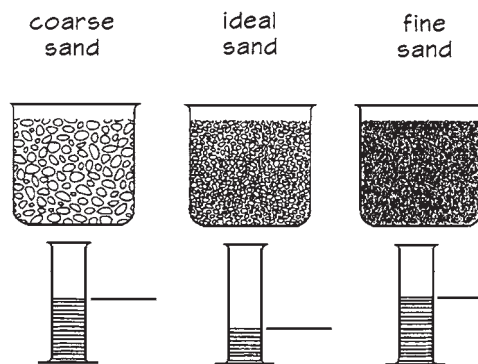
When locally available mason's sand does not meet ASTM C144 gradation requirements, it can still be used if laboratory tests determine that a mortar can be produced that meets the property specification requirements of ASTM C270, *Standard Specification for Mortar for Unit Masonry*. The volume ratio of aggregate to cementitious materials may be selected and tested at various levels within the specified range of  $2\frac{1}{4}$  to  $3\frac{1}{2}$  times the sum of the volume of the cementitious materials. If test results show that ASTM C270 property requirements for compressive strength, air content, and water retentivity are met, the aggregate is qualified for use at the tested ratio.

### 2.3.5 Water

Water for masonry mortar must be clean and free of harmful amounts of acids, alkalis, and organic materials. Whether the water is drinkable is not in itself a consideration, as some drinking water contains appreciable amounts of soluble salts, such as sodium and potassium sulfate, which can contribute to efflorescence. If necessary, laboratory analysis of the water supply should be used to verify suitability.

### 2.3.6 Mortar Admixtures

Although admixtures are often used with some success in concrete construction, they can have adverse effects on the properties and performance of masonry mortar and grout. ASTM mortar standards do not incorporate, nor in fact even recognize, admixtures of any kind.



The level of liquid in the cylinders represents the volume of voids in the sand mixture. A sand with the ideal mix of coarse and fine grains (complying with ASTM C 144 gradation limits) has a lower volume of voids and is therefore more economical because it requires less cementitious material to properly coat the particles.

**Figure 2-15** Sand gradation for masonry mortar. (From *Portland Cement Association, Trowel Tips—Mortar Sand*.)