# Standard Grindability Tests and Calculations

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Since the last publication of tabulated results of grindability tests by the authors[1] the total number of ball-mill tests made has more than doubled, and rod-mill tests have become increasingly important. Nearly all of the standard closed-circuit ball-mill and rod-mill tests made to date are included in the present tabulation, together with additional information not previously published.

## Standard Ball-mill Grindability Tests

The method of conducting these closed-circuit tests has not been altered. A sample of the ore or other material is stage-crushed in rolls set at $\frac{1}{16}$-in. opening with a 6-mesh screen until all of it has passed the screen. The combined minus 6-mesh screen undersize is mixed, sampled and screen-analyzed, and its apparent specific gravity is determined by packing and shaking in a standard container, and weighing. The apparent specific gravity ordinarily is about 60 per cent of the true specific gravity. The unit volume present in the mill in all tests is 700 c.c. of the packed minus 6-mesh roll product, and the number of grams occupying 700 c.c. is the unit test weight.

This weight is placed in the mill dry, ground for the number of revolutions estimated to be necessary, discharged, and screened mechanically in three testing sieves of the mesh size at which the test is to be conducted. The oversize, or circulating load, is weighed, sufficient fresh minus 6-mesh feed is added to bring the total weight up to that of 700 c.c., and the charge is returned to the mill for a second grinding period.

All standard ball-mill tests are conducted at 250 per cent circulating load, and the number of revolutions in the mill necessary to obtain this circulating load at any grinding period is estimated from the results of the previous period. The number of net grams of screen undersize produced per revolution of the mill approaches its final equilibrium value after several grinding periods, and this is recorded as the grindability, or relative ease of grinding, of the sample.

A cylindrical ball mill, 12 by 12 in. inside, with a smooth lining and rounded corners, is used with a revolution counter. Under standard grinding conditions it runs at 70 r.p.m., and contains a charge of 285 iron balls weighing 20,125 grams, ranging from $1\frac{1}{2}$ to $\frac{3}{4}$ in. in diameter.

Tests are conducted at the mesh size to which the ore is to be ground in practice, and the capacity to be expected from a given mill is calculated by comparing the grindability with that of a similar standard ore whose performance characteristics are known.

No satisfactory general formula for converting standard grindabilities into commercial power-consumption values has been

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[1] F. C. Bond and W. L. Maxson: Grindability and Grinding Characteristics of Ores. *Trans.* A.I.M.E. (1938).

found, since considerable judgment may be required in correlating such diverse factors as size of feed, varying circulating loads, stage grinding, presence of natural grain sizes and slimes, and mill speeds.

Caution should be used in making comparisons between ores that are widely dissimilar in nature, as well as between those with widely different grindabilities. If these limitations are observed, the standard grindability test supplies a relatively accurate method for predicting grinding results.

Table 1 gives the condensed results of 374 standard ball-mill grindability tests. Those for each mesh size are arranged in the order of increasing ease of grinding, so that the list for any mesh constitutes an ascending graduated scale of grindabilities.

The grindabilities of ores on which tests have been made at more than one mesh size are marked by an asterisk (*), and those on which standard rod-mill tests have also been made are marked by a dagger (†). In addition to the grindability at the specified mesh, the percentage of minus 200-mesh in the ball-mill product, the apparent and true specific gravities, and the reference test number are included in the tabulation.

If the grindabilities of the ores that have been tested at several different mesh sizes are plotted as abscissas on a logarithmic scale, against the mesh sizes at equal intervals on a linear scale, it is seen that in general the grindabilities of different ores follow parallel straight lines.

However, some ores with an important natural grain size, such as sandstones, have a much steeper slope than the average at mesh sizes larger than their natural grain size. The existence of natural grain sizes has considerable effect upon the plotted grindabilities, so that the grindabilities at different meshes cannot be predicted with dependable accuracy from a test made at only one mesh size.

### Standard Rod-Mill Grindability Tests

Standard closed-circuit rod-mill grindability tests are made in a mill 12 in. in inside diameter by 22 in. long, with a wave type of lining, and running at 46 r.p.m. The grinding charge consists of eight steel rods 21 in. long, weighing 33,380 grams. Six of the rods are 1¼ in. in diameter and two are 1¾ in. The mill is provided with a revolution counter.

The mill can be tilted through a complete circle by means of a tilting wheel. It is discharged through a trunnion bearing and a grate, which retains the rods when the mill is tilted downward. At intervals of 10 revolutions during a standard test it is tilted 5° upward for one revolution, then 5° downward for one revolution, and returned to the horizontal position for eight revolutions. If this is not done the test results are apt to be erratic, because of material that escapes grinding by lodging between the ends of the rods and the ends of the mill. After the grinding period has been completed, the mill is discharged by tilting it downward at an angle of 45° for 30 revolutions.

The unit volume present in the mill in all tests is 1250 c.c. of dry solids packed by shaking, and the number of grams occupying 1250 c.c. is the unit test weight. Unless the material is exceptionally soft, the feed should not be coarser than ½ in. All standard rod-mill grindability tests are conducted at 100 per cent circulating load.

The weight occupying 1250 c.c. packed is placed in the mill dry, rotated for the number of revolutions estimated to be necessary to produce 50 per cent of screen undersize, discharged, and screened at the mesh size at which the test is to be made. The oversize, or circulating load, is weighed, sufficient fresh feed is added to bring the total weight up to that of 1250 c.c., and the charge is returned to the mill for the second grinding period.

TABLE 1.—*Standard Ball-mill Grindability Tests*

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| **TESTS AT MINUS 28-MESH** | | | | | | | |
| | | | −28M. | | | | |
| Gold | Bernheim | S. Rhodesia | 1.26* | 27.9 | 1.77 | | 477 |
| Gold | Wright-Hargreaves | Ontario | 1.338* | 34.2 | 1.70 | 2.68 | 406 |
| Gravel | Pacific Coast Aggregates | California | 1.58* | 25.2 | 1.53 | | 324 |
| Copper | Amygdaloid, C. R. | Michigan | 1.76* | 31.0 | 1.87 | 2.93 | 1000 |
| Gold | Portland | Colorado | 1.966* | 27.2 | 1.63 | 2.69 | |
| Gold | Kerr-Addison | Ontario | 2.203* | 32.9 | 1.81 | | 799 |
| Gold | La Luz | Nicaragua | 2.48* | 30.0 | 1.79 | | 932 |
| Copper | New Cornelia | Ajo, Ariz. | 2.50* | 30.4 | 1.63 | 2.68 | 684 |
| Gold | Little Long Lac | Ontario | 2.726* | 40.2 | 1.69 | 2.64 | 570 |
| Gold | San Luis | Mexico | 2.905* | 20.5 | 1.67 | | 730 |
| Copper | Shale—White Pine | Michigan | 3.08* | 33.3 | 1.79 | 2.97 | 1000 |
| Copper | Quincy | Michigan | 3.12* | 21.0 | 1.98 | | 1036 |
| Gold | Rand-Springs Mine | S. Africa | 3.22* | 23.0 | 1.78 | 2.71 | 504 |
| Gold | Kerr-Addison | Ontario | 3.365* | 32.7 | 1.83 | | 799 |
| Copper | Miami Ore | Miami, Ariz. | 3.37* | 26.9 | 1.64 | 2.69 | |
| Quartz | Can. Silica Products | Quebec | 3.58 | 11.7 | 1.56 | 2.65 | 398 |
| Copper | Castle Dome Ore | Miami, Ariz. | 3.655* | 24.8 | 1.685 | | 1042 |
| Copper | Utah Copper—Arthur | Utah | 3.91*† | 26.5 | 1.715 | | 938 |
| Gold | Homestake | S. Dakota | 3.95* | 35.5 | 1.91 | 3.12 | |
| D.-L.[a] sinter | Eagle Picher | Illinois | 4.01 | 21.1 | 2.25 | | 341 |
| Silver | Hualgayoc | Peru | 4.27 | 25.2 | 2.45 | | 346 |
| Copper | Sandstone—Vein Rock | Michigan | 4.403*† | 20.7 | 1.83 | 2.68 | 1000 |
| Copper | Anaconda | Montana | 4.44* | 34.3 | 2.18 | 3.23 | 910 |
| Quartz | Pure Crystallized | California | 4.55* | 17.0 | 1.68 | 2.65 | |
| Magnetite | M. A. Hanna, Clifton | New York | 4.57† | 14.8 | 2.76 | | 1022 |
| Cassiterite | Vulcan Detinning | New Jersey | 5.09 | 23.1 | 3.60 | | 558 |
| Gold | East Malartic | Quebec | 5.42* | 37.8 | 1.87 | 2.79 | 779 |
| Syenite | Can. Nepheline Syenite | Ontario | 5.51† | 16.7 | 1.63 | 2.73 | 663 |
| Magnetite | Republic Steel, Chateaugay | New York | 6.265* | 8.8 | 2.98 | | 868 |
| Copper | Morenci | Arizona | 6.34*† | 24.8 | 1.57 | 2.63 | 913 |
| Copper | Sandstone—White Pine | Michigan | 8.63* | 13.8 | 1.70 | 2.635 | 1000 |
| Phosphate | Charleston Min. Co. | Tennessee | 8.87† | 14.3 | 1.86 | | 333 |
| Roasted | Sullivan Min. Co. | Idaho | 15.33* | 38.9 | 1.93 | | 740 |
| Gold | Red Cross Min. Co. | California | 20.9 | 26.7 | 1.56 | | 331 |
| **TESTS AT 35-MESH** | | | | | | | |
| | | | −35M. | | | | |
| Cast iron | Du Pont | Delaware | 0.062 | 8.6 | 3.12 | | 325 |
| Graphite | Alcoa | Tennessee | 0.24 | 25.4 | 1.01 | | 937 |
| Cast iron | Crucible Steel | Pittsburgh | 0.611 | 2.6 | 0.94 | | 436 |
| Copper | Conglomerate, C. & H. | Michigan | 1.231* | 33.5 | 1.69 | | 771 |
| Gravel | Pac. Coast Aggregates | California | 1.28* | 28.2 | 1.53 | | 324 |
| Copper | Amygdaloid, C. R. | Michigan | 1.53*† | 36.5 | 1.87 | 2.93 | 1000 |
| Copper | Amygdaloid, C. & H. | Michigan | 1.82* | 30.3 | 1.75 | | 771 |
| Gold | La Luz | Nicaragua | 2.08* | 36.0 | 1.79 | | 932 |
| Gold | Kerr-Addison | Ontario | 2.17* | 37.3 | 1.83 | | 799 |
| Copper | Tailings—Quincy | Michigan | 2.18* | 28.9 | 1.98 | | 1036 |
| Copper | New Cornelia | Ajo, Ariz. | 2.31* | 34.7 | 1.63 | 2.68 | 684 |
| Gold | Little Long Lac | Ontario | 2.35* | 32.6 | 1.69 | 2.64 | 570 |
| Gold | Benguet | P.I. | 2.38* | 35.6 | 1.69 | 2.66 | 550 |
| Gold | Rand-Springs Mine | So. Africa | 2.404*† | 27.7 | 1.78 | 2.71 | 504 |
| Gold | San Luis | Mexico | 2.495* | 25.7 | 1.67 | | 730 |
| Copper | Shale—White Pine | Michigan | 2.66* | 38.2 | 1.79 | 2.97 | 1000 |
| Gold | Kerr-Addison | Ontario | 2.95* | 37.6 | 1.81 | | 799 |
| Iron | Bowring | Morocco | 2.97* | 25.0 | 1.86 | | 288 |
| Copper | Castle Dome Ore | Miami, Ariz. | 2.99* | 29.5 | 1.68 | | 1042 |
| Iron | Bowring | Spain | 3.03* | 20.9 | 2.12 | | 291 |
| Copper | Anaconda | Montana | 3.31* | 29.3 | 2.18 | 3.23 | 910 |
| Copper | Utah Copper—Arthur | Utah | 3.91*† | 30.0 | 1.71 | | 938 |
| Copper | Sandstone—Vein Rock | Michigan | 4.05*† | 28.8 | 1.83 | 2.68 | 1000 |
| Copper | Morenci | Arizona | 4.50*† | 27.5 | 1.57 | 2.63 | 913 |
| Copper | Sandstone—White Pine | Michigan | 4.51* | 20.4 | 1.70 | 2.64 | 1000 |
| Iron | Republic Steel, Chateaugay | New York | 4.70* | 12.3 | 2.98 | | 868 |
| Iron | AlanWood Steel, Croton | New York | 5.35* | 16.2 | 2.18 | | 931 |
| Clinker | Cobrecite | Michigan | 7.10* | 12.6 | 0.76 | | 830 |
| Roasted | Sullivan Mines | Idaho | 8.04* | 40.8 | 1.93 | | 740 |

[a] Dwight-Lloyd.
* Standard ball-mill tests made at other mesh sizes.
† Standard rod-mill tests made on this ore.

TABLE 1.—(*Continued*)

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| **TESTS AT 48-MESH** | | | | | | | |
| | | | −48M. | | | | |
| Petr. coke | Alcoa | Tennessee | 0.304 | 26.9 | 0.97 | 1.78 | 700 |
| Scrap emery | Milwaukee Steel | Wisconsin | 0.408*† | 40.3 | 1.93 | | 989 |
| Zinc | National Zinc | Oklahoma | 0.572 | 23.7 | 0.97 | | 161 |
| Refractory | Laclede Christy | Illinois | 0.86* | 24.4 | 1.65 | | 941 |
| Gold | Bernheim | S. Rhodesia | 0.87* | 42.7 | 1.77 | | 477 |
| Flint | Tri-State Flint | Missouri | 0.90* | 29.4 | 1.54 | | 440 |
| Gold | Wright-Hargreaves | Ontario | 1.24* | 44.0 | 1.70 | 2.68 | 406 |
| Copper | Amygdaloid, C. R. | Michigan | 1.37*† | 42.3 | 1.87 | 2.93 | 1000 |
| Gold | Kelowna Expl. | B. Columbia | 1.37* | 47.5 | 2.09 | 3.22 | 676 |
| Gold | Noranda | Quebec | 1.47* | 44.9 | 1.85 | 2.86 | |
| Gold | Portland | Colorado | 1.64* | 36.7 | 1.63 | 2.69 | |
| Brick mix | Carnegie Steel | Illinois | 1.82 | 24.5 | 1.54 | | 907 |
| Gold | Little Long Lac | Ontario | 1.826* | 41.4 | 1.693 | 2.64 | 570 |
| Gold | La Luz | Nicaragua | 1.855* | 41.0 | 1.79 | | 932 |
| Copper | Tailings—Quincy | Michigan | 1.950* | 35.7 | 1.98 | | 1036 |
| Gold | A. O. Smith Corp., R. M. | Nevada | 1.96 | 34.9 | 1.61 | | 646 |
| Firebrick | Carnegie Steel | Illinois | 1.98 | 24.5 | 1.49 | | 907 |
| Gold | Rand-Springs Mine | S. Africa | 1.985* | 35.9 | 1.78 | 2.71 | 504 |
| Silver | Real Del Monte | Pachuca | 2.00* | 46.1 | 1.63 | | 881 |
| Copper | New Cornelia | Ajo, Ariz. | 2.10* | 40.0 | 1.63 | 2.68 | 684 |
| Gold | San Luis | Mexico | 2.123* | 27.7 | 1.67 | | 730 |
| Gold | San Fernando | Mexico | 2.28 | 34.6 | 1.64 | | 255 |
| Copper | Shale-White Pine | Michigan | 2.296* | 45.4 | 1.79 | 2.97 | 1000 |
| Gold | San Fernando | Mexico | 2.31 | 35.8 | 1.56 | | 255 |
| Gold | Saramarca | Peru | 2.39 | 32.4 | 1.82 | | 547 |
| Garnet | K. T. Felder | Georgia | 2.40 | 36.5 | 1.78 | | 269 |
| Phosphate | Al-Ke-Me Fertilizer | Brazil | 2.41* | 32.9 | 1.39 | | 252 |
| Copper | Castle Dome Ore | Miami, Ariz. | 2.52* | 36.1 | 1.68 | | 1042 |
| Copper | Miami Ore | Miami, Ariz. | 2.61 | 38.2 | 1.64 | 2.69 | |
| Lead-zinc | Montecatini | Italy | 2.69* | 31.4 | 2.32 | | 469 |
| Quartz | Pure Crystallized | California | 2.72* | 27.1 | 1.68 | 2.65 | |
| Copper | Anaconda | Montana | 2.75* | 34.4 | 2.18 | 3.23 | 910 |
| Gold | Homestake | S. Dakota | 2.95* | 45.1 | 1.91 | 3.12 | |
| Gold | Picacho Min. Co. | Arizona | 2.956* | 31.4 | 1.52 | | 880 |
| Copper | Sherritt Gordon | Manitoba | 2.97 | 31.2 | 1.86 | | |
| Copper | Cons. Copper Co. | Nevada | 3.00 | 35.0 | 1.54 | | 188 |
| Copper | Sandstone—White Pine | Michigan | 3.05* | 28.5 | 1.70 | 2.64 | 1000 |
| Spodumene | Solvay Process | New York | 3.15 | 23.1 | 1.73 | | 1073 |
| Copper | Sandstone—Vein Rock | Michigan | 3.15*† | 28.7 | 1.83 | 2.68 | 1000 |
| Copper | Utah Copper—Arthur | Utah | 3.23*† | 36.9 | 1.72 | | 938 |
| Copper | Morenci | Arizona | 3.33*† | 33.8 | 1.57 | 2.63 | 913 |
| Shale | St. Lawrence Brick | Quebec | 3.50* | 40.0 | 1.59 | | 279 |
| Gold | East Malartic | Quebec | 3.698* | 37.8 | 1.87 | 2.80 | 779 |
| Copper | Silver Bell | Arizona | 3.74* | 37.1 | 1.69 | | 1050 |
| Gold | C. M. & R.—Golden Rose | B. Columbia | 3.77* | 40.5 | 2.10 | | 864 |
| Gold | S. A. Devel. Co. | Ecuador | 4.08* | 38.7 | 2.67 | 3.81 | 752 |
| Iron | Alan Wood Steel, Croton | New Jersey | 4.34* | 21.6 | 2.18 | | 931 |
| Copper | Tennessee Copper | Tennessee | 4.80* | 30.2 | 2.08 | | 263 |
| Copper | Cons. Copper Co. | Nevada | 5.32 | 38.2 | 1.64 | | 189 |
| Magnesium | Basic Refr. Inc. | Ohio | 5.465* | 48.4 | 2.134 | 2.927 | 1033 |
| Al sinter | Aluminum Co. of Canada | Quebec | 5.70*† | 37.4 | 0.83 | | 1080 |
| Copper | Bingham Canyon, U. S. M. | Utah | 5.90* | 30.7 | 2.68 | 4.65 | |
| Iron | Inland Steel, B. R. F. | Wisconsin | 6.04* | 30.2 | 2.11 | | 837 |
| Zinc | Farrey Min. & Mill. Co. | Illinois | 6.74 | | 1.74 | | 184 |
| Graphite | C. A. Condon | Alabama | 9.26 | 24.5 | 1.35 | | 287 |
| Tripoli | Western Minerals | Kansas | 12.33† | 75.5 | 1.14 | | 883 |
| **TESTS AT 65-MESH** | | | | | | | |
| | | | −65M. | | | | |
| Cast iron | Miami Copper | Arizona | 0.044 | 29.3 | 3.51 | 7.07 | 372 |
| Chromium metal | Electro Met. Co. | New York | 0.313*† | 10.9 | 3.91 | | 1008 |
| Emery | Am. Emery Wheel Wrks. | Rhode Island | 0.459† | 51.2 | 2.47 | 3.89 | 410 |
| Copper | Amygdaloid, C. R. | Michigan | 1.180*† | 50.5 | 1.87 | 2.93 | 1000 |
| Gold | Kelowna Expl. | B. Columbia | 1.24* | 54.4 | 2.09 | 3.22 | 676 |
| Gold | Little Long Lac | Ontario | 1.49* | 50.8 | 1.69 | 2.64 | 570 |
| Silver | Real Del Monte | Pachuca | 1.53* | 45.6 | 1.63 | | 881 |
| Gold | La Luz | Nicaragua | 1.55* | 50.6 | 1.79 | | 932 |
| Copper | Tailings—Quincy | Michigan | 1.575* | 47.0 | 1.98 | | 1036 |

* Standard ball-mill tests made at other mesh sizes.
† Standard rod-mill tests made on this ore.

TABLE 1.—(*Continued*)

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| **TESTS AT 65-MESH—(*Continued*)** | | | | | | | |
| | | | −65M. | | | | |
| Copper | Britannia Min. & Sm. | B. Columbia | 1.577 | 39.1 | 1.71 | | 326 |
| Gold | A. O. Smith | Wisconsin | 1.583 | 54.2 | 1.60 | | 587 |
| Coal | Illinois Zinc | Illinois | 1.61 | 47.8 | 1.69 | 2.80 | 376 |
| Copper | Sandstone—White Pine | Michigan | 1.623* | 42.2 | 1.70 | 2.64 | 1000 |
| Sea shells | Calizos | Chile | 1.637 | 43.8 | 1.52 | | 967 |
| Gold | Rand-Springs Mine | S. Africa | 1.717* | 44.7 | 1.785 | 2.71 | 504 |
| Gold | Madsen Red Lake | Ontario | 1.730* | 40.5 | 1.70 | 2.65 | 626 |
| Gold | G. E. Smith | Oregon | 1.85 | 37.9 | 1.60 | | 321 |
| Granite | Picacho | Arizona | 1.877 | 39.3 | 1.53 | 2.64 | 517 |
| Gold | Spring Hill | Calif. | 1.903 | 45.9 | 1.70 | | 538 |
| Copper | Shale—White Pine | Michigan | 1.936* | 54.2 | 1.79 | 2.97 | 1000 |
| Iron | Bowring | Morocco | 1.94* | 36.8 | 1.86 | | 288 |
| Copper | New Cornelia | Ajo, Ariz. | 2.022* | 45.0 | 1.63 | 2.68 | 684 |
| Copper | Castle Dome | Miami, Ariz. | 2.023* | 44.9 | 1.685 | | 1042 |
| Copper | Chelan Copper | Washington | 2.07 | 44.5 | 1.64 | | 328 |
| Copper | Cons. Copper Co. | Nevada | 2.10 | 43.7 | | | 278 |
| Copper | Cyprus Mines | Cyprus | 2.110* | 43.4 | 2.69 | | 432 |
| Copper | Stadacona Rouyn | Quebec | 2.157 | 53.2 | 1.89 | | 561 |
| Serpentine | G. E. Baker Co. | Pennsylvania | 2.246 | 64.2 | 1.70 | | 1051 |
| Phosphate | Ipanema Plant | Brazil | 2.255* | 42.8 | 2.36 | | 352 |
| Gold | Picacho Min. Co. | Arizona | 2.26* | 46.4 | | | 880 |
| Gold | Cline Lake | Ontario | 2.29* | 54.7 | 1.78 | | 745 |
| Manganese | C. L. Walfred | Minnesota | 2.30* | 50.7 | 1.64 | | 867 |
| Gold | Santa Maria del Oro | Mexico | 2.31* | 33.3 | 2.08 | 3.10 | 574 |
| Gold | LaLuz | Nicaragua | 2.32* | 44.7 | 1.79 | | 932 |
| Iron | Moose Mountain | Ontario | 2.33*† | 53.9 | 2.44 | 3.42 | 756 |
| Copper | Sandstone, C. R. | Michigan | 2.34*† | 37.4 | 1.83 | 2.68 | 1000 |
| Lead-zinc | Montecatini | Italy | 2.39* | 42.6 | 2.32 | | 469 |
| Gold | Parcoy | Peru | 2.393* | 31.3 | 2.26 | | 567 |
| Gold | Minnesota Mines | Colorado | 2.420* | 43.0 | 1.85 | 2.81 | 637 |
| Copper | Anaconda | Montana | 2.435* | 41.2 | 2.18 | 3.23 | 910 |
| Copper | Morenci | Arizona | 2.52*† | 44.9 | 1.57 | 2.63 | 913 |
| Gold | Homestake | S. Dakota | 2.55* | 53.7 | 1.91 | 3.12 | |
| Gold | Ipo Mine | P.I. | 2.61* | 37.2 | 1.68 | | 329 |
| Copper | Utah Copper—Arthur | Utah | 2.65*† | 46.6 | 1.715 | | 938 |
| Gold | A. O. Smith | Wisconsin | 2.675 | 55.0 | 1.60 | | 587 |
| Salt | M. D. P. d'Alsace | France | 2.685*† | 22.9 | 1.32 | | 726 |
| Tungsten | Nevada-Mass. Co. | Nevada | 2.69† | 37.0 | 1.71 | | 942 |
| Copper | Silver Bell | Arizona | 2.80* | 46.0 | 1.68 | | 1050 |
| Iron | Alan Wood Steel, Croton | New Jersey | 2.86* | 31.2 | 2.18 | | 931 |
| Gold | S. A. Devel. Co. | Ecuador | 3.02* | 50.8 | 2.67 | 3.81 | 752 |
| Limestone | H. J. Kaiser Co. | California | 3.123 | 45.5 | 1.66 | | 877 |
| Gold | East Malartic | Quebec | 3.14* | 58.1 | 1.87 | 2.79 | 779 |
| Copper | Tennessee Copper | Tennessee | 3.29* | 40.9 | 2.08 | | 263 |
| Magnesite | N. W. Magnesite Co. | Washington | 3.370* | 38.6 | 3.09 | | 1031 |
| Copper | Cons. Copper | Nevada | 3.51 | 46.0 | 1.64 | | 276 |
| Slag | Monsanto Chem. | Alabama | 3.81* | 17.3 | 1.90 | | 1045 |
| Iron | Alan Wood Steel | New Jersey | 4.15† | 36.6 | 2.41 | 3.40 | 914 |
| Fe-Si, 25-75 | Electro-Met. Co. | New York | 4.17* | 33.9 | 1.94 | | 1067 |
| Al sinter | Aluminum Co. of Canada | Quebec | 4.23*† | 36.0 | 0.83 | | 1080 |
| Clay | H. J. Kaiser Co. | California | 4.235 | 32.7 | 1.36 | | 877 |
| Magnesium | Basic Magnesium | Nevada | 4.270* | 54.0 | 2.13 | 2.93 | 1033 |
| Fe-Mn alloy | Champion Rivet Co. | Ohio | 4.523 | 35.0 | 4.63 | | 442 |
| Fluorspar | Aluminum Ore Co. | Illinois | 5.700 | 35.0 | 1.88 | 2.98 | 619 |
| Clinker | Cobrecite | Michigan | 6.82 | 17.5 | 0.76 | | 830 |
| Pyrite | St. Joseph—Conc. | New York | 21.7 | 30.7 | 2.99 | | 847 |
| Bauxite | Swann and Co. | Alabama | 51.2 | 23.3 | 1.08 | | 738 |
| **TESTS AT 100-MESH** | | | | | | | |
| | | | −100M. | | | | |
| Petr. coke | Alcoa | Tennessee | 0.19 | 56.0 | 1.01 | | 700 |
| Cr Metal | Electro-Met. Co. | New York | 0.2115*† | 21.2 | 3.91 | | 1008 |
| Gold | Chas. Butters | Nicaragua | 0.393* | 56.7 | 1.53 | | 338 |
| Flint | Tri-State Flint | Missouri | 0.618* | 52.6 | 1.54 | | 440 |
| Gold | Bernheim | S. Rhodesia | 0.79* | 60.0 | 1.77 | | 477 |
| Gold | Veraguas Mines | Panama | 0.832 | 71.8 | 1.75 | 2.78 | 498 |
| Copper | Conglom.—C. & H. | Michigan | 0.833 | 63.4 | 1.69 | | 771 |
| Abrasive | Monsanto Chem. | Alabama | 0.858 | 30.2 | 2.11 | 3.91 | 656 |
| Fire clay | Standard Fuel | Michigan | 0.964* | 46.8 | 1.25 | | 835 |
| Gold | Wright-Hargreaves | Ontario | 0.98* | 61.0 | 1.70 | 2.68 | 406 |

* Standard ball-mill tests made at other mesh sizes.
† Standard rod-mill tests made on this ore.

TABLE I.—(*Continued*)

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| | | TESTS AT 100-MESH—(*Continued*) | | | | | |
| | | | −100 M. | | | | |
| Gold | Kelowna Expl. | B. Columbia | 1.01* | 67.5 | 2.09 | 3.22 | 676 |
| Gold | Western Mach. Co. | Calif. | 1.040 | 59.4 | 1.62 | | 903 |
| Gold | Noranda | Quebec | 1.079 | 69.9 | 1.85 | 2.86 | |
| Gold | Little Long Lac | Ontario | 1.150* | 67.8 | 1.69 | 2.64 | 570 |
| Gold | Wright-Hargreaves | Ontario | 1.15* | 67.7 | 1.70 | 2.68 | 406 |
| Copper | Amygdaloid—C. & H. Min. | Michigan | 1.185* | 66.1 | 1.745 | | 771 |
| Silver | Real Del Monte | Pachuca | 1.230* | 56.5 | 1.63 | | 881 |
| Copper | Sandstone—White Pine | Michigan | 1.250* | 55.6 | 1.70 | 2.64 | 1000 |
| Gold | Portland | Colorado | 1.256 | 56.6 | 1.63 | 2.69 | |
| Gold | Amer. Cyanamid | New Jersey | 1.288 | 62.7 | 1.68 | 2.61 | 524 |
| Sp. iron | Ford Motor | Michigan | 1.295* | 46.8 | 3.48 | | 1035 |
| Gold | LaLuz | Nicaragua | 1.30* | 63.4 | 1.79 | | 932 |
| Gold | Rand-Springs Mine | S. Africa | 1.323 | 62.3 | 1.78 | 2.71 | 504 |
| Gold | W. A. Liddell | Texas | 1.335 | 46.3 | 1.75 | 2.59 | 632 |
| Fire clay | Standard Fuel | Michigan | 1.355* | 52.4 | 1.23 | | 835 |
| Phosphate | Al-Ke-Me | Brazil | 1.36 | 61.8 | 1.39 | | 252 |
| Gold | San Luis | Mexico | 1.41* | 49.7 | 1.67 | | 730 |
| Copper | Tailings—Quincy | Michigan | 1.413* | 59.3 | 1.98 | | 1036 |
| Gold | E. T. Merritt | Ontario | 1.46 | 55.8 | 1.64 | | 301 |
| Phosphate | Ipanema Plant | Brazil | 1.47* | 59.6 | 2.36 | | 352 |
| Copper | Kanshanshi | Congo | 1.49 | 62.9 | 1.32 | | 316 |
| Silver | Cia. Min. Carlota | Chile | 1.51* | 72.0 | 1.88 | 3.00 | 660 |
| Gold | Madsen Red Lake | Ontario | 1.515* | 53.4 | 1.70 | 2.65 | 626 |
| Quartz | Pure Crystallized | Calif. | 1.523* | 53.0 | 1.68 | 2.65 | |
| Gold | Getchell Mine | Nevada | 1.535 | 59.3 | 1.45 | | 714 |
| Silver | Tonopah Min. | Nevada | 1.54 | 62.35 | 1.77 | | 802 |
| Copper | Shale—White Pine | Michigan | 1.56* | 70.6 | 1.79 | 2.97 | 1000 |
| Copper | New Cornelia | Ajo, Ariz. | 1.57* | 73.1 | 1.63 | 2.68 | 684 |
| Gold | Santa Maria Del Oro | Mexico | 1.575* | 45.7 | 2.08 | 3.10 | 574 |
| Copper | Sandstone—Vein Rock | Michigan | 1.577*† | 56.7 | 1.83 | 2.68 | 1000 |
| Gold | Dahlonega Gold | Georgia | 1.58 | 51.9 | 1.67 | | 250 |
| Gold | Sherritt Gordon | Manitoba | 1.64 | 57.0 | 1.85 | | 206 |
| Gold | Am. Metals | New Jersey | 1.676* | 50.0 | 1.74 | | 808 |
| Manganese | Gen. Manganese Co. | S. Dakota | 1.71 | | 1.62 | | 734 |
| Gold | Ziebright Mine | Calif. | 1.752 | 56.4 | 1.79 | | 505 |
| Copper | Castle Dome | Miami, Ariz. | 1.783* | 56.1 | 1.69 | | 1042 |
| Copper | Cyprus Mines | Cyprus | 1.786* | 60.3 | 2.69 | | 432 |
| Tin | Tainton Products | Bolivia | 1.80 | 52.1 | 2.42 | | 905 |
| Gold | F. Viles | Montana | 1.81 | 63.9 | 1.72 | | 564 |
| Copper | Miami Ore | Miami, Ariz. | 1.816* | 52.2 | 1.64 | 2.69 | |
| Manganese | C. C. Walfred | Minn. | 1.83 | 60.0 | 1.69 | | 867 |
| Copper | Anaconda Copper | Montana | 1.85* | 54.7 | 2.18 | 3.23 | 910 |
| Gold | Rochester-Plymouth | Nevada | 1.860* | 63.1 | 1.83 | 2.75 | 518 |
| Copper | Morenci | Arizona | 1.88*† | 54.5 | 1.57 | 2.63 | 913 |
| Gold | Cline Lake | Ontario | 1.92* | 67.3 | 1.78 | | 745 |
| Gold | Homestake | S. Dakota | 1.964* | 66.5 | 1.91 | 3.12 | |
| Copper | Silver Bell | Arizona | 1.98* | 59.6 | 1.68 | | 1050 |
| Gold | Atlantic Gulf & Pacific | P.I. | 2.01* | 52.9 | 1.68 | | 329 |
| Copper | Utah Copper—Arthur | Utah | 2.15*† | 57.8 | 1.72 | | 938 |
| Slag | Monsanto Chem. | Alabama | 2.16* | 31.6 | 1.90 | | 1045 |
| Tin | Pitts. Plate Glass | Mexico | 2.226* | 55.5 | 2.92 | | 1018 |
| Phosphate | Int. Agric. Corp. | Florida | 2.260 | 47.3 | 1.50 | | 394 |
| Fe-Cr alloy | Chromium Min. & Smelt. | Ontario | 2.27 | 47.8 | 3.97 | | 743 |
| Tin | Pitts. Plate Glass | Mexico | 2.335* | 56.7 | 3.04 | | 1018 |
| Nickel | Falconbridge | Ontario | 2.405 | 59.3 | 2.29 | 3.65 | 371 |
| Magnesite | NW. Magnesite Co. | Washington | 2.410* | 50.3 | 3.09 | | 1031 |
| Gold | S. Amer. Dev. Co. | Ecuador | 2.44* | 63.1 | 2.67 | 3.81 | 752 |
| Gold | E. Malartic | Quebec | 2.49* | 68.0 | 1.87 | 2.80 | 779 |
| Iron | Marquette Carbonate | Wisconsin | 2.50 | 79.2 | 2.17 | | 342 |
| Gold | C. M. & S.—Golden Rose | B. Columbia | 2.52* | 58.2 | 2.10 | | 864 |
| Copper | Cons. Copper | Nevada | 2.59* | 60.2 | 1.64 | | 276 |
| Iron | Bowring, N. Y. | Morocco | 2.66* | 49.4 | 1.80 | | 315 |
| Iron | Iron River Falls | Wisconsin | 2.72* | 58.7 | 2.39 | | 1023 |
| Fe-Si, 25–75 | Electro-Met. Co. | New York | 2.950* | 47.2 | 1.94 | | 1067 |
| Copper | Bingham Canyon | Utah | 2.99 | 42.6 | 2.68 | 4.65 | |
| Gold | Butte-Highlands | Montana | 3.12* | 58.3 | 1.67 | | 861 |
| Salt | Du Pont | New York | 3 48 | 44.8 | 1.39 | | 939 |
| Magnesium | Basic Refr. Inc. | Ohio | 4.125* | 61.9 | 2.13 | 2.93 | 1033 |
| Slag | Victor Chem. Wks. | Tenn. | 4.15 | 48.0 | 4.05 | | 284 |

* Standard ball-mill tests made at other mesh sizes.
† Standard rod-mill tests made on this ore.

TABLE 1.—(*Continued*)

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| **TESTS AT MINUS 150-MESH** | | | | | | | |
| | | | −150M. | | | | |
| Graphite | Long Valley—Cons. | New York | 0.31* | 49.8 | 0.96 | | 860 |
| Copper | Sandstone—White Pine | Michigan | 0.85* | 84.1 | 1.70 | 2.64 | 1000 |
| Gold | Kelowna Expl. | B. Columbia | 0.86* | 77.9 | 2.09 | 3.22 | 676 |
| Quartz | Fused Quartz sand | Illinois | 1.02 | 63.5 | 1.48 | | 854 |
| Gold | Little Long Lac | Ontario | 1.080* | 82.6 | | | 570 |
| Gold | Rand Springs Mine | S. Africa | 1.117* | 76.7 | 1.78 | | 504 |
| Gold | H. C. Winans | Brazil | 1.155 | 76.8 | 1.63 | | 474 |
| Gold | Powell-Rouyn | Quebec | 1.233* | 79.5 | 1.78 | | 949 |
| Copper | Sandstone—White Pine | Michigan | 1.249* | 73.1 | 1.78 | | 1000 |
| Gold | Bong Mieu | Indo-China | 1.31 | 75.7 | 2.00 | 3.07 | 339 |
| Gold | Kerr-Addison | Ontario | 1.32* | 81.6 | 1.81 | | 799 |
| Copper | Anaconda | Montana | 1.36* | 75.2 | 2.18 | 3.23 | 910 |
| Gold | Minnesota Mines | Colorado | 1.368* | 77.6 | 1.85 | 2.81 | 637 |
| Copper | Morenci | Arizona | 1.395*† | 77.2 | 1.57 | 2.63 | 913 |
| Copper | Castle Dome | Miami, Ariz. | 1.396* | 78.7 | 1.69 | | 1042 |
| Copper | Mines De Bor | Yugoslavia | 1.41* | 84.5 | 1.91 | | 249 |
| Copper | Shale—White Pine | Michigan | 1.430* | 83.7 | 1.79 | 2.97 | 1000 |
| Gold | Can.-Malartic Min. Co. | Quebec | 1.445 | 78.5 | 1.84 | | 586 |
| Gold | Parcoy | Peru | 1.495* | 72.8 | 2.26 | | 567 |
| Gold | Kerr-Addison | Ontario | 1.567* | 79.3 | 1.83 | | 799 |
| Nickel | B. C. Nickel Mines | B. Columbia | 1.607 | 71.4 | 2.47 | | 716 |
| Langbeinite | Union Potash & Chem. | New Mexico | 1.609 | 77.0 | 1.75 | | 1006 |
| Copper | Utah Copper—Arthur | Utah | 1.62*† | 77.1 | 1.72 | | 938 |
| Tin | Pitts. Plate Glass | Mexico | 1.675* | 74.6 | 2.92 | | 1018 |
| Iron | Moose Mountain | Ontario | 1.689*† | 81.5 | 2.44 | 3.42 | 756 |
| Gold | Buffalo-Ankerite | Ontario | 1.705 | 82.9 | 1.94 | 3.22 | 614 |
| Gold | M. A. Smith | Cuba | 1.725 | 78.2 | 1.86 | | 710 |
| Tin | Pitts. Plate Glass | Mexico | 1.783* | 76.2 | 3.03 | | 1018 |
| Zinc-lead | Callahan Zinc-Lead | Idaho | 1.81 | 60.4 | 2.23 | | 691 |
| Limestone | Lawrence Cement Co. | Pennsylvania | 1.870* | 76.2 | 1.90 | | 972 |
| Iron | Iron River Falls | Wisconsin | 1.916* | 77.3 | 2.39 | | 1023 |
| Gold | Preston East Dome | Ontario | 2.01* | 86.8 | 1.78 | | 694 |
| Gold | C. M. & S.—Golden Rose | B. Columbia | 2.03* | 74.1 | 2.10 | | 864 |
| Iron | Inland Steel Co. | Wisconsin | 2.09* | 62.8 | 2.10 | | 837 |
| Gold | E. Malartic | Quebec | 2.134* | 83.5 | 1.87 | 2.80 | 779 |
| Gold | Atienda | Italy | 2.84 | 84.4 | 1.42 | 2.56 | 629 |
| Magnesium | Basic Magnesium | Nevada | 2.855* | 79.5 | 2.13 | 2.93 | 1033 |
| Nickel | Nicaro Nickel Co. | Cuba | 3.48 | 73.8 | 1.13 | | 869 |
| Nickel | Nicaro Nickel Co. | Cuba | 5.55 | 86.0 | 1.29 | | 1075 |
| **TESTS AT MINUS 200-MESH** | | | | | | | |
| | | | −200M. | | | | |
| Graphite | Long Valley—Conc. | New York | 0.23* | | 0.96 | | 860 |
| Silicon carbide | Electro-Ref. | New York | 0.259 | | 1.89 | | 1047 |
| Flint | Tri-State Flint | Missouri | 0.491* | | | | 440 |
| Gold | Bernheim | S. Rhodesia | 0.56* | | 1.77 | | 477 |
| Shale | Korite Corp. | Wisconsin | 0.59 | | 1.59 | | 677 |
| Silicon carbide | Electro-Ref. | New York | 0.614 | | 1.25 | | 1047 |
| Titanium | Titanium Corp. | Arkansas | 0.620 | | 2.36 | | 559 |
| Copper | Amygdaloid C. & H. Min. | Michigan | 0.627* | | 1.69 | | 771 |
| Sp. Iron | Ford Motor Co. | Michigan | 0.664* | | 3.48 | | 1035 |
| Min. Wool | Mineralite Corp. | Penna. | 0.678 | | 0.19 | | 399 |
| Gold | San Luis | Mexico | 0.688* | | 1.67 | | 730 |
| Iron | Mabellite Corp. | New York | 0.719 | | 1.74 | | 419 |
| Silver | Real Del Monte | Pachuca | 0.720* | | 1.63 | | 881 |
| Copper | Sandstone—White Pine | Michigan | 0.733* | | 1.20 | 2.64 | 1000 |
| Gold | Kelowna Expl. | B. Columbia | 0.758* | | 2.09 | 3.27 | 676 |
| Copper | Tailings—C&H Min. | Michigan | 0.759* | | 1.75 | | 771 |
| Gold | Wright-Hargreaves | Ontario | 0.771* | | 1.70 | 2.68 | 406 |
| Gold | Cia. Minera Ciclon | Chile | 0.788 | | 1.84 | | 719 |
| Clay | Sun Oil Co. | Pennsylvania | 0.790 | | 0.66 | 1.09 | 641 |
| Gold | Carrizalillo | Chile | 0.816* | | 1.74 | | 808 |
| Copper | Noranda | Quebec | 0.83* | | 1.85 | 2.86 | 504 |
| Gold | Rand-Springs Mine | S. Africa | 0.859* | | 1.78 | 2.71 | |

* Standard ball-mill tests made at other mesh sizes.
† Standard rod-mill tests made on this ore.

TABLE 1.—(*Continued*)

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| | | TESTS AT MINUS 200-MESH—(*Continued*) | | | | | |
| | | | −200M. | | | | |
| Shale | Korite Corp. | Wisconsin | 0.86 | | 1.36 | | 677 |
| Quartz | Pure, crystallized | California | 0.878 | | 1.68 | 2.65 | |
| Iron | Du Pont | Pennsylvania | 0.89 | | 2.73 | | 251 |
| Gold | Little Long Lac | Ontario | 0.903* | 1 | 1.69 | 2.64 | 570 |
| Sand | Krebs Pigment | Maryland | 0.92 | | 2.79 | | 392 |
| Copper | New Cornelia Ore | Ajo, Ariz. | 0.942 | | 1.63 | 3.68 | 684 |
| Gold | Galigher Co. | Utah | 0.943 | | 1.65 | | 889 |
| Gold | Powell-Rouyn | Quebec | 0.960* | | 1.78 | | 949 |
| Gold | Santa Maria del Oro | Mexico | 0.981 | | 2.08 | 3.10 | 574 |
| Copper | Anaconda | Montana | 0.990* | | 2.18 | 3.23 | 910 |
| Gold | M. A. Smith | Cuba | 1.025 | | 1.85 | | 710 |
| Gold | Portland | Colorado | 1.035 | | 1.63 | 2.69 | |
| Copper | Castle Dome | Miami, Ariz. | 1.036* | | 1.69 | | 1042 |
| Silver | Cia. Min. Carlota | Chile | 1.042 | | 1.88 | 3.00 | 660 |
| Gold | Berens River Mines | Manitoba | 1.045 | | 1.95 | | 705 |
| Fe-Si, 25-75 | Electro-Met. Corp. | New York | 1.075* | | 1.94 | | 1067 |
| Ti | Vanadium Corp. Am. | Pennsylvania | 1.08 | | 2.44 | | 281 |
| Copper | Morenci | Arizona | 1.085*† | | 1.57 | 2.63 | 913 |
| Gold | Upper Can. Gold Mines | Ontario | 1.097 | | 1.88 | | 821 |
| Manganese | Gen. Manganese Corp. | S. Dakota | 1.136 | | 1.62 | | 734 |
| Copper | Miami Ore | Miami, Ariz. | 1.139 | | 1.64 | 2.69 | |
| Gold | Rochester-Plymouth | Nevada | 1.141* | | 1.83 | | 518 |
| Copper | Silver Bell | Arizona | 1.152* | | 1.68 | | 1050 |
| Gold | Kerr-Addison | Ontario | 1.153* | | 1.83 | | 799 |
| Gold | Baguio Gold Min. | P.I. | 1.160 | | 1.62 | 2.63 | 402 |
| Gold | Kerr-Addison | Ontario | 1.175* | | 1.81 | | 799 |
| Quartz | White Quartz—Sulphides | California | 1.20 | | 1.70 | | 725 |
| Gold | Cline Lake | Ontario | 1.225* | | 1.78 | | 745 |
| Iron | Moose Mountain | Ontario | 1.227* | | 2.44 | 3.42 | 756 |
| Copper | Utah Copper—Arthur | Utah | 1.23*† | | 1.72 | | 938 |
| Limestone | H. J. Kaiser Co. | California | 1.257* | | 1.66 | | 877 |
| Gold | Homestake | S. Dakota | 1.26* | | 1.91 | 3.12 | |
| Copper | Cyprus Mines Corp. | Cyprus | 1.284* | | 2.69 | | 432 |
| Copper | Shale—White Pine | Michigan | 1.304* | | 1.79 | 2.97 | 1000 |
| Zinc | New Jersey Zinc—Conc. | Penna. | 1.315 | | 2.51 | | 849 |
| Gold | So. Amer. Dev. Co. | Ecuador | 1.323* | | 2.67 | 3.81 | 752 |
| Lead-zinc | Axerio-Monteponi | Italy | 1.396 | | 2.88 | 4.43 | 562 |
| Gold | C. M. & S. Co.—Golden Rose | Ontario | 1.42* | | 2.10 | | 864 |
| Zinc | New Jersey Zinc Co. | Penna. | 1.482 | | 2.55 | | 503 |
| Clay | H. J. Kaiser Co. | California | 1.585* | | 1.36 | | 877 |
| Gold | E. Malartic | Quebec | 1.601* | | 1.87 | 2.80 | 779 |
| Limestone | Lawrence Cement | Pennsylvania | 1.667* | | 1.90 | | 972 |
| Magnesium | Basic Refr. Inc. | Ohio | 1.682* | | 2.13 | 2.93 | 1033 |
| Gold | Preston East Dome | Ontario | 1.69* | | 1.78 | | 694 |
| Gold | Butte Highlands | Montana | 1.81* | | 1.66 | | 861 |
| Copper | Bingham Canyon | Utah | 1.854 | | 2.62 | 4.65 | |
| Copper | Mines De Bor | Yugoslavia | 1.94 | | 2.1 | | 249 |
| Manganese | L. G. Aguilar & Co. | Cuba | 1.944 | | 1.87 | | 1028 |
| Lead slag | Arcade Sm. & Ref. | Mass. | 5.16 | | 4.53 | | 360 |

* Standard ball-mill tests made at other mesh sizes.
† Standard rod-mill tests made on this ore.

The number of revolutions necessary to obtain 100 per cent circulating load, or 50 per cent of screen undersize in the product, is calculated from the results of the previous period. The number of net grams of screen undersize produced per revolution of the mill at 100 per cent circulating load approaches its final equilibrium value after several grinding periods, and this is recorded as the rod-mill grindability, or relative ease of grinding, of the sample.

Tests are conducted at the mesh size to which the ore is to be ground in practice, and the capacity to be expected from a given mill is calculated by comparing the grindability with that of a similar standard ore. As with ball-mill

TABLE 2.—*Standard Rod-mill Grindability Tests*

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| **TESTS AT MINUS 3-MESH** | | | | | | | |
| | | | −3 M. | | | | |
| Clinker | Volunteer Cement Co. | Tennessee | 29.34* | 2.82 | 1.79 | | 828 |
| Granite | W. A. Burton | Texas | 31.6 | 2.76 | 1.60 | 2.65 | 875 |
| **TESTS AT MINUS 4-MESH** | | | | | | | |
| | | | −4 M. | | | | |
| Gravel | Warner Co.—Van Sciver | Pennsylvania | 22.2 | 5.71 | 1.69 | | 815 |
| Iron | Charleston Iron Min. | Minnesota | 25.2 | 9.2 | 2.34 | | 754 |
| Clinker | Volunteer Cement Co. | Tennessee | 26.15* | 2.67 | 1.79 | | 828 |
| Bauxite | Republic Min. & Mfg. | Arkansas | 37.0 | 17.50 | 1.51 | | 1053 |
| **TESTS AT MINUS 6-MESH** | | | | | | | |
| | | | −6 M. | | | | |
| Gravel | Material Service Corp. | Illinois | 22.2 | 8.55 | 1.60 | | 765 |
| Iron | Warren Pipe & Foundry | New Jersey | 49.5 | 5.72 | 2.08 | | 1065 |
| Calcite | New England Lime | Mass. | 133.6 | 4.02 | 1.77 | | 1066 |
| Dolomite | New England Lime | Connecticut | 319.0 | 2.39 | 1.85 | | 1066 |
| **TESTS AT MINUS 8-MESH** | | | | | | | |
| | | | −8 M. | | | | |
| Silicon-carbide | Exolon Co. | New York | 37.10* | 1.92 | 1.60 | 3.17 | 1052 |
| Phosphate | Federal Chem. Co. | Tennessee | 41.50* | 24.36 | 1.80 | | 814 |
| Coal Slag | H. B. Reed, Inc. | Indiana | 208.5 | 0.48 | 1.63 | | 1026 |
| **TESTS AT MINUS 10-MESH** | | | | | | | |
| | | | −10 M. | | | | |
| Limestone | Crushed Rock Prod. Co. | New York | 1.63 | 9.25 | 1.67 | | 906 |
| Brick | Cohart Refr. Inc. | Kentucky | 2.65* | 16.73 | 2.22 | | 809 |
| Limestone | Pitts. Limestone Corp. | Pennsylvania | 9.85 | 13.0 | 1.50 | | 723 |
| Gravel | Dravo Corp. | Pennsylvania | 11.64 | 12.98 | 1.64 | | 750 |
| Limestone | Franklin Limestone Co. | Tennessee | 12.65 | 15.20 | 1.65 | | 953 |
| Clinker | Volunteer Cement Co. | Tennessee | 13.03* | 7.72 | 1.79 | | 828 |
| Glass | Corning Glass Wks. | New York | 14.15 | 5.17 | 1.01 | | 945 |
| Sod. silicate | Du Pont | Indiana | 16.80 | 7.61 | 0.94 | | 954 |
| Chrome | Tekirova Madenleri Co. | Turkey | 37.40 | 11.74 | 2.05 | | 843 |
| **TESTS AT MINUS 14-MESH** | | | | | | | |
| | | | −14 M. | | | | |
| Radium | Eldorado Gold Mines | Ontario | 7.76 | 17.66 | 1.95 | 2.77 | 1063 |
| Tile | Arketex Ceramic Corp. | Indiana | 8.15 | 18.02 | 1.60 | | 766 |
| Fluorspar | Kinetic Chem. Inc. | New Mexico | 11.15* | 14.6 | 1.97 | | 763 |
| Calcines | Basic Dolomite Co. | | 13.50 | | 1.62 | | 583 |
| Feldspar | Golding Keene Co. | N. Hampshire | 14.90* | 13.85 | 1.78 | | 784 |
| Nickel matte | Int. Nickel Co. | W. Virginia | 20.96 | 13.98 | 3.81 | | 1009 |
| Langbeinite | Union Potash & Chem. | New Mexico | 40.90* | 8.77 | 1.59 | | 842 |
| Slag | Celotex Corp. | Ohio | 163.5 | | 0.36 | | 919 |
| **TESTS AT MINUS 20-MESH** | | | | | | | |
| | | | −20 M. | | | | |
| Graphite | U.S. Graphite Co. | Michigan | 2.22 | | 1.24 | | 728 |
| Brick | Cohart Ref. Co. | Kentucky | 2.57* | 20.61 | 2.22 | | 809 |
| Iron | Mozan | Japan | 4.20† | 20.19 | 2.41 | 3.42 | 914 |
| Alumina | Exolon Co. | New York | 5.19 | 10.84 | 2.65 | | 1052 |
| Silicon carbide | Exolon Co. | New York | 7.50 | 6.73 | 1.60 | | 1052 |
| Slag | Ohio Ferro-Alloys | Ohio | 8.40 | 21.82 | 1.99 | | 933 |

* Rod-mill tests made at other mesh sizes.
† Standard ball-mill tests made on this ore.

TABLE 2.—(*Continued*)

| Ore | Description by | Location | Net Grams Undersize per Revolution | −200-mesh in Product, Per Cent | Specific Gravity | | No. |
|---|---|---|---|---|---|---|---|
| | | | | | Apparent | True | |
| **TESTS AT MINUS 20-MESH—(*Continued*)** | | | | | | | |
| | | | −20 M. | | | | |
| Quartzite | Smith & Koelliker | Ohio | 9.26 | 15.43 | 1.84 | | 774 |
| Copper | Utah Copper—Arthur | Utah | 9.90*† | 25.07 | 1.72 | | 938 |
| Titanium | Nat. Lead Co. | Missouri | 11.50* | 13.0 | 2.64 | | 1017 |
| Rutile | American Rutile Corp. | Virginia | 11.95 | 31.75 | 1.81 | | 971 |
| Feldspar | Golding Keene Co. | N. Hampshire | 13.34* | 16.30 | 1.78 | | 784 |
| Copper | Morenci Ore | Arizona | 14.98*† | 23.75 | 1.57 | 2.63 | 913 |
| Feldspar | Cons. Feldspar Corp. | Tennessee | 16.36 | 14.45 | 1.52 | | 934 |
| Iron | Rep. Steel—Harmony | New York | 18.60† | 7.16 | 2.19 | | 822 |
| Bauxite | Porocel Corp. | Arkansas | 21.27 | 19.60 | 1.25 | | 884 |
| Iron | Rep. Steel—Old Bed | Mineville, N. Y. | 25.95† | 7.05 | 2.70 | | 822 |
| Iron | Rep. Steel—New Bed | Mineville, N. Y. | 28.22† | 7.05 | 2.71 | | 822 |
| Barite | Barium Min. Corp. | W. Virginia | 59.5 | 15.7 | 3.14 | | 1007 |
| **TESTS AT MINUS 28-MESH** | | | | | | | |
| | | | −28 M. | | | | |
| Cr Metal | Electro-Met. Co. | New York | 1.90† | 3.00 | 3.91 | 7.01 | 1008 |
| Sod. silicate | Diamond Alkali Co. | Ohio | 4.72 | 15.56 | 1.62 | | 739 |
| Glass | Pitts. Plate Glass Co. | Pennsylvania | 4.97 | 10.47 | 1.49 | 2.60 | 746 |
| Manganese | E. W. Creevy | Costa Rica | 7.45 | 24.00 | 2.02 | | 968 |
| Gypsum | Diamond Crystal Salt | | 7.77 | 41.60 | 1.90 | | 696 |
| Copper | Utah Copper—Arthur | Utah | 7.93*† | 31.21 | 1.72 | | 938 |
| Titanium | Nat. Lead Co. | Missouri | 9.165* | 17.12 | 2.64 | | 1017 |
| Iron | M. A. Hanna Co.—Clifton | New York | 9.30† | 15.00 | 2.76 | | 1022 |
| Copper | Morenci Ore | Arizona | 11.98*† | 28.86 | 1.57 | 2.63 | 913 |
| Ferrosilicon | Pitts. Met. Co. | New York | 20.92* | 10.36 | 2.77 | | 839 |
| **TESTS AT MINUS 35-MESH** | | | | | | | |
| | | | −35M. | | | | |
| Pumice | Barnsdall Tripoli Co. | Missouri | 4.52 | 58.4 | 0.64 | | 749 |
| Zinc | New Jersey Zinc Co. | N. Jersey | 5.73 | 26.0 | 2.39 | | 930 |
| Phosphate | Federal Chem. Co. | Tenn. | 5.87 | 37.84 | 1.38 | | 533 |
| Copper | Morenci Ore | Arizona | 6.45*† | 39.64 | 1.57 | 2.63 | 913 |
| Copper | Utah Copper—Arthur | Utah | 6.62*† | 35.53 | 1.72 | | 938 |
| Cold | Mineral Min. Corp. | S. Carolina | 7.09† | 54.61 | 1.43 | | 782 |
| Iron | Rep. Steel—Old Bed | New York | 9.15*† | 18.79 | 2.70 | | 822 |
| Iron | Rep. Steel—Harmony | New York | 9.43* | 17.58 | 2.20 | | 822 |
| Sylvanite | Union Potash & Chem. Co. | New Mexico | 11.22* | 20.21 | 1.30 | | 842 |
| Ferrosilicon | Pitts. Met. Co. | New York | 13.68* | 24.26 | 2.68 | | 839 |
| Barite | United Pigment—Meggen | N. Jersey | 21.01 | 37.09 | 2.98 | | 848 |
| Pitch | Crosset Chem. Co. | Arkansas | 35.2 | 26.24 | 1.27 | | 813 |
| Barite | United Pigment—Tenn. | N. Jersey | 73.43 | 39.94 | 3.09 | | 848 |
| **TESTS AT MINUS 48-MESH** | | | | | | | |
| | | | −48M. | | | | |
| Copper | Amygdaloid | Michigan | 1.995† | 48.94 | 1.87 | 2.93 | 1000 |
| Copper | Sandstone Vein | Michigan | 3.733† | 39.40 | 1.83 | 2.68 | 1000 |
| Gold | Seal Harbor Gold Mines | Nova Scotia | 4.66 | 40.4 | 1.78 | 2.76 | 602 |
| Kyanite | Phosphate Recovery Corp. | Virginia | 4.77 | 20.04 | 1.74 | 2.82 | 760 |
| Copper | Morenci Ore | Arizona | 4.89*† | 44.87 | 1.57 | 2.63 | 913 |
| Fluorspar | Kinetic Chem. Inc. | New Mex. | 5.40* | 30.5 | 1.96 | | 763 |
| Sylvanite | Union Potash & Chem. | New Mex. | 5.43 | 28.21 | 1.23 | | 842 |
| Copper | Utah Copper—Arthur | Utah | 5.43*† | 43.42 | 1.72 | | 938 |
| Langbeinite | Union Potash & Chem. | New Mex. | 5.73* | 31.27 | 1.59 | | 842 |
| Tripoli | Western Minerals, Inc. | Kansas | 6.89† | 77.35 | 1.14 | | 883 |
| Sinter | Aluminum Co. of Can. | Quebec | 8.75*† | 36.82 | 0.84 | | 1080 |
| Cryolite | Penna. Salt Mfg. Co. | Pennsylvania | 13.93 | 37.62 | 1.92 | | 958 |
| **TESTS AT MINUS 65-MESH** | | | | | | | |
| | | | −65M. | | | | |
| Fe-Si, 50–50 | Electro-Met. Co. | New York | 2.92 | 39.18 | 3.08 | | 947 |
| Sinter | Aluminum Co. of Can. | Quebec | 6.25*† | 41.45 | 0.84 | | 1080 |

* Rod-mill tests made at other mesh sizes.
† Standard ball-mill tests made on this ore.

grinding, judgment must be exercised in making this comparison.

Table 2 gives the condensed results of 85 standard rod-mill grindability tests, made at mesh sizes ranging from 3 to 65 mesh. The tests made at each mesh size are arranged in the order of increasing ease of grinding. The grindabilities of ores at which rod-mill tests have been made at more than one mesh size are marked by an asterisk (*), and those on which standard ball-mill tests have also been made are marked by a dagger (†). In addition to the grindability at the specified mesh, the percentage of minus 200-mesh in the rod-mill product, the apparent and true specific gravities, and the reference test number are included in the tabulation.

When the rod-mill grindabilities of samples tested at more than one mesh size are plotted on a logarithmic scale against the mesh sizes at equal intervals, the results usually are straight lines. However, there is more variation in the slopes for different materials than in the ball-mill tests, since the mesh sizes are larger and more of the total comminution accomplished is done above the natural grain sizes of the material.