

Rock Mechanics Testing User's Guide

Test	Standard/Specification	Sample Requirements ¹	Turnaround Time ²	I/P ³	Typical Data Use & Reported Data	Testing Capacities and Other Notes
Classification Tests						
Moisture Content and Density	ASTM D 2216 ASTM D 2937	Sample size requirements depend on sample particle size. Sample size requirement range from, a minimum of 20 gm. (max 2mm, 0.1% moisture accuracy). Minimum 500 gm. Required for samples consisting entirely of intact rock. If density is required, samples must be intact.	3 days, note that 16-hour required drying time drives sample processing.	I	Common Index test; strength is influenced by moisture & dry density characteristics. Report: dry density and percent water content.	
Specific Gravity	ASTM D 854	See note in column at right.	2-3 days.	I	Provides a measure of the grain density of the ground rock particles. Result reported: specific gravity.	Rock samples are disaggregated over sieves up to a #100 sieve size; the methods of ASTM D 854 are then applied to the material.
Specific Gravity & Absorption	ASTM C 127	Sample size requirements depend on particles size and may range from about 5 to more than 250 lbs.	3 days.	I	Specific gravity of aggregates in used in calculating the volume occupied in mixtures (e.g., concrete) and in the computations of voids. Report: specific gravity	Method is applicable to coarse aggregates.

<p>Atterberg Limits Test (modified for rock)</p>	<p>ASTM D 4318</p>	<p>Generally, a few cubic inches are adequate. See note in column at right.</p>	<p>2-3 days, assuming sample is air dried upon receipt.</p>	<p>I</p>	<p>Provides engineering information on rock material plasticity; also indicator of grain size and water and chemical retention capacity. Report: as per column to right.</p>	<p>Rock samples are disaggregated over sieves up to a minus #100 sieve size; the methods of ASTM D 4318 are then applied to the resulting material. Test results include plastic limit (moisture content at which prepared specimens becomes ductile), liquid limit (moisture content at which material flows), and plasticity index (difference between the two). Also includes Atterberg Classification (ML, MH, CL, CH or NP).</p>
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Strength Tests						
Direct Shear on Rock Joints	ASTM D 5607	Tests may be conducted on intact rock cores, insipient failure planes, natural joints or saw cut surfaces. Client must supply the series of normal stresses at which the tests are to be conducted.	1 week.	I	Provides design information on rock shear strength (e.g., for rock slopes, tunnels) including rocks which have non-planar joints or discontinuities. Report: Tabular data and plots of: shear load vs. shear displacement; shear stress vs. normal displacement; and normal stress vs. normal displacement; description of failure.	Failure mechanisms can result from friction across joints and from shearing motion; geometry of individual samples may induce overturning moments that can induce premature failure in tension rather than in shear.
Unconfined Compressive Strength (peak load only)	ASTM D 7012 Method C	Requires a right cylindrical sample with a 2:2.50 aspect (length-to diameter) ratio.	5 to 7 days.	P	Provides information on rock compressive strength (e.g., for design of foundations, mine pillars, rock wall stability and rock drill bits). Report: Unconfined compressive strength.	Loads up to 400,000 lbs.; core diameters up to 4 in. can be accommodated.
Unconfined Compressive Strength (with Stress-Strain curve, Young's modulus and Poisson's ratio)	ASTM D 7012 Method D	Requires a right cylindrical sample with a 2:2.50 aspect (length-to diameter) ratio; minimum diameter of 1 in. Intact samples with field moisture conditions preserved are preferred.	5 to 7 days.	P	Test data are used to calculate stress and deformation in rock structures. Report: Stress-Strain curve, Young's modulus, Poisson's ratio and Peak unconfined compression strength.	Rock core diameters up to 4 in. can be accommodated.
Triaxial Compressive Strength (peak load only)	ASTM D 7012 Method A	Client must provide confining pressures.	2 to 3 weeks.	P	Provides information on rock triaxial compressive strength. Report: Confining stress, triaxial compressive strength.	Confining pressures to 10,000 psi and vertical loads to 400,000 lbs.; core diameters up to 4 in. can be accommodated.

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Triaxial Compressive Strength (with Stress-Strain curve, Young's modulus and Poisson's ratio)	ASTM D 7012 Method B	Client must provide confining pressures. Requires a right cylindrical sample with a 2:2.50 aspect (length-to diameter) ratio.	2 to 3 weeks.	P	Test data are used to calculate stress and deformation in rock structures under confining pressures under which underground rock masses exist. Report: Stress-Strain curve, Young's modulus, Poisson's ratio, stress at failure, confining stress.	Confining pressures to 10,000 psi and vertical loads to 400,000 lbs.; core diameters up to 4 in. can be accommodated.
Indirect Splitting Tensile Strength (Brazilian Disc Method)	ASTM D 3967	Right circular disk with thickness-to diameter ratio of 0.5 - 0.75.	5 to 7 days.	P	Provides a measure of the tensile strength of rock specimens. Report: Splitting tensile strength.	This method provides a simpler, less expensive (though less reproducible) method for tensile strength determination than the uniaxial tension test.
Slake Durability Test	ASTM D 4644	Ten representative, intact, roughly equidimensional rock fragments of 40 to 60 gm. Each; total sample of 550 to 600 gm.	5 days.	I	Method provides a qualitative characterization of the durability of weak rocks under services conditions. Report: Slake durability index (I, II or III), descriptions of fragments.	Method is applicable to shale and other weak rocks.
Point Load Test	ASTM D 5731	Intact rock core, block, or irregular lump with minimum dimension of 30 mm and maximum dimension of 85 mm (50 mm preferred).	4 days.	I	Provides index-level information for strength classification of rock materials. Report: Point load strength index; estimated uniaxial compressive strength; calculated strength anisotropy index.	Method is not appropriate to obtain design or performance level strength data.
Sonic Velocities (Unstressed condition)	ASTM D 2845	Requires a right cylindrical sample with a 2:2.50 aspect (length-to diameter) ratio.	1 to 2 weeks.	I	Provides compression and shear wave velocities and ultrasonic values for elastic constants. Report: calculated compression and shear pulse velocities; degree of anisotropy; calculated elastic constants.	Wave velocity data are applicable to intact, homogeneous, isotropic rock specimens.

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Cerchar Abrasivity Index	ASTM D 7625	2 inch	5 days.	I	Provides the Cerchar Abrasivity Index, which is essential for any mechanical excavations or drilling project.	
Modulus of Rupture (modified for rock)	ASTM C 99	Samples must be adequate to cut a right rectangular block; nominal size 4x8x2.25 in., smaller samples may be cut from supplied rock core; minimum usable size is determined by rock grain size.	5 days.	I	Provides information useful in comparing the modulus of rupture among different rock samples. Report; modulus of rupture.	
Creep of Hard Rock in Uniaxial Compression	ASTM D 7070 Method A	Requires a right cylindrical sample with a 2.0 to 2.5:1 aspect (length-to diameter) ratio; minimum diameter of 1 7/8 in. Intact samples with field moisture conditions preserved are preferred.	Several months or more.	P	Test provides design strength parameters for rock materials subjected to constant load over long periods of time. Report: load (stress) applied to sample; strain vs. time curve; description of sample after test completion.	
Schmidt Rebound Hardness (modified for rock)	ASTM C 805 (Concrete) ASTM D5873 (Rock)	6" dia core (concrete) 100 mm minimum thickness (rock)	5 days.	I	Provides a measure of the rebound hardness of the rock/concrete sample. Using correction factors, certain strength properties can be inferred. Report: hammer rebound number.	

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Permeability Tests						
Permeability by Flowing Air Test (modified for rock)	ASTM D 4525	Requires a right cylindrical undisturbed or remolded sample with a 1:1 aspect (length-to-diameter) ratio.	5 to 12 days depending on sample properties and on sample permeability.	P	Measures gas permeability at design loads and/or depth; used in soil vapor extraction studies, dispersion studies and modeling. Report: Air conductivity in meters squared (Darcys); plot of reciprocal pressure vs. permeability.	Gradient-controlled method.
Back Pressure Permeability (Tx/Pbp by flow pump, modified for rock)	ASTM D 5084	Requires a right cylindrical undisturbed or remolded sample with a 1:1 aspect (length-to-diameter) ratio.	5 to 12 days depending on sample properties and on sample permeability.	P	Measures permeability at design loads and/or depth; used in dam design, ground water flow and dispersion studies and modeling. Report: hydraulic conductivity; plot of reciprocal pressure vs. permeability.	Gradient-controlled or volume controlled methods. Can be used to determine hydraulic conductivity/ compatibility of soil or rock materials to various pore fluids and/or leachates.

(1) - Sample requirements are provided as a rough guide for designing sample collection programs. However, actual requirements will depend on the suite of tests specified and sample characteristics. Users should consult the Laboratory prior to field sampling to ensure specimens are collected.

(2) - Times given are estimates of the number of normal working days required for sample preparation, testing data analysis, and report preparation; they assume available laboratory capacity at the time of sample receipt.

(3) - Indicates Index - or Performance - level tests. In general, Index tests are industry standard tests which provide basic information on intrinsic material properties; many of these tests require physical decomposition of the sample being tested. Performance tests measure large-scale or emulated in-situ strength or other performance characteristics of intact or reconstituted samples.