

Geotechnical and Construction Materials Laboratory Testing Schedule of Services

A. Volume Change Tests

1. **1-D Consolidation (ASTM D2435), 2.5" D**
 - a. Maximum loading 58 ksf (\leq 14 loadings)
 - b. Additional loading step (over 14 loadings), each
 - c. Up to 128 ksf Loading Steps
2. **1-D Consol. w/ CRS loading (ASTM D4186), 2.5" D**
3. **1-D Swell or Collapse of Soils (ASTM D4546)**
 - a. Method A, Multiple (4) Specimens
 - b. Method B, Single Specimen
 - c. Method C, w/ swell pressure & swell strain
4. **Expansion Index (ASTM D4829)**

B. Strength Tests: Direct Shear (Intact/Remold, ASTM D3080)

- a. Consolidated-Drained, 3 pts, Sand
- b. Consolidated-Drained, 3 pts, Silt/Clay ($<$ 3 day shear)
- c. Post Peak Strength Parameters, per Test

C. Soil Strength Tests: Triaxial Compression

1. **Unconfined Compression (ASTM D2166)**
 - a. Intact, 2.8" D, per specimen
 - b. Remolded, 2.8" D, per specimen
2. **Unconsolidated-Undrained (UU) (ASTM D2850, Tex-118-E)**
 - a. Intact, 2.8" D, per specimen, $<$ 120 psi Cell Pressure
 - b. Remolded, 2.8" D, per specimen, $<$ 120 psi
3. **Consolidated-Undrained (CU R-bar) (ASTM D4767, Tex-131-E)**
 - a. Intact, 2.8" D, with pore pressure, 3 pts
 - b. Remolded, 2.8" D, with pore pressure, 3 pts
 - c. High Cell/Back Pressure ($>$ 120 psi, up to 450 psi)
4. **Multi-Stage CU R-bar test (ASTM D4767, modified)**
 - a. Intact, 2.8" D, 3 stages, with pore pressure
 - b. High Cell/Back Pressures ($>$ 120 psi, up to 450 psi)
5. **Consolidated-Drained (CD test) (ASTM D7181)**
 - a. Intact, 2.8" D, with volume change, 3 pts
 - b. Remolded, 2.8" D, with volume change, 3 pts
 - c. Per pt., per day, 2.8" D ($>$ 3 days of consol & shearing)
6. **Special Triaxial Shear (Triaxial Extension, Ko Consol.)**
7. **Stress History & Normalized Soil Eng. Props (SHANSEP)**

D. Permeability Tests

1. **Granular Soils, 3" & 4.5" D, constant head (ASTM D2434)**
2. **Hydraulic Conductivity (ASTM D5084, Method C or F)**
 - a. Intact, 2.8" D, flexible-wall w/ back pressure
 - b. Intact, 4" D, flexible-wall w/ back pressure
 - c. Remolded, 2.8" D, flexible-wall w/ back pressure

E. Analytical Chemistry Testing

1. **Sulfates Content in Soil & Aggregate**
 - a. ion chromatography, EPA 300.0 or ASTM D4327
 - b. Colorimetric method (TxDOT Tex-145-E)
2. **Chloride Content in Soil & Aggregate**
 - a. ion chromatography, EPA 300.0 or ASTM D4327
 - b. Chloride ion, wet method (Tex-620-J)
3. **pH of Soil (ASTM D4972, G51, Tex-128-E)**

F. Rock Strength Tests

1. **Compressive Strength of Rock Core* (ASTM D7012)**
 - a. Method A, triaxial test (Peak Load Only)
 - b. Method B, triaxial test (Young's modulus & Poisson's ratio)
 - c. Method C, unconfined, peak load Only, w/o ASTM D4543
 - d. Method D, unconfined, w/ stress-strain, w/o ASTM D4543
 - e. add dimensional & shape tolerances (ASTM D4543)

* Pricing is for NX (2.16 in.) or NQ (1.87 in.) rock cores ONLY.
2. **CERCHAR Abrasivity Index (ASTM D7625)**
3. **Splitting Tensile Strength- Brazilian Test (ASTM D3967)**
4. **Slake Durability of Shales & Weak Rocks (ASTM D4644)**

G. Resilient Modulus Test** (AASHTO T307)

1. **Fine-grained material, per sample (2.8" D)**
 2. **Coarse-grained material, per sample (up to 4" D)**
- ** Client to provide Proctor, sieve analysis, Atterberg limits, specific gravity to categorize the material as Type 1 or Type 2 and define remolding parameters.

H. Thermal Resistivity Testing (ASTM D5334)

1. **As-Rcv'd Dry-Out Curve, Intact, per Soil specimen**
2. **Dry-Out Curve, Remolded, 2.8" D, per Soil specimen**
3. **Dry-Out Curve, Flowable Fill, 4.0" D, per specimen**
4. **Field In-situ Thermal Resistivity Testing**

I. Concrete Tests

1. **Compressive Strength, ASTM C39, per Cylinder**
2. **Compressive Strength of Cored Specimen, ASTM C42 (including Trimming and Sulfur Capping), each**
3. **Grout Prism Compression Strength, ASTM C1019**
4. **Mortar Compressive Strength, ASTM C109, per Cube**
5. **Air Content of Concrete (pressure method), ASTM C231**
6. **Unit Weight or Bulk Density of Concrete, ASTM C138**
7. **Slump Test, ASTM C143 (extras, no cylinders cast)**
8. **Concrete Cylinder Saw Cut or Cap (uneven cylinders)**

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Schedule of Services

J. Soil-Cement or Lime Mixtures

1. **Moisture-Density of Soil-Cement Mixture (ASTM D558)**
2. **Wetting & Drying Compacted Soil-Cement Mix (D559)**
3. **Unconfined Compression Soil-Cement, per specimen**
 - a. Method B, w/Curing (7 d) (ASTM D1633/D1632)
 - b. Curing (additional 7 days)
4. **Soil-Cement/Lime Testing (Tex-120/121-E, Part I)**
5. **Soil-Cement/Lime Testing (Tex-120/121-E, Part II)**
6. **Soil-Lime pH Testing (Tex-121-E Pt III or ASTM D6276)**
7. **Admixing Lime to Reduce Plasticity of Soil (Tex-112-E)**
 - a. 4 Lime Percentage Points

K. Grain-Size & Aggregate Tests

1. **Sieve Analysis**
 - a. 3" - 3/4" - #200 (ASTM D6913/C136)
 - b. 3/4" - #200 (ASTM D6913)
 - c. % Passing #200 sieve- Aggregate (ASTM C117)
 - d. % Passing #200 sieve- Soil (ASTM D1140/Tex-111-E)
 - e. Hydrometer Test (D7928, mechanical sieving excluded)
 - f. Particle Analysis of Soil (TxDOT, Tex-110-E, Part I)
 - g. Particle Analysis of Soil (TxDOT, Tex-110-E, Part II)
2. **Organic Impurities (ASTM D2974 or Tex-408-A)**
3. **Carbonate Content (ASTM D3042 modified Method J&L)**
 - a. Fine Aggregate (< 3/4" Sieve)
 - b. Coarse Aggregate (> 3/4" Sieve)
4. **Soundness Test (ASTM C88 or Tex-411-A)**
 - a. w/ Magnesium Sulfate
 - b. w/ Sodium Sulfate
5. **LA Abrasion**
 - a. Small-Size Coarse Aggregate (ASTM C131 or Tex-410-A)
 - b. Large-Size Coarse Aggregate (ASTM C535)
6. **Wet Ball Mill of Flexible Base (Tex-116-E)**
7. **Aggregate Durability Index (AASHTO T 210)**
 - a. Fine Aggregate (Passing No. 4 Sieve)
 - b. Coarse Aggregate (Retaining No. 4 Sieve)
8. **Crushed Face Count (Tex-460-A Part 1; ASTM D5821)**
9. **Sand Equivalent Test (ASTM D2419 or Tex-203-F)**
10. **Clay Lumps & Friable Particles (Tex-413-A/ASTM C142)**
11. **Flat & Elongated Particles, ASTM D4791 or Tex-280-F**
12. **Unit Weight/Bulk Density (Loose/Rodded), ASTM C29**

L. Water Content/Density (Unit Weight) Relationship

1. **Standard Proctor- 4 points**
 - a. Method A or B (ASTM D698)
 - b. Method C (ASTM D698)

2. Modified Proctor- 4 points

- a. Method A or B (ASTM D1557)
- b. Method C (ASTM D1557)

3. Oversize Particles Correction (ASTM D4718)

4. Base Material Compaction (Tex-113-E)

5. Subgrade & Backfill Compaction (Tex-114-E, Part I)

6. Subgrade & Backfill Compaction (Tex-114-E, Part II)

7. California Bearing Ratio (CBR) (ASTM D1883)

8. TxDOT Triaxial Compression (Tex-117-E, Part II) including:

- a. Molding, Curing and Testing 6 to 9 Specimens (Tex-117-E)
- b. Sieve Analysis (Tex-110-E, Part I)
- c. Atterberg Limits (Tex-104-E, 105-E, 106-E)
- d. Bar Linear Shrinkage of Soils (Tex-107-E)
- e. Moisture Density Relationship/Compaction (Tex-113-E)
- f. Wet Ball Mill (Tex-116-E)

M. Index Properties Tests

1. Water Content (ASTM D2216, Tex-103-E)

2. Water Content w/Density (ASTM D2216, 2937 & 7263)

3. Plastic and Liquid Limits (ASTM D4318)

4. Plastic & Liquid Limits (Tex-104-E, 105-E, 106-E)

5. Bar Linear Shrinkage of Soils (Tex-107-E)

6. Specific Gravity

- a. Soils (ASTM D854 or Tex-108-E)
- b. w/ Absorption of Coarse aggregates (ASTM C127)
- c. w/ Absorption of Fine aggregates (ASTM C128)

7. Organic Content (ASTM D2974 Method C)

Organic Content, UV-VIS Method C (Tex-148-E)

8. Rapid Carbonate Content (ASTM D4373)

9. Soil Resistivity Test (ASTM G57, G187, Tex-129-E)

- a. Miller Box for mini. resistivity
- b. additional (i.e. oven dry or saturated) test

10. Crumb Test, 2 pts per soil & 6 hrs (ASTM D6572)

11. Pinhole Dispersion (ASTM D4647)

12. Double Hydrometer/ Dispersion (ASTM D4221)

N. Sample Preparation & Extrusion

1. Hand-trimmed specimen (reducing diameter)

- a. UC/UU/CU Test Specimen, 2" or 2.4" dia.
- b. Permeability Test Specimen, 2" or 2.4" dia.

2. Pocket Penetrometer, per sample

3. Pocket Vane Shear, per sample

4. Damaged Shelby tube extrusion

5. Lab Labor Rate (PE/EIT/Tech): \$140/\$100/\$60 per Hour.