

USCS: read the evidence before the symbol

Educational overview | laboratory classification requires the applicable method

PARTICLE-SIZE DISTRIBUTION

Coarse-grained: <50% passes No. 200

Fine-grained: ≥50% passes No. 200

PLASTICITY

PI = liquid limit - plastic limit

Use LL and PI together

COARSE-GRAINED EXAMPLES

GW / GP: gravel gradation

SW / SP: sand gradation

M / C: character of fines

FINE-GRAINED EXAMPLES

CL / CH: inorganic clays

ML / MH: inorganic silts

Organic and borderline rules also apply

A group symbol summarizes classification; it does not supply a design strength.

Coarse vs fine division: 50% passing the 0.075 mm (No. 200) sieve.

Clean coarse soils: examine gradation; soils with fines need additional rules.

Example: inorganic fine soil, LL 42, PL 24, PI 18. A-line at LL 42 = 16.06.

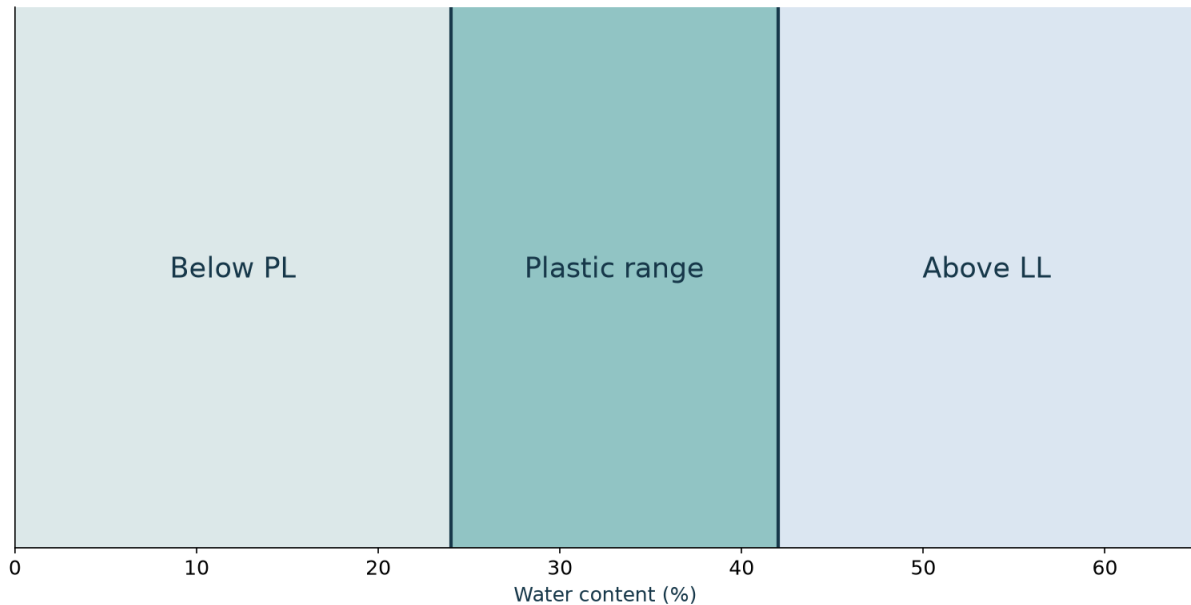
The example plots above the A-line and below LL 50: CL, subject to full checks.

Use ASTM D2487 for laboratory classification and D2488 for visual-manual work.

Source: FHWA HMEC Module B, Lesson 03; applicable ASTM methods.

Atterberg limits: a worked example

SYNTHETIC DATA | LL = 42% | PL = 24% | PI = 18 percentage points



$PI = 42 - 24 = 18$ | Index properties do not replace strength or settlement testing.

$PI = LL - PL$. Example: $42 - 24 = 18$ percentage points.

Water content = mass of water / mass of dry soil x 100.

Example: wet soil 28.4 g; dry soil 20.0 g; water content = 42%.

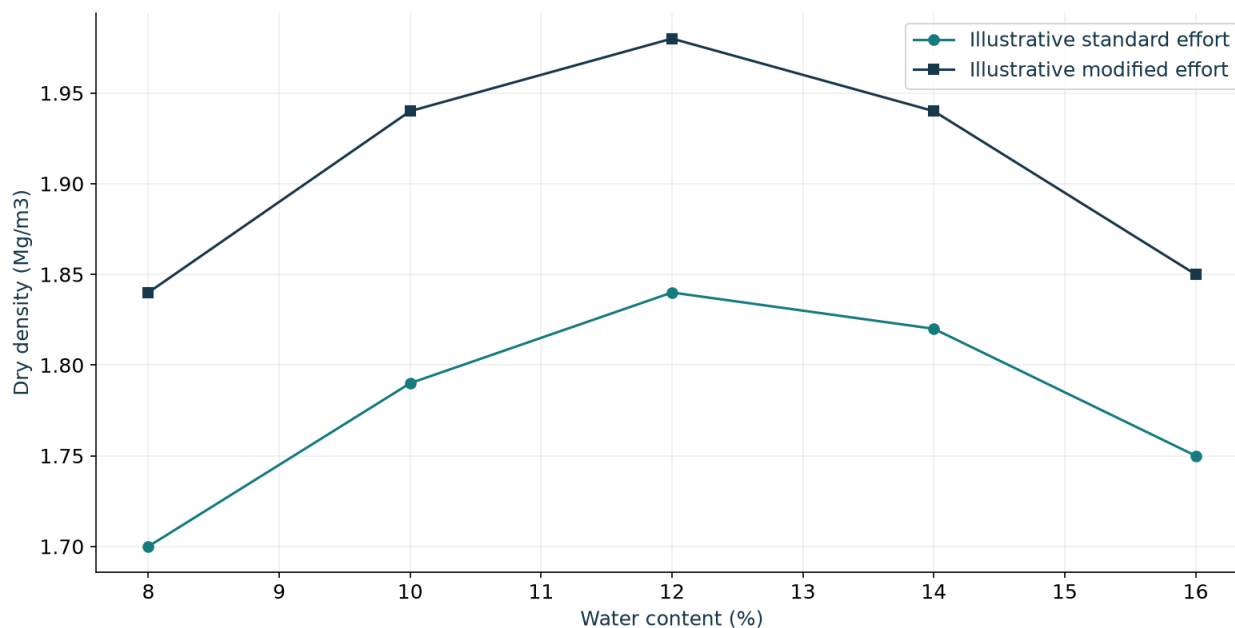
Container mass must be removed before computing the soil masses.

This is arithmetic practice, not a complete compliant test determination.

Source: ASTM D4318; FHWA Geotechnical Aspects of Pavements, Chapter 5.

Standard vs modified Proctor

SYNTHETIC CURVES | compare the specified test effort and material



Relative compaction must reference the specified laboratory maximum, not a universal value.

Standard effort: approximately 600 kN-m/m³; modified: 2,700 kN-m/m³.

Dry density = moist density / (1 + water content expressed as a decimal).

Example: $2.06 \text{ Mg/m}^3 / 1.12 = 1.839 \text{ Mg/m}^3$.

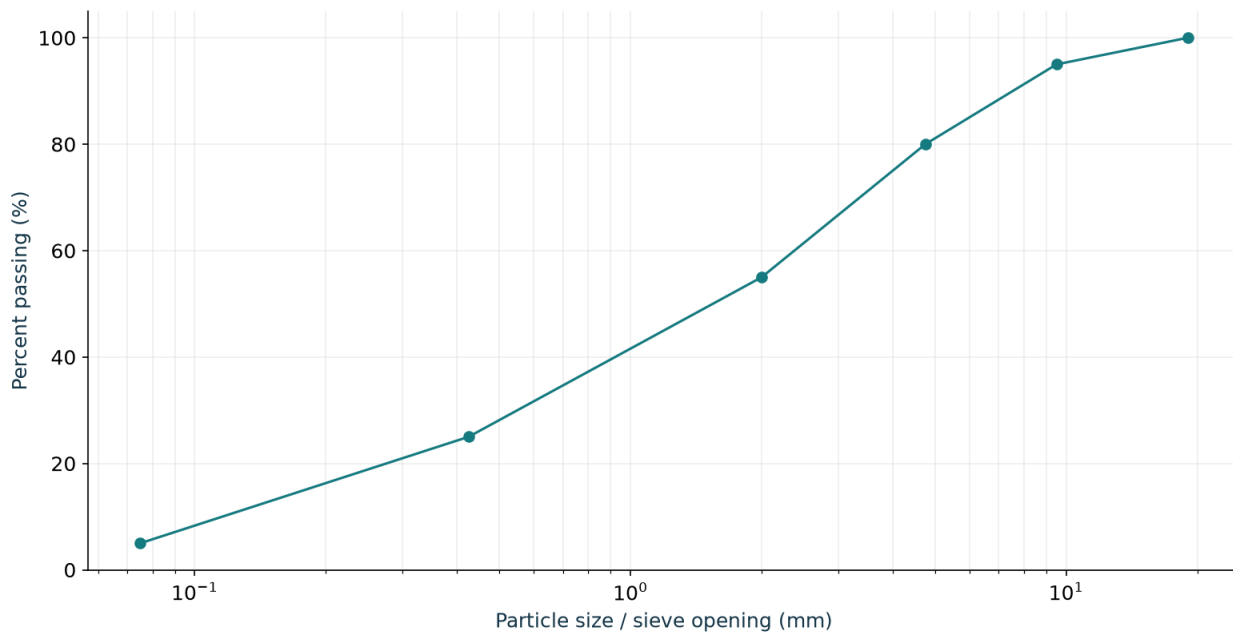
Relative compaction: $1.75 / 1.84 \times 100 = 95.1\%$, using this example reference.

No universal acceptance threshold is implied. Use the project specification.

Sources: ASTM D698 and D1557; synthetic plotted data.

Sieve analysis: from mass to percent passing

SYNTHETIC DATA | total dry mass = 1,000 g



At 4.75 mm: cumulative retained = 200 g; passing = $100 - (200 / 1,000 \times 100) = 80\%$.

Total dry mass 1,000 g. Retained masses: 0, 50, 150, 250, 300, 200, 50 g.

Openings: 19, 9.5, 4.75, 2.0, 0.425, 0.075 mm, followed by the pan.

At 4.75 mm: cumulative retained 200 g; percent passing = 80%.

At 0.075 mm: percent passing = 5%. The pan is not a zero-size sieve.

Mass balance closes exactly in this synthetic example; real tests require checks.

Source: ASTM D6913/D6913M for the applicable sieve-analysis procedure.