

Table 1.8 Unified Soil Classification Chart (after ASTM, 2009) (ASTM D2487-98: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification). Copyright ASTM INTERNATIONAL. Reprinted with permission.)

Criteria for assigning group symbols and group names using laboratory tests ^a				Soil classification	
				Group symbol	Group name ^b
Coarse-grained soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels	$C_u \geq 4$ and $1 \leq C_c \leq 3^e$	GW	Well-graded gravel ^f
		Less than 5% fines ^c	$C_u < 4$ and/or $1 > C_c > 3^e$	GP	Poorly graded gravel ^f
		Gravels with Fines	Fines classify as ML or MH	GM	Silty gravel ^{f, g, h}
		More than 12% fines ^c	Fines classify as CL or CH	GC	Clayey gravel ^{f, g, h}
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands	$C_u \geq 6$ and $1 \leq C_c \leq 3^e$	SW	Well-graded sand ⁱ
		Less than 5% fines ^d	$C_u < 6$ and/or $1 > C_c > 3^e$	SP	Poorly graded sand ⁱ
		Sand with Fines	Fines classify as ML or MH	SM	Silty sand ^{g, h, i}
		More than 12% fines ^d	Fines classify as CL or CH	SC	Clayey sand ^{g, h, i}
Fine-grained soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above “A” line ^j	CL	Lean clay ^{k, l, m}
			PI < 4 or plots below “A” line ^j	ML	Silt ^{k, l, m}
		Organic	Liquid limit—oven dried	OL	Organic clay ^{k, l, m, n}
			Liquid limit—not dried < 0.75		Organic silt ^{k, l, m, o}
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above “A” line	CH	Fat clay ^{k, l, m}
			PI plots below “A” line	MH	Elastic silt ^{k, l, m}
		Organic	Liquid limit—oven dried	OH	Organic clay ^{k, l, m, p}
			Liquid limit—not dried < 0.75		Organic silt ^{k, l, m, q}
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

^aBased on the material passing the 75-mm. (3-in) sieve.

^bIf field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^cGravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt; GW-GC well-graded gravel with clay; GP-GM poorly graded gravel with silt; GP-GC poorly graded gravel with clay.

^dSands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt; SW-SC well-graded sand with clay; SP-SM poorly graded sand with silt; SP-SC poorly graded sand with clay.

$$^e C_u = D_{60}/D_{10} \quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^fIf soil contains $\geq 15\%$ sand, add "with sand" to group name.

^gIf fines classify as CL-ML, use dual symbol GC-GM or SC-SM.

^hIf fines are organic, add "with organic fines" to group name.

ⁱIf soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^jIf Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

^kIf soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^lIf soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.

^mIf soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

ⁿPI ≥ 4 and plots on or above "A" line.

^oPI < 4 or plots below "A" line.

^pPI plots on or above "A" line.

^qPI plots below "A" line.

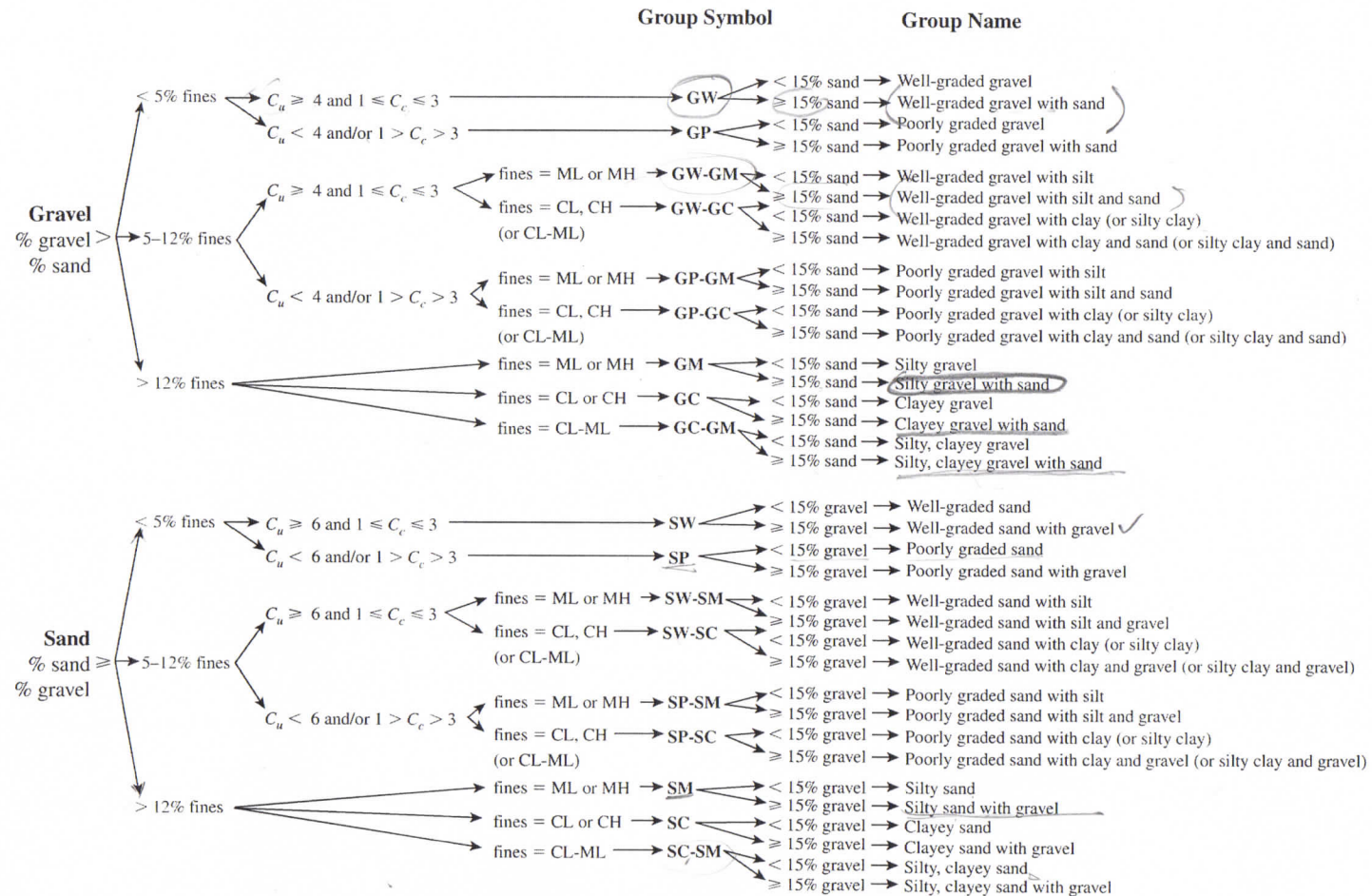


Figure 1.6 Flowchart for classifying coarse-grained soils (more than 50% retained on No. 200 Sieve) (After ASTM, 2009) (ASTM D2487-98: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification). Copyright ASTM INTERNATIONAL. Reprinted with permission.)

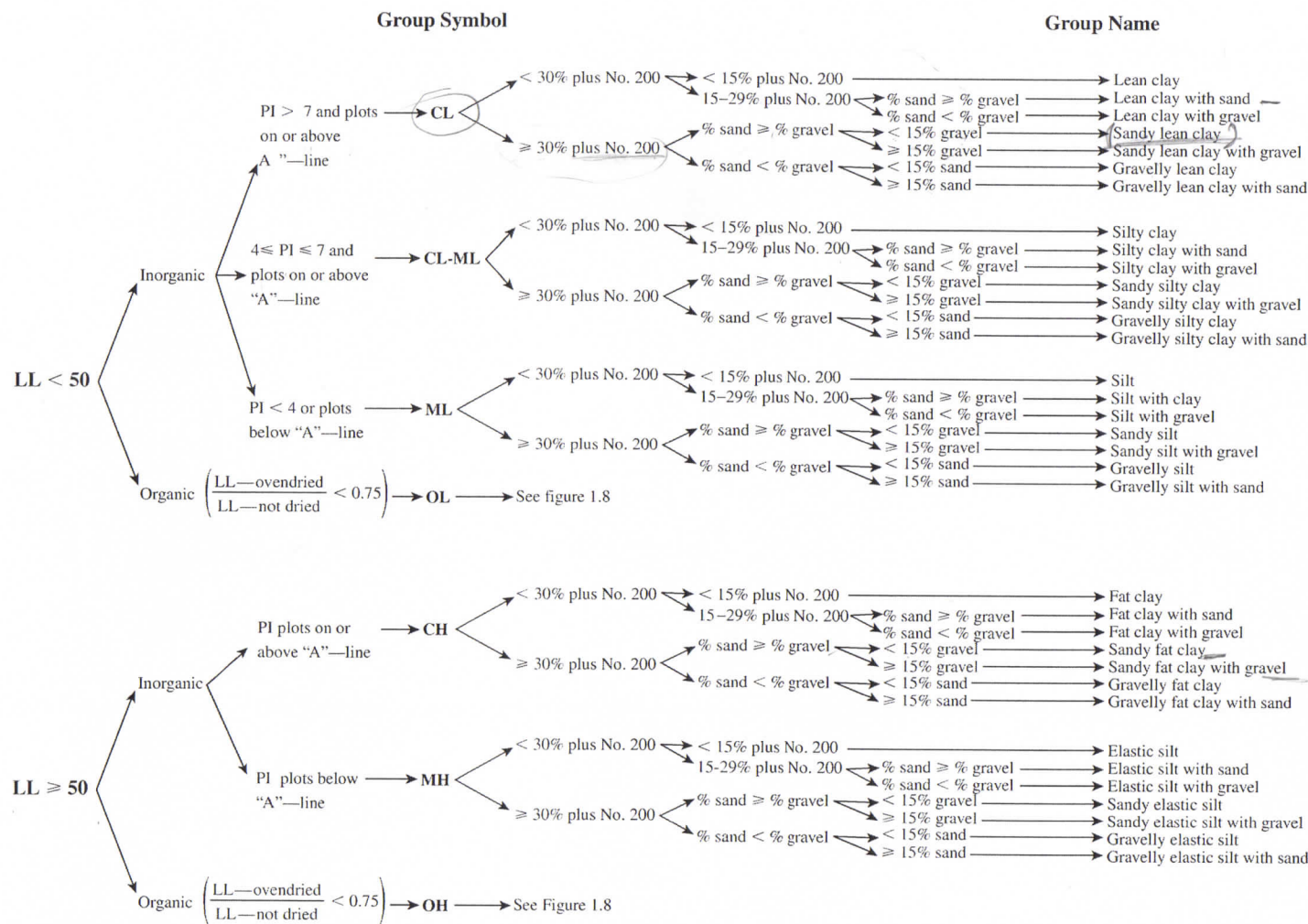


Figure 1.7 Flowchart for classifying fine-grained soil (50% or more passes No. 200 Sieve) (After ASTM, 2009)(ASTM D2487-98: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification). Copyright ASTM INTERNATIONAL. Reprinted with permission.)