Classes of Embedment and Backfill Materials

ASTM D2321	ASTM D2487				AASHTO M145	Suitable ADS Pipe Types (Seee ADS TN 2.01-2.04)	Visual Descriptions
Class	Description	Major Divisions	Notation	Description	Soil Group		
I	Crushed rock, angular (fractured face): 100% passing 1½-inch sieve, </= 25% passing ⅜-inch sieve, </=15% passing #4 sieve, and </= 12% passing #200 sieve	N/A[2]	N/A[2]	N/A[2]	-	N-12® HDPE (High-Density Polyethylene) HP Storm (Polypropylene)	
II	Coarse grained soils; SW, SP, GW, GP or any soil beginning with one of these symbols with </=12% passing #200 sieve. (Materials such as broken coral, shells, and recycled concrete, with </= 12% passing a #200 sieve are considered to be Class II materials. These materials should only be used when evaluated and approved by the engineer)	Gravels (less than 5% fines)	GW	Well-graded gravel	A1, A3 Refer to LRFD Section 12.12 for additional design commentary	N-12® HDPE (High-Density Polyethylene) HP Storm (Polypropylene)	
			GP	Poorly-graded gravel			
		Dual Classification Gravels (5 to 12% Fines)	GW-GM, GW-GC	Well-graded gravels with silts or clays			
			GP-GM, GP-GC	Poorly-graded gravels with silts or clays			
		Sands (less than 5% fines)	SW	Well-graded sand			
			SP[3]	Poorly-graded sand			
		Dual Classification Sands (5 to 12% fines)	SW-SM, SW-SC	Well-graded sands with silts or clays			
			SP-SM[3], SP-SC[3]	Poorly-graded sands with silts or clays			
III	Coarse grained soils with fines: GM, GC, SM, SC, or any soil beginning with one of these symbols, containing 12% to 50% passing #200 sieve.	Gravels with fines	GM	Silty gravel	A-2-4, A-2-5, A-2-6, or A-4 or A-6 soils< 70% passing #200 sieve	N-12® HDPE (High-Density Polyethylene) HP Storm (Polypropylene)	
			GC	Clayey gravel			
		Sands with fines	SM	Silty sand			
			SC	Clayey sand			
	Sandy or gravelly inorganic fine-grained soils; CL, ML, or any soil beginning with one of these symbols, with >/=50% to </= 70% passing #200 sieve and Liquid Limit <50.	Lean clay	CL	Sandy or gravelly lean clay			
		Silty clay	CL-ML	Sandy or gravelly silty clay			
		Silt	ML	Sandy or gravelly silt			
IV	Fine-grained inorganic soils; CL, ML, or any soil beginning with one of these symbols, with > 70% passing #200 sieve and Liquid Limit < 50.	Lean Clay	CL	Lean Clay	A-2-7 or A-4 or A-6 soils with >/=70% passing #200 sieve	HP Storm (Polypropylene)	
		Silty Clay	CL-ML	Silty Clay			
		Silt	ML	Silt			
V	Fine-grained inorganic soils, MH, CH, or any soil beginning with one of these symbols and liquid limit ≥ 50	Elastic Silt	MH	Elastic silt, may be sandy or gravelly	A5, A7	Not For Use	
		Fat Clay	CH	Fat clay, may be sandy or gravelly			
	Fine-Grained organic soils; OL, OH or PT. Can include other highly organic soils such as Muck	Organic Silt	OL	Organic silt, may be sandy or gravelly			
		Organic Clay	OH	Organic clay, may be sandy or gravelly			
		Peat	PT	Peat			

(1) Users of this document should refer to ADS Tech Notes 2.01-2.04 for compaction requirements and design considerations for use with compatible backfills. Please consult ADS engineering and ASTM D2321 for additional considerations on installation, backfill and design considerations not listed in ADS Tech Notes 2.01-2.04.
(2) Per ASTM D2487 The USCS Classification System is limited to naturally occurring soils. Typical examples include No. 5, 6, 57 or 67 aggregate per AASHTO M43
(3) Poorly graded fine sands (SP) with more than 50% passing a 100 sieve should be treated as Class III soils.
Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic Suffix: W = Well Graded, P = Poorly Graded, M = Silty, C = Clayey, H = High Plasticity (LL <= 50), L = Low Plasticity (LL>50)

AASHTO M 43 Table 1 Standard Sizes of Processed Aggregate																
Size Number	Nom. Size, Square Openings in (mm)	4 (100)	3½ (90)	3 (75)	2½ (63)	2 (50)	1½ (37.5)	1 (25)	¾ (19)	½ (12.5)	3/8 (9.5)	No.4 (4.75)	No.8 (2.36)	No.16 (1.18)	No.50 (300 µm)	No.100 (150 µm)
1	3½-1½ (90-37.5)	100	90-100	-	25-60	0	0-15	-	0-5	-	-	-	-	-	-	-
2	2½-1½ (63-37.5)	-	-	100	90-100	35-70	0-15	-	0-5	-	-	-	-	-	-	-
24	2½-¾ (63-19)	-	-	100	90-100	-	25-60	-	0-10	0-5	-	-	-	-	-	-
3	2-1 (50-25)	-	-	-	100	90-100	35-70	0-15	-	0-5	-	-	-	-	-	-
357	2″-No.4 (50-4.75)	-	-	-	100	95-100	-	35-70	-	10-30	-	0-5	-	-	-	-
4	1½-¾ (37.5-19)	-	-	-	-	100	90-100	20-55	0-15	-	0-5	-	-	-	-	-
467	1½″-No.4 (37.5-4.75)	-	-	-	-	100	95-100	-	35-70	-	10-30	0-5	-	-	-	-
5	1-½ (25-12.5)	-	-	-	-	-	100	90-100	20-55	0-10	0-5	-	-	-	-	-
56	1-3/8 (25-9.5)	-	-	-	-	-	100	90-100	40-85	10-40	0-15	0-5	-	-	-	-
57	1″-No.4 (25-4.75)	-	-	-	-	-	100	95-100	-	25-60	-	0-10	0-5	-	-	-
6	¾-3/8 (19-9.5)	-	-	-	-	-	-	100	90-100	20-55	0-15	0-5	-	-	-	-
67	¾″-No.4 (19-4.75)	-	-	-	-	-	-	100	90-100	-	20-55	0-10	0-5	-	-	-
68	¾″-No.8 (19-2.36)	-	-	-	-	-	-	100	90-100	-	30-65	5-25	0-10	0-5	-	-
7	½″-No.4 (12.5-4.75)	-	-	-	-	-	-	-	100	90-100	40-70	0-15	0-5	-	-	-
78	½″-No.8 (12.5-2.36)	-	-	-	-	-	-	-	100	90-100	40-75	5-25	0-10	0-5	-	-
8	3/8″-No.8 (9.5-2.36)	-	-	-	-	-	-	-	-	100	85-100	10-30	0-10	0-5	-	-
89	3/8″-No.8 (12.5-2.36)	-	-	-	-	-	-	-	-	100	90-100	20-55	5-30	0-10	0-5	-
9	N0.4-No.16 (4.75-1.18)	-	-	-	-	-	-	-	-	-	100	85-100	10-40	0-10	0-5	-
10	No.4-0* (4.75)	-	-	-	-	-	-	-	-	-	100	85-100	-	-	-	10-30

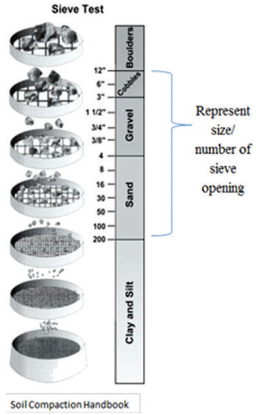
* Screenings

	Clay						Sand				
Consistency	Very Soft	Soft	Med. Soft	Stiff	Very Stiff	Hard	Very Loose	Loose	Medium	Dense	Very Dense
Thumb Penetration	Easily penetrated several inches by thumb. Exudes between thumb and fingers when squeezed in hand.	Easily penetrated one inch by thumb. Molded by light finger pressure.	Can be penetrated over ¼″ by thumb with moderate effort. Molded by strong finger pressure.	Indented about ¼″ by thumb but penetrated only with great effort.	Readily indented by thumbnail.	Indented with difficulty by thumbnail.	-	-	-	-	-
SPT	<2	2-4	4-8	8-15	15-30	>30	4	4-10	10-30	30-50	50
Field Test	-	-	-	-	-	-	Easily penetrated with ½″ reinforcing rod pushed by hand	Easily penetrated with ½″ reinforcing rod pushed by hand	Penetrated a foot with ½″ reinforcing rod driven with a 5-lb hammer	Penetrated a foot with ½″ reinforcing rod driven with a 5-lb hammer	Penetrated only a few inches with ½″ reinforcing rod driven with a 5-lb hammer

Source: Geotechnical Gauge: W.F. McCollough

Unified Soil Classification System (USCS)				
		mm	in	Sieve size
Gravel	Boulders	>300	>12	-
	Cobbles	75-300	3-12	-
	Coarse	75-19	3-0.75	-
	Fine	19-4.8	0.75-0.19	¾″-No.4
Sand	Coarse	4.8-2.0	0.19-0.08	No.4-No.10
	Medium	2.0-0.43	0.08-0.02	No.10-No.40
	Fine	0.43-0.08	0.02-0.003	No.40-No.200
Fine	Silts	<0.08	<0.003	<No.200
	Clays	<0.08	<0.003	<No.200

Angular Sub Angular Sub Rounded Rounded



Gravel Terminology

- Bank run - the gradation as it exists in nature, with little processing; gravel with sand & clay present (Generally Class 2).
- Crushed gravel - over-sized particles are crushed and fed back into the mixture (Generally Class 1 or 2)
- Dense-graded - all particle sizes are present, limited voids content (Generally Class 2)
- Open-graded - screened material with a narrow range of particle sizes and a large voids content (Generally Class 1 or 2 depending on screen size)
- Pea Gravel/River Rock/ Creek Rock - generally rounded, small stones with potentially wide range of stone types 4 sizes (Generally Class 2)

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ASTM D2321-14e1, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
ASTM D2487-11, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
AASHTO M 145-91 (2012), Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
AASHTO M43-05 (2013), Standard Specificatoin for Sizes of Aggregate for Road and Bridge Construction (ASTM D448-12).
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