

GRI GT 10 Specification High Strength Geotextile Tubes

- **focus is on coastal and riverine structures; also dewatering sludges**
- **addresses main tube and anchor tube**
- **also addresses the fill ports**
- **categories are “aggressive” and “typical”; but not defined further**
- **silent on type of fabric or polymer**

Preliminary Comments

- **properties lean toward woven GTs**
- **specification is for MQC**
- **values are either “min. ave.” or “max. ave.”**
- **they are not MARV values**
- **minimum testing frequencies are included**

Test Properties Included

1. main tube dimensions
2. anchor tube dimensions
3. wide width (incl. seams)
4. trapezoidal tear
5. puncture strength
6. app. opening size
7. water flow rate
8. ultraviolet resistance

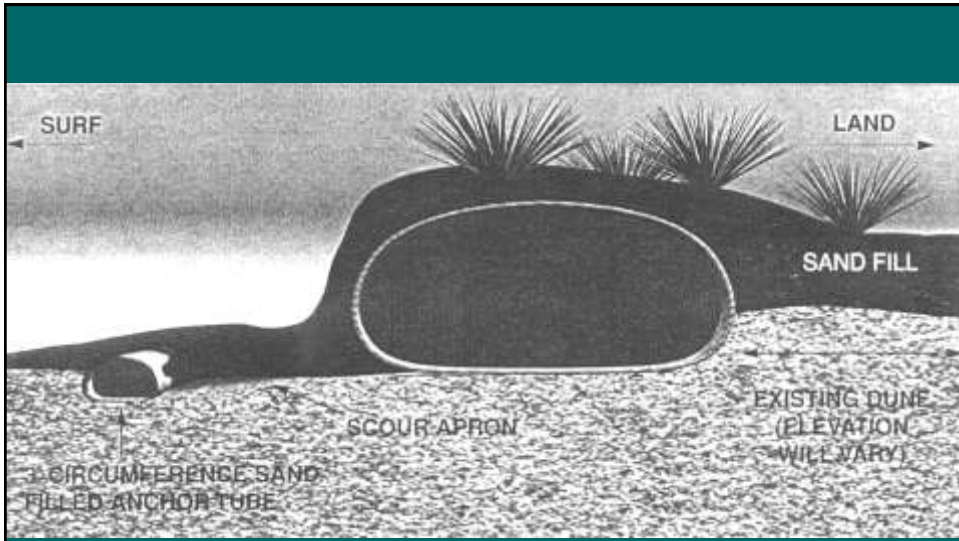
1. Main Tube Circumference

- factory manufactured in six circumferences
- 2.3; 4.6; 6.8; 9.1; 14 and 18 m (7.5; 15; 22.5; 30; 45 and 60 ft.)
- maximum size is 5.7 m (19 ft.) diameter... that's big!

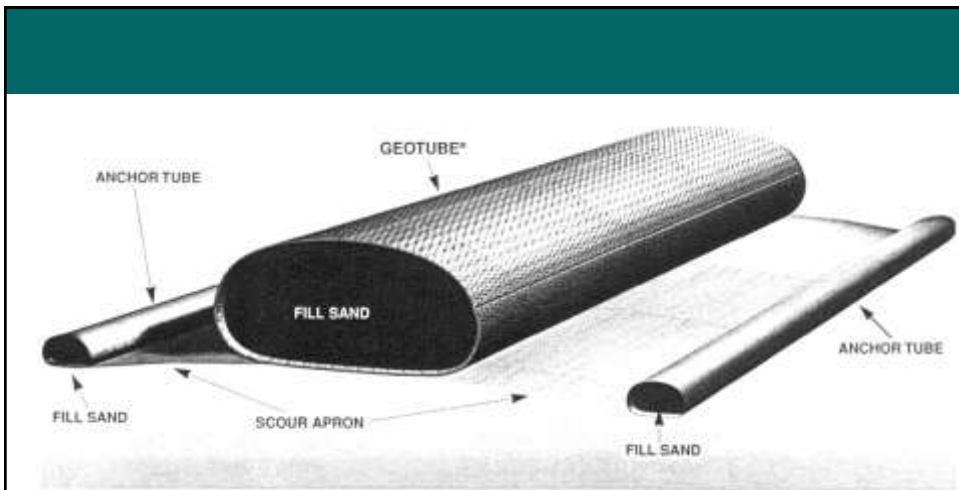


2. Anchor Tube Circumference

- 0.9 or 1.8 m (3 or 6 ft.) circumference
- connected to main tube by a fabric scour apron
- some designs call for two anchors
- see following sketches



Anchor Tube With Single Surf-Side Scour Apron



Anchor Tubes on Both Sides of Main Tube

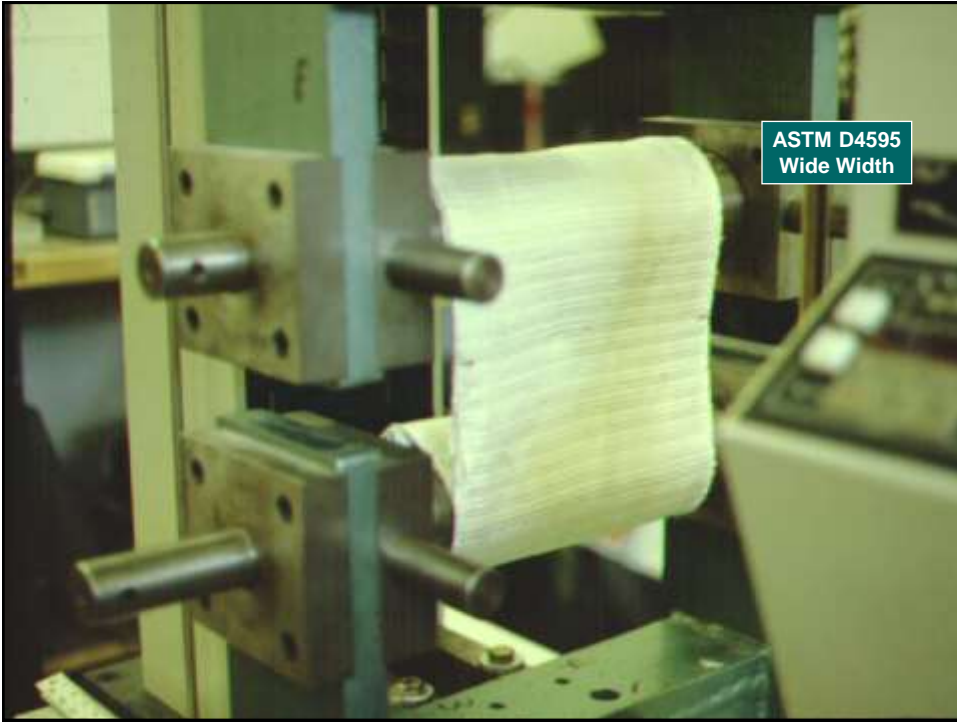
3. Wide Width and Seam Properties

(a) Main Tube Properties

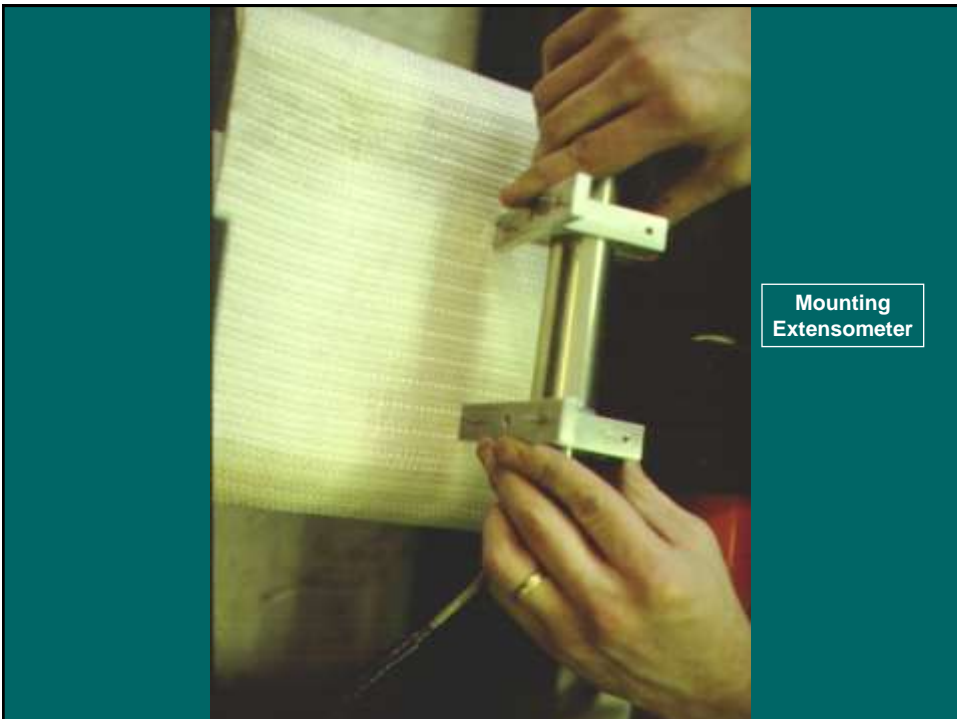
Property	ASTM	Aggressive	Typical
strength	D4595	175 × 175 kN/m (1000 × 1000 lb/in.)	70 × 95 kN/m (400 × 550 lb/in.)
elongation	D4595	15 × 15%	20 × 20%
seam	D4884	105 kN/m (600 lb/in.)	60 kN/m (350 lb/in.)

(b) Anchor Tube Properties

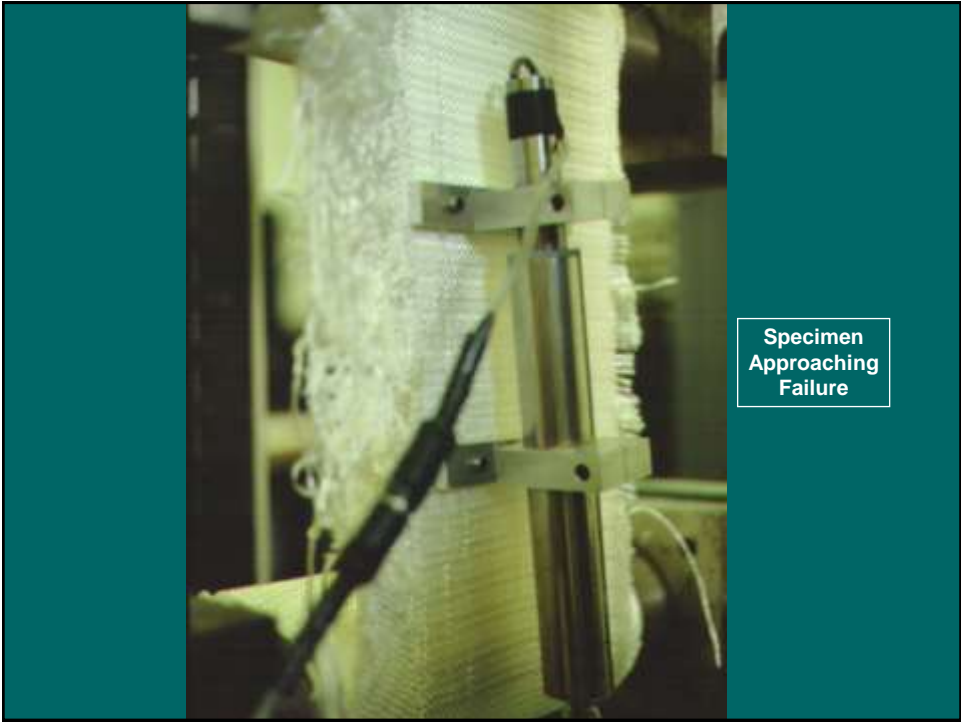
Property	ASTM	Aggressive	Typical
strength	D4595	70 × 95 kN/m (400 × 550 lb/in.)	70 × 95 kN/m (400 × 550 lb/in.)
elongation	D4595	20 × 20%	20 × 20%
seam	D4884	60 kN/m (350 lb/in.)	35 kN/m (200 lb/in.)



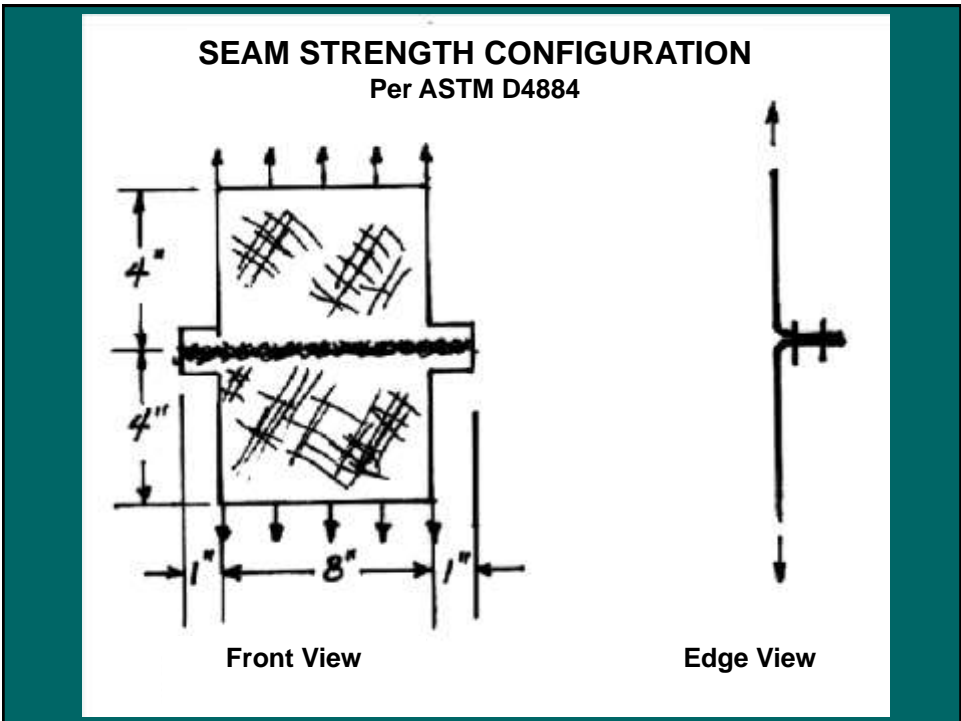
ASTM D4595
Wide Width

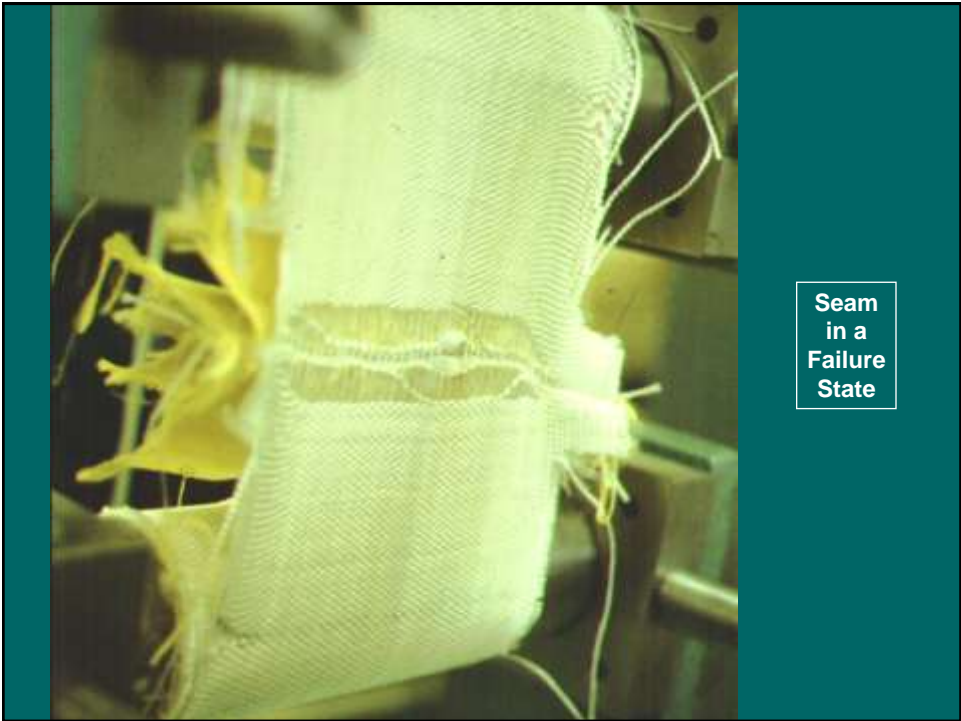


Mounting
Extensometer



Specimen
Approaching
Failure





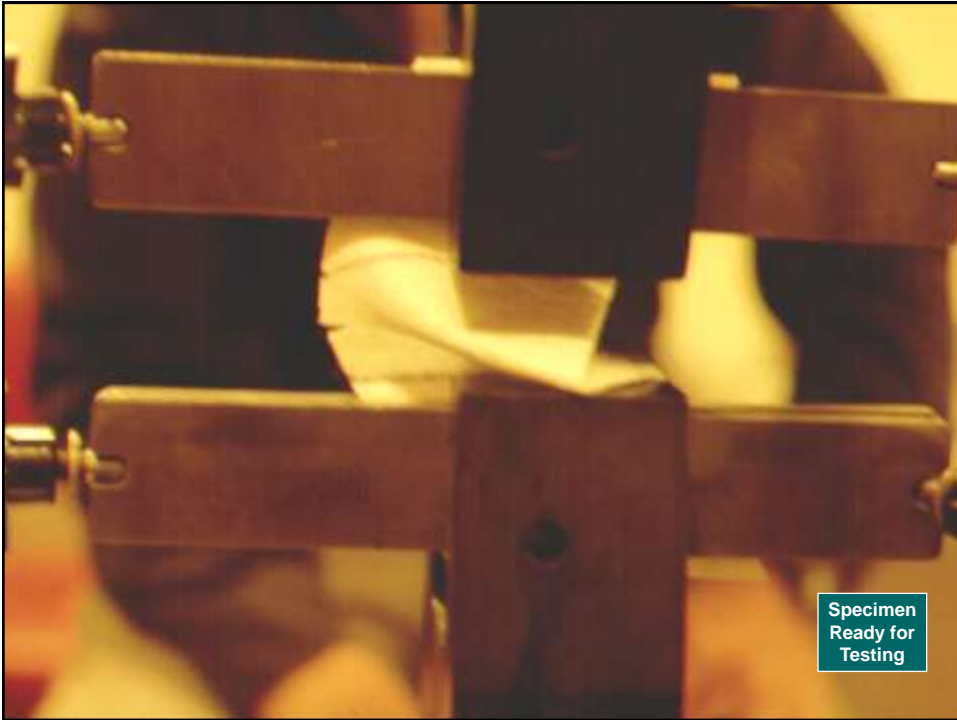
4. Trapezoidal Tear Strength

- follows ASTM D4533

location	aggressive	typical
main tube	2.7 × 2.7 kN (600 × 600 lb)	0.8 × 1.2 kN (180 × 270 lb)
anchor tube	0.8 × 1.2 kN (180 × 270 lb)	0.8 × 1.2 kN (180 × 270 lb)

- frequency is every 7500 m² (10,000 yd²)



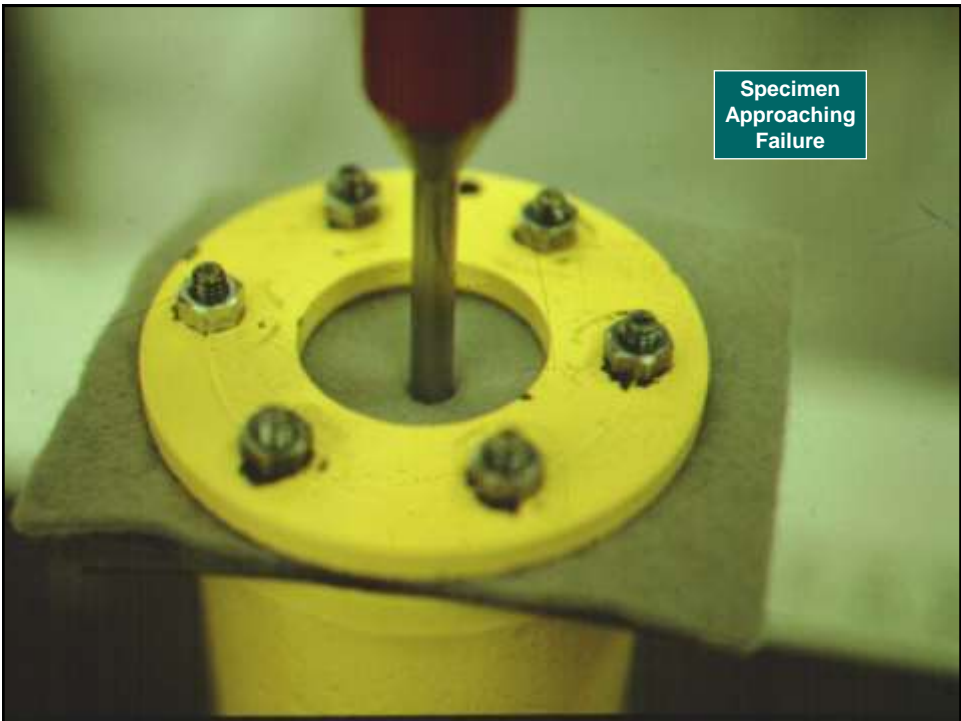
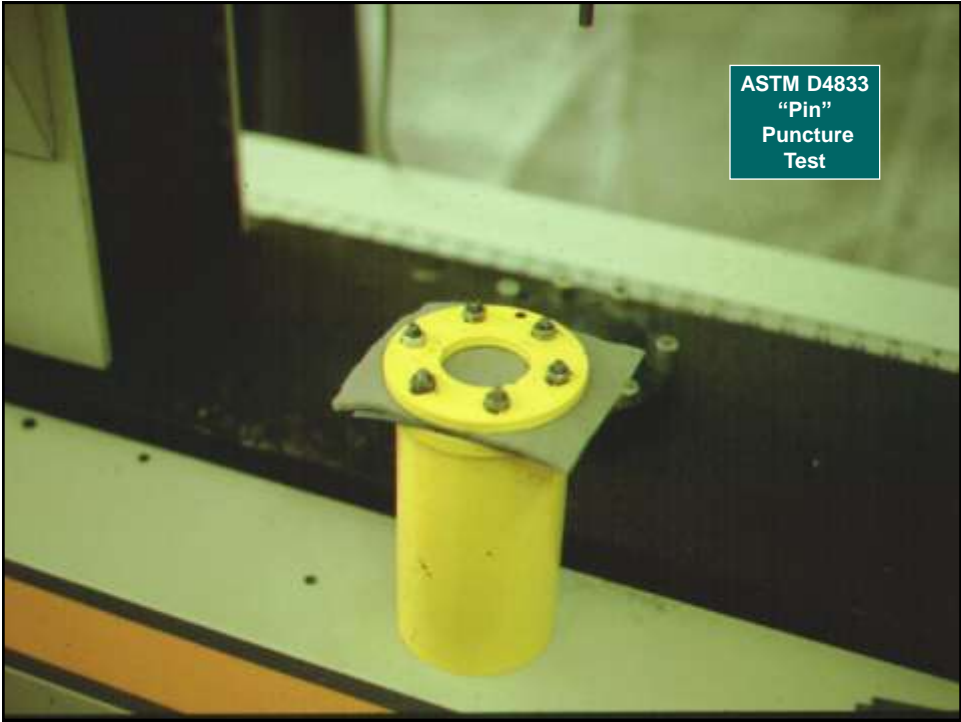


5. Puncture Strength

- follows ASTM D4833
- its called “pin” puncture
- uses a 8.0 mm (5/16 in.) probe

location	aggressive	typical
main tube	1.8 kN (400 lb)	1.2 kN (260 lb)
anchor tube	1.2 kN (260 lb)	0.7 kN (160 lb)

- frequency is every 10,000 yd² (7500 m²)

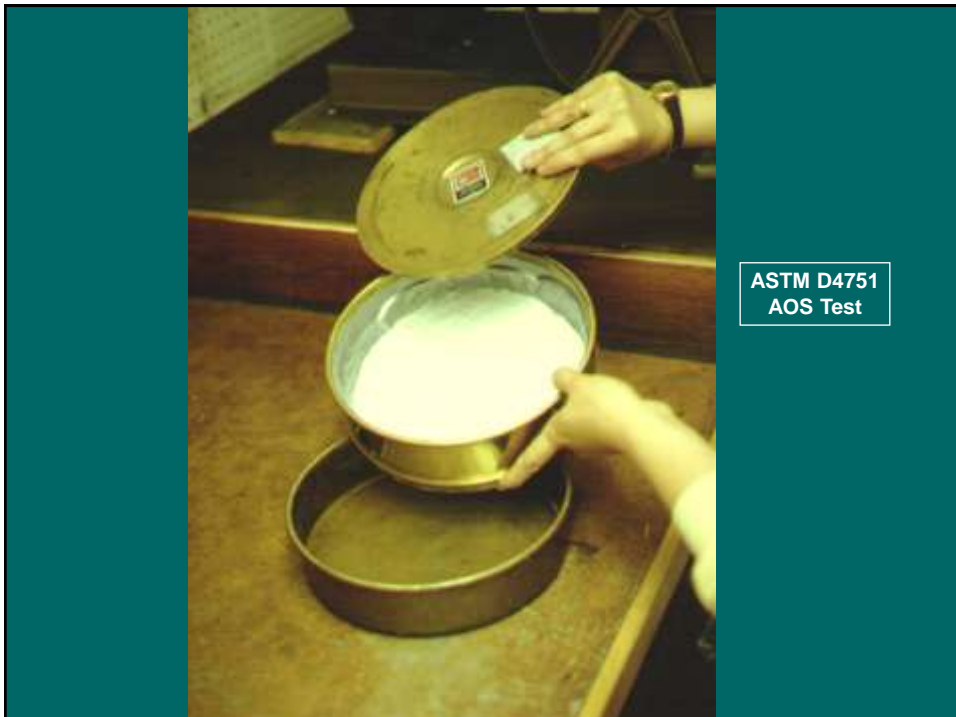


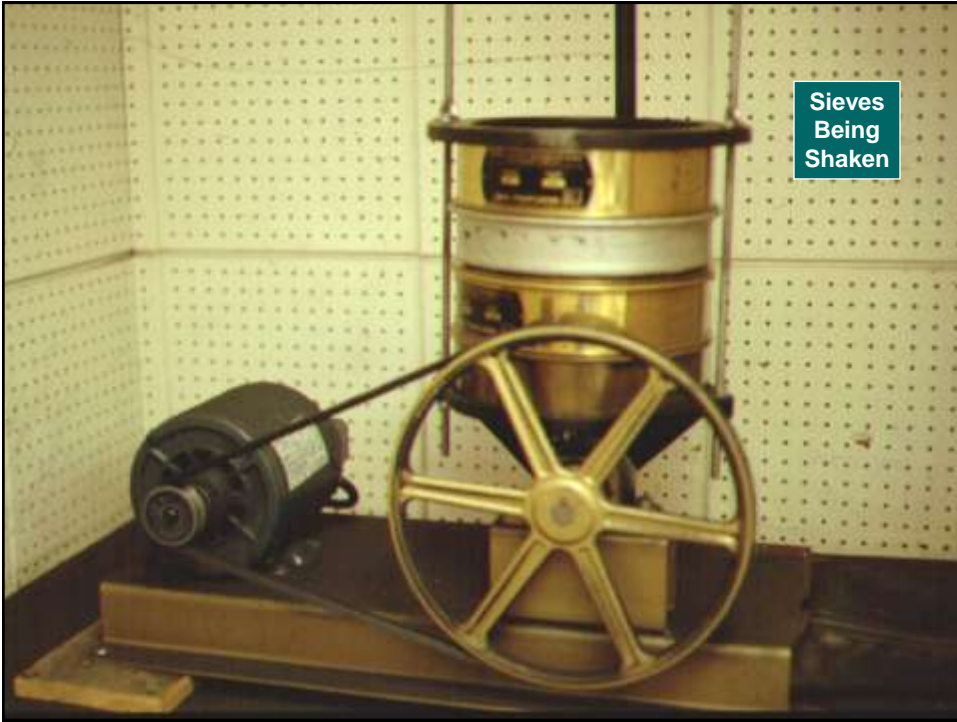
6. Apparent Opening Size

- its dry bead sieving, per ASTM D4751
- AOS is often called EOS
- it's a maximum value, i.e., "max. ave."
- either O_{95} in mm, or equivalent U. S. sieve size

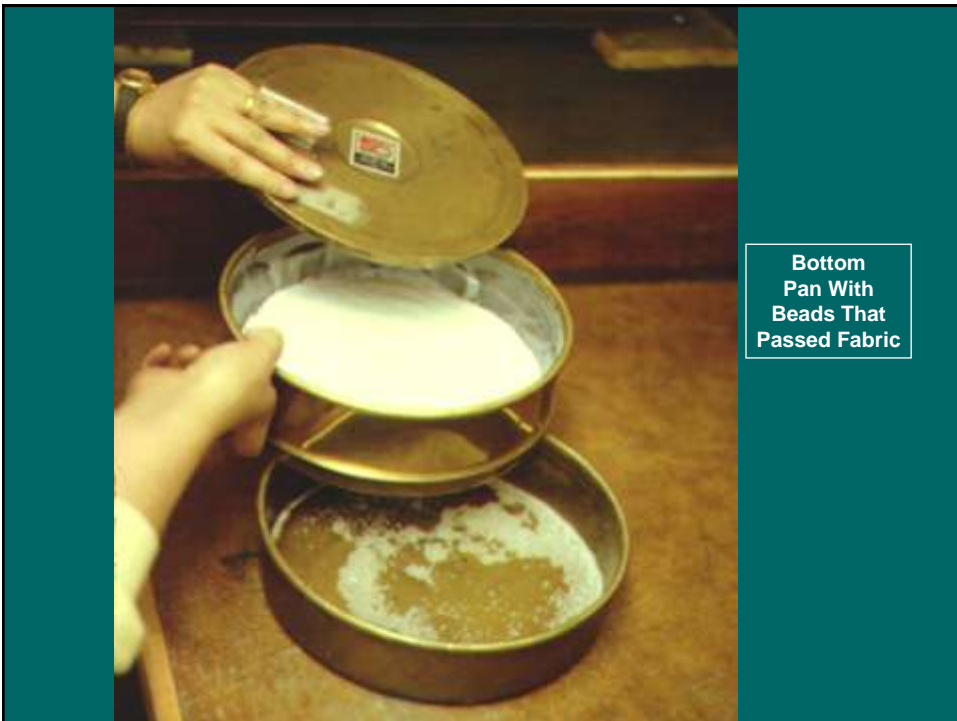
location	aggressive	typical
main tube	0.425 mm (No. 40)	0.425 mm (No. 40)
anchor tube	0.425 mm (No. 40)	0.60 mm (No. 30)

- frequency is every 40,000 m² (50,000 yd²)





Sieves
Being
Shaken



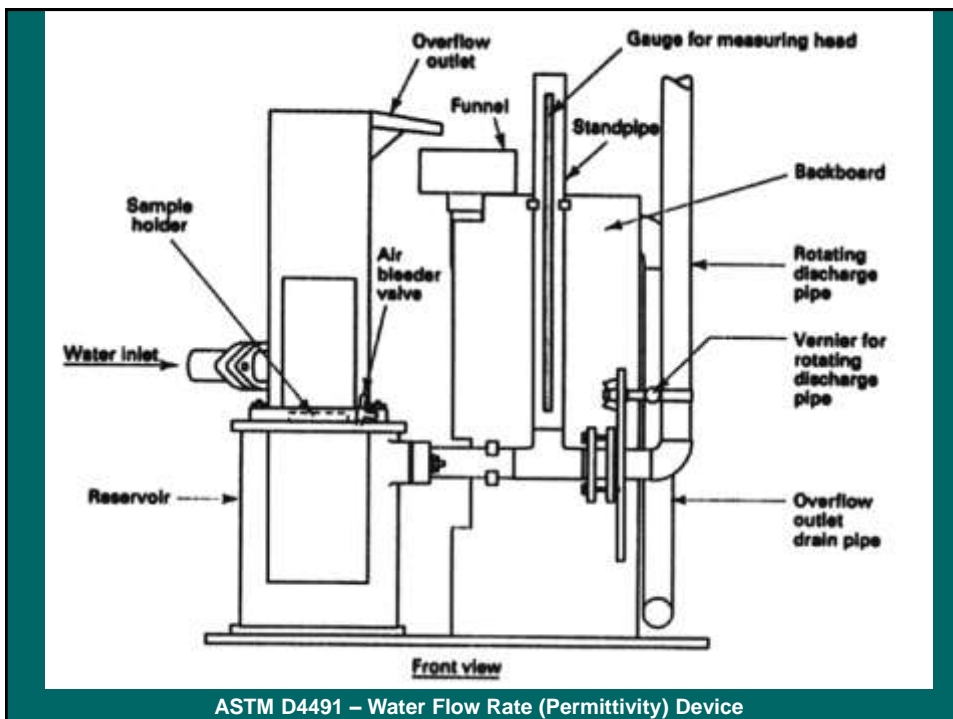
Bottom
Pan With
Beads That
Passed Fabric

7. Water Flow Rate

- uses ASTM D4491
- measures flow rate/unit area

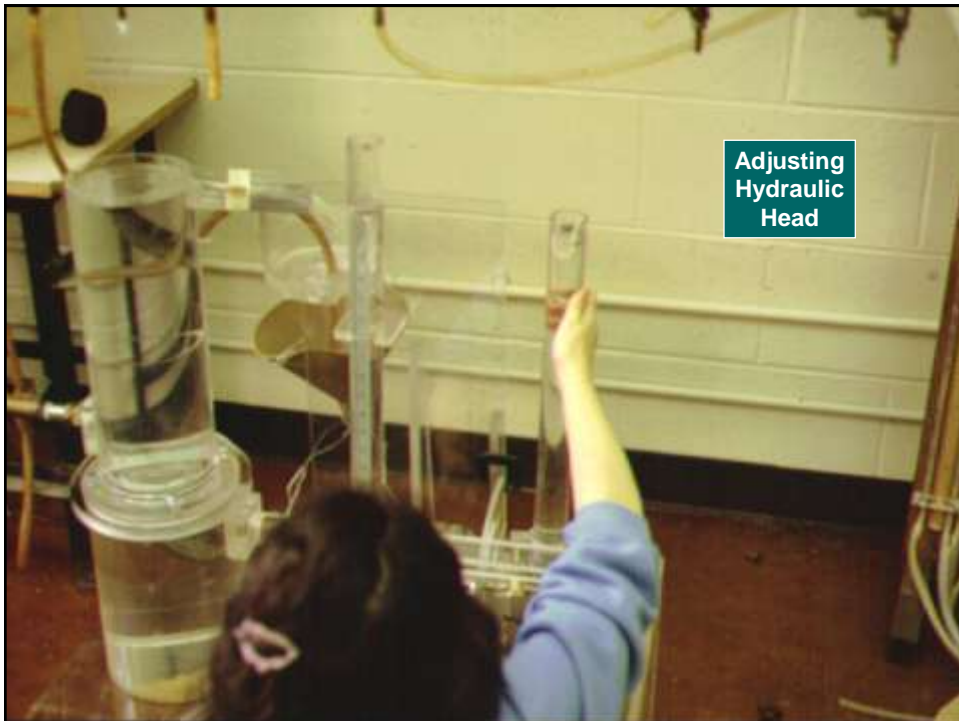
location	aggressive	typical
main tube	240 l/min-m ² (6.0 gal/min-ft ²)	240 l/min-m ² (6.0 gal/min-ft ²)
anchor tube	240 l/min-m ² (6.0 gal/min-ft ²)	240 l/min-m ² (6.0 gal/min-ft ²)

- frequency is every 40,000 m² (50,000 yd²)





Specimen
Being
Placed



Adjusting
Hydraulic
Head



8. Ultraviolet Resistance

- follows ASTM D7238
- it's the fluorescent tube device
- measures strength and elongation retained after 10,000 lt. hrs. exposure
- must be $\geq 65\%$ of original
- frequency is every formulation change



Concluding Comments

- focuses on geotubes for coastal and river structures; also sludge dewatering
- main tubes can be enormous
- hydraulic filled with sand for coastal erosion
- many other infills possible
- aggressive vs. typical conditions are listed, but subjective
- testing frequencies are also included

The Basic Tables follow

Main and Anchor Tubes – Aggressive Main and Anchor Tubes – Typical

Note: The most recent version of this specification (text and tables) is available on the GSI Web Site <geosynthetic-institute.org>.

Table 1(a): Class 1 Tubes - Aggressive Conditions
(all are minimum average values unless noted otherwise)

Property	Test Method ASTM	English Units		Metric Units	
		Property	Frequency	Property	Frequency
Physical					
Tube Circumference	Measured	7.5/15.25/31.8/45.80-8	n/a	2.2/4.6/8.3/13.9/18 m	n/a
PG Test (Access)	Measured	17 in 18 in	n/a	43 in 47 cm	n/a
Mechanical					
Wide Width Tensile Strength	D4991	1800 x 1080 lb/in	30,000 yd ²	275 x 275 kN/m	7500 m ²
Wide Width Elongation (max.)	D4991	15 x 15%	30,000 yd ²	15 x 15%	7500 m ²
Trapezoidal Tear Strength	D4853	880 x 600 lb	30,000 yd ²	3.7 x 2.7 kN	7500 m ²
Puncture Strength	D4853	400 lb	30,000 yd ²	1.8 kN	7500 m ²
Seam Strength (Direct)	D4854	800 lb/in	30,000 yd ²	185 kN/m	40,000 m ²
Hydraulic					
Aperture Opening Size (AOS)	D4751	No. 40 Sieve (max.)	30,000 yd ²	0.425 mm (max)	40,000 m ²
Water Flow Rate	D4401	8 gpa/ft ²	30,000 yd ²	240 l/min/m ²	40,000 m ²
Radiation					
Accelerated UV Resistance (% retained after 10,000 h, hv.)	D7338	85%	Indeterminate	85%	Indeterminate

Table 1(b): Class 1 Scott Aprons - Aggressive Conditions
(all are minimum average values unless noted otherwise)

Property	Test Method ASTM	English Units		Metric Units	
		Property	Frequency	Property	Frequency
Physical					
Aperture Tube Circumference	Measured	5.6 ft	n/a	0.9 - 1.8 m	n/a
Mechanical					
Wide Width Tensile Strength	D4991	400 x 518 lb/in	10,000 yd ²	75 x 91 kN/m	7500 m ²
Wide Width Elongation (max.)	D4991	38 x 10%	10,000 yd ²	20 x 10%	7500 m ²
Trapezoidal Tear Strength	D4853	180 x 270 lb	10,000 yd ²	0.8 x 1.2 kN	7500 m ²
Puncture Strength	D4853	200 lb	10,000 yd ²	1.1 kN	7500 m ²
Seam Strength (Direct)	D4854	350 lb/in	30,000 yd ²	80 kN/m	40,000 m ²
Hydraulic					
Aperture Opening Size (AOS)	D4751	No. 40 Sieve (max.)	10,000 yd ²	0.425 mm (max)	40,000 m ²
Water Flow Rate	D4401	5 gpa/ft ²	30,000 yd ²	240 l/min/m ²	40,000 m ²
Radiation					
Accelerated UV Resistance (% retained after 10,000 h, hv.)	D7338	85%	Indeterminate	85%	Indeterminate

Table 2(a): Class 2 Tubes - Typical Conditions
(all are minimum average values unless noted otherwise)

Property	Test Method ASTM	English Units		Metric Units	
		Property	Frequency	Property	Frequency
Physical					
Tube Circumference	Measured	5.5 (1.72) to 30 (9.14) ft	n/a	1.64 (0.50) to 9.14 m	n/a
Wall Feet (thickness)	Measured	12 to 18 in.	n/a	30 to 45 cm	n/a
Mechanical					
Wide Width Tensile Strength	D4985	400 x 110 ft-lb	10,000 psi	70 x 85 kN/m	7500 MPa
Wide Width Elongation (max.)	D4985	20 x 20%	10,000 psi	20 x 20%	7500 MPa
Tensile Tear Strength	D4033	180 x 270 lb	10,000 psi	6.80 x 1.2 kN	7500 MPa
Puncture Strength	D4833	300 lb	10,000 psi	1.3 kN	7500 MPa
Tensile Strength (dynamic)	D4884	310 ft-lb	10,000 psi	40 kN/m	40,000 MPa
Hydraulic					
Approved Opening Size (AOI)	D4711	7% to 40 (leaves (max.))	10,000 psi	6.421 mm (max)	40,000 MPa
Water Flow Rate	D4481	8 gpm/ft ²	10,000 psi	240 l/min/m ²	40,000 MPa
Endurance					
Accelerated UV Resistance (% retained after 10,000 hr test)	D7038	85%	Insulation	85%	Insulation

Table 2(b): Class 2 Score Aprons - Typical Conditions
(all are minimum average values unless noted otherwise)

Property	Test Method ASTM	English Units		Metric Units	
		Property	Frequency	Property	Frequency
Physical					
Anchor Tube Circumference	Measured	3-8 ft	n/a	0.9-2.4 m	n/a
Mechanical					
Wide Width Tensile Strength	D4985	400 x 400 ft-lb	10,000 psi	70 x 70 kN/m	7500 MPa
Wide Width Elongation (max.)	D4985	20 x 20%	10,000 psi	20 x 20%	7500 MPa
Tensile Tear Strength	D4033	180 x 270 lb	10,000 psi	6.80 x 1.2 kN	7500 MPa
Puncture Strength	D4833	180 lb	10,000 psi	0.78 kN	7500 MPa
Tensile Strength (dynamic)	D4884	280 ft-lb	10,000 psi	37 kN/m	40,000 MPa
Hydraulic					
Approved Opening Size (AOI)	D4711	7% to 30 (leaves (max.))	10,000 psi	6.40 mm (max)	40,000 MPa
Water Flow Rate	D4481	8 gpm/ft ²	10,000 psi	240 l/min/m ²	40,000 MPa
Endurance					
Accelerated UV Resistance (% retained after 10,000 hr test)	D7038	85%	Insulation	85%	Insulation