

BMRR REGULATION BRANCH

GUIDANCE DOCUMENT

Specifications, Test Methods, and Frequencies

Introduction

Citing the need for consistency and general guidance for document submittals and to facilitate staff review expedite issuance of Agency approvals, BMRR in collaboration with mining industry consultants, has prepared the following guidance document "Recommended Specifications, Test Methods, Frequencies, and Guidance". This guidance document is intended for current and future permittees/operators, engineers and consultants, governmental agencies, non-governmental organizations, and BMRR staff and is considered to be a "living" document to be revised periodically as the mining industry and regulations evolve.

In preparing this document, a comprehensive review of commonly accepted industry standards, practices, testing protocols, and frequencies was performed. Site specific conditions (e.g., climate, elevation, topography, depth to groundwater, seismic activity, etc.) will determine if an increased or reduced testing frequency is in order or if alternative testing protocols should be utilized. While discretion is given to the field engineer, permittees and their consultants are encouraged to contact the Regulation Branch Supervisor or their assigned Permitting Engineer for any questions regarding the submittal details, test methods, and frequencies.

Sources utilized in preparing this document include the following

- *American Concrete Institute (ACI)*
- *American National Standards Institute/American Water Works Association (ANSI/AWWA)*
- *American Society for Testing and Materials (ASTM)*
- *American Welding Society (AWS)*
- *Geosynthetics Institute (GSI)*
- *National Sanitary Foundation (NSF)*
- *Plastic Pipe Institute (PPI)*

Applicable Regulatory Requirements

- *NAC 445A.397 Contents of application: Engineering design report; specifications for fluid management system.*
- *NAC 445A.415 Granting of permit which allows lower level of engineered containment than required by minimum design criteria.*
- *NAC 445A.426 Notice of intent to commence active operation of process component.*
- *NAC 445A.428 Level of containment required for placer mining or physical separation facilities.*
- *NAC 445A.427 Duties of holder of permit upon construction or modification of process component.*
- *NAC 445A.429 Procedures required to prevent release of contaminants; requirements concerning impoundments.*
- *NAC 445A.433 Minimum design criteria: Universal requirements; areas where groundwater is near surface; proximity of new process components to dwellings; liability for degradation of water.*
- *NAC 445A.434 Minimum design criteria: Leach pads and other non-impounding surfaces designed to contain and promote horizontal flow of process fluids.*
- *NAC 445A.435 Minimum design criteria: Ponds.*

- NAC 445A.436 *Minimum design criteria: Vats, tanks and other containers which confine process fluids.*
- NAC 445A.437 *Minimum design criteria: Tailings impoundments.*
- NAC 445A.438 *Minimum design criteria: Liners.*
- NAC 445A.439 *Program required to control quality of construction of liner systems.*
- NAC 445A.440 *Monitoring: Site of facility.*
- NAC 445A.441 *Monitoring: Procedure upon variation in parameter or element being monitored.*
- NAC 445A.442 *Monitoring: Process components.*
- NAC 445A.443 *Monitoring: Beneficiation process.*

Submittals

Any engineering designs submitted to BMRR as Fee Based Reviews (Engineering Design Changes, Minor Modifications, Major Modifications, New Permits, and Permit Renewals), As-Built Report, and Quality Control/Quality Assurance (QA/QC) Documentation must include the minimum information:

- *Introduction and project description;*
- *Maps, Nevada PE-stamped engineering drawings and designs;*
- *Discussion of commissioning procedures;*
- *Proposed construction Schedule;*
- *Earthworks specifications, testing and test methods, testing frequency, and results;*
- *Soil placement and foundation specifications, testing and test methods, testing frequency, and results;*
- *Concrete specifications, placement, testing and test methods, testing frequency, and results;*
- *Pipe and liner specifications, placement, testing and test methods (including welding), testing frequency, and results;*
- *Other material specifications not previously identified; and*
- *Manufactured component specifications (pump size, tank capacity, throughput, etc.).*

In addition to the above minimum requirements, As-Built Reports and QA/QC documentation must also include:

- *Photographs;*
- *Parties involved and their assigned responsibilities;*
- *Deviations from BMRR-approved designs;*
- *Daily construction activity logs or field logs describing work performed, problems encountered, weather conditions, etc.; and*
- *Record documents including drawings, designs, and maps.*

For Non-Fee Based Reviews involving the repair, replacement, or reconstruction of a particular component, Permittees are encouraged to contact the Regulation Branch Supervisor or their assigned Permit Engineer regarding As-Built Reports and QA/QC documentation.

Earth Work and Soil Test Methods

Type of Test	ASTM Test Method
Atterberg limits	D4318
Moisture Content Laboratory In-Place	D2216 D3017
Grain Size Distribution	C136/D422
Laboratory Compaction (Proctor)	D1557
Field Density Nuclear Sand Cone Water Replacement	D2922 D2556 D2167
Permeability Laboratory In-Situ	D6084 Air Entry Permeameter

Minimum Recommended Earth Work and Soil Testing Frequencies

Test	Maximum Test Frequency
Subgrade	
Atterberg Limits (QA and QC)	Minimum one per soil type or one per 60,000 sq yds whichever is more frequent
Grain Size Distribution (QA and QC)	Minimum one per soil type or one per 60,000 sq yds whichever is more frequent
Laboratory Compaction (QA and QC)	Minimum one per soil type or one per 60,000 sq yds whichever is more frequent
In-Place Density and Moisture (QA and QC)	Minimum one per 7,500 sq yds.
Random Fill	
Atterberg Limits (QA and QC)	Minimum one per soil type or one per 20,000 cu yds whichever is more frequent.
Grain Size Distribution (QA and QC)	Minimum one per soil type or one per 20,000 cu yds whichever is more frequent.
Laboratory Compaction (QA and QC)	Minimum one per soil type or one per 20,000 cu yds whichever is more frequent.
In-Place Density and Moisture (QA and QC)	Minimum one per 2,500 sq yds placed.
Sand Cone (QA)	One per every 50 in-place density and moisture test.
Clay (When used specifically as a liner)	
Atterberg Limits (QA and QC)	Minimum one per 5,000 cu yds placed.
Grain Size Distribution (QA and QC)	Minimum one per 5,000 cu yds placed.
Laboratory Compaction (QA and QC)	Minimum one per soil type or one per 20,000 cu yds placed, whichever is more frequent.
Laboratory Permeability (QA)	Minimum one per 100,000 sq yds per 6-inch lift.
In-Situ Permeability (Air Entry Permeameter QA)	Minimum one per 100,000 sq yds per 6-inch lift.
In-Place Density and Moisture (QA and QC)	Minimum one per 2,500 sq yds per 6-inch lift.
Sand Cone (QA)	One per every 25 in-place density and moisture test.

Minimum Recommended Compaction Specifications

Fill Material	Minimum Percent of Maximum Dry Density (ASTM Method D1557)	Minimum/Maximum Moisture Content
Subgrade	90	+3% / -1% of optimum
Random Fill, Pipe Bedding, Pipe Backfill	90	+3% / -1% of optimum
Low Permeability Soil	90	+3% / -1% of optimum
GCL Subgrade	90	+3% / -1% of optimum
Rock Fill and Drain Gravel	No Compaction Required	N/A
Rip Rap	No Compaction Required	N/A
Wearing Course	95	± 2 % of optimum
Highly Compacted Random Fill	95	± 2 % of optimum
Clay (Meeting Criteria as Liner)	95	± 2 % of optimum
Overliner	No Compaction Required	N/A

Minimum Recommended Gradation Limits

Drain Gravel	
Sieve Size (US Sieve Series)	Weight Percent Passing
6 inch	100
1 inch	70 - 100
4 mesh	30 - 70
40 mesh	0 - 35
200 mesh	0 - 35
Underdrain Material	
Sieve Size (US Sieve Series)	Weight Percent Passing
2 inch	100
1 inch	30 - 100
3/8 inch	5 - 70
40 mesh	0 - 20
200 mesh	0 - 10
Wearing Course Material, Pipe and Liner Bedding Material	
Sieve Size (US Sieve Series)	Weight Percent Passing
3 inch	100
3/4 inch	60 - 100
3/8 inch	40 - 85
4 mesh	30 - 65
10 mesh	20 - 50
40 mesh	15 - 30
200 mesh	5 - 15

Minimum Recommended Synthetic Liner Test Methods and Testing Frequency

Property	Test Method	Maximum Test Frequency
Thickness	ASTM Method D5199	Per Roll
Tensile Properties	ASTM Method D638	Every 50,000 sq ft
Tear Resistance	ASTM Method D638	Every 50,000 sq ft
Puncture Resistance	ASTM Method D4833	Every 50,000 sq ft
Carbon Black Content	ASTM Method D1603	Every 50,000 sq ft
Carbon Black Dispersion	ASTM Method D5596	Every 50,000 sq ft
Density	ASTM Method D1505	Every Resin Batch
Stress Crack Resistance	ASTM Method D5397	Every Resin Batch
Dimensional Stability (Maximum Average %)	ASTM Method D1204	Every Resin Batch
Destructive Shear and Peel Tests	NA	Minimum Every 500 Linear Feet Of Seam For Each Welding Machine (Randomly Located)
Air Pressurization Testing, Vacuum Testing, or Equivalent Method	NA	Entire Length Of Field Welded Seams. Tests To Be Performed By Lining Contractor And Randomly Observed By The Field Inspector

Minimum Recommended Geonet Test Methods and Testing Frequency

Property	ASTM Test Method	Minimum Frequency	Units	Values			
Thickness (nominal)	D 5199	50,000 ft ²	mils	200	250	275	300
Density (minimum)	D 1505/D 792 Method B	50,000 ft ²	g/cm ³	0.94	0.94	0.94	0.94
Tensile Strength (machine direction)	D 5035	50,000 ft ²	lbs/in	45	55	65	75
Carbon Black Content	D 4218 D 1603 (modified)	50,000 ft ²	percent	2-3	2-3	2-3	2-3
Melt Flow Index	D 1238, 190°F, 2.16 kg	Per Resin Lot	g/10 minutes (maximum)	≤1.0	≤1.0	≤1.0	≤1.0
Transmissivity*	D 4716	500,000 ft ²	m ² /sec	2 x 10 ⁻³	3 x 10 ⁻³	6 x 10 ⁻³	8 x 10 ⁻³

*Gradient of 0.1, normal load 10,000 lb/ft², water 70 F between steel plates for 15 minutes

Minimum Recommended Reinforced Geotextile Test Methods and Testing Frequency

Property	ASTM Test Method	Minimum Average Roll Value (MARV)	Maximum Test Frequency
Grab Tensile Strength	D4632	390 lbs	1 per 85,000 ft ²
Grab Elongation	D4632	50 %	1 per 85,000 ft ²
Static Puncture Resistance (CBR Test)	D4833	1,125 lbs	1 per 85,000 ft ²
Trapezoidal Tear	D4533	155	1 per 85,000 ft ²
Burst Strength	D3786	800	1 per 85,000 ft ²
Water Flow Rate	D4491	50 gpm/ft ²	1 per 85,000 ft ²
Apparent Opening Size (US Sieve Series)	D4751	100 mesh	1 per 525,000 ft ²
Ultraviolet Stability	D4355	70 % retained after 500 hours	1 per 85,000 ft ²
Thickness	D5199	165 mils	1 per 525,000 ft ²
Mass Per Unit Area	D5261	16 oz /yd ²	Per Formulation

Minimum Recommended Geosynthetic Clay Layer (GCL) Test Methods and Testing Frequency

Property	ASTM Test Method	Specification	Maximum Test Frequency
Bentonite Swell Index	D5890	24 ml /2 grams minimum	
Bentonite Fluid Loss	D5891	18 ml maximum	
Bentonite Mass/Area	D58993	0.75 lb /ft ³ (3.6 kg /m ³)	
GCL Grab Strength	D4632 D6768	150 lbs minimum average roll value 37.5 lbs minimum average roll value	
GCL Peel Strength	D4632 D6496	15 lbs 2.5 lbs	
GCL Index Flux	D5887	$1 \times 10^{-8} \text{ m}^3/\text{m}^2/\text{sec}$ maximum	
GCL Hydraulic Conductivity	D5887	$5 \times 10^{-9} \text{ cm}/\text{sec}$ maximum	
GCL Hydrated Internal Shear Strength	D5321 D6243	500 lbs/ft ² @ 200 lbs/ft ² 6,500 lbs/ft ² @ 10,800 lbs/ft ²	

Minimum Recommended HDPE and LLDPE Seam Testing Specifications, Geosynthetic Institute (GSI)

Nominal Thickness	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge, Hot Air, and Ultrasonic seams							
Shear Strength, lb/in² <i>(value is for 4 out of 5 specimens, 5 th specimen can be as low as 80% of the listed values)</i>	57	80	100	120	160	200	240
Shear Elongation at Break, % <i>(omit for field testing)</i>	50	50	50	50	50	50	50
Peel Strength, lb/in <i>(value is for 4 out of 5 specimens, 5 th specimen can be as low as 80% of the listed values)</i>	45	64	76	91	121	151	181
Peel Separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
Shear Strength, lb/in² <i>(value is for 4 out of 5 specimens, 5 th specimen can be as low as 80% of the listed values)</i>	57	80	100	120	160	200	240
Shear Elongation at Break, % <i>(omit for field testing)</i>	50	50	50	50	50	50	50
Peel Strength, lb/in <i>(value is for 4 out of 5 specimens, 5 th specimen can be as low as 80% of the listed values)</i>	39	52	65	78	104	130	156
Peel Separation, %	25	25	25	25	25	25	25

Cement, Concrete, Concrete Aggregates, and Admixtures

Note: Local Building Codes supersede all standards and specifications listed below if they are more stringent.

- ASTM Method C150 Portland Cement
- ASTM Method C33 Concrete Aggregates
- ASTM Method C260 Air Entraining Admixtures for Concrete
- ASTM Method C494 Chemical Admixtures for Concrete
- ASTM Method C31 Making and Curing Concrete Test Specimens
- ASTM Method C94 Ready-Mixed Concrete
- ASTM Method C143 Test for Slump of Portland Cement Concrete
- ASTM Method C172 Sampling Fresh Concrete
- ASTM Method C231 Test for Air Content of Freshly Mixed Concrete by the Pressure Method

28-Day Compressive Strength (ASTM Method C94)

Mixed Concrete Items	Psi
<i>Structural slabs, beams, columns, walls and tunnels</i>	4,000
<i>Foundations, slabs-on-grade, curbs, sidewalks, and miscellaneous items</i>	3,000
<i>Floor fill over steel decking</i>	3,000
<i>Lean concrete fill</i>	1,000
<i>Heavy mass construction</i>	4,000
<i>Duct bank concrete</i>	3,000

Slump Tests (ASTM Method C143)

Recommended Slumps for Various Types of Construction			
Type of Construction	Slump in Inches		
	Maximum	Minimum	Recommended
<i>Reinforced foundation wall, pedestals, and piers greater than 12 inches</i>	4	3	4
<i>Reinforced foundation wall, pedestals, and piers less than 12 inches</i>	4	3	4
<i>Caissons and substructure walls</i>	4	3	4
<i>Building columns, beams, and girders</i>	4	3	4
<i>Footings and duct banks</i>	3	1	2
<i>Lean fill</i>	6	3	4
<i>Pavement</i>	3	2	2
<i>Heavy mass construction</i>	3	1	2

Curing and Joint Filler Materials, etc.

- *ASTM Method C156 Water Retention by Concrete Curing Materials*
- *ASTM Method C171 Sheet Materials for Curing Concrete*
- *ASTM Method C309 Liquid Membrane-Forming Compounds for Curing Concrete*
- *ASTM Method D1190 Concrete Joint Sealer, Hot Poured Elastic Type*
- *ASTM Method D1850 Concrete Joint Sealer, Cold-Application Type or ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)*
- *ASTM Method D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction*
- *ACI 211.1 Proportions for Normal, Heavyweight and Mass*
- *ACI 217.2 Selecting Proportions for Structural Lightweight Concrete*
- *ACI 214 Evaluation of Strength Test Results of Concrete*
- *ACI 221.1 State-of-the-Art Report on Alkali-Aggregate Reactivity*
- *ACI 301 Specifications for Structural Concrete For Buildings*
- *ACI 304 Measuring, Mixing, Transporting and Placing Concrete*
- *ACI 305 Hot Weather Concreting*
- *ACI 306 Cold Weather Concreting*
- *ACI 306.1 Standard Specification for Cold Weather Concreting*

- *ACI 309 Consolidation of Concrete*
- *ACI 311 Manual of Concrete Inspection*
- *ACI 318 Building Code Requirements for Reinforced Concrete*
- *ACI 347 Formwork for Concrete*

Welding Reinforced Steel Bar

- *AWS D12.1 Recommended Practices for the Welding of Reinforcing Steel*

Pipe and Pipe Weld Specifications

National Sanitary Foundation (NSF)

- *Standard #14-Plastic Piping Components & Related Materials*

American National Standards Institute/American Water Works Association (ANSI/AWWA)

- *ANSI/AWWA C901-08 Polyethylene (PE) pressure Pipe & Tubing, 1/2-inch through 3-inch diameter for Water Service*
- *ANSI/AWWA C906-07 Polyethylene (PE) pressure Pipe & Fittings, 4-inch through 63-inch diameter for Water Distribution and Transmission*
- *AWWA M55 Manual of Water Supply Practices, Polyethylene (PE) Pipe - Design and Installation*
- *ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800*
- *ANSI B16.5 Pipe flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys*

Plastic Pipe Institute (PPI)

- *TR-33 Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene (PE) Pipe*
- *PPI Handbook of Polyethylene (PE) Pipe*
- *PPI TR-33 Generic Butt Fusion Joining Procedure for Polyethylene (PE) Gas Pipe*
- *PPI TR-34 Disinfection of Newly Constructed Polyethylene (PE) Water Mains*
- *PPI TR-41 Generic Saddle Fusion Joining Procedure for Polyethylene (PE) Gas Piping*
- *PPI TN-42 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects*

American Society for Testing and Materials (ASTM)

- *ASTM Method F714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter*
- *ASTM Method F905 Standard Practice for Qualification of Polyethylene Saddle-Fused Joints*
- *ASTM Method F1055 Standard Specification for Electrofusion Type Polyethylene (PE) Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing*
- *ASTM Method F1290 Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings*
- *ASTM Method F1412 Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems*

- *ASTM Method F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air*
- *ASTM Method F2164 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure*
- *ASTM Method F2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock*
- *ASTM Method D2239 Standard Specification for Polyethylene (PE) Plastic Pipe (SDRPR) Based on Controlled Inside Diameter*
- *ASTM Method D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*
- *ASTM Method F2620 Standard Practice for Heat Fusion Joining of Polyethylene (PE) Pipe and Fittings*
- *ASTM Method D2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing*
- *ASTM Method D2737 Standard Specification for Polyethylene (PE) Plastic Tubing*
- *ASTM Method D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping*
- *ASTM Method D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing*
- *ASTM Method D3350 Standard Specification for Polyethylene (PE) Plastics Pipe and Fittings Materials*

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