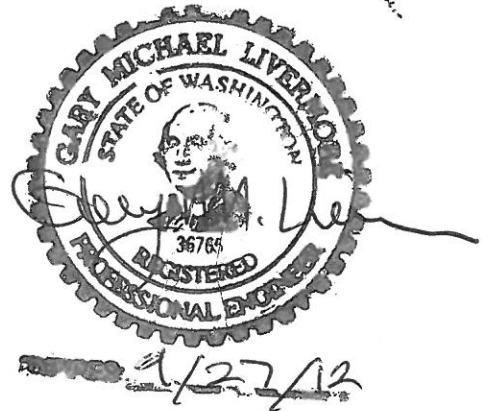


BSB-ZVI Reactor Vessel Mat Foundation Kent, Washington

SPECIFICATIONS

Release 4, C.O. #8
Date: 6/10/2011
Project Number: 208009.00



LIVERMORE

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Project Number: 208009.00

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DOCUMENT 00010

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SECTION 031513 PVC WATERSTOPS**PART 1 -GENERAL****1.1 SECTION INCLUDES**

- A. Provision of waterstops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent fluid migration.
- B. Non-metallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.

1.2 REFERENCES

- A. PVC WATERSTOP
 - 1. Corps of Engineers: CRD-C 572-74
 - 2. American Society for Testing Materials (ASTM)
 - 3. Bureau of Reclamation: C-902
 - 4. Canadian General Standards Board: 41-GP-35M Types 1 & 3

1.3 QUALITY ASSURANCE

- A. Waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store waterstops under tarps to protect from oil, dirt, and sunlight.

1.5 SUBMITTALS

- A. Product Date: For each type of product indicated.
 - 1. Indicate details of all splices and abutting conditions.

PART 2 -PRODUCTS**2.1 MATERIALS**

- A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak, profile style number "Dumbell" Type, Model 748.
- B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.
- C. Performance Requirements as follows:

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.

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Tensile Strength	ASTM D 638	2000 psi (13.78 Mpa) min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35° F (-37° C)
Stiffness in Flexure	ASTM D 747	600 psi (4.13 Mpa) min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 ±3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi (11.03 Mpa) min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalies after 7 days: Weight Change Hardness Change	CRD-C 572	between -0.10% / +0.25% +/- 5 points

2.2 ACCESSORIES

- A. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
- B. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
- C. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.

PART 3 -EXECUTION

3.1 INSTALLATION

- A. Field butt splices shall be heat fused welded using a Teflon coated thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
- B. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12 inches on center along the length of the waterstop and wire tie to adjacent reinforcing steel.

3.2 FIELD QUALITY CONTROL

- A. Waterstop splicing defects which are unacceptable include, but are not limited to the following:
 1. Tensile strength less than 80 percent of parent section.
 2. Misalignment of centerbulb, ribs, and end bulbs greater than 1/16 inch.
 3. Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness.
 4. Misalignment which reduces waterstop cross section more than 15 percent.
 5. Visible porosity in the weld.
 6. Bubbles or inadequate bonding.
 7. Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.
 8. Charred or burnt material.

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END OF SECTION 031513

SECTION 033000 - CAST-IN-PLACE CONCRETE**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Mixtures that do not contain Portland cement replacements.
- B. Design Mixtures: For each concrete mixture.
- C. Shop Drawings: For steel reinforcement. Material test reports certificates.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- C. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS**2.1 FORM-FACING MATERIALS**

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

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2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C.
- B. Normal-Weight Aggregates: ASTM C 33, graded, 1-inch (25-mm) nominal maximum coarse-aggregate size.
 - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Plastic Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- C. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

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2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, as per ACI 318-05 table 4.3.1.
- C. Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: meet all requirements of ACI 301.
 - 3. Slump Limit: for 3" (75mm), plus or minus 1 inch (25 mm).
 - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1inch (25-mm) nominal maximum aggregate size.

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2.8 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C.
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

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3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.
 - 1. Apply scratch finish to surfaces indicated.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated exposed to view.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less

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than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 1. Testing Services: Tests shall be performed according to ACI 301.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes structural steel.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
- C. Welding certificates.
- D. Mill test reports.
- E. Source quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 572/A 572M, Grade 50 (345).
- B. Angles: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Welding Electrodes: Comply with AWS requirements.

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2.2 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design.

2.3 SHOP CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.4 GALVANIZING

- A. Galvanize all steel surfaces except the following:
 - 1. Surfaces to be field welded.
- B. Surface Preparation: Clean surfaces to be galvanized. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Touch up all damaged surfaces that apply to 2.4A with galvanized coating.

2.5 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports. Comply with testing and inspection requirements of Part 3, Article "Field Quality Control."
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding.

PART 3 - EXECUTION

3.1 ERECTION

- A. Examination: Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

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1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Load and Resistance Factor Design Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds.
- B. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Provide a complete composite sheet membrane waterproofing system.
 - 2. Work includes all applicable sealants, waterstops and waterproofing flashings needed to ensure a complete waterproof system for buried concrete components at locations indicated.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 SUBMITTALS

- A. Comply with pertinent provisions of Division 1.
- B. Product data:
 - 1. Materials list of items proposed to be provided under this Section;
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
 - 3. Shop Drawings or catalog illustrations in sufficient detail to show installation and interface of the work of this Section with the work of adjacent trades;
 - 4. Manufacturer's current recommended installation procedures which, when reviewed by the Architect/Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.
 - 5. Written documentation of applicator's qualifications, including reference projects of similar scope and complexity, with current phone contacts of architects, engineers and owners for verification.
 - 6. Where work of this Section may potentially contact groundwater, include manufacturer's report confirming laboratory testing of membrane system with project groundwater samples and confirming suitability for installation in Project conditions.
- C. Mock-up: Prior to installation, prepare a sample panel of the work of this Section at a location on the job site where approved by the Architect/Engineer.
 - 1. Make the sample panel in dimensions approved by the Architect/Engineer and with one panel for each of the various types of installation.
 - 2. Show all aspects of the work of this Section to the quality specified.
 - 3. Make necessary adjustments in the sample panel(s) and secure the Architect/Engineer's approval.

4. The sample panel(s), when approved by the Architect/Engineer, will be used as a datum point for comparison with the remainder of the work of this Section for the purpose of acceptance or rejection.
5. Upon approval of the Architect/Engineer, the sample panel(s) may become actual part of the installation required for this Work.

1.03 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. Applicator qualifications:
 1. Applicator shall have at least three years experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.
 2. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.
- C. Convene a pre-installation job-site conference three weeks prior to commencing work of this Section:
 1. Secure attendance by Architect/Engineer, Contractor, applicator, and authorized representatives of the membrane system manufacturer and interfacing trades.
 2. Examine Drawings and Specifications affecting work of this Section, verify all conditions, review installation procedures, and coordinate scheduling with interfacing portions of the Work.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use.
- B. Maintain the products in a dry condition during delivery, storage, handling, installation, and concealment.
- C. Comply with pertinent provisions of Division 1.

1.05 SUBSTRATE CONDITIONS

- A. Provide applicator with substrates that are free of standing water, dirt and debris, loose material, voids and protrusions or deformations which may inhibit application or performance of waterproofing.

1. Where work of this Section will be installed on earth, provide subgrades that are stable, smoothed and compacted to minimum 85 percent modified proctor density.
 2. Where work of this Section will be installed on earth retaining system, fill gaps and voids in earth retaining system to conform with waterproofing manufacturer's requirements; fill voids and cavities exterior of wood-lagged shoring with sand or cement slurry; remove nails in wood lagging.
 3. Where work of this Section will be installed on concrete or masonry, provide substrates that are free of voids deeper than 3/8" and free of surface protrusions more than 1/4" above the surface.
 4. Where work of this Section will be installed on concrete footings, provide wood float or better finish to surfaces scheduled to receive the membrane.
 5. Where work of this Section will include bentonite waterstop strips, provide concrete surfaces as required for that installation.
 6. Rigidly install penetrations of membrane for detailing procedures.
- B. Groundwater:
1. Where work of this Section will encounter groundwater, provide waterproofing manufacturer with sufficient groundwater samples taken from Project at logged locations for manufacturer's laboratory analysis.
 2. Manufacturer shall provide written report confirming laboratory testing with regard to suitability of waterproofing system for installation in Project conditions.

1.06 WARRANTY

- A. Deliver to Architect/Engineer signed copies of the following written warranties against defective materials and workmanship for a period of ten years following date of completion. Warrant that installed waterproofing system shall be free of defects including waterproofing failure resulting from substrate cracking up to 1/8 inch.
1. Manufacturer's standard warranty covering materials.
 2. Applicator's standard warranty covering workmanship.

PART 2 PRODUCTS

2.01 GENERAL

- A. General:
1. Where indicated on the Drawings, provide a complete dual-waterproofing, resealable, composite sheet membrane system composed of high-density polyethylene with a sodium-

bentonite face designed for buried concrete or masonry construction having the following attributes.

- a. Acceptable products
 1. Paraseal Membranes
 2. or prior approved equal
2. Obtain primary waterproofing materials of each type required from a single manufacturer to greatest extent possible. Provide accessory materials that are approved by membrane manufacturer.
- B. Membrane properties: Equal to "Paraseal Membrane," for use on buried vertical and horizontal conditions such as backfilled foundation walls, below slab with bentonite-side down, and retaining walls:

1. Puncture resistance	169 lbs.	ASTM E154
2. Tensile strength	4,000 psi	ASTM D412
3. Water vapor permeance	0.03 perms	ASTM E96
4. Percent elongation	700 percent	ASTM D638, Type 4 Dumbbell
5. Resistance to hydrostatic head	150 feet	ASTM D751
6. Warranted crack-bridging capability	1/8 inch	
- C. For use in blindside conditions on retained earth, below slab with bentonite-side up, in elevator pits or where shotcrete/gunite is scheduled to be blown directly onto the membrane face, provide "Paraseal LG Membrane," which is the Paraseal Membrane with additional protective laminate layer of spun polypropylene.
- D. For use in subgrade conditions designed to be impervious to both water and natural gas, provide "Paraseal GM Membrane," which is Paraseal Membrane with modified overlap area providing for nonreinforced seam tape in special taping procedure within laps.
- E. For applications in areas where saline, alkaline, acid or otherwise contaminated groundwater conditions exist, provide "Saltwater Paraseal," which is Paraseal Membrane specially designed.

2.02 ACCESSORIES

- A. For installation at horizontal-to-vertical junctures, provide "Paragranular" loose bentonite granules in weatherproof 50 lb. bags and capable of swelling to occupy a minimum volume of 17 ml when 2 grams are dispersed into deionized water.
- B. For detailing vertical junctures and penetrations, provide "Paramastic" non-hydrated expandable mastic of trowelable consistency containing not less than 55 percent high swelling Wyoming sodium bentonite.
- C. Provide the following fasteners as needed:
 1. Case-hardened steel nail with fluted shank having a minimum 1" length and a minimum 1" diameter cap for use on green concrete and masonry substrates.

2. Powder shot steel pin having a minimum 3/4" diameter washer for use on hardened concrete and grouted masonry substrates.
 3. Steel staples approved by membrane manufacturer for use according to Project conditions.
- D. Provide the following seam tapes as needed:
1. " Temporary Tape" reinforced temporary joint closure tape 3" wide composed of acrylic adhesive bonded to polyvinyl chloride coated fabric used to protect seams against debris intrusion during backfill and for temporary terminations during periods of exposure to rain.
 2. " Permanent Seam Tape" reinforced, rubberized-asphaltic waterproofing seam tape 4" wide by 60 mils thick for sealing membrane overlaps wherever flood-testing is required and elsewhere as required by Project conditions or designs.
 3. " Para JT Tape" non-reinforced, adhesive tape of partially cross-linked polymeric elastomers 2" wide by 1/8" thick for molding form-fit seals around difficult contours and for taping seams within overlaps.
- E. Provide "Paraterm Bar" extruded aluminum bar with upper flange to receive sealant for terminations at grade line and on parapet walls.
- F. Provide "Vulkem 116 Sealant" one-part gun-grade polyurethane sealant for completing termination seals and other sealing recommended by manufacturer.
- G. Provide "TREMproof 201/60 polyurethane, liquid-applied, elastomeric waterproofing flashing.
- H. Provide "Parastick'N'Dry" pressure sensitive, double-sided tape laminate of bentonite sandwiched between a netting and non-woven fabric for wrapping through-concrete imbeds and other detailing.
- I. Provide "Superstop" flexible, reinforced, bentonite-laminate waterstop strips 1/2" by 1" by 20' - 0" with pressure-sensitive adhesive backing for sealing static cold joints in concrete.
- J. Provide "Paraprimer" versatile adhesive bonding agent primer formulated for use with tapes and pressure-sensitive waterproofing accessories.
- K. Provide an approved Tremco Inc. drainage mat from the TREMDrain series of products such as TREMDrain, TREMDrain 1000 or TREMDrain 2000 composed of a filter fabric laminated to free-draining high-density dimpled polystyrene drainage core.
- L. Provide TREMDrain Total-Drain: replaces perforated pipe and aggregate connect directly to the approved Tremco Inc. TREMDrain product.
- M. Provide base sheet of minimum 6 mil polyethylene sheet for use as hydration barrier below slabs.
- N. Provide protection course as recommended by the waterproof system manufacturer.

2.03 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor and approved by the membrane system manufacturer as compatible, subject to review of the Architect/Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

- A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section and to prevent damage to installed waterproofing.
- B. Applicator shall examine the areas and conditions under which work of this Section will be performed.
 - 1. Verify conformance with manufacturer's requirements;
 - 2. Report unsatisfactory conditions in writing to the Architect/Engineer;
 - 3. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. General: Surface preparation and detailing procedures shall be in accord with this Specification and the Drawings. Comply with waterproofing system manufacturer's instructions except where more stringent requirements are indicated or specified.
- B. Lay out project to determine and anticipate conditions prior to start of work.
 - 1. Note termination and penetration conditions to determine methods for creating a waterproof envelope. Verify that where below-grade waterproofing extends to grade, other waterproofing provides for substrate continuing above grade.

3.03 INSTALLATION

- A. General: Install waterproofing system in accord with manufacturer's instructions, recommendations and specific project instructions as applies to the Work.
 - 1. Coves: Form 2" coves with granular bentonite at horizontal-to-vertical junctures such as at footings and horizontal shelves; form 1" coves with sealant, elastomeric flashing or expandable mastic at vertical inside corners and under ledges.
 - 2. Place membrane in manner that assures minimum handling; fit closely to and seal around inlets, outlets and other penetrations; press membrane tight to corner surfaces and securely fasten.

3. Priming: Prime concrete, masonry and metal surfaces with substrate primer immediately prior to application of tapes and pressure-sensitive waterproofing accessories.
 4. Terminations: Terminate membrane system with termination bar finished off with bead of sealant or terminate to elastomeric flashing using reinforced waterproofing tape.
 5. Construction joints: Protect static construction joints in concrete with flexible, reinforced, bentonite-laminate waterstop strips; install to suitable hardened concrete surface prior to subsequent concrete placement.
- B. Below slab installation:
1. Bentonite-side up:
 - a. Install membrane sheets bentonite-side up with edges overlapped 3" minimum over stable, smoothed and compacted subgrade or mud slab; position membrane to stagger end laps 12"; securely fasten seams with staples every 8" on center.
 - b. Extend membrane upward 6" minimum within the formwork at bottom edges of mat slabs and wrapped footings to provide for proper tie-in to vertical membrane; install membrane in double layer continuous along bottom edges of slabs and wrapped footings extending 6" from edge in both directions.
 - c. Install membrane to wrap footings where shown on Drawings; carry membrane across top surfaces of unwrapped footings or mud slab to interior vertical faces of walls and columns and terminate as manufacturer recommends.
 - d. Waterproof penetrations in accord with manufacturers recommendations.
 - e. Verify membrane is protected from damage caused by rebar and support chairs.
 - f. Protect exposed bentonite from moisture with temporary plastic sheets; remove plastic sheets before final covering.
 - g. Inspect and repair damaged material immediately before concrete placement.
 2. Bentonite-side down:
 - a. Install polyethylene base sheets with edges lapped 5" over stable, smoothed and compacted subgrade or mud slab; trim base sheet away from penetrations and terminations.
 - b. Install membrane bentonite-side down over polyethylene base sheets with edges lapped 3" minimum; position membrane sheets to stagger end laps 12"; tape seams with reinforced seam tape closely following membrane placement and immediately secure by roll-pressing with hand-held metal seam roller.
 - c. Extend membrane upward 6" minimum within the formwork at bottom edges of mat slabs and wrapped footings; install a second layer of membrane, with the bentonite-side up, under the field membrane and extending upward within the formwork at bottom edges of mat slabs and wrapped footings to provide for proper tie-in to vertical membrane; membrane double layer continuous along bottom edges of slabs and wrapped footings shall extend 6" from edge in both directions.

- d. Install membrane to wrap footings where shown on Drawings; carry membrane across top surfaces of unwrapped footings or mud slab to interior vertical faces of walls and columns and terminate as manufacturer recommends.
 - e. Waterproof penetrations in accord with manufacturer's recommendations.
 - f. Verify membrane is protected from damage caused by rebar and support chairs.
 - g. Inspect and repair damaged material immediately before concrete placement.
- C. Backfilled wall installation:
1. Install membrane sheets in vertical or horizontal lifts with HDPE-side facing applicator to prepared surfaces conforming to manufacturer's requirements.
 - a. Vertical installation: Securely fasten membrane 12" on center along top edge with sheet extending out onto footing surfaces 6" minimum, overlapping below-slab membrane 6"; install subsequent membrane sheets to overlap previous sheets 1-1/2" minimum; securely fasten membrane 24" on center through both sheets at overlaps; securely fasten 18" on center to tops of footing surfaces and horizontal shelves; apply seam tape to seam overlaps.
 - b. Horizontal installation: Start membrane at lowest portion of wall; securely fasten membrane 24" on center along top edge with sheet extending out onto footing surfaces 6" minimum, overlapping under slab membrane 6"; install subsequent membrane sheets to overlap previous sheets minimum 1-1/2" in shingle fashion with staggered end laps; securely fasten membrane 24" on center through both sheets at overlaps; securely fasten 18" on center to tops of footing surfaces and horizontal shelves; apply seam tape to seam overlaps.
 2. Waterproof penetrations in accord with manufacturer's recommendations.
- D. Blindside wall installation:
1. Ensure that vertical surfaces to receive waterproofing system conform to manufacturer's requirements as applicable to the earth retaining system employed prior to commencing installation; contact manufacturer for requirements of project conditions not provided for in installation manuals.
 2. Install waterproofing membrane starter-strip to vertical surfaces of earth retaining system with bentonite-side facing applicator prior to placement of concrete footings or foundation mat slab.
 3. Prepare all vertical inside corners that occur along the earth retaining system by fastening a minimum 12" wide strip of membrane pressed tight into corner with bentonite-side facing applicator; securely fasten along vertical edges 24" on center.
 4. Install membrane sheets oriented vertically with bentonite-side facing applicator; overlap membrane sheets 3" minimum for poured-in-place walls and 4" minimum for shotcrete/gunite walls; securely fasten membrane through both sheets at overlap areas with nails every 24" on center and staples every 3" on center.

5. Verify which penetrations must be accessed after concrete placement for completion of waterproofing detail treatment and ensure that sufficient access to membrane is provided within a formed boxout; verify which penetrations will not be accessed after concrete placement for completion of waterproofing detail treatment and ensure that final detailing procedures are completed prior to erection of concrete formwork or shotcreting/guniting; waterproof penetrations in accord with manufacturer's current procedures; contact manufacturer for procedures at project conditions not provided for in installation manuals.
 6. Protect membrane system from excessive rain.
 7. Inspect and repair damages to membrane system immediately prior to erection of concrete formwork or shotcreting/guniting; ensure that concrete directly contacts membrane.
 8. Complete waterproofing details and terminations at gradeline coordinating with other trades.
- E. Drainage mat installation: Install drainage mat units where shown on Drawings according to manufacturer's installation instructions as shown in installation manuals.

END OF SECTION 071716