

CITY OF BERKELEY

ALAMEDA COUNTY, CALIFORNIA

PROJECT # PRWT 122013, SPECIFICATION # 24-11633-C

BERKELEY MARINA DOCK REPLACEMENT (D-E) PROJECT,
BERKELEY, CA

TECHNICAL SPECIFICATIONS

ISSUED FOR BID SUBMITTAL

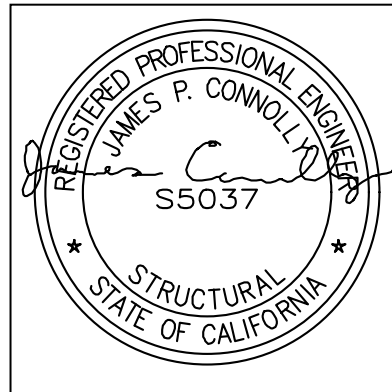
JANUARY 15, 2024

CERTIFICATION PAGE

The various portions of the specifications and other contract documents for "BERKELEY MARINA DOCK REPLACEMENT (D-E)," Project #PRWT 122013 Specification # 24-11633-C, Issued for Bid Technical Specifications, have been prepared under the direction of the following design professionals, licensed in the State of California.

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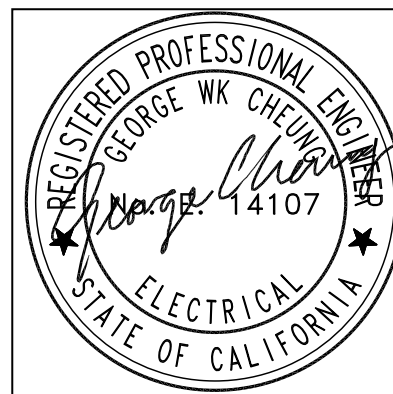
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BERKELEY MARINA DOCK REPLACEMENT (D-E) PROJECT
Issued for Bid Submittal

The various portions of the specifications and other contract documents for project "BERKELEY MARINA DOCK REPLACEMENT (D-E)," Project #PRWT 122013, Issued for Bid Specifications are documented in this document.

<u>Section No.</u>	<u>Section Title</u>	<u>Revision</u>	<u>Source</u>
DIVISION 1 - GENERAL REQUIREMENTS			
	See Division 1		
DIVISION 2 - SITE CONSTRUCTION			
02 22 10	LANDSCAPE SITE SALVAGE	0	Design Specification
02 22 50	STRUCTURE DEMOLITION	0	Design Specification
DIVISION 3 – CONCRETE			
03 30 00	CAST-IN-PLACE CONCRETE	0	Design Specification
DIVISION 5 – METALS			
05 50 00	METAL FABRICATIONS	0	Design Specification
05 50 13	ALUMINUM PIPE AND TUBE	0	Design Specification
05 50 13.10	ALUMINUM GANGWAY	0	Design Specification
DIVISION 6 - WOOD AND PLASTICS			
06 13 33	PRESERVATIVE TREATED LUMBER AND TIMBER	0	Design Specification
DIVISION 10 – SPECIALTIES			
10 14 00.10	EXTERIOR SIGNAGE	0	Design Specification
DIVISION 12 – FURNISHINGS			
12 93 00	SITE FURNISHINGS	0	
DIVISION 21 – FIRE PROTECTION			
21 00 00	FIRE PROTECTION CABINETS	0	Design Specification
21 05 29	HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING	0	Design Specification
21 11 00	FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING	0	Design Specification
21 11 19	FIRE DEPARTMENT CONNECTIONS	0	Design Specification
21 12 00	FIRE SUPPRESSION STANDPIPES	0	Design Specification
21 12 13	FIRE SUPPRESSION HOSES AND NOZZLES	0	Design Specification
DIVISION 22 – PLUMBING			
22 05 16	EXPANSION FITTINGS FOR PIPING	0	Design Specification
22 05 23.12	BALL VALVES FOR PLUMBING PIPING	0	Design Specification
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING	0	Design Specification
22 11 16	DOMESTIC WATER PIPING	0	Design Specification
DIVISION 26 – ELECTRICAL			
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	0	Design Specification
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	0	Design Specification

BERKELEY MARINA DOCK REPLACEMENT (D-E) PROJECT
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<u>Section No.</u>	<u>Section Title</u>	<u>Revision</u>	<u>Source</u>
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	0	Design Specification
26 05 33	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS	0	Design Specification
26 05 43	UNDERGROUND DUCTS AND REACE WAYS FOR ELECTRICAL SYSTEMS	0	Design Specification
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS	0	Design Specification
26 24 13	SWITCHBOARDS	0	Design Specification
26 24 16	PANEL BOARDS	0	Design Specification
26 26 00	POWER CENTER SUBSTATION	0	Design Specification
26 27 26	WIRING DEVICES	0	Design Specification
DIVISION 31 – EARTHWORK			
31 10 00	SITE CLEARING		
31 23 19	DEWATERING		
31 23 00.20	EXCAVATION AND FILL	0	Design Specification
31 62 13.20	PRESTRESSED CONCRETE GUIDE PILES	0	Design Specification
DIVISION 32 – EXTERIOR IMPROVEMENTS			
32 12 16.16	ROAD MIX ASPHALT PAVEMENT	0	Design Specification
		0	Design Specification
DIVISION 33 – SITE UTILITIES			
33 11 16	WATER UTILITIES PIPPING AND APPURTENANCES	0	Design Specification
33 13 00	PRESSURE PIPPING SYSTEMS	0	Design Specification
DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION			
35 31 19.13	ROCK SLOPE PROTECTION (RIP RAP)	0	Design Specification
35 51 13.20	CONCRETE FLOATING DOCK SYSTEMS	0	Design Specification

SECTION 02 22 10

LANDSCAPE SITE SALVAGE

PART 1 - GENERAL

1.01 SCOPE

This section includes specifications for the salvageable items pertaining to The Berkeley Marina Dock Replacement (D&E) Project (Project).

- A. Salvage items Includes (but Is Not Necessarily Limited to)
 - 1. Plaques
 - 2. Fixtures, Furnishings
 - 3. Irrigation Components: Valves, Valve Boxes, Controllers, Irrigation Heads
 - 4. Site Metals: Metal scrap including iron, steel, copper, brass, and aluminum.
- B. Salvaged and reused items on the project include:
 - 1. Restroom East Gate
 - 2. Fill
 - 3. Rip-Rap
- C. Related Sections:
 - 1. Section 02 22 50 – Structural Demolition

1.02 DEFINITIONS

- A. Recycle: Recovery of demolition waste for subsequent off-site processing in preparation for reuse.
- B. On-site Reuse: Recovery of demolition waste for subsequent on-site processing in preparation for reuse.
- C. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to City.

1.03 MATERIALS OWNERSHIP

- A. All items designated to be removed and salvaged are owned by the City of Berkeley. The Engineers are authorized to direct their removal, protection, and offsite delivery.
 - 1. Coordinate with the City Engineer who will establish special procedures for removal and salvage.

1.04 SUBMITTALS

- A. Itemized Salvage List:
 - 1. Contractor shall provide list of items to be removed and salvaged as indicated in the contract drawings and confirmed on-site, including sheet where shown, quantity, and secure location for item to be placed. Provide signed original to City Engineer prior to start of demolition.
- B. Schedule of Salvage Activities: Indicate the following:
 - 1. Detailed sequence of identification and removal work, with starting and ending dates for each activity.
 - 2. Written description of method of tagging.
 - 3. Coordination of delivery location for each item by type with Engineer.
 - 4. Pre-salvage Photographs: Show existing condition of the following items to be salvaged and reused: Restroom facility fence, fill and gate entry signs. Document any damage or irregularities that might be misconstrued as damage caused by removal and salvage operations. Submit before Work begins.

1.05 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6 and NFPA 241.
- B. Predemolition and Salvage Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Summary of the Work." Review methods and procedures related site demolition and salvage including, but not limited to, the following:
 - 1. Field identification of items to be salvaged.
 - 2. Protection of items to be removed and salvaged.
 - 3. Removal and salvaging of items as designated.
 - 4. Delivery of salvaged items to offsite location

1.06 PROJECT CONDITION

- A. Hazardous Materials: It is not expected that hazardous materials will be encountered in the landscape site Work.
- B. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify City. Hazardous materials will be removed by the general contractor as a change order.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Containers and Packing
 - 1. Cardboard boxes with over 75% post-consumer recycled contents.
 - 2. Previously used wooden pallet.
 - 3. Recycled paper packaging cushioning.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Review Project Record Documents of existing construction provided by the City Engineer. The City does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Tag each item (as applicable) to be removed and salvaged. Do not proceed until directed by to City's Representative.
 - 1. Tags shall be of non-marking material such as cloth, plastic or laminate.
- C. Review Project Record Documents of existing construction provided by the City if requested. The City does not guarantee that existing conditions are the same as those indicated in Project Record Documents. Drawings do not exist for all items.
- D. Inventory and record the condition of items to be removed and salvaged.
- E. When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to the Engineer.
- F. Verify that hazardous materials have been remediated before proceeding with site demolition operations.

3.02 PACKAGING AND PROTECTION

- A. Removed and Salvaged Items
 - 1. Clean salvaged items of dirt and demolition debris and pack or contain items after cleaning.
 - 2. Clearly attach to each container an itemized list of contents, along with the name of project, contractor, and City of Berkeley
 - 3. Keep boxes protected and clean and dry.
 - 4. Alert the City Engineer immediately to arrange for removal. Contractor is responsible for salvaged items until removed from site under the direction of the City.
- B. Plaques and Memorials
 - 1. Provide salvaged items in cardboard boxes. Wrap any item with packaging material as required to minimize damage.
- C. Irrigation Components.
 - 1. Contractor to be responsible for relocating and reinstalling the existing active irrigation system. For additional information of the exiting active irrigation system see Docks B and C As-built drawings dated 2010.
 - 2. Contractor shall salvage all sprinkler heads, valve boxes, valves, and backflow preventers. Pipe, wire, conduit, joints and miscellaneous

underground irrigation components shall be abandoned in place as directed by the City Engineer.

3. Provide salvaged items in cardboard boxes. Wrap any item with packaging material as required to minimize damage.

D. Recyclable Materials

1. Deposit all recyclable materials in the containers in a clean (no mud, adhesives, solvents, petroleum contamination), debris-free condition per field direction of the Engineer. Do not deposit contaminated materials into the containers until such time as such materials have been cleaned.

3.03 DELIVERY

- A. Salvaged items are to be to the City of Berkeley at the location provided by the Engineer.
- B. Notify the Engineer at least 72 hours before delivery.
- C. Remove all indicated recyclable materials from the work location to approved containers as directed by the City. All materials shall be stockpiled on-site and removed in an efficient operation. Failure to remove recyclable materials will be considered cause for withholding payment and termination of Contract.

PART 4 – MEASUREMENT AND PAYMENT

Full compensation for Landscape Site Salvage shall be considered as included in the contract lump sum cost for DEMOLITION and no separate payments will be made thereof.

END OF SECTION

SECTION 02 22 50

STRUCTURE DEMOLITION

PART 1 - GENERAL

1.01 SCOPE

This Section includes demolition and removal of selected portions of Dock D and E and/or other structures needed for completion of the project.

- A. Structures to be demolished consist of but not limited to the following.
 - 1. Landscaping
 - 2. Pier Abutment
 - 3. Pier Timber Deck and Timber Pilings
 - 4. Gangway
 - 5. Floating Dock System and Accessories
 - 6. Float Timber Piles and Precast Piles
 - 7. Associated Utilities to the Existing Docks
 - 8. Back Flow Preventer Slab and Accessories
 - 9. Concrete Pedestrian Pathway as needed for construction of new abutment and retaining wall.
 - 10. Asphalt Concrete Pavement for Utility Trenching
 - 11. Removal and Relocation of East Restroom Facility Fence
 - 12. Removal and Reinstallation of Rip-Rap

1.02 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.03 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each

activity, interruption of utility services, and locations of temporary partitions (if any) and means of egress.

- B. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit to City Representative before Work begins.
- C. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.04 QUALITY ASSURANCE

- A. Demolition Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.05 PROJECT CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by City as far as practical.
 - 1. Before selective demolition, City will remove the following items:
 - a. Loose appurtenances and loose stored items.
- B. Hazardous Materials: Hazardous materials may be present in the existing utility float pipes.
- C. Storage or sale of removed items or materials on-site is not permitted.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict.
- E. Engage a professional engineer to survey condition of site to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of the docks.
 - 3. Cut off pipe or conduit to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.03 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or

collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.04 POLLUTION CONTROLS

Environmental Protection Plan: The Contractor shall comply with requirements of the San Francisco Bay Regional Water Quality Control Board (RWQCB) by preparing and administering an Environmental Protection Plan for the project. The Environmental Protection Plan shall provide for each phase of Work, a detailed description of methods, equipment, and sequence of operations to be used to prevent release of debris, runoff, or other materials to the Bay. The Environmental Protection Plan shall include provisions for waste storage, collection and removal, and the associated preventive measure proposed to assure that:

- A. No construction material, including asphalt, concrete, wood, chemicals or fuels are to be discharged directly or drained indirectly to the bay from the construction, access or staging areas.
- B. Construction equipment will be maintained and fueled in areas where accidental spills could not reach the bay. The debris boom area will be cleaned out with the excavator at a minimum of twice a day.
- C. As part of the Environmental Protection Plan, the Contractor shall provide a floating debris barrier and absorbent boom and blanket to capture any debris, soil, or oil that could be released from the work area. Discharge of sawdust, wood, and other particulates is to be minimized to the greatest extent practicable. The debris boom shall be deployed and maintained to prevent any floating debris from escaping the work area. The floating debris barrier shall not be removed until a final inspection of the demolition by the City has been made. The absorbent boom and blankets shall be positioned to contain any oil that may be present in soil or groundwater currently contained by the existing seawall, in the event that failure of the seawall or other event causes soil or groundwater to be released. The spill containment and cleanup materials will be maintained on-site through the duration of the Work. Discharge of sawdust, wood, and other particulates is to be minimized to the greatest extent practicable.

3.05 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to

- minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 5. Dispose of demolished items and materials promptly.
- B. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- C. Dock Structures: All docks, floats and appurtenances to be removed as identified in the Contractor's approved demolition plan and as required by these specifications. The construction sequence will be submitted by the Contractor for review and approval by the City and based on operational criteria. The City will coordinate with the Contractor to provide as much advance notice to changes in sequence as practical.
- D. Utilities and Related Equipment: Existing utilities are to be disconnected seaward of pier and abutment. The existing utilities shall be removed and terminated in a manner conforming to all applicable codes. The Contractor shall provide temporary connections to the existing utilities when required in a manner conforming to all applicable codes.
- E. Timber Pile: Timber piles and stubs shall be completely removed and disposed of at Contractor's expense. Breaking off pile at the mud line shall not be allowed. Disposal site for timber piles to be disposed by contractor. Disposal of piles to be disposed to the approved site set by Regulatory Permits.
- F. Piling (materials other than timber): Where piles and stubs occur to be removed, all piles shall be completely removed and disposed of at the Contractor's expense. Breaking off pile at the mud line shall not be allowed.

- G. Shrub Debris: All shrub debris and rock interferences shall be removed and disposed of by the Contractor at no additional cost to the City.
- H. Rip Rap and Rocks: All Rip Rap and rocks interferences shall be removed, stock piled and reused to bring back the shoreline as close to its original gradation or as modified per the plans to accommodate the new gangway.
- I. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by City, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused or reinstalled, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off City's property and legally dispose of them.

3.07 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

PART 4 – MEASUREMENT AND PAYMENT

Full compensation for Structural Demolition shall be considered as included in the contract lump sum cost for DEMOLITION and no separate payments will be made thereof.

END OF SECTION

SECTION 03 30 00
CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE

This Section includes the elements of selected portions of Dock D and E and/or other structures requiring cast in place concrete as needed for completion of the project.

A. Furnish and install the following with cast in place concrete:

1. Utility concrete pads
2. Relocated restroom facility fence footing.
3. Bollard footing.
4. Concrete pavement
5. Concrete abutment and abutment wall
6. Other miscellaneous items.

1.02 STANDARDS

A. Unless otherwise shown or specified, all materials and methods shall conform to the appropriate current sections of:

1. All work shall conform to these Specifications, as well as all applicable codes of governmental agencies having jurisdiction over the work.
2. Applicable ASTM Specifications as they reasonably apply to this work, except for measurement and payment requirements.
3. American Concrete Institute (ACI), current standards.
 - a. ACI 301-20 - Specifications for Concrete Construction; American Concrete Institute International; 2020.
 - b. ACI 318-19 – Building Code Requirements for Structural Concrete; American Concrete Institute International; 2019.
 - c. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
4. Plywood U.S Product Standard

1.03 REVIEWS

- A. The City Representative shall review all formwork and/or steel reinforcing before any concrete is cast. Any concrete cast without review by the City Representative may result in removal and replacement at the Contractor's own expense.

1.04 TOLERANCES

- A. Tolerances for subgrade, subbase and finished grade shall be as specified by the Standard Specifications except that Contractor shall deliver the full aggregate base and concrete thickness shown. No combination of high and low tolerances that compromise the section will be permitted.
- B. Concrete Final Finishes: The Contractor shall demonstrate to the satisfaction of the City Representative that he, or his subcontractor, possesses sufficient skills and experience to perform the work.

1.05 QUALITY ASSURANCE

A. Concrete Forms

1. Concrete Forms: Clean concrete forms of all material or other objects considered deleterious to the concrete structure or surface.
2. Design Criteria: Design concrete forms or shoring to meet the requirements of the type of concrete, sequence of placing, schedule and conditions of the Project.
3. For calculating the strength required of forms, 1 cubic foot of standard weight concrete is assumed to weigh 160 pounds.
4. Construct concrete forms of stress-gradable materials. Unless noted otherwise, the maximum allowable design deflection shall be 1/270 of the span.
5. Provide wedges, jacks, or similar devices to ensure uniform take-up or release of the forms. Do not place wedges where they will be subject to undue bearing stress. Cribbing or stacking of blocking will not be allowed.

B. Reinforcing

1. Perform work of this section in accordance with ACI 301.
2. Identification of Reinforcement. The Contractor shall provide documentation with each load of reinforcement shipped to the project to indicate the manufacturer(s) and heat number(s) of all reinforcing bars included in the shipment, including mill certificates pertinent to each heat of reinforcing bars.
 - (a) Reinforcing bars that are not so identified shall be tested to document compliance with the physical and chemical properties of the applicable

ASTM specification.

3. Welding Qualifications: Welding procedure specifications, welding operators and welders shall be qualified in accordance with AWS D1.1, AWS D1.4, and as appropriate.
 - (a) Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.
 - (b) Welders whose work fails to pass inspection shall be re-qualified before performing additional welding.
4. Testing Service: The Contractor shall engage an approved testing lab to perform all production work tests, and inspections. The Contractor shall engage a testing laboratory to provide required submittal data including strength tests on alternate materials.
 - (a) Materials and installed work may require testing and retesting at any time during progress of Work.
5. Special Inspection. Special Inspection is required for the following elements of the work.
 - (a) Reinforcing steel placement. The special inspector shall verify the following.
 - (i) The reinforcing grade, size, number, location, and bend detailing are as shown on the drawings and are in acceptable condition.
 - (ii) All required devices have been properly installed to secure the reinforcement in place during the placement of concrete.
 - (b) Installation of mechanical couplers on reinforcing bars. The special inspector shall verify the following:
 - (i) The specific manufacturer and model of couplers have been approved for the application by the City Representative.
 - (ii) The couplers are installed according to the manufacturer's recommendations.
 - (c) Welding of reinforcing steel shall not be permitted.

1.06 SUBMITTALS

The following shall be submitted by the Contractor to the City in accordance with the applicable portions of the referenced specifications:

- A. Reinforcing Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
 - 1. Include special reinforcing required for openings through concrete elements.
 - 2. Prepare shop drawings under seal of a Professional Engineer experienced in design of work of this type and licensed in California.
 - 3. Each sheet of shop drawings submitted shall incorporate a pre-applied stamp for indicating the results of the engineering review.
- B. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- C. If applicable, submit product data and ICC-ES reports for the following products:
 - 1. Mechanical couplers.
 - 2. Deformed bar anchors.
- D. Reports: Submit certified copies of mill test reports for each type of reinforcing provided to the project, documenting compliance with the applicable ASTM specification, including chemical analysis, tensile tests and bend tests.
- E. Concrete
 - 1. The proposed mix design, giving the brand of cement, type, gradations and source of aggregates, water/cement ratio, mix proportions, and unit weight.
 - 2. Manufacturer's literature for admixtures, embedded items, liquid membrane-form curing compound and non-shrink grout.
 - 3. Certification that materials are in compliance with specification requirements.
 - 4. Method of transporting and placing concrete.

1.07 JOB CONDITIONS

- A. Weather Limitations: Construct concrete surface course only when atmospheric temperature is above 40 degrees F., when the underlying base is dry, and when weather is not rainy.
- B. Grade Control: Establish and maintain the required lines and grades, including cross-slope during construction operations. All concrete shall slope to drain with no ponding of water.

PART 2 - PRODUCTS

2.01 MATERIALS

Forms, Reinforcing and Concrete: Per Specifications. Materials for concrete forms may be new or used. The quality of the materials, not the age or previous usage, will be the determining factor as to their suitability.

2.02 FORMS

A. Plywood Forms

1. Framing lumber shall be of standard dimensions and of such quality as to meet the requirements of the stresses applied.
2. Use High Density Overlay, Plywood U.S. Product Standard PS-1, for all exposed concrete forms. The plywood shall be exterior type without splits or knotholes and sanded smooth. The face grain of the plywood shall run perpendicular to the studs or joists. All joints in surfaces of forms used on exposed surfaces shall be vertical or horizontal. Plywood shall not be less than 1/2-inch thick except where curved areas require the use of 1/4-inch thick material. When 1/4-inch-thick material is used, it shall be backed with heavier material.
3. Shiplap, square-edged boards, or tongue-and-groove sheathing may be used for forming unexposed concrete surfaces.
4. Use metal, fiberglass, or other special form lining where indicated on the Drawings.

B. Steel Forms

1. Steel forms to be fabricated at the site and in the shop shall be approved by the City Engineer prior to construction.

C. Miscellaneous Forms:

1. Paper, fiberglass, micarta, asphalt-impregnated fiber, and other miscellaneous form materials shall be approved prior to construction.

2.03 REINFORCING

Reinforcing Steel: ASTM A 615/A 615M Grade 60.

1. Deformed billet-steel bars.
2. Epoxy coated in accordance with ASTM A 775/A 775M.

- B. Reinforcing Steel: ASTM A 706/A 706M, deformed low-alloy steel bars.
1. Required where indicated on the drawings.
 2. May be used at Contractor's option in all other cases.
 3. Epoxy coated in accordance with ASTM A 775/A 775M.
- C. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
- D. Reinforcement Accessories:
1. Tie Wire: Annealed, minimum 16 gage.
 2. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI DA4.
 - d. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI Class 1) or stainless steel (CRS/ Class 2).
- E. Mechanical Couplers:
1. Mechanical Couplers shall provide Type 1 splices, unless indicated otherwise on the drawings.
 - a. Type 1 splices: Couplers shall be capable of developing 125 percent of the specified yield strength of the spliced reinforcing bar.
 - b. Type 2 splices: Couplers shall be capable of developing 125 percent of the specified yield strength and shall be capable of developing 100 percent of the specified tensile strength of the spliced reinforcing bar.
 2. Products.
 - a. Lenton Taper Threaded Rebar Splices, manufactured by ERICO Products, IAMPO-UES ER-129.
 - 1) Type 1 splices only.
 - b. HRC 510 Xtender Mechanical Couplers, manufactured by Headed Reinforcement Corp., ESR 2764. (available upon request or at www.icc-esc.org "ICC-ES Evaluation Report ESR-2764")
 - 1) Type 1 or Type 2 splices.

- c. Bar-Lock Coupler Systems, manufactured by Dayton Superior Corporation, IAMPO-UES ER-319.
 - 1) "S" Series: Type 1 splices only.
 - 2) "L" Series: Type 1 or Type 2 splices.
- F. Deformed Bar Anchors. ASTM A108, flux-filled, cold-worked wire.
 - 1. Nelson Type Deformed Bar Anchor Studs (ICC ESR-2907),
 - 2. Approved equivalent.
- G. Epoxy Rebar Coating Touch Up. Two component, 70% solids epoxy coating specifically manufactured to touch up epoxy-coated reinforcing steel.

2.04 CONCRETE

- A. Cast-in place concrete shall conform to the following:
 - 1. Cement: Type II modified conforming to ASTM C-150.
 - 2. Aggregate: Maximum 3/4 inch size.
 - 3. Compression strength at 28 days to be 5,000 psi minimum. Strength shall be 5,000 psi for any flatwork.
- B. Color Admixture:
 - 1. Add Hi-con black at a rate of 1/8 lb. per sack to all exposed concrete.
- C. Expansion Joint Filler: Fiber/expansion joint filler by Burke Co. Order #236, conforming to ASTM D-1751.
- D. Cleaning Agents: As required.
- E. Aggregate Base: Class II per Specifications.

2.05 FABRICATION

- A. Prefabricated Forms - All prefabricated forms, whether they are part of a patented system or custom-fabricated, shall be approved by the City prior to assembly.
 - 1. Form Liners and Coatings - Line, coat, or treat forms with a suitable bond-breaker to ensure their timely removal with minimum damage to concrete.

Bond-breaker material shall be non-coloring, non-toxic, and biodegradable product. Bond-breaker material shall not leave a film on concrete surface that will prohibit subsequent finishing activities required to attain desired appearance. Petroleum-based products shall not be used to ease release of forms.

2. Form Ties and Accessories - Form ties shall be manufactured items with stress values published. Form ties shall have a premeasured, break-back, weakened area so that ties can be removed within 3/4-inch of concrete surface.
 3. Tie rods for use with inserts shall be set back 1-1/2 inches from concrete surface. Tie-rod steel shall have published stress values.
 4. Wire ties and wood spacers will not be allowed.
 5. Corner brackets, column clamps, and other specialized accessories shall be utilized in accordance with the manufacturer's recommendations.
 6. Quick-release mechanisms, wedges, screw jacks, blocking, eccentric toggle levers, or other equipment shall be according to approved Drawings.
- B. Reinforcement - Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
1. Welding of reinforcement is is not permitted.
 2. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D 3963.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clear area to be paved of all debris and organic material. Re-compact and re-grade as necessary prior to placement of concrete. Verify that the subgrade and/or aggregate base is properly compacted and at suitable grade.
- B. Before beginning paving work and during construction, take all steps necessary for protection of existing improvements. As the concrete is being placed, extreme care shall be taken not to discolor or damage any improvements. If damage occurs, repair same, and if satisfactory repair cannot be made, remove and replace the section as directed.
- C. Formwork and Reinforcement:

1. Assure that excavations and formwork are completed.
 - a. Set forms to allow for structural camber plus an allowance for shrinkage and settlement. Finished concrete shall conform to lines and grades indicated on Drawings.
 - b. Design, erect, shore, brace, and maintain formwork and falsework, 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.
 - c. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance of ACI 117.
 - d. Forms for any concrete/grout structure shall be constructed to prevent leaching of wet concrete/grout and intrusion of seawater. Forms shall remain in place until the concrete/grout is cured.
2. Check that reinforcement is secured in.
 - a. Place, support and secure reinforcement against displacement. Do not deviate from required position.
 - b. Welding of reinforcing is not permitted.
 - c. Do not displace or damage vapor barrier.
 - d. Accommodate placement of formed openings.
 - e. Maintain concrete cover around reinforcing as indicated on Drawings.
3. Verify that expansion joint material, anchors, and other embedded items are secured in position.

3.02 INSTALLATION

A. Form Installation

1. Prior to final setting or placing of reinforcing steel, forms for exposed concrete surfaces shall be treated with a bond-breaker or parting compound. Apply compound at a rate recommended by manufacturer to provide a smooth surface free of dusting action caused by the chemical reaction of the compound.
2. Forms may be set with a slight bevel or draft for easy removal, where approved by the Engineer-of-Record. Use $\frac{3}{4}$ -inch chamfer strips on exposed inside and outside corners. All forms shall be waterproof. Standing water in forms will not be permitted. Clean forms immediately prior to placing of concrete. Forms shall

be high enough to prevent seawater intrusion at high tide. A top lid system can be used.

B. Form Removal

1. Do not remove or release forms without the approval of the Engineer-of-Record.
2. Forms may be removed when concrete has achieved 80 percent of design strength if no loads are to be applied provided that a curing compound is applied immediately. Do not apply the curing compound to a construction joint surface area between footing and column or wall or to any reinforcing steel. Wet-curing may be utilized in lieu of curing compound; however, at no time during removal of forms and subsequent curing period shall surfaces of concrete be allowed to become dry.
3. Do not release forms from under concrete which has been cured at a temperature under 50°F without first determining if concrete has gained adequate strength, without regard to the time element.

C. Finishes

1. Concrete Paving: Provide a rough-textured medium broom finish with strokes perpendicular to direction of travel along walks. Match adjacent walking surfaces.
2. Base for relocated fence: Shall be light broom finish parallel to longest surface direction.

3.03 FIELD QUALITY CONTROL

A. Reinforcement

1. An independent testing agency or City Representative will inspect installed reinforcement for conformance to contract documents before concrete placement.
2. Special Inspection of reinforcing steel shall include the following:
 - a. Confirm bar size, bends, condition, and placement, and adequacy of tying and support.
 - b. Confirm mechanical couplers are of approved type and are installed in accordance with manufacturer's recommendations and applicable ICC ER reports.
 - c. Confirm headed reinforcement are of approved type and are installed in

accordance with manufacturer's recommendations and applicable ICC ER reports.

- d. Perform site bend test on 10% on all deformed bar anchors and headed studs, in accordance with AWS D1.1.

3.04 CLEAN UP

Upon completion of the work under this section, remove immediately all surplus materials, rubbish, and equipment associated with or used in the performance of this work.

PART 4 - MEASUREMENT AND PAYMENT

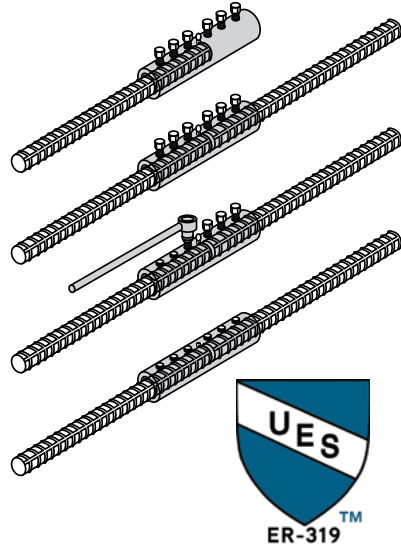
The Contract LUMP SUM price paid for LANDSIDE MARINA AND APPURTENANCES and for MARINA UTILITY INFRASTRUCTURE shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and installing cast-in-place concrete, complete in place, including concrete footings as needed, as shown on the plans, as specified in the State Standard Specifications and these Technical Specifications, and as directed by the engineer.

PART 5 - PRODUCT DATA SHEETS

Bar Lock couplers are easy to install and normally do not require any special training or rebar preparation. A typical installation procedure is as follows:

A. PROCEDURE:

1. Insert end of the first bar halfway into the coupler to the center pin. Hold bar in place and hand-tighten all bolts.
2. Insert end of the second bar halfway into the coupler to the center pin. Hold bar in place and hand-tighten all bolts.
3. In a random alternating pattern, tighten all bolts to approximately 50%.
4. In a random alternating pattern, tighten all bolts to approximately 75%.
5. Tighten all bolts in a random alternating pattern until all bolt heads shear off.



B. INSTALLATION TOOLS:

A high-quality, 1" - drive pneumatic, impact wrench and towable air compressor are required for sizes #8 thru #18. The requirements for air flow is 100 psig of operating pressure and 185 cfm of delivered air to the impact wrench through a 3/4" - 1" air hose. Sizes #4 thru #7 may be installed with smaller impact wrenches.

IMPORTANT NOTES:

- Prior to bolt tightening, the serrated rails **MUST** remain aligned in the same position as they were manufactured. If damaged or knocked out of alignment while positioning, installation **MUST** cease and a new coupler used to replace damaged coupler.
- Bolt tightening **MUST** be done in a *random alternating pattern* similar to tightening the lug nuts on an automobile wheel (i.e., 2-4-1-3).
- **By using the recommended and required tools, installers will see a minimization of installation time and energy. This translates to increased efficiency and cost savings.**

C. FREQUENTLY ASKED QUESTIONS:

Specifications and literature are subject to change without notice. Go to www.daytonsuperior.com for the most up-to-date information.

1. **Approvals:** Bar Lock couplers are test-certified to exceed the requirements of, and are pre-qualified, approved, or recognized by ACI 318, ICC AC-133, Caltrans Service Splice, Ministries of Transportation Canada, IAPMO UES Listed-ER-319, Army Corps of Engineers CW 03219, State DOTs, AASHTO, IBC, and City of Los Angeles.
2. **Center-pin:** Bar Lock couplers are manufactured with a removable center-pin for easy reference to the center of the coupler. As each bar is inserted into the coupler it will butt against the center pin providing the confirmation the rebar is inserted the proper distance within the coupler. The bar ends might not actually butt against one another.
3. **Serrated rails:** The internal grip rails are held into place by a simple "positional weld" only. During bolt tightening it is common this position weld may break loose, but this will not affect performance.
4. **Shear bolts:** The shearing of the bolt-heads simply confirms adequate torque has been achieved.
5. **Bar-ends:** The rebar may be shear cut, flame cut or sawn and generally require no special bar-end preparation for use with Bar Lock couplers.
6. **Transportation:** Assembled coupler samples must be restricted from rotation when transporting to a testing facility. It is recommended that samples be strapped to a skid lined with damping material like packing or egg crate foam.

D. EPOXY-COATED REBAR APPLICATIONS

Bar Lock Couplers can be used in conjunction with epoxy-coated rebar. When used with epoxy-coated, Grade 60 rebar, Bar Lock L-Series couplers develop 135% Fy strength and Bar Lock S/CA-Series Couplers develop 125% Fy strength. To achieve the full performance strengths the epoxy must be completely removed from the rebar in the region where the coupler engages the rebar.

E. LAB TEST GUIDELINES

Note: These guidelines address important issues when conducting "in-air" laboratory testing of Bar Lock® rebar couplers. Dayton Superior Bar Lock Couplers are very simple and easy to install and normally do not require any special equipment or operator training. However, since the length of some Bar Lock couplers is often greater than other rebar coupling systems, Dayton Superior recommends certain guidelines for laboratory "in-air" testing. A variation from these guidelines may affect coupler performance and test results.

Important — Test Machine Grip Clearance:

An assembled test splice of two rebars joined by any connector may not always achieve exact axial alignment. When the spliced system is placed under high tensile force, this misalignment will create artificial, secondary bending stresses as the spliced system straightens out. However, when the splice is embedded in concrete the tendency for the splice to straighten is restricted by the surrounding concrete. This reduces the secondary bending forces. Consequently, when testing "in-air" in a laboratory without the surrounding concrete, even the slightest misalignment will create secondary bending stresses which will affect tension and slip test readings.

A minimum grip-clear-length for Bar Lock couplers is:

Size	Grip Clear Length	Each rebar length (min.)	Resulting overall splice length
#3-6	12"	24"	24" + 24" = 48"
#7-10	18"	30"	30" + 30" = 60"
#11	20"	36"	36" + 36" = 72"
#14	30"	48"	48" + 48" = 96"
#18	30"	54"	54" + 54" = 108"

D250SCA Bar Lock S/CA-Series Couplers

Product Code		Coupler Designation	Bar Size Designation			Barrel Stamp Identification	Product Specifications			Bolt Specifications			Meets or Exceeds		
Black	Epoxy		US	Metric (mm)	CN (M)		Outside Dia. (in.)	Length (in.)	Weight (lbs.)	Bolt Qty.	Head Size (in.)	Shear Torque (ft. lbs)	Min % Fu*	Caltrans Service	ICC Type 1
400200	400210	3 S/CA	#3	[10]	—	3S...CA	1.3	3.9	1.24	4	0.5	40	125	YES	YES
400200	400210	4 S/CA	#4	[13]	[10]	4S...CA	1.3	3.9	1.24	4	0.5	40	125	YES	YES
400201	400211	5 S/CA	#5	[16]	[15]	5S...CA	1.7	4.5	2.11	4	0.5	80	125	YES	YES
400202	400212	6 S/CA	#6	[19]	[20]	6S...CA	1.9	6.3	3.57	6	0.5	80	125	YES	YES
400203	400213	7 S/CA	#7	[22]	—	7S...CA	1.9	8.0	4.30	8	0.5	80	125	YES	YES
400204	400214	8 S/CA	#8	[25]	[25]	8S...CA	2.4	10.2	6.10	8	0.625	180	125	YES	YES
400205	400215	9 S/CA	#9	[29]	[30]	9S...CA	2.9	9.0	11.88	6	0.75	350	125	YES	YES
400206	400216	10 S/CA	#10	[32]	—	10S...CA	2.9	11.5	15.17	8	0.75	415	125	YES	YES
400207	400217	11 S/CA	#11	[36]	[35]	11S...CA	3.1	14.0	20.50	10	0.75	415	125	YES	YES
400208	400218	14 S/CA	#14	[43]	[45]	14S...CA	3.5	19.1	31.75	14	0.75	475	125	YES	YES
400209	400219	18 S/CA	#18	[57]	[55]	18S...CA	4.3	27.2	62.00	20	0.75	475	125	YES	YES

Note in place of the "...", each Bar Lock Coupler is marked with a tracking code used for full manufacturing traceability.

* When used in conjunction with epoxy-coated Grade 60 rebar, 125% Fy strength is developed.

D250L Bar Lock L-Series Couplers

Product Code		Coupler Designation	Bar Size Designation			Barrel Stamp Identification	Product Specifications			Bolt Specifications			Meets or Exceeds			
Black	Epoxy		US	Metric (mm)	CN (M)		Outside Dia. (in.)	Length (in.)	Weight (lbs.)	Bolt Qty.	Head Size (in.)	Shear Torque (ft. lbs)	Min % Fu*	Caltrans Service	ICC Type 1	ICC Type 2
400327	144988	3 L	#3	[10]	—	3L...	1.3	4.0	1.67	4	0.5	40	100	YES	YES	YES
400226	400235	4 L	#4	[13]	[10]	4L...	1.3	5.5	1.67	6	0.5	40	100	YES	YES	YES
400227	400236	5 L	#5	[16]	[15]	5L...	1.7	6.3	2.90	6	0.5	80	100	YES	YES	YES
400228	400237	6 L	#6	[19]	[20]	6L...	1.9	8.0	4.44	8	0.5	80	100	YES	YES	YES
400229	400238	7 L	#7	[22]	—	7L...	1.9	9.8	5.10	10	0.5	80	100	YES	YES	YES
400230	400239	8 L	#8	[25]	[25]	8L...	2.4	12.3	8.94	10	0.625	180	100	YES	YES	YES
400231	400240	9 L	#9	[29]	[30]	9L...	2.9	11.5	15.07	8	0.75	350	100	YES	YES	YES
400232	400241	10 L	#10	[32]	—	10L...	2.9	14.0	18.50	10	0.75	415	100	YES	YES	YES
400233	400242	11 L	#11	[36]	[35]	11L...	3.1	16.5	23.75	12	0.75	415	100	YES	YES	YES
145831	145832	14 L	#14	[43]	[45]	14L...	3.5	21.58	35.14	16	0.75	475	100	YES	YES	YES
142996	142996	18 L	#18	[57]	[55]	18L...	4.3	32.2	97.80	24	0.75	475	100	YES	YES	YES

Note in place of the "...", each Bar Lock Coupler is marked with a tracking code used for full manufacturing traceability.

* When used in conjunction with epoxy-coated Grade 60 rebar, 135% Fy strength is developed.

D250XL Bar Lock XL-Series Couplers

Product Code			Coupler Designation	Bar Size Designation			Barrel Stamp Identification	Product Specifications			Bolt Specifications			Meets or Exceeds			
Black	Epoxy	Galvanized		US	Metric (mm)	CN (M)		Outside Diameter (in.)	Length (in.)	Weight (lbs.)	Bolt Qty.	Head Size (in.)	Nominal Shear Torque*	Min % Fu**	CAL TRANS Service	ICC Type 1	ICC Type 2
145314	145324	145147	4 XL	#4	[13]	[10]	4XL...	1.3	10.2	3.10	12	0.5	40	100	YES	YES	YES
145315	145325	145148	5 XL	#5	[16]	[15]	5XL...	1.7	11.5	5.29	12	0.5	80	100	YES	YES	YES
145316	145326	145149	6 XL	#6	[19]	[20]	6XL...	1.9	13.2	7.33	14	0.5	80	100	YES	YES	YES
145317	145327	145150	7 XL	#7	[22]	—	7XL...	1.9	15.0	7.81	16	0.5	80	100	YES	YES	YES
145318	145328	145151	8 XL	#8	[25]	[25]	8XL...	2.4	18.7	13.59	16	0.625	180	100	YES	YES	YES
145319	145329	145152	9 XL	#9	[29]	[30]	9XL...	2.9	19.1	25.03	14	0.75	350	100	YES	YES	YES
145320	145330	145153	10 XL	#10	[32]	—	10XL...	2.9	21.6	28.54	16	0.75	415	100	YES	YES	YES
145321	145331	145154	11 XL	#11	[36]	[35]	11XL...	3.1	24.1	34.69	18	0.75	415	100	YES	YES	YES
145322	145332	145155	14 XL	#14	[43]	[45]	14XL...	3.5	29.1	48.14	22	0.75	475	100	YES	YES	YES
145323	145333	145156	18 XL	#18	[57]	[55]	18XL...	4.3	44.8	136.06	34	0.75	475	100	YES	YES	YES

Note in place of the "...", each Bar Lock Coupler is marked with a tracking code used for full manufacturing traceability.

* Foot pounds.

** When used in conjunction with epoxy-coated Grade 75/80 rebar, 135% Fy strength is developed.



Bar Lock Coupler System User Guide

CERTIFICATION:

Bar Lock couplers meet or exceed applicable engineering requirements for tensile and compressive strength when spliced to rebar conforming to ASTM A615 grades 40, 60, 75, and 80; A706 grades 60 and 80. Bar Lock couplers are manufactured from U.S. steel, conforming to ASTM-A-519 specification.

RETURNS:

Returns must be pre-authorized by Dayton Superior who will issue credit for resalable couplers less an inspection and restocking charge of 25%. All unusable materials (including material of obsolete specifications) will be scrapped and will not be subject to any credit allowance. Dayton Superior will accept for credit only returns made within six months of the original shipment date. Returns must be returned to Dayton Superior Freight Prepaid; Freight Collect shipments will not be accepted. Any specialty orders, obsolete sizes, and non-stock items are not returnable for credit.

WARRANTY; CLAIMS; EXCLUSIVE REMEDY:

Bar Lock products at the time of shipment are warranted to conform to any applicable written description furnished to buyer by Dayton Superior and to be free from defects in material and workmanship. No other warranty, whether expressed or implied (including any warranty or merchantability of fitness), shall exist in connection with the sale or use of any Bar Lock product. Claims for errors, shortages, defects, or nonconformity's ascertainable upon inspection must be made in writing within 15 days after buyer's receipt of products. All other claims must be made in writing to Dayton Superior within 120 days from date of shipment. Products claimed nonconforming or defective must upon Dayton Superior's request be promptly returned to Dayton Superior for inspection. Claims not made as provided above and within the applicable time period may be excluded. Dayton Superior shall in no event be responsible if the products have not been stored or used in accordance with its specifications and recommended procedure. Dayton Superior will, at its option, either repair or replace nonconforming or defective products for which it is responsible or return to buyer their purchase price. The foregoing states buyers exclusive remedy for any breach of Dayton Superior's warranty and for loss or injury caused by the sale or use on any product. Without limiting the generality of the foregoing, Dayton Superior shall in no event be responsible for any loss of business or profits, downtime or delay, labor, repair, or material costs or any similar or dissimilar consequential loss or damage incurred by buyer.

SHIPMENT, PERFORMANCE, LIMITATIONS OF LIABILITY:

Any specified date or dates are estimates only. Dayton Superior shall have no liability on account of any delay or failure to manufacture, ship, or deliver any products or furnish any service, due directly or indirectly to fire, act of God, accident, illness, labor dispute, material shortage, inadequate transportation, government order, or other similar or dissimilar cause beyond Dayton Superior's reasonable control. Dayton Superior shall in no event be liable for any incidental loss or damage of any kind arising out of any delay or failure to perform, whether or not due to Dayton Superior's negligence or other causes within its control. Without limiting the generality of the foregoing, Dayton Superior shall not be responsible for any loss of business or profits, claims of buyer's customers or other third parties, downtime, delay, labor, repair, or material costs or any similar or dissimilar loss or damage incurred by buyer.

SHIPPING DAMAGES:

Accept shipment subject to inspection by noting on bill of Lading that "Carton was Broken or Damaged" in transit.

Notify carrier and shipper in writing (listing damaged materials) within 5 days after receipt.

Concealed damages must be reported in writing to the carrier and shipper within 30 days after receipt.

CORPORATE HEADQUARTERS:

1125 Byers Road
Miamisburg, OH 45342
937-866-0711

ACCESSORIES AND CHEMICALS:

Customer Service: 888-977-9600
Technical Assistance: 877-266-7732
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City of Los Angeles Approval - See Page 30

nVent LENTON Mechanical Splice System for Steel Reinforcing Bars in Concrete

CSI Section:

03 21 00 – Reinforced Steel

1.0 RECOGNITION

nVent LENTON Mechanical Splice System recognized in this report has been evaluated for use as mechanical splices for deformed steel reinforcing bars (rebar) in reinforced concrete structural members. The structural properties of the nVent LENTON Mechanical Splice System comply with the intent of the provisions of the following codes and regulations:

- 2018, 2015, 2012, 2009, 2006 and 2003 International Building Code (IBC®)
- 2018, 2015, 2012, 2009, 2006 and 2003 International Residential Code (IRC®)
- Building Code Requirements for Structural Concrete (ACI 318-14, -11, -08, -05, -02)
- 2020 City of Los Angeles Building Code (LABC) – attached Supplement
- 2020 City of Los Angeles Residential Code (LARC) – attached Supplement

2.0 LIMITATIONS

Use of the nVent LENTON mechanical couplers recognized in this report is subject to the following limitations:

2.1 Couplers shall be installed in accordance with the applicable code, the manufacturer’s instructions, and this report. Where conflict occur, the more restrictive governs.

2.2 Splice locations shall comply with applicable code requirements and be noted on plans approved by the building official.

2.3 Where required, special inspection shall be provided in accordance with Chapter 17 of the IBC®. Duties of the special inspector include verifying:

- Grade and size of rebar.
- Coupler identification.
- Position of the couplers.
- Installation of the couplers to the rebar.

2.4 The threaded rebar used with nVent LENTON mechanical splice couplers shall be fabricated by nVent or an approved fabricator complying with Section 3.3.1 of this report.

2.5 Mechanical couplers may be used on epoxy-coated or galvanized bars prior to rebar threading or in a manner as not interfere with proper thread engagement. All threads of the coupler and rebar are to be free of rust, adhered concrete, epoxy and galvanizing coating, and all debris at the time of coupling.

2.6 Under the 2018 IBC, for structures regulated by Chapter 18 of ACI 318-14 (as required by 2018 IBC Section 1905.1), to splice deformed reinforcing bars resisting earthquake-induced flexure, axial force, or both, in special moment frames, special structural walls, and all components of special structural walls including coupling beams and wall piers, with the nVent LENTON Mechanical Splice Systems, mill certificates of reinforcing bars shall be submitted to the building official as evidence that the steel reinforcing bars comply with ACI 318-14 Section 20.2.2.5.

2.7 Under the 2015 IBC, for structures regulated by Chapter 18 of ACI 318-14 (as required by 2015 IBC Section 1905.1), to splice deformed reinforcing bars resisting earthquake-induced flexure, axial force, or both, in special moment frames, special structural walls, and all components of special structural walls including coupling beams and wall piers, with the nVent LENTON Mechanical Splice Systems, mill certificates of reinforcing bars shall be submitted to the building official as evidence that the steel reinforcing bars comply with ACI 318-14 Section 20.2.2.5.

2.8 Under the 2012 IBC, for structures regulated by Chapter 21 of ACI 318-11 (as required by 2012 IBC Section 1905.1), to splice deformed reinforcing bars resisting earthquake-induced flexure, axial force, or both, in special moment frames, special structural walls, and all components of special structural walls including coupling beams and wall piers, with the nVent LENTON Mechanical Splice Systems, mill certificates of reinforcing bars shall be submitted to the building official as evidence that the steel reinforcing bars comply with ACI 318-11 Section 21.1.5.2.

2.9 Under the 2009 IBC, for structures regulated by Chapter 21 of ACI 318-08 (as required by 2009 IBC Section 1908.1), to splice deformed reinforcing bars resisting earthquake-induced flexural and axial forces in frame members, structural walls and coupling beams, with the nVent LENTON Mechanical Splice Systems, mill certificates of reinforcing bars shall be submitted to the building official as evidence that the steel reinforcing bars comply with ACI 318-08 Section 21.1.5.2.

The product described in this Uniform Evaluation Service (UES) Report has been evaluated as an alternative material, design or method of construction in order to satisfy and comply with the intent of the provision of the code, as noted in this report, and for at least equivalence to that prescribed in the code in quality, strength, effectiveness, fire resistance, durability and safety, as applicable, in accordance with IBC Section 104.11. This document shall only be reproduced in its entirety.





2.10 nVent LENTON mechanical couplers recognized in this report are produced in Solon, OH.

3.0 PRODUCT USE

3.1 General: nVent LENTON mechanical couplers for splicing deformed steel reinforcing bars (rebar) transfer tension and compression forces in reinforced concrete structural members. The nVent LENTON system complies with the requirements of the IBC and ACI 318-14 Sections 25.5.7 and 18.2.7 (ACI 318-11 Sections 12.14.3 and 21.1.6), for use as tension and compression mechanical splices for deformed steel reinforcing bar (rebar). The nVent LENTON system complies with both Type 1 and Type 2 mechanical splice requirements in accordance with ACI 318-14 Section 18.2.7.1 (ACI 318-11 Section 21.1.6.1) as shown in [Tables 1 to 19](#) of this report and consisting of:

- nVent LENTON Standard couplers (A2 & A12), nVent LENTON Standard Transition couplers (A2 & A12), nVent LENTON Form Saver (SA), nVent LENTON Position couplers (P9 & P8) couplers for ASTM A615 Grades 60, 75, and 80 bars; or ASTM A706 Grades 60 and 80 bars.
- nVent LENTON Form Saver (FS) couplers for ASTM A615 Grades 60 and 75 bars; or ASTM A706 Grade 60 bars.
- nVent LENTON Lock (B1) couplers for ASTM A615 Grades 60 and 75 bars; or ASTM A706 Grade 60 bars.
- nVent LENTON Lock (S1) couplers for ASTM A615 Grade 60 or ASTM A706 Grade 60 bars.
- nVent LENTON Interlok (LK) for ASTM A615 Grade 60, 75, and 80 bars; or ASTM A706 Grade 60 and 80 bars.
- nVent LENTON weldable half couplers (C2 & C3J) for ASTM A615 Grade 60 or A706 Grade 60 bars.
- nVent LENTON Ultimate standard couplers (FT12 & MT12), nVent LENTON Ultimate transition couplers (FT12 & MT12), and nVent LENTON Ultimate position couplers (PT15, MS15, & MT12), for ASTM A615 Grades 60, 75, and 80 bars; or ASTM A706 Grades 60 and 80 bars.
- nVent LENTON Connect (B12) couplers for ASTM A615 Grade 60 or ASTM A706 Grade 60 bars.
- nVent LENTON Connect (S2) couplers for ASTM A615 Grade 60 or ASTM A706 Grade 60 bars.

3.2 Design: nVent LENTON couplers shall be installed in accordance with the applicable code, this evaluation report, and manufacturer's installation instructions.

Where conflicts occur, the more restrictive shall govern. Splice locations shall be detailed on the plans approved by the building official. Minimum concrete cover shall be in accordance with applicable codes and measured from the outer surface of the connecting device or as defined by the registered design professional. Type 2 mechanical splices are permitted in any location within a member as allowed by the IBC, IRC, and ACI 318 in all seismic design categories.

3.3 Installation: Installation instructions are supplied with the product and/or are available on the nVent web site (www.erico.com) and as described in Sections 3.4 through 3.16 of this report. Where conflicts occur, the more restrictive shall govern.

3.3.1 Specially prepared ends of rebar shall be prepared in either the nVent facility or the facility of a fabricator approved by the building official and nVent as required in accordance with 2018 and 2015 IBC Section 1704.2.5.1, 2012 IBC Section 1704.2.5.2, or 2009 IBC Section 1704.2.2. The fabricator shall demonstrate the following items to the satisfaction of the building official for each nVent LENTON coupler series and steel reinforcing bar size:

- A) The fabricator prepares the ends of the steel reinforcing bar as required by nVent in a manner consistent with the qualifying test specimens. A description of the method of preparing the rebar ends is found at www.erico.com.
- B) For Type 2 splices, connections of each steel reinforcing bar using the fabricator-prepared steel reinforcing bars, tested in static tension, shall develop 100 percent of the specified tensile strength (f_u) of the steel reinforcing bar and 125 percent of the specified yield strength (f_y) of the reinforcing bar for use under the IBC and IRC. This requirement may be demonstrated in test report(s) submitted to the building official.
- C) For Type 1 splices, connections of each steel reinforcing bar using fabricator-prepared steel reinforcing bars, tested in static tension, shall develop at least 125 percent of the specified yield strength (f_y) of the steel reinforcing bars. This requirement may be demonstrated in test report(s) submitted to the building official.



Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

3.4 nVent LENTON Standard Coupler (A2 & A12) (illustrated below)



nVent LENTON standard coupler is used to connect bars where at least one bar is able to rotate freely. For field installation of the standard coupler, the thread protector is removed from the threaded rebar end, which is inspected for cleanliness and damage. In some cases, the coupler is fastened to the rebar at the fabrication facility to protect the threads. A wired brush should be used to remove rust and adhered concrete from the threads. Coupler is then screwed onto the threaded end of the rebar to be spliced and tightened by hand. The second rebar is then inserted into the coupler and rotated until hand-tight. Connection is then tightened per manufacturer's instructions.

3.5 nVent LENTON Standard Transition Coupler (A2 & A12) (illustrated below)



nVent LENTON Standard Transition coupler is similar to the Standard coupler except the coupler is designed to connect rebars of different sizes. Installation for transition couplers is the same as that for standard couplers as described in Section 3.4 of this report.

3.6 nVent LENTON Form Saver Coupler (SA & FS) (illustrated below)



nVent LENTON Form Saver coupler is the same in terms of form and function as the standard coupler, except that the SA or FS coupler type has a non-structural form mounting plate attached to the end of the coupler. Mounting plate simply provides a method of securing the SA or FS coupler

type and attached bar to form work. An internal thread protector is installed to protect the Form Saver coupler's internal threads. Form Saver FS coupler type is attached to the rebar by a friction forging process, whereby the rebar is attached to the coupler by forcing the components together while the coupler is revolving at a specific rate of speed. The other end of the Form Saver FS coupler type accepts rebar with tapered threads. Unlike the FS coupler type, the Form Saver SA coupler type accepts rebar with tapered threads at each end. As with the FS coupler type, the SA coupler type has a mounting plate that is attached to one end of the coupler. To install the Form Saver (SA or FS) coupler assembly, the mounting plate is used to position and secure the coupler types on the formwork. Upon completion of the concrete pour and removal of the formwork where the SA or FS coupler type is attached, the protectors are removed from both the rebar and the coupler. Taper threaded male rebar of the proper size is then screwed into the exposed end of the Form Saver SA or FS coupler type. Connection is then tightened per manufacturer's instructions. Note: For identification purposes, the face of the Form Saver SA or FS coupler type mounting plate, which is exposed when the formwork is removed, has nVent LENTON coupler bar-size information stamped on the surface.

3.7 nVent LENTON Position Coupler (P9 & P8) (illustrated below)



nVent LENTON Position coupler is used to connect curved or bent bars as well as straight bars that shall be held in a predetermined position during the connection process. Coupler may also be used where neither bar is free to rotate. All nVent LENTON Position couplers are manufactured to allow the coupler to rotate. Connection is tightened per manufacturer's instructions. In addition, position couplers are designed to accommodate rebars of different sizes.

3.8 nVent LENTON Lock Coupler (B1) (illustrated below):



nVent LENTON Lock coupler is used to connect two bars mechanically. One or both rebars are inserted into the



Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

coupler in a predetermined position and the bolts are tightened in accordance with manufacturer's instructions. As long as the torque values are achieved, the bolt heads are not required to shear off. Unsheared bolt heads may be cut off if concrete cover is an issue. Additional details are found in manufacturer's instructions. In addition to connecting the same bar size to the same bar size, the nVent LENTON Lock coupler may also be used to:

- Connect same size bar to same size bar where both bars are one size smaller than the size identified on the coupler.
- Transition from the bar size identified on the coupler to the next smaller bar size.
- Transition from the bar size identified on the LL25B1 and LL32B1 couplers to two steps smaller bar size.

3.9 nVent LENTON Lock Coupler (S1) (illustrated below):



nVent LENTON Lock coupler is used to connect two bars mechanically. One or both rebars are inserted into the coupler in a predetermined position and the bolts are tightened in accordance with the manufacturer's instructions. As long as the torque values are achieved, the bolt heads are not required to shear off. Unsheared bolt heads may be cut off if concrete cover is an issue. Additional details are found in manufacturer's instructions. In addition to connecting the same bar size to the same bar size, the nVent LENTON Lock coupler may also be used to:

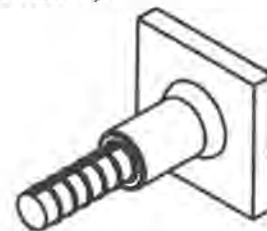
- Connect same size bar to same size bar where both bars are one size smaller than the size identified on the coupler, and
- Transition from the bar size identified on the coupler to the next smaller bar size.
- Transition from the bar size identified on the LL25S1 and LL32S1 couplers to two steps smaller bar size.

3.10 nVent LENTON Interlok (LK) (illustrated below):



nVent LENTON Interlok coupler is cylindrical, with one end threaded to receive tapered threaded rebar and the opposite end machined with internal annular ridges that are spaced approximately 1 inch (25.4 mm) on center. Interlok coupler shall be installed in accordance with the IBC or IRC, the evaluation report and manufacturer's installation instructions. The system consists of a coupler and grout from nVent. The available grouts are HY10L and HY15LM. The threaded end of the coupler is machined with a LENTON taper thread. A matching nVent LENTON tapered threaded piece of rebar is inserted into this end of the Interlok coupler and rotated until hand-tight. This portion of the connection is then tightened per manufacturer's instructions. The opposite end of the sleeve is open to receive the reinforcing steel of the adjoining precast structural member or projecting dowel. Pouring or pumping grout into the sleeve subsequently completes the connection. Temperatures during grouting shall range between 32°F and 100°F (0°C and 38°C). For HY15LM, additives are available to extend the temperature range down to 20°F and up to 122°F (-7°C to 50°C). Grout shall be mixed with water quantities determined from trial batches in accordance with Section 4.2.2 of this report. All oil, dirt, moisture, and other debris shall be removed from the coupler and other areas to be grouted. Mixed grout shall be either poured or pumped into the Interlok coupler. All spaces within the coupler shall be fully grouted. All spliced joints shall be adequately braced and supported to prevent movement of the rebar within the coupler. Braces are left in place for at least 24 hours, until the grout has attained a minimum compressive strength of 3,000 psi (20.7 MPa). Compression tests consist of 2-inch (51 mm) cubes tested in accordance with ASTM C109.

3.11 nVent LENTON Weldable Half Coupler (C2 & C3J) (illustrated below):





Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

nVent LENTON weldable half coupler provides a mechanical means of connecting rebar to structural steel plates and shapes. Coupler is manufactured from weldable grades of material. One end of the coupler is machined with an nVent LENTON taper thread and the opposite side is prepared for welding. Weld shall be designed by a registered design professional in accordance with American Welding Society (AWS) standards. Connection is then tightened per the manufacturer's instructions.

3.12 nVent LENTON Ultimate Standard Coupler (FT12 & MT12) (illustrated below):



nVent LENTON Ultimate standard coupler is used to connect bars where at least one bar is able to rotate freely. The coupler consists of two components: female taper threaded (FT12) and male taper threaded (MT12). The FT12 and MT12 components are attached to the connecting rebars by a friction forging process. Alternately, the MT12 component may be substituted by rebar with nVent LENTON tapered threads (illustration shown on the right). One or both connecting bars are rotated until hand-tight. Connection is tightened per manufacturer's instructions. In addition, Ultimate standard couplers are designed to accommodate rebars of different sizes.

3.13 nVent LENTON Ultimate Transition Coupler (FT12 & MT12) (illustrated below):



nVent LENTON Ultimate transition coupler is similar to the Ultimate standard coupler except the coupler is designed to connect rebars of different sizes. The MT12 component may be substituted by rebar with nVent LENTON tapered threads (illustration shown on the right). Installation for Ultimate transition couplers is the same as that for Ultimate standard couplers as described in Section 3.12 of this report.

3.14 nVent LENTON Ultimate Position Coupler (PT15, MS15, & MT12) (illustrated below):



nVent LENTON Ultimate position coupler is used to connect curved or bent bars as well as straight bars that shall be held in a predetermined position during the connection process. Coupler may also be used where neither bar is free to rotate. Ultimate position couplers are manufactured to allow the coupler to rotate. The length adjustability of the Ultimate position coupler allows significant tolerance for bar gap and positioning during the connection process. The coupler consists of three components: coupler sleeve (PT15), male parallel thread (MS15), and male taper thread (MT12). The MS15 and MT12 components are attached to the connecting rebars by a friction forging process. Alternately, the MT12 component may be substituted by rebar with nVent LENTON tapered threads (illustration shown on the right). Connection is tightened per manufacturer's instructions. In addition, Ultimate position couplers are designed to accommodate rebars of different sizes.

3.15 nVent LENTON Connect Coupler (B12) (illustrated below):



nVent LENTON Connect coupler is used to connect two rebars mechanically. One or both rebars are inserted into the coupler in a predetermined position and the bolts are tightened in accordance with the manufacturer's instructions. As long as the torque values are achieved, the bolt heads are not required to shear off. Unsheared bolt heads may be cut off if concrete cover is an issue. Additional details are found in the manufacturer's instructions. In addition to connecting two rebars of the same size, the Connect coupler may also be used to:

- Connect two rebars of the same size where both bars are one size smaller than the size identified on the coupler.



Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

- Transition from one rebar of the bar size identified on the coupler to another rebar of the next smaller bar size.

3.16 nVent LENTON Connect Coupler (S2) (illustrated below):



nVent LENTON Connect coupler is used to connect two rebars mechanically. One or both rebars are inserted into the coupler in a predetermined position and the bolts are tightened in accordance with the manufacturer's instructions. As long as the torque values are achieved, the bolt heads are not required to shear off. Unsheared bolt heads may be cut off if concrete cover is an issue. Additional details are found in manufacturer's instructions. In addition to connecting two rebars of the same size, the Connect coupler may also be used to:

- Connect two rebars of the same size where both bars are one size smaller than the size identified on the coupler, and
- Transition from one rebar of the size identified on the coupler to another rebar of next smaller bar size.

4.0 PRODUCT DESCRIPTION

4.1 General

nVent LENTON system consists of taper threaded rebar splicing and bolted rebar splicing and is designed for use in reinforced concrete construction. nVent LENTON taper threaded system utilizes a 6-degree tapered thread with a varying thread pitch of 1.25 mm, 2.0 mm, or 3.5 mm depending on the reinforcement size. nVent LENTON couplers are available in eleven styles: nVent LENTON Standard (A2 & A12), nVent LENTON Standard Transition (A2 & A12), nVent LENTON Form Saver (SA & FS), nVent LENTON Position (P9 & P8), nVent LENTON Lock (B1 & S1), nVent LENTON Interlok (LK), LENTON weldable half coupler (C2 & C3J), nVent LENTON Ultimate standard (FT12 & MT12), nVent LENTON Ultimate transition (FT12 & MT12), nVent LENTON Ultimate position (PT15, MS15, & MT12), and nVent LENTON Connect (B12 & S2). nVent LENTON couplers are designed to mechanically butt splice No. 4, 0.5-inch-diameter (12 mm) through No. 18, 2.25-inch-diameter (57 mm) deformed reinforcing steel bars.

All grades of rebar may be epoxy coated in accordance with ASTM A775 or A934 when utilizing nVent LENTON taper threaded or bolted couplers. In addition, all grades of rebar may be galvanized in accordance to ASTM A767 when utilizing nVent LENTON taper threaded connections. Coatings complying with ASTM A775, ASTM A934, and ASTM A767 shall be applied prior to rebar threading or in a manner as to not interfere with proper thread engagement.

All coupler styles, excluding the nVent LENTON Lock and Connect coupler types, have interior tapered threads for connecting the reinforcement. For the nVent LENTON threaded coupler types, threads on the rebar or attached components are right-handed and tapered to match the accompanying coupler. Before shipping from the rebar fabrication shop, threaded bar ends shall be protected.

4.2 Components

4.2.1 Couplers: The couplers' descriptions and illustrations are listed in [Tables 1](#) to [19](#) of this report.

4.2.2 Grout:

4.2.2.1: nVent LENTON Interlok HY10L Grout: HY10L grout is a dry, cementitious material, packaged in 50-pound (22.7 kg) bags. Batches of grout shall be mixed in accordance with nVent installation instructions. The amount of water shall be 0.7 to 0.8 gallons (2.7 to 3.0 L) per bag. The correct amount of water to be added to the grout is predetermined by field-testing the flow of trial batches of grout mixtures with a 2-inch-diameter (51 mm), 4-inch-tall (102 mm) cylinder and an nVent LENTON Interlok flow template to obtain a flow of 5 to 6 inches (127 to 152 mm). Where flows exceed 6½ inches (165 mm), the trial batch shall be discarded, and a new trial batch shall be prepared. The minimum compressive strength shall be 8,500 psi (58.6 MPa) at 28 days. Compressive strength tests shall be conducted in accordance with ASTM C942 on 2-inch (51 mm) cube specimens cured at 70°F (21°C). The shelf life of nVent LENTON Interlok HY10L Grout is 12 months from the manufacturing date printed on the bag when stored indoors in a cool, dry environment.

4.2.2.2 nVent LENTON Interlok HY15LM Grout: HY15LM grout is a dry, cementitious material, packaged in 50-pound (22.7 kg) bags. Batches of grout shall be mixed in accordance with nVent installation instructions. The amount of water shall be 0.7 to 0.78 gallons (2.7 to 2.95 L) per bag. For optimum pumping conditions, the correct amount of water to be added to the grout is predetermined by field-testing the flow of trial batches of grout mixtures with a 2-inch-diameter (51 mm), 4-inch-tall (102 mm) cylinder and a Interlok flow template. For ease of pumping, the desired flow is 7 to 12 inches (178 to 305 mm). The minimum compressive



EVALUATION REPORT

Number: 0129

Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

strength shall be 7,500 psi (51.7 MPa) for Grade 60 bars or 9,000 psi (62 MPa) for Grade 75 and 80 bars at 28 days. Compressive strength tests shall be conducted in accordance with ASTM C942 on 2-inch (51 mm) cube specimens cured at 70°F (21°C). The shelf life of Interlok HY15LM Grout is 12 months from the manufacturing date printed on the bag when stored indoors in a cool, dry environment.

5.0 IDENTIFICATION

All couplers and splices are packaged with a label bearing the manufacturer's name (ERICO International Corporation) or brand name (nVent LENTON), address, model and size, and the IAPMO Uniform ES Mark of Conformity and the Evaluation Report Number (ER-0129) to identify the products recognized in this report. Each nVent LENTON coupler is permanently stamped/labeled with the catalog number, size, heat number, Type 2 designation (except nVent LENTON Lock S1 and nVent LENTON Connect S2), and the name "LENTON."

6.0 EVIDENCE SUBMITTED

Data submitted in accordance with the ICC-ES Acceptance Criteria for Mechanical Connector Systems for Steel Reinforcing Bars (AC133), approved October 2015, (editorially revised May 2018). Test reports are from laboratories in compliance with ISO/IEC 17025.

7.0 STATEMENT OF RECOGNITION:

This report describes the results of research completed by the IAPMO Uniform Evaluation Service on nVent LENTON Mechanical Splice System for Steel Reinforcing Bars in Concrete to assess its conformance to the codes listed in Section 1.0 and serves as documentation of the product certification. The products are manufactured at the location noted in Section 2.10 of this report under a quality control program with periodic inspections under the supervision of IAPMO UES.

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Uniform Evaluation Service

Richard Beck, PE, CBO, MCP
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GP Russ Chaney
CEO, The IAPMO Group

For additional information about this evaluation report please visit www.uniform-es.org or email at info@uniform-es.org



or

IAPMO UES ER-0129



EVALUATION REPORT

Number: 0129

Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

Table 1: nVent LENTON® System Specification

Series	Part Number Suffix	Material Grade	Rebar Grades	Rebar Sizes	Code Compliance	Section
nVent LENTON Standard Coupler	A2, A12	American Iron and Steel Institute (AISI) 1117/1141 (or equivalent)	ASTM® A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No. 4 through 18	IBC®, IRC® TYPE I + II	3.4
nVent LENTON Standard Transition Coupler	A2, A12	AISI 1117/1141 (or equivalent)	ASTM A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No.4 through 18	IBC, IRC TYPE I + II	3.5
nVent LENTON FORM SAVER	SA	AISI 1117/1141 (or equivalent)	ASTM A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No.4 through 11	IBC, IRC TYPE I + II	3.6
	FS	AISI 1117 (or equivalent)	ASTM A706 Grade 60; A615 Grades 60 and 75	No.4 through 7	IBC, IRC TYPE I + II	
nVent LENTON Position Coupler	P9, P8	AISI 1141 (or equivalent)	ASTM A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No.5 through 18	IBC, IRC TYPE I + II	3.7
nVent LENTON Lock	B1	AISI 4118/4120 (or equivalent)	ASTM A706 Grade 60; A615 Grades 60 and 75	No.4 through 18	IBC, IRC TYPE I + II	3.8
	S1	AISI 4118/4120 (or equivalent)	ASTM A706 Grade 60	No.4 through 18	IBC, IRC TYPE I + II	3.9
	S1	AISI 4118/4120 (or equivalent)	ASTM A615 Grade 60	No.4 through 18	IBC, IRC TYPE I	3.9
nVent LENTON Interlok	LK with HY10L	ASTM A536 (or equivalent)	ASTM A706 Grade 60; A615 Grade 60	No.6 through 14	IBC, IRC TYPE I + II	3.10
	LK with HY15LM	ASTM A536 (or equivalent)	ASTM A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No.5 through 18	IBC, IRC TYPE I + II	3.10
nVent LENTON Weldable Half Coupler	C2, C3J	AISI 1018/1030/1035 (or equivalent)	ASTM A706 Grade 60; A615 Grade 60	No.4 through 18	IBC, IRC TYPE I + II	3.11



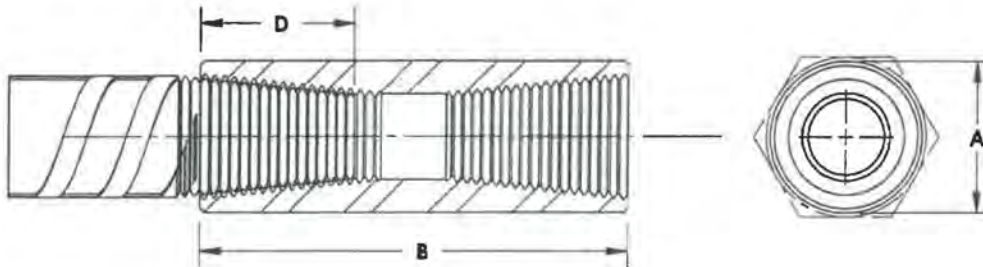
Table 1 Continued

Series	Part Number Suffix	Material Grade	Rebar Grades	Rebar Sizes	Code Compliance	Section
nVent LENTON Ultimate Standard Coupler	FT12, MT12 ¹	AISI 1045 (or equivalent)	ASTM A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No.4 through 18	IBC, IRC TYPE I + II	3.12
nVent LENTON Ultimate Transition Coupler	FT12, MT12 ¹	AISI 1045 (or equivalent)	ASTM A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No.4 through 18	IBC, IRC TYPE I + II	3.13
nVent LENTON Ultimate Position Coupler	PT15, MS15, MT12 ¹	AISI 1045 (or equivalent)	ASTM A706 Grades 60 and 80; A615 Grades 60, 75, and 80	No.4 through 18	IBC, IRC TYPE I + II	3.14
nVent LENTON Connect	B12	AISI 1030/1035 (or equivalent)	ASTM A706 Grade 60; A615 Grade 60	No.4 through 11	IBC, IRC TYPE I + II	3.15
	S2	AISI 1030/1035 (or equivalent)	ASTM A706 Grade 60	No.4 through 11	IBC, IRC TYPE I + II	3.16
	S2	AISI 1030/1035 (or equivalent)	ASTM A615 Grade 60	No.4 through 11	IBC, IRC TYPE I	3.16

¹Note: MT12 component may be substituted with nVent LENTON taper threaded rebar for IBC, IRC Type I + II.



nVent LENTON Standard Couplers - A2/A12 Series



A = Diameter
 B = Length of Coupler
 D = Bar Engagement

Table 2: nVent LENTON Standard Couplers – A2 Series

Reinforcement Bar Designation				Part Number	"A"		"B"		"D"	
No.	Metric (mm)	Canadian	Soft Metric		in	mm	in	mm	in	mm
4	12	10M	13	EL12A2*	11/16	17	1-5/8	41	9/16	14
5	16	15M	16	EL16A2*	7/8	22	2-3/16	56	7/8	22
6	20	20M	19	EL20A2*	1-1/16	27	2-13/16	71	1-1/8	29
7	22	–	22	EL22A2*	1-3/16	30	3-5/32	80	1-1/4	32
8	25	25M	25	EL25A2	1-3/8	35	3-11/32	85	1-3/8	35
9	28	30M	29	EL28A2	1-1/2	38	3-19/32	91	1-1/2	38
10	32	–	32	EL32A2	1-3/4	44	3-25/32	96	1-9/16	40
11	36	35M	36	EL36A2	1-7/8	48	3-31/32	101	1-11/16	43
–	38	–	38	EL38A2	2	51	4-1/8	105	1-3/4	44
–	40	–	–	EL40A2	2-3/16	52	4-15/16	125	2-3/16	56
14	43	45M	43	EL43TA2	2-1/4	57	5-1/4	133	2-1/8	56
–	50	–	–	EL50TA2	2-9/16	64	6-13/32	163	2-3/4	70
18	57	55M	57	EL57TA2	3	76	6-1/2	164	2-3/4	71

*Uses hexagonal material (measured across the flats); others use round material.



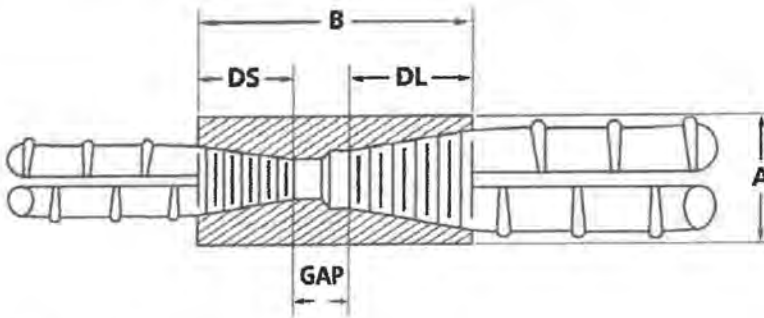
Table 3: nVent LENTON Standard Couplers – A12 Series

Reinforcement Bar Designation		Part Number	"A" mm	"B" mm	"D" mm
No.	Metric (mm)				
–	10	EL10A12*	17	48	18
4	12	EL12A12*	17	49	18
–	14	EL14A12*	22	55	21
5	16	EL16A12*	22	61	24
–	18	EL18A12*	27	71	29
6	20	EL20A12*	27	88	36
7	22	EL22A12*	33	91	38
8	25	EL25A12	33	96	41
9	28	EL28A12	37	101	43
–	30	EL30A12	37	121	53
10	32	EL32A12	42	107	46
–	34	EL34A12	41	128	56
11	36	EL36A12	46	121	53
–	38	EL38A12	52	124	54
–	40	EL40A12	52	131	58
14	43	EL43TA12	58	155	68
–	50	EL50TA12	64	163	71
18	57	EL57TA12	75	189	84

*Uses hexagonal material (measured across the flats); others use round material.



nVent LENTON Standard Transition Couplers - A2/A12 Series



A = Diameter
 B = Length of Coupler
 DL = Large Bar Engagement
 DS = Small Bar Engagement

Table 4: nVent LENTON Standard Transition Couplers – A2 Series

Reinforcement Bar Designation		Part Number	"A" in	"B" in	"DL" in	"DS" in
No.	Metric (mm)					
4 to 5	12 to 16	EL1612A2*	7/8	2-5/16	7/8	9/16
5 to 6	16 to 20	EL2016A2*	1-1/16	3	1-1/8	7/8
6 to 7	20 to 22	EL2220A2*	1-3/16	3-13/32	1-1/4	1-1/8
7 to 8	22 to 25	EL2522A2	1-3/8	3-11/16	1-3/8	1-1/4
8 to 9	25 to 28	EL2825A2	1-1/2	3-29/32	1-1/2	1-3/8
9 to 10	28 to 32	EL3228A2	1-3/4	4-1/8	1-9/16	1-1/2
10 to 11	32 to 36	EL3632A2	1-7/8	4-5/16	1-11/16	1-9/16
11 to 14	36 to 43	EL43T36A2	2-1/4	4-21/32	2-1/8	1-11/16
11 to 18	36 to 57	EL57T36A2	3	5-11/16	2-3/4	1-11/16
14 to 18	43 to 57	EL57T43TA2	3	6-5/16	2-3/4	2-1/8

*Uses hexagonal material (measured across the flats); others use round material.



Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

Table 5: nVent LENTON Standard Transition Couplers – A12 Series

Reinforcement Bar Designation		Part Number	"A" in	"B" in	"DL" in	"DS" in
No.	Metric (mm)					
4 to 5	12 to 16	EL1612A12*	7/8	2-13/32	15/16	3/4
5 to 6	16 to 20	EL2016A12*	1-1/16	3-5/32	1-3/8	15/16
6 to 7	20 to 22	EL2220A12*	1-3/16	3-3/4	1-7/16	1-3/8
7 to 8	22 to 25	EL2522A12	1-3/8	3-15/16	1-9/16	1-7/16
8 to 9	25 to 28	EL2825A12	1-1/2	4-1/8	1-5/8	1-9/16
9 to 10	28 to 32	EL3228A12	1-3/4	4-11/32	1-3/4	1-5/8
10 to 11	32 to 36	EL3632A12	1-7/8	4-23/32	2-1/16	1-3/4
11 to 14	36 to 43	EL43T36A12	2-1/4	5-13/16	2-5/8	2-1/16
11 to 18	36 to 57	EL57T36A12	3	6-9/16	3-1/8	2-1/16
14 to 18	43 to 57	EL57T43TA12	3	7-1/4	3-1/8	2-5/8

*Uses hexagonal material (measured across the flats); others use round material.



Originally Issued: 02/02/2009

Revised: 02/25/2021

Valid Through: 02/28/2023

nVent LENTON Form Saver Couplers – SA Series



- A = Diameter
- B = Length of Coupler Body
- D = Bar Engagement Non-Mounting Plate Side
- Dp = Bar Engagement Mounting Plate Side
- E = Length of Mounting Plate

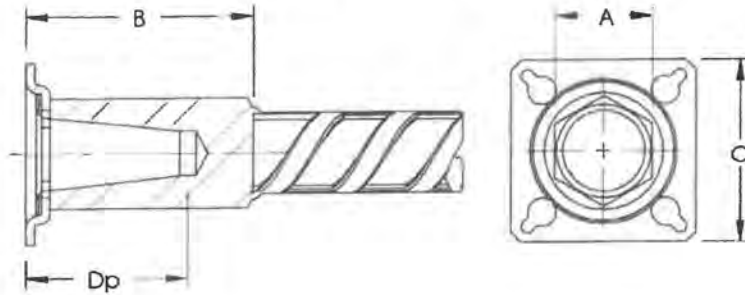
Table 6: nVent LENTON Form Saver Couplers – SA Series

Reinforcement Bar Designation		Part No.	"A"		"B"		"D"		"Dp"		"E"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm	in	mm
4	12	EL12SA*	11/16	17	1-15/16	49	9/16	14	7/8	22	2-1/4	57
5	16	EL16SA*	7/8	22	2-1/2	64	7/8	22	1-3/16	30	2-1/4	57
6	20	EL20SA*	1-1/16	27	3-1/8	79	1-1/8	29	1-7/16	37	2-1/4	57
7	22	EL22SA*	1-3/16	30	3-15/32	88	1-1/4	32	1-9/16	40	2-1/4	57
8	25	EL25SA	1-3/8	35	3-21/32	93	1-3/8	35	1-11/16	43	2-1/4	57
9	28	EL28SA	1-1/2	38	3-29/32	99	1-1/2	38	1-13/16	46	2-1/2	63
10	32	EL32SA	1-3/4	44	4-3/32	104	1-9/16	40	1-7/8	48	2-1/2	63
11	36	EL36SA	1-7/8	48	4-9/32	109	1-11/16	43	2	51	2-1/2	63

*Uses hexagonal material (measured across the flats); others use round material.



nVent LENTON Form Saver Couplers – FS Series



A = Diameter
 B = Length of Coupler
 C = Length and Width of Mounting Plate
 Dp = Bar Engagement

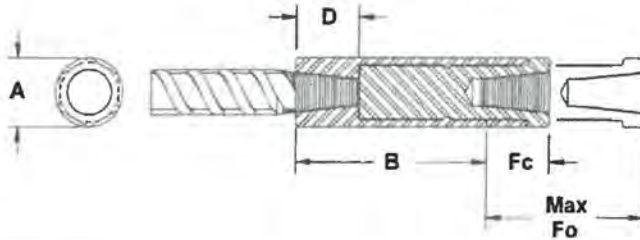
Table 7: nVent LENTON Form Saver Couplers – FS Series

Reinforcement Bar Designation		Part No.	"A"		"B"		"C"		"Dp"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm
4	12	ELC12FS2*	7/8	22	1-13/16	46	2-1/4	57	7/8	22
5	16	ELC16FS2*	7/8	22	2-1/16	52	2-1/4	57	1-3/16	30
6	20	ELC20FS2*	1-1/16	27	2-9/16	65	2-1/4	57	1-7/16	36
7	22	ELC22FS2*	1-3/16	30	2-13/16	71	2-1/4	57	1-9/16	39

*Uses hexagonal material (measured across the flats); others use round material.



nVent LENTON Position Couplers – P9 Series



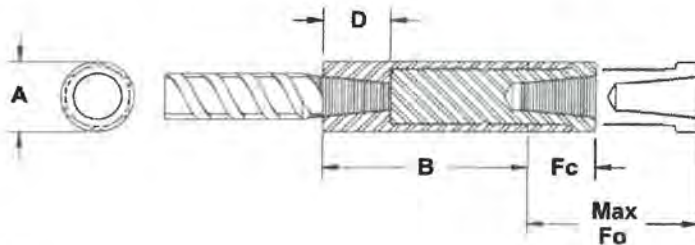
- A = Diameter
- B = Length of Coupler Body
- D = Bar Engagement
- Fc = Connector Closed Position
- Max. Fo = Connector Fully Open Position

Table 8: nVent LENTON Position Couplers – P9 Series

Reinforcement Bar Designation		Part No.	"A"		"B"		"D"		"Fc"		"Max. Fo"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm	in	mm
6	20	EL20P9	1-13/16	46	2-3/4	70	1-1/8	29	1-5/8	41	2-1/8	54
7	22	EL22P9	1-13/16	46	3-1/16	78	1-1/4	32	1-5/8	41	2-1/8	54
8	25	EL25P9	1-13/16	46	3-3/8	86	1-3/8	35	1-5/8	41	2-1/8	54
9	28	EL28P9	2-1/2	64	3-9/16	90	1-1/2	38	1-5/8	41	2-1/8	54
10	32	EL32P9	2-1/2	64	3-13/16	97	1-9/16	40	1-5/8	41	2-1/8	54
11	36	EL36P9	2-1/2	64	4-3/16	98	1-11/16	43	1-5/8	41	2-1/8	54
14	43	EL43TP9	3	76	5	127	2-1/8	54	3-13/16	97	4-5/8	117
18	57	EL57TP9	4	95	6-1/8	156	2-3/4	70	4-3/8	111	5-13/16	148



nVent LENTON Position Couplers – P8 Series



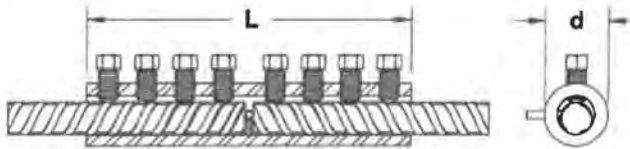
A = Diameter
 B = Length of Coupler Body
 D = Bar Engagement
 Fc = Connector Closed Position
 Max. Fo = Connector Fully Open Position

Table 9: nVent LENTON Position Couplers – P8 Series

Reinforcement Bar Designation		Part No.	"A"		"B"		"D"		"Fc"		"Max. Fo"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm	in	mm
5	16	EL16P8	1-13/16	46	4-7/16	113	7/8	22	1-1/2	38	2-9/16	65
6	20	EL20P8	1-13/16	46	4-7/16	113	1-1/8	29	1-9/16	39	2-9/16	65
7	22	EL22P8	1-13/16	46	4-15/16	125	1-1/4	32	1-1/2	38	2-3/4	70
8	25	EL25P8	1-13/16	46	5-5/16	135	1-3/8	35	1-1/2	38	2-13/16	72
9	28	EL28P8	2-1/2	64	5-5/8	143	1-1/2	38	1-1/2	38	2-15/16	75
10	32	EL32P8	2-1/2	64	6	152	1-9/16	40	1-1/2	38	3-1/16	78
11	36	EL36P8	2-1/2	64	6-7/16	164	1-11/16	43	1-9/16	39	3-3/8	85
14	43	EL43TP8	3	76	7-13/16	198	2-1/8	54	3-19/32	92	7-5/16	186
18	57	EL57TP8	4	95	9-17/32	242	2-3/4	70	4-5/32	106	8-15/32	215



nVent LENTON Lock Couplers – B1 Series



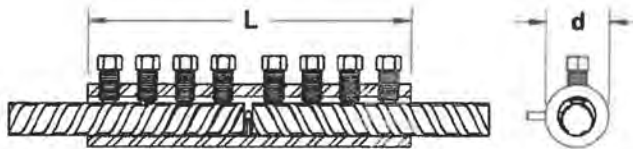
L = Coupler Length
d = Outside Diameter

Table 10: nVent LENTON Lock Couplers – B1 Series

Reinforcement Bar Designation		Part No	"L" Length		"d" Outside Diameter		Inside Diameter		Number of Bolts
No.	Metric (mm)		in	mm	in	mm	in	mm	
–	10	LL12B1	5	127	1.1	29	0.6	15	6
4	12	LL12B1	5	127	1.1	29	0.6	15	6
–	14	LL16B1	6.3	159	1.4	35	0.7	19	6
5	16	LL16B1	6.3	159	1.4	35	0.7	19	6
–	18	LL20B1	7.5	191	1.7	44	0.9	24	8
6	20	LL20B1	7.5	191	1.7	44	0.9	24	8
7	22	LL22B1	8.7	222	1.9	48	1.1	28	8
8	25	LL25B1	10	254	2.1	54	1.2	30	8
9	28	LL28B1	11.3	287	2.4	60	1.3	34	10
–	30	LL28B1	11.3	287	2.4	60	1.3	34	10
10	32	LL32B1	12.7	323	2.6	65	1.5	38	8
–	34	LL36B1	14.1	358	2.8	72	1.7	43	10
11	36	LL36B1	14.1	358	2.8	72	1.7	43	10
–	38	LL40B1	15.7	400	3.1	80	1.9	47	12
–	40	LL40B1	15.7	400	3.1	80	1.9	47	12
14	43	LL43B1	20.6	523	3.5	89	2.1	53	14
–	50	LL50B1	23.3	593	4.0	102	2.4	60	16
18	57	LL57B1	26.1	662	4.5	117	2.6	67	18



nVent LENTON Lock Couplers – S1 Series



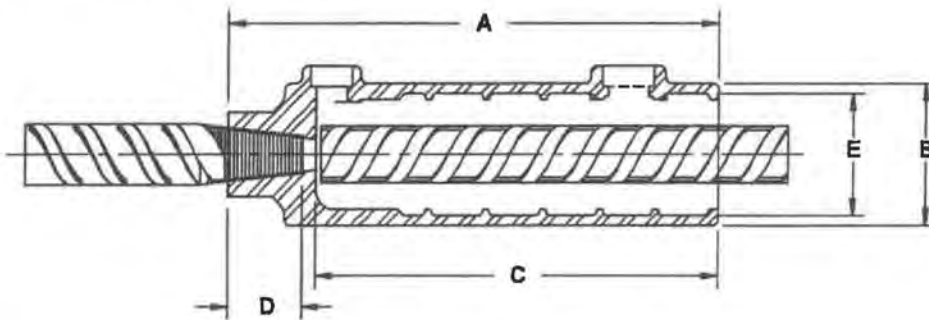
L = Coupler Length
d = Outside Diameter

Table 11: nVent LENTON Lock Couplers – S1 Series

Reinforcement Bar Designation		Part No	"L" Length		"d" Outside Diameter		Inside Diameter		Number of Bolts
No.	Metric (mm)		in	mm	in	mm	in	mm	
–	10	LL12S1	3.9	99	1.1	29	0.6	15	4
4	12	LL12S1	3.9	99	1.1	29	0.6	15	4
–	14	LL16S1	4.3	109	1.4	35	0.7	19	4
5	16	LL16S1	4.3	109	1.4	35	0.7	19	4
–	18	LL20S1	6.0	153	1.7	44	0.9	24	6
6	20	LL20S1	6.0	153	1.7	44	0.9	24	6
7	22	LL22S1	6.8	173	1.9	48	1.1	28	6
8	25	LL25S1	6.8	173	2.1	54	1.2	30	6
9	28	LL28S1	6.8	173	2.4	60	1.3	34	6
–	30	LL28S1	6.8	173	2.4	60	1.3	34	6
10	32	LL32S1	8.7	220	2.6	65	1.5	38	6
–	34	LL36S1	11.3	286	2.8	72	1.7	43	8
11	36	LL36S1	11.3	286	2.8	72	1.7	43	8
–	38	LL40S1	13.9	352	3.1	80	1.9	47	10
–	40	LL40S1	13.9	352	3.1	80	1.9	47	10
14	43	LL43S1	16.5	418	3.5	89	2.1	53	12
–	50	LL57S1	22.5	572	4.5	114	2.6	67	14
18	57	LL57S1	22.5	572	4.5	114	2.6	67	14



nVent LENTON Interlok Couplers – LK Series



- A = Length
- B = Outside Diameter
- C = Grouted Max. Bar Embedment
- D = Threaded Bar Engagement
- E = Inside Diameter

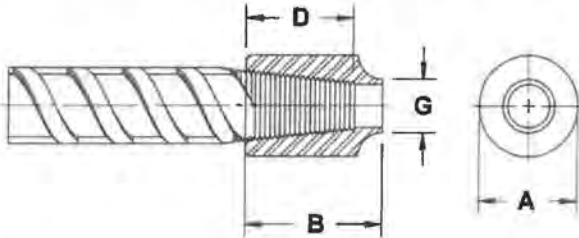


Table 12: nVent LENTON Interlok Couplers – LK Series

Reinforcement Bar Designation		Part No.	"A"		"B"		"C"		"D"		"E"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm	in	mm
5	16	LK5	7.81	198.4	2.56	65.1	6.13	155.5	0.86	21.8	2.13	54
5	16	LK16	7.91	200.9	2.31	58.7	6.62	168.2	1.190	30.22	1.88	47.6
6	20	LK6	7-5/8	195	2-7/16	62	6-1/8	156	1-1/8	29	1-7/8	48
6	20	LK20	8.79	223.3	2.44	61.9	7.0	177.8	1.691	42.95	2.0	50.8
7	22	LK7	7-5/8	195	2-7/16	62	6-1/8	156	1-1/4	32	1-7/8	48
7	22	LK22	8.89	225.8	2.56	65.1	7.01	178	1.784	45.32	2.13	54
8	25	LK8	8-5/8	219	2-5/8	67	7	178	1-3/8	35	2	51
8	25	LK25	8.98	228.1	2.69	68.3	7	177.8	1.884	47.86	2.25	57.2
9	28	LK9	9-3/4	248	2-3/4	70	8	203	1-1/2	38	2-1/8	54
9	28	LK28	10.07	255.8	2.81	71.4	8	203.2	1.970	50.04	2.38	60.3
10	32	LK10	10-13/16	275	2-15/16	75	9	229	1-9/16	40	2-5/16	59
10	32	LK32	11.2	284.5	3.0	76.2	9	228.6	2.100	53.34	2.56	65.1
11	36	LK11	12	295	3-1/8	79	9-7/8	251	1-11/16	43	2-7/16	62
11	36	LK36	12.34	313.4	3.19	81.0	9.88	251	2.364	53	2.69	68.3
-	40	LK40	15	381	3-11/16	94	12-3/4	324	2-1/8	56	2-3/4	70
14	43	LKT14	15	381	3-11/16	94	12-3/4	324	2-1/8	54	2-3/4	70
14	43	LKT43	15.94	404.9	3.69	93.7	12.75	323.8	3.093	60.03	3.06	77.8
-	50	LKT50	20-5/16	508	4-1/2	114	17	432	2-3/4	71	3-1/4	83
18	57	LKT18	20-5/16	508	4-1/2	114	17	432	2-3/4	72	3-1/4	83
18	57	LKT57	20.87	530.1	4.5	114.3	17	432	3.767	95.69	3.56	90.5



nVent LENTON Weldable Half Couplers – C2 and C3J Series



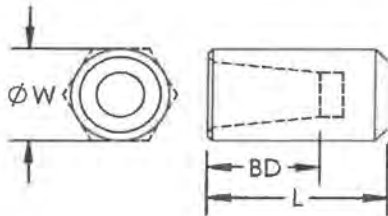
A = Coupler Diameter
 B = Length of Coupler
 D = Bar Engagement
 G = Small Diameter

Table 13: nVent LENTON Weldable Half Couplers – C2 and C3J Series

Reinforcement Bar Designation		Part No.	"A"		"B"		"D"		"G"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm
4	12	EL12C2	¾	19	1-3/16	30	9/16	14	7/16	11
5	16	EL16C2	1	25	1-3/8	35	7/8	22	9/16	14
6	20	EL20C3J	1-1/4	32	2-5/32	55	1-1/8	29	7/8	22
7	22	EL22C3J	1-1/4	32	2-13/32	61	1-1/4	32	3/4	19
8	25	EL25C3J	1-9/16	40	2-17/32	64	1-3/8	35	1	25
9	28	EL28C3J	1-9/16	40	2-11/16	68	1-1/2	38	15/16	24
10	32	EL32C3J	2	51	2-7/8	73	1-9/16	40	15/16	24
11	36	EL36C3J	2	51	2-31/32	75	1-11/16	43	1-1/8	29
14	43	EL43TC3J	2-3/8	60	3-3/4	96	2-1/8	54	1-13/32	36
18	57	EL57TC3J	3-1/8	79	4-1/2	114	2-3/4	71	1-3/4	44



nVent LENTON Ultimate Standard Couplers – FT12 Series



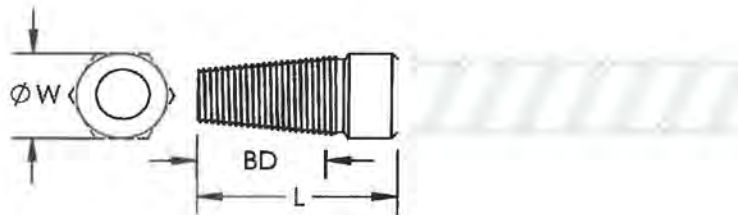
W = Coupler Diameter
 L = Length of Coupler
 BD = Bar Engagement

Table 14: nVent LENTON Ultimate Standard Couplers – FT12 Series

Reinforcement Bar Designation		Part No.	"W" Hex		"W" Round		"L"		"BD"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm
4	12	LU12FT12	11/16	17	----	----	1-9/16	39	3/4	19
5	16	LU16FT12	7/8	22	----	----	1-13/16	46	1	25
6	20	LU20FT12	1-1/16	27	----	----	2-15/32	63	1-7/16	36
7	22	LU22FT12	1-3/16	30	----	----	2-19/32	66	1-1/2	39
8	25	LU25FT12	----	----	1-3/8	35	2-3/4	70	1-5/8	41
9	28	LU28FT12	----	----	1-1/2	38	2-7/8	73	1-11/16	43
10	32	LU32FT12	----	----	1-3/4	44	3-1/16	77	1-27/32	47
11	36	LU36FT12	----	----	1-7/8	48	3-3/8	86	2-3/32	53
14	43	LU43TFT12	----	----	2-1/4	57	4-3/8	112	2-11/16	69
18	57	LU57TFT12	----	----	3	76	5-1/4	133	3-3/8	86



nVent LENTON Ultimate Standard, Transition, and Position Couplers – MT12 Series



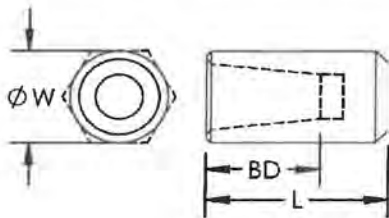
W = Diameter
 L = Length of Coupler
 BD = Bar Engagement

Table 15: nVent LENTON Ultimate Standard, Transition, and Position Couplers – MT12 Series

Reinforcement Bar Designation		Part No.	"W" Hex		"W" Round		"L"		"BD"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm
4	12	LU12MT12	11/16	17	----	----	1-21/32	42	3/4	19
5	16	LU16MT12	7/8	22	----	----	1-29/32	48	1	25
6	20	LU20MT12	----	----	1-3/8	36	1-13/32	61	1-7/16	36
7	22	LU22MT12	----	----	1-3/8	36	2-21/32	68	1-1/2	39
8	25	LU25MT12	----	----	1-1/2	38	2-13/16	71	1-5/8	41
9	28	LU28MT12	----	----	1-3/4	45	2-7/8	73	1-11/16	43
10	32	LU32MT12	----	----	2	51	3-7/32	82	1-27/32	47
11	36	LU36MT12	----	----	2-1/4	57	3-11/32	88	2-3/32	53
14	43	LU43TMT12	----	----	2-3/4	70	4-15/32	114	2-11/16	69
18	57	LU57TMT12	----	----	4	102	5-13/32	137	3-3/8	86



nVent LENTON Ultimate Transition Couplers – FT12 Series



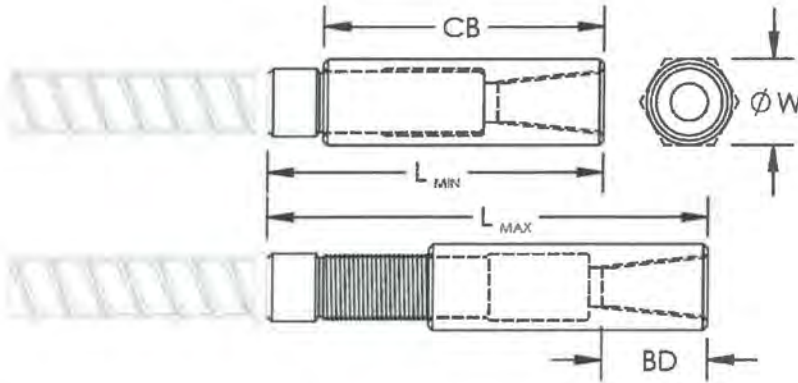
W = Coupler Diameter
 L = Length of Coupler
 BD = Small Bar Engagement

Table 16: nVent LENTON Ultimate Transition Couplers – FT12 Series

Reinforcement Bar Designation		Part No.	"W" Hex		"W" Round		"L"		"BD"	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm
4 to 5	12 to 16	LU1612FT12	7/8	22	----	----	1-13/16	46	3/4	19
5 to 6	16 to 20	LU2016FT12	1-1/16	27	----	----	2-15/32	63	1	25
6 to 7	20 to 22	LU2220FT12	1-3/16	30	----	----	2-19/32	66	1-7/16	36
7 to 8	22 to 25	LU2522FT12	----	----	1-3/8	35	2-3/4	70	1-1/2	39
8 to 9	25 to 28	LU2825FT12	----	----	1-1/2	38	2-7/8	73	1-5/8	41
9 to 10	28 to 32	LU3228FT12	----	----	1-3/4	44	3-1/16	77	1-11/16	43
10 to 11	32 to 36	LU3632FT12	----	----	1-7/8	48	3-3/8	86	1-27/32	47
11 to 14	36 to 43	LU4336FT12	----	----	2-1/4	57	4-3/8	112	2-3/32	53
11 to 18	36 to 57	LU5736FT12	----	----	3	76	5-1/4	133	2-3/32	53
14 to 18	43 to 57	LU5743TFT12	----	----	3	76	5-1/4	133	2-11/16	69



nVent LENTON Ultimate Position Couplers – PT15, MS15 Series



- W = Diameter
- CB = Length of Coupler Body
- BD = Bar Engagement
- L_{MIN} = Minimum Length Closed Position
- L_{MAX} = Maximum Length Fully Open Position



Table 17: nVent LENTON Ultimate Position Couplers – PT15, MS15 Series

Reinforcement Bar Designation		Part No.	"W" Hex		"W" Round		"CB"		"BD"		"L _{MIN} "		"L _{MAX} "	
No.	Metric (mm)		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
4	12	LU12PT15 LU12MS15	7/8	22	---	---	2- 17/32	64	3/4	19	3-1/4	82	4-3/16	106
5	16	LU16PT15 LU16MS15	1-1/16	27	---	---	3-3/32	79	1	25	4	102	5-3/16	132
6	20	LU20PT15 LU20MS15	---	---	1-3/8	35	4- 11/32	110	1-7/16	36	5-1/4	133	6- 31/32	177
7	22	LU22PT15 LU22MS15	---	---	1-3/8	35	4- 19/32	116	1-1/2	39	5-1/2	139	7-5/16	186
8	25	LU25PT15 LU25MS15	---	---	1-1/2	38	4-7/8	124	1-5/8	41	6	153	7- 15/16	201
9	28	LU28PT15 LU28MS15	---	---	1-3/4	45	5-1/8	131	1- 11/16	43	6-1/2	165	8- 15/32	215
10	32	LU32PT15 LU32MS15	---	---	2	51	5- 17/32	140	1- 27/32	47	6-7/8	174	9	228
11	36	LU36PT15 LU36MS15	---	---	2-1/4	57	6-3/16	157	2-3/32	53	7-1/2	191	9- 29/32	252
14	43	LU43TPT15 LU43TMS15	---	---	2-3/4	70	8-1/16	205	2- 11/16	69	9- 27/32	250	13- 1/16	332
18	57	LU57TPT15 LU57TMS15	---	---	4	102	10- 5/16	262	3-3/8	86	12-1/2	317	16-3/8	416

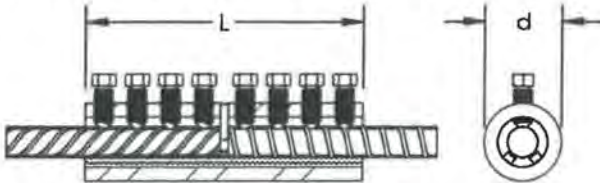


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nVent LENTON Connect Couplers – B12 Series



L = Coupler Length
d = Outside Diameter

Table 18: nVent LENTON Connect Couplers – B12 Series

Reinforcement Bar Designation		Part No.	"L" Length		"d" Outside Diameter		Number of Bolts
No.	Metric (mm)		in	mm	in	mm	
4	12	LC16B12	5.1	131	1.63	41.4	6
5	16	LC16B12	5.1	131	1.63	41.4	6
6	20	LC20B12	6.8	172	1.90	48.3	8
7	22	LC22B12	8.7	220	2.00	50.8	10
8	25	LC25B12	10.7	272	2.38	60.5	10
9	28	LC28B12	11.2	284	2.80	71.1	8
10	32	LC32B12	13.7	348	3.00	76.2	10
11	36	LC36B12	16.2	411	3.13	79.5	12

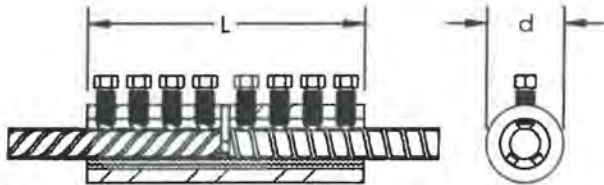


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nVent LENTON Connect Couplers – S2 Series



L = Coupler Length
d = Outside Diameter

Table 19: nVent LENTON Connect Couplers – S2 Series

Reinforcement Bar Designation		Part No	"L" Length		"d" Outside Diameter		Number of Bolts
No.	Metric (mm)		in	mm	in	mm	
4	12	LC16S2	3.5	89	1.63	41.4	4
5	16	LC16S2	3.5	163	41.4	41.4	4
6	20	LC20S2	5.1	131	1.90	48.3	6
7	22	LC22S2	6.9	174	2.00	50.8	8
8	25	LC25S2	8.7	221	2.38	60.5	8
9	28	LC28S2	8.7	221	2.80	71.1	6
10	32	LC32S2	11.2	284	3.00	76.2	8
11	36	LC36S2	13.7	348	3.13	79.5	10



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nVent LENTON Mechanical Splice System for Steel Reinforcing Bars in Concrete:

CSI Section:
03 21 00 Reinforcing Steel

1.0 RECOGNITION

The nVent LENTON Mechanical Splice System for Steel Reinforcing Bars in Concrete described in ER-0129 and this supplemental report have been evaluated for use as mechanical splices for deformed steel reinforcing bars (rebar) in reinforced concrete structural members. The Mechanical Splice System has been evaluated for structural performance properties, subject to the requirements in ER-0129 and this supplemental report. The Mechanical Splice System was evaluated for compliance with the following codes and regulations:

- 2020 City of Los Angeles Building Code (LABC)
- 2020 City of Los Angeles Residential Code (LARC)

2.0 LIMITATIONS

Use of the nVent LENTON Mechanical Splice System for Steel Reinforcing Bars in Concrete recognized in this supplement are subject to the following limitations:

2.1 Continuous special inspections of the Mechanical Splice System during installation shall be provided by Registered Deputy Inspectors as required by Section 1705 of the 2020 LABC, as applicable. The Registered Deputy Inspector shall verify the following: hardware and equipment; cleaning and condition of the bars in accordance with the specifications and the applicable code; and the installation procedures comply with the specifications and the manufacturer's published installation instructions.

2.2 The fabricator of the steel couplers shall be required to maintain a detailed procedure for material control and

suitable procedures and records attesting that the specified coupler has been furnished. The applicable splice designation (Type 1 or Type 2) or coating, as applicable, shall be included in each packaging assembly prior to shipment from the fabricator's plant. The fabricator's identification mark designation shall be established and on record prior to fabrication. Couplers that are not identifiable from marking and test records shall be tested to determine conformity to this report. The fabricator shall furnish an affidavit of compliance and test data shall be provided upon request.

2.3 The nVent LENTON Mechanical Splice System shall be selected at the jobsite by the Registered Deputy Inspector or by the building inspector and shall be tested by an approved testing agency in accordance with Section 1703 of the LABC. The test shall be conducted on each different rebar size and the frequency of tests shall be as follows: one out of the first ten splices; one out of the next ninety splices; one out of the next one hundred splices. The splice shall develop in tension or compression, as required, at least 125 percent of the specified yield strength of the bar as per Section 25.5.7.1 of ACI 318-14. For Type 2 splices, the splice shall develop at least 100 percent of the specified tensile strength of the steel reinforcing bar.

For Type 2 splices only, if failure of the tested splice should occur prior to obtaining the 125-percent of the specified yield strength and the 100-percent of the specified tensile strength, then 25-percent of all couplers shall be tested for both specified yield strength and specified tensile strength. If failure of the tested Type 2 splice occurs with testing of the 25-percent requirement, as stated above, then all couplers shall be rejected.

2.4 Minimum concrete cover and spacing between bars or sleeves shall be provided in accordance Section 1808.8.2 of the 2020 LABC.

2.5 The nVent LENTON Mechanical Splice Systems for Steel Reinforcing Bars in Concrete shall be installed in accordance with the applicable code, manufacturer's installation instructions, and this supplement. A copy of the manufacturer's installation instructions or specifications shall be available on site for all Registered Deputy Inspectors.

2.6 Splice locations shall be noted on the plans approved by the building official.

2.7 Installation procedures and specifications for splicing shall only be performed by qualified operators specified by the manufacturer.

For additional information about this evaluation report please visit www.uniform-es.org or email at info@uniform-es.org

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SCOPE

- A. Provide and install complete all metal work as shown and specified for the Berkeley Marina Dock Replacement (D&E) Project (Project) including, but not limited to the following:
1. Cleats and inserts
 2. Plates
 3. Entry Gate & Trellis Bolts
 4. Utility bolts inserts
 5. Restroom building improvements inserts.

1.02 STANDARDS

- A. The following codes and standards are hereby made a part of this section and miscellaneous metal work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements or governing rules and regulations.
1. Steel Structures Painting Council Surface Preparation Specifications, Vol. 2, Painting Manual.
 2. All work shall conform to these Specifications, as well as all applicable codes of governmental agencies having jurisdiction over the work.
 3. California Department of Boating and Waterways (DBAW) or City approved codes.
 4. American Welding Society (AWS)

1.03 SUBMITTALS

- A. Shop Drawings: Plates, insert and cleats.
- B. Catalog Cuts: Submit for each pre-manufactured item.

- C. Welding Qualifications: Submit copy of welder qualification papers to the City Representative for all welders.

1.04 FIELD MEASUREMENTS AND TEMPLATES

- A. Field Measurements: The Contractor shall secure field measurements required for adequate fabrication and installation of the Work covered by this Section. Exact measurements are the Contractor's responsibility.
- B. Templates: The Contractor shall furnish templates for exact location of anchor bolts and other items to be embedded in concrete, with setting instructions required for installation of embedded items.

1.05 SUBSTITUTIONS

- A. Written Acceptance: Specific reference to manufacturer's names and products specified in these sections are used as standards; this implies no right to substitute other materials without written acceptance of the City
- B. Contractors' Responsibility: Installation of accepted substitution(s) must be made to the satisfaction of the City Project Manager and without additional cost to the City.

PART 2 - MATERIALS

2.01 FASTENINGS

- A. Furnish all hardware required for fastenings, as shown on the drawings, and as specified herein, and as required to complete the work. All fasteners shall be hot-dip galvanized unless fastening at aluminum elements or unless coated. Fasteners shall include, but not be limited to, the following:
 1. Bolts: Bolts shall be ASTM F 3125 Grade A325 Type 3 or ASTM A 307 Grade A, as shown on the contract drawings, unless noted otherwise.

The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.
 2. Nuts: Nuts for ASTM A 307 bolts and threaded rods shall be of the same alloy group and the grade and style as recommended in the applicable ASTM standard for the type of bolt being used.

Nuts for ASTM F3125 Grade A325 bolts shall be heavy hex style grade DH3 or C3.
 3. Washers: Use ASTM F 844 flat washers for bolts and threaded rods. Use ASTM

F 436 flat washers for ASTM F3125 GRADE A325 bolts. Unless otherwise specified, all washers shall be of the same alloy group, and shall have a specified minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener.

4. Chains: Stud link chain, Grade 2 or Grade 3 ABS. Chains to be galvanized in accordance with ASTM A123 or ASTM A153 if any.
5. Shackles: Grade 80 screw pin shackles. Shackles galvanized in accordance with ASTM A 123 or ASTM A153 if any.

2.02 MATERIALS

A. Steel Fabrications

1. Steel plates, shapes, bars: Conforming to ASTM A36 Grade 36, UNO
2. Concrete inserts: Malleable iron, ASTM A 47, or cast steel, ASTM A 27, inserts, with steel bolts, washers and shims; hot-dip galvanized.
3. Anchors and inserts: Furnish inserts and anchoring devices to be built into other work for installation of miscellaneous metal items. Coordinate delivery to job site to avoid delay. Use non-ferrous metal or hot-dip galvanized anchors and inserts for exterior resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete.
4. Fasteners: Use fasteners made of the same basic metal as the fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined. Provide exposed fasteners, if any, which match finish of fastened metal, unless otherwise indicated.
5. Galvanizing repair, if any, shall conform to ASTM A780.

2.03 FINISH

- A. Structural steel members shall be hot dipped galvanized steel, and as shown on the drawings. All coating damaged during handling shall be recoated in accordance with paint-manufacturers recommendations, at Contractor's expense.
- B. All ferrous metal other than stainless steel shall be hot dipped galvanized. Hardware shall be galvanized in accordance with ASTM A153 and shall not be less than two ounces per square foot.

Galvanizing shall be performed before shipment and shall be by a hot dip process conforming to ASTM A123 Grade 100. Galvanizing for steel sheets less than 22 gauge shall conform to ASTM A653 and shall not be less than a total for both sides

of two ounces per square foot. Zinc shall conform to ASTM B695.

Preparation prior to galvanizing shall be by acid pickling. Galvanizing shall be performed the same day as pickling. After pickling and before galvanizing, all items shall be heated to 300 degrees F to expel hydrogen absorbed during pickling.

All cutting, punching, drilling and other machine work shall be performed as far as possible before galvanizing. Should any such work or any welding be necessary after galvanizing, the areas from which galvanizing has been removed shall be touched up in a manner described for repairs.

Components of bolted assemblies shall be galvanized before assembly.

Welded assemblies shall be galvanized after welding.

The zinc coating shall adhere tenaciously to the steel surface, shall be free from blisters and excess zinc, and be even, smooth and uniform throughout.

If necessary, the threads of nuts shall be retapped after galvanizing. Any damaged zinc coatings shall be repaired with galvanizing repair compound.

PART 3 - EXECUTION

3.01 GENERAL

- A. Verify all measurements at site prior to ordering materials.
- B. Coordinate all metal work with adjoining work for details of attachment, fitting, etc. Do all cutting, shearing, drilling, punching, threading, tapping, etc., required for miscellaneous metal or for attachment of adjacent work. Drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces.
- C. Conceal all fastenings where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Form joints exposed to weather to exclude water.
- D. Make all permanent connections in ferrous metal surfaces using welds where at all possible. Do not use bolts or screws where they can be avoided. Re-galvanize all welds made between galvanized metals. Re-coat all welds made between coated metals.
- E. Provide all lugs, clips, anchors and miscellaneous fastenings necessary for the complete assembly and installation.
- F. Set all work plumb, true, rigid, and neatly trimmed out.
- G. Where items must be incorporated or built into adjacent work, deliver to trade

responsible for proper location of such items.

3.02 WELDING

- A. Perform all welding in accordance with these Specifications, AWS standards, and industry practices.
- B. Welds shall be made only by operators experienced in performing the type of work indicated.
- C. Welds normally exposed to view in the finished work shall be uniformly made and shall be ground smooth.
- D. Where welding is done in proximity to San Francisco Bay waters, glass, or finished surfaces, such surfaces shall be protected from damage due to welds, sparks, spatter, or tramp metal.

3.03 CLEAN UP

- A. Protection and Cleaning: Remove all soiled and foreign matter from finished surfaces and apply such protective measures as required to prevent damage or discoloration of any kind until acceptance of project.
- B. During construction, keep premises as clear as possible of materials and debris, and at the completion of work remove all tools, appliances, materials, and debris from the premises.

3.04 Acceptance of Work: Final acceptance of the work will be provided following review by the City Representative.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for Metal Fabrications shall be considered as included in the contract lump sum price for OFFSHORE MARINA AND APPURTENANCES, LANDSIDE MARINA AND APPURTENANCES, MARINA UTILITIES INFRASTRUCTURE, and ACCESSIBILITY IMPROVEMENTS AND LANDSCAPING, and no separate payment will be made thereof.

END OF SECTION

SECTION 05 50 13

ALUMINUM PIPE AND TUBE

PART 1 - GENERAL

1.01 SCOPE

- A. Provide and install complete all aluminum pipe and tube railings as shown and specified for the Berkeley Marina Dock Replacement (D&E) Project (Project) including, but not limited to, the following: Abutment retaining wall railing extensions, gate extensions and gate frame.

1.02 PERFORMANCE REQUIREMENTS

- A. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Aluminum material grade
 - 3. Railing brackets.
 - 4. Grout, anchoring cement, and paint products.
- B. Construction Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.02 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Structural Pipe: ASTM B 429, Alloy 6063-T6.
- C. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- D. Castings: ASTM B 26, Alloy A356.0-T6.

2.03 MISCELLANEOUS MATERIALS

- A. Fasteners: Provide the following:
 - 1. Aluminum Railings and Retractable Ladders: Type 316 stainless-steel fasteners.
- B. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.04 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.

- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- F. Form changes in direction by inserting prefabricated elbow fittings.
- G. Bend members in jigs to produce uniform curvature without buckling or otherwise deforming exposed surfaces.
- H. Close exposed ends of railing members with prefabricated end fittings.
- I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers to transfer loads through wall finishes.

2.05 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: As selected by City.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Anchor posts in concrete by inserting into formed or core-drilled holes and grouting annular space.

3.02 CLEANING

- A. Remove any surplus railings and accessories from site.

PART 4 - MEASUREMENT AND PAYMENT

The Contract LUMP SUM price paid for LANDSIDE MARINA AND APPURTENANCES shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and installing aluminum pipe and tubing, complete in place, as shown on the plans, as specified in the State Standard Specifications and these Technical Specifications, and as directed by the engineer.

END OF SECTION

SECTION 05 50 13.10

ALUMINUM GANGWAY

PART 1 - GENERAL

1.01 SCOPE

The Work of this section consists of designing, furnishing and installing aluminum gangway and toe plate for the Berkeley Marina Dock Replacement (D&E) Project (Project).

1.02 REFERENCES AND STANDARDS

- A. American Welding Society (AWS) D1.2 – 2014 Structural Welding Code – Aluminum.
- B. 2005 California Department of Boating and Waterways (DBAW) Layout and Design Guidelines.
- C. 2022 California Building Code (CBC) applicable to the land side facility elements only.
- D. 2010 ADA Standard for Accessible Design, Section 235 Recreational Boating Facilities, and Section 1003.

1.03 SUBMITTALS

- A. Design: The Contractor shall employ the services of a professional Licensed Engineer registered in the State of California to prepare stamped design drawings and calculations for the gangway structures attesting that the gangway, attachment, related components, including handrails, conform to all specifications and regulatory agency requirements.
- B. Shop Drawings: Submit Shop Drawings for the complete gangway and handrail assembly, showing all materials, member shapes and sizes, dimensions, quantities, connecting details, accessories and calculations. Shop Drawings shall also be provided for all gate and fence fabrication and all other specially fabricated items and catalog sheets for standard manufactured items.
- C. Testing and Inspection Program: Submit a testing and inspection program for all aluminum fabrication welding to assure the welds and fabricated items meet all AWS, CBC and DBAW and other applicable codes and requirements. The cost of the welding testing and inspection shall be borne by the Contractor and no separate

payment will be made by the City for compliance with this requirement.

Submit written copy of Quality Control program prior to fabrication.

- D. Certification: Submit certification from manufacturers, suppliers, fabricators, etc., attesting that the following materials conform with the Contract requirements:
1. Aluminum.
 2. Fasteners.
 3. Certifications of welders.
 4. Certification that all aspects of the aluminum ramp/gangway materials, supply, fabrication, testing, inspection and installation meet all specified requirements, codes and standards.
- E. Samples: Submit samples for the non-skid decking.

1.04 DESIGN REQUIREMENTS

Information presented in these Specifications is based upon the best estimate of those environmental and physical factors that reasonably can be expected to affect the design, performance and durability of the gangways. These criteria shall be considered as minimum requirements; however, mere conformance to the minimum sizes, strengths and design parameters given herein will not automatically ensure approval. Final calculations shall be the responsibility of the Contractor and shall furnish proof that the gangway structure, using the criteria specified herein as a minimum standard, is designed to withstand the loading without damage throughout the design life of the system. Final design calculations shall be prepared and submitted to the City Representative for review before starting fabrication.

- A. Span Length and Width: The clear span length shall be determined based on the specific location and existing site conditions, but shall have a minimum length of 80 feet. The width shall be a minimum of 4 feet (48 inches) clear or 5 ft wide unless otherwise shown on the plans.
- B. Vertical Loads: The vertical design load shall be the combination of the dead weight of the structure, including attached utilities and either live load Case A or Case B, whichever governs.
1. Case A shall be a uniformly distributed load of 100 pounds per square foot of deck surface area.
 2. Case B shall be a concentrated load of 400 pounds applied on a six (6) inch by six (6) inch area located anywhere on the deck surface.

- C. Horizontal Loads: The horizontal design load shall be either a uniformly distributed wind load of seventeen (17) pounds per square foot of profile area, or a seismic load of 0.3 times the dead weight, whichever governs. The horizontal design load shall be applied in combination with the dead weight.
- D. Deflection: The maximum deflection under the combination of dead and live loads shall equal the span divided by (360).
- E. Safety Factors: The deck and structural components shall be designed with a minimum safety factor on working stress as specified in Aluminum Association - "Specifications for Aluminum Structures" for bridge type structures. For non-aluminum structural components, similar safety factors shall apply.
- F. Beam Design: The hollow aluminum box beam may be designed with uniform tapers at each end to conserve materials and improve aesthetics. The depth of beam at the shore hinge shall be such that the bottom of the beam shall clear the seawall (or abutment) at all stages of tide.

In lieu of a box beam design a Warren (vertical support) truss design is acceptable.

- G. Skid Resistance: The walking surface shall be provided with an aggressively non-skid surface and shall allow 43% of light to penetrate the deck surface.
- H. Handrails: The gangways and fixed ramp shall be fitted with a handrail on each side of the walking surface having the same length as the walking surface. The handrail shall be fabricated of aluminum pipe or tubing with a 1-1/2 inch outside diameter and a smooth gripping surface. Guardrail height shall be forty-two (42) inches from the top of the deck and the spacing of horizontal rails shall be such that a four (4) inch sphere cannot pass through the railing at any point. Handrail extension grab bar shall extend a minimum of 12-inches at either of the gangway.

Guardrail shall be a minimum of 42" in height with a handrail to meet ADA/IBC section 505 between 34" and 38" and CBC chapter 10.

- I. Toe Plate: The toe ramp plate shall make a smooth, gap-free transition between the gangway deck and the landing. The ramp plate shall be minimum 1/4 inch material. The ramp will have an aggressive slip resistant surface. The transition plate for all accessible gangways shall be the full width of the gangway deck and have a maximum slope not in excess of one (1) inch in twelve (12) inches at any tide elevation. The lower edge shall be fitted with a continuous UHMW polyethylene wear block of 1/2 inch thick.
- J. Wheels and Axle: Wheels or a UHMW sliding mechanism shall be installed at the lower end of the gangway. The wheels shall have an allowable load rating greater than that required by the combination of dead and live loads. Wheels shall be aluminum with a molded on polyurethane tread, minimum 2-1/2 inches wide, and sealed roller bearings. Fabricated nylatron GS wheels that meet above load ratings are also acceptable. Axle shall be stainless steel. The axle shall pass through

"double plates" welded to the frame. Wheels shall be located so that they will be within the wheel guide on the float deck at all stages of tide. If a UHMW sliding mechanism is used, 36" long angle track guides shall be installed as the sliding surface.

- K. Wheel Guides and Deck Protective Plates: The landing shall be protected from wear by wheel guides placed under each set of wheels. The wheel guides shall be a minimum of two (2) inches high and of such width and length to underlie the gangway wheels at all stages of tide.
- L. Shore Hinge or Transition Plate: The shore hinge shall provide a gap-free walking surface formed by a continuous pipe hinge. Shore hinge plate shall be a minimum 1/2 inch material and shall have two or more 2-1/2 inch diameter by 6 inch long pipe segments welded to mate with the gangway hinge pipe. Hinge pin shall be solid aluminum bar or steel pipe, secured with retainers that are lockable and removable. The gangway box beam shall be beveled at the shore hinge to prevent contact between the beam and the shore hinge supports at all stages of tide. Existing shore hinges may be re-used provided they are inspected; load-tested; and noted as suitable for re-use on the shop drawings.

If transition plate is used it should be minimum 1/4" material and have an aggressive slip resistant and metalized surface.

- M. Handling and Installation: The gangway design shall include calculation that address loads resulting from handling and installation.
- N. Safety and Disability Access: Design shall conform with Disability Access Requirements of Title 24 of the California Administrative Code, and Regulations of California OSHA, City of Berkeley Standard Accessibility Guidelines, California Building Code, Federal ADA Codes and Guidelines, and City of Berkeley requirements where applicable.
- O. Compatibility: The design shall be compatible with the existing site access and land side amenities and as approved by the City Representative.
- P. Experience of Fabricator: Gangways and fixed ramp shall be fabricated by a firm having a minimum of five (5) years experience in design and fabrication of bridge-type aluminum structures.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Aluminum: All aluminum used in the fabrication shall be Alloy 6061-T6 or 6063-T6. All welding of aluminum shall comply with Aluminum Association - Specifications for Aluminum Structures.

- B. Fasteners: All fasteners shall be 316 Series Stainless Steel.
- C. Welding Filler Wire: All welds shall be made with a filler metal alloy that will produce a weld that is compatible in corrosion resistance with the base metal.
- D. Steel Accessories: All approved mild steel components shall conform to ASTM A-36 and be galvanized after fabrication in accordance with ASTM A-123. All welding of steel shall comply with AWS D 1.1.
- E. Non-Skid Surface: Walking surface shall have a permanent aggressively non-skid finish with a minimum of 40% light emitting open area.
- F. Dissimilar Materials: Where dissimilar materials are in contact, or where aluminum is in contact with concrete, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint conforming to Federal Specification TT-V-51 to prevent corrosive action.

PART 3 - EXECUTION

3.01 FABRICATION

A. Workmanship:

All Work shall conform to the reviewed shop drawings, project drawings and this specification. Construction details, finishing details and colors shall be consistent throughout. Work shall be accurately set to establish lines and elevations, and securely fastened in place. Cutting, drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish.

B. Welding:

1. Preparation: Parts to be welded shall be free of dirt, grease and other contaminants, and shall fit up properly for sound welding. Surfaces to be welded shall not be cut with oxygen. Sawing, shearing or machining may be used.
2. Welding Procedure: All welding shall be with an inert gas shielded arc process. Machine settings shall be developed by making test welds of the same material alloy and geometry as the work pieces and testing the sample welds destructively. All welds shall be full circumference for either round or square material.
3. Utilities: Utilities (water and electrical) shall be attached to the underside of the gangways by means of "Globe Strut" Aluminum Framing System. Channels shall be welded to the gangway cross-framing on approximately four (4) foot on centers or as noted on drawings. Globe strut channel members shall be Part G 3812 A1 or equal.

All exposed surface of the gangway will be mill finish. Deck shall be sandblasted in accordance with Commercial Sand Blast SSPC-SP 6-63

4. All aluminum gangway welding, welding procedures, testing and inspection shall be done in accordance with the requirements of the Structural Welding Code.

Aluminum ANSI - AWS D1.2
(latest edition)
An American National Standard

The aluminum fabrications in this section shall be subject to testing according to the above specifications. The City Representative has the right to test the gangway or any part of the gangway she/he determines necessary to ensure that it meets the requirements of the specifications.

All welding procedures shall be submitted to the City Representative and approved by him/her in writing prior to use on the gangway. The gangway shall be fabricated only by certified welders, and welder certifications shall be submitted to the City Representative prior to start of fabrication.

All inspection and testing required on the aluminum gangway, the costs of welding procedures and welder certifications will be considered as included in the payment for this item and no additional compensation will be allowed.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for ALUMINUM GANGWAY FABRICATION shall be considered as included in the contract lump sum price for OFFSHORE MARINA AND APPURTENANCES and no separate payment will be made therefor.

END OF SECTION

SECTION 06 13 33

PRESERVATIVE TREATED LUMBER AND TIMBER

PART 1 - GENERAL

1.01 SCOPE

This Section includes the installation of the preservative treated lumber and timber of selected portions of Dock D and E and/or other structures needed for completion of the project.

- A. Preservative treated lumber and timber consist of but not limited to the following:
1. Entry gate timber trellis
 2. Float walers
 3. Float rub strips and other miscellaneous components.

1.02 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA U1	(2023) Use Category System: User Specification for Treated Wood
AWPA M4	(2006) Standard for the Care of Preservative-Treated Wood Products
AWPA M6	(2018) Brands Used on Forest Products

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 307 (2021) Standard Specification for
Carbon Steel Bolts and Studs, 60,000
PSI Tensile Strength

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-21035 (RevB; Notice 2) Paint, High Zinc
Dust Content, Galvanizing Repair
(Metric)

MIL-PRF-907 (Rev F) Antiseize Thread Compound,
High Temperature

1.03 SUBMITTALS

Contractor shall provide the following submittals to the City Representative. The following shall be submitted:

- A. Certificates
 - MSDS and CIS
 - Preservative Treatment

1.04 DELIVERY AND STORAGE

Close stack treated timber and lumber material in a manner that will prevent long timbers from sagging or becoming crooked. Keep ground under and within 5 feet of such piles free of weeds, rubbish, and combustible materials. Protect materials from weather. Handle treated timber with ropes or chain slings without dropping, breaking outer fibers, bruising, or penetrating surface with tools. Do not use cant dogs, peaveys, hooks, or pike poles. Protect timber and hardware from damage.

1.05 QUALITY ASSURANCE

- A. MSDS and CIS
 - Provide Material Safety Data Sheets (MSDS) and Consumer Information Sheets (CIS) associated with timber preservative treatment. Contractor shall comply with all safety precautions indicated on MSDS and CIS.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Lumber and Timbers

1. Solid Sawn

Provide solid sawn timbers of Douglas Fir-Larch, graded No. 1 or better, and identified by the grade mark of a recognized association or independent inspection agency using the specific grading requirements of an association recognized as covering the species used. The association or independent inspection agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

2. Preservative Treatment

Fabricate timbers before preservative treatment. Each piece of treated timber shall be branded, by the producer, in accordance with AWWA M6. Treat wood to be used in contact with saltwater splash in accordance with AWWA U1 with water-borne preservative. Use ACQ (Alkaline Copper Quaternary) with a minimum retention of 0.6 Lbs. per cubic foot or approved equal. The Contractor shall be responsible for the quality of treated wood products.

B. Hardware

Bolts with necessary nuts and washers, timber connectors, drift pins, dowels, nails, screws, spikes, and other fastenings. Bolts and nuts shall conform to ASTM A 307. Provide cast-iron ogee, malleable iron washers, or plate or cut washers where indicated. Provide bolts with washers under nut and head. Provide timber connectors and other metal fastenings of type and correct size shown. Hot-dip galvanize hardware.

C. Zinc-Coating

Galvanize steel specified or indicated by the hot-dip process in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable.

D. Antiseize Compound

MIL-PRF-907.

E. Fasteners

Fasteners shall be of the following:

1. Hot dip galvanized conforming to ASTM A153
2. Stainless Steel

PART 3 - EXECUTION

3.01 CONSTRUCTION

Cut, bevel, and face timbers prior to plant preservative treatment. In addition to the contract clause entitled "Accident Prevention" provide protective equipment for personnel fabricating, field treating, or handling materials treated with water-borne salts. Refer to paragraph 1.05, Quality Assurance.

A. Framing

Cut and frame lumber and timber so that joints will fit over contact surface. Secure timbers and post in alignment. Open joints are unacceptable. Shimming is not allowed. Bore holes for timber spikes with a bit size as recommended by the spike manufacturer. Bore holes for bolts with a bit 1/16 inch larger in diameter than rod or bolt. Counterbore for countersinking wherever smooth faces are indicated or specified.

B. Fastening

Vertical bolts shall have nuts on the lower end. Where bolts are used to fasten timber to timber, timber to concrete, or timber to steel, bolt members together when they are installed and retighten immediately prior to final acceptance of contract. Provide bolts having sufficient additional threading to provide at least 3/8 inch per foot thickness of timber for future retightening.

3.02 FIELD TREATMENT

A. Timberwork

Field treat cuts, bevels, notches, refacing and abrasions made in the field in treated lumber or timbers in accordance with AWPA M4, MSDS and CIS. Wood preservatives are restricted use pesticides and shall be applied according to applicable standards. Trim cuts and abrasions before field treatment. Paint depressions or openings around bolt holes, joints, or gaps including recesses formed by counterboring, with preservative treatment used for lumber or timber; and after bolt is in place, fill with hot pitch or a bitumastic compound.

B. Galvanized Surfaces

Repair and recoat zinc coating which has been field or shop cut, burned by welding, abraded, or otherwise damaged to such an extent as to expose the base metal. Thoroughly clean the damaged area by wire brushing and remove traces of welding flux and loose or cracked zinc coating prior to painting. Paint cleaned area with two coats of zinc oxide-zinc dust paint conforming to MIL-P-21035. Compound paint with a suitable vehicle in a ratio of one part zinc oxide to four parts zinc dust by weight.

C. Antiseize Compound

Coat threads of bolts prior to applying washers and nuts. Recoat bolt thread projection beyond nut after tightening.

PART 4 - MEASUREMENT AND PAYMENT

The Contract LUMP SUM price paid for OFFSHORE MARINA AND APPURTENANCES and for LANDSIDE MARINA AND APPURTENANCES shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and installing preservative treated lumber and timber, complete in place, as shown on the plans, as specified in the State Standard Specifications and these Technical Specifications, and as directed by the engineer.

END OF SECTION

SECTION 10 14 00.10
EXTERIOR SIGNAGE

PART 1-GENERAL

1.01 SCOPE

- A. Provide and install complete all metal work as shown and specified for the Berkeley Marina Dock Replacement (D&E) Project (Project) including, but not limited to, the following:
 - 1. Gate D and E sign on gate
 - 2. Slip signs
 - 3. Pile warning signs
 - 4. Accessible slip sign
 - 5. Fire clearance signs
 - 6. Other miscellaneous signs per City request
- B. Unless specifically noted otherwise, Contractor shall provide and pay for all labor, materials, equipment, tools, transportation, shipping, delivery, taxes, insurance, permits, government fees, licenses, inspections and all other facilities and services necessary for the proper execution and installation of the Work.

1.02 QUALIFICATION

- A. Fabricator Qualification Requirements: Signage fabricator shall demonstrate a minimum of five years of fabrication experience, and shall have the broad knowledge, diverse shop and field experience, flexibility, coordinating ability, skilled craftsmen and physical plant necessary to produce quality signs equivalent to or better than those specified. Submit qualifying data to the City for approval, including portfolio of previous work showing at least five relevant examples.

1.03 REFERENCES

- A. Published specifications, standards, tests or recommended methods of trade, industry or governmental organizations apply to work of this Section where cited by abbreviations noted below. Work shall adhere to the most restrictive code.
 - 1. California Building Code Standard (CBC).
 - 2. State of California, California Code of Regulations, Title 24 (CCR Title 24)
 - 3. American Society for Testing and Materials (ASTM).

4. American Welding Society: Standard Code for Arc and Gas Welding (AWS).
5. American Concrete Institute (ACI).
6. City of Berkeley Sign Ordinance.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturers' catalog sheets, brochures, illustrations, test results and/or other standard descriptive data for the following:
 1. Primers, paints and powder coatings, showing that coatings will withstand the marine environment.
 2. Lettering and graphics materials, showing that they will withstand the marine environment.

- B. Shop Drawings:
 1. All shop drawings shall be neat, well organized and clearly legible.
 2. All shop drawings shall be drawn to conventional scale(s) and not subsequently reduced to fit a drawing format.
 3. Submit elevations and plan views for all sign types, including graphic layouts, complete dimensions, materials, locations of all exposed fasteners, colors and finishes. Determine the total quantity for each sign type and note it in the shop drawings.
 4. Submit comprehensive section drawings for sign types where applicable, including sections of all typical members. Show fabrication and installation details, including details for securing members to one another, to building structures, and/or to site work. Show interior construction, reinforcements, anchorages, components and finishes. Reproduction of drawings shown in the Construction Drawings shall not be acceptable.
 5. Site Condition Verification: Where required by the City for specific items, Contractor shall inspect site to confirm installation conditions, then submit shop drawings and/or written documentation for approval indicating proposed mounting devices.

- C. Samples:
 1. Color and Finish: Submit 3 each, 6-inch x 6 inch samples of all paint colors, screen colors, vinyl colors, and material finishes. All paint and screen colors shall be applied to the appropriate substrate.
 - a. Contractor to submit verification of paint manufacturer used for submittal.
 - b. Prior to submittal, Contractor shall verify that all colors submitted as samples match accurately the samples or specifications provided by The City.

- D. Prototypes: Submit one full-size complete prototype for the interpretive signs.

- E. Patterns: Submit one representative full-size pattern each for all Sign Types for which a prototype is not required. All patterns shall be black vinyl graphics on a single carrier sheet and shall include the perimeter of the sign panel.
- F. Quality Control: Samples, mock-ups and prototypes shall be retained by the City for record and quality control until substantial completion unless otherwise indicated by the City.
- G. Adherence to Schedule:
 - 1. Provide fabrication and installation schedule to The City for review and approval.
 - 2. Delays: Delays caused by repeated resubmittals of unacceptable quality, or by tardy submittals or resubmittals, are the sole responsibility of Contractor and may result in the assessment of liquidated damages where applicable. All costs to The City resulting from such delays are the sole responsibility of the Contractor, who shall reimburse same.

1.05 QUALITY ASSURANCE

- A. Contractor shall verify and be responsible for all dimensions and conditions and shall visit the site to inspect and verify field conditions prior to fabrication and installation. The City Engineer shall be notified, in writing, of all discrepancies on Drawings, in field dimensions or conditions, and of changes required in construction details.
- B. Provide each type of sign as a complete unit produced by a single manufacturer, including all required mounting accessories, fittings and fastenings.
- C. Completed work shall be structurally sound, and free from scratches, distortions, chips, breaks, blisters, holes, splits or other disfigurements considered as imperfections for the specific material.
- D. All welding, including equipment, materials, procedures and inspection, shall conform to AWS standards.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials to jobsite until installation areas are ready to receive them. Delivery shall be responsibility of Contractor, and materials shall be insured for the total value of the contents. Freight damage claims and replacement items are the responsibility of Contractor.

- B. Wrap, package, transport, deliver, handle and store materials and equipment at jobsite in such a manner as required to prevent any and all damage, including damage resulting from the intrusion of foreign matter or moisture from any source.
- C. Packaging:
 - 1. Keep all packaged materials in original containers with seals unbroken and labels intact until they are incorporated into the Work.
 - 2. Packaged material shall bear the name of manufacturer, product, brand name, color, stock number and/or other complete identifying information as applies.
 - 3. All packages delivered to the jobsite showing indications of damage that may effect conditions of content are not acceptable.
- D. Labeling: Label each sign with the correct sign location plan reference number.
- E. Promptly remove all damaged or otherwise unsuitable materials and equipment from jobsite.
- F. Storage: Store materials and equipment in accordance with manufacturer's instructions, above grade and properly protected from weather and construction activities.
- G. Protection:
 - 1. Protect all adjacent finished building surfaces, including jambs and soffits of openings used as passageways through which materials and equipment are handled.
 - 2. Maintain finished surfaces clean and unmarred until occupancy by The City.

1.06 WARRANTY

- A. Warrant work against failure because of faulty materials, workmanship and structural design for a period of one year from date of substantial completion. Warranty to include specific date on which Contractor's warranty begins, date of expiration, and name, address and telephone number of contact person during warranty period.
- B. Fading, cracking, warping, peeling, delaminating, rusting, corroding, and/or structural failure, including distortion by whatever cause, shall be construed to mean failure because of faulty materials and workmanship.

- C. Failures during warranty period shall be repaired or replaced to the satisfaction of, and at no cost to, the City.
- D. Contractor shall guarantee unit pricing for all items for a period of one year, with an allowable cap of 10%.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Aluminum:
 - 1. Extruded Shapes: Provide alloy 6063; size as required, or as specified by Engineer.
 - 2. Flat Sheet: Provide alloy 3003; mill finish as specified, for all Work which will receive a painted finish.
- C. Fasteners, Hardware and Devices: Stock proprietary fastening devices of approved standard manufacture such as cadmium plated screws, bolts and washers, and stainless-steel hinges.
 - 1. Conceal all fasteners except where noted or shown otherwise.
 - 2. Finish on all exposed devices to match overall sign finish, unless otherwise noted.
 - 3. Provide vandal-resistant fasteners at all exposed locations unless otherwise noted.
 - 4. Use fasteners fabricated from metals that are noncorrosive to either the sign material(s) or the mounting surface.
- D. Very High Bond Tape: Provide #4905/.020"/clear and/or #4950/.045"/white closed cell acrylic foam carrier with VHB adhesive, very high solvent resistance and very high shear and peel adhesion, as manufactured by 3M Scotch or approved equal.

2.02 FABRICATION

- A. Intent of Specifications: All finished work shall be of the highest quality in order to pass eye-level examination and scrutiny by City.
 - 1. All Work shall be free from burrs, dents, raw edges and sharp corners.
 - 2. Finish all surfaces smooth unless otherwise indicated or specified.
 - 3. Surfaces which are intended to be flat shall be free from bulges, oil canning, gaps or other physical deformities. Such surfaces shall be fabricated to remain flat under installed conditions.

4. Surfaces which are intended to be curved shall be smoothly free-flowing to the required shape(s).
 5. All edges shall be true, and all corners shall be square. Where edges are specified to be painted, fill and sand smooth as required prior to painting.
 6. Isolate dissimilar materials. Exercise particular care to isolate nonferrous metals from ferrous metals as required to prevent corrosion.
 7. All surfaces shall be flat to a tolerance of plus or minus 1/16" when measured at any point with a ten foot straight edge.
 8. All visible sign surfaces of the same type shall have the same finish. Color and/or finish shall be consistent across the entire surface of a sign.
 9. All reveals shall be of uniform width; all butt joints shall be tight and closed along the entire length; all access panels shall have a nominal, uniform gap all around.
 10. All gaps between milled components, when assembled, shall not exceed a tolerance of .005".
- A. Provide colors and/or finish textures to be selected by the City.

PART 3-EXECUTION

3.01 INSPECTION

- A. Contractor shall inspect all installation locations for conditions which will adversely affect the execution, permanence and/or quality of the Work, and notify the City in writing of any and all unsatisfactory conditions. Contractor shall not proceed with installation until said unsatisfactory conditions have been corrected. Commencement of installation indicates acceptance of site conditions and guarantees delivery of an acceptable product.

3.02 INSTALLATION

Pre-installation Walkthrough: Attend a pre-installation walkthrough at the job site to confirm all typical installation conditions and determine installation locations for nontypical conditions. The exact locations for all exterior signs will be determined.

3.03 CLEANING AND PROTECTION

- A. At completion of installation, clean all sign surfaces in accordance with manufacturer's instructions.
- B. Protect all signs from damage until acceptance by City Engineer; repair or replace damaged units as required.

3.04 SITE CLEANUP

A. Final cleanup:

1. Clean and/or repair all evidence of installation work or damage to site work or other adjacent surfaces prior to completion of work.
2. Clean up work area after all installation has been completed. Restore all disturbed ground cover.
3. Remove all protective materials and dispose of properly off site.

3.05 CONTRACT CLOSE-OUT ITEMS

- A. Provide The City with written instructions for proper cleaning of the signs. Note any solvents that should not be used.

PART 4 - MEASUREMENT AND PAYMENT

The Contract LUMP SUM price paid for OFFSHORE MARINA AND APPURTENANCES and for LANDSIDE MARINA AND APPURTENANCES shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and installing exterior signage, complete in place, as shown on the plans, as specified in the State Standard Specifications and these Technical Specifications, and as directed by the engineer.

END OF SECTION

SECTION 12 93 00
SITE FURNISHINGS

PART 1 – GENERAL

1.01 SCOPE

- A. This Section includes the following site and street furnishings, including footings, fittings, connectors, and materials required for installation:
 - 1. (4) ADA Detectable Warning Surface Tactiles (Domes)
 - 2. (1) Reinstall of Pipe Bollards

1.02 SUBMITTALS

- A. Product Data: Manufacturer's current printed specifications and catalogue cuts for each site and street furnishing required.
- B. Shop Drawings: Show plans, elevations, with dimensions and installation details. Submit to City for approval.
- C. Samples: Color and finish for each type of furnishing.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Show not less than 5-years successful and continuous experience in work of the type required.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Packaging and Labeling: Furnish materials in manufacturer's unopened, original packaging, bearing original labels showing quantity, description and name of manufacturer. Verify that all materials and components are adequately padded and securely bound in such a manner that no damage occurs to the product during delivery and unloading at the site.
- B. Storage: Damaged materials will be rejected. Remove damaged materials from the job site immediately and pay cost of replacement. Determination of damage shall be the sole authority of the City.
- C. Painted Finishes: Provide non-scratching, non-staining, firmly bound covering for all shop-painted finishes until installed and accepted.

1.05 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate with the work of other sections to insure the following sequence of construction. Set anchors or sleeves in place and pour footings prior to installation of adjacent paving.

1.06 MAINTENANCE

- A. Maintenance Service: Immediately remove stains to materials or surrounding site improvements. Do not use cleaning solvents harmful to site materials. Do not permit cleaning agents to contaminate planted areas.

PART 2 – PRODUCTS

2.01 SITE AND STREET FURNISHINGS

- A. ADA Detectable Warning Surface Tactile (Domes)
 - 1. (4) 3ft x 5ft heavy duty galvanized steel, post installed tactile.
Powder coated safety yellow.
- B. Pipe Bollards
 - 1. Remove, protect and reinstall pipe bollard.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that site and street furnishings can be installed at indicated locations.
- B. Verify that no defects or errors exist in the work of other Sections that would lead to defective installation or latent defects in workmanship and function of items in this Section.

3.02 INSTALLATION

- A. General: Install site and street furnishings where indicated in accordance with manufacturer's instructions.
- B. Install per City standard detail: embedment or surface mount per city standard detail or per the City's direction.
- C. Provide new and touch up damage to paint as needed.

3.03 PROTECTION

- A. Wrappings: Do not remove protective wrappings from furnishings until instructed by the City Project Manager.

PART 4 - MEASUREMENT AND PAYMENT

The Contract LUMP SUM price paid for LANDSIDE MARINA AND APPURTENANCES and for ACCESSIBILITY IMPROVEMENTS AND LANDSCAPING shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and installing site furnishings including ADA detectable domes and pipe bollards, complete in place, as shown on the plans, as specified in the State Standard Specifications and these Technical Specifications, and as directed by the engineer.

END OF SECTION

SECTION 21 00 00
FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of all fire protection systems as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:

- 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
 - b. Fire hose valves.
 - c. Fire hoses and racks.

- B. Related Requirements:

- 1. Section 21 12 00 "Fire Suppression Standpipes" for fire-hose connections

1.03 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site or where designated.

- 1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing surface-mounting method and relationships of box and trim to surrounding construction.

1. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Samples for Initial Selection: For each type of exposed finish required.
- E. Product Schedule: For fire-protection cabinets. Indicate mounting. Coordinate final fire-protection cabinet schedule with fire-extinguisher and hose schedule to ensure proper fit and function.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.06 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers, hoses, hose valves, and hose racks indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with deck and railing.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.02 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher, hose, rack, and valve. Suitable for outdoor marine environment.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Guardian Fire Equipment, Inc.
 - b. Henderson Marine Supply.
 - c. Potter Roemer.

- B. Cabinet Construction: Nonrated.
 1. Fire-Rated Cabinets: Construct fire-rated cabinets with walls fabricated from minimum 1/8-inch fiberglass. Provide factory-drilled mounting holes.

- C. Cabinet Material: Fiberglass.
 1. Shelf: Same metal and finish as cabinet.

- D. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on deck with no trim.

- E. Door Material: Fiberglass.

- F. Door Style: Vertical duo panel with frame.

- G. Door Glazing: Break glass.

- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 1. Provide recessed door pull and friction latch, manufacturer's standard.
 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

- I. Accessories:
 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 3. Door Lock: Stainless Steel Cylinder lock, keyed alike to other cabinets.
 4. Fire Extinguisher: Nickel-plated, polished-brass body valves, Stainless steel handles and levers, with pictorial marking instruction label system complying with NFPA 10. Regular Dry-Chemical Type in Aluminum Container, minimum 2A-20 B:C and 2.5 lb capacity with sodium bicarbonate-based dry chemical in enameled-aluminum container. Provide manufacturer's standard stainless steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated baked-enamel finish

5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER INSIDE"
 - 1) Location: Applied to cabinet door or cabinet glazing.
 - 2) Application Process: Silk-screened or Decals.
 - 3) Lettering Color: Red.

J. Materials:

1. Fiberglass.
 - a. Finish: Gel coat.
 - b. Color: Yellow.
2. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.03 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Provide factory-drilled mounting holes.
 2. Prepare doors and frames to receive locks.
 3. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners formed and if needed ground smooth.

2.04 GENERAL FINISH REQUIREMENTS

- A. Protect finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping. Provide a marine environment rated clear coat over fiberglass for site installation.
- B. Finish fire-protection cabinets after assembly.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for valves and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine deck and rail for suitable installation where cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Examine fire extinguishers for proper charging and tagging.
- E. Remove and replace damaged, defective, or undercharged fire extinguishers

3.02 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
 - 2. Hose and Valve Cabinets:
 - a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
 - 3. Fire Extinguishers:
 - a. Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.03 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for fire protection cabinets shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 21 05 29

HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of all hangers and support systems for piping as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.

- B. Related Sections:

- 1. Section 05 50 00 "Metal and Hardware" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

- 1. Design supports for multiple pipes, capable of supporting combined weight of supported systems, system contents, and test water.
- 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 3. Design seismic-restraint hangers and supports for piping and obtain approval from the Engineer.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Structural Pipe Supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.
- D. Certification: Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualifications tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months. Conform to requirements specified in AWS D1.1/D1.1M and AWS D1.6/D1.6M.

1.06 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Structural Stainless Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.6/D1.6M, "Structural Welding Code – Stainless Steel."
- C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

- A. 316 Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of 316 stainless steel.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural 316 stainless-steel shapes with MSS SP-58 316 stainless-steel hanger rods, nuts, saddles, and U-bolts.

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted 316 stainless steel channel with inturred lips.
5. Channel Nuts: Formed or stamped 316 stainless steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of 316 stainless steel.

2.04 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-316 stainless steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, 316 stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.05 STRUCTURAL PIPING SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural 316 stainless-steel shapes.

2.06 MISCELLANEOUS MATERIALS

- A. Structural Stainless Steel: ASTM A 276 and A484, 316 stainless-steel plates, shapes, and bars.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with NFPA 13, MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with NFPA 13, MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from stainless-steel shapes selected for loads being supported. Weld stainless steel according to AWS D1.6/D1.6M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-stainless-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65)] and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.02 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and pipe supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M and AWS D1.6/D1.6M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.03 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

3.05 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment. All piping hangers, supports and hardware shall be 316 stainless steel unless otherwise noted on the drawings. Hangers and Supports shall comply with NFPA 13.
- B. Comply with NFPA 13 and MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use 316 stainless-steel pipe hangers and supports, and stainless-steel attachments for hostile environment applications.
- D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).

5. Adjustable, Band Hangers (MSS Type 7 or 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 7. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 8. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 9. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
- E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. 316 Stainless-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
- G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. 316 Stainless Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete deck.
 2. Welded-Stainless Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 3. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
 4. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 5. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

- H. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- I. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- J. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for hangers and support for fire suppression shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 21 11 00

FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of all fire suppression water service piping systems as indicated on the Project Drawings and specified herein.
- B. Refer to section Appendix for Fire-Suppression Water Hydraulic Calculations.

1.02 SUMMARY

- A. Section includes fire-suppression water-service piping and related components outdoors, and the following:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-suppression specialty valves.
- B. Related Requirements:
 - 1. Section 21 12 00 "Fire-Suppression Standpipes" for fire-suppression standpipes.
 - 2. Section 22 05 16 "Expansion Fittings For Piping" for fire-suppression hose fittings above ground where indicated on the drawings.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying the water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.07 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Construction Manager's or Owner's written permission.

PART 2 - PRODUCTS

2.01 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
- B. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - 2. Standard: UL 1091 except with ball instead of disc.
 - 3. Valves NPS 2 and NPS 2-1/2: 316 Stainless Steel body with threaded ends.
- C. 316 Stainless Steel OS&Y Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. United Brass Works, Inc.

2. Standard: UL 262.
3. Pressure Rating: Class 150.
4. Body Material: Stainless Steel 316.
5. End Connections: Threaded.

2.02 PE PIPE AND FITTINGS

- A. PE, Fire-Service Pipe: FM Global approved, with minimum thickness equivalent to Class 150.
- B. Molded PE Fittings: FM Global approved; PE butt-fusion type, made to match PE pipe dimensions and class.

2.03 SPECIAL PIPE FITTINGS

- A. Stainless Steel Flexible Expansion Joints:
 1. Description: Provide flexible expansion joints on fire suppression piping where indicated. Refer to Section 2200516 "Expansion Fittings for Piping".

2.04 JOINING MATERIALS

- A. Gaskets for Ferrous Piping: ASME B16.21, asbestos free.

2.05 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.06 CURB VALVES

- A. Curb Valves: Comply with AWWA C800 for high-pressure, service-line valves. Valve has bronze body, ground-key ball, wide tee head, and inlet and outlet matching service piping material.
- B. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 1. Shutoff Rods: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.07 DETECTOR CHECK VALVES

- A. Description: Epoxy coated ductile-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Corrosion protective coating shall include electrochemical corrosion inhibitor primer, microbial inhibitor and epoxy topcoat. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required. Flange connections shall be compliant to ASME B16.1 Class 125.
- B. Standards: UL 312 and FM Global's "Approval Guide."
- C. Pressure Rating: 175 psig.

2.08 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Standard: ASSE 1013 and AWWA C511.
 - 2. Operation: Continuous-pressure applications.
 - 3. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
 - 4. Size: Refer to Drawings.
 - 5. Body Material: Ductile iron with coating and interior lining complying with AWWA C550, or stainless steel for NPS 2-1/2 and larger. Refer to Drawings.
 - 6. End Connections: Flanged for NPS 2-1/2 and larger.
 - 7. Configuration: Designed for horizontal, straight through flow.
 - 8. Accessories:
 - a. Valves: OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Backflow Preventer Test Kits:
 - 1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.09 ALARM DEVICES

- A. General: UL 753 and FM Global's "Approval Guide" listing, of types and sizes to mate and match piping and equipment.
- B. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.
- B. Comply with NFPA 24 for fire-service-main piping materials and installation.
- C. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- D. Bury piping with depth of cover over top at least 30 inches, in accordance with the drawings, and according to the following:
 - 1. Under Walkways/Driveways: With at least 36 inches cover over top.
 - 2. In Loose Gravelly Soil and Rock: With at least 12 inches of additional cover.
- E. Extend fire-suppression water-service piping and connect to water-supply source at locations and pipe sizes indicated.
- F. Comply with requirements for fire-suppression water-service piping in the following Sections:
 - 1. Section 211200 "Fire-Suppression Standpipes"
- G. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping.

3.02 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
- H. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- I. Do not use flanges or unions for underground piping.

3.03 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.04 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24.
- D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

3.05 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers and piping on concrete piers. Comply with requirements for concrete piers in Section 033000 "Cast-in-Place Concrete."

3.06 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire-department connection to mains.

3.07 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
- C. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- D. Connect alarm devices to facility's fire-alarm system.

3.08 CONNECTIONS

- A. Connect fire-suppression water-service piping to utility water main.

3.09 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B. Piping Tests: Conduct piping tests before joints are covered. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig (zero kPa). Slowly increase again to test pressure and hold for one more hour. Maximum

allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

- D. Prepare test and inspection reports.

3.10 IDENTIFICATION

- A. Permanently attach plastic marker indicating fire-suppression water-service piping.

3.11 CLEANING

- A. Clean and disinfect fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow it to stand for three hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

- B. Prepare reports of purging and disinfecting activities.

3.12 PIPING SCHEDULE

- A. Underground fire-suppression water-service piping NPS 4 shall be one of the following:

1. PE, Class 150, fire-service pipe; molded PE fittings; and heat-fusion joints.

- B. Aboveground fire-suppression water-service piping NPS 2 and smaller shall be HDPE pipe and nipples; and fusion joints.
- C. Aboveground fire-suppression water-service piping NPS 3 and NPS 4 shall be one of the following:
 - 1. HDPE pipe; and fusion joints.
- D. Aboveground fire-suppression backflow preventer water-service piping shall be flanged-end standard pattern, ductile-iron pipe; glands, gasketed; with 316 stainless steel bolts and hardware and with marine environment epoxy coating.

3.13 VALVE SCHEDULE

- A. Standard-pressure, aboveground fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:
 - 1. 200-psig, AWWA, 316 stainless steel, OS&Y, metal resilient-seated gate valves.
 - 2. 175-psig, UL-listed or FM Global-approved, 316 stainless steel, OS&Y gate valves.
- B. Fire-suppression water-service check valves NPS 3 and larger shall be one of the following:
 - 1. UL-listed or FM Global-approved check valves.
 - 2. UL-listed or FM Global-approved detector check valves.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for facility fire-suppression water-service piping shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

APPENDIX – FIRE-SUPPRESSION WATER HYDRAULIC CALCULATION



Hydraulic Calculations by HydraCALC

YEI ENGINEERS
7677 Oakport Street
Suite 200
Oakland, CA 94621
(510) 383-1050

Job Name :
Drawing : NA
Location : Berkeley Dock
Remote Area : 1
Contract :
Data File : Standpipe Calc.WXF

HYDRAULIC DESIGN INFORMATION SHEET

Name - KF Date - 10/27/23
 Location - Berkeley Dock
 Building - NA System No. - 1
 Contractor - Contract No. -
 Calculated By - YEI Engineers Drawing No. -
 Occupancy -

S (X)NFPA 14 Number of Standpipes ()1 (X)2 ()3 ()4 ()
 Y ()Other
 S ()Specific Ruling Made by KF Date 10/27/23
 T
 E Flow at Top Most Outlet - 250 Gpm System Type
 M Pres. at Top Most Outlet - 100 Psi (X) Wet () Dry
 Flow For Ea. Additional Standpipe - 250 Gpm
 D Total Additional Flow - 750 Gpm
 E Elevation at Highest Outlet - 3 Feet
 S Hose Valve Connection ()1 1/2" (X)2 1/2"
 I Class Service (X)I ()II ()III
 G Note:
 N

Calculation	Gpm Required	Psi Required	At Test
Summary	C-Factor Used:	Overhead	Underground 0

W Water Flow Test:	Pump Data:	Tank or Reservoir:
A Date of Test - 07/15/22		Cap.
T Time of Test -	Rated Cap. 3000	Elev.
E Static (Psi) - 92	@ Psi 150	
R Residual (Psi) - 69	Elev.	Well
Flow (Gpm) - 750		Proof Flow Gpm
S Elevation - 12		

U
 P Location: Hydrant 3 Spinnaker Way
 P
 L Source of Information: EBMUD Fire Service
 Y

Fittings Used Summary

YEI ENGINEERS

Page 2
Date

Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

SUPPLY ANALYSIS

Node at Source	Static Pressure	Residual Pressure	Flow	Available Pressure	Total Demand	Required Pressure
FDC2	See Information on Pump Curve			217.37	750.0	153.041
HYD	92.0	36	1500.0	76.466	750.0	76.466

NODE ANALYSIS

Node Tag	Elevation	Node Type	Pressure at Node	Discharge at Node	Notes
H1	4.0		100.0	250.0	
H2	4.0		101.04	250.0	
H3	4.0		111.45	250.0	
ST1	0.0		105.18		
ST2	0.0		106.22		
ST4	0.0		115.22		
ST3	0.0		116.63		
ST5	0.0		120.37		
GW2	0.0		121.09		
GW1	3.0		141.94		
FDC2	3.0		153.04		
FDC	3.0		52.37		
BF2	3.0		52.49		
BF1	-3.0		71.89		
UG1	-3.0		78.54		
HYD	2.0		76.47		

Final Calculations : Hazen-Williams

YEI ENGINEERS

Page 4
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqiv Len	Pipe Ftngs Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
H1 to ST1	4 0	+ 250.00	250.00 250.0	2.5 2.469	T 12.0	4.000 12.000 16.000	120 0.2154	100.000 1.732 3.447			Vel = 16.75
ST1			0.0 250.00					105.179			K Factor = 24.38
H2 to ST2	4 0	+ 250.00	250.00 250.0	2.5 2.469	T 12.0	4.000 12.000 16.000	120 0.2154	101.037 1.732 3.447			Vel = 16.75
ST2			0.0 250.00					106.216			K Factor = 24.26
H3 to ST3	4 0	+ 250.00	250.00 250.0	2.5 2.469	T 12.0	4.000 12.000 16.000	120 0.2154	111.452 1.732 3.447			Vel = 16.75
ST3			0.0 250.00					116.631			K Factor = 23.15
ST1 to ST2	0 0		250.00 250.0	4 4.39		120.000 120.000	150 0.0086	105.179 0.0 1.037			Vel = 5.30
ST2 to ST4	0 0		250.00 500.0	4 4.39	E 23.033	266.000 23.034 289.034	150 0.0312	106.216 0.0 9.008			Vel = 10.60
ST4 to ST5	0 0		0.0 500.0	4 4.39		165.000 165.000	150 0.0312	115.224 0.0 5.142			Vel = 10.60
ST5			0.0 500.00					120.366			K Factor = 45.57
ST3 to ST5	0 0		250.00 250.0	4 4.39	T 46.066	386.000 46.065 432.065	150 0.0086	116.631 0.0 3.735			Vel = 5.30
ST5 to GW2	0 0		500.00 750.0	4 4.39		11.000 11.000	150 0.0660	120.366 0.0 0.726			Vel = 15.90
GW2 to GW1	0 3		0.0 750.0	4 4.39	4E 92.132	92.000 92.133 184.133	150 0.0660	121.092 8.701 12.149			** Fixed Loss = 10 Vel = 15.90
GW1			0.0 750.00					141.942			K Factor = 62.95
GW1 to FDC2	3 3		750.00 750.0	4 4.1	4E 58.134	48.000 58.134 106.134	140 0.1046	141.942 0.0 11.099			Vel = 18.23
FDC2			0.0 750.00					153.041			K Factor = 60.63
System Demand Pressure								153.041			
Safety Margin								64.329			
Continuation Pressure								217.370			
Pressure @ Pump Outlet								217.370			
Pressure From Pump Curve								-164.997			
Pressure @ Pump Inlet								52.372			

Final Calculations : Hazen-Williams

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Page 5
Date

Node1 to Node2	Elev1 Elev2	K Fact	Qa Qt	Nom Act	Fitting or Eqiv	Len	Pipe Ftngs Total	CFact Pf/Ft	Pt Pe Pf	*****	Notes	*****
FDC to BF2	3 3		0.0 750.0	4 4.26			1.000 1.000	120 0.1160	52.372 0.0 0.116			Vel = 16.88
BF2 to BF1	3 -3		0.0 750.0	4 4.26			7.000 7.000	120 0.1153	52.488 18.599 0.807		** Fixed Loss = 16	Vel = 16.88
BF1 to UG1	-3 -3		0.0 750.0	4 4.1	3E	43.601	20.000 43.601 63.601	140 0.1046	71.894 0.0 6.650			Vel = 18.23
UG1 to HYD	-3 2		0.0 750.0	12 12.34	T	93.767	84.000 93.767 177.767	140 0.0005	78.544 -2.166 0.089			Vel = 2.01
HYD			0.0 750.00						76.467			K Factor = 85.77

EBMUD FIRE SERVICE AVAILABLE FLOW & PRESSURE INFORMATION**Contact Information:**

Bryan Hayes
 YEI Engineers
 7677 Oakport Street Suite 200
 Oakland, 94605

Request Number: 7714

E-mail: bhayes@yeiengineers.com
Phone: 2098144930
Cell:
Fax:

Property Information:

7 Spinnaker Way
 BERKELEY, 94720

The following available flow and pressure information is based on a Maximum Day Demand Hydraulic Model Analysis of EBMUD's water distribution system. This information should be used as a guideline of the approximate available flow. It is recommended that a design allowance be made for possible reductions in pressure and/or flow that could occur under other possible scenarios. Applicant understands that the District cannot guarantee any specific values for pressure and flow. If you have any questions, please contact us at nbo@ebmud.com or call (510)287-1008.

Available flow and pressure at possible fire service connection for above property:**Possible Fire Service Connection #1**

Existing Hydrant location, Hydrant No. 14592, located off off the 12-inch main (12SMM70) in Breakwater Drive, on the east side of Breakwater Drive, approximately 20 feet south of Spinnaker Way.

Pressure Zone: Central

Connection Point Elevation (feet): 17
Connection Point Static Pressure (psi): 90
Residual Pressure at gpm (psi):
Residual Pressure at 0 gpm (psi): 83
Residual Pressure at 750 gpm (psi): 66
Residual Pressure at 1500 gpm (psi): 31

Possible Fire Service Connection #2

Off the 8-inch main (8SMB81) in Spinnaker Way, on the south side of Spinnaker Way, approximately 50 feet west of Breakwater Drive.

Pressure Zone: Central

Connection Point Elevation (feet): 19
Connection Point Static Pressure (psi): 89
Residual Pressure at gpm (psi):
Residual Pressure at 0 gpm (psi): 82
Residual Pressure at 750 gpm (psi): 65
Residual Pressure at 1500 gpm (psi): 30

Possible Fire Service Connection #3

Existing Hydrant location, Hydrant No. 12325, located off off the 12-inch main (12SMM65) in Right-Of-Way 2010, on the south side of Right-Of-Way 2010, approximately 955 feet south of Spinnaker Way.

Pressure Zone: Central

Connection Point Elevation (feet): 12
Connection Point Static Pressure (psi): 92
Residual Pressure at gpm (psi):
Residual Pressure at 0 gpm (psi): 86
Residual Pressure at 750 gpm (psi): 69
Residual Pressure at 1500 gpm (psi): 36

Engineer's Comments: The pressure and flow information stated is available at the street main connection on Breakwater Drive, Spinnaker Way, and Right-Of-Way 2010. Connection #1 is also representative of pressure and flow available at the street main connection for existing public hydrant, Hydrant No. 14592. Connection #3 is an existing public hydrant location and is not potential fire or water service connections to the property.

Flow and pressure data is valid for one year after the approval date. You will need to submit a new request and pay applicable fee after the expiration date.

NBO: WMACH Engineer: DCHIU Supervisor: JMC GREGO Date: 2022-07-15
 13:48:10.0



New Business Office | East Bay Municipal Utility District | 510.287.1008 | 375 11th St (MS 104) Oakland 94607

The information provided is not a proposal to provide water service and is based on preliminary information and is subject to revision. A completed water service application is needed for final determination.

SECTION 21 11 19

FIRE DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of the fire department connection equipment as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:
 - 1. Exposed-type fire-department connections.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.01 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- A. Standard: UL 405.
- B. Type: Exposed, for pipe flange mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Marine environment type, with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, lugged swivel connections, and check devices or clappers. Provide Storz connection as indicated on drawings.
- F. Caps: Lugged type, with gasket and chain for marine environment.

- G. Outlet: Back, with pipe threads.
- H. Number of Inlets: Two.
- I. Finish: Rough brass or bronze.
- J. Outlet Size: NPS 4.
- K. Storz Connection size: NPS 5.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.
- B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install flanged-end fire-department connections.
- B. Install two protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Section 055000 "Metal and Hardware."
- C. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for Fire Department connections shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 21 12 00

FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of the fire-suppression standpipes as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Hose connections.

1.03 DEFINITIONS

- A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS

- A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

1.05 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.
- B. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
 - 1. Minimum residual pressure at each hose-connection outlet is as follows:
 - a. NPS 2-1/2 Hose Connections: 100 psig.
 - 2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:

a. NPS 2-1/2 Hose Connections: 175 psig.

C. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Welding certificates.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

F. Field quality-control reports.

1.08 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.09 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

- a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

1.10 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.
 - 2. Do not proceed with interruption of fire-suppression standpipe service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.02 PIPE AND FITTINGS

- A. SDR 9 HDPE piping with fused joints.

2.03 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 2 and NPS 2-1/2: 316 Stainless Steel body with threaded ends.

C. 316 Stainless Steel OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: Class 150.
4. Body Material: Stainless Steel 316.
5. End Connections: Threaded.

2.04 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Stainless Steel 316.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.

2.05 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire Protection Products, Inc.
 - c. Guardian Fire Equipment, Inc.
 - d. Mueller Co.; Water Products Division.
 - e. NIBCO INC.
 - f. Tyco Fire & Building Products LP.
2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Material: Brass or 316 Stainless Steel.
5. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle.
9. Finish: Rough.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.02 EXAMINATION

- A. Examine roughing-in for hose connections to verify actual locations of piping connections before installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression standpipe piping to water-distribution piping.

3.04 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.
- C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.
- F. Fill wet-type standpipe system piping with water.

3.05 JOINT CONSTRUCTION

- A. Install couplings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install flanges on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- D. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.06 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.
- B. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.07 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device.

3.08 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

3.09 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 4. Verify that equipment hose threads are same as local fire-department equipment.
- C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train or train owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

- A. Standard-pressure, wet-type, fire-suppression standpipe piping, NPS 4 and smaller, shall be one of the following:
1. SDR 9 HDPE with fused joints.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for fire-suppression standpipes shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 21 12 13

FIRE-SUPPRESSION HOSES AND NOZZLES

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of all fire-suppression hoses and nozzles as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:

- 1. NPS 1-1/2 by NPS 2-1/2 rack-type hose stations.

- B. Related Requirements:

- 1. Section 21 00 00 "Fire Protection Cabinets" for hose cabinets.
 - 2. Section 21 12 00 "Fire-Suppression Standpipes" for fire hose valves.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings:

- 1. Include plans, elevations, sections, and mounting and attachment details.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each product type to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 NPS 1-1/2 BY NPS 2-1/2 RACK-TYPE HOSE STATIONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. American Fire Hose.
 2. Guardian Fire Equipment.
 3. North American Fire Hose.
- B. Hose Rack:
1. Standard: UL 47.
 2. Material: Brass finish.
 3. Type: Hose-rack assembly. Include hose valve, reducer adapter, hose rack, water-retention device, hose pins, and hose.
 4. Operation: Semiautomatic.
 5. Sized to hold fire hose.
- C. Hose Valve:
1. Standard: UL 668, NPS 2-1/2, for connecting fire hose.
 2. Type: Nonadjustable.
 3. Pressure-Control Device: pressure restricting.
 4. Hose Valve and Trim Finish: Rough brass or bronze.
 5. Pressure Rating: 300 psig minimum.
 6. Pattern: Angle.
 7. Material: Brass or bronze.
 8. Pressure-Control Device: UL 1468, integral or for field installation if indicated.
 9. Size: NPS 2-1/2.
 10. Inlet: Female pipe threads.
 11. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.
 12. Reducer Adapter: NPS 2-1/2 by NPS 1-1/2.
- D. Hose, double-jacket:
1. Standards: NFPA 1961 and UL 219, lined fire hose with swivel inlet, coupling, gaskets, and nozzle.
 2. Size: NPS 1-1/2.
 3. Length: 75 feet.
 4. Jacket: Combination of natural and synthetic threads or Synthetic thread.
 5. Lining: Rubber, plastic, or combination of rubber and plastic compounds.
 6. Cover: Rubber, plastic, or combination of rubber and plastic compounds.
 7. Nozzle: UL 401 spray nozzle unless plain nozzle is indicated.

- a. Material: Brass.
- b. Type: Spray, adjustable from shutoff to fog spray or straight stream.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire hoses, racks, and monitors.
- B. Examine roughing-in for standpipe systems to verify actual locations of piping connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 HOSE-STATION INSTALLATION

- A. Install freestanding hose stations for access and minimum passage restriction.
- B. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device unless otherwise indicated.
- C. Install cabinet wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 210000 "Fire Protection Cabinets."

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for fire-suppression hoses and nozzles shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 22 05 16

EXPANSION FITTINGS FOR PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Flexible-hose expansion joints.
 - 2. Expansion joint anchors.

1.03 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to structure.
 - 2. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.05 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of expansion joint, from manufacturer.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 EXPANSION JOINTS

- A. Flexible-Hose Expansion Joints:
 - 1. Description: Manufactured assembly with flexible-metal-hose in long-radius, 180-degree return bend.
 - 2. Domestic Water Flexible Hose: NSF 61 compliant UV and ozone resistant, rubber tubing, spiral-ply synthetic fabric reinforced.
 - 3. Fire Water Flexible Hose: UV and ozone resistant, synthetic fiber reinforced, SBR rubber tubing with NBR covering and ends fused to inner tubing.
 - 4. Expansion loops for Domestic Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.
 - a. Hoses and sheaths with minimum 3 times working pressure in psig, at 70 deg F.
 - 5. Expansion loops for Piping NPS 2-1/2 to NPS 6: Stainless-steel fittings with flanged end connections.
 - a. Hoses and sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

PART 3 - EXECUTION

3.01 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.02 ANCHOR INSTALLATION

- A. Attach expansion fittings to pipe and secure pipe by attachments to pier structure.
- B. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected pipe.
- C. Anchor Attachments:
 - 1. Anchor Attachment to stainless-Steel and ductile iron Pipe: Attach with pipe hangers and supports.
- D. Fabricate and install stainless steel anchors. Comply with ASME B31.9.

1. Anchor Attachment to Steel Structural Members: Attach by bolting.
 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- E. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for expansion fittings for piping shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 22 05 23.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of all ball valves for the plumbing piping as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.

1.03 DEFINITIONS

- A. CWP: Cold working pressure.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.18 for solder-joint connections.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Handlever: For quarter-turn valves smaller than NPS 4.

2.02 BRASS BALL VALVES

- A. One-Piece, Brass Ball Valves:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Forged brass or bronze.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Brass or stainless steel.
 - h. Ball: Chrome-plated brass or stainless steel.
 - i. Port: Reduced.

2.03 BRONZE BALL VALVES

- A. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:

1. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:

1. NPS 2 and Smaller: Threaded ends.

3.04 DOMESTIC COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Two-piece, brass ball valves with full port and brass trim.
3. Two-piece, bronze ball valves with full port and bronze or brass trim.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for ball valves for plumbing piping shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of all hangers and support systems for plumbing piping as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Metal framing systems.

- B. Related Sections:

- 1. Section 05 50 00 "Metal and Hardware" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

- 1. Design supports for multiple pipes, capable of supporting combined weight of supported systems, system contents, and test water.
- 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- 3. Design seismic-restraint hangers and supports for piping and obtain approval from the Engineer.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Metal framing systems.
 2. Structural Pipe Supports.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

- A. 316 Stainless-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of 316 stainless steel.

2.02 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. Thomas & Betts Corporation.
 - e. Unistrut Corporation; Tyco International, Ltd.
 - f. Wesanco, Inc.
 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 3. Standard: MFMA-4.
 4. Channels: Continuous slotted 316 stainless steel channel with inturred lips.
 5. Channel Nuts: Formed or stamped 316 stainless steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of 316 stainless steel.

2.03 STRUCTURAL PIPING SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural 316 stainless-steel shapes.

2.04 MISCELLANEOUS MATERIALS

- A. Structural Stainless Steel: ASTM A 276 and A484, 316 stainless-steel plates, shapes, and bars.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from stainless-steel shapes selected for loads being supported. Weld stainless steel according to AWS D1.6/D1.6M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.02 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and pipe supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M and AWS D1.6/D1.6M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.03 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

3.05 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment. All piping hangers, supports and hardware shall be 316 stainless steel unless otherwise noted on the drawings. Gangway piping channel supports shall be galvanized steel.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use 316 stainless-steel pipe hangers and supports, and stainless-steel attachments for hostile environment applications.
- D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 5. Adjustable, Band Hangers (MSS Type 7 or 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 7. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 8. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).

9. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
- E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. 316 Stainless-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
- G. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for hangers and supports for plumbing piping shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of domestic water piping system as indicated on the Project Drawings and specified herein.

1.02 SUMMARY

- A. Section Includes:
 - 1. Aboveground domestic water pipes, tubes, and fittings.

1.03 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.04 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61.

2.02 HDPE TUBE AND FITTINGS

- A. HDPE SDR 9 Tube and fusion fittings.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install shutoff valve, at each domestic water-service connection.
- C. Install domestic water piping level without pitch and plumb.
- D. Install piping indicated to be exposed at right angles or parallel to deck and walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping to permit valve servicing.
- F. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- J. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.02 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

3.03 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.05 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.06 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.07 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for domestic water piping shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of low-voltage electrical power conductors and cables, connectors, and splices. These equipment and materials are used to establish electrical connections between distribution equipment and any loads that require electrical power. Cable shall comply with UL and type THHN and/or THWN-2.

1.02 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

A. Available Manufacturers:

1. Alcan Aluminum Corporation; Alcan Cable Div.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.

2.02 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated. All splices on the dock shall be submersible type. All connections to bus bars in switchgear, power panels, mini power centers shall be solderless crimp with 2-hole style connectors.

B. Available Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in raceway and utility chase: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in flexible conduit: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished deck, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with marina application and submersible type.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for low-voltage electrical power conductors and cables shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation, and inspection of grounding and bonding materials equipment: conductors, jumper wires, connectors, and grounding electrodes. The new PG&E transformer shall be grounded according to the NEC and other relevant codes. Grounding conductors shall be provided to every load requiring electrical power. Grounding and bonding materials must meet NETA.

1.02 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - a. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.03 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression - type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.04 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 1. Bury at least 24 inches (600 mm) below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

3.05 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Flexible raceway runs.
 - 5. Armored and metal-clad cable runs.
 - 6. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- D. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.06 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. Use exothermic welds for all below-grade connections.
 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Shall be at least 12 inches (300 mm) deep, with cover.
1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.07 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
 - 3. Substations and Pad-Mounted Equipment: 5 ohms.
 - 4. Manhole Grounds: 10 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify promptly and include recommendations to reduce ground resistance.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for grounding and bonding for electrical systems shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of conduit and cable support devices, mounting, anchoring, and other attachment components to secure electrical raceway to surfaces including such as the underside of aluminum gangway and dock walkways.

1.02 SUMMARY

- A. Section Includes:
1. Conduit and cable support devices.
 2. Support for conductors in vertical conduit.
 3. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
- B. Related Requirements:
1. Products and installation requirements necessary for compliance with seismic and marina environment criteria.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.

i.Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.

2. Slotted support systems.

3. Equipment supports.

4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.04 INFORMATIONAL SUBMITTALS

Welding certificates.

1.05 QUALITY ASSURANCE

Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

1. Manufacturers:

a. Alli3d Tubing

b. Cooper Industries

c. Unistrut

d. Or Approved Equal

A. Standard: Comply with stainless steel components for field assembly.

B. Conduit and Cable Support Devices: Stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of stainless steel.

- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; stainless steel.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Stainless steel fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Allowed Manufacturers are:
 - a. Hilti, Inc
 - b. OZ Gedney
 - c. Or Approved Equal
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Allowed Manufacturers are:
 - a. Cooper B-Line
 - b. Hilti, Inc
 - c. Or Approved Equal
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-stainless steel springhead type.
 - 7. Hanger Rods: Threaded stainless steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 101
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with stainless steel slotted support system, sized so capacity can be increased by at least 30 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag stainless steel screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Anchor equipment to concrete base as follows:
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for hangers and supports for electrical systems shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of conduits, fittings, pull boxes, junction boxes, enclosures, cabinets, and solutions to facilitate the pulling of electrical cable through conduits. Conduit shall be provided to enclose and protect electrical cables used for whole electrical distribution system. Electrical raceway and boxes will shall be corrosive-resistant due to marine environment.

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Surface raceways.
 - 6. Boxes, enclosures, and cabinets.
 - 7. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
- B. Available Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Electri-Flex Co.
 - 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 6. LTV Steel Tubular Products Company.
 - 7. Manhattan/CDT/Cole-Flex.

8. O-Z Gedney; Unit of General Signal.
 9. Wheatland Tube Co.
- C. Rigid Steel Conduit: ANSI C80.1.
- D. Aluminum Rigid Conduit: ANSI C80.5.
- E. IMC: ANSI C80.6.
- F. Fittings: NEMA FB 1; compatible with conduit and tubing materials.
1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. GRC: Comply with ANSI C80.1 and UL 6.
 3. ARC: Comply with ANSI C80.5 and UL 6A.
 4. IMC: Comply with ANSI C80.6 and UL 1242.
 - a. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch (1 mm), minimum.
 5. EMT: Comply with ANSI C80.3 and UL 797.
 6. FMC: Comply with UL 1; zinc-coated steel.
 7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Metal Fittings:
1. Comply with NEMA FB 1 and UL 514B.
 2. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 3. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
 4. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 5. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
- B. Available Manufacturers:
 - 1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. ENT: Comply with NEMA TC 13 and UL 1653.
 - 3. RNC: Type EPC-80-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 - 4. LFNC: Comply with UL 1660.
 - 5. Rigid HDPE: Comply with UL 651A.
 - 6. Continuous HDPE: Comply with UL 651A.
 - 7. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
 - 8. RTRC: Comply with UL 2515A and NEMA TC 14.
 - 9. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
- C. Solvents and Adhesives: As recommended by conduit manufacturer. Available Manufacturers:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
 - 3. Available Manufacturers:
 - a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
 - b. Thomas & Betts Corporation.
 - c. Walker Systems, Inc.; Wiremold Company (The).
 - d. Wiremold Company (The); Electrical Sales Division.
- D. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
 - 1. Material: sheet metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: IMC.
 - 2. Concealed Conduit, Aboveground: IMC.
 - 3. Underground Conduit: RNC.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMTRNC.
 2. Concealed in Ceilings and Interior Walls and Partitions: EMT ENT or RNC.
 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 4. Damp or Wet Locations: GRC.
 5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 1 inch (25 mm) 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to IMC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.

- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 - a.
 - 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 - 3. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.
- EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.07 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for raceways and boxes for electrical systems shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of underground raceways and related equipment for all underground conduit applications such as the feed from the new PG&E transformer to the new electrical switchboard.

1.02 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Precast manholes.
6. Utility structure accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include accessories for manholes, handholes, boxes, and other utility structures.
2. Include underground-line warning tape.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include grounding details.

1.04 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Coated Steel Conduit: PVC-coated GRC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.02 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- C. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
- C. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 75 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
 - 1. Color: Red dye added to concrete during batching.
 - 2. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.04 PRECAST PULLBOX

- A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
- B. Comply with ASTM C 858.
- C. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.
- D. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
 - 1. Splayed location.
 - 2. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
 - 4. Knockout panel shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - 5. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.
- E. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - 1. Type and size shall match fittings to duct to be terminated.

2. Fittings shall align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.
- F. Ground Rod Sleeve: Provide a 3-inch (75-mm) PVC sleeve in pullbox floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the duct entering the structure.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

3.02 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

- A. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C 891 unless otherwise indicated.
 2. Install units' level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- B. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- C. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for underground ducts and raceways for electrical systems shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of labeling materials, laminations, bands, preprinted tubes, tapes, stencils, and cable ties. These materials shall be used to clearly identify electrical equipment, raceways, and low-voltage cables by their attributes and sources of power.

1.02 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.02 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters.
 - 2. Legend: Indicate voltage and system.
- B. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.

2.03 LABELS

- A. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

2.04 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.05 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.
- D. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

2.06 CABLE TIES

- A. General-Purpose Cable Ties: Self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- E. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- F. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- G. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- H. Underground Line Warning Tape:
 1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- I. Write-on Tags:
 1. Place in a location with high visibility and accessibility.
 - J. Laminated Acrylic or Melamine Plastic Signs:
 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - K. Cable Ties: General purpose, for attaching tags, except as listed below:
 1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- (75-mm-) high, black letters on 20-inch (500-mm) centers.
- C. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive labels.
- D. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl tape applied in bands.
- E. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 1. "POWER."
- F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use **color**-coding bands to identify the phase.

- G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- H. Workspace Indication: Apply tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- I. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- K. Arc Flash Warning Labeling: Self-adhesive labels.
- L. Equipment Identification Labels:
 - 1. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a laminated acrylic or melamine label.
 - b. Switchboards.
 - c. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - d. Enclosed switches.
 - e. Enclosed circuit breakers.
 - f. Contactors.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for identification for electrical systems shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation, and inspection of switchboards, disconnecting and overcurrent protective devices, accessory components and features, and identification. A new electrical switchboard shall be provided to distribute electrical power to all loads in the project. Switchboard shall withstand the possible fault current.

1.02 SUMMARY

A. Section Includes:

- 1. Service and distribution switchboards rated 600 V and less.
- 2. Disconnecting and overcurrent protective devices.
- 3. Instrumentation.
- 4. Control power.
- 5. Accessory components and features.
- 6. Identification.
- 7. Mimic bus.

B. Related Requirements

- 1. Provide "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

1.03 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, ground-fault protector, accessory, and component.

- 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 2. Detail enclosure types for types NEMA 250, Type 3R.
 3. Detail bus configuration, current, and voltage ratings.
 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 6. Detail utility company's metering provisions with indication of approval by utility company.
 7. Include evidence of NRTL listing for series rating of installed devices.
 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
 10. Include diagram and details of proposed mimic bus.
 11. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.
- D. Delegated Design Submittal:
1. For arc-flash labels.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field Quality-Control Reports:
1. Test procedures used.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.
- C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.08 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- C. Unusual Service Conditions: NEMA PB 2, as follows:
1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet (2000 m).
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Owner's written permission.
 4. Comply with NFPA 70E.

1.09 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory

installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.02 SWITCHBOARDS

- A. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 2.
- E. Comply with NFPA 70.
- F. Comply with UL 891.
- G. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- H. Front- and Side-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Section Alignment: Front aligned.
- I. Front- and Rear-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- J. Nominal System Voltage: 480Y/277 V.
- K. Main-Bus Continuous: 800 A.
- L. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- M. Indoor Enclosures: Steel, NEMA 250, Type 1.
- N. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- O. Outdoor Enclosures: Type 3R.
1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
 2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.
 3. Doors: Personnel door at each end of aisle, minimum width of 30 inches (762 mm); opening outwards; with panic hardware and provisions for padlocking. At least one door shall be sized to permit the largest single switchboard section to pass through without disassembling doors, hinges, or switchboard section.

4. Accessories: LED luminaires, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack luminaire installed on wall of aisle midway between personnel doors.
 5. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer, with spare capacity of 25 percent, within the switchboard. Supply voltage shall be 120 V ac.
 6. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source.
- P. Barriers: Between adjacent switchboard sections.
- Q. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
- R. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
 2. Space-Heater Power Source: Transformer, factory installed in switchboard.
- S. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
- T. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- U. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- V. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.
- W. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- X. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
 3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
 4. Copper feeder circuit-breaker line connections.
 5. Tin-plated aluminum feeder circuit-breaker line connections.
 6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
 7. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical compression connectors for feeder and branch-circuit ground conductors.
 8. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 9. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
 10. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 11. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 12. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- Y. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- Z. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
- AA. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 8. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."

- g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
- 1. Fixed circuit-breaker mounting.
 - 2. Two-step, stored-energy closing.
 - 3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Time adjustments for long- and short-time pickup.
 - c. Ground-fault pickup level, time delay, and I squared t response.
 - 4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - 5. Remote trip indication and control.
 - 6. Communication Capability: Web enabled integral Ethernet communication module and embedded Web server with factory-configured Web pages (HTML file format). Provide functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - 7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - 8. Control Voltage: 120-V ac.

2.04 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

2.05 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.
 - 1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
- B. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
 - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches (50-mm) above concrete base after switchboard is anchored in place.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to switchboards.
 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install overcurrent protective devices, surge protection devices, and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Install spare-fuse cabinet.
- H. Comply with NECA 1.

3.03 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.04 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Tests and Inspections:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Perform the following infrared scan tests and inspections, and prepare reports:

- a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
- b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
- c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Switchboard will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.07 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.08 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for switchboards shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of electrical panelboards, disconnecting and overcurrent protective devices, identification, and accessory components and features. Panelboards shall be packaged together along with transformers in a power center for further distribution of power to pedestals, light fixtures, and other loads.

1.02 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. MCCB: Molded-case circuit breaker.
- E. SPD: Surge protective device.
- F. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.

2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 certified.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA 3R, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANELBOARD REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets with padlock.
 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R.
 - b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 2. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12 Height: 84 inches (2.13 m) maximum.

3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 7. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 8. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- F. Incoming Mains:
1. Location: Bottom Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
 7. Split Bus: Vertical buses divided into individual vertical sections.
- H. Conductor Connectors: Suitable for use with conductor material.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: Five percent.
- K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and

branch devices listed and labeled by an NRTL for series-connected short-circuit rating.

1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.03 POWER PANELBOARDS

- A. Manufacturer:
 1. Eaton.
 2. General Electrical Company.
 3. Square D.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers .
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

- G. Branch Overcurrent Protective Devices: Fused switches.
- H. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
4. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. For "Shunt Trip" Subparagraph below, 120-V units trip at 55 percent or more of rated voltage; all other voltages trip at 75 percent or more of rated voltage.
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - h. Multipole units enclosed in a single housing with a single handle to operate as a single unit.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.06 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.07 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Comply with mounting and anchoring requirements per manufacturer recommendation.
- E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

- F. Mount panelboard cabinet plumb and rigid without distortion of box.
- G. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- H. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.
- I. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- J. Install filler plates in unused spaces.
- K. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- L. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- M. Mount spare fuse cabinet in accessible location.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 1. Measure loads during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.06 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for panelboards shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 26 00

POWER CENTER SUBSTATION

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for fabrication, installation and inspection of power center substations and the individual components: transformers, panelboards, overcurrent protection devices, cooling fans, and surge protection devices. Power centers serve power pedestals at each dock, and shall meet NEMA 3R for marine environment. Power centers additionally serve light fixtures and RUMs.

1.02 SUMMARY

- A. Section includes freestanding, prepackaged power distribution units for transforming, and distributing electrical power.

1.03 DEFINITIONS

- A. SPD: Surge protection device.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for power distribution units.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting details.
- C.
 - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Seismic Qualification Certificates: For power distribution units, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Certificates: For each type of power distribution unit, signed by product manufacturer.
- D. Source quality-control reports.
 1. For each factory test of power distribution units.
- E. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power distribution units to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain a service center capable of providing training, parts, and emergency on-site repairs in less than eight hours' maximum response time.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.
- B. Store equipment in spaces with environments controlled within manufacturer's ambient temperature and humidity tolerances for non-operating equipment.

1.09 FIELD CONDITIONS

- A. Environmental Conditions: Units shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability.
 - 1. Storage Temperature Range: Minus 67 to plus 185 deg F (Minus 55 to plus 85 deg C).
 - 2. Operating Temperature Range: 32 to 104 deg F (0 to 40 deg C).
 - 3. Relative Humidity Range: 0 to 95 percent, noncondensing.
 - 4. Altitude: Sea level to 1000 feet above sea level.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Eaton marina power equipment or equal
- B. Source Limitations: Obtain power distribution unit and associated components specified in this Section from a single manufacturer with responsibility for entire power distribution unit installation.

2.02 MANUFACTURED UNITS

- A. Description: Integrated and coordinated assembly of power-line-conditioning and distribution components packaged in a single cabinet or modular assembly of cabinets each with full-swivel casters mounted to bottom frame. Include the following components:
 - 1. Input-power, circuit-breaker section.
 - 2. Step down 480v – 208/120v 3 phase transformer.
 - 3. Cooling fan system.
 - 4. Output panelboard.
 - 5. Surge Protection Device system.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. Wiring Access: Bottom wiring access.
- E. Unit Capacity Rating: Carry indicated rms kilovolt-ampere load continuously without affecting the normal operation of the circuit breakers, monitoring system, or unit controls and without exceeding rated insulation temperature for the following input voltage and load current:
 - 1. Input Voltage: Within rated input-voltage tolerance band of unit.
 - 2. Load Current: Minimum of 3.0 crest factor and 85 percent total harmonic distortion.

2.03 INPUT-POWER, CIRCUIT-BREAKER SECTION

- A. Description: Three-pole, thermal-magnetic-type circuit breaker, rated for indicated interrupting capacity and 125 percent of input current of unit at 100 percent rated load at unit capacity rating.

2.04 TRANSFORMER SECTION

- A. Description: Dry-type, electrostatically shielded, three-phase, common-core, convection-air-cooled isolation transformer.
 - 1. Comply with UL 1561 including requirements for nonsinusoidal load-current-handling capability defined by designated K-factor.
 - 2. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses, one leg per phase.
 - 3. Coil Material and Insulation: Copper windings, 220 deg C insulation class.
 - 4. Temperature Rise: Designed for 150 deg C rise above 40 deg C ambient.
 - 5. Output Impedance: 3.5 plus or minus 0.5 percent.
 - 6. Regulation: 2 to 4 percent maximum, at full-resistive load; 5 percent maximum, at rated nonlinear load.
 - 7. Full-Load Efficiency: Minimum 96 percent at rated nonlinear load.
 - 8. Magnetic-Field Strength External to Transformer Enclosure: Less than 0.1 gauss at 450 mm.
 - 9. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

- a. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - b. Indicate value of K-factor on transformer nameplate.
 - c. Unit shall meet requirements of NEMA TP 1 when tested according to NEMA TP 2 with a K-factor equal to one.
10. Electrostatic Shielding: Independently shield each winding with a full-width, single, copper, electrostatic shield arranged to minimize interwinding capacitance.
- a. Coil leads and terminal trips shall be arranged to minimize capacitive coupling between input and output connections.
 - b. Shield Terminal: Separate, and marked "Shield" for grounding connection. Shield shall be connected to the reference ground point for the distribution panels.
 - c. Capacitance: Limit capacitance between primary and secondary windings to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - d. Common-Mode Noise Attenuation: 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
 - e. Normal-Mode Noise Attenuation: 52 dB minimum, 1.5 to 10 kHz.
11. Neutral Rating: 1.732 times the system full-load ampere rating.
12. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.05 SPD SYSTEM

- A. Description: Integrated SPD system, complying with Surge Protection for Low-Voltage Electrical Power Circuits, to protect unit panelboard, and having the following features:
1. Disconnect Device: Manual, three-pole, fused disconnect switch to de-energize SPD system while permitting power distribution units to continue operation. Fuses are rated at 200-kA interrupting capacity.
 2. Nonlinear Loading: System shall accommodate rated-load current with a minimum 3.0 crest factor and 85 percent total harmonic distortion.

2.06 OUTPUT PANELBOARDS

- A. Description: Panelboards complying with Section 262416 "Panelboards" except for mounting provisions. Mount single panelboards on power distribution unit behind flush doors. Include the following features:
1. Construction: 30 pole, 208 V, three phase; capable of accepting branch circuit breakers rated to 100 A.
 2. Panelboard Rating: 300A, 400A, with main circuit breaker.
 3. Panelboard Phase, Neutral, and Ground Buses: Copper, with neutral bus at least 1.732 times the nominal phase bus rating.
 4. Isolated Ground Bus: Copper, adequate for branch-circuit equipment ground conductors; insulated from supports.
 5. Branch Circuit Breakers: Bolt on.
 6. Cable Racks: Removable and arranged for supporting and routing cables for panelboard entrance.
 7. Access Panels: Arranged so additional branch-circuit wiring can be installed and connected in the future.

2.07 SOUND LEVEL

- A. General: Fully assembled products comply with minimum sound-level requirements in NEMA ST 20 for transformers of corresponding ratings when factory tested according to IEEE C57.12.91.
- B. General: Fully assembled products have a minimum of 3 dB less than the maximum sound levels prescribed for transformers of corresponding ratings when factory tested according to IEEE C57.12.91.
1. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
 - a. 51 to 150 kVA: 45 dBA.
 - b. 151 to 300 kVA: 50 dBA.
- C. Mount transformer on rubber isolation pads.

2.08 ENCLOSURE REQUIREMENTS

- A. A single, freestanding, stainless steel, NEMA Type 3R enclosure. Opening of an exterior door shall not provide access to any live parts. Panels and covers that expose hazardous voltages shall require tools to remove.
- B. Access from front, top, and side only for all installation, operations, and normal maintenance, including infrared scanning of bus and breakers. All normal

operating controls and instrumentation shall be located on the front of the enclosure.

- C. Arrange enclosure to allow lifting and moving via forklift.

2.09 FINISHES

- A. Manufacturer's standard finish over corrosion-resistant pretreatment and primer.

2.10 SOURCE QUALITY CONTROL

- A. Factory Tests: Design and routine tests shall comply with referenced standards.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment. Comply with IEEE C57.12.91 and NEMA ST 20.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Arrange power distribution units to provide adequate access to equipment and circulation of cooling air. Locate transformers away from corners and not parallel to adjacent wall surface.
- B. Coordinate size and location of concrete bases with actual power distribution unit provided.
- C. Equipment Mounting:
 - 1. Install power distribution units on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and existing foundations.
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 3. Supports shall penetrate and be independent of the access flooring.
- D. Identify equipment and install warning signs according to Section 260553 "Identification for Electrical Systems."
- E. Coordinate layout and installation of power distribution units with Owner's equipment.

1. Meet jointly with electronic equipment representatives and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute record to other participants.
3. Adjust arrangements and locations of power distribution units to accommodate and optimize arrangement and space requirements of equipment.

3.02 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
 1. Separately Derived Systems: Make grounding connections to grounding electrodes as indicated; comply with NFPA 70.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Install flexible connections at conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification for circuit breakers, molded case; and for transformers, dry type, air cooled, low voltage. Certify compliance with test parameters.
 2. Perform functional tests of power distribution units throughout their operating ranges. Test each monitoring, status, and alarm function.

- D. Remove malfunctioning units, replace with new units, and retest as specified above.
- E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of conductor and bus connections.
 - 1. Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform two follow-up infrared scans of main breaker, transformer, and panelboards, one at 4 months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying connections checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.
- G. Power distribution unit will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

3.04 STARTUP SERVICE

- A. Perform startup service.
 - 1. Verify that power distribution units are installed and connected according to the Contract Documents.
 - 2. Verify that electrical wiring installation complies with manufacturer's submittal and with written installation requirements in other electrical Sections.
 - 3. Complete installation and startup checks according to manufacturer's written instructions.

3.05 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- B. Adjust power distribution units to provide optimal voltage to equipment served throughout normal operating cycle of loads served. Record input and output voltages and adjustment settings, and incorporate into test results.

3.06 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.07 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain power distribution units.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for power center substations shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes specifications for the lighthouse power pedestal and the installation and field quality control of locking receptacles.

1.02 SUMMARY

- A. Section Includes:
 - 1. Twist-lock receptacles.
 - 2. Prefabricated lighthouse power pedestal.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Receptacles with ground fault device.

1.04 WARRANTY FOR DEVICES

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

PART 2 - PRODUCTS

2.01 LOCKING RECEPTACLES

- A. NEMA L5-30, 125 V, 30A; Isolated Ground Locking:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Leviton Manufacturing Co., Inc.

2. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

- a. Reference Standards: UL CCN RTRT and UL 498.

B. NEMA L6-50, 280 V, 50A; Isolated Ground Locking Receptacle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
- b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- c. Leviton Manufacturing Co., Inc.

2. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

- a. Reference Standards: UL CCN RTRT and UL 498.

4. Options:

- a. Configuration:
 - 1) 2 pole, 3 wire, grounding NEMA L6-50R.

C. Lighthouse Power Pedestal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Eaton, Electrical Sector.

2. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

- a. Durable construction: to withstand outdoor conditions and heavy sunlight.
- b. Double-sided receptacles access.
- c. Cable TV, phone, internet and water connections.
- d. Digital metering & remote monitoring.
- e. Ground fault notification.

PART 3 - EXECUTION

3.01 INSTALLATION OF LOCKING RECEPTACLES

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 4. Consult Architect for resolution of conflicting requirements.
- C. Identification:
 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.02 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

- A. Field tests and inspections must be witnessed by city of Berkeley
- B. Tests and Inspections:
 1. Insert and remove test plug to verify that device is securely mounted.
 2. Verify polarity of hot and neutral pins.

3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for wiring devices shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
8. Temporary erosion and sedimentation control.

1.03 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain City's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.05 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.06 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from City and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed trafficways if required by City or authorities having jurisdiction.
- B. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- C. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 23 00.20 "Excavation and Fill."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

- B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to City.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.03 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Division 1 "General Requirements."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Division 1 "General Requirements."

3.04 EXISTING UTILITIES

- A. City will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. City will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by City or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify City not less than three days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without City's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, and plumbing, electrical, communications, and utilities sections; and in Demolition section.

3.05 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.06 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.07 STOCKPILING ROCK

- A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.
- B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
 - 1. Limit height of rock stockpiles to 36 inches.
 - 2. Do not stockpile rock within protection zones.
 - 3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.

3.08 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.09 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off City's property.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for Site Clearing shall be considered as included in the various other bid items requiring site clearing, protecting existing vegetation to remain, removing existing vegetation, clearing and grubbing, removing, stockpiling and offhauling waste materials, etc., and no separate payment will be made thereof.

END OF SECTION

SECTION 31 23 00.20
EXCAVATION AND FILL

PART 1 - GENERAL

1.01 SCOPE

- A. Perform all structural excavation, trenching, and backfilling work as shown in the specified including but not limited to, utility trenches, footings, and foundations, and for the Berkeley Marina Dock Replacement (D&E) Project.

1.02 STANDARDS

- A. All work shall conform to these Specifications, as well as all applicable codes of governmental agencies having jurisdiction over the work.

1.03 SUBMITTALS

- A. Product Data
 - 1. Aggregate base
- B. Test Reports
 - 1. Fill and backfill test
 - 2. Select material test
 - 3. Density tests
 - 4. Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General Backfill: Backfill material shall be approved by the City's Representative prior to its use. Excavated material and excess material from site grading may be re-used for backfilling and grading, provided such fill shall be homogeneous, free from rocks, rubbish, organic material, etc., and shall consist of fragments capable of being thoroughly crushed and consolidated into a dense, uniform compact fill,

and shall meet the following requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
6 inch	100
3 inch	95-100
No. 200	10-75
Plasticity index	15 maximum

B. Structural Backfill/Base Material

Aggregate base shall be Caltrans Class 2 Aggregate base. Aggregate base shall consist of crushed stone or slag, gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the No. 4 sieve shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested as specified in ASTM C 131. At least 50 percent by weight retained on each sieve shall have one freshly fractured face with the area at least equal to 75 percent of the smallest midsectional area of the piece. Aggregate shall be reasonably uniform in density and quality. Aggregates shall have a maximum size of 1 1/2 inches and shall be within the limits specified as follows:

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	Rigid Pavement Base Course
2"	100
1 1/2"	90-100
3/4"	50-85
No. 4	25-85
No.30	10-25
No. 200	2-9

PART 3 - EXECUTION

3.01 EXCAVATING AND BACKFILLING FOR TRENCHES

- A. Perform all necessary excavation, shoring, pumping and dewatering and

backfilling required for the proper laying of all underground pipes and conduits.

- B. All piping in ground shall have a minimum cover of 2'-0", except as otherwise shown, and shall be laid in ditches dug true to grade and line, avoiding sharp breaks. Piping shall bear equally over its entire length at bottom of ditch. Rock or unstable material encountered at grade shall be replaced with sand fill to a depth of 6 inches below pipe.
- C. Backfill: Fill trenches with excavated material in 6 inch to 8 inch uncompacted thick layer, compacted to 90% relative density. Backfill should be moisture-conditioned to near-optimum in accordance with ASTM D 1557.
- D. Backfilling shall be commenced as soon as practical after subsurface work is installed and reviewed by the Landscape Architect.
- E. No wood or debris shall be buried in any fill. The fill material shall be non-expansive.
- F. Provide shoring, excavation pumping and other requirements as necessary at excavations for points of connection.

3.02 STRUCTURAL EXCAVATION

- A. Structural Excavation: Make all excavation to the grades and elevations shown on the drawings, or to the subgrades required to obtain the finished grades shown thereon. Accurately cut footing trenches. Where footings are to be cut "neat", the trench or excavation width shall be increased by 2 inches from the dimensions shown on the drawings, so as to permit pouring footings against earth banks. If soil type or weather does not permit such excavations, excavate wide enough to permit full forming of footings. If any excavation is made below proper grade, the City shall be immediately notified, and the grade shall be restored in whatever manner, at no expense to the City. All excavations shall be kept free of standing water until concrete work, paving or backfilling is complete. Shore and brace excavations when required to prevent cave-ins.
- B. Foundations from previous structures, underground utilities or other buried structures shall be removed in their entirety and replaced with compacted engineered fill.
- C. When zones of soft or saturated soils are encountered at the overexcavated levels during excavation and compaction, deeper excavation shall be required to expose firm soil. This shall be determined in the field by the Geotechnical Engineer.

3.03 STRUCTURAL BACKFILL/BASE

- A. A minimum of 8 inches of Caltrans Class 2 aggregate base (AB) should be placed and compacted to at least 90% relative compaction for all new reinforced concrete

slabs and footings.

- B. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted and as indicated on the drawings for placement against the retaining wall. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.04 SURPLUS MATERIAL

- A. Any excavated material which proves to be unsuitable or which is not required for backfilling shall be removed from the immediate work area and disposed of off-site.

3.05 CLEANUP

- A. Upon completion of the work under this Section, remove immediately all surplus materials, rubbish and equipment associated with or used in the performance of this work. Failure to perform such cleanup operations within 48 hours shall be considered adequate grounds for having the work done by others at the Contractor's expense.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for Excavation and Backfill shall be considered as included in the various bid items requiring structural excavation, trenching, and backfilling work, and no separate payments will be made thereof.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Dewatering, depressurization, draining and maintaining trenches, excavations and foundation beds in a stable condition.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 32 30, Progress Schedules and Submittals
- B. Administrative Submittals:
 - 1. Discharge permits.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

- A. Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages, and provide adequate backup systems to maintain control of water.

3.02 SURFACE WATER CONTROL

- A. Remove surface runoff controls when no longer needed.

3.03 DEWATERING SYSTEMS

- A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.
- B. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.
- C. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

3.04 DISPOSAL OF WATER

- A. Obtain discharge permit for water disposal from authorities having jurisdiction.
- B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.
- C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.
- D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

3.05 PROTECTION OF PROPERTY

- A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems necessary to prevent damage to existing facilities, completed Work, and adjacent property.
- B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for DEWATERING shall be considered as included in the various bid items requiring dewatering, depressurization, draining and maintaining trenches, excavations and foundation beds in a stable condition, and no separate payments will be made thereof.

END OF SECTION

SECTION 31 62 13.20

PRESTRESSED CONCRETE GUIDE PILES

PART 1 - GENERAL

1.01 SCOPE

This section includes specifications for fabrication, installation and inspection of all concrete prestressed piles used for the floating dock guide piles, including cone hat at the top of piles, as indicated on the Project Drawings and specified herein. These piles will resist loads from the docks and moored vessels as noted in Section 35 51 13.20, Concrete Floating Dock System.

1.02 PERMIT AND CONDITIONS

The Contractor shall conform to the project permits for the installation of all piles. The number of piles depicted on plans are minimum requirements.

1.03 GEOTECHNICAL DATA

All geotechnical design data is based on the geotechnical investigation report by Treadwell & Rollo, "Geotechnical Investigation, Berkeley Marina Rehabilitation December 16, 2004, available upon request.

Berkeley Marina Dock D & E Replacement Project, Pile Driving & Height Geotechnical Memo, Dated April 25, 2022.

1.04 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI):

ACI 211.1 (1991) Selecting Proportions for Normal, Heavyweight and Mass Concrete Reapproved 2009

ACI 214 (1977, R 2011) Evaluation of Strength Test Results of Concrete

ACI 315 (2017) Details and Detailing of Concrete Reinforcement

ACI 318 (2019) Building Code Requirements for Reinforced Concrete

ACI 543R-12 Recommendations for Design, Manufacture and Installation of
Concrete Piles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

ASTM A 416 (2018) Standard Specification for Low-Relaxation, Seven -Wire
Steel Strand for Prestressed Concrete

ASTM A 706/ A 706M (2016) Standard Specification for Deformed and Low
Alloy Steel Bars for Concrete Reinforcement

ASTM A 615/A 615M (2020) Standard Specification for Deformed and Plain
Carbon-Steel Bars for Concrete Reinforcement

ASTM A 1064/A1064M (2018) Standard Specification for Carbon Steel Wire and
Welded Wire Reinforcement, Plain and Deformed for Concrete.

ASTM C 31 (2021) Making and Curing Concrete Test Specimens in the
Field

ASTM C 33 (2018) Standard Specification for Concrete Aggregates

ASTM C 39 (2021) Standard Specification Compressive Strength of Cylindrical
Concrete Specimens

ASTM C 136 (2020) Standard Test Method for Sieve Analysis of Fine and Coarse
Aggregates

ASTM C 143 (2020) Standard Test Method for Slump of Hydraulic Cement
Concrete

ASTM C 150 (2021) Standard Specification for Portland Cement

ASTM C 172 (2017) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C 260 (2016) Standard Practice for Air Entraining Admixtures for
Concrete

ASTM C 494 (2020) Standard Practice for Chemical Admixtures for Concrete

ASTM C 618 (1994) Standard Specification for Coal Fly Ash and Raw or
Calcined Natural Pozzolan for Use in Concrete

AMERICAN WELDING SOCIETY (AWS):

AWS D1.4 (2018) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI):

1. PCI JR-382 Design, Manufacture and Installation of Prestressed Concrete Piling
2. PCI MNL-116 (2021) Manual for Quality Control for Plants and Production of Structural Precast Concrete Products
3. PCI Design Handbook Eighth Edition with all Interims and Errata

1.05 SUBMITTALS

A. Contractor shall submit the following:

1. Pile Shop Drawings: Prepare shop drawings in accordance with ACI 315. Indicate placement of reinforcement including tendons. Indicate location of embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up. Shop drawings shall bear the seal of a professional engineer with a current registration in the State of California attesting that the piles conform to all design requirements.
2. Pile cap data sheet

B. Pile Installation Plan:

1. Show locations of all the dock system guide piles and identify each pile with a unique identification number. Piles on plan may be relocated based on the Contractors and Float fabricator's recommendation. Note the minimum number of piles are depicted on plans.
2. Provide a plan indicating where the numbered piles are to be installed including a sequence or phasing plan with estimated drive dates for each location. Use the identification number on all pile records. Indicate the driving sequence and record the date of driving as work progresses. This plan will be a record document. Contractor to determine final pile location

based on industry standard practice.

3. Provide installation procedures for the pile driving plan. The installation instruction shall contain a schedule of pile installation and proposed barge or crane locations to drive the piles. Indicate how the required tolerances will be met.
4. Provide make and model of pile-driving equipment proposed for the work and capacity of each type of equipment proposed for use in the work. Show details of driving helmets, cap-blocks, and pile cushions. Submit procedure for pile cut-off, pile repair, and finishing.
5. Submit the initial pile installation plan at least 3 weeks prior to the start of pile driving and an updated record plan.

C. Concrete Mix Design Data:

Submit a concrete mix design. Submit at least 3 weeks before concrete is placed. Include the following:

1. Strength
2. Slump.
3. Unit weight of concrete.
4. Quantities of all ingredients.
5. Type of Portland cement.
6. Quantity of air entrained.
7. Source of fine and coarse aggregate.
8. Previous tests or past service.
9. Sieve analysis for aggregates, including fineness modulus.
10. Admixtures
11. Name and address of proposed concrete supplier

D. Quality Control Procedures.

Submit precasting manufacturer's quality control procedures and qualifications of quality control personnel in accordance with PCI MNL-116.

E. Factory Test Reports:

Prior to pile fabrication, submit certified test reports for the following tests specified in ASTM C 33 for all aggregates:

1. Gradation (sieve analysis).
2. Amount of Material Finer than No. 200 Sieve.

3. Organic Impurities.
 4. Soundness.
 5. Clay Lumps and Friable Particles.
 6. Coal and Lignite.
 7. Weight of Slag.
 8. Fineness Modulus.
 9. Reactive Aggregates.
- F. Field Test Reports: Submit concrete cylinder compressive strength test results.
- G. Certificates:
1. Prestressing Steel. Certification from suppliers attesting to the ultimate strength of the strands.
 2. Reinforcing Steel. Certification from suppliers shall attest to the yield strength of the reinforcing steel.
 3. Concrete Mix Design. Certify, using an Engineer approved independent commercial testing laboratory, that proportioning of mix is in accordance with ACI 211.1 or ACI 318 for specified strength and is based on aggregate data which has been determined by laboratory tests during last twelve months.
 4. Corrosion Inhibiting Additive. Certification from manufacturer attesting that the proposed product has been in use for five years in waterfront concrete construction without harmful reactivity with cement, aggregate or reinforcing.
- H. Records:
1. Submit pile driving records no more than 5 business days after installation of piles.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cement: ASTM C 150, Type II, low alkali, with tricalcium aluminate (C3A) content less than 8 percent.
- B. Water: Use potable water.
- C. Aggregates: ASTM C 33, except as modified herein. Provide aggregate free from any substance which may be deleteriously reactive with alkalis in cement in an

amount sufficient to cause excessive expansion of concrete.

D. Admixtures:

1. All concrete shall use an air entraining admixture that conforms to the requirements in ASTM C 260 to obtain air entrainment of 5 percent, plus or minus 1 percent.
2. All concrete shall contain a calcium nitrite corrosion inhibiting solution that conforms to the requirements in ASTM C 494, Type C, as follows:
 - a. The calcium nitrite admixture shall be as manufactured by W.R. Grace, "DCI", or approved equal.
 - b. The calcium nitrite admixture shall be added to the concrete at the rate of 2.5 gallons per cubic yard.
 - c. The water in the corrosion inhibiting solution shall be considered as part of the mixing water.
3. Do not use admixtures containing chlorides.
4. Fly Ash shall conform to ASTM C 618, Class F.
5. Use High-Range Water Reducing Agent, ASTM C 494, Type C or Type F as manufactured by W.R. Grace, or approved equal.

E. Prestressing Steel: Use seven-wire low relaxation strand conforming to ASTM A 416, Grade 270. Use prestressing steel free of grease, oil, wax, paint, soil, dirt, and loose rust. Do not use prestressing strands or wire having kinks, bends, or other defects.

F. Reinforcing Steel: All reinforcing steel including dowels shall conform to ASTM A 615/A 615M, Grade 60, deformed bars.

G. Ties and Spirals: Steel, ASTM A 82 for spirals and ASTM A 615/A 615M for ties.

2.02 CONCRETE MIX DESIGN

A. ACI 211.1 or ACI 318. The concrete to be used for the piles shall have a minimum compressive strength of 6,500 psi at 28 days and a maximum size aggregate of 3/4 inch. The water cement ratio shall not exceed 0.35.

2.03 FABRICATION OF PILES

A. Formwork:

1. Provide forms of metal, braced and stiffened against deformation, accurately constructed, watertight, and supported on unyielding casting beds. Forms shall produce a smooth, dense surface. Chamfer edges and ends $\frac{3}{4}$ inch, unless otherwise indicated.
 2. Forms shall permit movement of pile without damage during release of prestressing force. Make piles to dimensional tolerances in accordance with PCI MNL-116.
- B. Pretensioning: Measure tension to which steel is to be pretensioned by jack pressure read on a calibrated gage and verify by elongation of steel. Use gage calibrated within last 6 months by a laboratory approved by CALTRANS. Provide means for measuring elongation of steel to nearest $\frac{1}{8}$ inch. When difference between results of measurement and gage reading is more than 5 percent, determine cause of discrepancy and correct. Give tensioning steel a uniform prestress prior to being brought to design prestress. Induce same initial prestress in each unit when several units of prestressing steel in a pile are stretched simultaneously.
- C. Casting:
1. Conveying. Clean conveying equipment thoroughly before each run. Convey concrete from mixer to forms as rapidly as practicable by methods which will not cause segregation or loss of ingredients. Deposit concrete as nearly as practicable to its final position. During placing, make any free vertical drop of the concrete less than 3 feet. Remove concrete which has segregated in conveying or placing.
 2. Placing and Finishing. Perform concrete casting within 3 days after pretensioning steel; however, do not deposit concrete in forms until placement of reinforcement and anchorages has been inspected and approved by pile manufacturer's quality control representative. Produce each pile of dense concrete with reinforcement retained in its proper position during fabrication. Use vibrator with heads smaller than the minimum distance between steel for pretensioning. Finish exposed top surface of square pile to obtain a face that is as smooth and true to line as the formed surfaces of the pile. Make surface of pile ends perpendicular to axis of pile.
- D. Curing of Piles:
1. Moist Curing. Moist cure using moist burlap coverings, plastic sheeting, or membrane curing compound until minimum strength to detension is achieved.

2. Accelerated Curing. After placement of concrete, moist cure for a period of 4 hours. Accelerated cure until concrete has reached specified release strength. Enclose casting bed for accelerated curing with a suitable enclosure. During application of steam or heat, increase the air temperature at a rate not to exceed 60 degrees F per hour. Cure at a maximum temperature of 160 degrees F until concrete has reached specified release strength. Reduce temperature at a rate not to exceed 60 degrees F per hour until a temperature of 20 degrees F above ambient air temperature is reached. After accelerated curing, moist cure using either water or membrane curing until a total accelerated and moist curing time of 72 hours is achieved.
 3. Detensioning. Perform releasing of prestressed steel in pretensioned piles in such an order that eccentricity of prestress will be minimized. Gradually release tension in strands from anchorage. Detension after approval by pile manufacturer's quality control representative. Perform transfer of prestressing force when concrete has reached a minimum compressive strength of 4,500 psi.
 4. Pile Marking. Mark piling with lines of high visibility, non-permanent paint at one-foot intervals from bottom to top. Number every five feet. Markings shall be clearly visible and legible to the naked eye at a distance of 75 feet. Piles not properly marked will be rejected. Mark pickup points. Maintain a record of pile casting activity which includes concrete test results, casting date, shipping data and other pertinent data to correlate the manufacturing and the driving records.
- E. Finishing of Pile Surface: All faces of the octagonal pile shall have a smooth finish. Top 20 feet of pile to have Class 1 finish.

2.04 PRODUCT QUALITY CONTROL

- A. Concrete piling shall be manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control" perform product quality control in accordance with PCI MNL-116.

- B. Aggregate Tests:

Take samples of fine and coarse aggregate at concrete batch plant and test. Perform mechanical analysis (one test for each aggregate size) in accordance with ASTM C 136. Tabulate results of tests in accordance with ASTM C 33.

- C. Strength Tests:

Sample concrete in accordance with ASTM C 172 at time concrete is deposited for

each production line. Perform slump tests in accordance with ASTM C 143. Mold cylinders in accordance with ASTM C 31. Mold at least six cylinders per day or one for every 20 cubic yards of concrete placed, whichever is greater. Cure cylinders in same manner as piles and for accelerated curing, place at coolest point in casting bed. Perform strength tests in accordance with ASTM C 39. Test two cylinders of each set at 7 days or 14 days, or at a time for establishing transfer of prestressing force (release strength) and removal of pile from forms. Test remaining cylinders of each set 28 days after molding. Contractor shall retain one additional spare cylinder.

D. Changes in Proportions:

If, after evaluation of strength test results, compressive strength is less than specified compressive strength, make adjustments in proportions and water content and changes in temperature, moisture, and curing procedures as necessary to secure specified strength. Submit changes in mix design to the Engineer in writing.

E. Compressive Strength Test Results:

Evaluate compressive strength test results at 28 days in accordance with ACI 214 using a coefficient of variation of 10 percent. Evaluate strength of concrete by averaging test results of each set of standard cylinders tested at 28 days. Not more than 10 percent of individual cylinders tested shall have a compressive strength less than specified compressive strength.

2.05 PILE DRIVING EQUIPMENT

- A. The Contractor shall be responsible for selecting a hammer and driving system, which is capable of driving the piles to the design tip elevation without overstressing the piles in either tension or compression.
- B. Any special equipment and methods necessary to drive the piling to the required penetration and within specified tolerances shall be provided by the Contractor.
- C. The Contractor shall anticipate and allow for the presence of surface and subsurface debris. This allowance shall include provisions for the possibility of removing through excavation, debris that obstructs the installation of piling.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Pile Hammers:

Furnish a hammer capable of driving piles to indicated tip elevation considering hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross section, length, and total weight of pile; and character of subsurface material to be encountered.

B. Driving Helmets and Cushion Blocks:

Hammer Cushion or Capblock: Use a steel driving helmet or cap including a pile cushion between top of pile and driving helmet or cap to prevent impact damage to pile. Use a driving helmet or cap and pile cushion combination capable of protecting pile head, minimizing energy absorption and dissipation, and transmitting hammer energy uniformly over top of pile. Use pile cushion of solid wood or of laminated construction using plywood, softwood or hardwood boards with grain parallel to end of pile. Provide pile cushion with thickness of 6 inches minimum and 12 inches maximum. Replace pile cushion for each new pile, or when it becomes highly compressed, charred or burned, or has become spongy or deteriorated in any manner.

3.02 DRIVING PILES

A. Driving Piles:

Drive piles to the indicated elevation. If a pile fails to reach indicated elevation, notify the Engineer and perform corrective measures as directed. During driving operations, the trowel finished face of each pile shall be turned away from main and marginal walkways for the least visibility to provide the best overall uniform pile appearance.

B. Protection of Piles:

Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving. Maintain axial alignment of pile hammer with that of the pile. Square pile rotational axis to the axis of the main walkway or the finger float.

C. Tolerances in Driving:

The dock system itself may be used as pile location guide during stabbing and driving.

Piles shall be driven to within 2 inches of the required horizontal and vertical location shown on the plans. Pile shall be driven with a variation of not more than 1.0 percent from vertical and not more than 5° rotation of square. Maintain and check axial alignment and rotational alignment of pile at all times. If subsurface conditions cause pile drifting or rotation beyond allowable alignment tolerance, notify the City Representative and perform corrective measures. The City

Representative may direct the Contractor to remove the pile that is installed beyond the tolerances indicated and require the Contractor to reinstall the pile.

3.03 FIELD QUALITY CONTROL

A. Pile Records:

For each pile, keep a record of the number of blows required for each foot of penetration and number of blows for the last 6 inches penetration. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record re-tap data and unusual occurrences during pile driving. Notify the City Representative 2 weeks prior to driving of piles.

Pile driving shall only occur on weekdays between 8:00 a.m. and 5:00 p.m. and no pile driving shall occur on weekends or federal holidays. Additionally, pile driving times and procedures shall comply with the conditions of all environmental and work permits. Because project is in a residential area, follow all good-neighbor practices if established during initial project or public meetings.

3.04 BROKEN AND DAMAGED PILES

- A. Piles broken or damaged during handling or driving shall, at the discretion of the City Representative, be repaired in an acceptable manner or be replaced.
- B. The Contractor shall submit for the City Representative's review his proposed method of repairing piles, which are damaged.
- C. Pile repair or replacement shall be at no cost to the City nor cause any delay in the construction schedule.

3.05 TIMING

- A. The Contractor shall comply with the allowable pile driving window pursuant to the project permits.

PART 4 - MEASUREMENT AND PAYMENT

The Contract LUMP SUM price paid for OFFSHORE MARINA AND APPURTENANCES shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in fabrication, installation and inspection of all concrete prestressed piles used for the floating dock guide piles, including cone hat at the top of piles, complete in place, as shown on the plans, as specified in these Technical Specifications, and as directed by the engineer.

END OF SECTION

SECTION 32 12 16.16

ROAD MIX ASPHALT PAVEMENT

PART 1 - GENERAL

1.01 SCOPE

This section includes specifications for fabrication, installation and inspection of all asphalt concrete paving on landside improvements, as indicated on the Project Drawings and specified herein.

- A. Section Includes (but is not necessarily limited to):
 - 1. Plant-mixed asphalt concrete (AC) pavement and other asphaltic concrete items for paving of new road works, where indicated.
 - 2. Concrete Pavement, where indicated.
 - 3. Pavement markings and curb painting.

1.02 QUALITY ASSURANCE

- A. The following reference is hereby made part of this Specification and all work of this Section shall conform to the requirements therein, except as herein modified.
 - 1. Standard Specifications of the City and Construction Standards in Public Right of Way by City of Berkeley Public Works Engineering Division Dated September 2022 Refer as "Standard Details".
 - 2. Caltrans Standard Specifications (CTSS or State Standard Specifications, 2022) and Caltrans Standard Plans (CTSP). Delete all references to statistical testing and measurement and payment.
 - 3. In case of conflict between State Standard Specifications (or CCSF Specifications) and this Specification, this Specification governs.
- B. Contractor shall be responsible for materials mix design.

1.03 SUBMITTALS

- A. Contractor shall submit information to substantiate compliance with this Specification. Minimum information submitted shall include a manufacturer's certification for asphalt products and an asphalt concrete mix design by an independent, qualified laboratory. Production of asphaltic concrete for this Project shall not begin until the materials and the mix design have been reviewed and accepted by the City's Representative.
- B. Contractor shall submit manufacturer's literature describing all paint, thermoplastic material, and markers prior to any paving work.

PART 2 - PRODUCTS

2.01 ROAD PAVEMENT

- A. Aggregates for asphaltic concrete shall conform to the requirements of Section 2001 of the City Standard Department of Public Works Details, maximum 1/2-inch size or Section 89.
- B. Asphaltic Materials:
 - 1. Asphalt Cement: Section 92, Asphalt Binders, of State Standard Specifications, with performance grade PG64-10 for use as binder in the asphalt mixture. Amount of asphalt cement shall be based on mix design.
 - 2. Paint Binder: 92 of the State Standard Specifications.
 - 3. Pavement Fabric: Conform to Section 39 of the State Standard Specifications (if any).
 - 4. Aggregate Base: Conform to Section 7597 of the City Standard Specification.
 - 5. Concrete Pavement: Conform to Section 8144 of the City Standard Specification.

2.02 PAVEMENT MARKINGS

- A. Pavement markers and traffic lines shall conform to the requirements shown in Drawing STR-6222 of the City Standards. All other pavement delineation not shown on Drawing STR-6222 shall conform to the applicable details shown on CTSP A20 through A24. Where pavement markings are removed, they shall be replaced in kind.
 - 1. Traffic lines and pavement markings shall be thermoplastic material in accordance with CTSS Section 84, "Markings." Traffic lines shall be placed in the locations and color indicated in the Project Drawings.
 - 2. Pavement markers shall be in accordance with State Standard Specification Section 85, "Pavement Markers".
 - a. Adhesive for cementing markers to pavement shall be Rapid Set Epoxy in accordance with State Standard Specification Section 95-1.02E.
- B. Thermoplastic material shall conform to either State Specification 8010-21C-21 or 8010-21C-19. The State Specification for thermoplastic material and may be obtained from the Transportation Laboratory, PO Box 19128, Sacramento, CA 95819, telephone, 916-739-2400.

PART 3 - EXECUTION

3.01 PROTECTION

- A. Concrete walks, curbs and other improvements adjacent to construction shall be protected. Contractor shall be responsible for damage caused by his employees or equipment and shall make necessary repairs. Buildings and other surfaces shall be covered with paper or other protection, where required.

3.02 CONFORM AREAS

- A. Where new paving is adjacent to existing pavement, areas shall be treated per the requirements of Section 2001 of the City Standard Specifications.

3.03 SURFACE PREPARATION

- A. Prior to commencing, all existing pavement shall be prepared in conformance with the requirements of the City Standard Department of Public Works Specifications.

3.04 ASPHALT CONCRETE

- A. Asphalt concrete base, subbase, leveling course, and wearing surfaces shall be placed and spread in accordance with the requirements of City Standard Specifications Department of Public Works.
- B. Where new pavement is to be placed over existing pavement, the existing pavement shall first be planed in conformance to the requirements Under Streets and Sidewalks of the City Standard Department of Public Works Specifications.

3.05 CONCRETE PAVEMENT

- A. Installation shall conform to Section 7597 to 20A of the City Standard Details.

3.06 APPLICATION OF PAVEMENT MARKINGS

- A. Markings shall be applied as indicated. Where markings are indicated to connect to existing markings, they shall be applied so as to match existing site pavement markings in both materials and character, except as otherwise revised or modified as shown on the Drawings.
- B. Where existing traffic lines and pavement markings are revised by new layout patterns, existing markings shall be removed by grinding.
- C. Where existing pavement markings or traffic lines have become damaged or hard to read as a result of the construction, said pavement markings and traffic lines shall be removed and replaced at the contractor's expense.
- D. Surface Preparation: Thoroughly clean surfaces before application of paint.

- E. Thermoplastic material for traffic lines shall be applied at a minimum thickness of 0.070-inch. Thermoplastic material for pavement markings and crosswalks shall be applied at a thickness of 0.100 to 0.150-inch.
- F. Paint shall be applied pneumatically, where applicable, and at the rate of coverage recommended by the paint manufacturer.
- G. Provide guideline sand templates as necessary to control paint application.
- H. Edges of marking shall be sharply outlined.
- I. Follow paint manufacturer's recommendations regarding drying time required to prevent undue softening of bitumen and to prevent pickup, displacement, or discoloration by tires of traffic.
- J. If there is a deficiency in drying of markings, discontinue operation until cause can be determined and corrected.
- K. If discoloration of paint occurs owing to bleeding of bituminous materials, apply paint in two coats.
 - 1. Apply first coat at 35 to 40 percent recommended coverage.
 - 2. Apply second coat after drying to complete manufacturer's recommended coverage rate.

3.07 CURB PAINTING

- A. If existing curbs are not protected from AC staining, curb painting, where indicated, shall be provided by Contractor, at no expense to The City.

3.08 ADJUSTMENT OF MANHOLE FRAMES AND OTHER CASTINGS

- A. The Contractor shall comply to Manhole Sewers by the City of Berkeley Department of Public Works, Standard Specifications concerning adjustment of frames and castings.
- B. The Contractor shall adjust all manholes and/or castings including, but not limited to, those owned by the Department of Public Works, Department of Electricity (Telecommunication and Information System), Police Department, Fire Department, and of the Auxiliary Water System, and Water Department, and Public Utilities Commission.
- C. The Contractor will be assessed \$500 for each manhole and/or castings left buried after seven (7) calendar days.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for road mix asphalt pavement shall be considered as included in the contract lump sum price for LANDSIDE MARINA AND APPURTENANCES and no separate payment will be made therefor.

END OF SECTION

SECTION 33 11 16

WATER UTILITY PIPING AND APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings for potable water supply piping including domestic water.
 - 2. Valves
 - 3. Underground pipe markers
 - 4. Precast concrete valve and meter boxes
 - 5. Pipe Supports and Anchoring
 - 6. Accessories

- B. Related Requirements:
 - 1. Section 02 22 50 – Structure Demolition
 - 2. Section 31 23 00 – Excavation and Fill
 - 3. Section 31 23 19 – Dewatering

1.02 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 - 4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 5. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

- B. American Water Works Association:
 - 1. AWWA C105 - ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 2. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm), for Water.
 - 3. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
 - 4. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.

5. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
- C. Manufacturer's Standardization Society of the Valve and Fittings Industry:
 1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.
- D. National Fire Protection Agency:
 1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.03 SUBMITTALS

- A. Section 01 13 00 – Administrative Requirements and Submittals: Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.
- C. Shop Drawings: Submit shop drawings for pipe, fittings, and appurtenances. Indicate piece numbers and locations and restrained joint locations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Manufacturer's Instructions: Indicate special procedures required to install Products specified.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 17 00 – Execution Requirements and Section 01 17 70 Closeout Procedures: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.05 QUALITY ASSURANCE

- A. Valves: Mark valve body with manufacturer's name and pressure rating

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- D. Deliver and store valves in shipping containers with labeling in place.
- E. Store and protect products in accordance with manufacturers' instructions.
- F. Store with seals and labels intact and legible.
- G. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- H. For exterior storage of fabricated products, place on sloped supports above ground.

1.07 EXISTING CONDITIONS

- A. Verify field measurements prior to fabrication. Indicate field measurements on shop drawings.

PART 2 PRODUCTS

2.01 GENERAL

- A. All solid wall pipe shall be continuously and permanently marked in conformance with the appropriate ASTM.
- B. The Contractor shall also require the manufacturer to mark the date of extrusion on the pipe.
- C. Refer to Sections 22 11 16 “Domestic Water Piping” and 21 11 00 “Fire-Suppression Water-Service Piping” for piping products.

2.02 UNDERGROUND PIPE MARKERS

- A. Manufacturer and Product List or approved equal:
 - 1. Reef Industries, Model Terra “D”.
- B. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service. Tape color and lettering shall be in accordance with the APWA Uniform Color Code for Marking of Underground Utility Location. The identifying lettering shall be a minimum of 1-inch high permanent black lettering.
- C. Trace Wire: Electronic detection materials for non-conductive piping products.
 - 1. Unshielded 10 AWG. THWN insulated copper wire. Taped to top pipe at 3 ft intervals for all non-metallic pipe.
 - 2. Conductive tape.

2.03 PRECAST CONCRETE VALVE BOXES AND METER BOXES

- A. Conform to City of Berkeley Standards and East Bay Municipal Utility District Standards.

2.04 BEDDING AND COVER MATERIALS

- A. Unless otherwise specified or shown, all material used for pipe embedment shall be as specified in Section 31 20 00, "Earthwork".

2.05 ACCESSORIES

- A. Concrete for Thrust Restraints: Conform to Section 03 31 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspection:
 - 1. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.
 - 2. Verify that all pipes may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the Engineer.
 - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 HANDLING

- A. The Contractor shall provide and use proper implements, tools and facilities for the safe and proper handling and protection of the pipe, all as recommended by the manufacturer. Pipe shall be handled in such a manner as to avoid damage to the pipe material or any coating and especially to the ends.
- B. When damaged pipe cannot be repaired to the satisfaction of the Owner, it shall be removed from the job.
- C. Pipe shall be stored in a safe location, protected from the elements where damage therefrom could result.
- D. The pipe shall be carefully lowered in the trench to prevent damage. Under no circumstances shall pipe be dropped or dumped into trenches. Remove foreign matter and dirt from the inside of the pipe and keep it clean during and after laying.

- E. The Contractor shall take care to keep from damaging the pipe by heavy loads and unnecessary compactive effort especially for shallow lifts. All damaged pipe shall be replaced. Normally, repairs will not be acceptable.

3.03 INSTALLATION

- A. General: Install all pipes in strict accordance with plans and with manufacturers' recommendations as approved by the Engineer.
- B. Delivery, storage and handling of ductile-iron pipe and fittings shall follow the recommendations of AWWA and as specified herein.
- C. Pressure pipe:
 - 1. Pressure pipe shall be laid in accordance with plans and profiles and typical sections. Before new pipe is placed the subgrade material shall be graded so that pipe will rest firmly on undisturbed granular material for its full length.
 - 2. In general, this should be accomplished by over-excavation, adding stabilization material as required, the inclusion of imported bedding material as shown on the plans. All adjustments to line and grade shall be made by scraping away or filling in the bedding to the body of the pipe and in no case by wedging a blocking. Pipe shall be laid on an unyielding foundation to proper line and grade with uniform bearing under the full length of the pipe with slight hand excavation for the coupling to allow for its thickness.
 - a. Where soft or spongy conditions are encountered in the trench at pipe subgrade, this foundation situation shall be corrected by the use of imported stabilization material as specified in Section 31 20 00, "Earthwork".
 - b. All pipe, especially the ends, shall be carefully cleaned before the pipe is joined. Whenever Work ceases for any reason, the end of the pipe shall be closed with a watertight fitting, plug or cover. The interior of the pipe shall be kept free from dirt, foreign material or debris as the Work progresses and the pipe shall be cleaned after completion.
 - c. Pressure line shall be laid to the line and grade shown on the plans. In instances where grade shows constant uphill grade to structures or air relief valve, the Contractor shall take all precautions necessary to secure continual smooth alignment to such appurtenances.
 - 3. Joint deflection shall not exceed 50 percent of the manufacturer's recommended maximum deflection. Fittings shall be provided as required to meet the line and grade indicated on the Contract Drawings.
- D. Contractor shall notify Owner in advance per Division 1 requirements of need to shut down any water main and shall notify affected customers at least 7 days in

advance if shutdown is to exceed 2 hours. Owner's staff will perform water main shutoffs.

- E. The Contractor is responsible for any and all measures required to remove trapped air from the lines, including making temporary taps as required. Some main segments will need to be installed at greater than the minimum cover to avoid creation of high points or to force the high point to the location of an appurtenance (service tap, etc.)

3.04 PROTECTION, BARRICADES, ETC.

- A. Pipe strung out along the trench or stored where it can be damaged or where injury may result to children or the public shall have special precautions taken to prevent damage from occurring. Pipe shall not be spread along trenches for extended periods prior to its actual use. Pipe shall be stored in a safe location out of the traveled way and properly barricaded with suitable lights provided to prevent vehicular damage.

3.05 LAYING BEDDING

- A. All buried pipe shall be laid on a prepared bed as hereinbefore specified. After laying, additional bedding material shall be added to a depth of 3 inches or about the mid-point of the pipe depending upon diameter, after which it shall be tamped with a suitable tool to secure uniform full length bedding up to the mid-point of the pipe. Additional bedding material shall then be placed to the depth shown in the standard details of the plans and compacted by mechanical methods to a relative compaction of 90 percent.
- B. Take necessary precautions to prevent uplift and floating of the pipe prior to backfilling.
- C. Spigot end of the pipe shall be laid in the direction of normal flow away from the booster pumping system.
- D. Water in trenches shall be removed by pumping.

3.06 CUTTING PIPE

- A. General: Cut pipe for inserting valves, fittings, closure pieces, and as otherwise required, in a neat and workmanlike manner without damaging the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe.
- B. Ductile iron pipe: Cut pipe with milling-type cutter, rolling pipe cutter, abrasive saw cutter, or with sledge and cold cutter. Do not flame cut.
- C. Dressing cut ends:
 - 1. Dress cut ends of pipe in accordance with the type of joint to be made.

2. Dress cut ends of mechanical joint pipe to remove sharp edges or projections that may damage the rubber gasket.

3.07 THRUST RESTRAINT

- A. Provide fire protection pipe bends with concrete thrust blocks. Pour concrete thrust blocks against undisturbed earth. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and so pipe and fitting joints will be accessible for repair. Provide minimum sq ft thrust restraint bearing on subsoil per Industry Standards.
- B. Install thrust blocks at dead ends of fire water pipe.

3.08 APPURTENANCES

- A. General: See plans for location of valves and appurtenances to be installed as a portion of the water line.
- B. Tape Wrap: Apply tape wrap per manufacturer's recommendations.

3.09 TOLERANCES

- A. Horizontal Line Tolerance: 2 inches.
- B. Vertical Grade Tolerance: 1 inch. Any deviation with respect to design line and grade shall be recorded at least once per foot and the records shall be submitted to the Engineer as requested. If the alignment is off line or grade, the necessary corrections shall be made to return to the plan alignment at a rate of not more than 1 inch per 25 feet. All corrective work, including new design, if required, shall be performed by the Contractor at no additional cost to the Owner and is subject to the approval of the Engineer.

3.010 REPAIRS

- A. Only new pipe free from defects shall be installed. Portions of broken pipe or short lengths may be used providing they are properly cut back and used as stubs, or short lengths required at structures for flexible joints.
- B. Broken or leaking sections of pipe must be replaced. Repair clamps will not be approved.

3.011 PROTECTION OF FINISHED WORK

- A. Section 01 17 00 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

3.012 CLEANING

- A. Care shall be taken to keep the pipe clean at all times during the installation. Prior to testing the pipe shall be flushed so that the velocities of 5 feet per second are obtained sufficient to clean the entire length of pipe.
- B. If the Contractor digs out any sections subsequent to this where debris could enter the line, the line shall be again flushed through the section that was disturbed.

3.013 TESTING AND FINAL CLEANING

- A. Testing and final cleaning of all pipe shall conform to the requirements of Section 33 13 00, "Pressure Piping Systems Testing".

3.014 DISINFECTION OF POTABLE WATER LINES

- A. Conform to Section 22 11 16 "Domestic Water Piping".

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for water utility piping and appurtenances shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

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SECTION 33 13 00

PRESSURE PIPING SYSTEMS TESTING

PART 1 GENERAL

1.01 REQUIREMENT

- A. The Contractor shall provide all materials, equipment, and labor necessary to perform and complete all pipeline deflection testing, pressure testing, and leakage testing for all pressure piping systems, as specified herein.
- B. The Contractor shall be responsible for conveying test water from the source to the point of usage and also for proper disposal, as required, of water used in the testing operations. All costs associated with supply and disposal of test water shall be at the Contractor's expense.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1 General Requirements.

1.03 CONTRACTOR SUBMITTALS

- A. A testing schedule, including proposed plans for conveyance, control and disposal of test water shall be submitted in writing to the Engineer for review a minimum of 72 hours before testing is to start.
- B. The Contractor shall submit laboratory calibration certificates for all gages to the Engineer for review along with the testing schedule.

PART 2 PRODUCTS

2.01 MATERIAL REQUIREMENTS

- A. All testing equipment and materials shall be provided by the Contractor. No materials shall be used which would be injurious to pipeline system or structure and future function. All test gages shall be laboratory-calibrated test gages and shall be recalibrated by a certified laboratory at the Contractor's expense prior to the leakage test.

PART 3 EXECUTION

3.01 GENERAL

- A. All lines shall be cleaned and flushed prior to leakage testing and video inspection using methods acceptable to the Engineer.
- B. Contractor will be solely responsible for the proper disposal of all water used in the

flushing and testing process. Disposal of all water shall be in accordance with appropriate regulatory agency requirements.

- C. All flushing and testing operations shall be performed in the presence of the Engineer.
- D. All pipe shall be backfilled prior to leakage testing. All tests shall be completed and approved prior to placing of permanent surfacing. When leakage exceeds the amount allowed, the Contractor at its expense, shall locate the leaks and make the necessary repairs or replacements in accordance with the Specifications to reduce the leakage to the specified limits. Any individually detectable leaks shall be repaired, regardless of the results of the tests.

3.02 PRESSURE AND LEAKAGE TESTING OF PRESSURE PIPING SYSTEMS

- A. General: All pressure piping systems shall be tested for pressure and leakage using a hydrostatic test.
- B. Pressure Piping Hydrostatic Test: The Contractor shall furnish all materials, equipment and labor for making a hydrostatic test. Test equipment shall be approved by the Engineer.
 - 1. Furnish the following equipment and materials for the tests:

AMOUNT	DESCRIPTION
2	Approved graduated containers
2	Approved pressure gauges
1	Hydraulic force pump approved by the Engineer
As Required	Suitable hoses and suction pipe

Gauges for testing shall be calibrated with a standardized test gauge provided by the Engineer at the start of each testing day. The calibration shall be witnessed by the Engineer.

- 2. Conduct the tests on buried pipe after the trench has been completely backfilled. The Contractor may, if field conditions permit, partially backfill the trench and leave the joints open for inspection and conduct an initial test. The acceptance test shall not, however, be conducted until all backfilling has been completed. Conduct the tests on exposed piping after the piping has been completely installed, including all supports and hangers.
- 3. Pressure Test: After the pipe has been laid and backfilled and final compaction has been obtained, the Contractor shall test pressure pipe between each valve section or pipe run. The pipe shall be slowly filled with water so that air is removed and the pipe shall be tested hydrostatically to a pressure of 200 psi for a minimum of one hour. Reaction blocking pipe restraints and the like shall be installed prior to test. All exposed pipe, fittings, valves and joints shall be examined during the test for seepage or other defects. Defects noted by this test shall be removed and replaced by the Contractor with sound material. Afterwards, the test shall be repeated to

the satisfaction of the Engineer.

4. Leakage Test: A leakage test shall be conducted after the pressure test has been satisfactorily completed. The duration of each leakage test shall be two hours and during the test the main shall be subjected to a pressure of 100 psi. Leakage shall not exceed that as shown in Table 6A of AWWA Standard C600-93 or not in excess of 10 gallons per day per inch diameter per mile, whichever is less. If any test discloses leakage greater than specified, the Contractor shall at his own expense locate and repair the defective joints until the leakage is within the specified allowance.
5. The separate pressure and leakage tests described above for pressure pipe may be combined into one test by testing the pipe hydrostatically to a pressure of 200 psi for a minimum of two hours while completing all inspections and testing required above for seepage, defects and leakage.
6. Requirements for Exposed Pipelines: All exposed pipelines shall have no visible leakage during the specified test period. Any exposed pipeline with leakage shall be repaired or replaced.

3.03 FINAL CLEANING

- A. Prior to final acceptance, all pipelines shall be flushed out and all accumulated construction debris and other foreign matter removed. Cleaning shall be done in a manner that will keep flushed debris from entering equipment and in a manner approved by the Owner.
- B. Clean and disinfect domestic water pipelines in accordance with AWWA C651 and in accordance with Section 22 11 19, Domestic Water Piping.
- C. Clean fire-suppression water pipelines in accordance with Section 21 11 10, Fire-Suppression Water-Service Piping.

PART 4 - MEASUREMENT AND PAYMENT

Full compensation for pressure piping systems testing shall be considered as included in the contract lump sum price for MARINA UTILITIES INFRASTRUCTURE and no separate payment will be made therefor.

END OF SECTION

SECTION 35 31 19.13

ROCK SLOPE PROTECTION - RIP RAP

PART 1 GENERAL

1.01 SCOPE

This section provides requirements for placing stone for the of existing rip rap at the abutment an abutment walls and all other work not specifically mentioned necessary to repair existing site in the event supplemental rip-rap is required.

1.02 REFERENCES

- A. Standard Specifications - State of California. Department of Transportation.
 - 1. Section 72 - Slope Protection.
 - 2. Section 96 - Geosynthetics.
- B. American Society for Testing and Materials
 - 1. (2009) ASTM C 535 - Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.03 SUBMITTALS

- A. Contractor shall submit a written plan of the means, methods, equipment and sequences to be employed in the transportation and placement of rock to be used in the work.
- B. Contractor shall designate in writing to the City Representative, the source or sources of rock to be used in the work.
- C. Contractor shall not commence shipment of any rock without written acceptance of the materials to be used based on the certificates of compliance and plans of means and methods as previously described.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Repair of existing rip rap revetment shall be a graded shore protection system of materials as shown on the Project Drawings.

- B. Materials shall be sound, suitable for the intended use, and shall be approved by the City Representative. A sample shall be provided to the City Representative prior to Contractor ordering the material.
- C. Rock used in the revetment shall be composed of angular, close-grained, durable and hard quarry rock. Rock shall be free from seams of weaker materials, not subject to weathering or fracture, and of such character as to be suitable for the intended use in permanent construction, and as to resist disintegration from the action of sea water, waves, and weather. Neither breadth nor thickness of individual stones shall be less than one-third its length. Rounded stones or boulders will not be acceptable.
- D. Rip Rap (RSP) if required

Only quarried stone, and on-site reclaimed revetment, shall be used. Rock materials shall be well graded and shall conform to CALTRANS “Light Class” Rock Slope Protection and gradation noted in the table below.

Percent Larger By Weight (SSD)	Limits of Stone Weight (Lbs)
0-5%	500
50-100%	200
95-100%	25

- E. Rock quality shall conform to the following requirements:

TEST METHOD	METHOD	REQUIREMENTS
Apparent Specific Gravity	CA 206	2.5 Minimum
Absorption	CA 206	4.2% Maximum
Durability Index	CA 229	52 Minimum
Abrasion Loss	ASTM C 535	25% Max./1000

- F. Woven type rock slope protection fabric shall be Class 8 or 10 per CTSS and conform to the following requirements:

Specification	Requirement
Weight, grams per square meter, min. ASTM Designation: D 3776	135

Grab tensile strength (25-mm grip), kilonewtons, min. in each direction ASTM Designation: D 4632	0.45
Elongation at break, percent max. ASTM Designation: D 4632	35
Toughness, kilonewtons, min. (Percent elongation x grab tensile strength)	15
Permittivity, 1/sec., min. ASTM Designation: D 4491	0.5

PART 3 EXECUTION

3.01 GRADATION

- A. Control of gradation shall be by visual inspection. Contractor shall provide separate samples, at the construction site, of each class of revetment material used in the work meeting the specified gradations. These samples shall be used in the work meeting the specified gradations. These samples shall be used as a frequent reference by the City Representative for judging the gradation of revetment materials supplied and placed by the Contractor. Any difference of opinion between the City Representative and the Contractor shall be resolved by dumping and physically checking the gradation of random loads of revetment materials as selected by the City Representative. Mechanical equipment, a sorting site, and labor needed to assist in checking gradation shall be provided by the Contractor at no cost to the City. Samples of revetment materials may be used in completing the revetment.

3.02 RIP-RAP PLACEMENT

- A. Contractor shall develop means and methods of rip-rap placement at the project site and present such means and methods to the City Representative for review and approval, prior to commencing work.
- B. Placement shall conform to Method B placement as designated in Section 72-2.03 of the Standard Specifications. Revetment materials shall be placed to the lines and grades shown on the Project Drawings. Local surface irregularities of the revetment slope shall not vary from the planned slopes by more than 1.0 foot above grade, measured at right angles to the surface of the slope, and shall not in any case be below grade.
- C. Rock slope protection fabric shall be placed prior to placing rock slope protection,

when the fabric is shown on the plans, or specified in the special provisions, or ordered by the Engineer.

- D. Rock slope protection fabric shall conform to the provisions in Section 96, "Geosynthetics," Section 96-1.002I of the Standard Specifications and shall be placed in conformance with the details shown on the plans and as specified in these specifications. The fabric shall be woven, Class 8.
- E. Rock slope protection fabric shall be placed in accordance with provisions set in Section 72-1.03 of the Standard Specifications.
- F. Any rip-rap material misplaced and judged objectionable by the City Representative shall be removed by the Contractor at Contractor's expense prior to acceptance of the work.
- G. Prior to acceptance of the work, if additional revetment material is required to conform to the sections on the Project Drawings, Contractor shall return to the points requiring such additional revetment material and place same, without any additional compensation.
- H. Contractor shall not mound rip-rap materials higher than the thickness indicated on the Project Drawings. Stockpiling of revetment materials adjacent to the top of the slope will not be permitted without the approval of the City Representative.
- I. Rip-rap materials shall be carefully placed and worked to provide a minimum of voids. The City Representative may direct the Contractor to rehandle the materials or redress slopes in order to achieve an acceptable finished revetment slope.

3.03 INSPECTION

- A. The City Representative will conduct a visual survey of final slope to verify that the final revetment slope conforms to the design intent.

PART 4 - MEASUREMENT AND PAYMENT

The Contract LUMP SUM price paid for RIP-RAP shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and installing rock slope protection-rip rap, complete in place, as shown on the plans, as specified in the State Standard Specifications and these Technical Specifications, and as directed by the engineer.

END OF SECTION

SECTION 35 51 13.20

CONCRETE FLOATING DOCK SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. Work Included: This section includes design, fabrication, labor, materials, and installation of a complete concrete berthing system for the Berkeley Marina Dock Replacement (D&E) Project (Project) of the Base Bid Design addressing the 79 slips and Alternative Bids BA1 – 4ft Finger (1 Total) – 35 ft Long at Dock D (164 SF), BA2 – 4 ft Fingers (2 Total) – 40 ft long each at Dock D (368 SF), BA3 – 4 ft Fingers (2 Total) – 40 ft long each at Dock E (368 SQ) and BA4 – 4ft Fingers (2Total)- 46ft long each at Dock E (416 SF), including but not limited to precast concrete floats and fingers (including ramp landing floats and related); wales, rub rails, and related connectors; guide piles; fire protection system; electrical and domestic water systems; pile guide connections and hardware; and dock accessories such as cleats, filler panels, and bumpers.
- B. Applicable Publications: The publications listed below form a part of these Specifications to the extent referenced. The publications are referred to in the text by the basic designation only.
1. American Society of Testing and Materials (ASTM) Publications.
 2. American Concrete Institute (ACI) Publications.
 3. 2005 California Department of Boating and Waterways (DBAW) Layout and Design Guidelines for Marina Berthing Facilities and other City approved codes.
 4. City of Berkeley Fire Department and National Fire Protection Association Standard

1.02 GENERAL REQUIREMENTS

- A. The dock system shall be made of concrete floats designed in such a manner that modules may be replaced with replacement modules in cases of repairs. The dock system shall have the dimensions shown on the Project Drawings addressing the Base Bid and Alternative Bid Design.

The Designer shall comply with and include all specific details and requirements

identified in these specifications and the Project Drawings. Float designer shall follow all industry accepted details or standards not noted on Project Drawings, Specifications, or within any of the referenced standards. The float designer and fabricator shall have a minimum of five (5) consecutive years experience in the design and manufacturing of concrete floats.

- B. Precast Concrete Floats shall be connected to form continuous sections of floating dock with connections capable of transmitting all loads imposed upon individual dock floats, or combination of floats, to the floating dock restraint system.
- C. All pre-cast concrete floats shall be delivered to the job site free of defects with no signs of spalling. All floats will be free of structural cracks. Floats shall be stored to prevent damage such as overstressing, warping or twisting. Damaged units will be rejected, indelibly marked and removed from the job site. Units that display repetitive defects or cracking may be cause for rejection.
- D. The general dimensions and layout of the berthing system are shown on the Project Drawings. The Contractor shall verify existing conditions and dimensions relating to the Work of this section. Notify the City Representative in writing of any conditions that differ from the drawings. Commencement of Work without such notification shall be construed as acceptance of all conditions.
- E. Final dimensions are to be shown on the Shop Drawings. All Work shall conform to the approved Shop Drawings. Construction details, finishing details and colors of the completed berthing system shall be consistent throughout.
- F. Each component of the berthing system shall carry a warranty for five (5) years from the date of Project acceptance. Acceptance is clarified to be the date of the beginning of the warranty period of that portion of the Project. The design service life for the floating dock system shall be 30 years.
- G. The Contractor shall be limited to the area designated for the construction staging as shown on the Project Drawings. The construction staging area shall be used for the storage of materials and the Contractor's primary work area.

1.03 SUBMITTALS

- A. Certificates: Before delivery of materials, manufacturer's mill certificates and or certificates of compliance shall be submitted for the following materials:
 - 1. Concrete Admixtures.
 - 2. Portland cement. The certification shall identify the cement: brand name, type, mill location, chloride content, quantity control sample, lot number, and source

of shipment.

3. Steel reinforcement, welded wire fabric, and protective coatings including galvanizing and epoxy.
4. Aggregates. Certified test reports for the following test specified in ASTM C-33, ASTM C330.
5. Lumber grades and treatment certifications
6. Submittals are required for all identified material and as specifically requested by the City Representative.

B. Concrete Mix Design:

1. The Contractor shall provide a certificate for the concrete mix design for the floatation system. The certification must confirm that the mix has been proportioned in accordance with ACI 211.2 or ACI 318 for the specified strength and is based on aggregate data, which has been determined by laboratory tests during the last six months.
2. The mix designs shall be submitted together with the certified test reports or past break history showing the results of the test specified for the various materials, and the results of the 28-day compressive strength tests.
3. If for any reason before or during the course of construction the source of any material for the concrete is changed, quantities varied or deficiency in the strength of the concrete identified the Contractor shall make necessary adjustments to ensure the specified requirements and strengths are maintained.

All changes and/or corrections to the concrete mix design shall be submitted along with revised test data and shall be at the Contractor's expense.

C. Design Calculations:

1. The Contractor shall employ the services of a Professional Engineer Licensed and Registered in the State of California to be the Designer and prepare all design calculations for the floatation system for the base bid and alternative bid design.

The Float Designer shall furnish professional and technical support to the Contractor throughout the duration of the construction contract. The float designer may not be changed once the design has been approved.

2. Prior to fabrication of the concrete floats, the Designer shall prepare and submit

complete design calculations to the City Representative for review, including but not limited to, structural and floatation calculations for the entire berthing system for the base bid and alternative bid.

a. Structural Calculations: Structural calculations shall include, but not be limited to, wind and wave loads, impact loads, torsional stability, component connections, cleat anchorage, and pile connections.

b. Floatation Calculation: Floatation calculations are required for all floats.

The floatation calculations shall include all respective dead loads carried by the specific floats and must demonstrate that the floatation meets performance and freeboard criteria. All means of support used to meet the design freeboard and stability criteria shall be identified and included within the floatation calculation.

Floatation calculations shall be based on the actual weights of the materials being used to construct the floats for the berthing system, including but not limited to dock accessories, dock utilities, lumber, concrete, hardware, polystyrene core, steel components, and miscellaneous designated dead loads.

c. Handling Calculations: Calculations for loading imposed by the handling and lifting methods to be employed shall be submitted for review and approval and shall be based on the concrete strength expectancy at the time of lifting or moving of the floats.

D. Drawings:

1. Final design drawings for the entire concrete floatation system shall be submitted to the City Representative for review and approval. The final approved design drawings shall bear the seal and signature of the Designer/Engineer of Record and shall be prepared in accordance with the Specifications. The drawings shall indicate all details relative to layout and general construction methods, including conformance with 2005 DBAW guidelines and other approved codes.

The design of the Fire Protection system shall be prepared and stamped by a Licensed Registered California Engineer certified to design fire systems in accordance with NFPA guidelines.

2. Shop drawings shall be submitted for review and approval.

Shop Drawings shall identify the specific details relative to fabrication, details of construction, system assembly and erection. Fabrication of the concrete units shall be for the design load conditions and spans indicated on the design drawings (or per design by Float designer) and for any additional loads imposed

by erection of members, openings or support of the work of other trades.

Any specifics relative to the manufacturer's method of operation, including handling, shall be shown on the Shop Drawings and shall be submitted for approval.

The Shop Drawings for concrete docks shall show manufacturer's details and materials for the Work required herein and the following:

- a. Marking of the float units for assembly.
 - b. Connections for work of other trades.
 - c. Details of lumber, carpentry, hardware, and miscellaneous metal fabrications.
 - d. Float dimensions, reinforcing, quantities, design weights.
 - e. Berthing system layout.
 - f. Float layouts and float identification including phased installation schedule.
 - g. Electrical routing layouts and future electrical layouts.
 - h. Plumbing fixture layouts and future plumbing fixture layouts.
 - i. Fire hose cabinet layout and future hose cabinet layouts.
 - j. Power pedestal layout and future pedestal layouts.
 - k. Filler panel and utility details.
 - l. Cleat layout and connection details.
- E. Catalog Sheets: Manufacturer's catalog sheets showing compliance with these Specifications shall be submitted for all standard manufacturers' items.
- F. Manufacturing Records:
1. The Contractor shall provide complete and accurate manufacturing records of all floats furnished for the Project.

The records shall include projected and current float production, float identification, float weights, date cast, related concrete cylinder strength tests and any other quality assurance test or inspection items performed by the fabricator.

The manufacturing records for the floats shall be updated and kept current with ongoing production activities and submitted upon request. The Contractor shall submit for approval the formats to be used for all manufacturing records.
 2. The Contractor shall provide delivery dates and production schedule information for all other materials as part of the manufacturing records.

1.04 QUALITY CONTROL PROCEDURES

- A. Submit detailed quality control procedures established in accordance with PCI Manual MNL-116 and the General Requirements of these Specifications.
- B. Tests and inspections shall be performed by certified testing individuals, engineering companies or testing laboratories for the tests and inspections specified herein and any other such tests or inspections as directed by the City Representative to establish the acceptability of the work.
- C. In house testing and inspection services for tests to be performed at the manufacturing plant shall be retained by the Contractor at his expense.
- D. Furnish material and handling for test cylinders and any other samples that the City Representative requires for analysis of concrete work.
- E. Production Quality Control: Where floats are manufactured in a plant with an established quality control program, as attested to by a current certification in the PCI "Certification Program for Quality Control", perform product quality control in accordance with PCI Manual MNL-116. Where floats are manufactured by specialists or in plants not currently enrolled in the PCI "Certification Program for Quality Control", set up a product quality control system in accordance with PCI Manual MNL-116 and perform concrete and aggregate quality control testing using an independent testing laboratory approved by the City Representative in accordance with the following. Test results shall be submitted to the City Representative.
 - 1. Aggregate Tests: The Contractor shall have samples of the fine and coarse aggregate used at the concrete batch plant tested in accordance with ASTM C-33. Perform mechanical analysis (one test for each aggregate size) including determination of the specific gravity. Tabulate the results of the tests in accordance with ASTM C-33.
 - 2. Strength Tests:
 - a. Sample concrete in accordance with ASTM C-172 at the time the concrete is deposited for each production line.
 - b. The making and curing of test specimens shall be in accordance with ASTM C 31. Compression tests shall conform to methods of ASTM C-39. Perform slump tests in accordance with ASTM C-143.
 - c. A minimum of six (6) cylinders shall be molded and tested for each day of float casting. In the event that more than fifty (50) yards of concrete is batched per day an additional set of six (6) shall be made and tested.
 - d. Curing and test of cylinders shall be in accordance with ASTM and ACI standards.
 - e. Molding and testing of cylinders shall be performed by ACI certified personnel and a certified testing laboratory.

- f. Perform strength tests:
 - Two (2) cylinders of each set twenty-eight (28) days after molding the cylinders.
 - Test one cylinder of each set at time of removal of floats from forms.
 - Test one (1) at time of delivery if delivery is less than 28 days from fabrication.
 - Hold two (2) cylinders as spares.
3. Changes in Proportions: If, after evaluation of strength test results, the compressive strength falls below the specified compressive strength, make adjustments in the proportions and water content and changes in the temperature, moisture and curing procedures as necessary to secure the specified strength. Submit all changes to the City Representative in writing.
4. Strength Test Results:
Evaluate compression test results at twenty-eight (28) days in accordance with ACI 214.
5. Reinforcing: Where certified mill test reports (required above under "Submittals") are not furnished or available, or where positive identification of strands or bars cannot be made, the City Representative may require the Contractor to submit samples to an approved testing laboratory for testing at the Contractor's expense.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cement: Portland cement shall conform to specification ASTM C-150 Type II modified, low alkaline.
- B. Water: Water for mixing and curing, including the moisture and water in the aggregate, shall be fresh, clean potable or recycled.
- C. Aggregate:
 1. Standard weight aggregate shall conform to specification ASTM C-33.
 2. Lightweight aggregate shall conform to specification ASTM C-330 for aggregates prepared by expanding products. Lightweight aggregate shall consist of expanded and coated shale or equivalent material of sufficient strength and durability to provide concrete of the required strength and conform to ASTM C-330. Naturally expanded lightweight aggregates are unacceptable.
- D. Reinforcement:

1. Reinforcing steel shall conform to ASTM A-615, Grade 60 and shall be epoxy coated in accordance with ASTM A-775.
2. Welded wire mesh shall be electrically welded of cold drawn wire and shall conform to ASTM A-497 Grade 80. Welded wire mesh shall be hot-dipped galvanized.
3. Tie wire used to tie reinforcing steel shall be epoxy or plastic coated.

E. Misc. Metals and Fiber Reinforced Rods

All steel components of the floating dock system shall be ASTM A36. All steel members shall be hot dip galvanized after fabrication in accordance with ASTM A123. All bolt holes, slots, etc. shall be drilled prior to galvanizing. Welding of mild steel shall comply with AWS D 1.1.

Fiber reinforced rods shall have a minimum shear strength of 14,600 pounds, minimum nut strength of 18,000 pounds and clamping force of 4850 pounds.

F. Admixtures:

1. The use of admixtures shall be subject to review and approval of the City Representative.
2. When more than one admixture is used in a mix, the Contractor shall furnish satisfactory evidence that the admixtures to be used are compatible in combination with the cement and aggregates to be used for the Project.
3. No admixtures containing calcium chloride are allowed.
4. Admixtures such as DCI or equivalent shall be used to increase density and reduce porosity of the concrete to provide added security against water intrusion and corrosion of steel reinforcement.

G. Embedments: All embedment's in concrete shall be hot dip galvanized steel, unless noted otherwise.

H. Polystyrene Foam:

1. Foam Core – Foam core for floats shall be rigid block of closed cell expanded polystyrene. The polystyrene foam shall have a unit weight between 0.95 pounds per cubic foot and 1.25 pounds per cubic foot. Properties of the foam shall conform to ASTM D-1621 for density, compressive and flexural strength, water vapor permeability, water absorption and dimension. Storage of polystyrene foam shall be out of direct sunlight prior to the installation in a float

form. Reuse of EPS may not exceed ten percent (10%) of new. Reused EPS pieces shall not exceed 0.5” in diameter.

I. Lumber:

1. Refer to Technical Specification 06 13 33 "Preservative Treated Lumber and Timber"

2.02 CONCRETE

A. Requirements:

1. Concrete mix designs shall be in accordance with ACI 211.2 Chapter 4 and/or ACI 318 Part 6.
2. Concrete for floats fabrication shall be reinforced concrete with minimum compression strength as required by the float designer.
3. Aggregate size shall be sized per the manufacturer’s production requirements.
4. The unit weight of wet concrete shall not exceed 150 pounds per cubic foot.
5. The water/cement ratio shall not exceed 0.45. Proportioning of material shall be accomplished by weighing.

B. Mix Design:

1. Concrete shall be designed in accordance with ACI 318, Part 6.
2. The concrete may be proportioned from additional data derived from ACI 211.2 and ACI 214 for an assumed coefficient of variation of fifteen percent (15%) with a test failure of 1 test in 10, provided that mix designs reflect actual concrete plant standard deviations, and the resulting production concrete conforms to the specified requirements.
3. The mix design shall be based on aggregate data tested within the past six (6) months. In the absence of such data the Contractor shall sample and test the aggregates for conformance with ASTM C-330 and ASTM C-33. Aggregate test results certified by a laboratory shall accompany the mix design.

C. Air-entrained Concrete:

1. If air-entrained admixtures are included within the mix design they shall be added in solution in a portion of the mixing water by means of a mechanical batcher to ensure uniform distribution of the agent.
2. The air content of freshly mixed air-entrained concrete shall not exceed 7½% in accordance with ASTM C-173. The percentage of air shall be determined by

ASTM C-173 on samples of concrete during placing of the concrete.

2.03 FABRICATION OF PRECAST CONCRETE FLOAT SYSTEM

A. Formwork:

1. Concrete floats shall be cast in forms of sufficient strength and rigidity to maintain the intended size and shape during the casting process.
2. Forms shall be of plywood or steel.
3. Plywood shall conform to Department of Commerce product standard PS-1 BB concrete form grade Class II, free of raised grain, torn surfaces, worn edges, patches, or other surface defects that would impair the texture of the concrete surface.
4. Surfaces of steel forms shall be free from irregularities, dents and sags.
5. Forms shall be constructed and braced to fabricate the precast float within PCI allowable tolerances.
6. Forms shall be constructed such that floats can be cast without construction joints, however control (contraction) joints shall be provided. Manufacturer shall design and locate control joints to provide long-term durability of the concrete surfaces. Show joints (panel spacing) on shop drawings. Panel spacing rule of maximum 1.25: 1 aspect ratio shall apply for all floating dock surfaces.
7. Forms shall be thoroughly cleaned after each use and contact surfaces shall be coated with non-staining mineral oil or suitable non-staining form coating compound to prevent bonding of the concrete and to leave clean, smooth and hard surfaces. The use of diesel fuel is unacceptable.
8. Forms may be removed within twenty-four (24) hours after placing concrete, providing concrete has attained a rigid set and providing curing procedure as herein required is strictly adhered to.

B. Polystyrene Cores:

1. The exterior concrete surfaces of floats shall form a completely enclosing envelope cast around an expanded polystyrene core. If the bottom of the floatation unit is not encapsulated in concrete, it shall have a rigid membrane to prevent direct contact between the polystyrene foam and seawater, and to prevent the polystyrene foam from marine growth and borers. Alternatively, a rigid cementitious membrane may be used to prevent direct contact between the polystyrene foam and seawater.
2. The core shall be pre-formed to the interior concrete configuration as a solid block of non-interconnected cell expanded polystyrene.

3. Cores shall be securely anchored in place during float construction to prevent displacement or distortion during the casting of concrete. Displacement outside PCI tolerances shall be cause for rejection.
 4. Polystyrene cores shall be accurately cut to ensure sufficient concrete coverage for embedments and designed reinforcement. Cores shall be sized to insure a minimum of 1-1/2 inch thick side and end wall sections and a minimum of a 2 inch thick top deck section.
- C. PVC Conduit: PVC tubing may be used in conjunction with bolted connections or chases, or for utility routing ducts as long as the PVC is properly sized for the application and sufficient clearances are maintained. All PVC conduit shall be placed true to location shown in the Shop Drawings.
- D. Concrete Mixing and Placing:
1. Before handling concrete materials, all handling equipment and forms shall be thoroughly cleaned of concrete splatter, dirt, debris and other foreign matter, and forms shall be coated as specified elsewhere herein.
 2. Size of batches shall be so controlled that concrete is placed in forms within one (1) hour after materials have been placed in the mixer.
 3. Re-tempering of concrete will not be permitted.
 4. Concrete shall be transported from the mixer and deposited in its final position in a manner to prevent separation and segregation of materials. Flowing shall be avoided as causing segregation. Floats shall be cast monolithically and the placing of concrete shall be a continuous operation from the start to the completion of casting of any float unit.
 5. The plastic concrete shall be thoroughly compacted during placing by means necessary to fill all form cavities and by surrounding all reinforcement and embedments. This shall be done generally by vibrating forms with a powerful vibrator, care being taken not to vibrate to the extent of floating aggregates. Spading may be done as necessary to position mesh reinforcing but should be limited to the extent that it will not cause air pockets.
 6. Temporary, removable spacers may be used to hold reinforcement in place during casting, but these shall not in any way distort forms and shall be removed as the work progresses so that no pockets of non-homogeneous materials will result. Plastic or concrete spacers are also allowed to be used as rebar spacers.
 7. Prior to the placing of concrete in any section of the forms, all of the reinforcement and other embedments in that section shall be in place as shown on the Shop Drawings and secured against displacement during the placing of concrete.

E. Concrete Finishing:

1. Concrete deck surfaces shall be broom finished in the (transverse to the main axis of the individual float) direction parallel to the thru-bolt in the float to give a medium, non-slip surface. Submit a 24 inch by 24-inch sample pad of the broom finish for review and approval by the City Representative. All edges shall be finished uniformly 2" back onto the deck with a finishing tool that will give a bull nosed edge to ½" radius.
2. Create all control joints while the concrete is plastic. Exterior surfaces shall be hard, dense, smooth and true within 1/8".
3. Each concrete float shall be permanently marked in an accessible place on the exterior surface.
4. Voids up to 1/2" diameter, 1/8" depth, shall be patched with an approved epoxy grout. Larger voids shall be cause for rejection of the float.
5. Pre-cast concrete containing hairline cracks that are visible, but not measurable by ordinary means, may be accepted. Pre-cast concrete containing structural cracks of width measurable by ordinary means (0.05" wide and over) shall require the approval of the City Representative.

F. Curing, Handling and Storage:

1. Except, as otherwise approved, floats shall be cured per PCI or Caltrans requirements using water, curing compound or steam.
2. Float castings shall remain in their place of casting until sufficient stripping strength is attained to prevent damage during stripping and handling. Stripping and handling criteria shall be as identified in the Contractor's Quality Control Procedures.
3. During the curing/storage period floats shall be protected against damage from any cause.
4. Concrete surfaces shall be free of fins or form marks, aggregate pockets, or water pockets.
5. Shipping and handling of the floats is the sole responsibility of the Contractor. Damage during shipping and handling shall be repaired prior to installation. Repair methods and procedures shall be submitted and approved by the City Representative.

2.04 DOCK PILE GUIDES/RUB BLOCKS

- A. Rub blocks and strips shall be black Ultra-High Molecular Weight (UHMW) polyethylene. UHMW shall have a minimum density of 0.93 per ASTM D-792, minimum hardness of sixty-eight (68) per ASTM-D-2240, coefficient of static

friction to steel of 0.20 per ASTM D-1894, and UV stability for use in direct sunlight. Block and strips shall be secured with Type 316 stainless or galvanized steel fasteners. Fasteners shall be counter bored to allow flush contact without damage to piles or floats.

2.05 DOCK CLEATS

- A. Dock cleats shall be gray cast iron, hot-dipped galvanized, open base heavy duty cleats (model number as noted on drawings) as supplied by Henderson Marine Supply, or approved equal. Bolt heads shall be recessed into cleats; use hot-dipped galvanized bolts. Cleat sizes shall be as follows:

10" – Slips upto 40' in length
12" – Slips 41' to 60' in length

2.06 DOCK BUMPERS

- A. Dock bumpers shall be #302 as supplied by Henderson Marine Supply or approved equal. All outside corners shall be protected with #03-06A corner bumpers or approved equal, attachment to be with large head stainless steel or aluminum nails, 4-inch on center in the vertical surface and 4" on center in the horizontal surface.

2.07 FILLER PANELS

- A. Filler panels for triangles finger connections and pile assemblies shall not be constructed using plywood. The designer shall identify a material applicable for the application with sufficient strength and aesthetic value. Cut openings in filler panels to accommodate pile penetrations shall not be over cut more that one (1) and 1/8 inch in any direction around the pile. Filler panels will be flush with the concrete deck surface and structurally supported in all directions.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall be as shown on the Project Drawings with bolts and other connections tightened as required after complete installation of each unit of the work in the water and before final inspection.
- B. The dock system uses walers that are not considered structural. The lumber shall have a maximum 1/4-inch gap between adjacent pieces. The length of each waler shall be as long as possible but at no time will walers be secured to the floats with less then two (2) bolts. Minimum bolt size shall be 5/8" diameter.
- C. Top of walers and trim lumber adjacent to the floats shall all be flush with the finished concrete deck surface.

- D. When triangle fillets and pile frame assemblies are used adjacent to the floats all surfaces shall be flush with the finished deck surface.
- E. Lumber joints of wood members abutting at 90 degrees shall be cut and assembled true and level. Lumber joints at other than 90 degrees shall be mitered to provide a true and level joint.
- F. Structural steel fabrication and installation shall conform to the requirements of AISC Specifications for the design, fabrication and erection of structural steel.
- G. Fabricated steel components shall be designed for the application plus provide support for such items as power centers, locker boxes and fire hose cabinets, foot traffic and opening around concrete pile.
- H. Fabricated steel components used to secure concrete pile shall provide means for positive adjustment to accommodate pile location.
- I. All welding shall be performed by certified welders and shall conform to the current specifications of the American Welding Society (AWS).
- J. Hot dipped galvanized iron round plate washers shall be used under all bolt heads and nuts on wood, except where cut washers are required.
- K. Bolts shall be of the size required, with adequate thread length. All lag bolts and screws shall be pre-bored and turned into place. Driving will not be allowed.

3.02 INSTALLATION OF DOCK ACCESSORIES

- A. All dock accessories shall be installed in accordance with the Approved Shop Drawings and the manufacturer's recommended method of installation.
- B. Schedule installation of dock accessories so as to prevent damage from work by other trades.
- C. Special attention shall be given to locating of the fire hose cabinets and power pedestals to avoid those locations that will present the potential for damage during mooring activities.

3.03 DESIGN CRITERIA

- A. The floats shall have sufficient floatation to support a live load of twenty-five (25) pounds per square foot of deck area with a freeboard of not less than twelve (12) inches.

The dock structures shall have sufficient floatation to support the transmitted dead load and live load of the gangways. At electrical equipment such as power centers, the dock structures shall have sufficient floatation to support the transmitted dead

load of all equipment and adjacent live load.

The floatation calculations for floats with imposed loads such as gangways, power centers, pile assemblies and special applications shall include the imposed loads as part of the floatation calculation.

The freeboard under these imposed loads shall meet the requirements for transverse and longitudinal slopes set forth in the TOLERANCE section 3.04 below.

- B. Uniform freeboard under dead load shall not be less than sixteen inches (16") or exceed eighteen inches (18").

The floatation units shall be capable of supporting a 400-pound concentrated load at any location while maintaining the deck surface slope requirements, set forth in Section 3.04 B below.

- C. The floatation units shall be capable of withstanding anticipated current (C) loads of 2.0 feet per second, impact loads from a 60 ton vessel impacting at 1.0 feet/sec approach velocity (kinetic energy loading of a 1/3 stress increase is allowed since the force is transient), a 1.0 foot wave (W) (Operating condition, 1/3 stress increase) and a 2.0 foot wave (W) (Extreme condition, 1/3 increase allowed).

- D. Load Combination shall be as following:

LRFD

$$1.2C + 1.6W$$

$$1.2C + 1.2W + 1.6 Wa \text{ (operational)}$$

$$1.2C + 1.2W + 1.2 Wa \text{ (extreme)}$$

ASD

$$1.0C + 1.0W \text{ (Allowable Overstress 1.0)}$$

$$1.0C + 1.0W + 1.0 Wa \text{ (operational) (Allowable Overstress 1.0)}$$

$$1.0C + 1.0W + 1.0 Wa \text{ (extreme) (Allowable Overstress 1.33)}$$

- E. Lateral Load shall be applied at +7.5 MLLW.

- F. Dead loads shall consist of the floats, framing, decking connections, and all permanently attached equipment.

The weight of lumber for dead load calculations shall be assumed at not less than forty (40) pounds per cubic foot or the actual lumber weight, whichever is greater.

- G. Wind (W) loads for the finger floats shall be a uniformly distributed load of fifteen (15) pounds per square foot acting on the above water profile of potential berthed craft.

The profile area shall be determined by using the length and an average profile

height equal to fifteen percent (15%) of the boat length.

3.04 TOLERANCES

Install berthing system to within the following tolerances from the planned dimensions shown on the Project Drawings. All floats exceeding the specified tolerance shall be removed and properly replaced at no cost to the City.

A. Float Fabrication (allowable variation of construction dimension from nominal dimension shown on Plans):

1. Float Width: +5 inches, -0 inches from nominal float width
2. Float Depth: As required to satisfy freeboard requirements.

NOTE: The above tolerances are intended to permit flexibility, adapting available formwork for use on this Project. Once the construction dimension is fixed by the Contractor, more stringent casting tolerances shall govern.

B. Berthing System Performance In-Place After One Year

1. Minimum Dead load dock freeboard (measured from deck to water surface): 16 inches.
2. Dead load shall include dead load of all dock utilities, dock accessories, gangways, pile assemblies, transformers, etc.
3. Dead load deck surface slope:
 - a. Finger and main walkway transverse direction Not more than ¼ inch per foot of nominal width to an overall maximum of 1”
 - b. Marginal walkway transverse direction Not more than 1/8 inch per foot of nominal width to a maximum of 1”
 - c. All docks longitudinal Not more than 1 inch per 10-foot length while direction remaining within the freeboard tolerances
4. Assembly gap between adjoining concrete floats: minimum ¼ inch, maximum ½ inch.
5. Vertical height difference: maximum 1/8 inch between adjoining concrete floats, walers and plywood deck panels.

6. Float weight: (+ or -) 6% of design weight

3.05 FLOAT PRODUCTION - BASIS FOR ACCEPTANCE

- A. The Contractor is responsible for providing the highest quality product from the float manufacturer, fabricators, material suppliers, and all other vendor. Quality inspection and acceptance for delivery to the project site prior to installation is the responsibility of the Contractor. The Contract documents shall be the basis for the level of quality expected for the project. Final acceptance is the sole discretion of the City Representative.
- B. The deck finish shall be consistent over the entire surface of the float including an even broom finish without waves or irregularities. Finish shall be free of any debris or markings other than the broom finish. The deck finish shall be based on the sample submitted by the Contractor and approved by the City Representative.
- C. Floats shall be edged straight and with a hardened smooth finish. Edges shall be consistent without waves or rolled edges or corners.
- D. Each float shall be square and of the same height, width, and length as indicated on the Shop Drawings.
- E. The side-walls and end-walls shall have a consistent smooth finish free of voids and/or large rock pockets, or show evidence of insufficient vibration or improper concrete consolidation.
- F. Cast-in components such as junction boxes, PVC tubing, handling inserts, or other embeds shall be flush to adjacent surfaces and shall not alter the overall finish or impact the assembly.
- G. Prior to acceptance the Contractor shall supply the following: acceptable concrete strength and testing results, respective material certificates of compliance, verification of float weights, and respective production Quality Control documentation.
- H. Floats shall be permanently marked with the approved marking system and shall include the date of production, float type and any other reference marking relating to the production Quality Control procedures.

PART 4 - MEASUREMENT AND PAYMENT

The Contract LUMP SUM price paid for OFFSHORE MARINA AND APPURTENANCES shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and installing concrete floating dock system, complete in place, including concrete footings as needed, as shown on the plans, as specified in the State Standard Specifications and these Technical Specifications, and as directed by the engineer.

PART 5 - PRODUCT DATA SHEETS

Henderson 504H Cleats

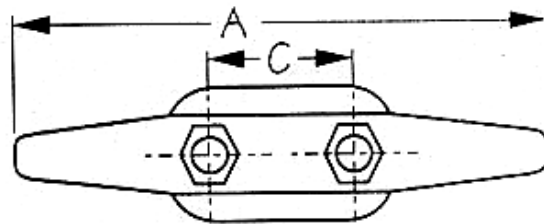
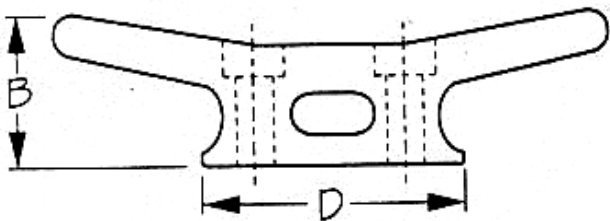


HENDERSON 504H CLEAT

CAST DUCTILE IRON – HOT DIPPED GALVANIZED

These cleats are designed for general installation where medium and large cleats are required. These cleats are the key to safely mooring a vessel to a dock; therefore, the cleat should always be bolted completely through the main structure of the dock. Designed with recessed mounting holes to accommodate hex head machine bolts.

ITEM NO.	NAME	A	B	C	D	Holes for Bolt Diameter	Weight
05-07N	IAN	8"	2 3/8"	2"	4" x 2 1/4"	1/2"	3 lbs.
05-08N	WYMAN	10"	3 1/4"	2 1/2"	4 5/8" x 2 1/2"	1/2"	6
05-09N	DICK	12"	3 3/8"	3 1/4"	6 7/8" x 3"	5/8"	11
05-10N	DAWSON	15"	3 3/4"	3 1/2"	7 1/4" x 3 1/2"	3/4"	12.75
05-11N	BRIAN	18"	4 1/2"	3 7/8"	7 1/2" x 4"	3/4"	21
05-12N	WILD BILL	24"	5"	6 5/16"	13" x 4 1/2"	7/8"	35

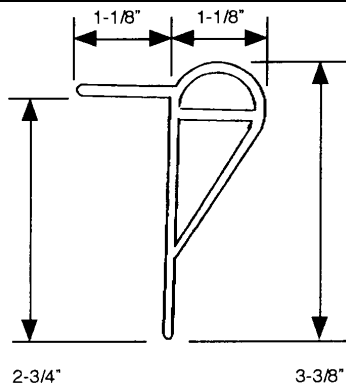
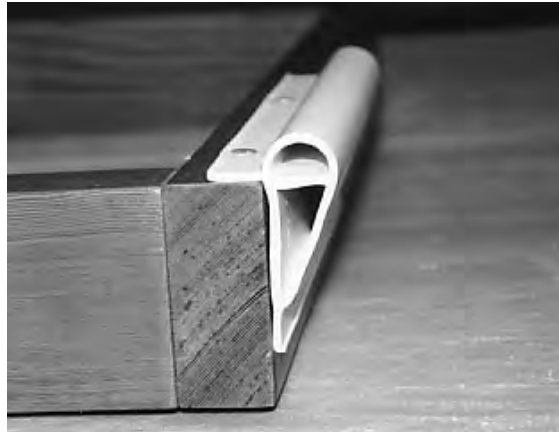


HENDERSON MARINE SUPPLY, INC.
800-523-1586 www.hendersonmarine.com

Specifications subject to change without notice. Not responsible for rust.
Liability limited to product replacement at the option of Henderson Marine Supply, Inc.
Not responsible for any inaccuracies in specifications.

Page 05-2
Last Updated: 3/12/2003 10:29:00 AM

Henderson Bumper Strips



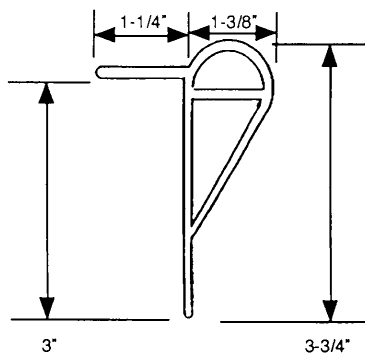
302 HENDERSON HEAVY WEIGHT BUMPER STRIP ITEM NO. 03-02

Material: Designed and extruded from marine-grade vinyl, resistant to yellowing. Meets commercial standard CS230-60.

Weight: 0.85 pounds per foot. **Average Wall Thickness:** 5/32"

Packaging: 12 pieces of 8-foot lengths per shipping carton, 96 feet total.

Application: On wood structures, nail with large-headed aluminum or stainless steel nails, 4 inches on center of top and bottom flanges. On metal structures, use stainless steel or aluminum sheet metal screws and washers.



310 HENDERSON EXTRA WEIGHT BUMPER STRIP ITEM NO. 03-10

Material: Designed and extruded from marine-grade vinyl, resistant to yellowing. Meets commercial standard CS230-60.

Weight: 1.35 pounds per foot. **Average Wall Thickness:** 5/32"

Packaging: 10 pieces of 8-foot lengths per shipping carton, 80 feet total.

Application: On wood structures, nail with large-headed aluminum or stainless steel nails, 4 inches on center of top and bottom flanges. On metal structures, use stainless steel or aluminum sheet metal screws and washers.

For corner dock protection see catalog page 03-5. For orders less than full cases, a 25% "split case" charge will apply.



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Page 03-3
Last Updated: 9/17/2003 5:18:00 PM

END OF SECTION