Special Specification 7237
Fender and Dolphin Installation

1. DESCRIPTION

Furnish and install a new fender and dolphin system to replace the existing dolphins and both East and West Fender Systems at the IH-10 San Jacinto River Bridge in accordance with the plans. Removal of the existing systems is covered by other items.

2. MATERIALS

Use materials conforming to the various Standard Specification Items which normally govern items of work under this contract and to the details shown on the plans, unless modified herein.

2.1. **Steel Pipe Piles**. Furnish steel pipe piling in lengths indicated on the plans. Use pipe piling of a particular size and grade that is manufactured to one material specification. Use steel pipe piling that has the outside diameter and wall thickness indicated on the plans. At the Contractor's expense, the pipe piling may be fabricated by welding together sections of piling. Spiral-welded pipe is not allowed.

Provide steel pipe piling conforming to one of the following specifications:

- ASTM A572 Grade 60 (Min. Yield Strength = 60 ksi), or
- ASTM A252 Grade 3 Mod (Min. Yield Strength = 60 ksi) allowed alternate for fender piling only.

Provide steel for pipe piling conforming to the following additional criteria:

- The yield strength to tensile strength ratio does not exceed 0.9.
- The minimum yield strength is 60 ksi and the maximum yield strength is 80 ksi.
- The carbon equivalency (CE) does not exceed 0.45 as defined in AWS D1.1, Section X15.1, and the sulfur content does not exceed 0.05%.
- The circumference of the steel shell ends does not vary more than plus or minus 0.375 in. from the size shown on the plans or as directed.
- The maximum allowable edge alignment for pipe is 0.1875 times the wall thickness or 0.063 in., whichever is less.
- Steel pipe straightness conforms to the requirements of API 5L.
- Steel pipe pile welds must be complete penetration welds and that conform to the requirements of AWS D1.1 and the amendments listed herein. Do not join steel piles by welded lap splicing. Weld by either an automatic fusion weld or an electric resistance weld process. Perform or restore incomplete penetration welds and defective welds of steel pipe piles to achieve complete joint penetration groove welds.
- Non-destructive test (NDT) one hundred percent of each longitudinal and circumferential weld that is made by the pipe manufacturer by either radiographic, radioscopic, real time imaging systems, or ultrasonic methods that are in conformance with the requirements of AWS D1.1 or API Specification 5L. The acceptance and repair criteria will conform to the requirements of AWS D1.1, Section 6, for tension cyclically loaded nontubular connections. If repairs are required in a portion of the weld, perform additional NDT. Perform the additional NDT on both sides of the repair for a length equal to 10% of the lengths of the pipe outside circumference.

Apply a marine-grade immersion coating system to the pipe piling to the limits shown on the plans in accordance with Item 407, "Steel Piling." Perform any repair needed on the coating in accordance with Item 407, "Steel Piling."

2.2. **Structural Steel.** Furnish structural steel (pipe bracing members, plates, w-shapes, bolts, etc.) to the dimensions and specifications as shown on the plans and in accordance with Item 441, "Steel Structures." Apply marine-grade immersion coating system to all structural steel components in accordance with the requirements given in Item 407 "Steel Piling."

2.3. **Ultra High Molecular Weight Polyethylene (UHMW-PE).** Furnish the UHMW-PE pads to the dimensions indicated on the plans. Fabricate ultra high molecular weight polyethylene pads in accordance with the plans from polyethylene material as specified herein. The polyethylene will be 100% cross-linked for abrasion resistance and ultraviolet (UV) stabilized with 0.6% to 2.5% carbon black. The polyethylene will be composed of 100% virgin material. Chamfer the exterior edges of the polyethylene pads. The UHMW-PE pads will be yellow in color.

Supply polyethylene sheets manufactured in one continuous piece to the lengths shown on the plans. Butt-welded UHMW-PE will be accepted provided the following requirements are met:

- The manufacturer has at least 5 yr. of experience in welding UHMW-PE in thicknesses greater than 1 in.
- The manufacturer has produced butt-welded material for critical technical applications and is able to produce documentation to substantiate butt-welded applications.
- The welded joint has at least 90% of the tensile strength of the base material. Weld seams are flush with smooth contour.

Provide UHMW-PE provided that conforms to the physical properties in Table 1.

Table 1

Property	Value	Test Method
Molecular Weight	3.5 - 6 million	ASTM D-4020-11
Izod Impact Strength Double notch, 23°C	18 ft.-lb./in. 2 Min	ASTM D-256-10e1
Hardness	65 Durometer Min	ASTM D-2240-15
Tensile Strength Yield Break Elongation @ Break	 3,000 lb. Min 4,500 lb. Min 300% Min	ASTM D-638-14

Perform machining by the manufacturer before delivery to the field. Provide the UHMW-PE pads to the tolerances listed in Table 2.

Table 2

Pad Size	
Thickness	+1/16 in.
Width and length	+1/4 in.
Machining	
Hole location	+0.05 in.

3. CONSTRUCTION

Install the new fender and dolphins at the locations shown on the plans once the existing fender and dolphins have been removed. Operate water going vessels, barges, etc., in accordance with United States Coast Guard regulations.

3.1. **Steel Pipe Piles**. Install the steel pipe piling as shown on the plans.

3.1.1. **Pile Toe Protection**. Provide pile toe protection to the piles in accordance with Item 407 conforming to the following requirements:

- Pile toe protection steel grade is greater than or equal to that of the pile.

- An outside diameter equal to the outer diameter of the pile and an inner diameter at least 1 in. but no more than 2 in. less than the inside diameter of the pile.
- A length of at least 12 in. but no more than 24 in.
- A bevel at the end which is outward facing

Weld the toe protection to the pile with a full penetration weld or in accordance with the supplier's instructions.

3.1.2. **Steel Pipe Pile Splices**. Piles may be made by splicing lengths of pipe together to obtain the required pile length. However, the minimum length of pipe between splices is 10 ft. Perform splices with complete penetration groove welds in accordance with this Item and Item 448, "Structural Field Welding." The Contractor is advised that accurate alignments of the pile splices in critical pipe sections will be aligned so that the maximum misalignment between sections is no more than 1 in 200.

For piles with an outside diameter of 18 in., the maximum number of splices per pile is seven. For piles with outside diameter of 54 in., the maximum number of splices per pile is four.

3.1.3. **Welding Inspection**. The Contractor's welding inspection procedures, techniques, methods, acceptance criteria, and inspector qualifications will be in accordance with the latest edition of AWS D1.1. Inspection must be performed by a Certified Welding Inspector (CWI), who is qualified and certified in accordance with the provision of AWS QC1, Standard for Qualification and Certification.

Perform nondestructive testing in addition to visual inspection. Testing and inspection applies to welding performed in the shop and in the field. The extent of the inspection will be as follows:

- Welds are 100% visually inspected. Perform visual inspection before, during, and after the completion of welding.
- Complete penetration groove welds in pile splices are 100% ultrasonically inspected. If defects are found, repairs will be made and additional non-destructive testing is performed to ensure that the repairs are satisfactory. This testing includes the repaired area plus at least 2 in. on each side of the repaired area.

After the Contractor has completed the welding inspection, the Contractor will allow the Engineer enough time to perform quality assurance ultrasonic welding inspection.

Keep the welding inspection reports on file for use by the Engineer. Deliver field test results to the Engineer within five days of the inspections.

3.1.4. **Pile Installation**. Install piles in accordance with Item 404, "Driving Piling" except as modified herein.

Before installation, mark piling in 1-ft. increments from the pile tip with the distance from the tip indicated at 5-ft. intervals.

Unexpected obstructions may be encountered during construction. Be prepared to excavate and remove the obstructions if encountered within 10 ft. of the ground surface or mudline.

Re-drive any piling raised when driving adjacent piling. Withdraw and properly replace or correct broken, split, or displaced piling as directed, based on a design analysis.

3.1.5. **Tolerance for Driving.** Accurate placement of the steel pipe piling is critical. Exercise care while placing and driving steel pipe piling. To assure accurate location of steel pipe piling for Fenders and Dolphins, construct temporary falsework frames or templates for driving the piles. Verify the location of the falsework frames or templates by survey before placing the first pile in each structure and check for movements before driving each successive pile in a structure.

Survey the location of each pile before driving and during driving to verify the pile is within the specified tolerances.

Do not exceed the following allowable variation from plan alignment for dolphin piles:

- 1 in. in any direction horizontally,
- plus or minus 1 in. vertically, and
- 1 in. in 10 ft. 0 in. for plumbness or coincidence with axis

Do not exceed the following allowable variation from plan alignment for fender piles:

- 4 in. horizontally parallel to the fender face,
- 2 in. horizontally perpendicular to the fender face,
- plus or minus 1 in. vertically, and
- 1 in. in 10 ft. 0 in. for plumbness or coincidence with axis

Extract and reposition piling placed beyond the specified tolerance to the proper location at no expense to the Department. Repair any damage to the piling will be repaired to the satisfaction of the Engineer at no expense to the Department.

3.1.6. **Protection of Pile Heads.** Drive steel pipe piling with a helmet compatible with the size and strength of the piling driven.

3.1.7. **Driving Equipment**. Use driving equipment for steel pipe piling that complies with Item 404 and is of sufficient size to drive steel pipe piling to the minimum penetrations shown on the plans.

Provide details of pile driving equipment and a Wave Equation Analysis of pile drivability for selection of the hammer along with a statement of driving procedures. The Wave Equation Analysis is to be completed by the Contractor's Engineer. Run the analysis at the estimated tip elevation as well as other required elevations to define maximum stress levels in the pile during driving. Ensure the analysis considers the proposed hammer assembly, pile cap block, and cushion characteristics, the pile properties and estimated lengths and the soil properties anticipated to be encountered throughout the installed pile length based on static capacity analysis with consideration of driving gain/loss factors. Only one specific model of pile hammer may be used for each pile type and capacity. Ensure the Wave Equation Analysis demonstrates that the piles will not be damaged during driving, indicates that the driving stresses will be maintained within appropriate limits, and indicates the blow count necessary to achieve the required penetration.

3.1.8. **Penetration**. If hard driving conditions are encountered and plan penetration is not obtained, advance the pipe piling by removal of the soil plug within the pipe piling by auger or another suitable device. At no time should the auger or other device extend beyond the pile tip. Ensure all the equipment and material to implement soil plug removal is available at the site within 24 hr. of a soil plug forming. After soil plug removal, continue to drive the pipe pile until the minimum penetration requirement is satisfied. Repeat the process of driving and cleaning out within the pipe as many times as necessary to achieve the penetration requirement. Dispose of the removed soil plug material off-site in accordance with applicable regulations.

Maintain water elevations within the steel pipe piling at or above the water elevation outside of the piling.

3.2. **Ultra High Molecular Weight Polyethylene (UHMW-PE).** Install the UHMW-PE pads as shown on the plans. Replace any pads damaged by over tightened bolts or gouges at no expense to the Department.

3.3. **Submittals**. Submit to the Engineer information demonstrating that the pile installer meets qualification requirements. Include in the information for the pile installer, a resumé for the field superintendent or foreman who will be responsible for pile installation and a list of at least five marine projects, with contact information, where pile installation services have been provided in the past five yr.

Before delivery of materials, submit to the Engineer the following for review and approval:

- Piling manufacturer, mill test reports, supplemental test documentation, and certifications required by this Item and the relevant Items of the Standard Specifications.
- Shop drawings of the pipe piling including details, location of splices, and coating system information.

- Shop drawings of the dolphins and fender system including details, splice locations, and coating system information.
- Shop drawings of the UHMW-PE pads including dimensions and details of all chamfers and bolt holes.
- Catalog cuts for the proposed UHMW-PE describing the physical properties of the material. Provide a manufacturer's certificate of quality and two random samples of the UHMW-PE material furnished. Ensure the samples are representative of the color to be used. Ensure the certificate identifies the quantity and type of carbon black used, that the material is 100% virgin, and meets all other requirements of this Item.
- Barge and derrick size and capacity including method of anchoring, type of pile driving leads, and arrangement of pile driving equipment on barge.
- Copies of the Wave Equation Analysis calculations including computer input and output, graphs showing soil resistance versus blow count, and maximum tension and compression stresses versus blow count.
- Hammer type and size including manufacturer's specification data and any modifications.
- Drawings and calculations of the template or diaphragm support frame proposed for the proposed dolphin and fender piles. Ensure the drawings and calculations are prepared by, or under the direct supervision of, a Professional Engineer licensed in the State of Texas. The template or diaphragm support frame must include lateral bracing and must be designed to withstand the loads anticipated during placement and driving of piles.
- At the end of each working day submit a daily log and record for the piles constructed that day.
- As-constructed location and plumbness of the steel pipe piles after completion of driving.

Assume responsibility for the completeness of the drawings and other information. Clearly indicate any deviations from the plans on the submittals. The review and approval of drawings and other information should be in conformance with the design concept and should be understood to be an acceptance of the character and sufficiency of the details and not a check of dimensions.

4. MEASUREMENT

4.1. **Dolphins.** Dolphins will be measured by each dolphin structure.

4.2. **Fender System.** Fender system will be measured by the lump sum for each fender (East or West).

5. PAYMENT

The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Dolphin" or "Fender System" as appropriate, which is full compensation for furnishing and installing steel pipe piling, structural steel, UHMW-PE pads, and for the labor, tools, equipment, and incidentals necessary to complete the work in accordance with this Item; including removal of soil plugs to reach minimum tip elevation, if required.

Steel sheet piling for the scour protection of the WB ML Bridge Bent 28 foundation is a separate bid item and will not be included in the payment for "Dolphin" or "Fender System."