# SECTION 317216 JACKED STEEL CASING

## PART 1 - GENERAL

### A. Description

This section includes materials and installation for tunneling by jacked steel casing method for crossings under the Santa Maria River levee and a storm drain south of the intersection of Blosser Road and Canal Street.

### B. Related Work Specified Elsewhere

1. Coordination of Work, Permits, and Regulations: 011100.
2. General Concrete Construction: 030500.
3. Trenching, Backfilling, and Compacting: 312316.

### C. Submittals

1. Submit shop drawings in accordance with Section 013300.
2. Submit materials list showing material of casing with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced pipe standards, e.g., ASTM A36, ASTM A139, ASTM A283, and AWWA C200. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.
3. Submit diameter, thickness, and class of steel casing.
4. For casings 36 inches and larger, submit certified original copies of mill test reports on each heat from which steel is rolled. Tests shall include physical and chemical properties.
5. Submit data for casing spacers.
6. Submit certificates of welding consumables used for shop and field welding.
7. Submit welding procedure specifications (WPS) and procedure qualification records (PQR) for each welding process and welder qualification records (WQR) for each welder and welding operator. Submit bend and tensile test coupons concurrently with welder qualification and procedure qualification records. Welding procedures shall be required for welds for pipe cylinders, casing joint welds, and grout coupling connections.
8. Submit shop drawings showing the method of preventing pipe flotation and how the backfill will be terminated at the end of the tunnel.

9. Submit location of approach trench.

10. Submit schedule and method of tunnel construction. Include also approach trench backfill and pipe installation and backfill.

11. Submit plan for monitoring ground movement above the jacked steel casing.

12. Submit ground movement-monitoring reports, certified by a California licensed Land Surveyor, for crossings made by the jacked steel casing method.

D. Tunnel Classification

The Owner has obtained from the State of California, Department of Industrial Relations, Division of Occupational Safety and Health, Mining and Tunneling Unit, a Tunnel Classification for each bore. Copies of the classifications are included in Appendix A of these specifications. It shall be the Contractor's responsibility to post the classification at each site and see that the work is done in conformance with California Code of Regulations Title 8. It shall also be the Contractor's responsibility to call the required safety meeting(s) with representatives from the State of California Mining and Tunneling Unit prior to beginning of construction of each bore.

E. Scheduling

If the pipeline is not installed within the casing as a continuous operation following completion of jacking, then bulkhead the portals and backfill the approach trenches and later reopen them for pipe installation.

F. Jurisdiction

1. Comply with the applicable regulations of 29CFR 1926, Subpart S, "Underground Construction, Caisson, Cofferdams, and Compressed Air" as amended.

2. For casing pipe crossing under roadways or other structures not within the jurisdiction of the Owner, comply with regulations and permit requirements of said authority.

G. Inspection

Perform work in the presence of the District’s Representative unless the District’s Representative has granted prior approval to perform such work in its absence.

PART 2 - MATERIALS

A. Steel Casing

1. Fabrication of casing shall be in accordance with AWWA C200, as modified below. Casing material shall conform to ASTM A283, Grade C; ASTM A139, Grade B; or ASTM A36. Obtain minimum diameter and wall thickness from drawings. The Contractor may select a greater thickness and diameter to accommodate the method of work, loadings involved, the site and possible interferences, but at no additional cost to Owner. Provide 2-inch grout connections in the form of threaded couplings welded to the steel shell as shown on the drawings.

2. Join casing sections by butt-welding in the field. Prepare ends of casings for welding by providing 1/4-inch by 45-degree chamfer on inside edges.

B. Casing Spacers

Casing spacers shall be bolt-on style with a shell made in two sections of Type 304 stainless steel. Connecting flanges shall be ribbed. The shell shall be lined with a PVC liner 0.090 inch thick with 85-90 durometer. Nuts and bolts shall be 18-8 stainless steel. Construct runners of ultra high molecular weight polymer. Support runners by risers made of Type 304 stainless steel. Weld the supports to the shell, and passivate the welds. Casing spacer placement along carrier pipeline and number and spacing of risers/runners shall be as shown on the drawings. Casing spacers shall be Cascade Waterworks Mfg. Co., PSI, APS, or equal.

C. Casing Seals

Casing seals shall be 1/8-inch-thick synthetic rubber, designed to fit snugly around pipe and casing. Casing seals shall be one piece with no field seams. Bands and hardware for attachment to pipe and casing outside diameter shall be stainless steel. Products: PSI or equal.

D. Grout

Lean grout shall consist of one part portland cement, four parts sand, and sufficient water to produce a workable mixture. Sand for grout to be placed outside the casing shall be of such fineness that 100% will pass a No. 8 sieve and not less than 35% will pass a No. 50 sieve.

E. Concrete Backfill

1. See Section 030500.

F. Sand Backfill

1. Sand shall be dry (water content not more than 6% or less than 3%), free from organic matter, and containing not over 5% by weight of deleterious substances. It shall be hard, dense, durable, clean, sharp, and graded evenly from fine to coarse as follows:

| Sieve Size | Percent By Weight | | |
|---|---|---|---|
| 3/8 inch | | | 100 |
| No. 4 | 97 | to | 100 |
| No. 8 | 79 | to | 85 |
| No. 16 | 60 | to | 78 |
| No. 30 | 36 | to | 47 |
| No. 50 | 10 | to | 20 |
| No. 100 | 0 | to | 4 |

2. Sand shall have a fineness modulus per ASTM C136 of between 2.70 and 3.30, inclusive.

G. Bentonite

Bentonite shall be a commercially processed powdered bentonite, Wyoming type, such as Immacco-gel, Black Hills, or Big Horn Brand, as distributed by Industrial Mineral and Chemical Company, 7275 Reese Road, Florin, California; Los Angeles Chemical Company, 4545 Ardine, South Gate, California; Brumley-Donaldson Company, 3050 Slauson Avenue, Huntington Park, California; or equal.

PART 3 - EXECUTION

A. Fabrication, Assembly, and Erection

1. Prepare edges of plate to be butt-welded. Butt-weld all joints.

2. Beveled ends for butt-welding shall conform to ASME B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, chip out slag before welding.

3. Fabrication shall comply with ASME B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code or AWS D1.1 or AWS B2.1. Prequalified welding procedures may be used.

4. The minimum number of passes for welded joints shall be as follows:

| Steel Cylinder Thickness (inch) | Minimum Number of Passes for Welds |
|---|---|
| Greater than 0.25 | 3 |

5. Welds shall be full penetration, except that partial-penetration butt-welds, where used, shall develop the full tensile strength of the mating plates.

6. Use the shielded metal arc welding (SMAW) submerged arc welding (SAW), flux-cored arc welding (FCAW), or gas-metal arc welding (GMAW) process for shop welding. Use the SMAW process for field welding.

7. Welding preparation shall comply with ASME B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ASME B31.3, Table 341.3.2 and paragraph 341.4 for visual examination.

8. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.

9. Welding electrodes shall comply with AWS A5.1.

B. Sectional Shield or Jacking Head

Fit a sectional shield or steel jacking head to the leading section of the casing to extend around the outer surface of the upper two-thirds of the casing and project at least 18 inches beyond the driving end of the casing but do not protrude more than 1/2 inch outside of the outer casing surface. Anchor the head to prevent wobble or alignment variation during the jacking operation. To avoid causing a collapse of ground outside the casing, carry out excavation entirely within the jacking head and not in advance of the head.

C. Jacking Pit

1. Place in the approach trench or jacking pit and firmly bed on the required line and grade guide rails, structural steel, or concrete cradle of sufficient length to provide accurate control of jacking alignment. Provide space to permit the insertion of the lengths of casing to be jacked. Anchor the guide rails and structural steel sections to ensure action of the jacks in line with the axis of the casing. Interpose between the jacks and the end of the casing a bearing block consisting of a timber or structural steel framework constructed to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.

D. Jacking Plate Design Criteria

1. Ultimate passive pressure for the design of the jacking plate can be estimated as 3,500 pounds per square foot. This estimation assumes a jacking plate area of approximately 5 square feet and a minimum of 10 feet of cover. This estimation can be used as input for evaluation of jacking methods and equipment.

E. Pit Dewatering

Provide and operate equipment adequate to keep excavations free of water. Dewater subgrade to a minimum of 3 feet below bottom of excavation. Remove water during period when steel casing is being jacked, when carrier pipe is being laid, concrete is being deposited, and during the placing of backfill. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property and obtain and comply with NPDES permit per Specification Section 011100. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation.

F. Control of Alignment and Grade

Control the application of jacking pressure and excavation of material ahead of the casing as it advances to prevent the casing from becoming earthbound or deviating from required line and grade. Do not encroach upon the minimum annular space detailed. Restrict the excavation of material to the least clearance necessary to prevent binding in order to avoid causing a collapse of ground and consequent settlement or possible damage to overlying structures.

G. Exterior Grouting

Monitor jacking and boring operations to identify potential areas of ground caving, raveling ahead of the casing, or removal of large particles, that may require post-installation grouting. See Part 3.K – Monitoring of Ground Surface and Subsurface Movement.

Immediately after completion of the jacking or boring operation, inject lean grout through the grout connections in such a manner as to completely fill all voids outside the casing pipe resulting from the jacking or boring operation. Control grout pressure to avoid deformation of the casing, and avoid movement of the surrounding ground.

Inject grout material until one of the following occurs: (1) grouting appears in nearest adjacent port; or (2) maximum allowable grout pressure of 0.5 x overburden pressure is reached.

After completion of grouting, close the grout connections with malleable iron or cast-iron threaded plugs.

H. Backfill

Backfill with material indicated in the drawings and as follows:

1. Sand Backfill: After placement of the pipe within the casing, install casing seals at both ends of the casing and fill the intervening annular space between the pipe and the casing with sand, placed by a pneumatic gun.

2. Concrete Backfill: After placement of the pipe within the casing, construct a permanent bulkhead at each end of the casing or use casing seals, and fill the intervening annular space with concrete conforming to Section 030500.

I. Closing the Jacking Pit

Seal the end of the casing with casing seals. After jacking equipment and muck from the tunnel have been removed from the approach trench or jacking pit, prepare the bottom of the jacking pit as a pipe foundation. Remove loose and disturbed material below pipe grade to undisturbed earth and recompact the material in accordance with Section 312316.

J. Alignment

The variation in the field position of the casing from the line and grade as indicated in the drawings shall be limited to 1 inch in lateral alignment and 1/4 inch in vertical grade.

K. Monitoring of Ground Surface and Subsurface Movement – Santa Maria River Levee Crossing

The ground above the jacked steel casing shall be monitored for movement (e.g., settlement/heave) during the jacking and boring operation.

The Contractor shall submit a detailed ground surface and subsurface movement monitoring plan. This plan shall address all requirements including proposed survey grid, frequency of monitoring, and proposed subsurface monitoring plan.

At a minimum, monitor surface movement for the levee crossing at two locations: one at each side of the south and north sides of the levee crest. At each location, establish three (3) surface monuments: one at the pipe centerline, and one each at 6 feet to the left and 6 feet to the right of the centerline. Monitor subsurface settlement by installing subsurface settlement-monitoring devices at two locations above the levee crossing at the pipe centerline. One shall be installed to a depth of 3 feet and one to a depth of 6 feet. A typical detail for a settlement monitoring device is included as detail 2 on sheet C-501.

At a minimum, the ground surface and subsurface movement monitoring plan shall meet the following criteria and tolerances for ground settlement/heave:

| Monitoring Point | Monitoring Frequency | Settlement/Heave Tolerance | Maximum Allowable |
|---|---|---|---|
| Surface | Hourly when heading is within 15 feet of the monitoring point; otherwise daily | ± 0.25 inches | 0.5 inches |
| Subsurface | Hourly when heading is within 15 feet of the monitoring point; otherwise daily | ± 1.5 inches | 2.5 inches |

If the tolerances are exceeded, modifications to the pipe installation procedures shall be made to prevent excessive settlement or heave. If the heave or settlement exceeds the maximum allowable then mitigation measures such as grouting and repair to the levee will be required.

L. Monitoring of Ground Surface and Subsurface Movement – Storm Drain Crossing

The roadway and the storm drain above the jacked steel casing shall be monitored for movement (e.g., settlement/heave).

The Contractor shall survey the roadway at a minimum of 3 locations along the centerline of the casing before, during, and after the jacking and boring operation.

Jacking and boring shall cause no impact to the flowline of storm drain. Video the storm drains before and after the jacking and boring operation.

At a minimum, meet the following criteria and tolerances for ground settlement/ heave:

| Monitoring Point | Monitoring Frequency | Settlement/Heave Tolerance | Maximum Allowable |
|---|---|---|---|
| Roadway (Surface) | Daily | ± 0.25 inches | 0.50 inches |
| Storm Drain (Subsurface) | Before and After | ± 0.10 inches | 0.10 inches |

If the tolerances are exceeded, modifications to the pipe installation procedures shall be made to prevent excessive settlement or heave. If the heave or settlement exceeds the maximum allowable then mitigation measures such as repair or replacement of the storm drain and/or roadway will be required

END OF SECTION