

SECTION 1406

THRUST RESTRAINT

1406.0100 GENERAL

1406.0101 Description of Work. The work under this section shall consist of furnishing all labor, materials and equipment required to resist the hydrodynamic thrust forces acting to separate the joints of water mains and appurtenances in accordance with the details shown on the project plans and the requirements of these specifications. (SD 600 SD 610)

1406.0103 Submittals. When specified in the special specifications or required by the Engineer, shop drawings and manufacturer's literature shall be submitted to the Engineer for all materials and components.

All submittals shall reference the project plan number.

1406.0104 Delivery, Storage and Handling. Joint restraint devices shall be delivered to the site, stored, and handled in accordance with the manufacturer's instructions.

1406.0200 PRODUCTS

1406.0201 Materials.

(A) **Ductile Iron Pipe (DIP).** When mechanically restrained joints are required for ductile iron pipe, they shall comply with the approved materials list in Appendix A. Mechanically restrained joints shall be manufactured integrally with the pipe or provided as accessory mechanisms as described in this section.

Field welding of ductile iron pipe for joint restraint shall not be permitted. Cadwelds for corrosion protection are acceptable.

Mechanical joint retainer gland restraints for ductile iron pipe shall be designed to fit standard mechanical joint bells with standard "tee" head bolts conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53. Glands shall be manufactured of ductile iron conforming to ASTM A36 grade 60-42-10. Set screws shall not be permitted. Mechanical joint restraint devices shall have a working pressure of at least 250 PSI with a minimum safety factor of 2:1.

Glands shall be provided with a restraining mechanism consisting of a sufficient number of individually set gripping surfaces which impart a wedging action against the pipe, increasing in resistance with increasing pressure. The gripping surfaces shall incorporate twist-off nuts to insure proper setting. Restraint mechanisms shall be installed in accordance with the manufacturer's recommendations.

(B) **Concrete Cylinder Pipe (CCP).** Concrete cylinder pipe shall be restrained by welding the joints. All joints which are proximate to in-line valves, bends, tees, outlets larger than 12", bevels, and dead ends and are within the limits noted on the plans or shop drawings shall be welded evenly around the entire external circumference (360°) of the pipe cylinder (bell and spigot rings) in accordance with the pipe manufacturer's recommendations.

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(C) **Polyvinyl Chloride Pipe (PVC).** Polyvinyl chloride pipe joints shall be secured by means of a mechanical restraint device which shall be on the approved list in Appendix A.

Restraint harnesses shall consist of: a split ring that fits behind the bell; either a split or full restraint ring that installs on the spigot end; and tie bars or tee bolts which connect the two rings. The harness restraint may be split to enable installation after the pipe spigot has been installed into the bell. All components which comprise the restraint harness shall be manufactured of ductile iron conforming to the requirements of ASTM A536. Each ring shall have serrations on its full inside diameter (360°) or a sufficient number of individually adjusted gripping surfaces.

All clamping bolts, tie bars, tee bolts, nuts, and washers shall be manufactured of either 1) "Corten" high strength low-alloy structural weathering steel (or approved equal) in accordance with ASTM A242 or A588, or 2) 316 stainless steel with Xylan coated stainless steel nuts.

Provide restraint against thrust loads. Typically, external joint restraints employ individual external clamps that fit behind the bell and around the pipe, and tie rods between the clamps.

Thrust restraint utilizing Portland cement concrete thrust blocking shall be only for modifications to existing pipe lines or as may be approved by the Engineer. Portland cement concrete thrust blocks shall comply with the requirements of Subsection 1406.0300(D).

(D) **High Density Polyethylene Pipe (HDPE).** Mechanical joints to polyethylene pipe are fully restrained against thrust load only if pressure and tensile tests cause the pipe to yield before the pipe and fitting disjoin. Mechanical joints that provide full thrust restraint are designed to mechanically compress the pipe OD against a rigid tube or stiffener in the pipe bore.

Insert fittings are pushed into the mating pipe bores, and use individual compression sleeves on the pipe OD's. Compression couplings fit over the pipe ends, and use individual insert stiffeners in the pipe bores.

(E) **WHEN JOINING PLAIN END PIPE TO BELL-AND-SPIGOT OR MECHANICAL-JOINT TYPE FITTINGS OR PIPE, AN EXTERNAL JOINT RESTRAINT MUST BE USED TO PROVIDE RESTRAINT AGAINST THRUST LOADS.** Typically, external joint restraints employ individual external clamps that fit behind the bell and around the pipe, and tie rods between the clamps.

1406.0300 EXECUTION.

1406.0301 General. The contractor shall provide and install thrust restraint at all points of directional change (i.e., fittings, valves, bends, tees, and plugs). All thrust restraint methods shall be installed prior to pressure testing. Wooden blocks, wedges, or other non-permanent techniques will not be permitted.

The length of pipe to be restrained shall be as indicated on the plans, shop drawings and as called for by manufacturers requirements.

(A) **Workmanship.** All personnel of the contractor shall be skilled and knowledgeable with regard to the installation procedures for the thrust restraint being installed.

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(B) Welding. Welded joint restraint for CCP shall be in accordance with the pipe manufacturer's recommendations. The length, size and type of weld shall comply with the requirements of the approved plans and shop drawings.

Field welding shall be in accordance with the American Welding Society and AWWA C206. Welding shall be performed by certified welders.

The following maximum allowable stress shall be used to determine the steel cylinder thickness required to account for longitudinal thrust within the welded length:

Axial stress in steel
cylinder (f_s)
= 15,000 psi at test pressure
= 12,560 psi at design pressure

Field welds on CCP shall be placed in passes not more than 1/8 inch thick unless otherwise approved by the Engineer. Size and type of electrodes, current, and voltages shall be in accordance with the manufacturer's requirements and subject to the approval of the Engineer. Particular attention shall be given to the alignment of edges to be joined in order that complete fusion and penetration will be effected throughout the root of the weld. Welds shall contain no valley or undercuts in the center or edges of the weld. Each pass shall be thoroughly cleaned of dirt, slag, or flux before the succeeding welding pass is applied.

All completed field welds of PCCP or CCP joints shall be visually inspected. Non-destructive testing of field welds may be specified in the special specifications for critical locations or be required by the Engineer to supplement visual inspections. When non-destructive testing is required, the initial test shall be paid for by the Agency. In the event of rejected welds, all retests shall be at the contractor's sole expense. Porosity, cracks, trapped welding flux, or other defects in welds discovered during field inspection shall be completely ground out in a manner that will permit proper and complete repair by welding. Under no circumstances will caulking of defective welds be permitted.

Welding of joints shall be by the electric arc process in accordance with the applicable requirements of AWWA C206. Field welding shall commence as soon as practicable after the laying operation. Field welds shall be completed before lining or coating of joints. All required field welds shall be specified in the shop drawings and pipe design calculations.

(C) Portland Cement Concrete Thrust Blocks. The use of Portland cement concrete thrust blocks is not permissible except as shown on the plans or with the approval of the Engineer.

Portland cement concrete thrust blocks when approved, shall be placed against undisturbed earth. Where it is not practicable to place the concrete thrust block against undisturbed earth, the fill material placed between the pipe's bearing surface and the undisturbed soil shall be compacted to a minimum of 95% of the maximum density as determined in accordance with the requirements of Arizona Test Methods 225, 226, 227, 230 or 231, and 232.

(D) Thrust Restraints. Thrust restraints shall be in accordance with Section 1407 and Appendix A.

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(E) **Corrosion Control.** Joint restraint devices of dissimilar material shall be protected against corrosion in accordance with SD700 through SD711.