

## 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 with the requirements of these specifications (see TW Standard Details 600 and 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 Tucson Water 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 (4- to 12-inch DIP only).** When mechanically restrained joints are required for ductile iron pipe, they shall comply with the Approved Materials List (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 pounds per square inch with a minimum safety factor of 2 to 1.

Glands shall be provided with a restraining mechanism consisting of a sufficient number of individually set gripping surfaces that impart a wedging action against the pipe, increasing in resistance with increasing pressure. The gripping surfaces shall incorporate twist-off nuts to ensure proper setting. Restraint mechanisms shall be installed in accordance with the manufacturer's recommendations. DIP 16 inches in diameter and larger will need to be submitted for Engineer approval.

## SECTION 1406

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

**(C) Polyvinyl Chloride Pipe (PVC).** Polyvinyl chloride pipe joints shall be secured by means of a mechanical restraint device on the Approved Materials List (Appendix A).

Restraint harnesses shall consist of:

- (1) A split ring that fits behind the bell
- (2) Either a split or full restraint ring that installs on the spigot end
- (3) Tie bars or tee bolts connecting the two rings

The harness restraint may be split to enable installation after the pipe spigot has been installed into the bell. All components comprising the restraint harness shall be manufactured of ductile iron conforming to the requirements of ASTM A536. Each ring shall have either serrations on its full inside diameter (360 degrees) or a sufficient number of individually adjusted gripping surfaces.

All clamping bolts, tie bars, tee bolts, nuts, and washers shall be manufactured of either:

- Corten high-strength, low-alloy structural weathering steel (or approved equal) in accordance with ASTM A242 or ASTM A588
- Type 316 stainless steel with Xylan-coated stainless-steel nuts

Typically, external joint restraints employ individual external clamps that fit behind the bell and around the pipe, and tie rods between the clamps. All restraints shall be encased with 8-millimeter polyethylene wrap in accordance with AWWA C105, Method C.

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 1406.0301(C).

**(D) High Density Polyethylene Pipe (HDPE).** All material will need to be submitted under the current contract requirements or current approved plans. All HDPE will be project specific under the requirements listed for the current Tucson Water plan. Any HDPE installed will have special provisions according to the Engineer's requirements. HDPE highline will be installed per Section 0209 and TW Standard Detail 375.

## SECTION 1406

### 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 Contractor is responsible for providing restraint against thrust loads during testing.

The length of pipe to be restrained shall be as indicated on the plans, shop drawings, and as called for in TW Standard Details 600 and 610.

**(A) Workmanship.** All the Contractor's or subcontractor's personnel shall be skilled and knowledgeable regarding installation procedures for the thrust restraint being installed.

**(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:

**Table 1406-1  
Axial Stress in Steel Cylinder ( $f_s$ )**

<b>Pressure Type</b>	<b>Maximum Stress</b>
Test Pressure	15,000 psi
Design Pressure	12,560 psi

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 Engineer's approval. Particular attention shall be given to the alignment of edges to be joined in order to effect complete fusion and penetration 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 Agency shall pay for the initial test. In the event of rejected welds, all retests shall

## SECTION 1406

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 in the following cases:

- As shown on the plans or with the Engineer's approval
- For installation of approved tapping sleeves

When approved, Portland cement concrete thrust blocks shall be placed against undisturbed earth (see TW Standard 610). Where it is not practicable to place the concrete thrust block against undisturbed earth, the fill material between the pipe's bearing surface and the undisturbed soil shall be compacted to a minimum of 95 percent of the maximum density as determined in accordance with the requirements of Arizona Test Methods 225, 226, 227, 230 or 231, and 232. See Tucson Water Standard Detail 610.

**(D) Thrust Restraints on Tapping Sleeves.** Thrust restraints for tapping sleeves will follow the concrete thrust block per TW Standard Detail 610, sheet 3.

**(E) Corrosion Control.** Joint restraint devices of dissimilar material shall be protected against corrosion in accordance with TW Standard Details 700 through 711.