SEISMIC RESTRAINT FOR DRAIN, WASTE, AND VENT LINES

S10.1 – Introduction:

Waste, drain, and vent lines typically do not hold pressure; nor do they run completely full all the time. Typically the materials used for the manufacture of the pipes used for waste and drain lines are cast iron, steel, or PVC plastic. These materials are usually considered to be low deformability, brittle, materials. Also, the fittings used to connect the sections of pipe are traditionally slip type fittings. Therefore, extra care must be used when restraining waste, drain, and vent lines.

S10.2 – Restraint Locations for Drain, Waste, and Vent Lines:

Because these lines carry little if any pressure and do not normally run full, there is no real need to rigidly connect the pipe joints together. Pipes that are intended to carry pressure and run full a usually joined using threaded fittings, welding, soldering, brazing, or “grooved” type couplings Cast iron drain, waste, and vent lines usually have “slip type” couplings. Hub type pipes have a hub on one end with an I. D. that is just slightly larger than the O. D. of the pipe. The hub less end of one pipe goes into the hub end of the other pipe with some type of seal. Pipes without a hub are joined together with a flexible coupling that slips over the O. D. of the pipes and is clamped with band clamps. This is called a No-Hub pipe coupling, and will be discussed more fully in Section S10.5. PVC drain, waste, and vent lines are usually joined with socket type fittings whose joints are solvent welded. In general, hub type and No-Hub type fittings can not be counted on to carry tensile longitudinal loads. The plastic pipe and fittings are considered to be made from low deformability materials. This is because the solvent weld joints are certainly more brittle than the surrounding material and because the plastic itself has a lower modulus of elasticity and flexure strength that do its metal counterparts.

The problem with joining pipe with slip type fittings is that during an earthquake a run of drain, waste, or vent pipe could be placed in differential motion where two adjacent sections of would

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move in opposite directions. In this case the possibility of having the drain or waste line separate and empty in to living space is very real. Since, the materials used for the pipes in waste and drain lines are typically low deformability materials, that are brittle and can not tolerate large deflections, and the connections are suspect drain, waste, and vent lines require more restraints than other types of piping associated with normal construction. Figure S10-1 shows what might be a typical portion of a run of waste or drain line.

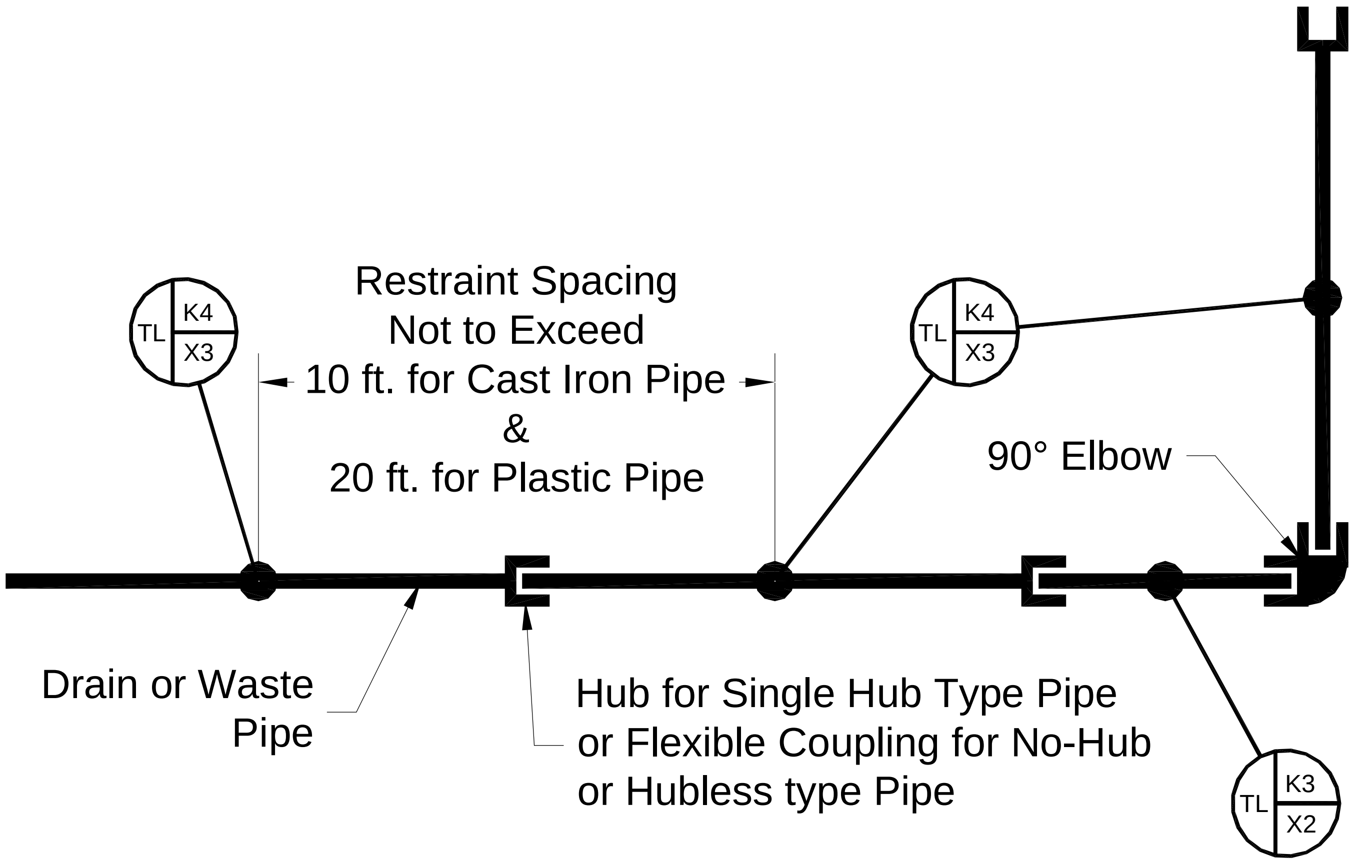

Figure S10-1; Typical Seismic Restraint Scheme for Drain and Waste Lines

Referring to Figure S10.1, drain, waste, and vent lines must be seismically restrained in the following manner.

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1. Each joint of drain, waste, and vent line must have at least one transverse and one longitudinal seismic restraint.
2. Even if adequately braced in accordance with this section the spacing between transverse restraints must not exceed 10 feet for cast iron pipe and 20 feet for PVC plastic pipe due to the brittle nature and low mechanical properties of the pipe material itself.
3. Seismic restraints must be located at or very near the support hangers for the drain, waste, or vent line, and this hanger must be capable of transferring compressive loads. See Section S1.0 RULE #3.
4. Longitudinal seismic restraints are not to be attached to a clevis hanger. They should be attached to the pipe as described in Section 1.0 RULE #16.
5. Section S1.0 RULE #9 ***does not*** apply to drain, waste, and vent piping.

S10.3 – Sizing Seismic Restraints for Drain, Waste, and Vent Lines:

Since these types of lines are typically empty, it is fair to select the seismic restraints based on something less than the filled pipe weight. It is recommended, however, that the seismic restraints for drain and waste lines be selected based on the pipes being at least half full of water. The seismic restraints for vent lines, however, may be based on the empty pipe weight. The weights of the pipe typically used for drain, waste, and vent lines are provided in Appendices A2.3 and A2.4.

S10.4 – Underground Buried Drain, Waste, and Vent Lines:

Drain, waste, and vent lines that are buried underground do not require additional seismic restraint. The soil compacted around the pipes will keep them moving together with the ground motion, and prevent separation. Any ground motion that causes excess differential transverse motion will fail the pipes whether they are restrained or not.

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S10.5 – No-Hub Pipe Couplings for Seismic Applications:

No-Hub piping utilizes straight joints of steel, plastic, or hub less cast iron pipes that are joined together by a slip "sleeve" type No-Hub coupling. An example of this type of pipe joint is illustrated in Figure S10-2. A No-Hub coupling consists of a "hose" that slips over the ends of the mating pipes. This "hose" is often covered by some type of corrugated stainless steel shield. The "hose" and shield are clamped to the pipes with band type clamps that are tightened to a specified torque level. The No-Hub coupling is still a slip type joint that is held together by friction forces between the pipe and the gasket.

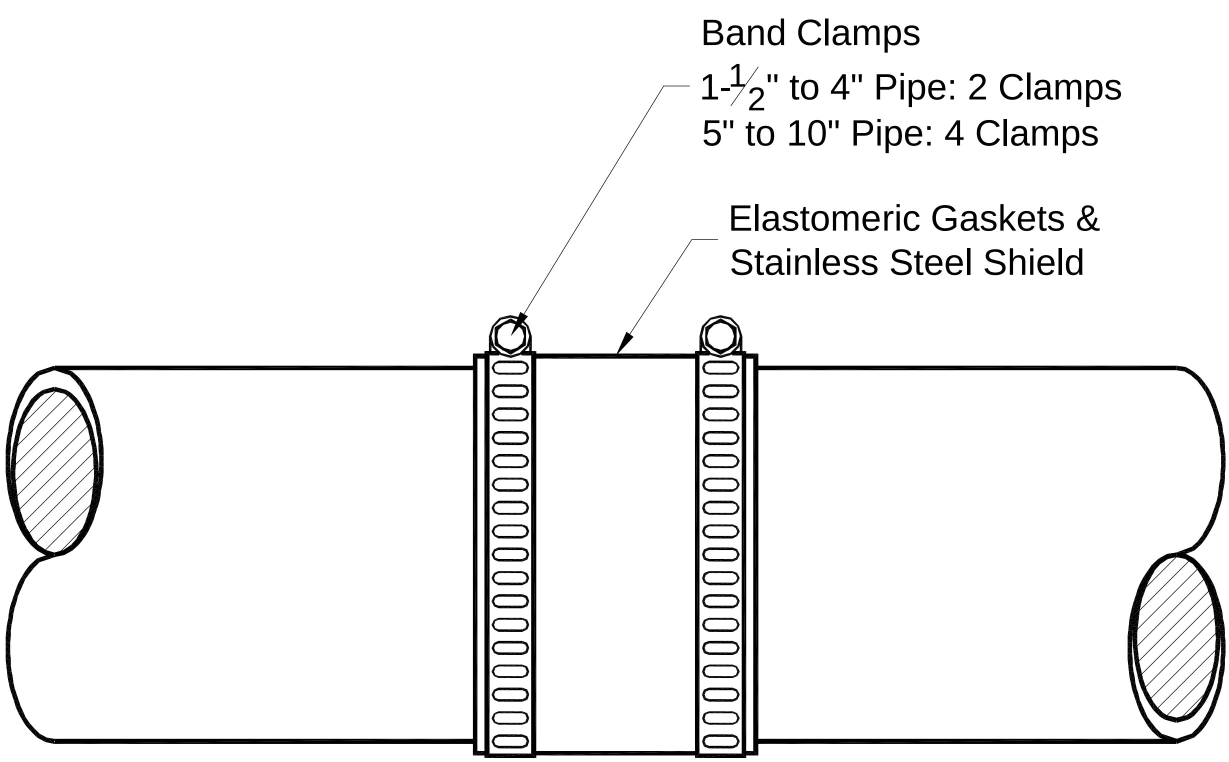

Figure S10-2; Typical Standard No-Hub Pipe Coupling

For seismic applications where the failure of the waste, drain, or vent lines could render an essential facility uninhabitable or inoperable, the level of safety that is provided by the standard No-Hub coupling, even with restrained piping is not considered to be sufficient. This is primarily

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due to a lack of redundancy with the band clamps providing the frictional resistance that maintains the joint integrity. ASHRAE's A Practical Guide to Seismic Restraint[1] recommends doubling the number of band clamps that secure the shield and gasket to the ends of the pipes. This may be accomplished by specifying heavy duty No-Hub couplings similar to that shown in Figure S10-3.

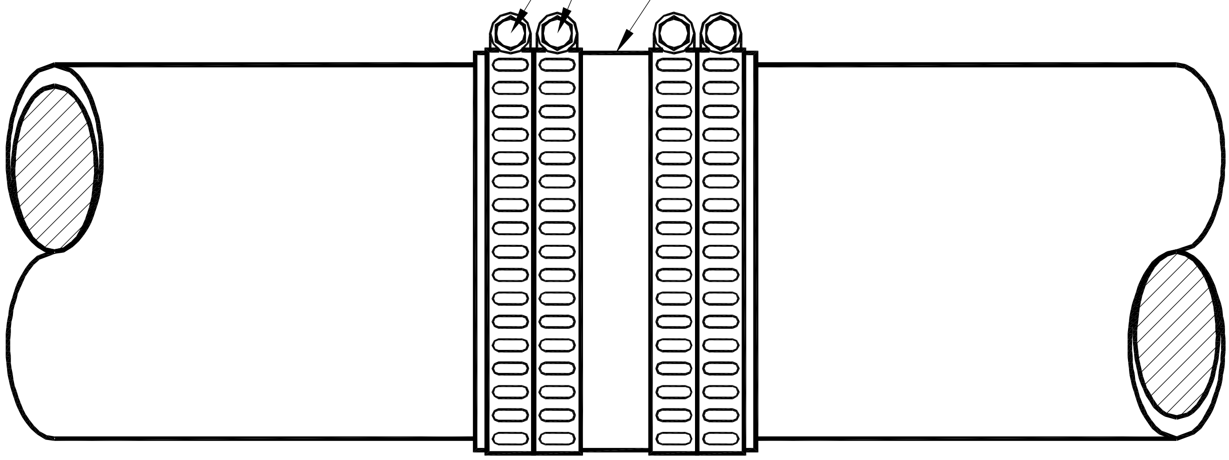

Figure S10-3; Typical Heavy Duty No-Hub Pipe Coupling

S10.6 – Reducing the Number of Restraints for Drain, Waste, and Vent Lines:

In order to reduce labor and material costs, there is always an interest in reducing the number of seismic restraints used for a run of pipe. With drain, waste, and vent lines, this is difficult, and can be accomplished only with proper planning.

[1] Tauby, James R.; Lloyd, Richard; Noce, Todd; and Tünnissen, Joep; A Practical Guide to Seismic Restraint; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, Georgia 30329, 1999.

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The first technique will apply to both hub type pipe and No-Hub pipe. It may be used when the run consists of more than two joints of pipe, and involves longitudinally "trapping" one joint of pipe between two others, see Figure S10-4 below. The longitudinal restraints on the two end joints of pipe trap and longitudinally restrain the center joint of pipe. This eliminates the need for a longitudinal restraint on the center joint of pipe. The center joint of pipe must still have a transverse restraint due to the fragile nature of the pipe couplings.

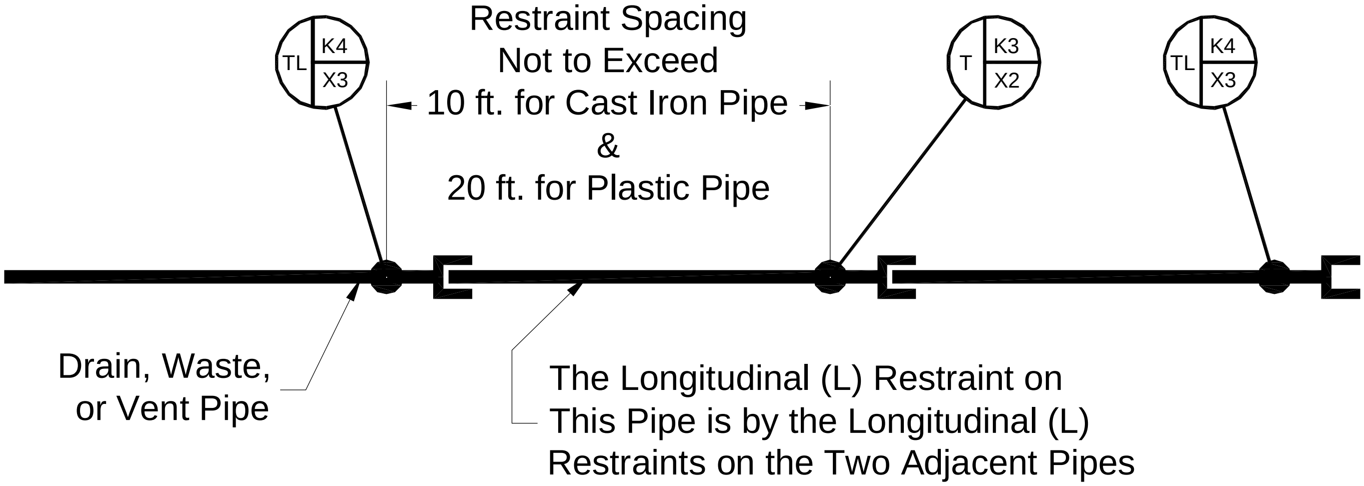

Figure S10-4; Reducing Longitudinal Restraints by "Trapping" a Joint of Pipe between Two Longitudinally Restrained Joints of Pipe

The second technique will also apply only to No-Hub and hub type pipe. For No-Hub pipe this technique involves the use of either a 16 gage steel half sleeve around the No-Hub coupling that is clamped to the pipe on each side of the coupling or two pipe clamps and two spacer bars. For hub type pipe the technique will involve the use of two pipe clamps and two spacer bars. Both of these methods have been proposed by SMACNA.[2] These arrangements are intended to carry the tensile longitudinal seismic loads across the coupling. A possible detail of the arrangement using the 16 gage steel half sleeve and clamps with No-Hub pipe is shown in Figure S10-5. The pipe clamps and spacer bars with No-Hub pipe is shown in Figure S10-6. Finally the pipe clamps and

[2] SMACNA; Seismic Restraint Manual – Guidelines for Mechanical Systems, 3rd Edition – March 2008; Sheet Metal and Air Conditioning Contractors' National Association, Inc. 4201 Lafayette Center Drive Chantilly, VA 20151-1209; Pp 10.10 and 10.11.

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spacer bars with hub type pipe is shown in Figure S10-7. The half sleeve and pipe clamps with spacer bars can be used to reduce the number of restraints required as shown in Figure S10-8. Because the two joints of pipe are "hard" connected via the half sleeve or pipe clamps with spacer bars, the longitudinal restraint on the joint of pipe on the left may be eliminated. The following rules should be applied for restraint spacing when a half sleeve or two pipe clamps with spacer bars are used to bridge across a No-Hub or hub type coupling to eliminate one longitudinal restraint.

1. For cast iron pipe in 10' long joints: Transverse Restraint Spacing = 10' Maximum & Longitudinal Restraint Spacing = 20' Maximum.
2. For PVC & CPVC pipe in 20' long joints: Transverse Restraint Spacing = 20' Maximum & Longitudinal Restraint Spacing = 40' Maximum.

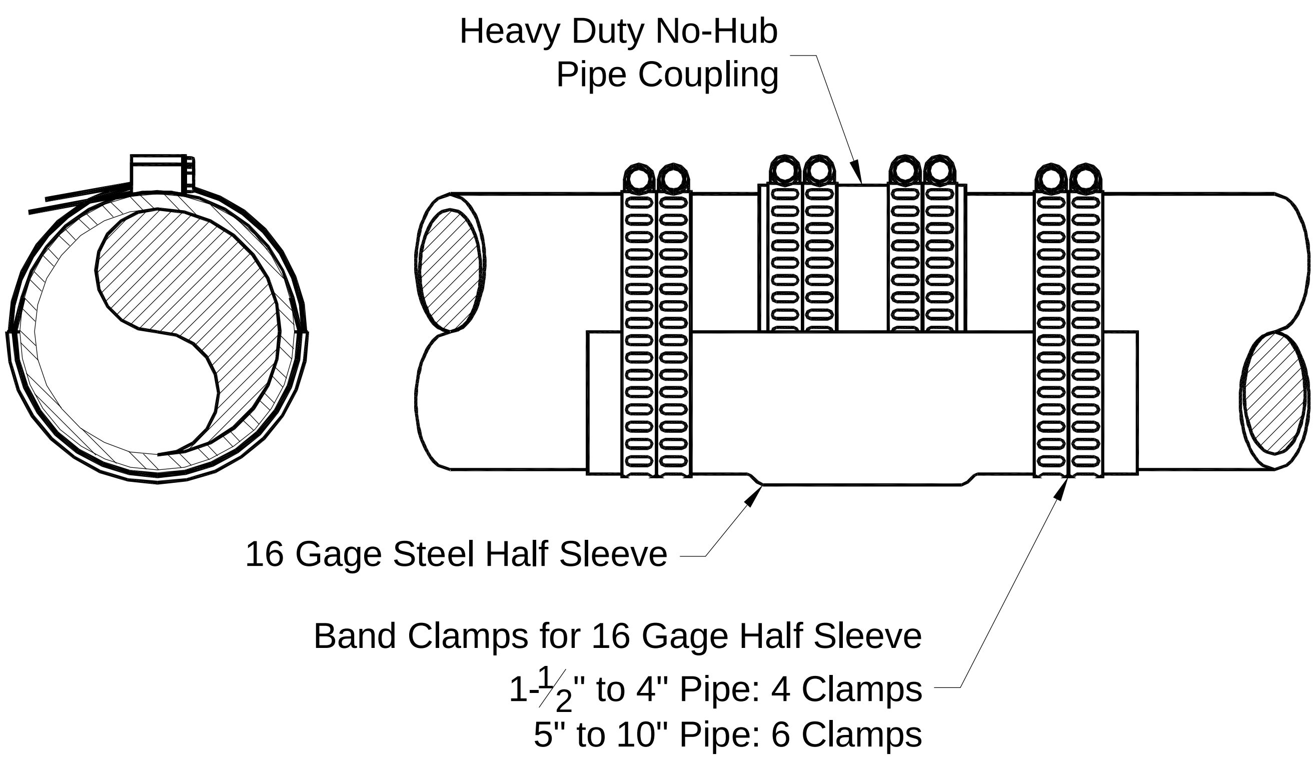

Figure S10-5; 16 Gage Steel Half Sleeve to Carry Seismic Tensile Loads Across a No-Hub Coupling

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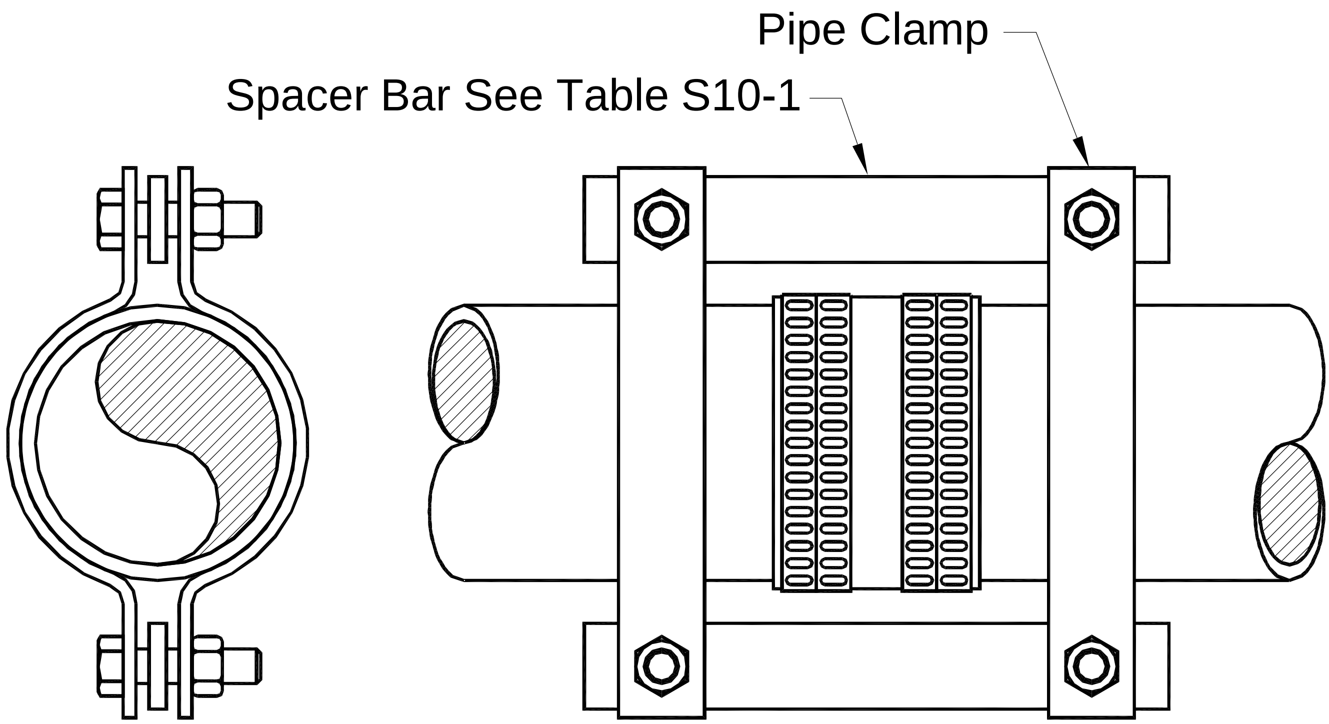

Figure S10-6; Two Pipe Clamps with Two Spacer Bars to Carry Seismic Tensile Loads Across a No-Hub Coupling

Table S10-1; Space Bar Section Sizes for Figures S10-6 and S10-7 – Length of Bars per Application[2]

Pipe Size (in)	Spacer Bar Size (in)
Up to 2	1/4 x 1-1/4
2-1/2 to 3	1/4 x 1-1/4
4 & 5	1/4 x 1-1/4
6	3/8 x 1-1/2
8	3/8 x 1-1/2

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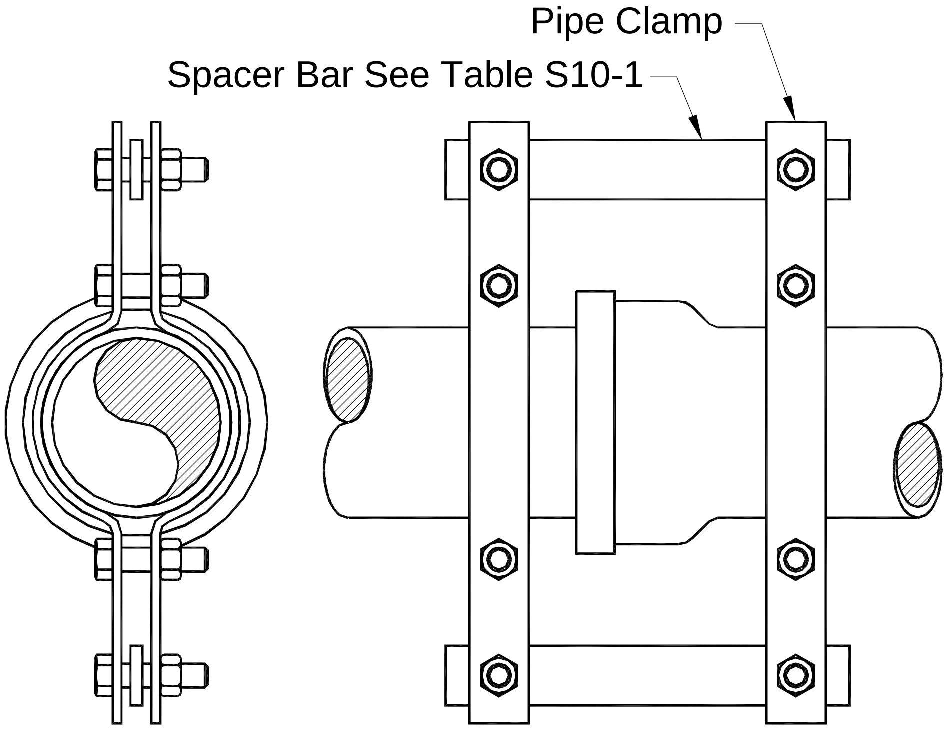

Figure S10-7; Two Pipe Clamps with Two Spacer Bars to Carry Seismic Tensile Loads Across a Hub Type Coupling

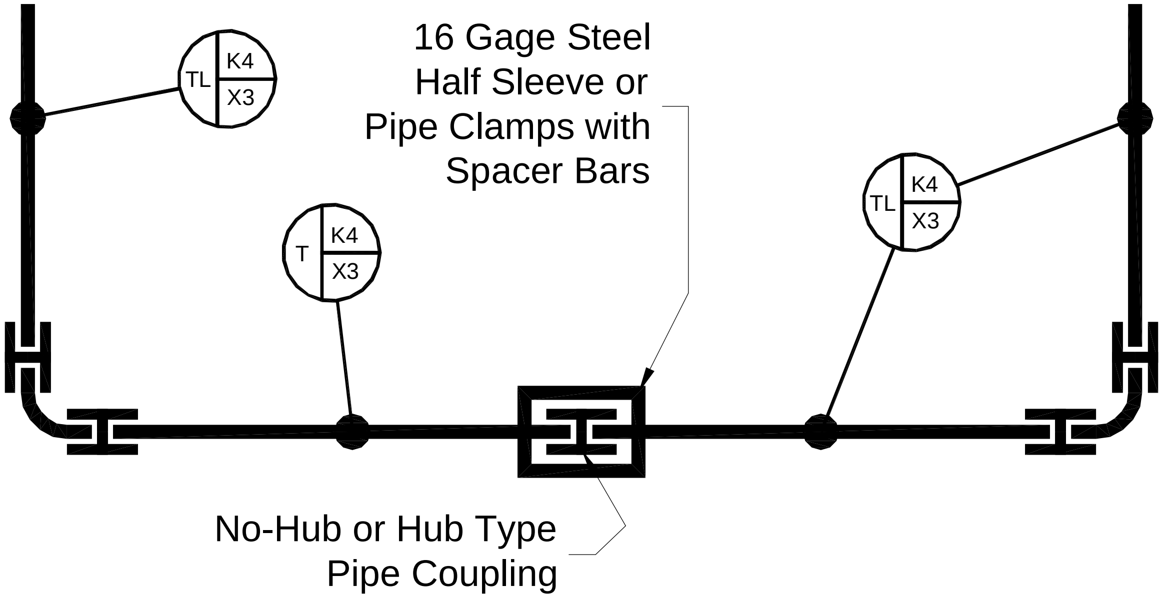

Figure S10-8; Application #1 of the 16 Gage Steel Half Sleeve

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When other lines Tee into a run of pipe, the half sleeve should be used to bridge across all of the fittings between hanger locations to eliminate the need to individually restrain the fittings as shown in Figure S10-9.

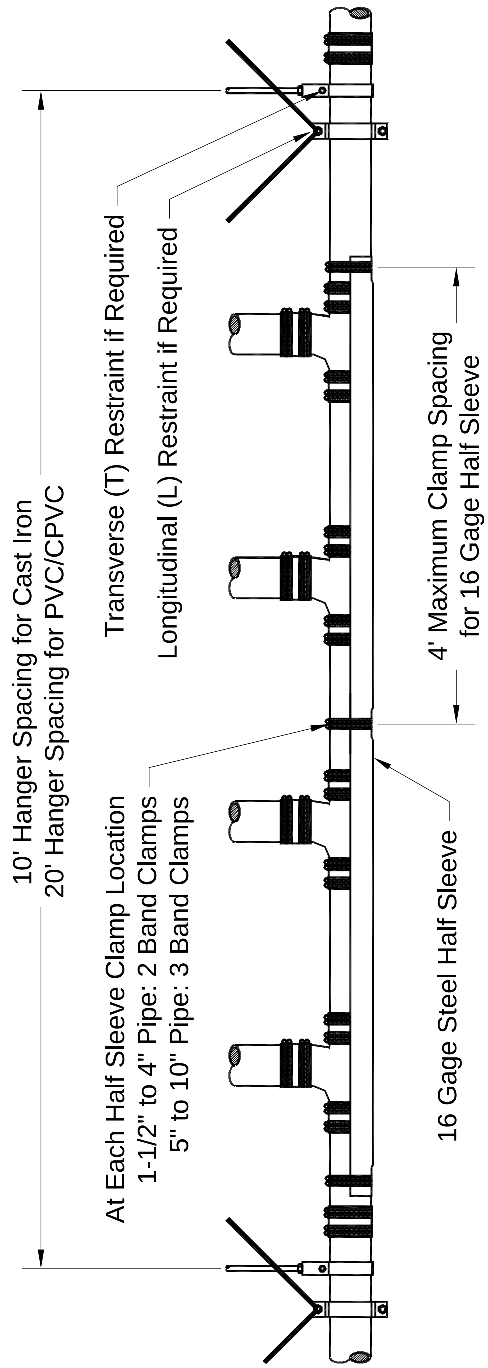

Figure S10-9; 16 Gage Steel Half Sleeve Used to Carry Tensile Loads Across Many Fittings

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