top of the initial backfill to the ground or surface line of the trench. To prevent water from undercutting the underside of the pipe, concrete collars keyed into the trench sides and foundation may be poured around the pipe or a PE waterstop can be fabricated onto the pipe.

Sunlight Exposure

Placing pipe that has been in direct sunlight in a cooler trench will result in thermal contraction of the pipe's length. This contraction can generate force which could result in pull-out at mechanical couplings or other buried structures. Allow pipe to cool before making connections to an anchored joint, flange, or a fitting that requires protection against excessive pull-out forces. Covering the pipe with embedment will facilitate cooling.

Cold (Field) Bending

Coiled lengths and long strings of PE fused pipe may be cold bent in the field. The allowable bend ratio is determined by the pipe diameter and the dimension ratio. See Figure 8 and Table 4. Because fittings and flange connections are rigid compared to the pipe, the minimum bend radius is 100 times the pipe's outside diameter (OD), when a fitting or flange connection is present in the bend. The bend radius should be limited to 100 x OD for a distance of about 5 times the pipe diameter on either side of the fitting location.

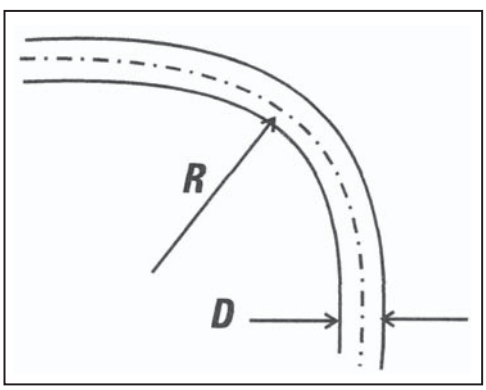

Figure 8 Bend Radius, R

TABLE 4
Minimum Bend Radius for PE Pipe Installed in Open Cut Trench

Dimension Ration, DR	Minimum Cold Bend Radius
7, 7.3, 9	20 x Pipe OD
11, 13.5	25 x Pipe OD
17, 21	27 x Pipe OD
26	34 x Pipe OD
32.5	42 x Pipe OD
41	52 x Pipe OD
Fitting or flange present in bend	100 x Pipe OD

Installation of Pipe in Curves

Field bending involves excavating the trench to the desired bend radius, then sweeping or pulling the pipe string into the required bend and placing it in the trench. Temporary restraints may be required to bend the pipe, and to maintain the bend while placing the pipe in the trench and placing initial backfill. Temporary blocks or restraints must be removed before installing final backfill, and any voids must be filled with compacted initial backfill material. **Considerable force may be required to field bend the pipe, and the pipe may spring back forcibly if the restraints slip or are inadvertently released while bending. Observe appropriate safety precautions during field bending.**

Transition from PE Pressure Pipe to Gasket Jointed Pipe

The heat fusion joint used for PE pipe creates an essentially continuous length of pipe. When the pipe is pressurized two significant internal forces are present in the pipe. End thrust from bends or end caps is transmitted through the pipe as a longitudinal force. Hoop stress (hoop thrust) occurs due to the internal pressure. The longitudinal force tends to grow the pipe length while the hoop thrust expands the diameter (ever so slightly) and tends to contract the pipe's length in proportion to Poisson's Ratio. In an all PE pipe system the length effects from these two forces tend to cancel each other out. As a result, buried PE pipes are self-restrained and require no thrust blocking. A different situation occurs when PE pipe transitions to a type of pipe material that is joined by non-restrained gasket joints. The longitudinal force may be no longer present. The result is that hoop expansion is unbalanced and will cause contraction of the PE pipe. This contraction can result in pulling apart of gasket joints in line with the PE pipe.

Generally, it is necessary to anchor the ends of a PE pipeline that transitions into an unrestrained gasket jointed pipe system. If the gasket joints are restrained anchoring is unnecessary. See Appendix 3, "Pull-out of Mechanical Joints due to the Poisson Effect" for a complete discussion of the pull-out effect.