Thrust Block Supports

PE pipes and fittings joined by butt welding, electrofusion, or other end load bearing joint system do not normally require anchorage to withstand loads arising from internal pressure and flow.

For joint types which do not resist end loads, plus fabricated fittings which incorporate welded PE pipe segments, anchorage support must be provided in order to prevent joint or fitting failure. In addition, appurtenances such as valves, should be independently supported in order to prevent excessive shear loads being transferred to the PE pipe.

Static Pressure Thrust

$$R = \frac{2PA \,.\, \sin \phi \,.10^{-3}}{2}$$

where

R = resultant thrust (kN)

P = pressure (MPa)

A = area of pipe cross section (mm^2)

ϕ = angle of fitting (degrees)

For blank ends, tees and valves

$$R = PA\ 10^{-3}$$

For reducers

$$R = P(A_1 - A_2)\ 10^{-3}$$

Velocity (Kinetic) Thrust

The velocity or kinetic thrust applies only at changes of direction.

$$R = \frac{2\, w\, a\, V^2 .\, \sin \phi .10^{-9}}{2}$$

where

w = fluid density (kg/m^3)

a = inside pipe cross section area (mm^2)

V = flow velocity (m/s)

The velocity thrust is generally small in comparison to the pressure thrust.

The pressure used in the calculations should be the maximum working, or test pressure, applied to the line.

Bearing Loads of Soils

The thrust developed must be resisted by the surrounding soil. The indicative bearing capacities of various soil types are tabulated below:

The figures in the table below are for horizontal thrusts, and may be doubled for downward acting vertical thrusts. For upward acting vertical thrusts, the weight of the thrust block must counteract the developed loads.

In shallow (<600mm) cover installations or in unstable conditions of fill, the soil support may be considerably reduced from the values tabulated, and a complete soil analysis may be needed.

Soil Type	Safe Bearing Capacity (N/m^2)
Rock and sandstone (hard thick layers)	100×10^5
Rock- solid shale and hard medium layers	90×10^4
Rock- poor shale, limestone	24×10^4
Gravel and coarse sand	20×10^4
Sand- compacted, firm, dry	15×10^4
Clay- hard, dry	15×10^4
Clay- readily indented	12×10^4
Clay/Sandy loam	9×10^4
Peat, wet alluvial soils, silt	Nil

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Thrust Block Size Calculations

1. Establish the maximum pressure to be applied to the line
2. Calculate the thrust developed at the fitting being considered
3. Divide (2) by the safe bearing capacity of the soil type against which the thrust block must bear.

Worked Example

What bearing area of thrust block is required for a 160 mm PN12.5 90° bend in hard, dry clay?

1. Maximum working pressure of PN12.5 pipe is 1.25 MPa.

   Test pressure is 1.25 x WP

   = 1.56 MPa.

2. $R = \frac{2\,PA\,.\sin\phi.10^{-3}}{2}$

   $= 3.8 \times 10^{-4}$ N

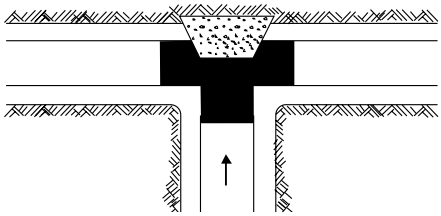
3. Bearing capacity of hard, dry clay is 15×10^4 N/m^2

$$\text{Bearing area of thrust block} = \frac{3.8 \times 10^4}{15 \times 10^4}$$

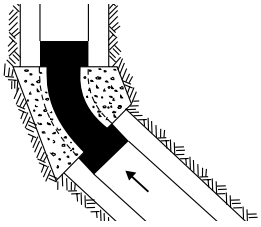
$$= 0.25 \text{m}^2$$

Thrust blocks may be concrete or timber. Where cast insitu concrete is used, an adequate curing period must be provided to allow strength development in the concrete before pressure is introduced to the pipeline. Where timber blocks are used, test pressures may be introduced immediately, but care needs to be taken to ensure that the blocks will not rot and will not be attacked by termites or ants.

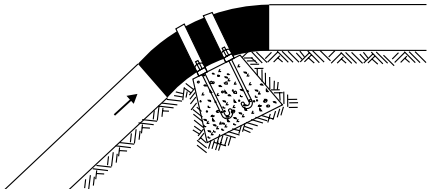
Figure 4.8 Thrust Blocks



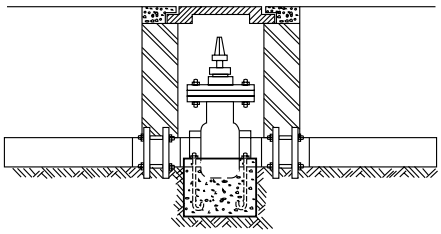
Tee anchorage



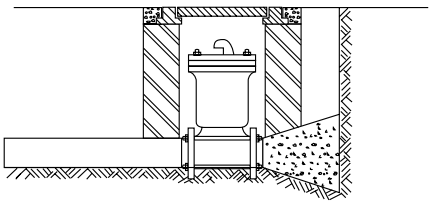
Bend in horizontal plane anchorage



Bend in vertical plane anchorage



Valve anchorage



Closed end and hydrant anchorage

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