Parker NHC
Project No. 22057
Calculated by FKF

Thrust Block Calculation for 8" Water

Table A.10.8.2(b) Required Horizontal Bearing Block Area

Nominal Pipe Diameter (in.)	Bearing Block Area (ft^2)	Nominal Pipe Diameter (in.)	Bearing Block Area (ft^2)	Nominal Pipe Diameter (in.)	Bearing Block Area (ft^2)
3	2.6	12	29.0	24	110.9
4	3.8	14	39.0	30	170.6
6	7.9	16	50.4	36	244.4
8	13.6	18	63.3	42	329.9
10	20.5	20	77.7	48	430.0

Notes:
(1) Although the bearing strength values in this table have been used successfully in the design of thrust blocks and are considered to be conservative, their accuracy is totally dependent on accurate soil identification and evaluation. The ultimate responsibility for selecting the proper bearing strength of a particular soil type must rest with the design engineer.
(2) Values listed are based on a 90-degree horizontal bend, an internal pressure of 100 psi, a soil horizontal bearing strength of 1000 lb/ft^2, a safety factor of 1.5, and ductile iron pipe outside diameters.
(a) For other horizontal bends, multiply by the following coefficients: for 45 degrees, 0.541; for 22½ degrees, 0.276; for 11¼ degrees, 0.139.
(b) For other internal pressures, multiply by ratio to 100 psi.
(c) For other soil horizontal bearing strengths, divide by ratio to 1000 lb/ft^2.
(d) For other safety factors, multiply by ratio to 1.5.

Example: Using Table A.10.8.2(b), find the horizontal bearing block area for a 6 in. diameter, 45–degree bend with an internal pressure of 150 psi. The soil bearing strength is 3000 lb/ft^2, and the safety factor is 1.5.

From Table A.10.8.2(b), the required bearing block area for a 6 in. diameter, 90-degree bend with an internal pressure of 100 psi and a soil horizontal bearing strength of 1000 psi is 7.9 ft^2.

For example:

$$Area = \frac{7.9\ ft^2 (0.541)\left(\frac{150}{100}\right)}{\left(\frac{3000}{1000}\right)} = 2.1\ ft^2$$

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Table A.10.8.2(c) Horizontal Bearing Strengths

Soil	Bearing Strength (S_b)	
	lb/ft^2	kN/m^2
Muck	0	0
Soft clay	1000	47.9
Silt	1500	71.8
Sandy silt	3000	143.6
Sand	4000	191.5
Sand clay	6000	287.3
Hard clay	9000	430.9

Note: Although the bearing strength values in this table have been used successfully in the design of thrust blocks and are considered to be conservative, their accuracy is totally dependent on accurate soil identification and evaluation. The ultimate responsibility for selecting the proper bearing strength of a particular soil type must rest with the design engineer.

It can be easily shown that $T_y = PA \sin \theta$. The required volume of the block is as follows:

$$V_g = \frac{S_f PA \sin \theta}{W_m}$$

where:
V_g = block volume (ft^3)
S_f = safety factor
P = water pressure (psi)
A = cross-sectional area of pipe interior
W_m = density of block material (lb/ft^3)

In a case such as the one shown, the horizontal component of thrust force is calculated as follows:

$$T_x = PA(1 - \cos \theta)$$

where:
T_x = horizontal component of thrust force
P = water pressure (psi)
A = cross-sectional area of pipe interior

The horizontal component of thrust force must be resisted by the bearing of the right side of the block against the soil. Analysis of this aspect follows the same principles as the previous section on bearing blocks.

A.10.8.3 A method for providing thrust restraint is the use of restrained joints. A restrained joint is a special type of joint that is designed to provide longitudinal restraint. Restrained joint systems function in a manner similar to that of thrust blocks, insofar as the reaction of the entire restrained unit of piping with the soil balances the thrust forces.

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8" Tee

Known Data	Qty		
Pipe Diameter	8	in.	
Horizontal Bearing Strength	4000	lb/sq ft	Sand per NFPA 24 Table A.10.8.2©
Pipe Pressure	150	psi	150 psi internal
Bend Angle	90	deg	
Bend Angle Coefficient	1.0		From Note 2a from NFPA 24 Table A.10.8.2(b)
Factor of Safety	1.5		
Bearing Block Area (Unfactored)	13.6	sq ft	Per NFPA 24 Table A.10.8.2(b)

Solve for Required Horizontal Bearing Block Area

$$Area = \frac{Bearing\ Block\ Area\ (Bend\ Angle\ Coef.)\left(\frac{Pipe\ Pressure}{100\ psi}\right)}{\left(\frac{Soil\ Bearing\ Strength}{1000\frac{lb}{ft^2}}\right)}(Factor\ of\ Safety)$$

Req'd AREA = 7.65 Sq Ft

Thrust Block Dimensions

H=	2	ft
W=	4.00	ft
Area=	8.00	sq ft

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Thrust Block Calculation for 8" Water

6" Tee

Known Data	Qty		
Pipe Diameter	6	in.	
Horizontal Bearing Strength	4000	lb/sq ft	Sand per NFPA 24 Table A.10.8.2©
Pipe Pressure	150	psi	150 psi internal
Bend Angle	90	deg	
Bend Angle Coefficient	1.0		From Note 2a from NFPA 24 Table A.10.8.2(b)
Factor of Safety	1.5		
Bearing Block Area (Unfactored)	7.9	sq ft	Per NFPA 24 Table A.10.8.2(b)

Solve for Required Horizontal Bearing Block Area

$$Area = \frac{Bearing\ Block\ Area\ (Bend\ Angle\ Coef.)\left(\frac{Pipe\ Pressure}{100\ psi}\right)}{\left(\frac{Soil\ Bearing\ Strength}{1000\frac{lb}{ft^2}}\right)}(Factor\ of\ Safety)$$

Req'd AREA = 4.44 Sq Ft

Thrust Block Dimensions

H=	2	ft
W=	2.25	ft
Area=	4.50	sq ft