

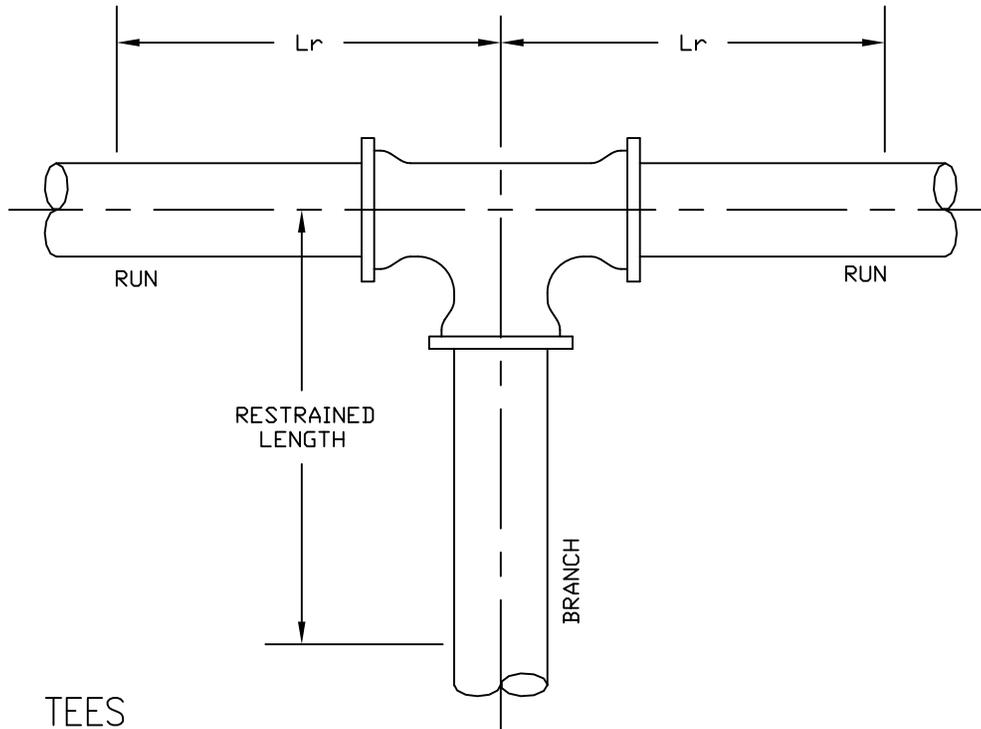
RESTRAINED JOINTS

NOTES

1. The lengths of restrained or continuous pipe called out in the following tables are for installation of mechanically restrained fittings and are calculated based on the following parameters:
  - a. All ductile iron (DI) is polyethylene encased.
  - b. The soil type is "GP" as defined by the Unified Soil Classifications, ASTM Standard D2487.
  - c. The test pressure of the water system is two hundred pounds per square inch (200 psi).
  - d. The trench is Type 5, as per ANSI/AWWA C150/A21.5, Trench Conditions.
  - e. The depth of cover is two feet (2').
  - f. The Safety Factor shall be 1.5.
  
2. If field conditions varying significantly from these parameters are encountered, the contractor shall immediately advise the Tucson Water Field Inspector. The Tucson Water Field Inspector will advise the contractor of the required length of restrained pipe necessary to meet the existing conditions.
  
3. The consultant or design firm shall specify soil type, test pressure, trench type, and depth of cover in the water distribution plans. If the Department judges that the required restrained length exceeds that specified in the tables, or if the pipe diameter exceeds 12", a professional civil engineer registered in Arizona shall prepare and submit for approval appropriate restrained length calculations.

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ALL THRUST RESTRAINTS SHALL BE IN COMPLIANCE WITH SECTION 1406.

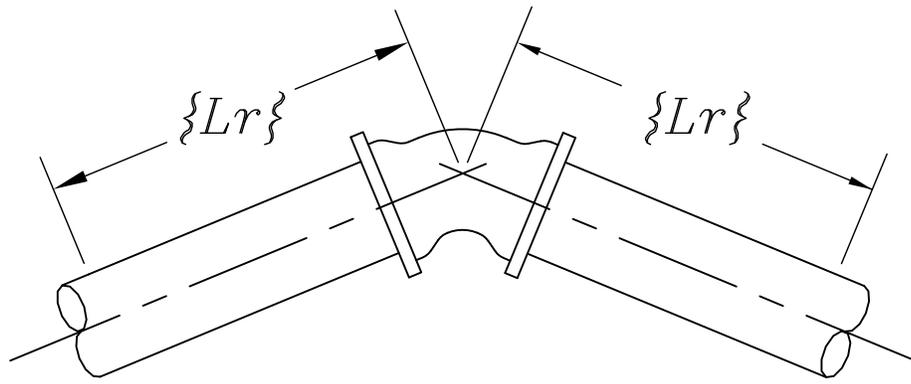


### TEES

The minimum attached length of pipe ( $L_r$ ) to extend in each direction along the run of the tee shall be a solid pipe without joints, fittings, etc. The length of the restrained branch shall be derived from the following table.

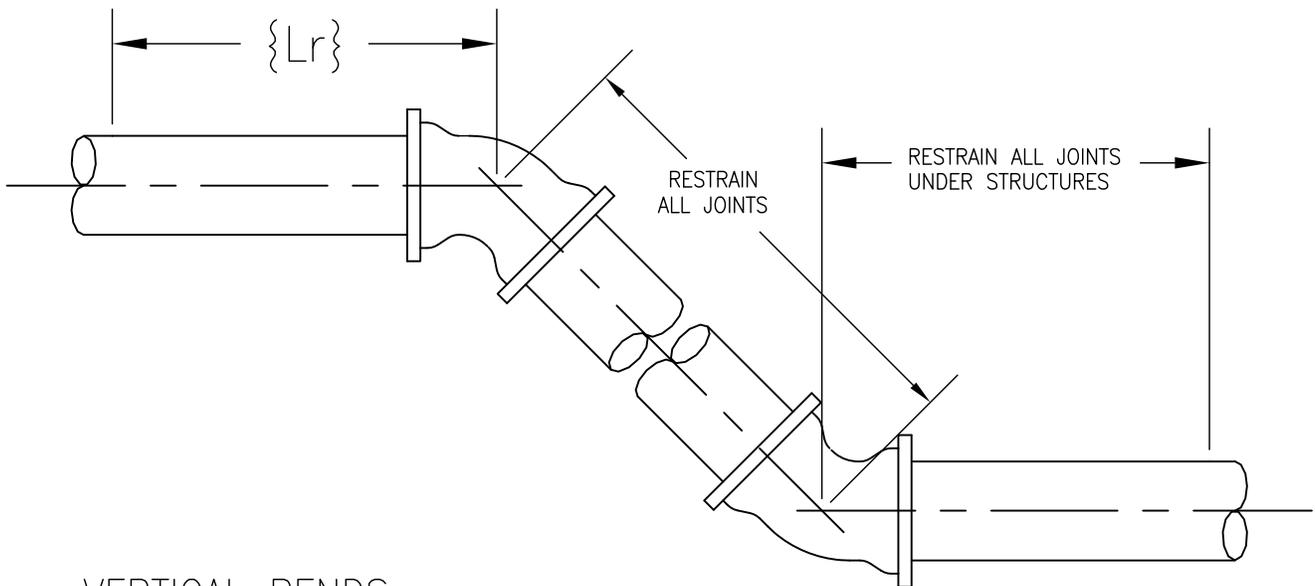
TEE SIZE & PIPE MATERIAL		MINIMUM ATTACHED LENGTH OF PIPE ( $L_r$ )										
		0'	2'	4'	6'	8'	10'	12'	14'	16'	18'	20'
		LENGTH OF RESTRAINED BRANCH										
PVC PIPE	4x4	74'	64'	53'	42'	32'	21'	11'	1'	1'	1'	1'
	6x4	74'	58'	42'	26'	11'	1'	1'	1'	1'	1'	1'
	6x6	104'	93'	82'	71'	61'	50'	39'	28'	18'	7'	1'
	8x4	74'	53'	31'	10'	1'	1'	1'	1'	1'	1'	1'
	8x6	104'	89'	75'	60'	46'	31'	17'	3'	1'	1'	1'
	8x8	135'	124'	113'	102'	91'	80'	69'	59'	48'	37'	26'
	12x4	74'	41'	7'	1'	1'	1'	1'	1'	1'	1'	1'
	12x6	104'	81'	58'	35'	13'	1'	1'	1'	1'	1'	1'
	12x8	135'	118'	101'	83'	66'	49'	32'	15'	1'	1'	1'
12x12	189'	177'	166'	155'	144'	132'	121'	110'	98'	87'	76'	
DI POLY WRAP	4x4	112'	96'	80'	64'	48'	32'	17'	1'	1'	1'	1'
	6x4	112'	88'	64'	40'	16'	1'	1'	1'	1'	1'	1'
	6x6	157'	141'	124'	108'	92'	75'	59'	43'	27'	10'	1'
	8x4	112'	80'	48'	15'	1'	1'	1'	1'	1'	1'	1'
	8x6	157'	135'	113'	91'	70'	48'	26'	4'	1'	1'	1'
	8x8	204'	187'	171'	154'	138'	121'	105'	88'	72'	55'	39'
	12x4	112'	61'	11'	1'	1'	1'	1'	1'	1'	1'	1'
	12x6	157'	122'	88'	54'	19'	1'	1'	1'	1'	1'	1'
	12x8	204'	178'	152'	126'	100'	74'	48'	22'	1'	1'	1'
12x12	284'	267'	250'	233'	216'	199'	182'	165'	148'	131'	114'	

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## HORIZONTAL BENDS

The minimum restrained length of pipe ( $L_r$ ) to extend in both directions from the horizontal bend shall be derived from the following table.



## VERTICAL BENDS

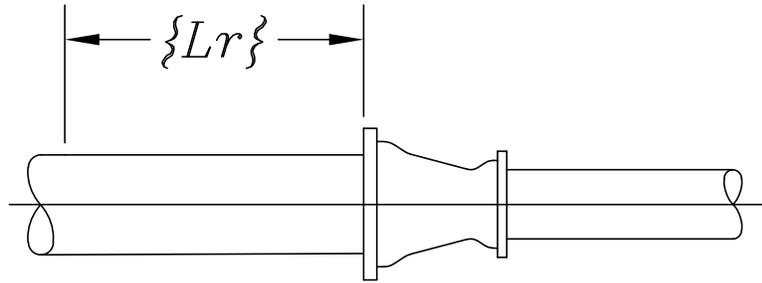
The minimum restrained length of pipe ( $L_r$ ) to be restrained on both sides of the vertical off set shall be derived from the following table.

PIPE SIZE & MATERIAL		HORIZONTAL BENDS				VERTICAL BENDS			
		11 1/4'	22 1/2'	45°	90°	11 1/4'	22 1/2'	45°	90°
PVC PIPE	4"	3'	5'	11'	27'	7'	15'	31'	*
	6"	4'	7'	15'	37'	10'	21'	43'	*
	8"	5'	10'	20'	48'	13'	27'	56'	*
	12"	6'	13'	27'	65'	19'	38'	78'	*
DI POLY WRAP	4"	3'	6'	13'	31'	11'	22'	46'	*
	6"	4'	8'	18'	42'	15'	31'	65'	*
	8"	5'	11'	23'	54'	20'	41'	84'	*
	12"	7'	15'	31'	74'	28'	57'	118'	*

\*NOT RECOMMENDED

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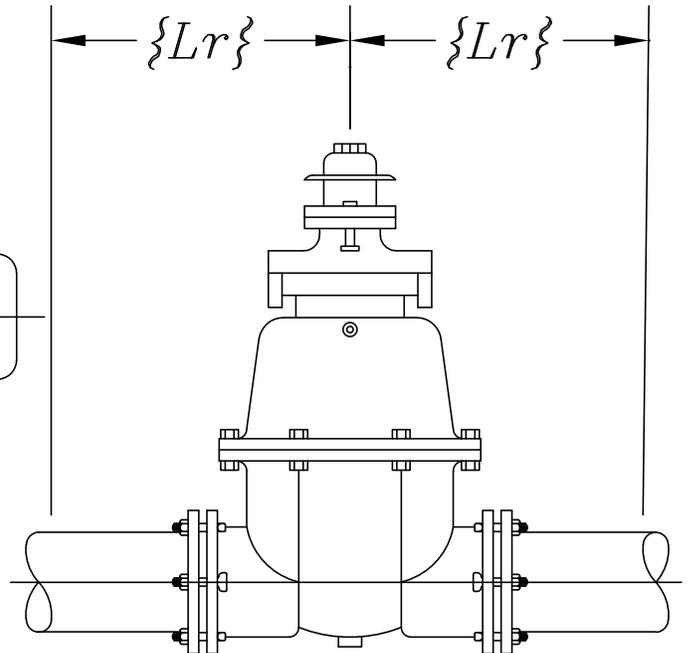
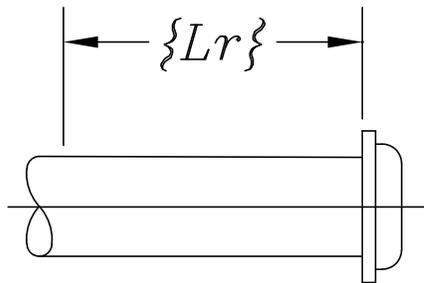
REDUCER SIZE & PIPE MATERIAL		MINIMUM RESTRAINED LENGTH
PVC PIPE	6x4	53'
	8x4	97'
	8x6	56'
	12x4	164'
	12x6	137'
	12x8	100'
DI POLY WRAP	6x4	81'
	8x4	147'
	8x6	85'
	12x4	247'
	12x6	207'
	12x8	151'



## REDUCERS

The minimum length of pipe ( $L_r$ ) to be restrained on the large side of the reducer shall be derived from the above table

DEAD END SIZE & PIPE MATERIAL		MINIMUM RESTRAINED LENGTH
PVC PIPE	4	74'
	6	104'
	8	135'
	12	189'
DI POLY WRAP	4	112'
	6	157'
	8	204'
	12	284'



## DEAD ENDS & VALVES

The minimum length of pipe ( $L_r$ ) to be restrained on a dead end shall be derived from the above table.

Concrete thrust blocks may be used with permission of the Engineer. All valves shall be considered dead ends in both directions.

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