

## **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 "GM" OR "SM" 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), EXCEPT FOR TABLE 2, PAGE 6 FOR IN-LINE VALVES.
  - D) THE TRENCH IS TYPE 5, AS PER ANSI/AWWA C150/A21.5, TRENCH CONDITIONS.
  - E) THE DEPTH OF COVER IS THREE AND ONE-HALF FEET (3.5'), APPROXIMATELY 44".
  - F) THE SAFETY FACTOR USED IS 1.5.
2. THE FOLLOWING RESTRAINT TABLES WILL BE USED UNLESS ALTERNATE TABLES FOR CONDITIONS OTHER THAN THOSE INCLUDED HEREIN ARE APPROVED BY THE DISTRICT ENGINEER OR SHOWN ON THE APPROVED PLANS.
3. ALL FITTINGS WITHIN THE CALCULATED RESTRAINED LENGTH SHALL BE RESTRAINED.
4. VALVES SHALL BE RESTRAINED IN ACCORDANCE WITH PAGE 6, THIS DETAIL.
5. MECHANICAL JOINT SLEEVES AND FABRICATED REPAIR COUPLINGS REQUIRE RESTRAINT WHEN THEY ARE WITHIN THE CALCULATED RESTRAINED LENGTH OF OTHER FITTINGS.
6. FOR EXAMPLES OF RESTRAINED LENGTH REQUIREMENTS, SEE MDWID STANDARD DETAIL MW-600A.



## **RESTRAINED JOINT NOTES**

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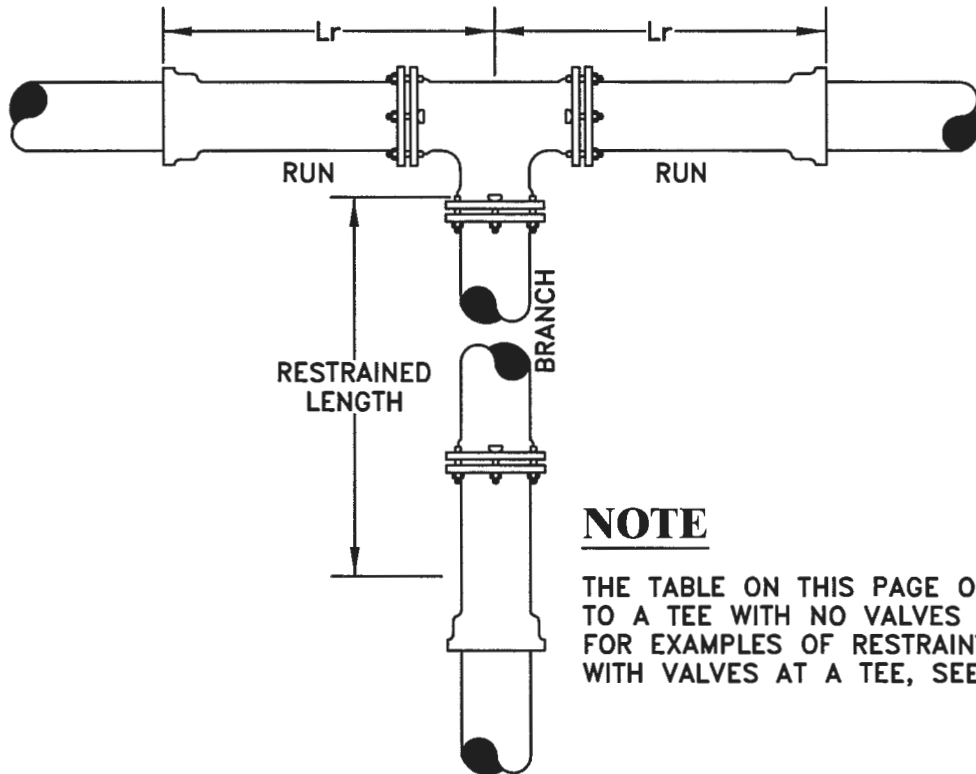
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ALL THRUST RESTRAINTS SHALL BE IN COMPLIANCE WITH SECTION 1406.



**NOTE**

THE TABLE ON THIS PAGE ONLY APPLIES TO A TEE WITH NO VALVES AT THE TEE. FOR EXAMPLES OF RESTRAINT CALCULATIONS WITH VALVES AT A TEE, SEE MW-600A

**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. FOR RESTRAINT OF TAPPING SLEEVES, USE  $L_r$  EQUAL TO ZERO (0).

TEE SIZE (IN) & PIPE MATERIAL		MINIMUM ATTACHED LENGTH OF PIPE ( $L_r$ )										
		0'	2'	4'	6'	8'	10'	12'	14'	16'	18'	20'
		LENGTH OF RESTRAINED BRANCH (FT)										
PVC	4x4	45	33	21	9	1	1	1	1	1	1	1
	6x4	45	27	9	1	1	1	1	1	1	1	1
	6x6	63	51	39	26	14	2	1	1	1	1	1
	8x4	45	21	1	1	1	1	1	1	1	1	1
	8x6	63	47	31	15	1	1	1	1	1	1	1
	8x8	83	70	58	46	33	21	9	1	1	1	1
	12x4	45	8	1	1	1	1	1	1	1	1	1
	12x6	63	38	13	1	1	1	1	1	1	1	1
	12x8	83	64	45	26	7	1	1	1	1	1	1
DI, POLY	12x12	118	105	92	80	67	54	42	29	17	4	1
	4x4	67	49	31	13	1	1	1	1	1	1	1
	6x4	67	40	13	1	1	1	1	1	1	1	1
	6x6	94	76	58	39	21	3	1	1	1	1	1
	8x4	67	31	1	1	1	1	1	1	1	1	1
	8x6	94	70	46	22	1	1	1	1	1	1	1
	8x8	124	105	87	68	50	31	13	1	1	1	1
	12x4	67	13	1	1	1	1	1	1	1	1	1
	12x6	94	57	20	1	1	1	1	1	1	1	1
	12x8	124	95	67	39	11	1	1	1	1	1	1
12x12	175	156	137	118	100	81	62	43	25	6	1	



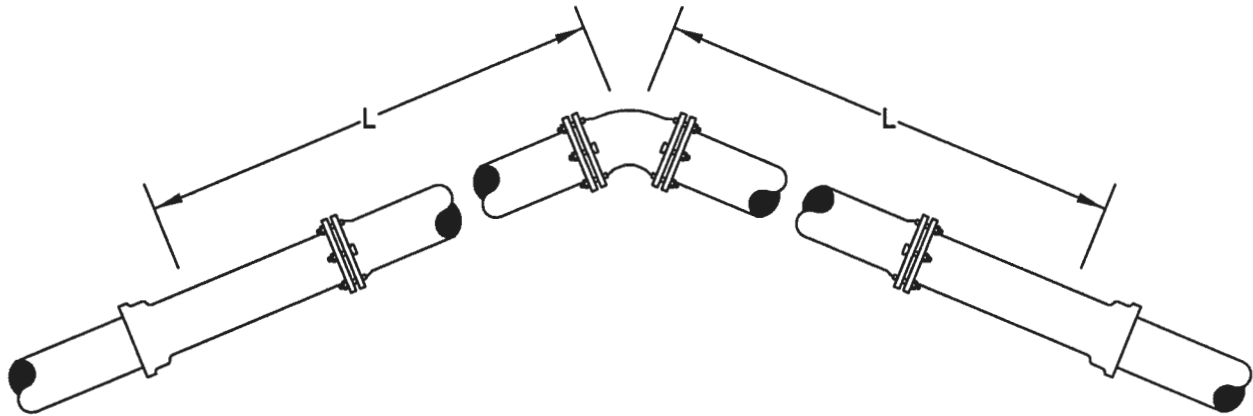
**RESTRAINED JOINTS**

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## HORIZONTAL BENDS

THE MINIMUM RESTRAINED LENGTH OF PIPE (L) TO EXTEND IN BOTH DIRECTIONS FROM THE HORIZONTAL BEND SHALL BE DERIVED FROM THE FOLLOWING TABLE. FOR MULTIPLE HORIZONTAL BENDS, SEE NOTE BELOW.

PIPE SIZE (IN) & MATERIAL		HORIZONTAL BENDS			
		11.25°	22.5°	45°	90°
LENGTH OF RESTRAINT (FT)					
PVC	4"	1	3	6	15
	6"	2	4	9	21
	8"	3	5	11	27
	12"	4	8	16	38
DI, POLY	4"	2	3	7	17
	6"	2	5	10	23
	8"	3	6	13	30
	12"	4	8	18	42

### NOTE:

IN CASES WHERE THE RESTRAINED LENGTH OF PIPE (L) OVERLAP BETWEEN MULTIPLE HORIZONTAL BENDS, RESTRAINT REQUIREMENTS SHALL BE BASED ON COMBINED BEND ANGLE.



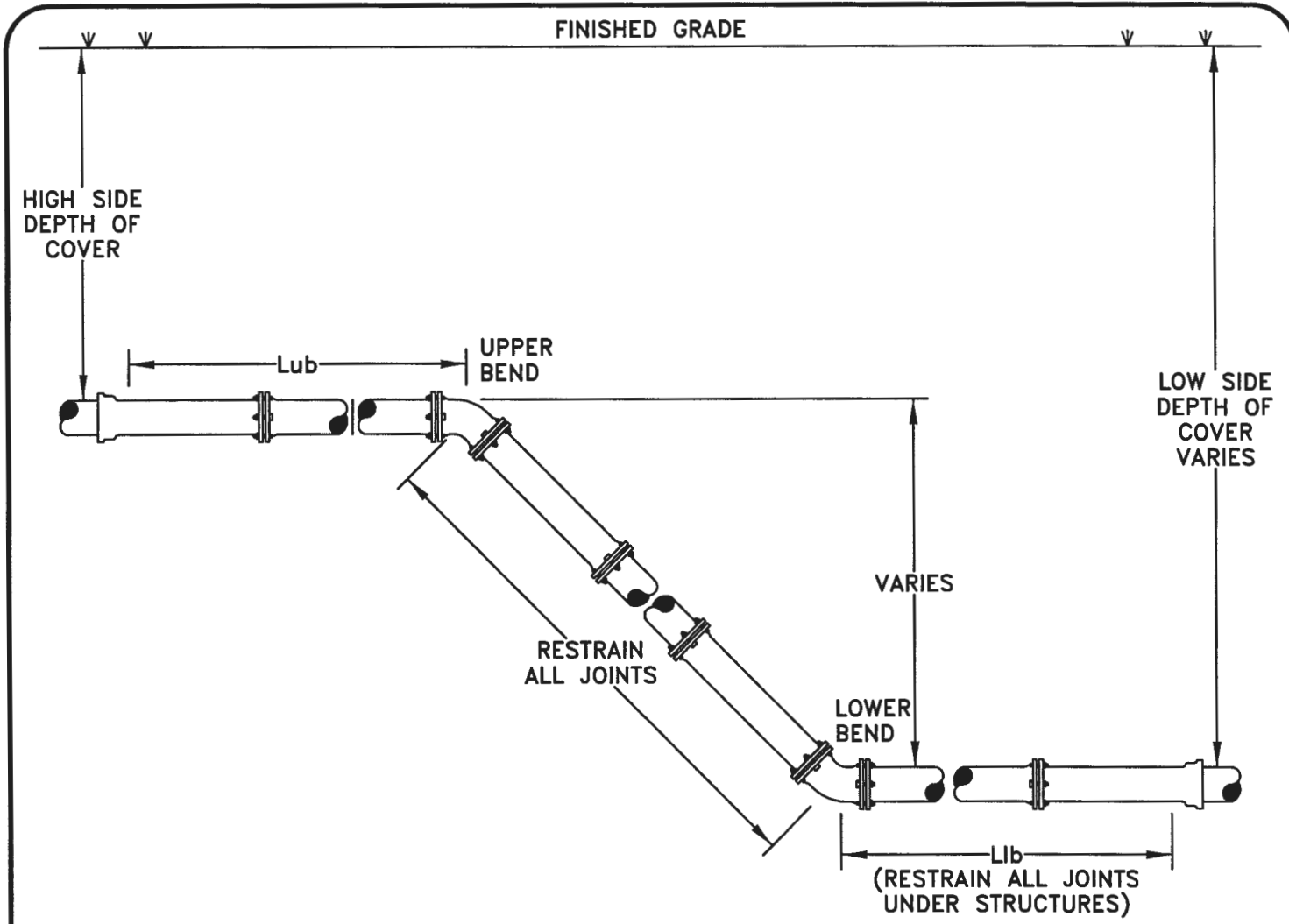
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## VERTICAL OFFSETS

THE MINIMUM RESTRAINED LENGTH OF PIPE FOR THE UPPER BEND (Lub) TO BE RESTRAINED ON BOTH SIDES OF THE VERTICAL OFFSET SHALL BE DERIVED FROM THE FOLLOWING TABLE. RESTRAINED LENGTHS SHOWN ARE BASED ON HIGH SIDE DEPTH OF COVER OF 3.5 FEET. FOR DIFFERENT CONDITIONS, CALCULATIONS WILL BE REQUIRED. 90° VERTICAL OFFSETS ARE NOT RECOMMENDED.

PIPE SIZE (IN) AND MATERIAL		UPPER BEND (Lub)			LOWER BEND (Lib)		
		11.25°	22.5°	45°	11.25°	22.5°	45°
		LENGTH OF RESTRAINT (FT)					
PVC	4"	4	9	19	1	3	5
	6"	6	13	26	2	4	8
	8"	8	16	34	2	5	10
	12"	12	23	49	3	7	14
DI, POLY	4"	7	13	28	1	3	6
	6"	9	19	39	2	4	9
	8"	12	25	51	3	5	11
	12"	17	35	72	4	7	16



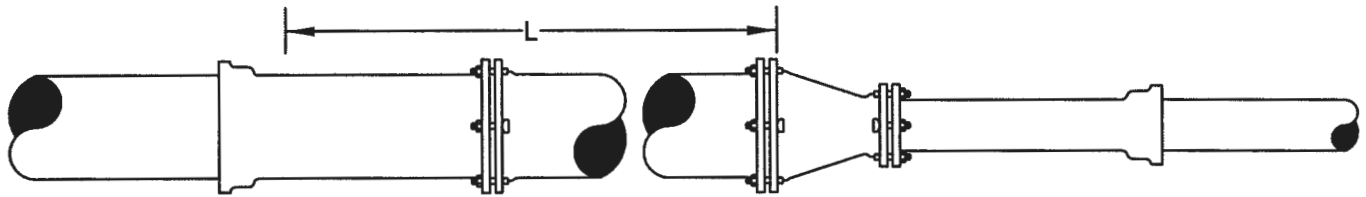
## RESTRAINED JOINTS

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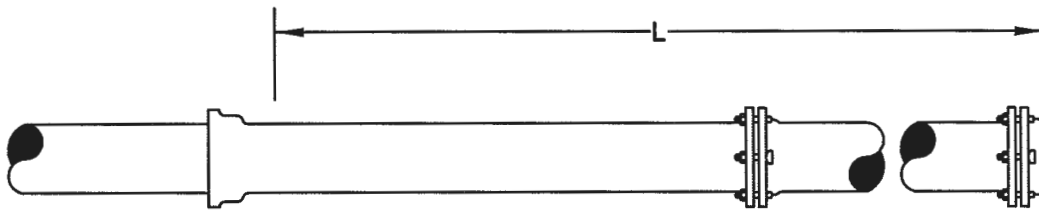
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REDUCER SIZE (IN) & PIPE MATERIAL		MINIMUM RESTRAINED LENGTH (FT)
PVC	6x4	33
	8x4	60
	8x6	35
	12x4	102
	12x6	85
	12x8	62
DI, POLY	6x4	49
	8x4	89
	8x6	52
	12x4	152
	12x6	127
	12x8	93

### REDUCERS

THE MINIMUM LENGTH OF PIPE (L) TO BE RESTRAINED ON THE LARGE SIDE OF THE REDUCER SHALL BE DERIVED FROM THE TABLE ON THE LEFT.



DEAD END SIZE (IN) & PIPE MATERIAL		MINIMUM RESTRAINED LENGTH (FT)
PVC	4	45
	6	63
	8	83
	12	118
DI, POLY	4	67
	6	94
	8	124
	12	175

### DEAD ENDS

THE MINIMUM LENGTH OF PIPE (L) TO BE RESTRAINED ON A DEAD END SHALL BE DERIVED FROM THE TABLE ON THE LEFT.

## RESTRAINED JOINTS



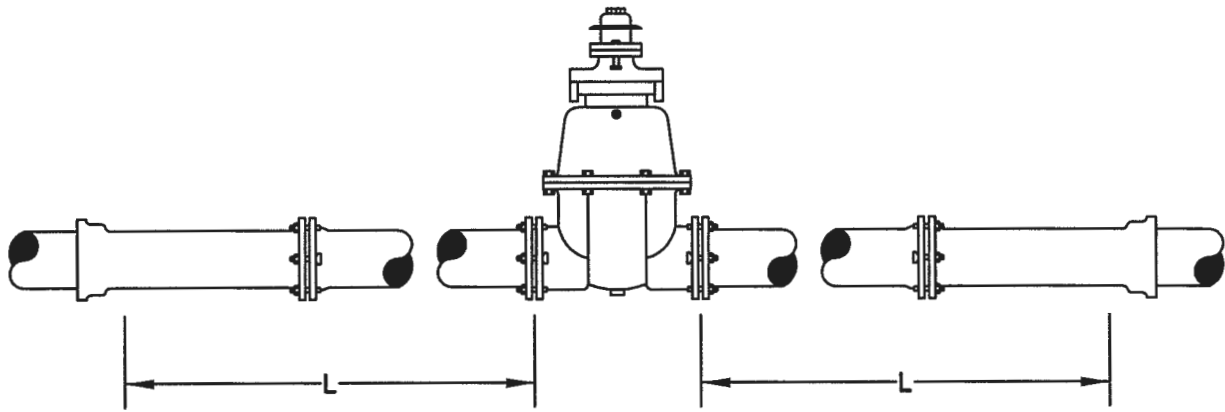
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## VALVES

THE MINIMUM LENGTH OF PIPE (L) TO BE RESTRAINED ON EACH SIDE OF THE VALVE SHALL BE DERIVED FROM THE APPROPRIATE TABLE BELOW.

### TABLE 1

INCLUDES VALVES THAT ARE SUBJECT TO TEST PRESSURES (I.E., PROJECT PHASING, OFFSITE, AND TRANSMISSION LINES).

VALVE SIZE (IN) & PIPE MATERIAL		MINIMUM RESTRAINED LENGTH (FT)
PVC	4	45
	6	63
	8	83
	12	118
DI, POLY	4	67
	6	94
	8	124
	12	175

### TABLE 2

VALVES USED ONLY FOR ISOLATION DURING NORMAL OPERATION. RESTRAINED LENGTHS CALCULATED USING 100 PSI.  
NOTE: VALVES ARE NOT TO BE USED DURING TESTING OF NEW WATER SYSTEMS.

VALVE SIZE (IN) & PIPE MATERIAL		MINIMUM RESTRAINED LENGTH (FT)
PVC	4	22
	6	32
	8	41
	12	59
DI, POLY	4	33
	6	47
	8	62
	12	87

## NOTES:

- WHERE VALVES ARE CONNECTED TO FITTINGS OTHER THAN TEES, RESTRAINED LENGTH REQUIRED ON EACH SIDE OF FITTING SHALL BE DETERMINED USING THE APPROPRIATE TABLE ABOVE.
- VALVES TO BE SUBJECT TO TEST PRESSURES ACCORDING TO TABLE 1 SHALL BE IDENTIFIED PRIOR TO CONSTRUCTION. FOR CLARIFICATION OR ADDITIONAL INFORMATION, CONTACT THE MDWD ENGINEERING DIVISION AT (520) 575-8100.



## RESTRAINED JOINTS

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