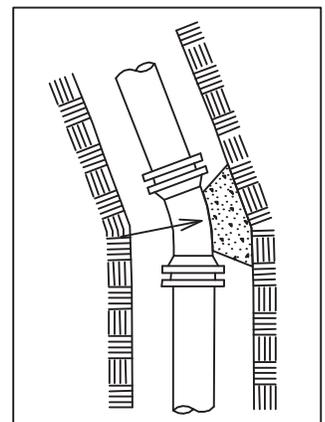
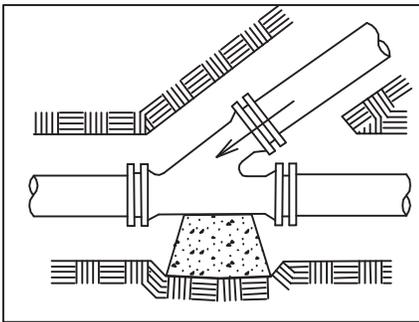
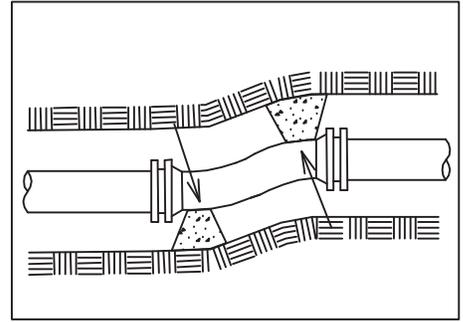
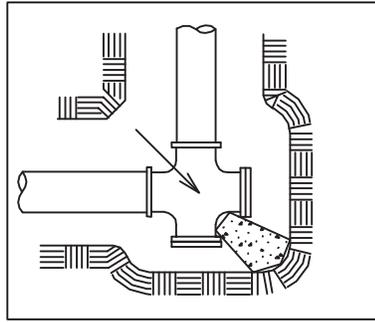
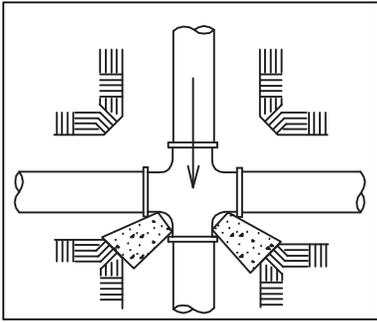
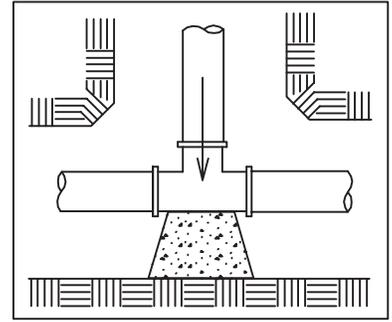
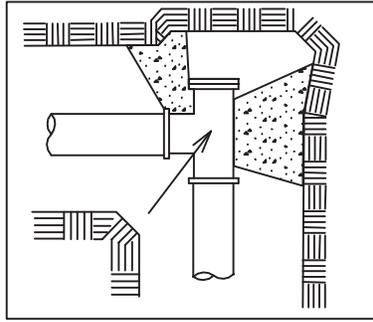
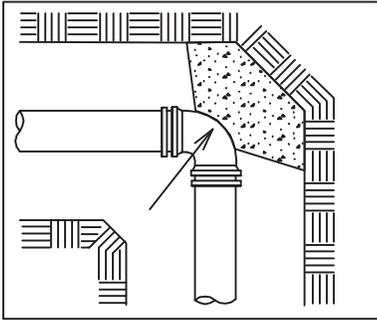


FILE NO.: 2500-021
APPROVAL DATE: APRIL 2003
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CEDAR RAPIDS METROPOLITAN AREA STANDARD DETAILS FOR PUBLIC IMPROVEMENTS	
THRUST RESTRAINT DETAILS - SHEET 1 OF 4	
NO. 2500-021	



NOTES:

1. WHERE A HORIZONTAL BEND IS MADE, THE PIPING SHALL BE RESTRAINED BY MEANS OF A THRUST BLOCK AS DETAILED ON THIS SHEET. WHERE VERTICAL OFFSETS ARE MADE, THE TOP BEND SHALL BE RESTRAINED BY RESTRAINING RODS AND STRAPS, CONCRETE THRUST ANCHOR BLOCKS AND RESTRAINING RODS, OR A COMBINATION OF BOTH. THE BOTTOM BENDS SHALL BE RESTRAINED BY THRUST BLOCKS AS DETAILED.
2. "A", "B" AND "D" DIMENSIONS SHALL BE AS LARGE AS POSSIBLE WITHOUT INTERFERING WITH THE MECHANICAL JOINTS OR THE M.J. BOLTS.
3. "C" DIMENSIONS SHALL BE LARGE ENOUGH TO MAKE ANGLE  $\theta$  EQUAL TO OR LARGER THAN 45°.
4. ANGLE  $\theta$  SHALL BE EQUAL TO OR LARGER THAN 45°.
5. "B" AND "D" DIMENSIONS SHALL PROVIDE REQUIRED BLOCKING AREA AS LISTED IN SHEETS 3 AND 4 OF THIS DETAIL. REFER TO THE SPECIFICATIONS FOR THE PRESSURE RATING OF THE PIPING SYSTEMS.
6. CONCRETE SHALL BEAR ON THE CONCRETE QUADRANT OF PIPE AS A MINIMUM, SEE DETAIL ABOVE.
7. THE THRUST BLOCK AREAS SHOWN ON SHEETS 3 AND 4 OF THIS DETAIL ARE CALCULATED USING A SOIL BEARING CAPACITY OF 2000 PSF. IF GREATER SOIL BEARING CAPACITY IS AVAILABLE, THE CONTRACTOR MAY, AFTER REVIEW BY THE ENGINEER, REDUCE THE THRUST BLOCK AREAS SHOWN. THE THRUST BLOCK AREA SHALL BE INCREASED IF THE SOIL IS NOT CAPABLE OF PROVIDING 2000 PSF SOIL BEARING CAPACITY.

FILE NO.: 2500-021	CEDAR RAPIDS METROPOLITAN AREA STANDARD DETAILS FOR PUBLIC IMPROVEMENTS		THRUST RESTRAINT DETAILS - SHEET 2 OF 4	NO. 2500-021
APPROVAL DATE: APRIL 2003				
REVISION NO.:				
REVISION DATE: JULY 2010				

THRUST RESTRAINT DETAILS

RESULTANT THRUST AT FITTINGS, POUNDS  
FOR TEST WATER PRESSURE OF 100 PSI

SIZE IN.	TEE OR DEAD END	90-DEG BEND	45-DEG BEND	22.5-DEG BEND	11.25-DEG BEND
4	1,810	2,559	1,385	706	355
6	3,739	5,288	2,862	1,459	733
8	6,433	9,097	4,923	2,510	1,261
10	9,677	13,685	7,406	3,776	1,897
12	13,685	19,353	10,474	5,340	2,683
16	23,779	33,628	18,199	9,278	4,661
20	36,644	51,822	28,046	14,298	7,183
24	52,279	73,934	40,013	20,398	10,249
30	80,425	113,738	61,554	31,380	15,766
36	115,209	162,931	88,177	44,952	22,585
42	155,528	219,950	119,036	60,684	30,489
48	202,683	286,637	155,127	79,083	39,733
54	256,072	362,140	195,989	99,914	50,199

MINIMUM AREA FOR THRUST BEARING, SQ. FT.  
FOR TEST WATER PRESSURE OF 100 PSI

SIZE IN	TEE OR DEAD END	90-DEG BEND	45-DEG BEND	22.5-DEG BEND	11.25-DEG BEND
4	1.0	1.3	1.0	1.0	1.0
6	1.9	2.6	1.4	1.0	1.0
8	3.2	4.5	2.5	1.3	1.0
10	4.8	6.8	3.7	1.9	1.0
12	6.8	9.7	5.2	2.7	1.3
16	11.9	16.8	9.1	4.6	2.3
20	18.3	25.9	14.0	7.1	3.6
24	26.1	37.0	20.0	10.2	5.1
30	40.2	56.9	30.8	15.7	7.9
36	57.6	81.5	44.1	22.5	11.3
42	77.8	110.0	59.5	30.3	15.2
48	101.3	143.3	77.6	39.5	19.9
54	128.0	181.1	98.0	50.0	25.1

THE ABOVE AREAS ARE BASED UPON A SOIL BEARING CAPACITY OF 2000 PSF. IF ACTUAL SOIL BEARING STRENGTH IS LESS THAN 2000 PSF, THE THRUST BEARING AREA SHALL BE INCREASED BASED ON THE ACTUAL SOIL BEARING STRENGTH.

FILE NO.: 2500-021	CEDAR RAPIDS METROPOLITAN AREA STANDARD DETAILS FOR PUBLIC IMPROVEMENTS	
APPROVAL DATE: APRIL 2003		
REVISION NO.:	THRUST RESTRAINT DETAILS - SHEET 3 OF 4	
REVISION DATE: JULY 2010		
	NO. 2500-021	

THRUST RESTRAINT DETAILS

RESULTANT THRUST AT FITTINGS, POUNDS  
FOR TEST WATER PRESSURE OF 150 PSI

SIZE	TEE OR	90-DEG	45-DEG	22.5-DEG	11.25-DEG
IN.	DEAD END	BEND	BEND	BEND	BEND
4	2,715	3,839	2,078	1,059	533
6	5,609	7,932	4,293	2,189	1,100
8	9,650	13,646	7,385	3,765	1,892
10	14,516	20,528	11,109	5,664	2,846
12	20,528	29,030	15,711	8,010	4,025
16	35,669	50,442	27,299	13,917	6,992
20	54,966	77,733	42,069	21,447	10,775
24	78,419	110,901	60,020	30,597	15,374
30	120,638	170,607	92,331	47,070	23,649
36	172,814	244,397	132,266	67,428	33,878
42	233,292	329,925	178,554	91,026	45,734
48	304,025	429,956	232,691	118,625	59,600
54	384,108	543,210	293,984	149,871	75,299

MINIMUM AREA FOR THRUST BEARING, SQ. FT.  
FOR TEST WATER PRESSURE OF 150 PSI

SIZE	TEE OR	90-DEG	45-DEG	22.5-DEG	11.25-DEG
IN.	DEAD END	BEND	BEND	BEND	BEND
4	1.4	1.9	1.0	1.0	1.0
6	2.8	4.0	2.1	1.1	1.0
8	4.8	6.8	3.7	1.9	1.0
10	7.3	10.3	5.6	2.8	1.4
12	1.03	14.5	7.9	4.0	2.0
16	17.8	25.2	13.6	7.0	3.5
20	27.5	38.9	21.0	10.7	5.4
24	39.2	55.5	30.0	15.3	7.7
30	60.3	85.3	46.2	23.5	11.8
36	86.4	122.2	66.1	33.7	16.9
42	116.6	165.0	89.3	45.5	22.9
48	152.0	215.0	116.3	59.3	29.8
54	192.1	271.6	147.0	74.9	37.6

THE ABOVE AREAS ARE BASED UPON A SOIL BEARING CAPACITY OF 2000 PSF. IF ACTUAL SOIL BEARING STRENGTH IS LESS THAN 2000 PSF, THE THRUST BEARING AREA SHALL BE INCREASED BASED ON THE ACTUAL SOIL BEARING STRENGTH.

FILE NO.: 2500-021	CEDAR RAPIDS METROPOLITAN AREA STANDARD DETAILS FOR PUBLIC IMPROVEMENTS	
APPROVAL DATE: APRIL 2003		
REVISION NO.:	THRUST RESTRAINT DETAILS - SHEET 4 OF 4	
REVISION DATE: JULY 2010		
	NO. 2500-021	