



**City Utilities
Design Standards
Manual**

Exhibit W5-13

Length of Restraint – Unwrapped Ductile Iron Pipe

Created: June 10, 2014

Revised:

UNWRAPPED DIP NON-ENCROACHING THRUST RESTRAINT CALCULATIONS

CITY OF FORT WAYNE
Assumptions
Unwrapped Ductile Iron Pipe
Design/Test Pressure=150 psi
Safety Factor = 1.5 (recommended by DIPRA)
Type 3 laying condition (representative of actual field conditions)
5' Cover
Soil/Backfill Conditions = Clay 2 (DIPRA Chart) = Saturated Soil

CALCULATED RESTRAINT LENGTHS ARE FOR EACH SIDE OF THE FITTING. ALL FITTINGS SHALL BE RESTRAINED THE CALCULATED LENGTH AT A MINIMUM.

NOTE: IF FITTINGS ARE IN CLOSE PROXIMITY TO EACH OTHER AND THE CALCULATED RESTRAINED LENGTHS OVERLAP, THIS TABLE IS NOT APPLICABLE. REFER TO THE DIPRA DESIGN MANUAL FOR RESTRAINED LENGTH CALCULATIONS FOR ENCROACHMENT APPLICATIONS.

| PIPE DIA. | HORIZONTAL BENDS AND VERTICAL UP BENDS | | | VERTICAL DOWN BENDS | | | DEAD ENDS | PIPE DIA. |
|-----------|--|-------|-----|---------------------|-------|-----|-----------|-----------|
| | 11.25° | 22.5° | 45° | 90° | 22.5° | 45° | | |
| 4" | 1 | 3 | 6 | 15 | 5 | 11 | 14 | 4" |
| 6" | 2 | 4 | 9 | 21 | 8 | 16 | 20 | 6" |
| 8" | 3 | 5 | 11 | 27 | 10 | 21 | 26 | 8" |
| 10" | 3 | 7 | 14 | 33 | 12 | 26 | 31 | 10" |
| 12" | 4 | 8 | 16 | 40 | 15 | 31 | 37 | 12" |
| 16" | 5 | 10 | 21 | 52 | 19 | 41 | 49 | 16" |
| 20" | 6 | 13 | 26 | 64 | 24 | 50 | 61 | 20" |
| 24" | 7 | 15 | 31 | 76 | 29 | 60 | 73 | 24" |
| 30" | 9 | 19 | 39 | 93 | 36 | 75 | 90 | 30" |
| 36" | 11 | 22 | 46 | 110 | 43 | 89 | 108 | 36" |

Tee Branch Restraint (Assumed Restraint of "Run" Pipe is 20ft each side of Tee)

| Tee Run Dia. | Tee Branch Diameter | | | | | | | | 30" | 36" | Tee Run Dia. |
|--------------|---------------------|----|----|-----|-----|-----|-----|-----|-----|-----|--------------|
| | 4" | 6" | 8" | 10" | 12" | 16" | 20" | 24" | | | |
| 4" | 0 | | | | | | | | | | 4" |
| 6" | 0 | 0 | | | | | | | | | 6" |
| 8" | 0 | 0 | 0 | | | | | | | | 8" |
| 10" | 0 | 0 | 0 | 5 | | | | | | | 10" |
| 12" | 0 | 0 | 0 | 0 | 11 | | | | | | 12" |
| 16" | 0 | 0 | 0 | 0 | 3 | 22 | | | | | 16" |
| 20" | 0 | 0 | 0 | 0 | 0 | 16 | 34 | | | | 20" |
| 24" | 0 | 0 | 0 | 0 | 0 | 9 | 28 | 45 | | | 24" |
| 30" | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 39 | 62 | | 30" |
| 36" | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 32 | 57 | 79 | 36" |