1. RESTRAINED JOINTS ARE ACCEPTABLE INSTEAD OF THRUST BLOCKS, WHERE APPROPRIATE. THE DISTRICT WILL BE THE SOLE DETERMINER IF THE APPLICATION IS APPROPRIATE. THE FOLLOWING APPLICATIONS MUST USE RESTRAINED JOINTS UNLESS IMPRACTICAL:
1.1. DEAD END MAINS THAT MAY BE EXTENDED IN THE FUTURE.
1.2. SOFT OR SATURATED SOILS, FITTINGS NEAR TOP OF SLOPE, OR BEARING AGAINST AN ADJACENT UTILITY.
1.3. VERTICAL BENDS WITH FORCE DIRECTION UPWARDS ARE NOT COVERED HERE. MUST BE DESIGNED BY ENGINEER FOR EACH CASE.

2. MECHANICAL JOINT RESTRAINTS SHALL BE COATED WITH FUSION BONDED POLYESTER, OR ZINC & EPOXY COATING. EBAA MEGABOND, ROMAC ROMABOND, FORD ARMORGUARD E-COAT, OR APPROVED EQUAL.

3. THE FOLLOWING PRODUCTS ARE NOT ALLOWED: SET-SCREW RESTRAINTS, TYLER/McWANE TUFGRIP, ALL GRIPPER STYLE GASKETS (FIELD-LOK, SURE-STOP, ETC.) LARGER THAN 12" DIAMETER.

4. THE FOLLOWING TABLES ARE BASED ON EQUATIONS FROM THE *DUCTILE IRON PIPE RESEARCH ASSOCIATION'S 2016 THRUST RESTRAINT FOR DUCTILE IRON PIPE*. THE FOLLOWING CONDITIONS MUST BE MET FOR THESE RESULTS TO BE VALID. IF ANY OF THESE CONDITIONS CANNOT BE MET, PROJECT SPECIFIC CALCULATIONS MUST BE PROVIDED:
4.1. THESE TABLES ONLY FOR BARE (UNWRAPPED) DUCTILE IRON OR PVC PIPE.
4.1. PIPE LAYING CONDITION TYPE 4 or 5, DEFINED AS:
4.1.1. SELECT GRANULAR BEDDING MATERIAL BELOW PIPE.
4.1.2. PIPE ZONE BEDDING EXTENDING TO TOP OF PIPE MECHANICALLY COMPACTED IN LIFTS.
4.2. PIPE RESTING DIRECTLY ON NATIVE TRENCH BOTTOM IS NOT ACCEPTABLE.
4.3. SANDY SILT BEDDING. FOR IMPORT CLEAN SAND OR 5/8" TOP COURSE, LENGTHS MAY BE REDUCED BY 25%.
4.4. DEPTH OF COVER IS 3.5 FEET MINIMUM AT THE TIME OF PRESSURE TESTING.
4.5. 250psi TEST PRESSURE MAXIMUM. FOR HIGHER TEST PRESSURE, MULTIPLY "L" BY THE PROPORTIONAL DIFFERENCE.
4.5.1. EXAMPLE: FOR 300psi, 300/250=1.2 THEREFORE, LENGTHS MUST BE MULTIPLIED BY 1.2.

THE LENGTH "L" GIVEN BELOW IS THE DISTANCE THAT PIPE MUST BE RESTRAINED PAST THE FITTING JOINT. ALL JOINTS WITHIN THIS DISTANCE MUST BE RESTRAINED, INCLUDING THE FITTING.

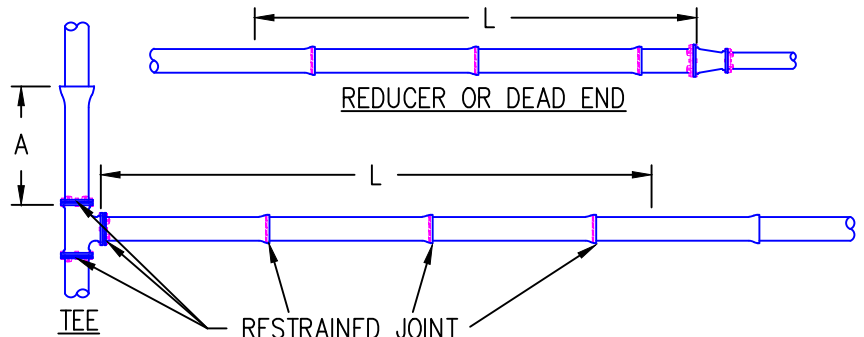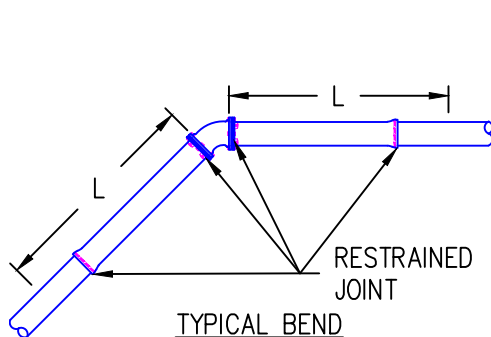| DIA.	11¼° BEND	22½° BEND	33¾° BEND	45° BEND	67½° BEND	90° BEND	DEAD END	REDUCER *
4"	3'	5'	8'	10'	17'	25'	61'	20'
6"	4'	7'	11'	14'	23'	34'	86'	58'
8"	5'	9'	14'	19'	30'	44'	112'	81'
10"	6'	11'	16'	22'	36'	53'	135'	83'
12"	7'	13'	19'	26'	41'	62'	158'	84'
16"	8'	16'	24'	33'	53'	78'	203'	86'
18"	9'	18'	27'	36'	58'	86'	224'	121'
PVC**	1.2x	1.2x	1.2x	1.2x	1.2x	1.2x	1.4x	1.4x

* Assumes reducer down 2 sizes. (example 12"x8"). Larger reductions shall be treated as a tee.
** For PVC or poly-bagged pipe, multiply the lengths by the value shown in the PVC row.

STANDARD & BRANCH REDUCING TEES (1.4x for PVC)

BRANCH DIAMETER	RUN DIAMETER						
	4"	6"	8"	10"	12"	16"	18"
4"	46'	39'	31'	23'	15'	1'	1'
6"	–	70'	65'	60'	55'	43'	37'
8"	–	–	97'	93'	89'	80'	75'
10"	–	–	–	119'	116'	109'	105'
12"	–	–	–	–	143'	137'	133'
16"	–	–	–	–	–	187'	184'
18"	–	–	–	–	–	–	207'

Restrain tee/cross run legs with a minimum 5' stick of pipe in each leg (dimension "A").
Branch increasing or "bullhead" tees restrained as a dead-end, length based on largest size.

RESTRAINED JOINT

TYPICAL BEND

REDUCER OR DEAD END

TEE

RESTRAINED JOINT