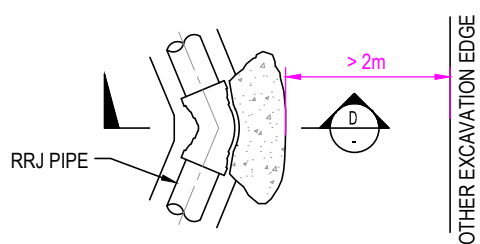
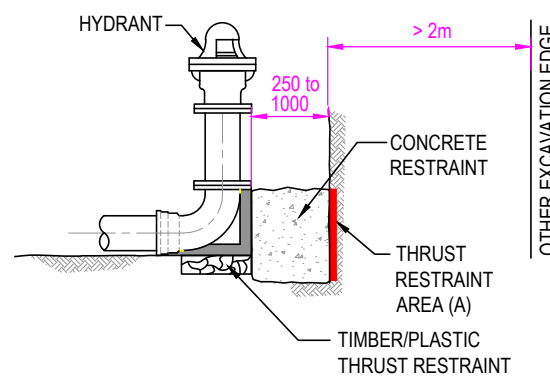


**FIGURE 205A-A: PLAN VIEW
PLAIN THRUST RESTRAINT FOR TEES**



**FIGURE 205A-C: PLAN VIEW
PLAIN THRUST RESTRAINT FOR BENDS**



**FIGURE 205A-E: ELEVATION
FLUSHING / WASHOUT BEND THRUST RESTRAINT**

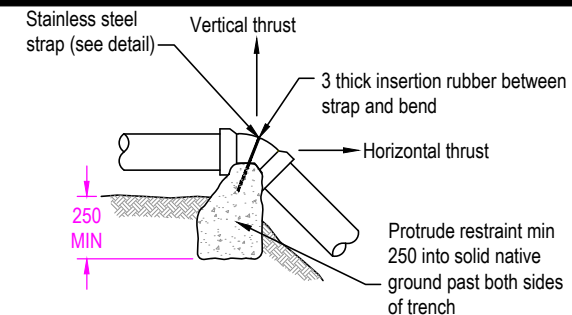
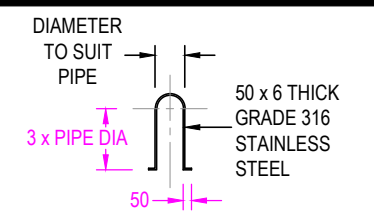


FIGURE 205A-F: VERTICAL BEND ELEVATION



**FIGURE 205A-G:
TYPICAL SS STRAP**

**TABLE 205A-A: VERTICAL BEND
CONCRETE RESTRAINT VOLUMES**

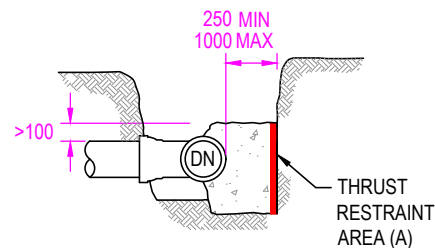
PIPE DN	CONCRETE VOLUME m ³		
	11.25° BEND	22.5° BEND	45° BEND
100	0.1	0.2	0.35
150	0.2	0.4	0.75
200	0.35	0.7	1.25
225	0.45	0.85	1.6
250	0.55	1.05	1.95
300	0.75	1.5	2.8

NOTES on Vertical Bend Thrust Restraints:

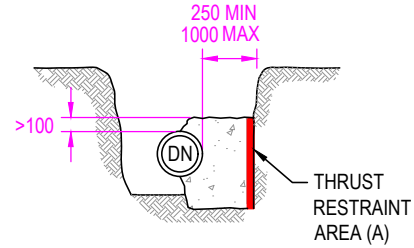
- Vertical bend thrust restraints and socket spigot joints are not permitted for major crossings (refer to MRWA-W-210).
- Vertical bend restraints require Water Agency approval.
- Locate restraint centrally around bend.
- Key restraint into trench a minimum depth of 250.
- The concrete volumes in Table 205A-A are based on a test pressure of 1000 Kpa.

NOTES Regarding FIGURE 205A-E:

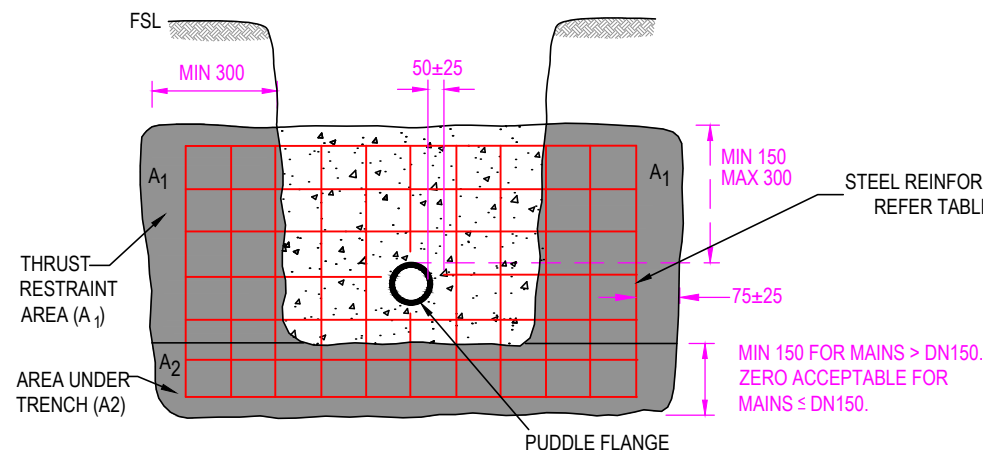
- thrust area is that required for a dead end.
- washout bends as shown are not suitable for end of lines likely to be used to charge future stages. Refer mrwa-w-308 for requirements in this case.



**FIGURE 205A-B: SECTION VIEW
PLAIN THRUST RESTRAINT FOR TEES**

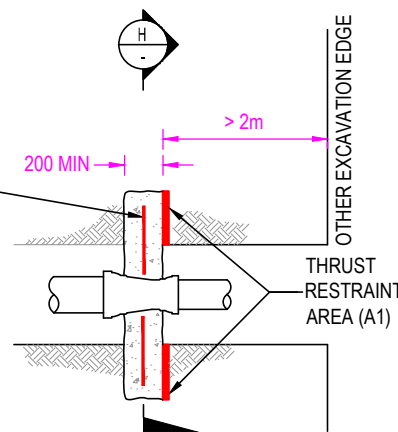


**FIGURE 205A-D: SECTION VIEW
PLAIN THRUST RESTRAINT FOR BENDS**

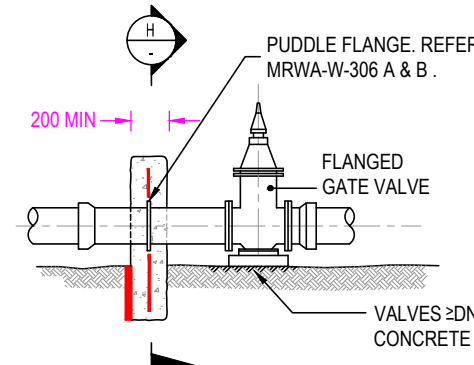


**FIGURE 205A-H: ELEVATION,
IN LINE CONCRETE THRUST RESTRAINT**

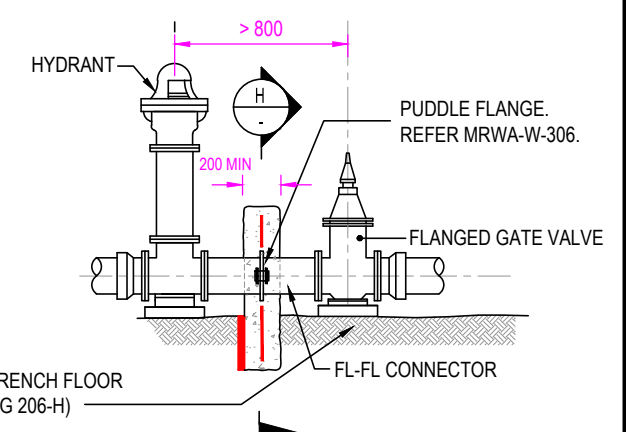
THRUST RESTRAINT AREA
 $A = 2A_1 + A_2$



**FIGURE 205A-I: - PLAN VIEW,
IN LINE THRUST RESTRAINT**



**FIGURE 205A-J: SECTION VIEW,
VALVE AND INLINE THRUST RESTRAINT**



**FIGURE 205A-K: SECTION VIEW,
VALVE AND HYDRANT WITH INLINE THRUST RESTRAINT**

**TABLE 205A-B: IN LINE RESTRAINT STEEL
REINFORCEMENT SELECTION (SINGLE MAIN)**

THRUST RESTRAINT AREA	MESH REQUIREMENTS
0.3m ²	None if Restraint is >400 thick, Otherwise 1 Layer of SL81
0.31m ² to 1.5m ²	1 Layer of SL81
1.51m ² to 3.0m ²	1 Layer of RL1018 or 2 layers of SL81
>3.0m ²	2 layers of SL81

NOTES on Steel Reinforcing:

- Inline thrust restraint reinforcement is to consist of mesh as per Table 205A-B and N10 grade bar (as per AS/NZS 4671).
- Steel reinforcement shall have 75 clear cover of concrete (± 25).
- Where there are 2 layers of reinforcement, maintain min 150 separation between layers.
- Cut reinforcement or tie in additional bars to ensure reinforcement is located within 50±25 of pipe OD at all intersections of reinforcement and pipe.
- When using RL (rectangular mesh) in longitudinal restraints, the main wire (thicker closer spaced wire) shall span the trench.

GENERAL NOTES:

- Plain thrust restraints shall have a minimum of 2m of solid undisturbed ground behind the bearing area.
- For plain restraints, maximum encasement around pipe is 180°.
- In line thrust restraints shall have a minimum of 2m of solid undisturbed ground or compacted crushed rock around the bearing area on both sides of the restraint.
- For Reducers, it is acceptable to place an in line concrete restraint behind the pipe socket instead of around a puddle flange.
- Cast the thrust area of all thrust restraints against a clean face of a material with an AHP > 50 kPa. Where soils have an AHP < 50 kPa, restrained joints shall instead be used as per MRWA-W-207. Do not cast thrust restraints against loose sand or landfill.
- Thrust restraints shall not interfere with other services. Restraints may be cast around sleeved gas services (as shown) where there is no reasonable alternative.
- Gas mains shall be deflected away from the concrete restraint where practicable and minimum cover can be maintained above the gas main.
- Use grade N20 concrete or better.
- All concrete restraints must be formed at the sides (ie: edges other than bearing surface) using temporary formwork or sand bags.
- When pouring concrete against fittings place a membrane of polyethylene, PVC or felt between the fitting and concrete to prevent damage to the fitting. Joints, bolts and nuts to be clear of concrete.

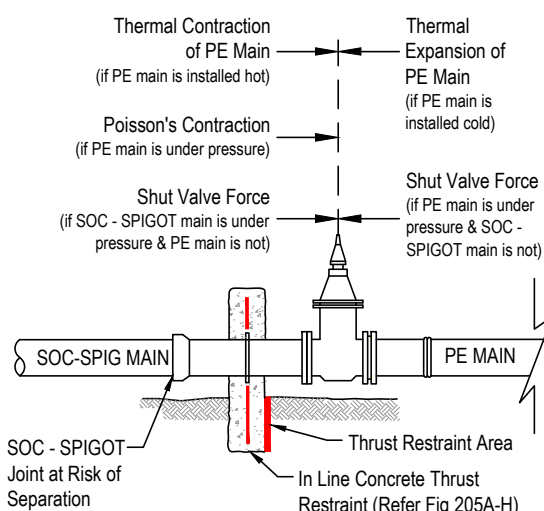


FIGURE 205A-L: JUNCTION OF PE PIPE AND RRJs

NOTES on PE Pipe Thrust Restraint:

- Thrust Restraint Area = F / P (Test Pressure)
 $F = \text{Net Force (KN)} = \text{Force (Poisson's ratio effect)} + \text{Force (Temperature Effect)}$, OR
 $= \text{Force (Temperature Effect)} + \text{Force due to dead end (if valve present)}$.
 [the calculation spreadsheet available on mrwa.com.au/pages/standards/water shall be used to calculate changes in length, restraint forces & areas]
- The designer shall specify the installation requirements at the junctions of all PE mains with RRJs. This shall be done by ensuring that no spigot ends retract from RRJs by more than 20mm. This can be done by:
 - Reducing the length of main (although typically the main length will need to be very short (<5-10m) to avoid the need for shrinkage restraints altogether), &/or
 - Reducing the PE mains temperature at the time of connecting to RRJs. The designer shall assume a main temperature at time of connection of 25 °C when calculating PE restraint sizes. Where the restraint area is large (ie:>2m²), the designer shall calculate the size of the PE restraints based on 20°C and shall re-consider whether the AHP assumed could reasonably be increased. The Contractor shall then limit the temperature of the PE main (at the time of constructing the RRJ junctions) to the temperature stated in the design by:
 - Constructing at a cooler time of year, &/or
 - Constructing restraints and RRJ junctions at a cooler time of day, (ie: early morning), &/or
 - Backfilling the pipe (except for RRJ junctions) and allowing the pipe to settle to the temperature of the earth (ie: leave the main overnight) before constructing the restraints and RRJ junctions.

REV	DESCRIPTION	DATE	APPROVED
3	TABLE 205A-B & PE SHRINKAGE UPDATED	1/12/16	R. JAGGER
2	PUBLISHED FIRST ISSUE	23/03/12	R. JAGGER
1	PRE PUBLISHED DRAFT FOR COMMENT	12/07/11	R. JAGGER

DESIGNED	DATE	DRAWN	DATE
R. JAGGER	05/04/2011	D. TOLENTINO	05/04/2011

CHECKED:	NAME	DATE	APPROVED:	NAME	DATE
<input checked="" type="checkbox"/>	C. RIVETTE	23/03/12	<input checked="" type="checkbox"/>	R. CARRUTHERS	23/03/12
<input checked="" type="checkbox"/>	C. PAXMAN	23/03/12	<input checked="" type="checkbox"/>	G. REYNOLDS	23/03/12
<input checked="" type="checkbox"/>	K. DAWSON	23/03/12	<input checked="" type="checkbox"/>	A. COSHAM	23/03/12

MELBOURNE RETAIL WATER AGENCIES

CityWest Water™

South East Water

Yarra Valley Water

MRWA WATER SUPPLY STANDARDS

SINGLE MAIN CONCRETE RESTRAINTS AND PE PIPE THRUST RESTRAINT

NOT TO SCALE

MRWA-W-205A

ISSUED 2012 REVISION NO. 3