## GENERAL PRINCIPALS OF PIPE RESTRAINT:

1. All valves connected to unrestrained pipework on one side must be restrained with a concrete restraint (as restrained pipework immediately downstream on the other side of the valve may be cut at some stage).
2. Restrained main options maybe necessary where:
   - 2.1. Thrust restraints cannot be placed against a bearing surface of adequate allowable horizontal bearing pressure (ie: AHBP < 50kPa), or
   - 2.2. There are inappropriate conditions (ie: obstructions) at the fitting for a thrust restraint.
3. Inline thrust restraints can be used off the branch of a tee instead of a plain restraint behind the tee, provided the pipework between the tee's offtake and the inline restraint is fully restrained (ie: has no unrestrained joints).
4. Vertically cantilevered restraints may be used instead of normal restraints where the ground to the sides of the trench is **inadequate** but the ground underneath the trench is **adequate**, or where other obstructions make the use of a normal restraints impracticable.

## TABLE 104A-A: PIPELINE TYPE AND JOINT DESIGN OPTIONS (≤DN250)

| OPTION | DESCRIPTION | JOINT TYPES | TYPICAL PIPE TYPES | DESIGN REQUIREMENTS | TYPICAL USE | REFERENCE |
|---|---|---|---|---|---|---|
| A | UNRESTRAINED | RUBBER RINGED JOINT (RRJ) | PVC-O, PVC-M, FW GRP, DI or MS | THRUST RESTRAINTS REQUIRED AT CHANGES OF DIRECTION, VALVES, TAPERS AND TEES | SIMPLE RETICULATION CONFIGURATIONS | FIG 104-A. MRWA-W-205A |
| B | RESTRAINED HIGH SHRINKAGE | WELDED (W), PUSH FIT (PF), RESTRAINED (RS) or BAYONET (BNC) | PE | THRUST RESTRAINTS REQUIRED AT END OF MOST PE PIPELINES TERMINATING AT A RRJ | WHERE THERE ARE MULTIPLE INTERSECTING MAINS &/OR OBSTRUCTIONS IN CLOSE PROXIMITY | FIGURE 104-B |
| C | RESTRAINED LOW SHRINKAGE | FLANGED (FL), WELDED (WC or SSJ), LOCKED JOINT (LJ) or BAYONET (BNC) | DI (FL, LJ or BNC). MS (FL, WC or SSJ) | NO THRUST RESTRAINTS TYPICALLY REQUIRED (UNLESS RRJ NEAR A BEND- REFER FIGS 104-E & F). | WHERE ONE OR MORE FITTINGS WOULD BE DIFFICULT OR IMPRACTICABLE TO RESTRAIN | FIGURE 104-C |

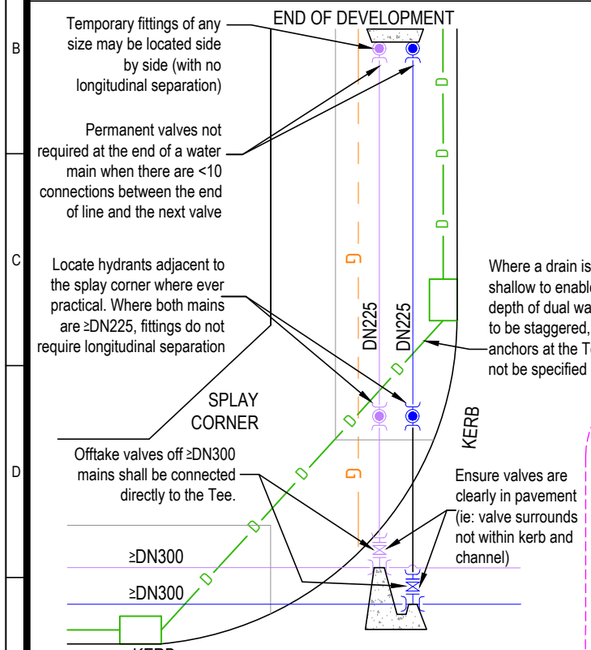


FIGURE 104A-A: OPTION A EXAMPLE- UNRESTRAINED ≥DN225 OFFTAKE FROM ≥DN300 MAIN

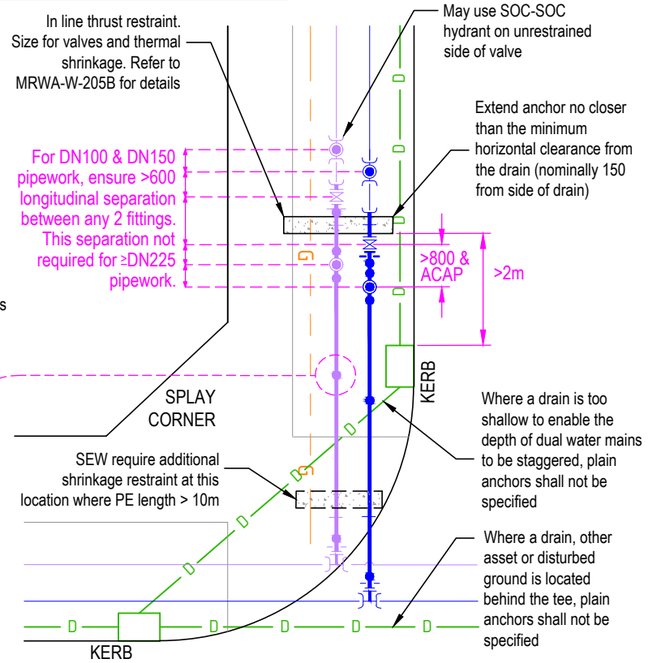


FIGURE 104A-B: OPTION B EXAMPLE- PE PIPEWORK

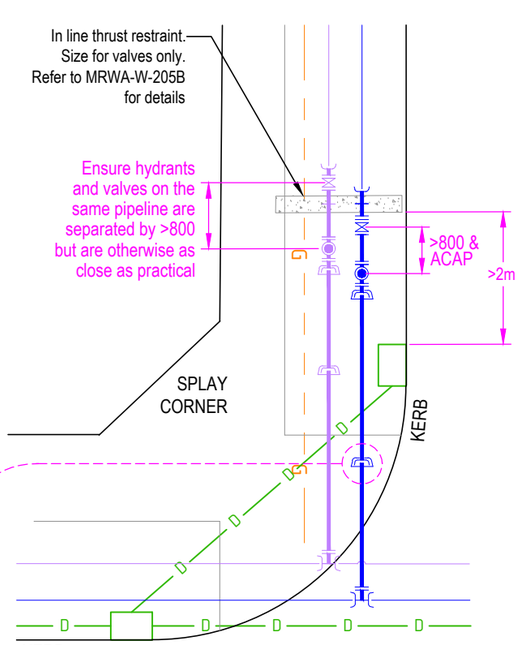


FIGURE 104A-C: OPTION C EXAMPLE- RESTRAINED LOW SHRINKAGE PIPEWORK

## NOTES Regarding Table 104A-A & Figures 104A-A to F:

1. The designer shall minimise the number of Options A, B or C used and the amount of changing between one option and another.
2. Where the majority of the design is Option A (RRJ) pipework, Option B or Option C pipework is typically only be introduced when:
   - 2.1. The ground behind the fitting is disturbed or weak (ie: there is a drain or other service behind the fitting),
   - 2.2. There is an obstruction in front of the fitting (ie: drain) which prevents dual water mains being staggered to a greater depth,
   - 2.3. There are two opposing fittings too close together to be able to install a plain restraint behind both fittings (ref Figures 140B-A & B).
3. Where one of these situations occurs, restrained pipework shall be specified between Tees and splay valves to eliminate the need for plain thrust restraints.
4. The designer shall indicate:
   - 4.1. restrained pipework with bold linework (3 x normal thickness), and
   - 4.2. indicate suitable joints in any detailed design schematics.
   - 4.3. indicate suitable pipe types for all (even short) sections.
5. **Option B (PE) shall be the default** restrained pipework option for sizes ≤DN355 (provided there is no ground contamination risk). In line thrust restraints shall be sized to accommodate the valve thrust + PE thermal shrinkage thrust (worst case scenario).
6. Where PE pipework (Option B) has been selected in the design, the contractor may choose any Water Agency approved Option C pipe and jointing option and then:
   - 6.1. Construct in line restraints to the size nominated in the design (which may have a contribution of PE shrinkage built in), **or**
   - 6.2. Apply to the designer to have the PE shrinkage contribution removed from the restraint size where the restraint area is > 2m². Design changes of this type do not need to be submitted to the water agency for acceptance / approval.
7. Where Option B (PE) pipework is not suitable and ≤DN355 Option C pipework is indicated in the design, the Contractor may select any Water Agency approved Option C pipe and joint combination.

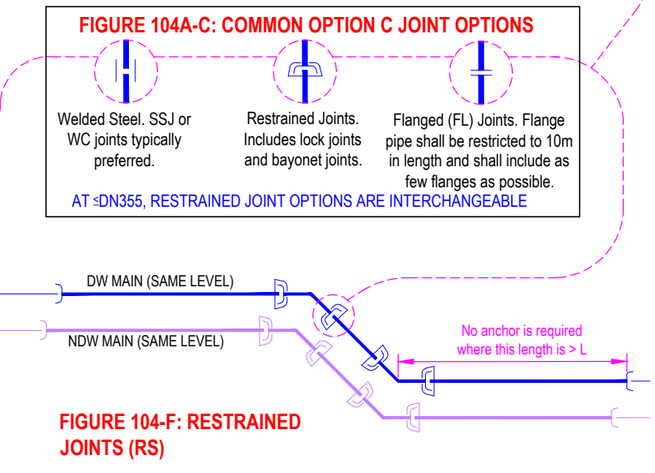


FIGURE 104-E: RESTRAINED MAINS WITH IN LINE ANCHORS

FIGURE 104-F: RESTRAINED JOINTS (RS)

RESTRAINED MAINS BETWEEN OPPOSING DUAL WATER BENDS

### FIGURE 104A-C: COMMON OPTION C JOINT OPTIONS



Welded Steel. SSJ or WC joints typically preferred.

Restrained Joints. Includes lock joints and bayonet joints.

Flanged (FL) Joints. Flange pipe shall be restricted to 10m in length and shall include as few flanges as possible.

AT ≤DN355, RESTRAINED JOINT OPTIONS ARE INTERCHANGEABLE

## Notes Regarding RRJs near Restrained Bends:

A. L = the minimum length of restrained main required between a bend and a RRJ before the bend needs thrust control.

B. L(mm) = 0.75 x ∠(deg) x OD(mm), where ∠ is the bend angle and OD is the main's outside diameter.

C. Where a restrained bend exists within L of a RRJ, either:
   - C.A. Extend the section of restrained main to exceed L (preferred), or
   - C.B. Install an in line thrust restraint at the end of the restrained main (as per Figure 104A-E), or
   - C.C. Install a plain restraint behind the bends (as per Fig 104B- C & D).

D. Size the restraint as per MRWA-W-204. Make an allowance for PE shrinkage in the thrust restraint design when using PE.

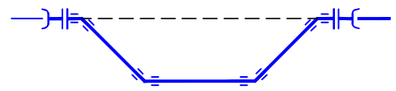

FIGURE 104A-G: DOGLEG USING RIGID MILD STEEL OPTION C PIPEWORK

Provided the main to either side of the dog leg is in line, no restraints are required.
When the pipework is not co-linear, implement restraints for the net change in direction as per MRWA-W-204.

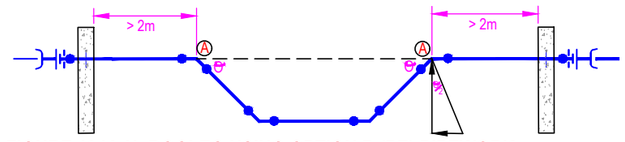


FIGURE 104A-H: DOGLEG USING OPTION B (PE) PIPEWORK

To counter rotational forces on the bends at location A (which may be a problem with a flexible main like PE), and provided the main to either side of the dog leg is in line, size the in line restraints as follows:

Thermal contraction + Poisson's + (Restraint area for Bend A (as if plain anchour) x Sin(½)).

Restraints may not be required at all for very short lengths of PE.
When the main on either side of the dog leg is not co-linear, increase the size of the thrust restraints to compensate for the net change in direction as per MRWA-W-204.

| REV | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|
| 3 | TABLE 104-A, RESTRAINT AT BENDS, TIES | 01/12/16 | RJ / CP / JT |
| 2 | PUBLISHED FIRST ISSUE | 21/03/12 | R. JAGGER |
| 1 | PRE PUBLISHED DRAFT FOR COMMENT | 12/07/11 | R. JAGGER |

| | NAME | DATE |
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| ☒ CWW | C. RIVETTE | 21/03./12 | ☒ CWW | R.CARRUTHERS | 21/03/12 |
| ☒ SEWL | C.PAXMAN | 21/03/12 | ☒ SEWL | G.REYNOLDS | 21/03/12 |
| ☒ YVW | K.DAWSON | 21/03/12 | ☒ YVW | A.COSHAM | 21/03/12 |

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MRWA WATER SUPPLY STANDARDS

PIPELINE RESTRAINT OPTIONS, BRANCH & BEND ARRANGEMENTS AND FITTING LAYOUT

NOT TO SCALE

MRWA-W-104A

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