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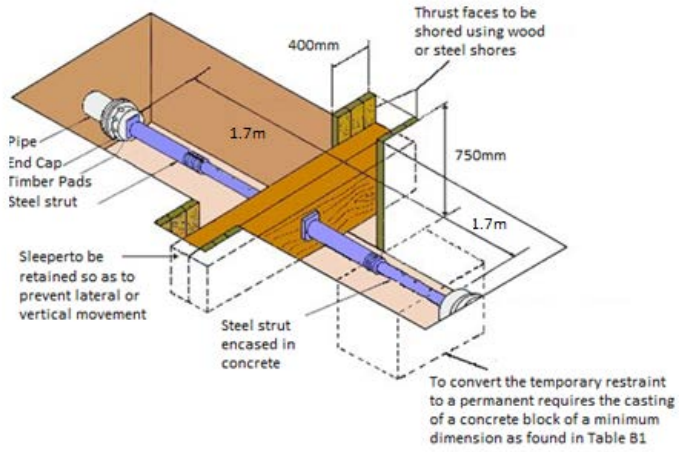
Safety Management Framework

Work Instruction for Anchorage on Systems up to and Including 7 bar (≤60 KN) - Operatives



Work Instruction for Anchorage on Systems up to and Including 7 bar (≤60 KN)

SGN/WI/ANC/4.2.2

Document Owner: **Bob Hipkiss**

Context

Who is this Work Instruction for?

This work procedure is for operatives, qualified to NCO2 Mainlaying qualification or equivalent, and be trained in the installation of anchorage. Operational Managers who are involved in the construction of mains and large diameter services must be trained in anchorage systems and been assessed as competent.

What does this Work Instruction do?

This work Instruction provides instruction on how to identify when anchorage is required and how to construct anchorage systems.

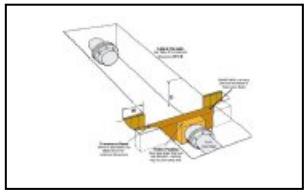
Scope

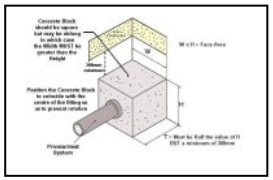
Covers all mains and large service related work up to and equal to 7 bar operations that has a maximum pressure thrust force not exceeding 60 kN.

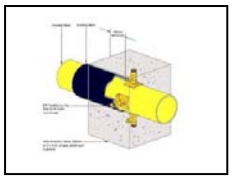
Why do we need this Work Instruction?

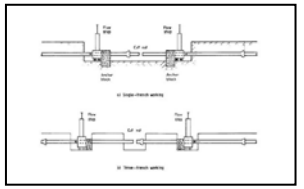
To support safe and consistent installation.

Anchorage on Systems up to and Including 7 bar Overview









Temporary Anchorage		Permanent Anchorage		Anchorage of PE pipe		Cut Out Operations		Other Situations	
A1	Guidance Notes on the Installation of Type 1, 2 and 3 Temporary Model Anchorage Systems.	B1	Permanent Anchor Blocks on End Caps.	C1	Using Tapping Tees or Branch saddles for Anchorage.	D1	Using AVK Caps Without Anchorage.	E1	Working Near to SGN plant
A2	Temporary Anchorage System 1.					D2	Single or Three Trench Cut Out Operations	E2	Working near to other utilities plant
A3	Temporary Anchorage System 2.	B2	Permanent Anchorage Blocks on Steep Gradients and at bends.	C2	Using Anchor Plates/Loose flange and electrofusion coupler for Anchorage.	D3	Pipe clamping.	E3	Pressure Testing
A4	Temporary Anchorage System 3.	B3	Converting temporary to permanent Anchorage.			D4	Unsupported Ground.	E4	Inspection of anchorage
A5	Selection of Wooden Traverse Beam.					D5	Other situations.		
A6	Selection of Steel Traverse Beam.								

Appendix							
A	References	B	Pressure Thrust Force Chart	C	Inspection Form	D	Torque Wrench Instruction

APPROVAL | DISCLAIMER | END NOTE

Guidance Notes

All work carried out on mains and services up to 7 bar pressures will contain forces in the pipe which may require anchorage. The greater the diameter and / or pressure, the greater the force will be.

You must have all documents relating to the task being carried out; this may include work instruction, associated permits, Safe Control of Operations (SCO) documentation, material lists and construction drawings, which you must adhere to.

Roles and responsibilities

Roles	Responsibilities
Operative • Team Leader responsible for undertaking the work.	• Identification of potential anchorage issues. • Can only install anchorage that they are trained and deemed competent installing • Undertaking a site-specific anchorage Risk Assessment and proposing/agree risk mitigation measures with their Operational Manager. • Ensure all temporary/permanent anchorage material are on site prior to the operations commencing. • Coordination of work on site ensuring that the temporary and permanent anchorage installations are completed in accordance with written instruction, for example Routine Operations (RO), Non-Routine Operations (NRO), Permit to Work (PTW). • Monitor any temporary anchorage until permanent anchorage is installed.
Operational Manager • Team/Project Manager responsible for managing the work.	• Identification of potential anchorage issues. • Undertaking a site-specific anchorage Risk Assessment and proposing/agree risk mitigation measures with Operatives. • Ensure that ROs, NROs or PTW (where required) have anchorage requirements included. • Ensure all temporary/permanent anchorage material are on site prior to the operations commencing. • Co-ordination of work to ensuring that the temporary and permanent anchorage installations are completed correctly. • Ensure monitoring of temporary anchorage is completed until permanent anchorage is installed or no longer required. • Undertake anchorage audits.
Senior Operational Managers • Engineering/General Manager	• Ensure that ROs, NROs or PTW (where required) have anchorage requirements included. • Ensure monitoring of temporary anchorage is completed until permanent anchorage is installed or no longer required. • Undertake anchorage audits. • Check and approve more complex anchorage installations.
SGN's Specialist design team/advisors.	• Provide calculations and design requirements for systems with a thrust force above 160 Kn.

Remember, you need anchorage when:

- flexible non-end loaded compression joints are fitted.
- a non-end load bolted joint including valves, form the test end.
- making full bore connections to existing swaged or inserted PE pipes that are in tension.
- PE pipe has been subject to temperature variation before or after connection.
- during Flow stopping activities dependent on the thrust forces involved.
- exposed pipes are installed or identified, for example above ground bypass and permanent above ground pipework.
- Where it is expected that ground movement or flotation of pipework could occur - where ground movement or flotation of pipework could occur, work must not be progressed until the site conditions have been assessed and any additional anchors have been installed.

If you encounter something that requires a change of design during installation or you are in any doubts, then stop and contact your Operational Manager for guidance. When installing any anchorage, everyone must ensure it is installed correctly and as per the design. Anchorage can be categorized in to 6 areas of design and installation work:

- Temporary Anchorage system.
- Permanent Anchorage system.
- Anchorage of PE pipe.
- Anchorage during Cut Out Operations.
- Anchorage for pressure testing operations.
- Other situations.

When Anchorage is Not Required

Anchorage for fittings other than end caps up to 0.1 KN, do not normally require anchorage providing they have been torqued (see Appendix D on how to use the SGNs stocked Norbar Torque Wrench) to the maximum setting as stated by the manufacturer. With reference to Appendix B, the following mains diameter will not require anchorage unless a joint (excludes welded/welded flanged) upstream has been exposed in the excavation or your work instruction/Operational Manager requires it: -

- Iron and steel 3”, 4”, 5” or 6” operating up to 30 mbar
- Iron and steel 3”, 4” or 5” operating up to 40 mbar
- Iron or steel 3” operating up to 75 mbar
- Steve Vick 3”– 8” Live Insertion gland box operating up to 40 mbar
- Correctly torqued AVK end caps up to 12” in diameter, operating up to 75 mbar on Iron and steel networks providing the requirement in Section D1 are applied
- Welded flanged and/or welded steel pipework

- Fully fused (butt or electrofused) jointed Polyethylene (PE) pipework.
  Note: Any non-end loaded fittings, for example PECAT adapter, Maxi adapters, etc., used to connect PE systems to metallic or non- standard materials need special consideration as movement of PE systems could cause a compression joint to be disturbed.

You must always confirm with your Operational Manager that anchorage is required or not.

Installing anchorage

Good Anchorage relies on correct installation: -

- by competent operatives
- following the guidance given in this work instruction
- to the right dimensions and using the correct materials and equipment.

Failure to do so will weaken the anchorage system and could put you and others in danger. When installing non-end loaded fittings, the bolts must be torqued to the manufacturers maximum torque setting, for example AVK End Caps must be torqued to 30 Nm (see Appendix D - Use of the SGN torque wrench). If you do not use a torque wrench, or a non-end loaded joint is exposed in the excavation, then anchored must be applied. Once non-end loaded fittings have been installed you should either spray paint or mark the main with chalk as this will help to identify if the fitting has moved during inspections.

Site Safety Requirement	Testing	PPE Requirements	Competency
During live gas operations and whilst preparing for the installation of anchorage, there is a risk to operatives both within and outside the trench that end caps and other fittings may become dislodged. You must ensure that all personnel involved understand the risks, and under that no circumstances must anyone stand in front of a live unrestrained end cap or other fitting. Fencing and or barriers as appropriate must be provided to protect all those involved and the general public. Requirements for deep excavations must be followed. All visitors to site must be briefed on the risks with the site.	Testing pressures are significantlt more that operating pressures, and anchorage needs to reflect able to restrain this higher pressure. Mains and large diameter services will normally be constructed using materials which will not normally require anchorage. However operatives must always be alert to the possibliity that joints and fittings can fail suddenly, this includes PE systems. Ensure that all protection measures and signage are in place prior to commencing a test.	Operatives must ensure they wear or have available (as appropriate) all necessary PPE. This includes: • Hard Hats • Gloves • Boots • Eye protection • Approved fire retardant workwear • Hi Vis work wear appropriate for the Road classification/Risk Assessment. • Ear Defenders • Dust masks • Breathing Apparatus • Fire Extinguishers	GNO Level 2 minimum **Special Equipment** Specialist equipment can include if required: • Adjustable Steel Trench Struts • Acrows / Props /struts • Wooden beams • Rectangular Steel Beams • Timber, wedges for shuttering • Steel shuttering sheets • Formwork (Temporary or Permanent mould into which concrete is poured – min 18 mm Plywood) • Concrete • Clamp Systems • Steel Rings

Temporary Anchorage	Permanent Anchorage	Cut outs Operations	Site Records	Tooling Equipment
All temporary Anchorage must be undertaken by competent and qualified operatives. When requried, assistance should be obtained from Senior Operational Managers or SGN's specialist design team/advisors.	All permanent Anchorage must be undertaken by competent and qualified operatives. When requried, assistance should be obtained from your Operational Managers or SGN's specialist design team/advisors.	When carrying out cut out operatons consideration must be given to using a three excavation system particularly for medium and intermediate pressure operations.	Site inspection forms must be completed and passed to the Operational Manager and kept in the project file.	Tooling can include if required: • Tooling Air compressor • Callibrated Torque Wrench (see Appendix D Use of the SGN torque wrench). • Main/service layer tool kit. • 'On Test' signage and barriers.

A1 Guidance Notes on the Installation of System Type 1, 2 and 3 Anchorage Systems

Guidance Notes

Anchorage systems 1, 2 and 3 are temporary designs that have been based on poor quality soils (the worst case) for thrust force not exceeding 60 kN. Each design is based on the following assumptions:

- System type 1 up to 10 kN (1 Tonne force) can be used on LP (75 mbar) up to 46", MP (2 bar) up to 8", IP (7 bar) up to 3".
- System type 2 up to 30 kN (3 Tonne Force) can be used on LP (75 mbar) up to 48", MP (2 bar) up to 14", IP (7 bar) up to 7".
- System type 3 up to 60 kN (6 Tonne Force) can be used on all LP mains, MP (2 bar) up to 21", IP (7 bar) up to 10".
  Note: Non-end loaded fittings should be torqued to maximum manufactures setting – See Appendix D for instruction on use.

Where higher forces need to be restrained greater than 60 kN, for example for mains testing, higher pressures and larger diameters then these will be provided to you by your Operational Manager. If the soil type is known, then your Operational Manager can recalculate these design systems to reduce the requirements. These are know as System type 4, and cover designs provided to you by your Operational Manager.

Note: Where temporary anchorage is to be made into permanent anchorage, then use a Rigid Hollow Section (RHS) Steel beam instead of timber beams and/or a steel strut.

You must:

agree which system is going to be installed with your Operational Manager prior to any operation commencing
ensure that all the necessary materials are on site and all required excavation work has been completed
contact your operational manager if you are unsure of what temporary or permanent anchorage is required.

When systems 1 to 3 are not suitable

Where it is not possible to use any of the anchorage systems model designs types 1, or 3, your Operational Manager will either issue instructions to install a System Type 4 or a permanent anchor block. When an anchorage system is designed especially for your particular operation it must be followed exactly and if any problems are identified these must be reported to your Operational Manager.

DO NOT assume that these designs can be reused at another site.

A2 Temporary Anchorage System Type 1 Model design up to 10 KN – End Cap or Tee

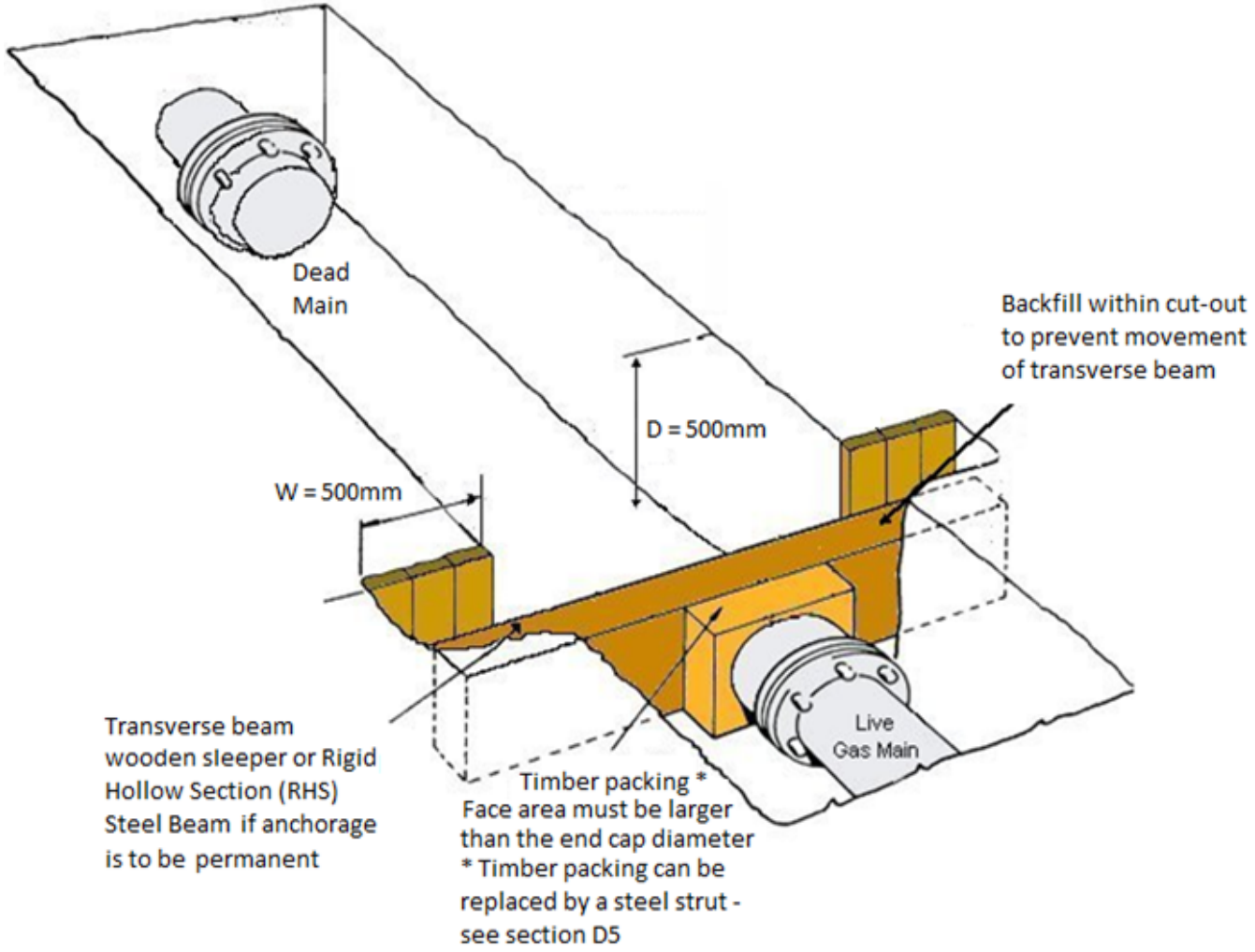


Figure A2-1 - System 1 for Thrust Anchorage up to 10 kN

This system can be used on LP (75 mbar) up to 46", MP (2 bar) up to 8", IP (7 bar) up to 3".
Note: Non-end loaded fittings torqued to maximum setting.

Minimum Trench Depth D = 500 mm

Cut-out minimum width of W = 500 mm

Minimum trench width 500 mm, maximum trench width of 1500 mm.

See Table A5-1 for Transverse Timber Beam Selection and Table 6-1 for Rigid Hollow Section (RHS) Steel Beam selection.
Note: Where temporary anchorage is to be made permanent anchorage, use a RHS Steel beam instead of timber beams and/or a steel strut.

Any spaces behind the shoring must be filled with compacted granular material, compacted lean concrete or structural concrete.

Timber packing must be larger than the end cap diameter.
Note: If using a steel strut, then no metal to metal contact.

Either spray paint or mark the main (with chalk) and the end cap, as this will help to identify if the end cap has moved during inspections.

A3 Temporary Anchorage System Type 2 Model Design from >10 to ≤30 KN – End Cap or Tee

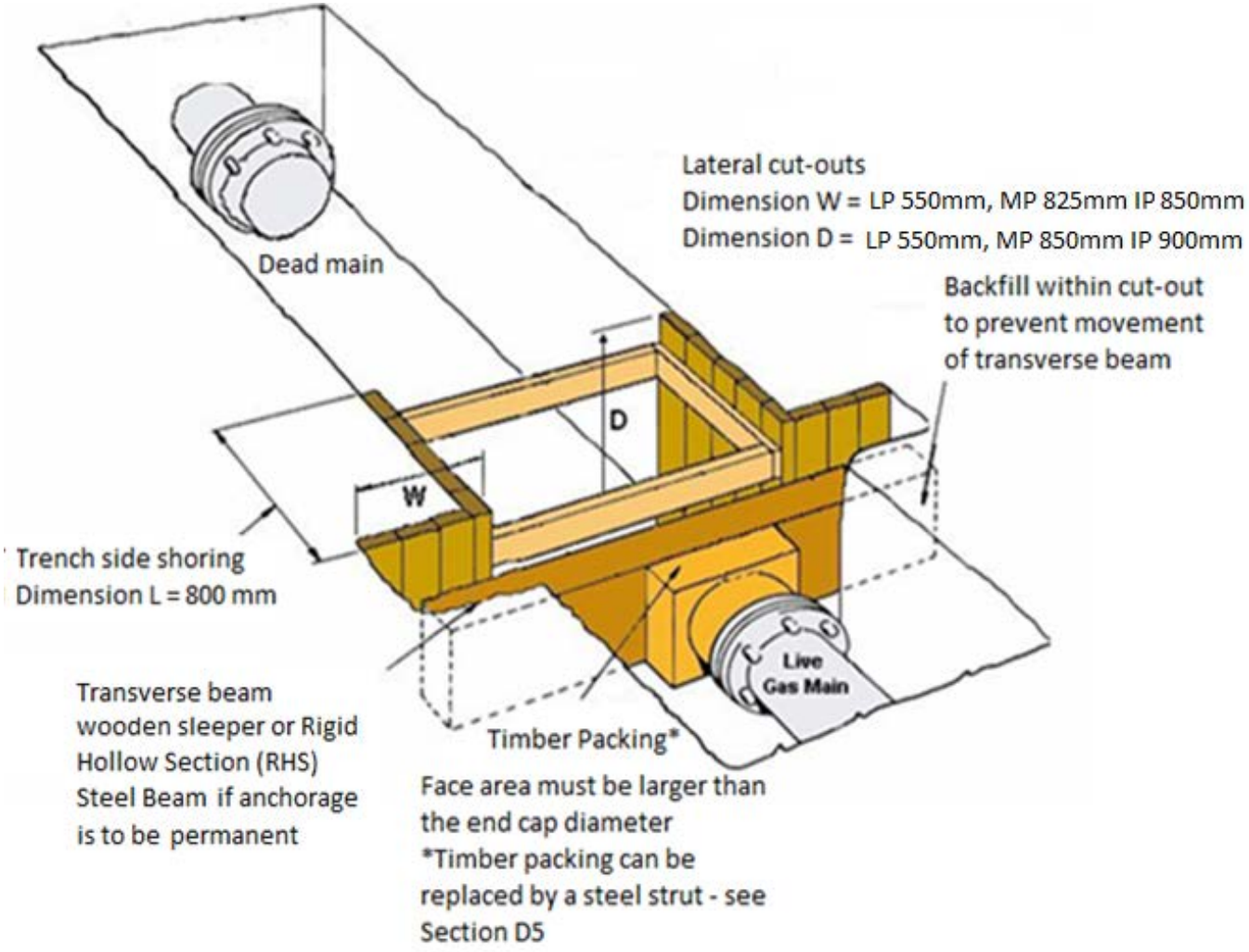


Figure A3-1: System 2: Anchorage up to 30 kN

This system can be used on LP (75 mbar) up to 48", MP (2 bar) up to 14", IP (7 bar) up to 7".
Note: Non-end loaded fittings torqued to maximum setting.

Minimum Trench Depth D for LP, MP and IP.

Cut-out minimum width of W for LP, MP and IP.

Trench Side shoring dimension L=800 mm.

Minimum trench width 500 mm, maximum trench width of 1500 mm.

See Table A5-1 for Transverse Timber Beam Selection and Table 6-1 for Rigid Hollow Section (RHS) Steel Beam selection.
Note: Where temporary anchorage is to be made permanent anchorage, use a RHS Steel beam instead of timber beams and/or a steel strut

Any spaces behind the shoring must be filled with compacted granular material, compacted lean concrete or structural concrete.

Timber packing must be larger than the end cap diameter.
Note: If using a steel strut, then no metal to metal contact.

Either spray paint or mark the main (with chalk) and the end cap, as this will help to identify if the end cap has moved during inspections.

A4 Temporary Anchorage System Type 3 Model Design from >30 to ≤60 KN – End Cap or Tee

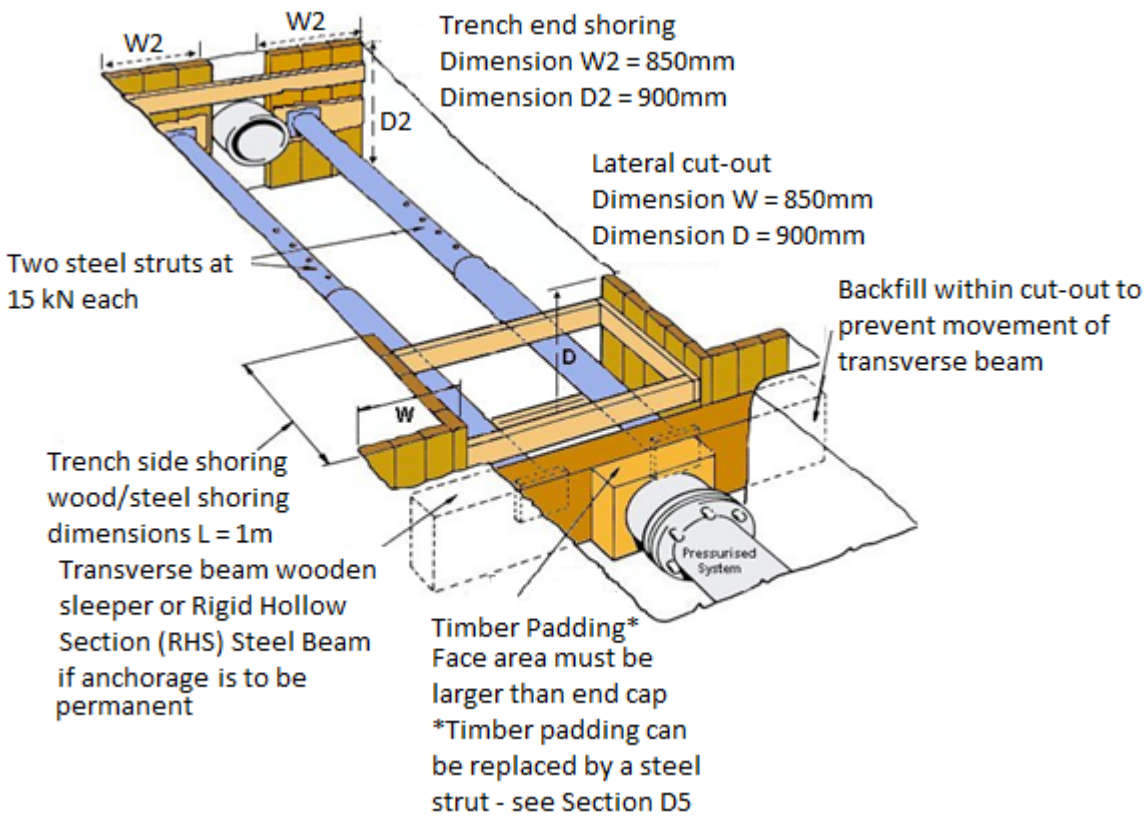


Figure A4-1: System 3 – Anchorage up to 60 kN.

This system can be used for MP (2 bar) up to 21", IP (7 bar) up to 10".

Note: Non-end loaded fittings torqued to maximum setting.

Minimum Trench Depth D = 900 mm

Cut-out minimum width of W = 850 mm

Trench End Shoring Width W2 = 850 mm

Trench End Shoring depth D2 = 900 mm

In addition to the cut outs a section of the mains trench will also need to be close boarded to support and strengthen the trench sides shoring dimension L = 1.00m

Minimum trench width 500 mm, maximum trench width of 1500 mm.

See Table A5-1 for Transverse Timber Beam Selection and Table 6-1 for Rigid Hollow Section (RHS) Steel Beam selection.

Note: Where temporary anchorage is to be made permanent anchorage, use a RHS Steel beam instead of timber beams and/or a steel strut.

Any spaces behind the shoring must be filled with compacted granular material, compacted lean concrete or structural concrete.

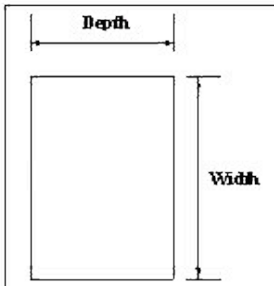
Timber packing must be larger than the end cap diameter.

Note: If using a steel strut, then no metal to metal contact.

Either spray paint or mark the main (with chalk) and the end cap, as this will help to identify if the end cap has moved during inspections.

A5 Selection of Wooden Traverse Beam

Using Table A5-1 will establish the traverse beam size required for the given Thrust Force. Structural timber beams with a minimum strength of 40 KN/m^2 complying with BS EN 338, and railway sleepers conforming to BS EN 13145 can be used for temporary anchorage (see Table A5-1).



Dimensions for Timber Beams			
BS EN 338 – Structural Timber Wide range of sizes available			
BS EN 13145 – Wood Sleepers & Bearers Typical UK railway sleeper dimensions			
Depth	125	mm	
Width	250	mm	
Length	2600	mm	
Trench width mm	Maximum allowable thrust forces on beams		
	Single beam kN	Two beams kN	Three beams kN
500	11	45	100
750	9	36	80
1000	7	30	65
1250	6	25	50
1500	5	20	45

Table A5-1: Structural Timber and Wooden Railway Sleepers

If there is any doubt that the beam does not meet the above requirements, then Rectangular Hollow Sections (RHS) steel beams should be used see Table A6-1. The maximum allowable thrust force for one or more transverse beams can be found in Table A6-1 by selecting the trench width on site and find the appropriate thrust force required to determine the number of beams required.

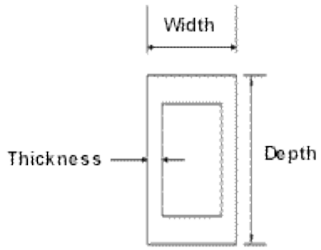
Wooden transverse beam example: If you have a trench width of 1 m, and are installing Model System 1, then you will need 2 x beams (Depth 125 mm x Width 260 mm x Length 2 m.)

Only timber beams and railway sleepers meeting the above requirements should be used for temporary anchorage. Old wooden railway sleepers/timber beams pressure treated with creosote or coal tar must not be used. Wood that has or is believed to have been treated with creosote or coal tar are a health hazard if handled or cut, so must not be used.

A6 Selection of Rectangular Hollow Section (RHS) Steel Traverse Beam

RHS steel beams with a yield strength of 235 N/mm^2 and conforming to EN 10210-2 can be used for temporary anchorage. Steel beams strengths are classed from A to E and for a given a known trench width and thrust force Table A6-1 can be used to select the appropriate beam.

Transverse Steel (RHS) Beams to BS EN 10210-2



Dimensions for Beam types A to E			
Class of Beam	Depth mm	Width mm	Thickness mm
A	120	60	5
B	150	100	5
C	200	100	5
D	250	150	6.3
E	300	200	6.3

Trench Width mm	5kN	10kN	15kN	20kN	25kN	40kN	60kN
50	A	A	A	B	B	D	D
750	A	A	B	B	C	D	D
1000	A	B	B	C	C	D	D
1250	A	B	B	C	C	D	E
1500	A	B	C	C	D	D	E

Table A6-1: Transverse Timber Beam Selection

Example: Using Table A6-1, if you have a trench width of 1 m, and are installing Model System 1, then you will need 1 x RHS steel beam with a Depth 150 mm x Width 100 mm x thickness 5 mm Length 2 m.

B1 Permanent Anchorage

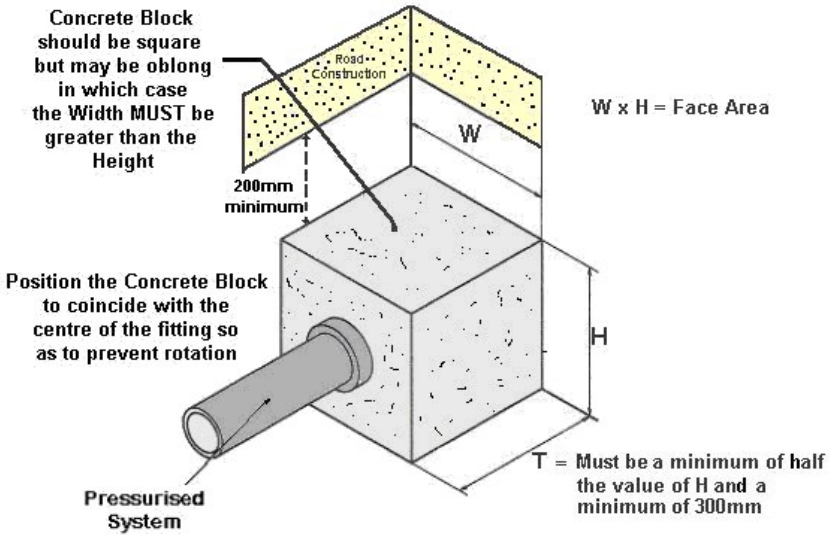


Figure B1-1 – Permanent Anchorage Requirements

Minimum Anchor Block Size				
Model Design	Width (W) mm	Height (H) mm	Thickness (T) mm	Surface Area (m^2)
Type 1 ≤10kN	710	710	355	0.50
Type 2 >10 ≤30kN	1240	1240	620	1.53
Type 3 >30 ≤60kN	1735	1735	870	3.00

Table B1-1- Permanent Anchor Block – End Cap

Guidance Notes

Obtain an adequate supply of concrete, sand and aggregate for a typical mix of 1: 2: 4 or use ready mixed concrete.

- The concrete must comply with the recommendations of the relevant Parts of BS 1992-1.
- Aggregate should be used to give a minimum crushing strength of 20 NM/m^2 after 28 days.
- The cement must be OPC (Ordinary Portland Cement) complying with BS EN 197-1, aggregate must comply with BS EN 12620:2002 + A1:2008.

During frosty weather the newly cast concrete anchor block should be protected with dry sacking or straw. In hot weather a newly cast concrete anchor block should be protected with wet sacking or straw.

The use of Calcium Chloride as a rapid hardener accelerator must be avoided due to corrosion concerns.

Note: You must confirm with your Operational Manager which accelerators can be used.

In single trench working, ensure that the permanent anchorage block based is either placed below the trench bed or cut into the sides of the excavation. Note: See Section D2

Procedure for installing a Concrete Anchor Block

If you are using the 1-3 Model designs (Section A2, Section A3 and Section A4), these are shown in Table B1-1. If you are not using these model designs, then the block size will be designed by your Operational Manager.

1. Protect any pipes and fittings from corrosion using approved paints or tapes.

2. Confirm the size of the concrete block to be constructed with your Operational Manager
3. Check the area to be excavated for cables and other utility plant.
4. Proceed to excavate an area for the block, making allowance for the size of plywood shuttering (minimum 18 mm) and the guidance notes for the positioning of the block.
   Note: Excavations must be cut square and into firm ground below the trench bed.
5. The centre line of a block should coincide (approximately) with the centre line of the fitting or pipe that the block is restraining, to prevent rotation of the block.

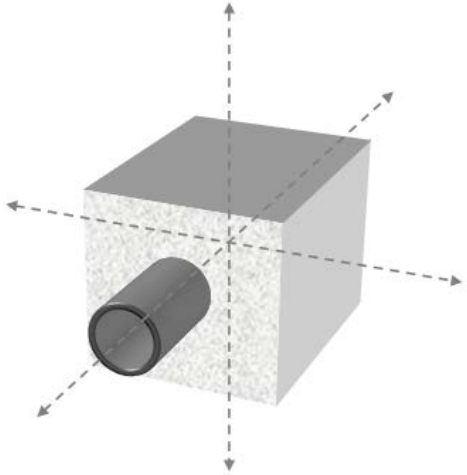


Figure B1-2 Positioning of Permanent Anchor Block

6. Having completed the excavation, set the shuttering into position making sure that it is secure from movement.
7. The shuttering should be appropriately shaped, to suit the profile of the pipe or fitting, and should be firmly located to withstand the weight of poured concrete.
8. If you mix the concrete your, then:
   a. Typically, 1: 2: 4 mix of cement: sand: aggregate
   b. The cement must be stored in dry conditions. Any cement that becomes contaminated or has deteriorated must not be used.
   c. If the concrete is supplied ready mixed make sure that supplier documentation conforms to the above requirements.
9. If required rapid hardeners can be used otherwise at least two days will need to be allowed for the concrete to harden.
10. Pour the concrete into the shuttered excavation ensuring that you do not dislodge the shuttering.
11. Make sure that the concrete is compacted and that no voids are created.
12. Allow to cure before pressuring the pipe work.
13. Once the concrete has fully cured the shuttering can be removed but care must be taken to fill any voids created.
14. Backfilling can commence around the anchor block in layers not exceeding 100 mm layers, each compacted by at least three passes of a mechanical rammer/ compactor or hand rammed (or otherwise compacted in accordance with the HAUC Specification of Reinstatement of Openings in Highways) before the next layer is placed.
15. Complete all site records of the operation.

B2 Permanent Anchorage on Gradients and at Bends

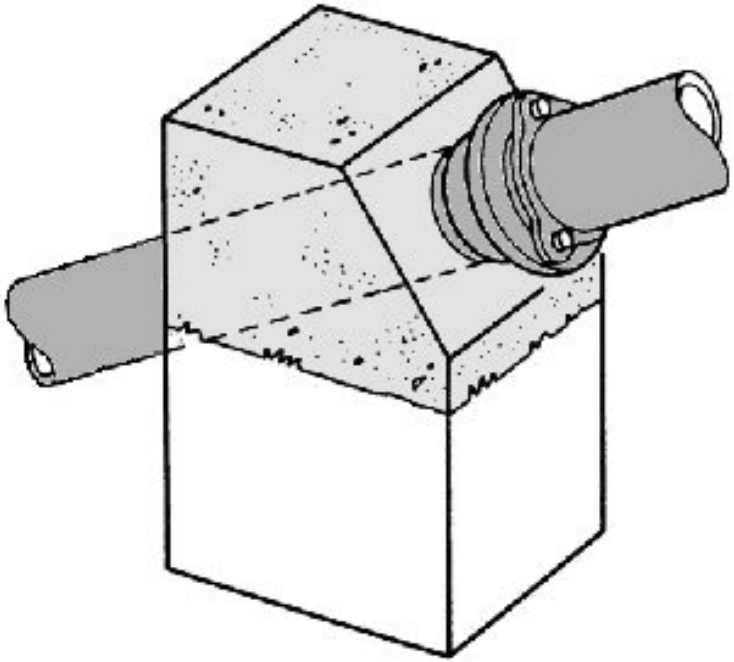


Figure B2- 1 - Anchorage on Gradients (1 in 6 or steeper) or Exposed Mains

Guidance Notes

In rare situations where the mechanical or lead jointed main are found in place on slopes 1 in 6 or steeper then an anchor block should be installed to restrain the pipe. The procedure and design requirements will be provided by your Operational Manager.

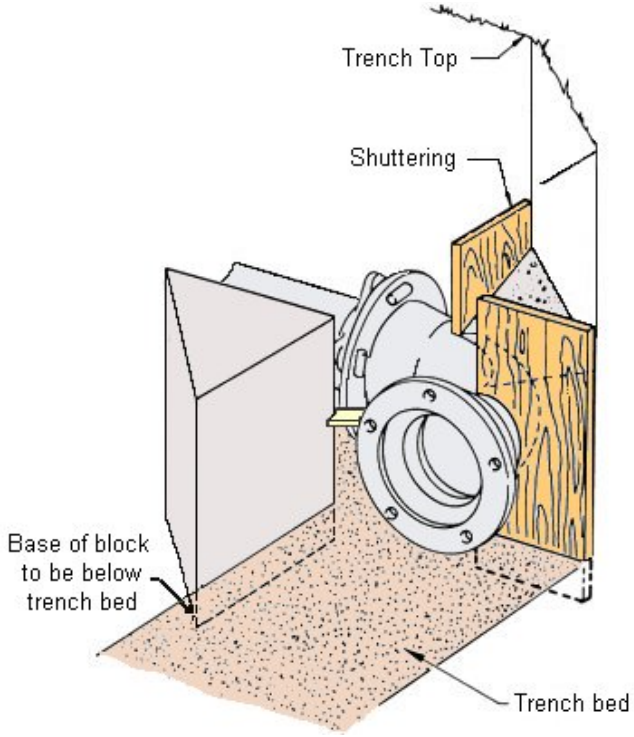


Figure B2- 2 Shuttering for Concrete in Contact with Pipework or Fitting – for clarity plastic sheeting protection is not shown

Guidance Notes

When Mechanical jointed bends are discovered without anchorage, inform your Operational Manager. Do not enter the excavation until the site has been assessed for safety by your Operational Manager. Your Operational Manager will advise you if a pressure reduction is required, and provide details of the design.

B3 Converting Temporary Anchorage to Permanent

Guidance Notes

Where model design 1 temporary anchorage has been applied (see Section A2), it can be converted into a permanent anchorage by following the procedure below.

This procedure can be used for model designs 2 and 3 providing that the anchor block dimensions are taken from Table B1-1.

Do not remove temporary anchorage until the permanent concrete anchor block has been fully cured or hardened.

The permanent concrete anchor encasing a steel strut or RHS beam (if it's used see Figure B3-2 and Figure B3-1) must be protected against corrosion using approved protection, for example densomastic tape.

Procedure

1. Follow the guidance in Section B1.
2. Using a minimum of 18 mm plywood, create shuttering to the required dimensions for a permanent anchor block – see Figure B3-1 and refer to Table B1-1 if using model designs 2 or 3. If concreting a steel strut refer to Figure B3-2. All these dimensions should be confirmed by your Operational Manager prior to starting.
3. The shuttering should be centrally position around the end cap, gas main and temporary anchorage.
4. Pour the mixed concrete into the shuttering taking care not to dislodge the formwork.
5. Make sure that no voids are created during the pouring of the concrete.
6. Allow the concrete to harden or cure taking account of any rapid hardening additives.
7. Backfill around the newly created anchor block in layers not exceeding 100 mm thickness, each compacted by at least three passes of a mechanical rammer/ compactor or hand rammed (or otherwise compacted in accordance with the HAUC Specification of Reinstatement of Openings in Highways) before the next layer is placed.
8. Remove unwanted shoring and struts.

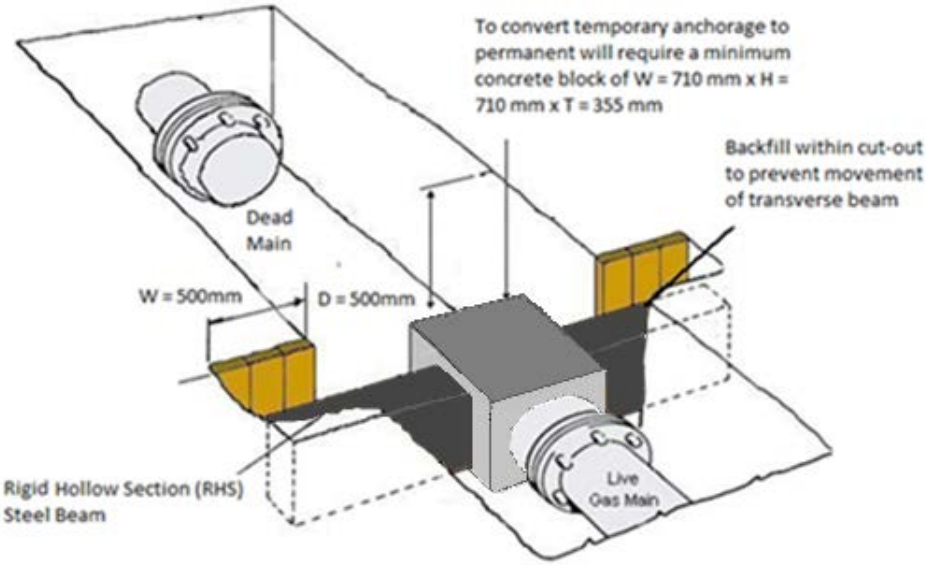


Figure B3-1 Temporary Anchorage to Permanent Anchorage - Model Design 1

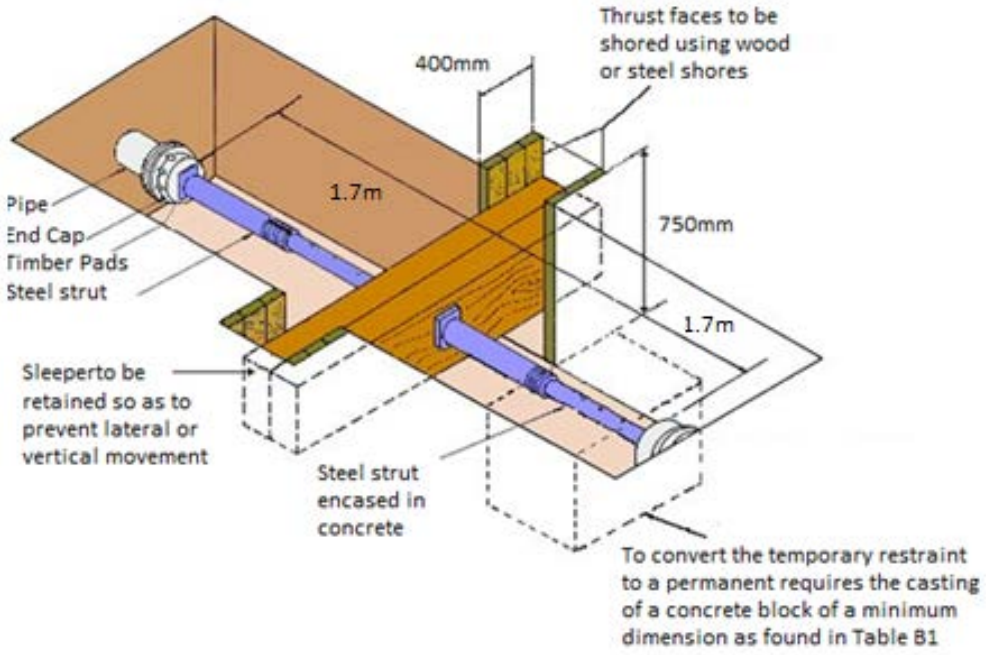


Figure B3-2 Conversion of Steel Struts from Temporary Anchorage to Permanent by Casting a Concrete Block

C1 Anchorage of PE Systems – Using saddles and or Tapping Tees - 2 Bar and below

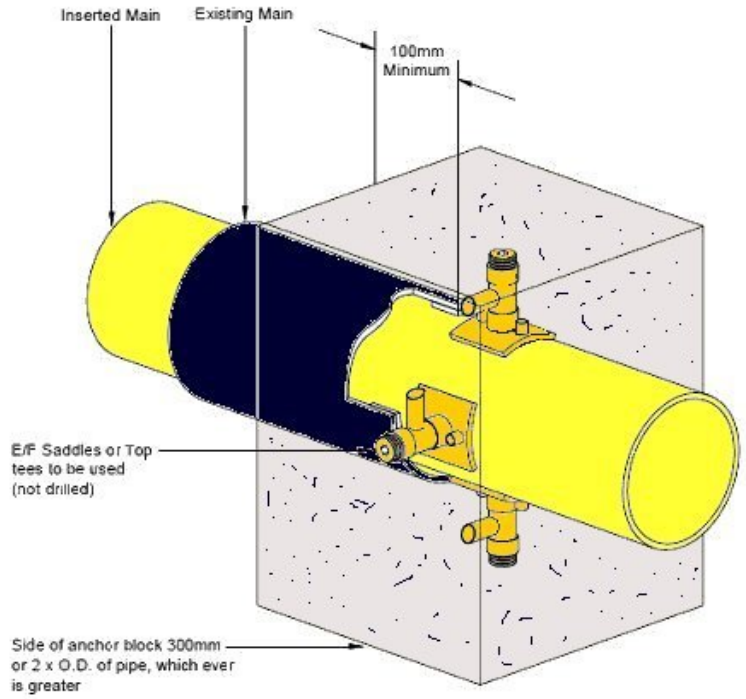


Figure C1 -1 PE Anchorage Using Tapping Tees (open view)

Guidance Notes

PE mains will expand due to increase in temperature and when inserted in to old mains will cool down causing the pipe to contract. This will cause the pipe to pull out of mechanical couplings which are non-end loaded fittings unless they are restrained. PE mains require permanent anchorage, using concrete anchor block(s) where:

- The carrier pipe on inserted mains is not suitable for anchorage.
- Connecting a new pipe to existing swaged lined or inserted pipe that is in tension to restrain the pipework when it is cut.
- If laying by open cut, connecting PE pipe to a metallic main with a non-end load bearing joints.
- Where no other forms of anchorage are practicable.
- **The PE pipe must not be operating above 2 bar.**

The anchor block must be constructed by casting concrete over undrilled saddles or service tapping tees fused to the PE main. The number required for each pipe diameter is shown in Table C1-1 below.

Pipe Diameter (mm)	Number of Saddles/Tapping Tees	
	SDR 11	SDR 17.6/ 21
90	2	2
125	2	2
180	3	2
250	4	3
315	5	4
355	6	4
400	8	6
500	12	8
630	16	10

Table C1-1 Number of Tapping Tees Required for Anchorage on Systems Up to 2 bar

Your manager will provide you details of the required block size and confirm the number tapping saddles.

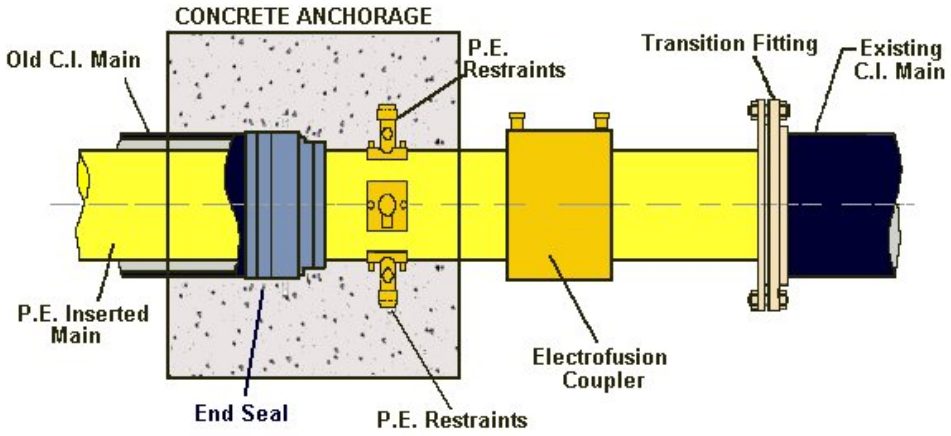


Figure C1 -2 PE Anchorage Using Tapping Tees (side view)

Procedure

1. Having first made the mains connection between the old cast iron main and the newly inserted PE main (in accordance with SGN/WI/ML2), fit a Steve Vick end seal to the liner pipe and the inserted PE pipe.
2. Fuse the appropriate number of Saddles or Tapping tees in accordance with Table C1-1. Proximity distances between fittings must be maintained in accordance with SGN/WI/ML/2.
3. The outlets of the Tapping tees or Saddles must be capped.
4. Protect the pipe to be encased in concrete with plastic sheeting wrapped tightly around the pipe and secured in place.
5. Carefully set up shuttering around the pipe to form a square box.

The minimum size of the block must be 300 mm square or two times the diameter of the PE pipe whichever is the greater, for example 250 mm diameter P. E. requires a 500 mm square block. Obtain an adequate supply of concrete as per Section B1. Confirm with your Operational Manager on the block size.

NOTE: The mix needs to be poured into the shuttering carefully to avoid disturbing the shuttering.

6. If it is likely that the pipework will need to be pressurised soon after the connection has been made, the use of approved rapid hardener additives will be required to reduce the concrete curing times.
   Note: You must confirm with your Operational Manager which accelerators can be used.
7. Once the concrete has hardened and cured the pipe work can be pressurised in accordance with SGN main laying procedures SGN/WI/ML/2.

C2 Anchorage of PE Systems Using Anchor Plate/Loose Flange and Electrofusion Coupling

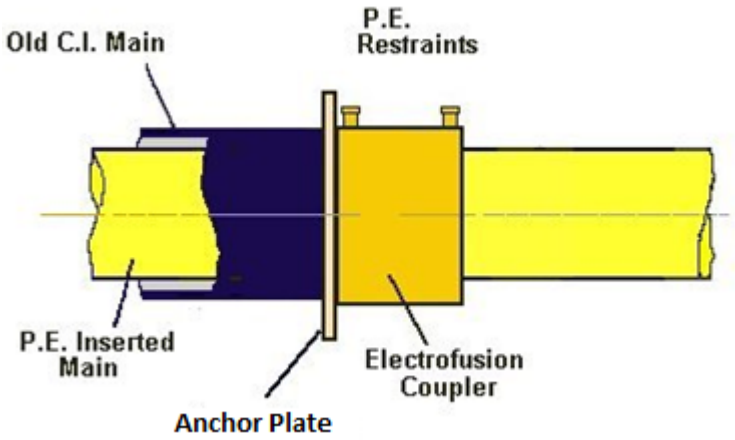


Figure C2- 1 PE Anchorage Using Anchor Plate

Guidance Notes

Anchor plates can be used for permanent anchorage on LP and MP (2 bar) Live and dead insertion mains. When using this system for anchorage:

- the pipe end of the iron main must be cut square
- use Table C2-2 to determine anchor plate requirements and use the correct sized anchor plate for the host main and inserted pipe
- re-round the PE pipe as required
- electrofusion coupling use to fix the plate must not be on a live gas connection. It is sacrificial coupler for fixing the anchor plate in position.

Procedure

1. Cut the host main square and re-round the PE pipe.
2. Before making final connection place both the anchor plate and electrofusion coupling over the pipe.
3. Make the final connection but do not commission main.
4. Prepare the PE pipe as normally required by scrapping the pipe or peeling the outer coating.
5. Slide loose flange up against the old inserted pipe.
6. Slide the new electrofusion coupling up against the anchor plate jamming it against the old main.
7. Fit a pipe clamp against the side electrofusion coupling to hold it in place.
8. Electrofusion the coupling and allow cooling time.
9. Once completed remove the clamp and commission the main in following the procedure within SGN/WI/ML/2.

Nominal Size	SGN Stock Code	Nominal Size	SGN Stock Code
55 mm x 3”	227123	75 mm x 6”	227132
63 mm x 3”	227124	90 mm x 6”	227134
75 mm x 3”	227125	125 mm x 6”	227135
55 mm x 4”	227126	55 mm x 8”	227136
63 mm x 4”	227127	63 mm x 8”	227137
75 mm x 4”	227128	75 mm x 8”	227138
90 mm x 4”	227129	90 mm x 8”	227139
55 mm x 6”	227130	125 mm x 8”	227140
63 mm x 6”	227131	180 mm x 8”	227141

Table C2-2 – Stock Code for Anchorage Plate

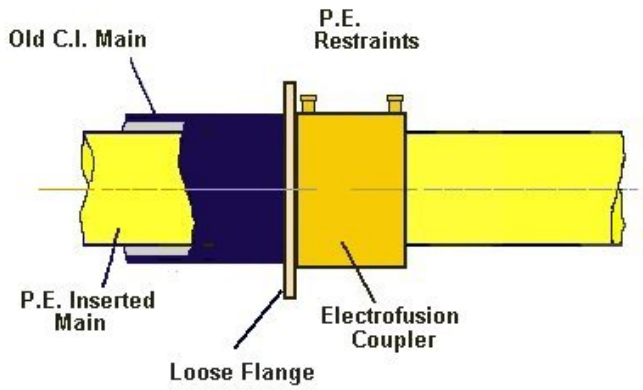


Figure C3- 1 PE Anchorage Using Loose Flange

Guidance Notes

Anchor plates can be used for permanent anchorage on above 180 mm to 630 mm LP and MP (2 bar) Live and dead insertion mains. When using this system for anchorage:

- the pipe end of the iron main must be cut square
- use Table C3-2 to determine loose flange requirements and use the correct sized flange for the host main and inserted pipe
- re-round the PE pipe as required
- electrofusion coupling use to fix the plate must not be on a live gas connection. It is sacrificial coupler for fixing the anchor plate in position.

Procedure

1. Cut the host main square and re-round the PE pipe.
2. Before making final connection place both the anchor plate and electrofusion coupling over the pipe.
3. Make the final connection but do not commission main.
4. Prepare the PE pipe as normally required by scrapping the pipe or peeling the outer coating.
5. Slide loose flange up against the old inserted pipe.
6. Slide the new electrofusion coupling up against the anchor plate jamming it against the old main.
7. Fit a pipe clamp against the side electrofusion coupling to hold it in place.
8. Electrofusion the coupling and allow cooling time.
9. Once completed remove the clamp and commission the main in following the procedure within SGN/WI/ML/2.

Nominal Size (mm)	CI/SI/ST/DI (ins)	Plate Diameters Inside Diameter (ID) x Outside Diameter (OD x Thickness (T) (mm)
90	4	96 x 155 x 4
125	6	131 x 210 x 6
180	8	186 x 265 x 6
180	10	186 x 335 x 6
250	12	257 x 395 x 8
250	14	257 x 450 x 10
355	16	362 x 500 x 10
355	18	362 x 560 x 12
400	20	407 x 610 x 15
500	24	568 x 720 x 15
630	36	639 x 1040 x 25

Table C3-2 - Guidance to Determine Anchor Plate Thickness and Diameters for Inserted PE to Host Main Sizing's

You must always seek advice from your Operational Manager before using loose flange and sacrificial coupler on large diameter LP and MP systems to ensure this method provides adequate restraint.

D1 Cut Out Operations - Using AVK Caps Without Anchorage

Figure D1-1 Approved AVK Series 248/32 Universal End Cap Supplied to SGN

Guidance Notes

In specific situations it is possible to install end cap fittings without anchorage, these situations are:

- the end cap is to be fitted on a system operating at a pressure no greater than 75 mbar, **and**
- diameter is 12" /300 mm or less, **and**
- the end cap has been approved by SGN for use without anchorage (AVK series 248/32), **and**
- the end cap is to be fitted in a below ground situation **and**
- there are no other exposed joints in the same excavation on the pipe to which the end cap is to be fitted, **and**
- the mechanical end cap fitting, sealing gland, backing ring and bolts have not been damaged, **and**
- the pipe end is prepared and cleaned to accept the end cap **and**
- that 30 Nm torque settings is applied to the bolts.

All these conditions MUST apply. Cap supplied other manufacturers will require additional anchorage

Procedure for fitting caps

1. Check that the conditions stated in the guidance notes fully apply to your site circumstances, if not seek advice from your Operational Manager.
2. Check that you have the manufacturer's installation instructions available to you and read them.
3. Prepare and clean the pipe end.
4. Check Table D1-1 to ensure Outside Diameter (OD) is with sealing range of the fitting.
5. Undo the fitting and lay out the backing ring, gland and bolts in a dry location within your work area.
6. Slide the backing ring over the pipe end.
7. Slide the sealing gland over the pipe end.
8. Place the end cap onto the pipe; obtain assistance if the weight of the fitting is too much for you on your own.
9. Locate the cap snugly onto the pipe end.
10. Pull up the sealing gland into the cap make sure that it is evenly fitted around the pipe.
11. Pull the backing ring up into the end cap and against the sealing gland
12. Hold the fitting in place and insert the correct number of bolts into the backing up ring and the end cap.
13. Hand tighten the bolts.
14. Confirm correct alignment of cap on the pipe.
15. In turn tighten the bolts and make the final torque setting on the bolts to 30 Nm. DO NOT over tighten – see Table D1-1 and Appendix D - Use of the SGN torque wrench current supplied.

Tighten bolts gradually in rotation according as shown in Figure D1-2.

16. Standing clear of the end cap allow the main to pressurise and check for any signs of leakage using a testing solution.

Ductile Iron Self Anchored Joints.

Ductile iron mains may be encountered which when originally installed had mechanical self-locking end caps. The use of a self-locking end cap alone is unacceptable and all end caps other than those meeting the requirements stated in Section D1 must be provided with an external anchorage system.

Nominal Size	Nominal Pipe Diameter (mm)			Sealing Range (mm)		Torque Setting
	Steel	Ductile	Cast	Min	Max	N/M
3”/80 mm	88.9	98	96	88	99	30
4”/100 mm	114.3	118	122	113	124	30
5”/125 mm	139.7	NA	150	138	152	30
6”/150 mm	168.3	170	177	167	179	30
7”/175 mm	193.7	NA	205	192	207	30
8”/200 mm	219.1	222	232	217	234	30
9”/225 mm	244.5	NA	260	242	261	30
10”/300 mm	273.0	274	286	270	288	30
12”/300 mm	323.9	326	334	320	336	30

Table D1-1 – Sealing Range of 3” to 12” AVK Ltd Universal End Caps

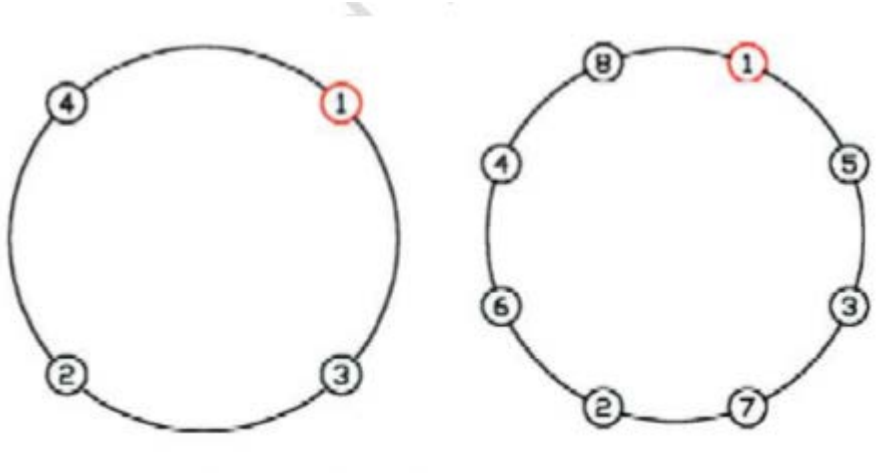


Figure D1- 2 Bolt Tightening Sequence 4 and 8 Bolts

D2 Cut Out Operations - Single or Three Trench Cut Out Operations

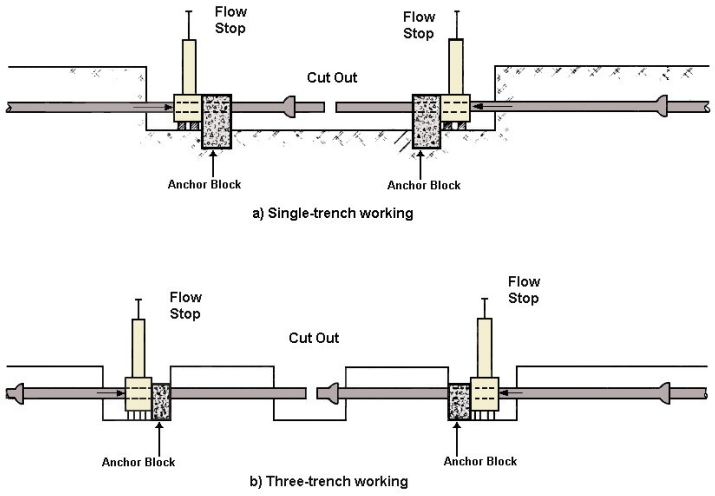


Figure D2- 1 Single and Three-hole Trench Cut-Outs

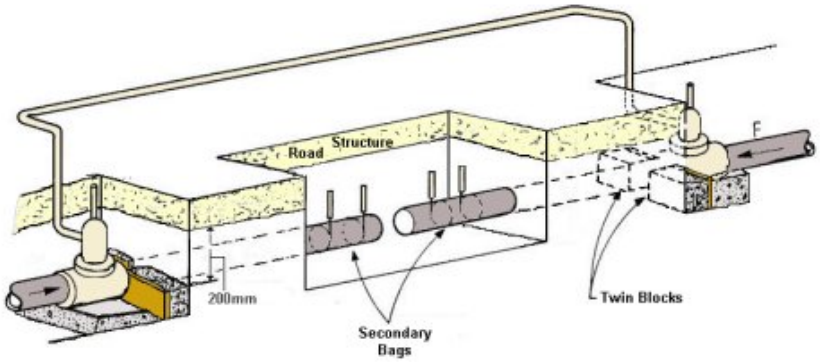


Figure D2 - 2 Three-hole Trench in Progress

Guidance Notes

Where practical, you use should be made of a three-hole system for cut out operations and this is especially true for Medium and Intermediate operations and all Iris, stopple and Large diameter operations. Three-hole systems have the following advantages:

- The soil between the trenches provides additional restraint.
- Vertical support is provided to the main, whilst work is being carried out.
- The effects of any accident are limited by isolating the three work sites from each other whilst allowing access to the stopping off equipment.

Always discuss with your Operation Manager to agree if a single or three-hole system is to be used. When Constructing Concrete blocks consider the following:

- Concrete must not encase valves, fittings, mechanical or lead joints within concrete.
- The main should be protected against corrosion and sleeve with PE pipe protected plastic sheeting.
- The block needs to be placed centrally to the fitting / pipe to prevent rotation of the block.
- The top of the block no nearer that 200 mm from the bottom of the road construction (if applicable).
- During frosty weather the newly formed concrete anchor block should be protected with dry sacking or straw.
- During hot weather a newly cast concrete anchor block should be protected with wet sacking or straw.
- Anchorage should be constructed on stable ground that will be able to support the mass of the block. If unsure of ground stability contact your Operational Manager for guidance.

- Concrete shall be allowed to cure to the minimum required strength before loading, for example removal of abandoned main at rear of anchor block or removal of any temporary anchorage. A minimum of 2 days (48 hours) must be allowed.
- The block thickness may be reduced only if the block incorporates structural reinforcement bars, but this would be a specialist design that your Operational Manager will provide.

In one trench working, the anchor block must be either:

a. set below the trench bed using the dimensions for each system given in Table B1-1, or
b. cut out are made into the side of the trench using the W dimension Figure A2-1, Figure A3-1 and Figure A4-1.

This will provide the restraining force required to prevent any movement of the block. The thickness of a block must be at least 50% of the block height (vertical dimension), with an absolute minimum thickness of 300 mm or or two times the diameter of the pipe whichever is the greater, for example 10”/250 mm diameter main requires a minimum 500 mm square block but taking a and b requirements above.

Ductile iron mains may be encountered which when originally installed had mechanical self-locking joints (Stanlock). The use of a self-locking joints alone is unacceptable, so when working within one excavation joints must be anchored.

For three-hole excavations the block can be supported by the end of trench, the dimension determined by your Operational Manager or from from Table B1-1 in Section B1.

Procedure for Single and Three Hole Operations

1. Refer to guidance notes and follow the requirements for cut out operations contained within SGN/PR/ML/2.
2. When your Operational Manager determines that anchorage is required within the excavation and will advise which system is required.
3. For temporary anchorage systems refer to Section A2, Section A3 and Section A4, for PE anchorage refer to Section C1 or Section C2 and for simple end cap anchorage Section D1.
4. If using the three hole method, refer to Section D4 to determine the the minimum undisturbed ground between excavations to be allowed for Iris Stopping and other Operations upto 2 bar.
5. For single hole operations first determine if mechanical or lead joints are within the excavation. If this is the case, then additional anchorage for these joints must be provided. Your Operational Manager will determine the size of concrete anchor block required for your situation based on the pressure in the pipe, the pipe diameter and the soil conditions.
6. Excavate for the anchorage at a point on the cut-out side of the stopping off equipment allowing enough room for shuttering for the required dimensions for the concrete block.
7. Obtain an adequate supply of concrete, sand and aggregate for a typical mix of 1: 2: 4 or use ready mixed concrete. Your Operational Manage will advise you.
   Note: The mix needs to be poured into the shuttering and carefully to avoid the movement of the shuttering.
8. Where required rapid hardener additives can be used to reduce the concrete setting and curing times.
9. Once the concrete has been hardened and cured the cut-out operation can be carried out in accordance with SGN mainlaying procedures.
10. Once the operation has been completed if the anchorage was only required for the anchorage of the cut-out operation the concrete must be broken up and removed from the excavations. Care must be taken when working near live gas apparatus.

D3 Pipe Clamping

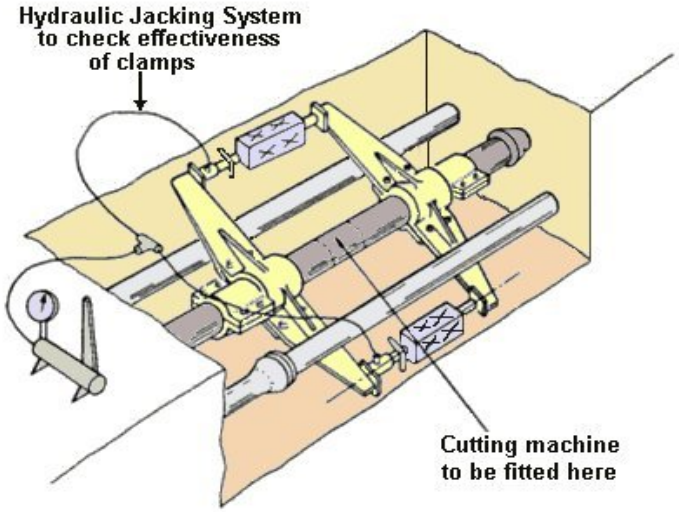


Figure D3-1 Steel Load Bearing Frame

Guidance Notes

When installing clamps information from the supplier / manufacturer must be followed. These clamps are used when cutting out a section of main and it is recommended that they are installed in an excavation separate to the Flow stop equipment.

Procedure Steel Frame

1. Carefully clean the surface of main where the clamp is to be fitted.
2. Initially tape the urethane rubber liner to the main, here the main is to be clamped.
3. Split sleeves of the appropriate size are fitted within the yoke assemblies.
4. The Yoke assemblies are then fitted over the liners one to each side of the cut-out location.

The Yoke assemblies can be fitted at any required angle to the horizontal but aligned with each other.

5. Torque the bolts on the assemblies to the predefined levels see Appendix D - Use of the SGN torque wrench current supplied.
6. Fit screw props between the yokes [to take up the slack].
7. Apply hydraulic load to the required setting from the chart supplied with the equipment.
8. If the load is applied to the pipe without slippage then the system is ready to use. If not release the loading and reset or tighten the equipment.
9. Proceed with the cut out in the normal manner
10. Once the work has been completed, and the end caps fitted, a permanent concrete anchor block can be installed, or use made of a steel strut, your Operational Manager will advise you what is required.
11. Once any concrete used has fully cured the clamp can be removed.

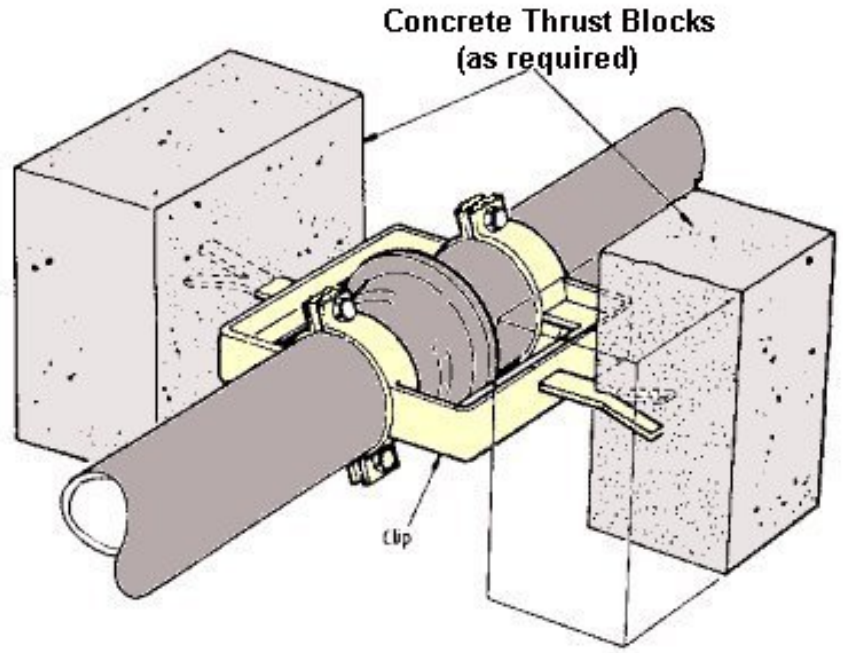


Figure D3-2 Pipe Clamp and Anchor Block

Procedure for Clamp

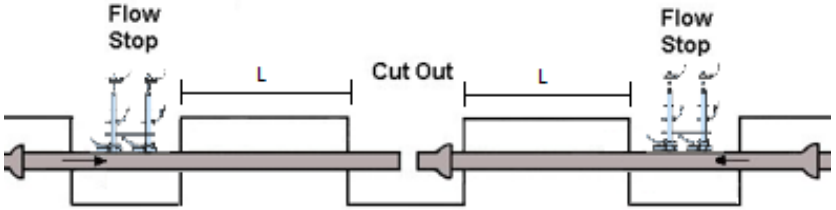
1. Excavate either side of the main for the dimensions of the concrete anchor blocks as specified to you.
2. Install the shuttering for the concrete blocks.
3. Carefully clean the surface of main where the clamp is to be fitted.
4. Make sure that the clamp has been protected against corrosion.
5. Assemble the clamp around the main making sure that the anchor bars for the concrete blocks are aligned correctly.
6. Using the procedure for constructing concrete blocks BX mix and pour the concrete into the prepared shuttering locations either side of the main.
7. Allow the concrete to cure.
8. Once the curing has taken place the cut-out operation can proceed.

The concrete block may be removed but only if alternative anchorage is in place or the anchorage is no longer required.

D 4 Unsupported Ground

Guidance Notes

Table D4-1 gives guidance where restraint is to be provided during iris stop and other flow stop operations using ground resistance to prevent movement of undisturbed buried pipe. If this technique is used during cut-out operations, anchor blocks will not be required, although any exposed pipe must be supported. For other operations up to 2 bar see Table D4-2 for the minimum undisturbed ground between excavations to be allowed.

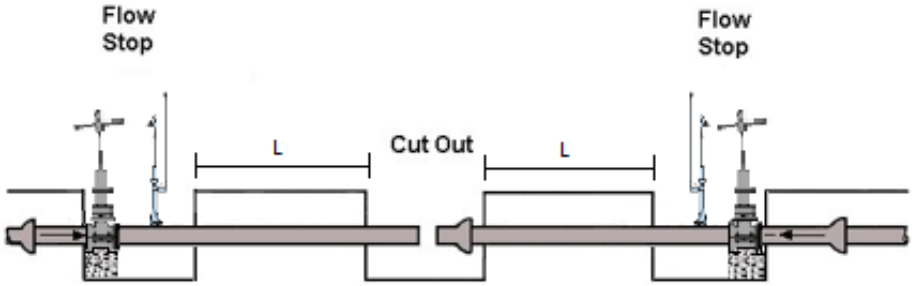


Pipe Diameter	Maximum Pressure During Iris Stop	Minimum Length (L) of Undisturbed Buried Pipe to provide restraint during Iris Stop Operation
4”/100 mm	1.0 Bar	1.7 m
6”/150 mm	1.0 Bar	2.8 m
8”/200 mm	1.0 Bar	3.6 m
10”/300 mm	1.0 Bar	4.4 m
12”/300 mm	0.850 Bar	4.4 m
15”/375 mm	0.600 Bar	3.7 m
18”/450 mm	0.350 Bar	2.4 m
24”/600 mm	0.350 Bar	2.9 m
30”/750 mm	0.100 Bar	1.0 m
36”/900 mm	0.070 Bar	0.8 m
42”/1050 mm	0.035 Bar	0.4 m
48”/1200 mm	0.035 Bar	0.3 m
Note: A minimum depth of cover of 600 mm has been assumed		

Table D4- 1 – Minimum Undisturbed Ground on Iris Stop Operations

Use the guidance notes to determine if the site of the works has the available ground to allow the use the undisturbed ground rather than anchorage.

These distances are the minimum distances required and must not be reduced unless other means of anchorage is provided.



Pipe Diameter	Minimum Length (L) of Undisturbed Buried Pipe to Provide Restraint During Cut-out Operation
4”/100 mm	1.7 m
6”/150 mm	2.8 m
8”/200 mm	3.6 m
10”/300 mm	4.4 m
12”/300 mm	5.1 m
15”/375 mm	6.3 m
18”/450 mm	7.0 m
24”/600 mm	8.4 m
30”/750 mm	7.8 m
36”/900 mm	10.9 m
42”/1050 mm	11.6 m
48”/1200 mm	14.3 m
Note: A minimum depth of cover of 600 mm has been assumed	

Table D4-2 – Minimum Undisturbed Ground on Cut-Out Operations With an Operating Pressure of 2 bar.

D 5 Other situations

Guidance Notes

There will be situations where placing struts between end caps will be the most suitable solution for temporary Anchorage. In some cases, at a later stage this type of anchorage can be converted to permanent anchorage see Section B3.

Installation of Steel Trench struts/Props

Adjustable steel struts/Props must only be used at the instruction of the Operational Manager. The struts selected must be suitable for the restraining the force required, check with your Operational Manager and the supplier to verify the maximum load for the struts/Props.

Adjustable steel trench struts are available are normally designed for use with timber waling's and are available in 4 sizes, ranging from 0.32 m to 1.73 m long, with a load capacity of 20 KN. Table D5-1 below details the generic sizes and maximum/minimum adjustable lengths and maximum load capacity.

Trench Struts	Lengths (m)		Maximum Load Capacity (kN)*
	Closed (Min)	Open (Max)	
No. 0 Strut	0.32	0.47	20 kN
No. 1 Strut	0.49	0.73	
No. 2 Strut	0.69	1.09	
No. 3 Strut	1.03	1.73	

Table D5-1 Generic Trench Strut Limits

Steel trench struts should be used, but where they cannot then adjustable steel props can be used instead. These come in 6 sizes from 1.04 m to 6.1m, again with a maximum load capacity of 20 kN. Table D5-2 below details the generic sizes and maximum/minimum adjustable lengths and maximum load capacity.

Steel Prop	Lengths		Maximum Load Capacity (kN)*
	Closed (Min)	Open (Max)	
No. 0 Strut	1040	1700	20
No. 1 Strut	1750	2250	20
No. 2 Strut	1980	2250	20
No. 3 Strut	2590	3960	If used below 20 kN consult Manufacturer literature.
No. 4 Strut	3200	4880	
No. 5 Strut	3650	6100	
If using above 20 kN consider using 2 props and consult manufacturers Literature			

Table D5-2 Generic Prop Limits

*You should check with your supplier the maximum load capacity of any strut/prop. SGN applies a 1.5 factor of safety to the maximum loading for both struts and props.

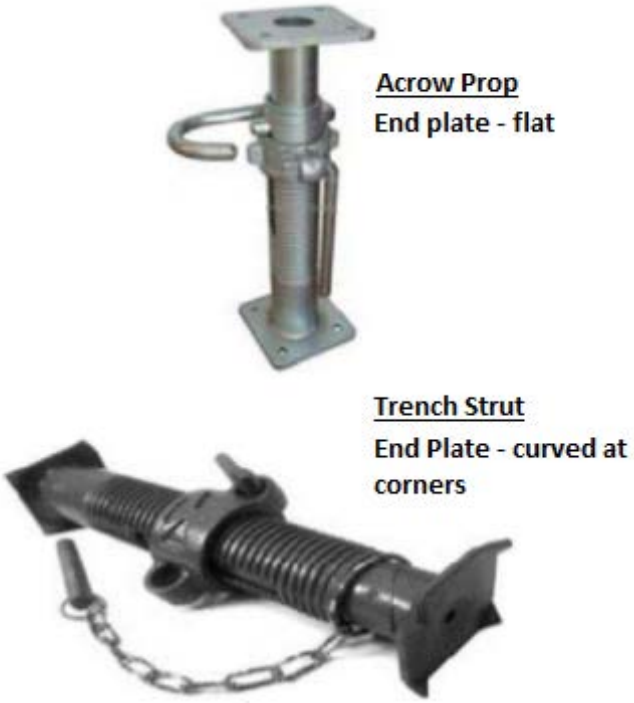


Figure D5-1 Acrow and Trench Recognition

The follow checks must be made before use, ensure:

- the inner and outer tubes are straight, telescope easily and are in good condition
- the pin, attached to the prop by a chain, is in good condition.
- struts are supported, from the trench bed or from the ground surface.
- struts end plates cannot move laterally.
- that end plate corners are bent over for maximum grip on timbers beams, or secure struts to timber with nails.

Where struts are used at the end of a trench, the end face of the trench must be vertical and shored with timber or steel plates over a minimum width of 500 mm.

If shoring is timber, the cross section of vertical timbers should be like the transverse beam - see Table A5-1 in Section A5, or your Operational Manager will provide the dimension.

The minimum shored area required must be based on the face areas determined from Table B1-1.

Care must be taken to ensure that any apparatus buried within the trench bed or behind vertical shoring is not damaged or put under excess force. The bed and/or end of the trench should be surveyed with CAT and Genny prior to installing any lateral restraint.

Struts should be used to react forces in line with the direction of thrust only and should be central and perpendicular to timber/steel shoring to ensure the thrust force is spread evenly.

If an offset arrangement is unavoidable, for example bends you must contact your Operational Manager.

Procedure for using a single steel strut.

1. Check guidance notes and prepare the trench to accommodate the either steel trench sheets or timber beams according to what is going to be supplied to you.
2. After main has been cut and capped install trench sheeting or wooden beams at the opposite end of the trench to the cap as shown Figure D5-2. If the distance is greater than 1.7 metres it is recommended that two steel struts are used see Figure D5-2.
3. Install the strut centrally on the cap timber pad and align both horizontally and vertically to the far trench end onto the sheeting or beam.
4. Where steel trench sheets are used the strut should bear against a wooden pad. Similarly, at the end cap a wooden pad must be installed.
5. Use pegs or pins and wedges to help keep the strut in place
   Note: Ensure Cat and Genny sweep has been completed.

6. Tighten the strut fully and check that all is secure.
7. With no persons in the trench, slowly pressurise the end caps.
8. Once pressurised, leakage testing must be completed by standing to the side or behind the end cap.
9. Install permanent anchorage in accordance with Section B3.

Under no circumstances should you stand in front of the end cap.

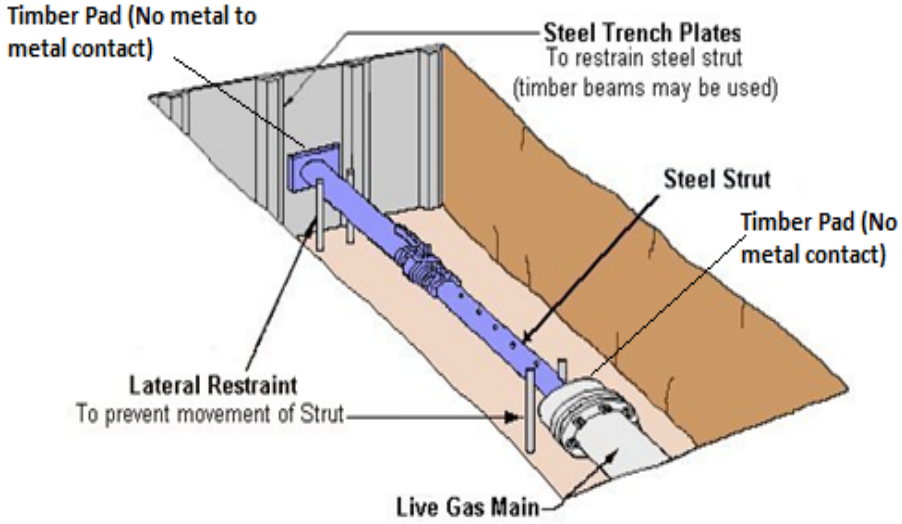


Figure D5 - 2 Arrangement for Using a Single Steel Strut

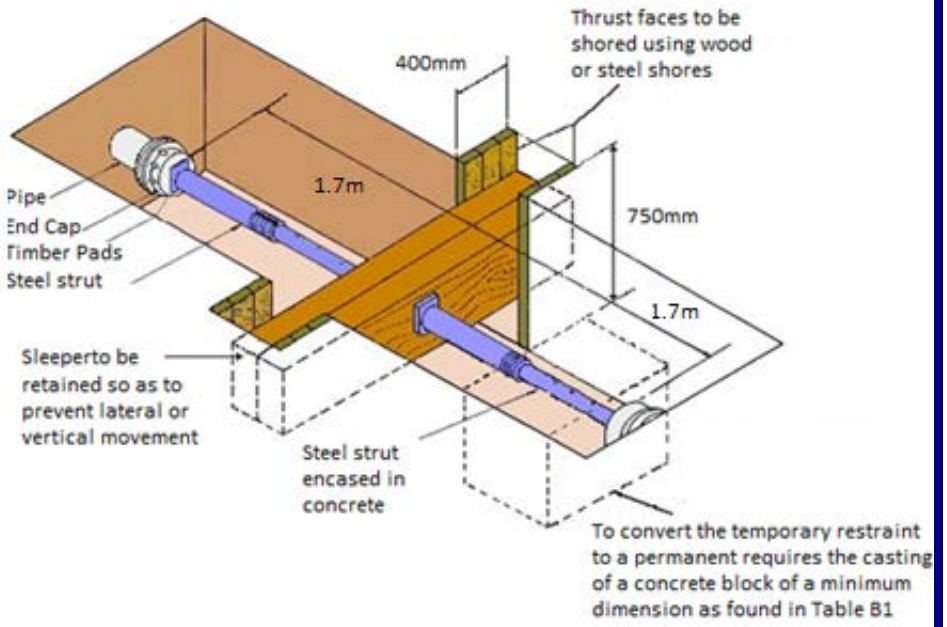


Figure D5 - 3 Arrangement for Using Two Steel Struts

Procedure for using two steel struts.

1. Check guidance notes and prepare the trench to accommodate either a central steel or timber beam (s) according to what is going to be supplied to you.
   Note: You will need to consider the need to close shutter the upstream and downstream sides of the cut-out area. This will vary according to pressure and diameter of the gas main see advice for temporary anchorage in section B. Your Operational Manager will advise you.
2. After main has been cut and capped install a steel or wooden beam as required into the cut out already constructed see Figure D5-2.

3. Secure the beam in place.
4. Where steel trench sheets are used the strut should bear against a wooden pad. Similarly, at the end cap a wooden pad must be installed.

5. Install the strut centrally on the cap and align both horizontally and vertically to beam. Use pegs or pins and wedges to help keep the strut in place.
6. Tighten the strut fully and check that all is secure.
7. Repeat the process if two caps are to be secured in this manner.
8. Remove personnel from the trench.
9. With no persons in the trench, slowly pressurise the end caps.

10. Once pressurised, leakage testing must be completed by standing to the side or behind the end cap. ***Under no circumstances should you stand in front of the end cap***.
11. Install permanent anchorage in accordance with Section B3.

Procedure for Using Two steel Struts Cap to Cap.

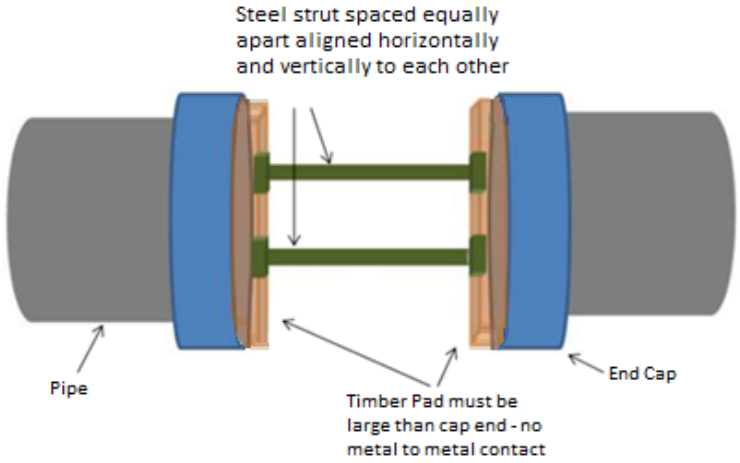


Figure D5-4 Arrange for Using Two Steel Struts Cap to Cap

1. Check guidance notes and prepare the trench to accommodate installation of Cap to Cap, ensuring that the distance between cap is between 0.32 – 1.73 m – see Table D5-1.
2. After the main has been cut and capped, install timber pads and steel struts against the caps.
3. Tighten the struts fully and check that all is secure.
4. Remove all personnel from the excavation.
5. With no persons in the trench, slowly pressurise the end caps.
6. Once pressurised, leakage testing must be completed by standing to the side or behind the end cap. ***Under no circumstances should you stand in front of the end cap.***
7. Install permanent anchorage in accordance with Section B3.

E1 Working Near to SGN Plant

Guidance Notes

When excavating on to buried pipes care must be taken to ensure existing anchor blocks or their supporting ground are not disturbed, unless proper precautions have been taken to restrain pressure and loads created by temperature change.

Failure due to inadequate anchorage may result in:

- Fitting and debris flying through air causing fatality /injuries and/or property damage.
  High Volume Gas Escapes (potential gas ingress into buildings, ignition of gas, closure of road / rail / flight routes).
- Loss of supply
- Damage to adjacent exposed services
- Equipment damage

If, whilst excavating on to existing plant, the need for installation or upgrading of anchorage becomes apparent, this work must be carried out before any excavation work continues. Contact your Operational Manager who will advise on the work required.

The assumption should be made that the anchorage is not adequate unless there is evidence to confirm otherwise.

DO NOT

- Remove concrete from around pipes and fittings
- Remove ground supporting anchor blocks or mass concrete
- Remove any steel spikes or wooden stakes which may have been installed as anchorage, whilst these are not acceptable as anchorage removing them will increase the danger.
- Assume that circlips, which in some cases were installed on ductile iron systems, are suitable to restrain and or anchor the joints. Reliance on these systems must not be made and alternative anchorage applied.
- Assume that bolts on flanged fittings are secure and fit for purpose. The bolts may have corroded since original installation.

DO

- Check that pipes and fittings including couplings (particularly medium and intermediate pressure systems) have anchorage in place (but DO NOT remove or disturb existing anchorage).
- Check the size of anchorage and use this procedure and discuss with your Operational Manager to determine if it is adequate.
- Provide an alternative system of anchorage before removing any existing anchorage.
- Consider the need to reduce pressure to allow safe working practice.

Consider the need to provide anchorage when none is present but is required. Contact you Operational Manager so that suitable anchorage can be installed.

E2 Working Near to other Utilities plant

Guidance Notes

Anchorage will frequently be installed on water mains, oil pipelines pressurised sewers, and you may also uncover other company's gas supply pipes including the National Grid Transmission pipelines.

Make use of maps, plans, pipe and cable locating devices to help identify the location of other plant and equipment.

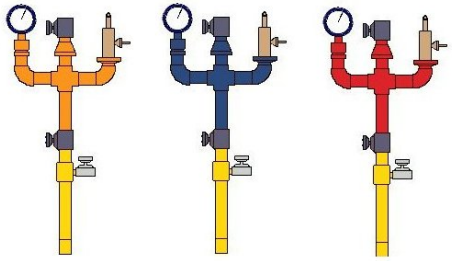
Use the general advice given in Section E1 but where other utilities plant is concerned contact should be made with the owner and their advice should be obtained as soon as a problem is identified.

Concrete near other plant may have been provided to protect the apparatus and to act as anchorage. Cables and pipes may be buried within the concrete or only just below it.

You should also follow the advice in additional reference material to: -

- HSE Guidance Note; HSG47 "Avoiding Danger from Underground Services"
- NJUG "Utilities Guidance on Positioning and Colour Coding of Apparatus"

E3 Pressure Testing



Guidance Notes on Anchorage when testing Mains and Services

Flexible fittings / joints [compression end caps] must not be used on sections of pipe systems under pressure test. However, where blanked open valves or flanged joints form the end cap of a test section then anchorage of these fittings must be provided.

The Testing requirements for pipe systems are stated in SGN/WI/ML/2- Work Instruction for Mainlaying up to and including 630 mm diameter at Pressures up to and including 7 bar must be followed. The purpose of testing is to confirm the integrity of the pipe system. Whilst preparing, during and de-pressurising the test pressure, it must be assumed that the pipe work could fail suddenly this equally applies to PE systems.

- Personnel must not enter any excavation whilst a pipework remains under test pressure or is being pressurised / de-pressurised.
- Personnel must not attempt to adjust anchorage whilst pipework is pressurised or is being pressurised / de-pressurised.
- Personnel must not attempt to adjust pressurised pipework or fittings which are suspected of movement.
- Designs for anchorage MUST consider the correct pressure, for example if testing then the full test pressure and not the operating pressure must have been used.
- All anchor blocks must be completely backfilled before any pressure testing commences.
- As much pipe as possible of open cut sections of pressurised pipework should be backfilled.
- Where an excavation contains mains under pressure, and a temporary anchorage system has been constructed, the excavation should be temporarily backfilled to prevent unauthorised interference.
- Pipe ends should be below ground during pressure tests to minimise the risk of injury in the event of a pipe end failure. If this is not practicable, a site-specific risk assessment must be undertaken and recorded, and adequate controls must be applied to prevent injury to site personnel and the public.
- Where above ground pipe work is to be pressure tested, a protective barrier must be used [e.g. Heras type fencing, as a minimum] and the pipe ends must be restrained.
- End caps used on temporary installations or for testing must be fusion fittings or blank flange PECAT [fused] fittings.
- Work areas must be correctly barriered to protect the public and workers onsite and where required by the Work Procedures SGN/WI/ML/2 “mains under test” signs must be displayed.
- The full number of appropriate studs or bolts provided for pipe flanges and under pressure-drilling equipment must always be used. Any studs or bolts with worn or damaged threads must be replaced.
- Mains/pipes must not be subjected to any form of shock loading or work of any description whilst a pressure test is ongoing.

Where temporary anchorage is to be dismantled following a pressure test or mains operation, care must be taken to ensure the system is fully depressurised before dismantling commences

E4 Inspection of Anchorage Systems

Guidance Notes for Inspections

The team leader on site is responsible for undertaking visual inspections of anchorage and trench support systems at frequent intervals to confirm that all anchorages, thrust and other restraints are secure and that no hazard exists.

As a minimum, inspections should be made at the start and end of operations each day or when any activity has been carried out which may affect the anchorage system. In some cases, it may always be appropriate to maintain a presence on site to minimise the impact of failure of these systems. In all cases your Operational Manager will advise you of the inspection requirement on the Site-Specific Risk Assessment.

A typical inspection form for recording the results is shown in Appendix C.

Actions

Pipe or Anchorage Movement During Pressure Test

Where it is observed that pipework, fittings or anchorage has moved, then take the following actions: -

- Immediately contact your Operational Manager to make them aware of the situation, they will confirm if the test procedure is to be abandoned and if depressurisation is required.
- No person can be allowed to enter the excavation until the main has been safely de-pressurised before any action is taken to refit and retighten the fittings or anchorage.

Trench Support System or Trench Movement.

If it is observed that the trench or the trench support system is collapsing or has collapsed and that it will potentially affect any of the following: -

- the main
- the anchorage system,
- any services or utility
- Cause a hazard above ground.

Then the test must be abandoned and the main safely de-pressurised before any action is taken to refit the trench support system. No person can be allowed to enter the excavation until the main has been safely de-pressurised.

Where it is identified that the movement will not cause a hazard and that the area surrounding the excavation is secure then the test can remain in place. Consideration must be given to additional inspections to ensure that further deterioration can be identified.

Appendix A References and Definitions

This Work Instruction refers to the documents listed below

A.1 Internal Documents

SGN/WI/ML/2	-	Work Instruction for Mainlaying up to and Including 630 mm Diameter at Pressures up to and Including 7 bar
GDN/PM/SCO/1	-	Management Procedure for Safe Control of Operations.
GDN/PM/SCO/4	-	Management Procedure for the Safe Control of Operations – The Control of Non-Routine Gas Supply Operation.
GDN/PM/SCO/5	-	Management Procedure for the Safe Control of Operations – Control of Routine Gas Supply Operations.
SGN/PM/ECP2		Management Procedure for Cathodic protection of buried steel systems.

A.2 External Documents

BS 12 replaced by BS EN 197	-	Specification for ordinary and rapid-hardening of Portland Cement Cement. Composition, specifications and conformity criteria for common cements
BS 338	-	Structural timber. Strength classes
BS 4074:2000	-	Steel trench Struts
BS 5930	-	Code of practice for site investigations
BS 8110 replaced by BS EN 1992	-	Structural use of concrete: Part 1 – Code of practice for design and construction Part 2 – Code of practice for special circumstances Part 3 – design charts for singly reinforced beams, doubly reinforced beams and rectangular columns
BS EN 1065:19989	-	Adjustable telescopic steel props Ð Product specifications, design and assessment by calculation and tests
BS EN 12620:2002+A1:2008	-	Specification for aggregates from natural sources for concrete Aggregates for concrete

Replaces BS 882BS 882		
EN 10210-2	-	Hot finished structural hollow sections of non-alloy and fine grain steels. Tolerances, dimensions and sectional properties
EN 13145	-	Railway applications. Track. Wood railway sleepers and bearers

A.3 Reports and other material used in the development of this work instruction

ERS R 4009	British Gas Engineering Research Station report dated August 1988 – Design guide for methods of restraining longitudinal thrusts on pipe and fittings during and after connections – Authors – P Hunter and R C Owen
Advantica R5356	Advantica report dated July 2002 – Restraint loads for temporary and permanent mains anchorage
AESL - RP2697	Advanced Engineering Solutions reports dated Nov 2008 – Assessment of methods for the design of pipe end restraints – Author - I Martin
AESL - RP 2898	Advanced Engineering Solutions reports dated March 2009 – Assessment of simplified methods of designs for thrust restraint – Authors – I Martin and I Bell.
CIRIA report R128	Guide to the Design of Thrust Blocks for Buried Pressure Pipelines.
Excel calculator for end restraint	Excel spreadsheet for the determination of end restraint on pipes dated October 2008 - Author - P R Pearson

A.4 The definitions applying to this Work Instruction are given below

Anchor	-	A means to isolate movement of a pipe or fittings in all three planes.
End-loaded device	-	A fitting that contains a combination of properties and component and joint design such that under any load condition the pipe will fail before the fitting.
Floatation	-	A condition whereby the pipe becomes buoyant
Force	-	A power put in motion
Operational Manager	-	Managers Undertaking Work Duties in the role of Operational Managers or Team Managers (First Line)

Prop	-	Two tubes (an inner and outer tube) which are normally used as horizontal support for building or civil Engineering work. They contain a simple screw mechanism to allow adjustment of total length. At the ends of the prop are flat these end plates are used for securing the prop.
Restraint	-	A means to isolate movement of pipe or fittings in two planes and allowing movement in the remaining third plane.
SDR	-	Standard Dimension Ratio - numerical designation of a pipe series, approximately equal to the dimension ratio of the nominal outside diameter, and the nominal wall thickness.
Shore	-	Timber or other material used as a temporary prop for excavations or buildings; may be sloping, vertical, or horizontal.
Strut	-	Two tubes (an inner and outer tube) which are normally used as horizontal support for building or civil Engineering work. They contain a simple screw mechanism to allow adjustment of total length. At one end a claw plate is provided which is used to grip a timber member. Normally used in the Horizontal plane.
Technical Services Contract	-	A contract made by SGN with outside agencies for professional expert advice. These contracts are call off contracts for individual projects and costs are charged to each project.
Thrust	-	The force or pressure of one part of a construction against other parts
Transverse beam	-	A horizontally supported crosswise piece of timber used for restraining an end cap
Young’s Modulus	-	Is a measure of the stiffness of a given material. It is defined as the ratio, for small strains, of the rate of change of stress with strain. The Young's modulus allows the behaviour of a material under load to be calculated.

Appendix B Pressure Thrust Force Chart

TABLE B.1 - PRESSURE THRUST FORCE (KN) FOR TYPICAL PIPE SIZES AT RELEVANT PRESSURES

Nominal Mains Diameter	LP (LP and Test Pressure)						MP (MP and Test Pressure)				IP (IP and Test Pressure)		
	30 mbar	40 mbar	75 mbar	140 mbar	200 mbar	350 mbar	1 bar	1.4 bar	2 bar	3 bar	4 bar	7 bar	10 bar
3 inch/75 mm	0.04	0.05	0.08	0.15	0.21	0.37	1.1	1.5	2.1	3.2	4.2	7.3	11
4 inch/100 mm	0.05	0.07	0.12	0.22	0.32	0.6	1.6	2.2	3.2	4.7	6.3	11	16
5 inch/125 mm	0.07	0.09	0.17	0.32	0.45	0.8	2.3	3.2	4.5	6.8	9.0	16	23
6 inch/150 mm	0.10	0.13	0.23	0.43	0.7	1.1	3.1	4.3	6.1	9.2	13	22	31
7 inch/175 mm	0.12	0.16	0.30	0.6	0.8	1.4	4.0	5.6	7.9	12	16	28	40
8 inch/200 mm	0.15	0.20	0.38	0.7	1.0	1.8	5.0	7.0	10.0	15	20	35	50
9 inch/225 mm	0.19	0.25	0.46	0.9	1.3	2.2	6.1	8.6	13	19	25	43	
10 inch/250 mm	0.22	0.30	0.6	1.1	1.5	2.6	7.4	11	15	22	30	52	
12 inch/300 mm	0.32	0.42	0.8	1.5	2.1	3.7	11	15	21	32	42		
14 inch/350 mm	0.42	0.6	1.1	2.0	2.8	4.9	14	20	28	42	56		
15 inch/375 mm	0.47	0.7	1.2	2.2	3.2	5.5	16	22	32	47			
16 inch/400 mm	0.6	0.8	1.4	2.5	3.6	6.2	18	25	36	53			
18 inch/450 mm	0.7	0.9	1.7	3.1	4.5	7.8	23	31	45				
20 inch/500 mm	0.8	1.1	2.0	3.8	5.4	9.4	27	38	54				
21 inch/525 mm	0.9	1.2	2.2	4.1	5.9	11	30	41	59				
22 inch/550 mm	1.0	1.3	2.4	4.5	6.4	12	32	45					
24 inch/600 mm	1.2	1.5	2.8	5.3	7.5	14	38	53					
26 inch/650 mm	1.3	1.8	3.3	6.1	8.7	16	44						
27 inch/675 mm	1.4	1.9	3.5	6.6	9.3	17	47						
28 inch/700 mm	1.5	2.0	3.8	7.0	10.0	18	50						
30 inch/750 mm	1.7	2.3	4.3	8.0	12	20	57						
32 inch/800 mm	2.0	2.6	4.8	9.0	13	23							
33 inch/825 mm	2.1	2.8	5.1	9.5	14	24							
36 inch/900 mm	2.4	3.2	6.0	12	16	28							
38 inch/950 mm	2.7	3.6	6.7	13	18	31							
40 inch/1000 mm	3.0	3.9	7.3	14	20	35							
42 inch/1050 mm	3.2	4.3	8.0	15	22	38							
44 inch/1100 mm	3.5	4.7	8.8	17	24	41							
46 inch/1150 mm	3.9	5.1	9.6	18	26	45							
48 inch/1200 mm	4.2	5.5	11	20	28	49							

Key:

All Systems up to 0.1 kN Thrust:
No Anchor Block is Required

All Systems 0.1 to 10.0 kN Thrust:
System Type 1) - see Section A2

All Systems 10.1 kN to 30 kN Thrust:
System Type 2) – see Section A3

All Systems 31 kN to 60 kN Thrust:
System Type 3) – see Section A4

All Systems over 60 kN Thrust:
Refer for Operational Manager

Appendix C Inspection Form

This inspection sheet should be used where temporary anchorage has been installed and other suitable inspection forms are not available. It assumes that the design of the system has been carried out in accordance with Management Procedure SGN/PM/ANC/4.2.

LOCATION:	SIZE OF MAIN	PRESSURE IN MAIN	IS MAIN UNDER TEST?	IF MAIN UNDER TEST DURATION OF TEST	IS THE OPERATION A CUT-OUT?
			YES / NO		**YES / NO**

Type of Anchorage System used (Tick box)			
	Wooden Railway sleeper / Wooden Beam ☐	Concrete Block ☐	
	Rectangular Hollow Section ☐	Other e.g. Pipe clamps ☐	

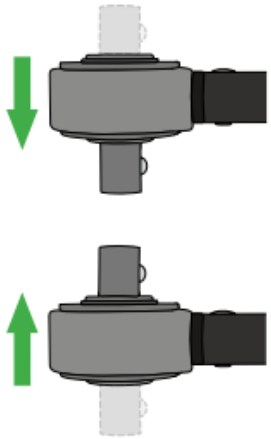
	ITEM	INSPECTION				ITEM	INSPECTION		
		1ST	**2ND**	**3RD**			**1ST**	**2ND**	**3RD**
1	Is there heavy traffic adjacent to the works site, e.g. heavy lorries and buses or high numbers of cars and vans?				**7**	Are all PE fittings securely anchored?			
2	Are there any piling or other activities ongoing near the site which may affect the anchorage system?				**8**	Are non-end loaded fittings used on a PE pipe system			
3	Do any Prop, Strut, Shore, Acrow etc show any signs of movement?				**9**	Are there exposed bends in the excavation connected to the pressurised pipe work?			
4	Is there water in the excavation?				**10**	Are exposed bends adequately anchored?			
5	Do any beams, wedges etc show any signs of becoming dislodged?				**11**	Is there any movement of the pipe or fittings?			
6	Has any of the trench support system collapsed and /or moved?				**12**	Has the pressure in the main decreased or increased since the last inspection?			

Enter date of Inspections 1st …… 2nd …… 3rd ……

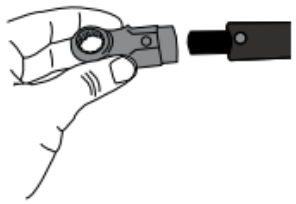
Inspection completed by (Name) ……. **Signed …….**

Appendix D Use of a Torque Wrench

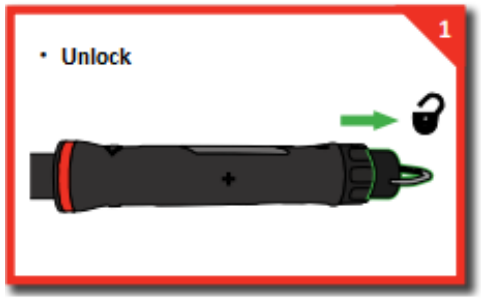
- Ratchet

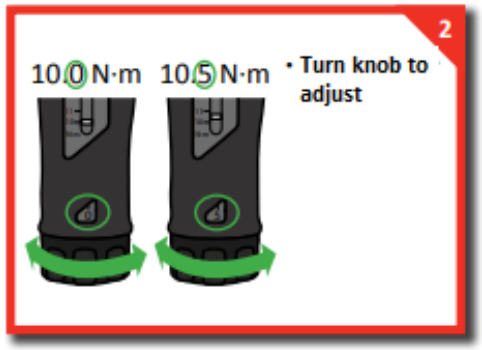


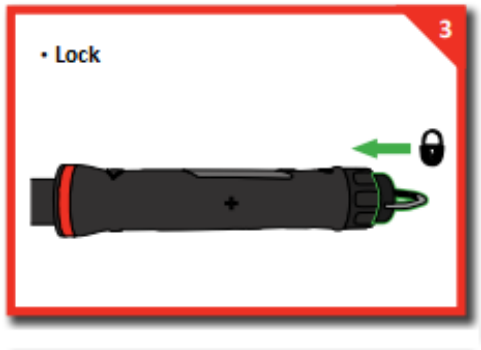
- Spigot End

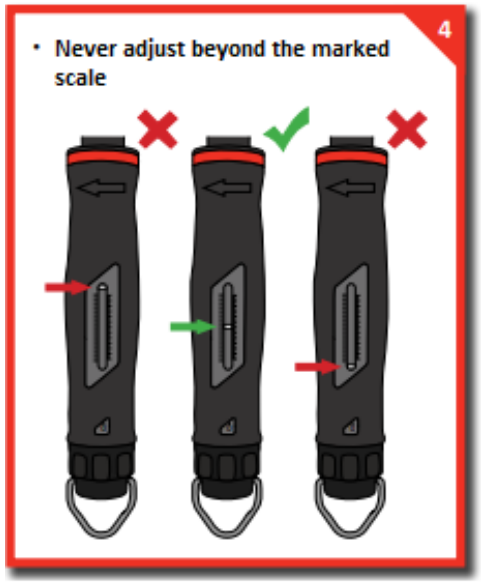


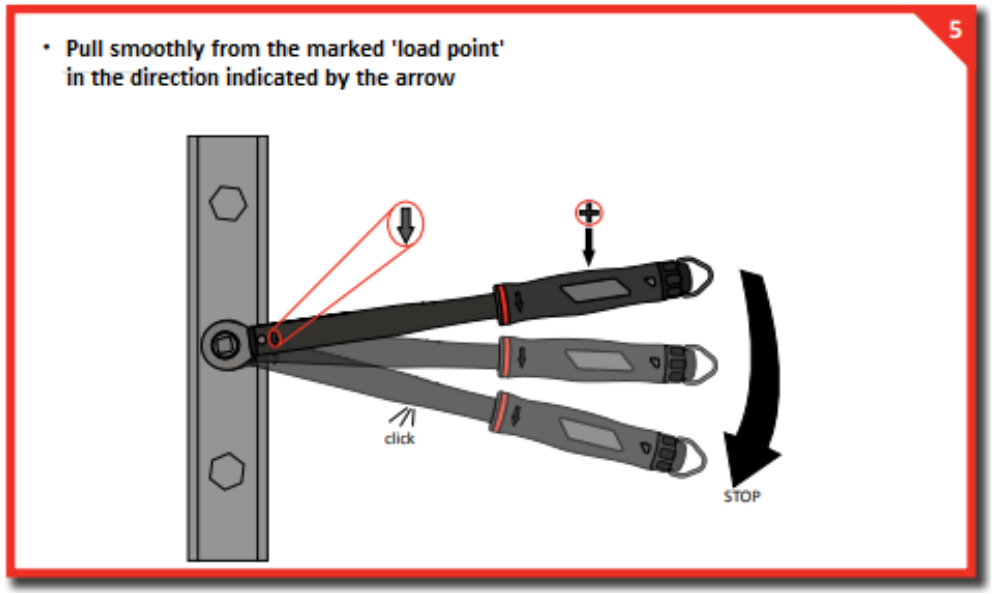
- Female Torque Handle











APPROVAL

This Work Instruction was approved by Bob Hipkiss on 17th December 2019 for use by managers, engineers and supervisors throughout SGN.

SGN documents are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition by referring to the SHE and Engineering Document Library available on Digital Hub.

Compliance with this safety and engineering document does not confer immunity from prosecution for breach of statutory or other legal obligations.

BRIEF HISTORY

First published as SGN/WI/DIS/4.2.2	November 2012	DESC-117-8062012
Editorial updates to reflect inspection audit findings in 2018	December 2019	DESC-2181-16052019

KEY CHANGES

Section	Amendments
All sections	Tables, text, figures, pitchers and references updated
Scope	Made it clear that scope of the Work Instruction only covers model designs up to 60 kN.
Guidance Notes	Updated guidance notes and included roles and responsibilities section.
Guidance Notes	Text updated and clearly stated when anchorage is needed and when it is not.
Section A1	New text section - Guidance on Model designs.
Section A2	Model temporary design for up to 10 kN – rationalised design that fits anything 10 kN or below.
Section A3	Model temporary design for up to 30 kN – rationalised design that fits anything 30 kN or below.

Section A4	Model temporary design for up to 60 kN – rationalised design that fits anything 60 kN or below.
Section B1	Permanent block size requirement for three model designs detailed in Section A2, A3 and A4.
Section B2	Removed detail on permanent anchorage on gradients and at bends and referenced to manager to provide detailed requirements.
Section B3	Updated figures and made it clear that when converting Temporary Anchorage to Permanent that Steel beams/acrows should be used .
Section C2	New approval for Steve Vick Anchorage plates into Table.
Section D1	Updated requirement for torque wrench use – range of AVK end cap extended from 8” to 12”.
Section D2	Made it clear that in on trench working requirement permanent block to be set below or dug into the side of the excavation.
Appendix A	Updated references
Appendix B	Updated Table to show only up to 60 kN
Appendix D	New section on the use of the Norbar Torque wrench

DISCLAIMER

This safety and engineering document is provided for use by SGN and such of its contractors as are obliged by the terms and conditions of their contracts to comply with this document. Where this document is used by any other party it is the responsibility of that party to ensure that this document is correctly applied.

MANDATORY AND NON-MANDATORY REQUIREMENTS

In this document:

must: Indicates a mandatory requirement.

should: indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment must be completed to show that the alternative method delivers the same, or better, level of protection.

END NOTE

Comments

Comments and queries regarding the technical content of this safety and engineering document should be directed to The SHE and Engineering Registrar at: **engineering.registrar@sgn.co.uk**

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