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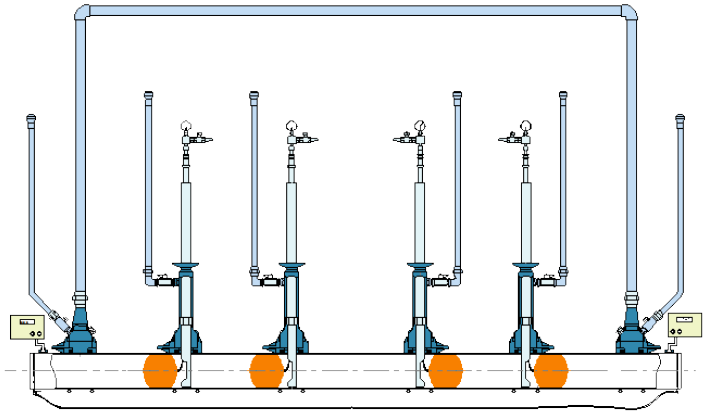
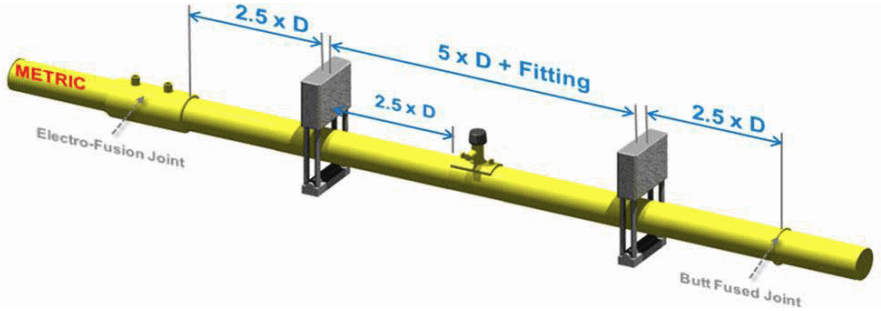
SGN/WI/ML/2

SAFETY MANAGEMENT FRAMEWORK

Work Instruction for Mainlaying up to and including 630mm diameter at Pressures up to and including 7 bar.





Work Instruction for Mainlaying up to and including 630mm diameter at Pressures up to and including 7 bar.

SGN/WI/ML/2

Document Owner: Bob Hipkiss

Context

Who is this Work Instruction for?
This work instruction is for operatives qualified to GNO Level 2 minimum and managers who are involved in the construction, testing, commissioning and decommissioning of mains at an operating pressure of up to and including 7 bar, who have received training and been assessed competent.

What does this Work Instruction do?
This work instruction provides instruction on how to install mains operating up to and including 7 bar.

Scope
This work instruction covers all mains work up to and including 7 bar operating pressure.

Note: Some activities may need to be undertaken by specialist contractors who have the necessary equipment for large diameter mains, such as squeeze off above 400 mm diameter.

Why do we need this Work Instruction?
To support the safe and consistent installation of gas mains.

Using links in this document

This document uses links (Hot Links) to Figures, Tables, other parts of the document and links to other SGN documents. These links can be identified within the text by text shown "example", to use the link place the cursor over the blue underlined text and left click, you will then be sent to either the Figure, Table, other part of this document or other documents selected. Returning to your place in the original document is achieved by clicking on an icon in the toolbar at the top of the document. (see below).

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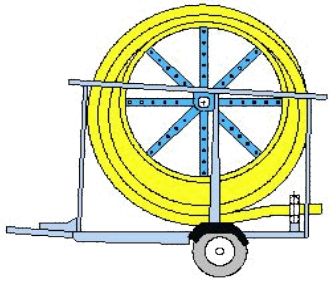
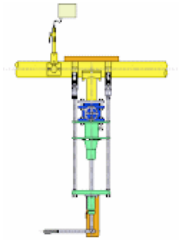
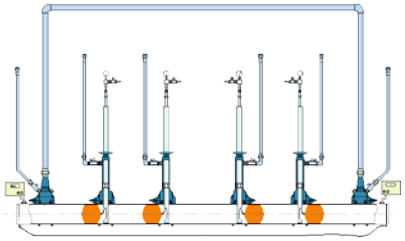
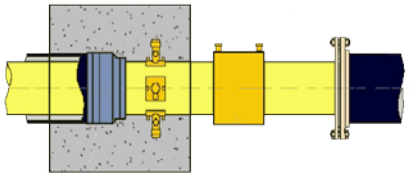
Work Instruction for Mainlaying - Overview



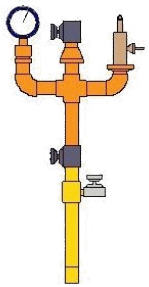
Site Setup		PE Pipelaying		Steel Pipelaying	
A1	Site setup	B1	PE Mainlaying General requirements	C1	Steel Pipe mainlaying by open cut
		B2	Dead Insertion		
		B3	PE Mainlaying by Live Insertion up to and including 180 mm.		
		B4	PE Mainlaying by Live Insertion greater than 180 mm.		
		B5	Impact Moling		
		B6	Open Cut Mainlaying		

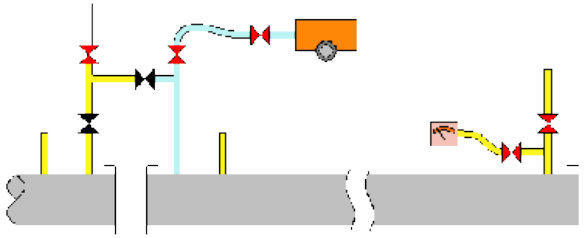






Connections		Flow Stopping		Anchorage	
D1	Under Pressure Tee metallic	E0	Flow stopping - General	F1	Anchorage systems
D2	Branch Saddle Connection	E1	PE single squeeze off		
D3	Connection to Swagelined mains	E2	PE Double squeeze off		
		E3	Metallic bag off		
		E4	Single Hole bag off system		
		E5	PE bag stop		
		E6	Foam plugging Low Pressure		
		E7	Isolation and Decommissioning of one way fed metallic mains		
		E8	Bypass with integral pressure sensor		





Testing		Commissioning and Decommissioning	
G1	Mains air pressure testing – Coils and pipes for insertion	H1	Commissioning and Decommissioning Direct
G2	Mains air pressure testing – buried pipework	H2	Commissioning by Direct Purging using Squeeze offs
G3	Hydrostatic Pressure Testing	H3	Decommissioning by Direct Purging
G4	Acoustic Pressure Testing (APT)	H4	Purging during Flowstop operations of shorts Sections
G5	Testing under pressure tee and branch connections	H5	Decay Testing
		H6	Commissioning_Pipe_coils

Appendix					
A	References	B	Minimum distances between fused fittings	C	Preparation for Electrofusion
D	Electrofusion of PE Pipe and Fittings	E	Butt Fusion of PE Pipe	F	Mechanical Jointing
G	Installation of valves and chambers	H	Mains Breakout Tool	I	PE Fittings & Pipe Faults – Reporting Arrangements
J	Abandoned Pipe Record Requirements	K	Pneumatic pressure Test Certificate	L	Using of CCTV systems
M	Risk Assessment for the use of the Mini Pipe Handler	N	Metric / Imperial conversion tables		
APPROVAL		DISCLAIMER		END NOTE	

Pre-requisites
All work carried out in relation to Mainlaying operations are managed under SGN/PM/MSL/1 Part 1 "Management Procedure for Mains and service laying".
You should also refer to SGN/WI/ML/1 for guidance on excavation, reinstatement, temporary bridging of excavations and other general safety requirements.
Guidance on the signing of roadworks is to be found in .
You must be in possession of a set of documents specifically describing the full range of the activities being undertaken, associated permits and SCO documentation, which you must follow.
It is vital to make sure that all components used in a pressure system are suitable for the pressure range of that system. It is therefore important that connections made to test points are made using materials designed for that pressure range.
Remember:

- Class B fittings are only suitable for use up to 5.5 bar. ***Note: Refer to GIS/PL2-4.***
- Class C fittings are only suitable for use up to 7 bar. ***Note: Refer to GIS/PL2-4.***
- All Butt and Electrofusion operations must be undertaken when ambient temperature is warmer than minus five degrees centigrade (-5°C).
- All butt and Electrofusion jointing operations must be protected from rain and wind chill which will affect jointing performance and integrity.
- Inspect all pipes and fittings for cuts, scratches or other damage before use. Pipe or fittings with damage greater than 10% of wall thickness must not be used.
- Squeeze off operations should not be carried out when pipe temperature is below 0°C, the pipe should be protected against the cold. HDPE pipes and fittings must conform to GIS/PL2-8.
- PE pipes must not be installed in locations where the temperature of the ground surrounding the pipe is expected to exceed 20°C.
- For pressures greater than 2 bar, the details of the Pipe, fittings, under pressure tees and valve and other items must be recorded in the SGN/PM/PS/5 paperwork.

Competency

Mainlaying Operatives must be trained to GNO/NCO Level 2 minimum or to a recognised equivalent level. All personnel should be reviewed and assessed using SGN's CAS system as competent for the tasks to be undertaken.

Materials

All pipe and fittings used for Mainlaying operations must be approved by SGN or to the appropriate Gas Industry Standard. See Appendix A for the appropriate standards.
For HDPE pipelines, pipes must meet the requirements of GIS/PL2-8, Polyethylene (PE) fittings may be either medium density polyethylene (MDPE) or HDPE meeting the 7 bar requirements of GIS/PL2- Part 4 and Part 6 depending on the pressure rating of the pipeline. Further details can be obtained from Engineering Policy.

The use Excavator mounted pushing machines **(see** Section B2 or Section B3)

The excavator operator must be trained and competent in the use of both the excavator and the excavator mounted pushing machine. The operator must understand how to set up and attach the pushing machine, and be aware of its limitations. Prior to using an excavator mounted PE pushing machine, a Site Specific Risk Assessment (SSRA) must be completed and its use agreed with the Team Manager.

The excavator mounted pushing machine can be used for live or dead main insertion. The disconnection, decommissioning and abandonment of 'Live' gas mains must be completed in accordance this work instruction. A mains camera survey must be undertaken in accordance with Appendix L. This will locate any blockages or restrictions that could damage or prevent the mains insertion. Anchorage requirements must be assessed and installed in accordance with SGN/WI/DIS/4.2.2. This work instruction extends the use of mini-excavators as set out in SGN/PR/TE/P6.2 to cover mains insertion of PE pipe using an excavator mounted pushing machines. This extension of use is only permissible under the following conditions. The excavator driver must:

- comply with the requirements of SGN/PR/TE/P6.2 clauses 5.5 & 5.6.
- have been assessed as competent to use a mini-excavator for the insertion of PE pipe by SGN or their appointed representative.
- Make sure that the excavator used is in accordance with the manufacturer's requirements and ranges between 1.5 tonne to 5 tonnes.

Reference must also be made Section B2 – Dead insertion and Section B3 – Live insertion.

A Site-Specific Risk Assessment (**SSRA**) must be completed by the Team Leader and agreed with your Team Manager before using an excavator mounted pushing machine. This will cover:

- designating the banks man to control all operations of the excavator
- designating the coil trailer operative to dispensing the pipe
- Where the attachment/detachment of the pushing machine to and from the excavator will take place, for example, within site barriers and the machine turned off
- PE pipe handling, manoeuvring and insertion via the excavator
- the movement of the excavator arm
- proximity (10m) of any High-Pressure pipelines or installations. ***Note: Refer to*** *SGN/WI/SW/2*
- other plant in the area. ***Note: Guidance is given in*** *SGN/PM/SW/3.*
- The use of the insertion trumpet to prevent damage to the PE main on dead insertion.
- any Permitry (SCO) requirements.

Communication

You must make sure that adequate arrangements are in place on site for the communications with Team members, consumers, the public, third parties and your Operational Manager. Refer to SGN/WI/ML/1 Appendix D for details.

PPE	Tools and Equipment	Tools and Equipment -cont'd	Specialist equipment
Operatives must wear or have available (as appropriate) all necessary PPE as determined by risk assessment. This includes: • hard hats • gloves • boots • eye protection • probanised workwear • reflective waistcoats and jackets • ear defenders • dust masks • minimum 2 x 9 kg dry powder fire extinguishers • breathing apparatus X 1 per operative • PAM In addition task specific items such as • welding visors • protective gloves • full face visor • Voltstick Further guidance on PPE requirements can be referenced in Safety Handbook Task Cards – PPE Selection.	• alignment and re-rounding clamps • bag inflation pump • bag stop drilling machines & bases • Bead gauge • clean, damp, non-synthetic cloth or paper towelling • continuity bond • cup drills with pilot • de-beading tool • DI/CI/ST pipe cutters • electro fusion control unit & power source • End Seal kit • flame traps • flow stop bags & spares • foam off isolation equipment • foot-pump • gland box (GIS/E58:2006) • gas detector • leakage Detection Fluid • live head • mains break out tools • metallic pipe cutter • PE Coupler clamp • Pipe Exposure Tool (PET) • PE Pipe bead gauge • PE pipe cutter/saw • PE pipe squeeze offs • PE scraper & marker pen	• PE squeeze off applied tape • pipe insertion edge protector(trumpet) • pipe expanding stoppers • pipe Support or rollers • pressure gauges • pressure testing and purging equipment. • spanners & torque wrench • tent or cover • test ends for pressure testing with restraint devices • test standpipe (certified), Colour coded: LP: orange MP: blue, IP: red. Common lower standpipe, where fitted, for LP and MP standpipes: yellow. • test warning sign • top loading clamp for PE connections • trench guide (goal post) • timber support and wedges • vent pipes (metalic) • Wask tee set • wire brushes • air compressor • butt fusion machine – fully automatic butt fusion control unit	• bypass or bypass with integral pressure sensor • callipers • CCTV camera • drilled blank flange with pressure relief facility where appropriate • drill – 52mm for PE bagstops. • earthing strap • electronic test equipment • foam off isolation equipment • hand and/or air driven under pressure branch drilling machine • lifting equipment • live mains inserton equipment • load indicator • mini-excavator (range 1.5 – 5.0 tonne)* • nitrogen bottles & regulators • PE pipe pusher attachment for excavator • PE saddle fittings for bagstops. • pipe coil trailer • print control unit or electronic data store • purge ejector • purge compressor(s)

Excavations	Construction	Connections & Flow stopping	Testing
Before undertaking any excavation work on site, the work area must surveyed using the Cat and Genny in accordance with SGN/WI/EL/15005. Plans must be available on site detailing utilities plant, local authority structures, private land owner's utility and third party pipelines owners of above and below ground plant and structures that may be in the vicinity. Trial holes must be hand dug to confirm the location, depth and route of the apparatus/structures. Where work is located within shaded area on SGN mapping system, information on the hazardous plant and/or plant owner and contact numbers can be assessed through the Dig Query button. Guidance on safe digging techniques is found in SGN/PR/SW/1 and the Safety Handbook. Guidance on using PVC shoring is to be found in SGN/SEI/557. When working on or near high pressure gas apparatus reference must be made to SGN/WI/SW/2. If mechanical excavators are used, guidance can be found in SGN/PM/SW/3 and Safety Handbook.	Valves should be installed on medium pressure mains as detailed in project drawings and specifications. **Risk Assessment** Prior to undertaking any work activity you must undertake a risk assessment. SGN has developed an index of reviewed, rebranded risk assessments. These can be viewed on SGNnet Risk Assessment Page, and provide you with best practice and up to date templates.	All connections must be made in accordance with this work instruction. The following documentation must be available on site: • Job instruction • Routine/non routine operation procedure • Permits to work. Branch saddle connections may be undertaken by Specialist Drilling contractors, depending on the size of the main. Where squeeze-off is to be undertaken on PE80 SDR17.6 pipe, the maximum operational pressure of the pipe must be 3.0 bar.	Pressure testing of mains is potentially hazardous due to stored energy in test medium. Testing must be suitably recorded. Testing equipment should be within calibration date and stored and labelled correctly. Pipe under test must be suitably restrained. Testing must not be carried out on PE pipe above ground unless in accordance with Section G1. **Emergency Situations** In the event of an incident occuring on site, if you are Emergency Leak Repair (ELR) trained to deal with emergency situation, follow the requirements in SGN/PR/EM/72 and undertake repairs in SGN/PR/EM/74B. If you are NOT ELR trained, then: • Stop work and secure the area • remove all personnel from danger • call 0800 111 999 and request assistance • monitor the situation and inform your Team Manager.

Purge & Commission	Permitry	Pushing Equipment	Lifting & Handling
Prior to commencing the Operational Manager should confirm: • whether direct purging is to be used • sequential or simultaneous purging of branches • size of riders and vents • regulator outlet pressure for rider governor • approximate duration of purge	A system of document control to manage operations. The need for a Permit to Work (PTW) will be determined by the Site specific Risk assessment (SSRA). Permits must be issued in accordance with:- • GDN/PM/SCO/2. All lifting operations on, over or near live mains must be subject to a SSRA and have lifting PTW's in place. Guidance on lifting can be found in • SGN/PM/DIS/3.6. All Connection and flow stopping operations must have an approved written procedures (RO/NRO) in accordance with: • GDN/PM/SCO/4, GDN/PM/SCO/5.	Follow the manufacturers' instructions when setting up and fitting the pushing machine on to the excavator. All equipment needed for the operation and 'on site' maintenance of the pushing machine must be 'on site' and stored in a secure place when not in use. A full set of manufacturer's instructions must be on site. Refer to manufacturer's for operational check sheet and maintenance sheets You must discuss and agree with your Team Manager the proposed plan of operation and the equipment to be used on site.	Guidance on manual handling can be found in • SGN/WI/ML/1 Section C2. • SGN/PM/SHE/15. When carrying out Lifting Operations reference must be made to SGN/PM/DIS/3.6. **Site Records** • As built records must be updated following pipe construction, including:Test certificates (the test certificate must be completed and passed to the Operational Manager) • location of valves

A1 Work Instruction Mainlaying – Site Setup

GENERAL REQUIREMENTS

1. Complete a Site Specific Risk Assessment (SSRA) to identify any hazards so that they can be mitigated by appropriate means.
   Note: Reference must also be made to the Safety Handbook, which covers manual handling. You should be aware of the hazards associated with the equipment you are to use. Hazards associated with the increased energy in the pipe pushing systems and the problems that could arise.

THE SITE SURVEY

1. You must wear PPE appropriate to the task being undertaken.
2. Refer to Pre-requisites and make sure all tools and equipment to complete this task are available on site.
3. Set up the correct signing, lighting and guarding in accordance with with NRSWA guidance D4.
4. All appropriate underground plant plans must be available**.**
5. Use suitable plant location equipment over marked route (typically the 33 kHz CAT & Genny).
   Note: All available modes should be used; sole use of the CAT is not acceptable). Guidance on the location of underground utilities can be found in the HSE publication "HSG47 - Avoiding danger from underground utilities".
6. Survey these locations and mark all utility plant on the ground.
   Note: All plant must be located, marked and labelled with type, depth and ratings on the ground surface (this can be done using either water based spray paint or chalk).
7. Check for existing street furniture and recent signs of excavation work such as BT covers, cable boxes, street lighting and new reinstatement patches.
8. Replace covers immediately after inspection.
9. Check the depth and route of drainage systems by lifting drainage covers.
10. Check for overhead lines.
11. Map depths of other utilities within the vicinity of the main.
12. You must excavate trial holes to establish the depth and location of plant before starting impact moling where the depth of utility plant cannot be verified from drawings or using the location equipment.
13. Check that any pipe insertion will not be obstructed by valves, syphons and bends.
    Remember: A camera survey will be carried out before the mains isolation for any insertion technique.
14. Where electric cables are located crossing the path of the route of the impact mole, the cables must be exposed to establish depth and exact location.
15. Identify the route of the new main and where excavations are to be made.
    Note: Consider the minimum bend radius for the pipe being laid.
    See Table 4 and Table 5

EXCAVATION

All excavation work must be carried out following the guidance in SGN/PR/SW/1and SGN/PM/SW/3.

1. Excavate enough trial holes to confirm a proposed route for the new main.
2. Excavate carefully onto the main.
3. For insertion operations, you need to make several excavations for:
   - Launch pit
   - Receive pits
   - Mains connections
   - Bends, Syphon's and Valves
   - Service connection
4. Table 1 provides guidance on sizes of excavations for launch pits but these may need to be changed because of site conditions.

Intermediate excavations at bends (refer to Table 4 & Table 5), syphons, valves or other intermediate points must be long enough to enable the fitting to be cut out and for the insertion pipe to go through.

5. For impact moling operations you need to make excavations for:
   - Launch pit
   - Receive pits

SIZE OF EXCAVATONS

Live and dead insertion using pushing machine

1. The excavation dimensions for the different diameters of main are shown in Table 1.
   Note: The launch/reception excavations should be kept to a minimum.
2. For excavations, greater than 1m depth of cover the bend radius of the main must be considered.

PE Pipe diameter (mm)	Size of Excavation required				Excavator Size Tonnes
	Minimum total length (m)				
	Up to 1 m cover	1m to 2m cover	2m to 3 m cover	Width*[1] (mm)	
55-90	4	5	N/A	700	1.5-2.5
125-140	5	6	N/A	750	3.0
160	6	7	N/A	750	3.0
180-213	6	7.5	N/A	800	3.0
250-268	7	9	N/A	900	3.0-5.0
315-355	8	10	N/A	1200	5.0
400	9	12	N/A	1250	5.0
500	10.5	13.5	N/A	1300	5.0
630	12	15	N/A	1450	*[2]

Table 1- Excavation Sizes by Diameter - Dead Insertion using Excavator

Note 1: It may not be necessary for the whole length of the excavation to be the same width
Note 2: refer to manufacturer's instructions.

3. Once the connection excavation has been completed, survey the exposed pipe for joint and repair clamps.

IMPACT MOLING

1. The launch and receive pits to suitable depth, the minimum the depth is 10 times the diameter of the impact mole.
   Note: This is to reduce the heave along the bore of the mole - See Table 2.
2. Check the proposed launch excavation to be certain that there is no apparatus present which could be damaged by the securing spikes.
3. The reception pit should be excavated to the minimum size, depending upon the boring technique used, and provision should be made for:

- Retrieval of the impact mole at the reception pit.
- Reversal of the impact mole, pulling PE pipe behind it, (in which case a smaller pit can be used).

Impact mole size (mm)	Recommended bore length (m)	Launch/receive pit Dimensions D x W x L (m)
45	10 - 12	1.2 x 0.5 x 0.5
55	15 - 20	1.5 x 0.5 x 0.6
65	20 - 25	1.5 x 0.5 x 0.7
75	25 - 30	1.6 x 0.5 x 0.9
110	35 - 50	1.9 x 0.5 x 1.0
145	35 - 50+	2.0 x 1.0 x 1.6
180	35 - 50+	2.0 x 1.0 x 2.0

Table 2- Impact Mole Launch and Receive Pit Dimensions

A1 Work Instruction Mainlaying – Site Setup

OPEN CUT

1. Where required excavate trials holes to confirm the line and level underground plant.
2. Consider the maximum bend radius for the pipe being laid.
3. Determine the route of the proposed main.

STEEL PIPE LAYING

1. Where required excavate trials holes to confirm the line and level underground plant.
2. Consider the number and location of any bends which may have to be installed.
3. Confirm the route of the proposed main.

PE BRANCH SADDLE CONNECTIONS

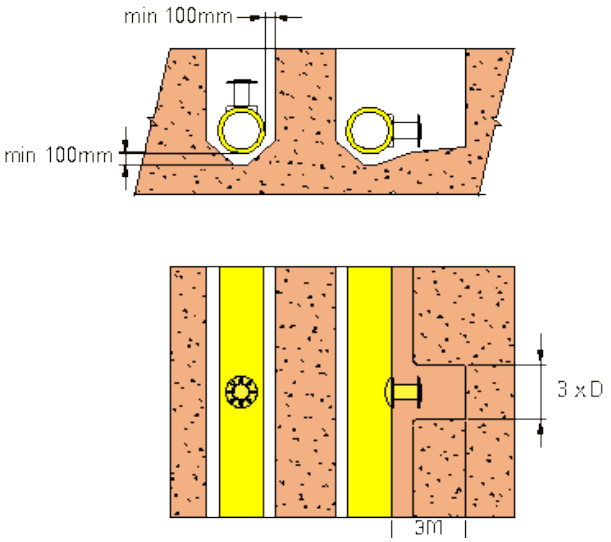


Figure 1- Recommended Excavation Dimension

1. Check that a minimum of 250mm clearance from other utilities plant. ***Depending on the orientation of the branch saddle (horizontal or vertical) sufficient clearance around the pipe and for the drilling machine must be made, refer to Figure 1 for dimensions.***
2. Where the branch saddle is to be installed in the vertical plane, there must be sufficient cover to protect the proposed new main or branch outlet.
3. If this is not possible, the Operational Manager must be informed before continuing with the operation to be sure that appropriate measures are provided to protect the pipe.

DRILLING EQUIPMENT

You must check that the drilling equipment is suitable for the maximum pressure of the main to be drilled (for example Wask drilling equipment is suitable up to 2 bar).

REINSTATEMENT

1. Cover the pipes with suitable fine fill material or sand to a depth of 250mm above crown of the pipe.
2. Lay gas marker tape on top of fine fill.
3. The remainder of the reinstatement must follow the requirements of the Road or Highway Authorities.

B1 Work Instruction Mainlaying – PE General requirements

PREPARATION FOR JOINTING

1. Inspect all pipes and fittings for cuts, deep scratches or other damage before use.
   Note: Any defective material must not be used refer to page B1-2 for guidance on damage assessment.
2. Before joining pipes, inspect the bore and clear any foreign matter from the pipe.
   Note: Wherever possible fusion jointing, particularly butt jointing, should be carried out above ground if the road traffic conditions and the type and number of underground obstructions permit.
3. You must take precautions against adverse weather conditions.
   Note: These include severe wind chill effects by the provision of jointing tents and the temporary sealing of pipe ends.
4. You must take precautions when carrying out pipe jointing if the air temperature is below -5 °C or above 40 °C

- At or below -5 °C, you should only carry out fusion in a heated tent.
- At or above 40°C, you must allow extra cooling time prior to removal of the pipe clamps.

Note 1: In addition, in such extremes of temperature, written advice should be sought from the equipment and pipe manufacturer before commencing fusion jointing .

Note 2: Pipes made from dissimilar polymers must only be joined by electrofusion or mechanical methods.

Note 3: Where electrofusion couplings are used to connect sections of thin walled swagelined pipe (such as SDR 26 or thinner), steel inserts may be required. Check with the manufacturer.

Note 4: Inserts will prevent pipe wall collapse during the fusion operation.

Note 5: Electrofusion inserts are not required for loose fit inserted pipe.

PIPE JOINTING

Pipes must be joined by one of the procedures detailed in Appendix D or E. Butt fusion is the preferred method.

1. Check that each pipe is marked by the pipe manufacturer:

- GAS;
- Polymer type, typically. A, S or X;
- Size that is outside diameter and SDR Each fitting must be marked:
- Size that is outside diameter and SDR;
- SDR, for fittings of outside diameter greater than 250 mm;
- Fusion time(s);
- Cooling time.

2. You must only make joint using dry pipe and fittings.
3. DO NOT touch a fusion surface which has been cleaned by trimming/scraping or removal of the peelable layer.
4. Support and clamp the pipe to prevent it being moved during the heating, fusion and cooling phases.
5. Support long pipes to avoid misalignment due to sagging.
6. Do not carry out pressure testing until the complete system has cooled down to ambient temperature.

LIVE GAS WORKING

When making live gas connections, full use should be made of equipment designed to reduce the amount of gas discharged to the absolute minimum during drilling, tapping and other operations.

Note: Although this equipment should be checked and proved to be safe before use, it is always necessary to be prepared for mechanical or other failure.

Breathing apparatus and fire extinguishers must be assembled, ready for use and easily accessible, alongside the excavation. Electrofusion control boxes must not be used in gaseous or potentially gaseous atmospheres.

SURFACE DAMAGE TO PE PIPES

When PE pipe is transported, laid, inserted, excavated or otherwise worked on, there is a possibility of damage. A small amount of damage is permissible.

PE pipe can sustain damage on site of up to 10% of the pipe wall thickness and still perform satisfactorily over its design life.

1. You must inspect all PE pipes and fittings for cuts, deep scratches, ovality or other damage before use see Figure 2.
2. If you discover any damage you must measure the depth of damage as follows:
   a) Take a reference reading on the pipe away from the damage using a dial test indicator on a bridge between two rollers,
   b) Then using the same device to obtain a depth reading on the damaged area.

   Notes:

   For Peelable pipes, most damage is likely to be absorbed by the outside skin layer.

   Where the skin is pierced by damage, then it may be readily observable by the change in pipe colour if conditions are relatively clean.

   Damage to this extent must be checked prior to commissioning the pipe to establish the extent of the damage and determine whether the pipe requires remediation.
3. Score a patch of skin surrounding the damaged area using the PET and peel off the pipe.

   Note: This makes sure the depth of the damage is measured directly.
4. Where the skin is pierced and the damage is less than 10% of the pipe wall thickness in an area where the pipe is to be joined, lightly scrape the pipe core to remove any possible contamination.

   If the damage is greater than 10% of the pipe wall thickness, then the section of main must not be used and must be clearly marked DO NOT USE.

Table 3 shows the minimum and maximum wall thickness for PE80 and PE100 peelable pipes together with the measurement equivalent to 10% of the pipe wall thickness. This 10% thickness is based on the minimum diameter for the pipe wall.

5. You MUST NOT use any kinked PE pipe.
6. Pipes must be re-rounded where ovality is identified.

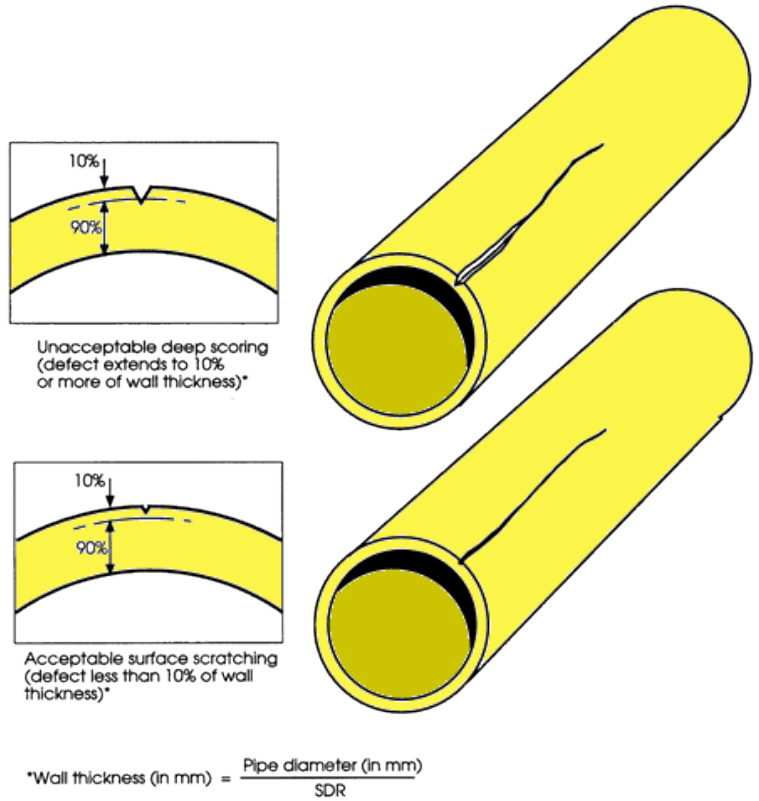


Figure 2 - Surface Damage to Polyethylene Pipe

MULTILAYER PIPE DISBONDMENT AND CONTAMINATION

After removal of the peelable layer additional steps may be required to be sure of a satisfactory performance of the core pipe. This may be required where the peelable layer has been damaged or disbonded from the pipe end.

Disbondment

Disbondment between peelable layer and core pipe is possible on the very end of the pipe, for up to 20 or 30mm. A slight shading effect is normally visible on the external surface adjacent to the pipe end. Where this occurs, you must peel the pipe as normal in preparation for electrofusion and then scrape the end of the pipe to remove the disbonded area.

Note: This shows as separation of the peelable layer from the core pipe. After removing the peelable layer from the core pipe.

Contamination

Contamination may occur because of soil/moisture falling onto the peeled surface.

1. If this occurs, remove the contamination by scraping the pipe surface.
2. This is the same procedure you would use where a conventional PE pipe has been scraped once then becomes contaminated and needs to be scraped a second time.

   Note: Contamination may also result from damage to the peelable layer during handling or installation, which may result in the peelable layer being damaged or worn from the pipe at the jointing location. This will be identified during peeling when a section is found to be missing.
3. Identify the area affected and remove the contamination using a scraping tool.

   Note: In very cold weather, the peelable layer can become harder and more difficult to peel. Any surface cuts or scratches will then be liable to fail in a brittle manner.
4. When the temperature is cold or the peelable layer is scored, peel the layer from the pipe slowly and at an angle to the pipe.

   Note: The same principles should be applied when pipe has been inserted and is scored all around its surface.

PE Pipe DIA (mm)	Wall thickness for PE 80 & PE 100 pipe (mm)														
	SDR 11			SDR 13.6			SDR 17.6			SDR 21			SDR 26		
	min	max	10%	min	max	10%	min	max	10%	min	max	10%	min	max	10%
50	4.6	5.2	0.46	-	-		2.9	3.3	0.29	-	-	-	-	-	-
55	5.1	5.8	0.51	-	-		-	-	-	-	-	-	-	-	-
63	5.8	6.5	0.58	4.7	5.4	0.47	3.6	4.1	0.36	3.0	3.4	0.3	-	-	-
75	6.8	7.6	0.68	5.6	6.4	0.56	4.3	4.9	0.43	3.6	4.1	0.36	-	-	-
90	8.2	9.2	0.82	-	-		5.2	5.9	0.52	4.3	4.9	0.43	-	-	-
110	10.0	11.1	1.0	-	-		6.3	7.1	0.63	5.2	5.9	0.52	-	-	-
125	11.4	12.7	1.14	-	-		7.1	8.0	0.71	6.0	6.7	0.6	-	-	-
140	12.7	14.1	1.27	-	-		8.0	8.9	0.8	6.7	7.5	0.67	5.4	6.1	0.54
160	-	-	-	-	-		9.1	10.1	0.91	7.6	8.5	0.76	6.2	7.0	0.62
180	16.4	18.2	1.64	-	-		10.3	11.5	1.03	8.6	9.6	0.86	7.0	7.8	0.7
200	18.2	20.2	1.82	-	-		11.4	12.7	1.14	9.5	10.6	0.95	7.7	8.6	0.77
213	-	-	-	-	-		-	-	-	-	-	-	8.2	9.2	0.82
225	-	-	-	-	-		12.8	14.2	1.28	10.7	11.9	1.07	8.6	9.6	0.86
250	22.7	25.1	2.27	-	-		14.2	15.8	1.42	11.9	13.2	1.19	9.6	10.7	0.96
268	-	-	-	-	-		-	-	-	-	-	-	10.3	11.5	1.03
280	25.4	28.1	2.54	-	-		15.9	17.6	1.59	13.3	14.8	1.33	10.7	11.9	1.07
296	-	-	-	-	-		-	-	-	-	-	-	11.4	12.6	1.14
315	28.6	31.6	2.86	-	-		17.9	19.8	1.79	15.0	16.6	1.5	12.1	13.5	1.21
355	32.3	35.7	3.23	-	-		20.2	22.4	2.02	16.9	18.7	1.69	13.7	15.2	1.37
400	36.4	40.2	3.64	-	-		22.8	25.2	2.28	19.0	21.0	1.9	15.4	17.1	1.54
440	-		-	-	-		-	-	-	-	-	-	16.9	18.8	1.69
450	40.9	45.1	4.09	-	-		25.6	28.3	2.56	21.4	23.7	2.14	17.3	19.2	1.73
469	-	-	-	-	-		-	-	-	22.3	24.7	2.23	-	-	-
500	45.5	50.2	4.55	-	-		28.4	31.4	2.84	23.8	26.3	2.38	19.2	21.3	1.92
560	50.9	56.1	5.09	-	-		31.9	35.2	3.19	26.7	29.5	2.67	21.5	23.9	2.15
630	57.3	63.2	5.73	-	-		35.8	39.5	3.58	30.0	33.1	3.0	24.2	26.8	2.42
710	64.5	71.1	6.45	-	-		40.3	44.5	4.03	33.9	37.4	3.39	27.2	30.1	2.72
800	72.6	80.0	7.26	-	-		45.4	50.1	4.54	38.1	42.1	3.81	30.6	33.8	3.06

Table 3- Wall Thicknesses and 10% Damage Dimensions for PE 80 & PE100 Pipe

Note: Data from GIS/PL2-2 and Manufacturer's data sheets.

Note 1 – 180mm diameter SDR21 is not supplied to SGN dimensions stated are for SDR 17.6

Note2: 10% Values for Peelable and multilayer pipe are for damage to the black or white core pipe after penetration of the out skin.

B1 Work Instruction Mainlaying – PE General requirements

ACCEPTABLE USE FOR MULTILAYER PIPE

Multi-layer pipe in both SDR 21 and SDR 26 can be used for the following methods of construction.

- Live and dead mains insertion
- Impact moling up to and including 180mm (see note 1)
- Open cut (see note 2)
- Directional drilling (see Note 3)

Note 1: You must consult the SGN/PM/MSL/1 Part 1 for the maximum towing or pushing loadings for this technique)

Note 2: For SDR 26, where the minimum cover cannot be maintained then alternative materials must be used.

Note 3: Profuse pipe may be used but only after a thorough analysis has been made of the individual project and site circumstances.

BENDING PE PIPE

Never bend PE pipe to a radius tighter than that shown in Figure 3, Table 4 and Table 5.

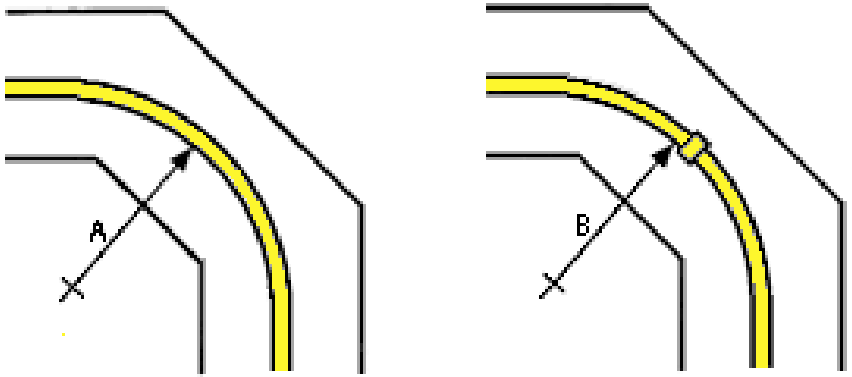


Figure 3- PE Pipes Minimum Bending

Diameter	SDR 11	SDR 17.6	SDR 21	SDR 26
	15 X Outside diameter		35 X Outside diameter	
55	0.825	-	-	-
63	0.945	-	-	-
75	1.125	-	-	-
90	1.35	1.35	3.15	-
110	1.65	-	3.85	-
125	1.875	1.875	-	-
140	-	2.1	-	4.9
160	-	2.4	-	5.6
180	2.7	2.7	-	-

Table 4_Minimum Bend Radii - A Pipe Without Joints

Diameter	SDR 11	SDR 17.6	SDR 21	SDR 26
	25 X Outside diameter	45 X Outside diameter		
55	1.375	-	-	-
63	1.575	-	-	-
75	1.875	-	-	-
90	2.25	4.05	4.05	-
110	2.75	-	4.95	-
125	3.125	5.625	-	-
140	-	6.3	-	6.3
160	-	7.2	-	7.2
180	4.5	8.1	-	-

Table 5- Minimum Bend Radii - B Pipe With Joints

DEPTHS OF COVER

1. PE pipes should be laid at the depths of cover stated in SGN/WI/ML/1
2. If it is not possible to achieve the required depth of cover then you must contact your Operations Manager.

If PE 100 SDR 26 is being laid an alternative material must be selected.

PROXIMTY

PE proximity distances are stated in SGN/WI/ML/1.

Note: The preferred method of PE insertion is to push the pipe under controlled conditions from the launch pit.

B2 Work Instruction for PE Mainlaying by Dead Insertion

Where it is intended to achieve insertion by using a winch, specialist advice MUST be sort before any work proceeds. See *SGN/PM/MSL/1 Part 2*

Note: Dead insertion involves either the use of redundant gas pipes or the disconnection and abandonment of a section of main and its subsequent insertion with a new main.

The Sealback TM system allows the insertion of PE into a Tee from a remote location (10m - 13m) to where it intersects its parent pipeline, usually from a side road into the main carriageway is a specialist activity see SGN/PM/MSL/1 Part 2.

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. A camera survey must be carried out prior to the mains isolation for any insertion technique.
   The camera survey will identify dust and other debris which may obstruct the insertion.
4. Prior to the day of the isolation and insertion operation check that:
   - All excavations have been completed see Section A1.
   - ***See Table 6, for length of ground to be removed when bends are found.***
   - All gas services on the section of main affected have been replaced.
   - That access is available to the properties affected.
   - Access will be available to the entire site.
   - That the Routine Operation procedure is available on site.

MULTILAYER PIPE

The additional outer coating (skin) of the pipe is approximately 0.6 to 1.5mm thick and should have little bearing on the ability to use equipment for pushing operations but equipment should be checked to be sure that the clamping and shells are suitable for use.

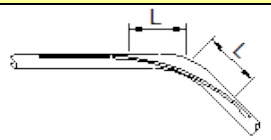
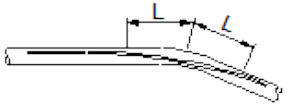
Bend Type	Minimum lengths (L) to be removed at bends in terms of insertion pipe outside diameter (D)				
	Coiled Pipe	Pipe with joints			
	SDR11 or 17	SDR11	SDR 17	SDR21	SDR 26
45 ° 	6D	10D	18D	20D	25D
22½° 	4D	6D	9D	10D	12D
11¼° 	2D	3D	4D	5D	6D

Table 6-Recommended Minimum Length of Main to be Removed at Bends

PROCEDURE – MAINS ISOLATION FOR DEAD INSERTION

1. Carry out the flow stop operation on the section of main to be inserted as per Section E3 or Section E4.
   Use twin sets of equipment at either end.
2. Carryout decay test as per Section H5.
3. If unsatisfactory the Operational Manager must be consulted to determine course of action to be taken.
4. If satisfactory decommission the main to be inserted following procedure in Section H3
5. Cut out sections of main at either end ensuring the pipe is cut square.
6. Fit cap ends and where necessary with anchorage on the remaining live end(s), (see SGN/WI/DIS/4.2.2).
7. Break out any service or other connections on the section of main to be inserted before the main is inserted.

ISOLATIONS AFTER INITIAL SECTION HAS BEEN INSERTED

Following insertion of the 1st section of main subsequent sections will require isolation on the side to be inserted using Section E3 or Section E4 and the side to be reconnected using squeeze off equipment see Section E1 or Section E2.

GAUGING THE METALLIC PARENT MAIN

Insert a pull through into the main to be inserted and inspected for damage at each intermediate excavation.

Note: This will confirm if the metallic parent main is clear of obstructions.

INTEGRITY TEST OF PIPE FOR INSERTION

1. Cap the PE coil or pipe string and allow to cool.
2. Prior to inserting the pipe string should be subjected to an integrity pressure test. See Section H1 or H2.
3. On completion of a successful test, depressurise the main and complete a pressure test certificate for dead insertion.

PREPARATION FOR INSERTION OF FIRST PIPE STRING

Typical insertion layouts are shown in Figure 4 and Figure 5

1. Protect the PE pipe to be inserted from sharp edges of the existing parent main at each point of entry, see Figure 6.
2. Fit the nose cone to the leading end of the pipe.

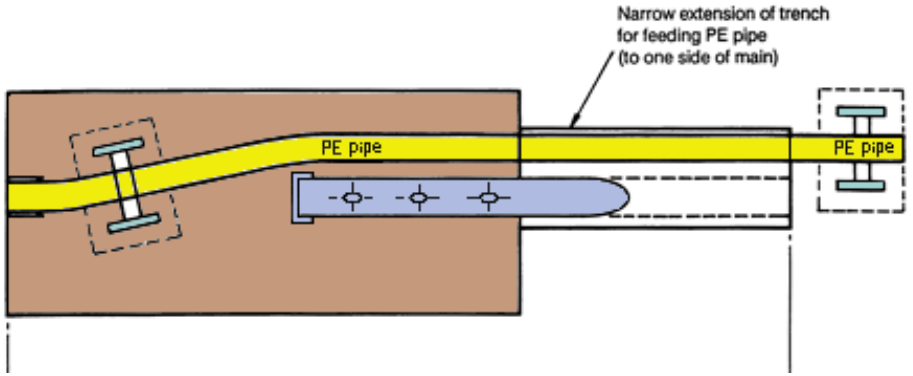


Figure 4 -Typical Insertion Layout-Plan

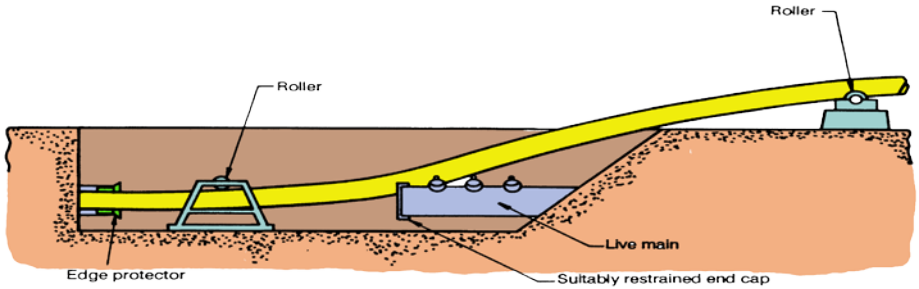


Figure 5 - Typical Insertion Layout Elevation

3. Position pipe rollers of the correct size at road level and in the launch excavation to guide the PE pipe into the metallic parent main.
4. Site the pushing machine or excavator with a pushing attachment and any other equipment ready to accept the pipe for insertion.
5. Check the position and size of guide rollers are ready to assist the pipe to negotiate any bends.

Consider the need for additional rollers, and to ensuring that the pipe coil trailer is securely anchored and won't move should the pipe snag during roll out.

You must mechanically restrain the lead end of pipe coils until it is securely fastened in the pushing machine or pushing attachment.

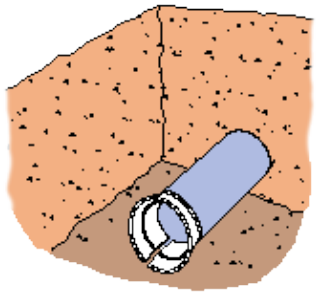


Figure 6- Protection from Existing Main

A straight length may be fused to the leading end to reduce the resistance during insertion.

Excavator mounted pushing machines can be used for live and dead insertion of Polyethylene (PE) mains from 63mm to 630mm PE in diameter. Only pushing machines approved by SGN may be used for this task.

PREPARATION - GENERAL

Preparation will be different depending on the type of equipment used for the insertion.

HOST MAIN PREPARATION

If one excavation insertion is required, then traditional pushing machines can be used instead in accordance with the following Section.

PROCEDURE – INSERTION OF THE NEW MAIN USING PUSHING MACHINE

1. Feed the pipe over the rollers and into the pushing machine.
2. Connect the compressor to pushing machine.
3. Carryout a final check that all site safety precautions have been taken.
4. Start the compressor.
5. Taking care not to stand in front of the pipe, open the valve on the pushing machine and following the manufacturer's instructions to feed the new pipe from the pushing machine into the carrier pipe.
6. Once the pipe enters the carrier pipe stop the machine and mark the pipe and check its alignment.
7. Restart the pushing machine and progress the insertion.
8. As the work progresses mark each pipe/coil at appropriate intervals as it is inserted.
   This will indicate the remaining length to be inserted, and be sure the PE insertion head can be located should there be an obstruction.
9. During the insertion process, inspect the PE main for visible damage at the intermediate excavations. (see advice.)
   Surface damage must not exceed 10% of the pipe wall thickness
10. Where this occurs, the pipe must not be used.
11. If deep scratching or scoring of the pipe has occurred, investigate the cause of the scoring before continuing with the insertion operation.
12. If you add a new pipe to the pipe string, the new butt fused joint must be allowed to cool and the bead removed before continuing.
13. The bead must be inspected as per Appendix E and passed to your Operational Manager.
14. Allow additional pipe at each end of the insertion for final connections.
15. Once the pipe has been inserted, close valves on the pushing machine and shut off compressor.
16. On completion of the insertion, examine the surface of the leading pipe for signs of damage.
17. Proceed to testing.

PREPARATION FOR USING AN EXCAVATOR MOUNTED PUSHING MACHINE

1. A minimum of three persons are required to undertake both live and dead insertions using an excavator mounted pushing machine:

- A Banksman
- Coil Trailer/Pipe string Operative
- Excavator Driver

Note: The number persons on site could be increased or reduced depending on the site-specific risk assessment.

2. Load the coil trailer in accordance with the requirements of SGN/WI/ML/1.

Note: Pipe strings must be positioned inside a barrier system and positioned on pipe rollers/bogeys to prevent damage during insertion.

3. Position the excavator at least 0.5m away from the edge of the excavation.
4. Position the pipe coil trailer/pipe string so that the insertion of the main is always pulling toward the excavator.

Note: The use of stop blocks should be considered to prevent the coil trailer being pulled into the excavation or the excavator getting too close to the edge of the trench.

5. Mechanically restrain coiled pipe until the lead end is inserted into the main and securely fastened into the PE pipe pusher attachment
6. On coiled pipe, butt fuse a straight length onto the leading end.

Note: This will reduce the resistance during insertion.

7. Check that the gap created by cutting out the pipe will not cause the pusher mechanism or the pipe to be inserted to touch the live capped end.

Operatives must not enter the excavation and must stay clear of the moving arm of the excavator during insertion process.

PREPARATION OF THE EXCAVATOR MOUNTED PUSHING MACHINE

1. You must refer to the manufacturer's instruction for the set up and preparation of pushing machine.

Note: The guidance below is generic and must be used in conjunction with the manufacturer's instructions.

2. Move the excavator to a flat preferably hard surfaced within the site barrier system.
3. Remove the excavator bucket from the machine and secure the pins.

Care must be taken NOT to push the securing pins with fingers as fingers could become trapped and cause injury.

4. Position the excavator so that the arm can be lowered onto the pushing machine.
5. Align the excavator and secure the pushing machine onto the excavator arm ensuring the pins are secure with "R" clips.

Note: For connection using a 'Quick Hitch' reference must be made to the manufacturer's instruction depending on the version of hitch.

6. Secure the pushing machine to the 'Quick Hitch' by inserting safety pins.
7. Connect hydraulic hoses to the connectors on the excavator, if required.
8. Check that the positioning of the hoses is not going to restrict any movement of the excavator and that they are not going to cause any obvious obstruction throughout the operations.
9. Check that the pushing machine is securely attached to the arm of the excavator.

PREPARATION FOR INSERTION OF FIRST PIPE STRING

1. Position excavator over the host main with the insertion action moving towards the excavator see Figure 7.
2. The excavator must be a minimum of 0.5m away from the edge of the excavation.
3. Do not straddle the trench with the excavator.
4. Lower the excavator arm into the excavation and attached onto the PE pipe in accordance with the manufacturer's instructions.
   Note: If this requires operatives to enter the excavation the excavator must be turned off until the pushing machine is clamped to the PE main.
5. Position insertion trumpet, rollers and goal post.
   Note: Operatives must exit the excavation and must not enter the excavation while the excavator/Pushing machine is in use.
6. Check the operation of the pushing machine.
   Note: If any adjustments are required to the pushing machine, the excavator must be turned off.
7. Select a point on the pipe that will give the safest and most effective stroke minimising stress to the exposed host main.
8. A minimum of 500mm clearance must be maintained between the anchored live end cap and the pipe being inserted.
9. The operator must stop where excessive resistance is encountered.
   Note: Excessive force may damage the PE being inserted.
10. Remove the pushing machine from the new main after the main has been inserted.
    Note: If operatives must enter the excavation to undertake this operation the excavator must be switched off.

PUSHING MACHINE REMOVAL

Detach the pushing machine in reverse the attachment process and in accordance with the manufacturer's instructions.

Note: If a Quick Hitch is not used, care must be taken NOT to push the securing pins with figures as fingers could become trapped and cause injury.

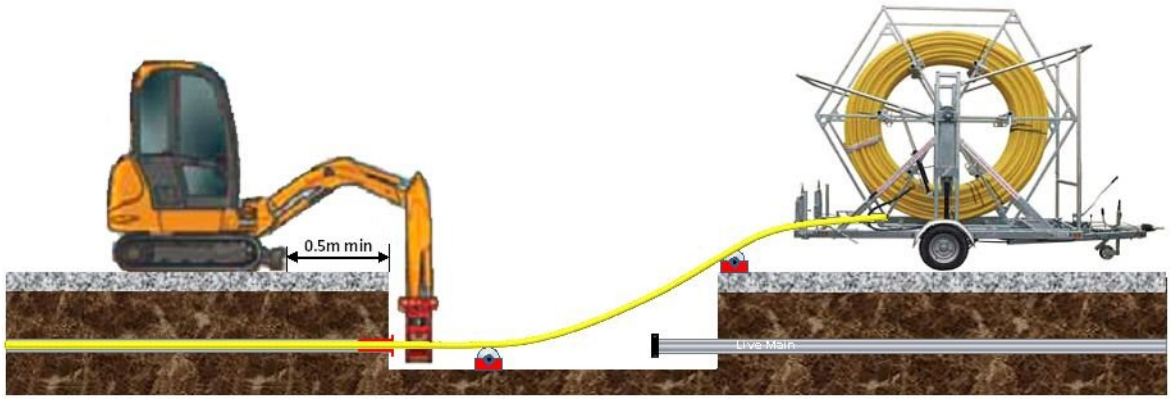


Figure 7 - Typical Insertion Coil Layout - Elevation

PRESSURE TEST

1. Fuse PE end caps to the ends of the inserted main.
2. The pipe must be suitably restrained before proceeding.
3. Pressure test inserted main in accordance with Section G2.
4. You must make sure that the new pipe work is adequately supported.
5. Anchor the live pipe and fittings in accordance with SGN/WI/DIS/4.2.2.

RECONNECTION OF MAIN

If the test is satisfactory the new pipe can be re-connected to the existing part of the network.

1. Make the connections using the procedures in Section E.
2. Commission the main in using procedures in Section H
3. Seal the annular spaces between the inserted main and the existing main.

LATERAL CONNECTIONS

1. To make a connection onto the PE inserted pipe a section of the carrier pipe to have to be removed.
2. Care must be taken when breaking out the carrier pipe.
   Note: See guidance in Appendix H.
3. If you know the location of a lateral connection in advance of the insertion you must remove the carrier pipe after isolation but before the PE pipe is inserted.
4. Where the location of a lateral connection is not known or where a connection is to be added subsequently, it is important to check that minimal PE pipe damage is caused.
   Note: Care is necessary to avoid damage by wheel cutters to the inserted main.
5. At lateral connections, seal the annular spaces between the inserted main and the existing main and the pipe work adequately supported.

REINSTATEMENT

Reinstate the excavations by following guidance in Section A1-Reinstatement

B3 Work Instruction for PE Mainlaying by Live Insertion up to and including 180mm diameter

This Section describes the procedure to be followed for the Live insertion of one or two-way fed systems up to and including 180mm diameter. For two way fed mains the launch excavation should be used for insertion in both directions by installing a gland box on either side of the cut out main.

On D.I. and steel systems specialist window cutters must be used to cut out for main and service connections. This Live insertion technique is not advisable on DI and steel systems where there are multiple service connections.

1. Live insertion involves inserting the new pipe through an existing pipe. Suitable sizes are given in Table 7 below.

Size of main to be replaced	55 mm	63 mm	75 mm	90 mm	110 mm	125 mm	140 mm	180 mm
3"	√							
4"	√	√	√	√				
5"	√	√	√	√	√			
6"	√	√	√	√	√	√		
8”	√	√	√	√	√	√	√	√
10”	√	√	√	√	√	√	√	√
12”	√	√	√	√	√	√	√	√

Table 7-Acceptable PE Insertion Diameters (to 180mm) for Metallic Carrier Pipes

SITE SURVEY

Complete a site survey see Section A1.

SITE PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. All excavations must be completed following guidance in Section A1.
4. A camera survey must be carried out prior to the mains isolation for any insertion technique.
   Note: The camera survey will identify dust and other debris which may obstruct the insertion or block the live insertion head.
5. Prior to the day of the isolation and insertion operation check that:

- All excavations have been completed see Section A1.
- See Table 6, when bends are found. If the bends cannot be inserted the replacement method must be reviewed.
- Gas services replacement is planned for after the insertion.
- Check that the insertion will not be obstructed by valves, syphons and bends.
- If you identify any obstruction inform your Operational Manager.
- Access will be available to all parts of the site.
- That the Routine Operation procedure is available on site.
- Consider the need for additional rollers, and to ensuring that the pipe coil trailer is securely anchored and won’t move should the pipe snag during roll out.

MULTILAYER PIPE

The additional outer coating (skin) of the pipe is approximately 0.6 to 1.5 mm thick and should have little bearing on the ability to use equipment for pushing operations but equipment should be checked to make sure that the clamping and shells are suitable for use.

INTEGRITY TEST OF PIPE FOR INSERTION

1. Cap the PE coil or pipe string and allow to cool.
2. Prior to inserting, the pipe coil or string should be subjected to an integrity test. See Section G1.

PREPARATION – PIPE FOR INSERTION

1. After a successful test a suitable live head nozzle must be fitted to the pipe string or coil.
2. The Manufacturer's instructions should be checked to confirm that the live head chosen is suitable for the intended live insertion operation.
   Note: Live insertion glands used on PE 80 pipes should cope with the minor increase in diameter of the outer skin of Multilayer (PE 100) pipes.
3. Refer to the End Seal manufacturer's instruction to confirm the expected length of travel of the foam.
4. **YOU MUST cross hatch the PE pipe using a marker pen for the length of the foam travel. Allow a factor of safety which is 3 X Diameters**.
   Note: This process will provide a visual indication when the time comes for the retrieval of the live head.
5. Remove the external weld beads of any butt fused joints.
6. Visually inspect the pipe before insertion. See Section B1 pipe inspection.

PE Diameter to be inserted mm)	Recommended distance between temporary end cap and gland box for excavation up to 1m cover Distance 'A'
55	2m
63	
75	
90	
110	3m
125	
180	4m

Table 8- Recommended Distances Between Temporary End Cap and Gland Box Where Bag Stop Equipment is Used.

PROCEDURE – MAINS ISOLATION FOR LIVE INSERTION

1. Carry out the flow stop operation on the section of main to be inserted as per Section E1, E2,E3 or Section E4. See also Table 8.
   Note: Use twin sets of equipment at either end.
2. Decommission the short section of main between excavations to be inserted following procedure in Section H4.
   Note: For live insertion using an excavator mounted pushing machine and using two excavations an additional section of main will need to be decommissioned.
3. Cut out sections of main at either end ensuring the pipe is cut square.
4. Fit cap ends and where necessary with anchorage on the remaining live end(s), (see SGN/WI/DIS/4.2.2).
5. Install: (see Figure 8)
   - a retrievable gland box incorporating a valve may be installed, or
   - alternatively, a gland box incorporating a plastic seal, which acts as a valve until the PE is inserted through it.

   Note: Refer the manufacturer's instructions for the correct installation procedure.
6. Make sure that the exposed carrier pipe is supported throughout its length during the preparation and insertion process.
7. If using bag stop equipment on the side not being inserted (up stream) the equipment should be removed.
   Note if Squeeze off equipment is being used upstream it should remain in place.
8. The bypass must remain in position.

ISOLATIONS AFTER INITIAL SECTION HAS BEEN INSERTED

Following insertion of the 1st section of main subsequent sections will require isolation on the side to be inserted using Section E3 or Section E4 and the side to be reconnected using squeeze off equipment see Section E1 or Section E2.

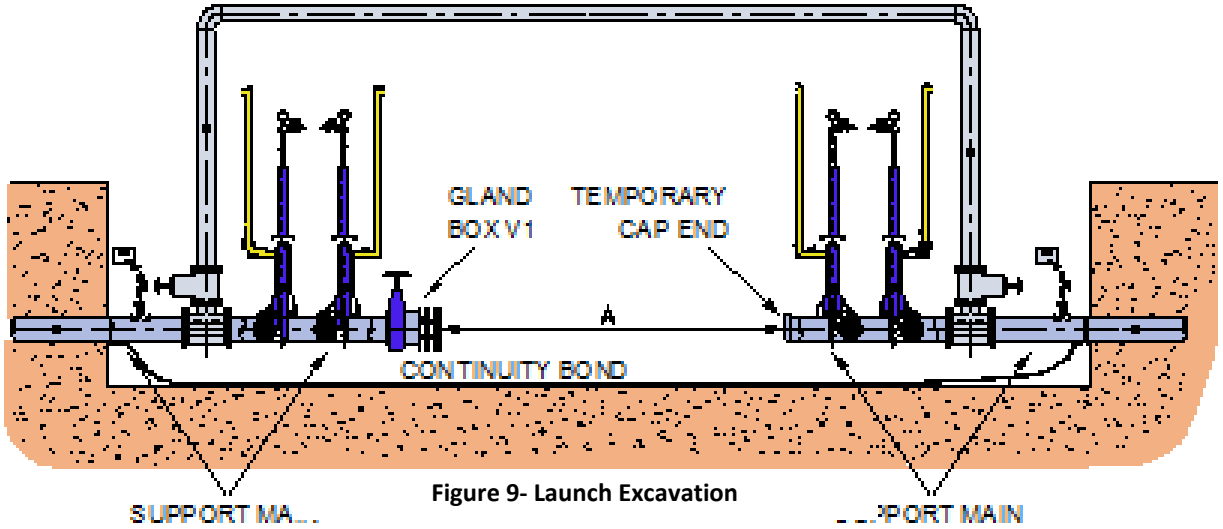


Figure 9- Launch Excavation

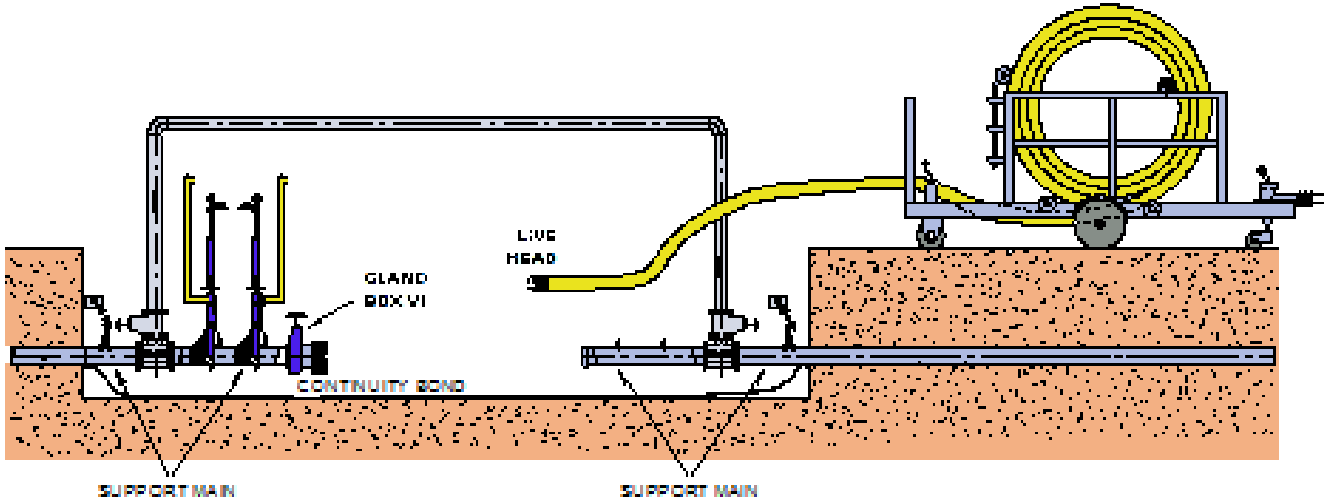


Figure 8- Live Head Installed on to PE Main

PREPARING FOR INSERTION BY PUSHING MACHINE

Only use an SGN approved pushing machine.

1. Locate the pushing machine in either:
- the launch excavation see Figure 9.
- Alternatively, it can be positioned above the trench or
- on a slope leading into the launch excavation.
2. Before anchoring by pining down the machine, check that the area below is free of other utilities plant using an approved cable locator.
3. Set up the correctly sized pipe rollers or other suitable packing both at road level and in the launch excavation as necessary to guide the inserted main into the existing main.

   Note: The use of pipe coils is the preferred method for live insertion up to and including 180mm PE.
4. If a partially used coil does not have the remaining banding in place it must not be used.
5. You must mechanically restrain the lead end of pipe coils until it is securely fastened into the PE pipe-pushing machine.
6. Install a 1" purge vent pipe to the end of the PE coil/pipe string in accordance with Section G1.

PROCEDURE – INSERTION OF PIPE USING PUSHING MACHINE

1. Insert live head into the gland until it meets Valve V1, plastic seal see Figure 10.
2. For one way fed mains commission in accordance with Section H1 opening the purge rider and the purge vent pipe at the end of the PE coil/pipe string.
3. Monitor pressures continually during this operation.

   Note: Pressure must not be allowed to drop below that stated on the routine operational procedure.
4. For two way fed mains commissioning of the main can be undertaken by pushing the PE through the plastic seal or opening valve V1 in the gland box.
5. Commission coil see Section H6.

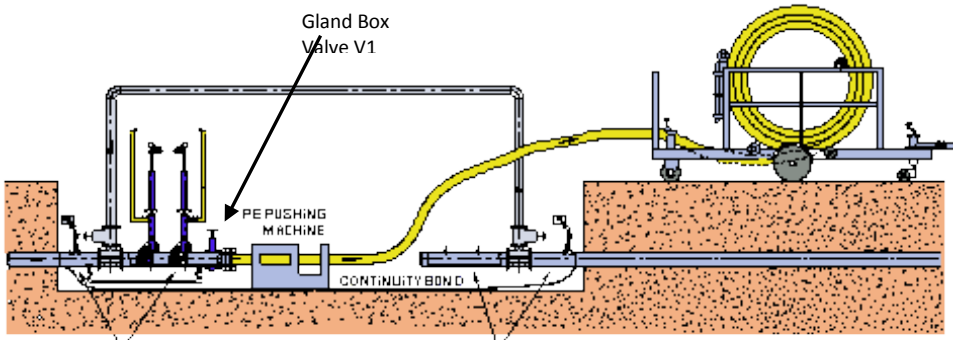


Figure 10- Insertion of PE Main into Live Main

6. When the purge is achieved, disconnect and remove the bags tubes in the main to be inserted.
7. On one-way systems attach a pressure gauge to the far end of the main to be inserted to check if pressures are lost during insertion process due to blockages caused by debris or water.
8. Set up a system of communication between the launch excavation and at the far end of the main to be inserted.
9. Start pushing the PE main into the carrier pipe, monitoring pressures in the carrier pipe.
10. Carefully record the length of new pipe pushed in as it passes into the gland box, in order that the position of the live head is known for future retrieval.

    Note: Cross hatching of the leading pipe must have been carried out as described in the Preparation Section.

PREPARING FOR INSERTION BY EXCAVATOR MOUNTED PUSHING ATTACHMENT

1. Fit the correct live head nozzle to the pipe coil.
2. Support the host main with timber and wedges against the side of the trench to prevent vertical or lateral movement on the host main during insertion. See Figure 11 and Figure 12.

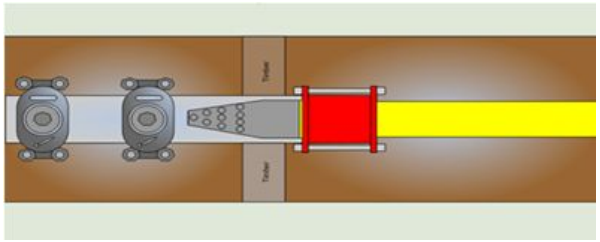


Figure 11 - Timber Support for the Host Main (plan view)

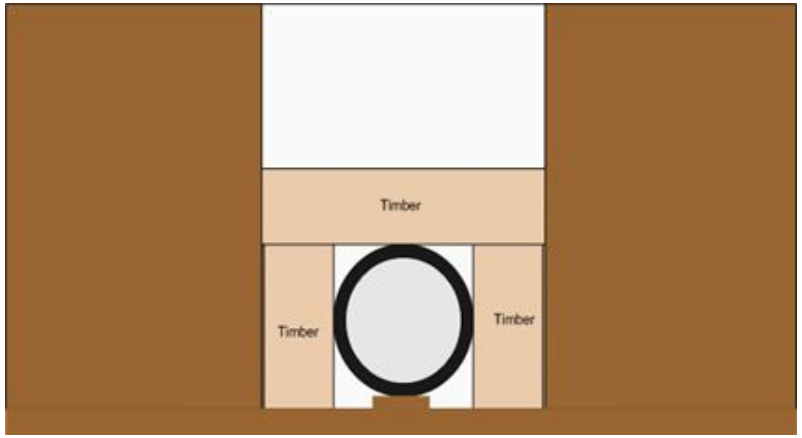


Figure 12- Timber Sport for the Host Main (side view)

3. Position the excavator over the host main with the insertion action pulling towards the excavator.
4. The excavator must be a minimum of 0.5m away from the edge of the excavation.

Note: Under no circumstances must the excavator straddle the trench.

5. Lower the excavator arm into the excavation and attach onto the PE pipe in accordance with the manufacturer's instructions.
   Note: If this requires operatives to enter the excavation the excavator must be turned off until the pushing machine is clamped to the PE main. Operatives must exit the excavation and must not enter the excavation while the excavator/pushing machine is in use.
6. Position insertion trumpet, roller and goal post.
   Note: Operatives must exit the excavation and must not enter the excavation while the excavator/Pushing machine is in use.
7. Check the operation of the pushing machine.
   Note: If any adjustments are required to the pushing machine, the excavator must be turned off during this period.

LIVE INSERTION USING EXCAVATOR MOUNTED PUSHING ATTACHMENTS

Only use excavator mounted pipe pushing attachments approved by SGN for this task.

Live Mains insertion can be undertaken using one excavation (see Figure 14) if the risk assessment determines that it's safe to proceed and no joints or repair clamps are exposed on the host main.

Where a one excavation technique cannot be used a two-excavation technique should be used see Figure 13. This limits any movement to the host main caused by the movement of the excavator arm during the insertion process.

The section of purged main beneath the excavator creates the correct alignment of the PE main prior to insertion through the Gland Box and into the live host main.

PROCEDURE – INSERTION OF PIPE USING EXCAVATOR MOUNTED PUSHING ATTACHMENT

1. Operate the controls on the excavator to bring the PE into the host main through the insertion trumpet with a smooth controlled horizontal motion.
   Note: A minimum of 500mm clearance must be maintained between the end cap and the pipe being inserted.
2. Push the pipe until the live head reaches the live insertion gland box and guide the live head into the gland box, an additional roller may be required to aid alignment of the main.
3. Purge the coil in accordance with Section H6 then deflate and remove flow stop from the main Section E3.
4. Continue to insert the main into the host main until the required length has been inserted.
5. The operator must stop where excessive resistance is encountered.
   Note: Excessive force may damage the PE being inserted.

PROCEDURE – INSERTION COMPLETION

1. When the new PE pipe has been 'pushed' in to the required length, stop the pushing machine.
2. Confirm the distance and location of the live head and recorded on the job documentation.
3. Remove pushing machine
   Note: For excavator mounted attachments, if operatives must enter the excavation to undertake this operation the excavator must be switched off.
4. Install insertion seal either at the first service or 5 metres away whichever is the furtherest away.
5. Breakout the main and install end seal at this point.
   Note: The purpose of this is to abandon the section of main that could have been disturbed during the insertion process.
6. If the valve gland box and seal is to be recovered an additional insertion seal must be inserted in the bag hole nearest the glandbox.
7. The valve and glandbox can then be slid away from the inserted pipe.
8. Fix a squeeze off at a minimum of 6 x pipe diameters from insertion seal.
9. Apply the squeeze off confirm a satisfactory seal (refer to Section E1 or E2).
10. Decommission the pipe coil following the procedures in Section H3.
11. Cut PE pipe at a suitable point to allow for installation onto existing supply host main. If the gland and valve is to be recovered then this can now be recovered.
12. Re-apply the flow stopping equipment on the existing main.
13. Connect new PE main to existing main.
14. Purge mains connection as per Section H1.
15. Remove flow stopping equipment.
16. Remove squeeze off unit.
17. Test all new joints with approved leak detection solution, washing off the solution with clean water on the PE main.
18. Close bypass whilst monitoring pressures, if pressures remain stable decommission and remove bypass.
19. If pressures fall or are unstable, reopen bypass and contact your Operational Manager.
20. Plug all holes and complete a final test with approved leak detection solution.
21. Reinstate excavation in accordance with the Section A1 - Reinstatement.

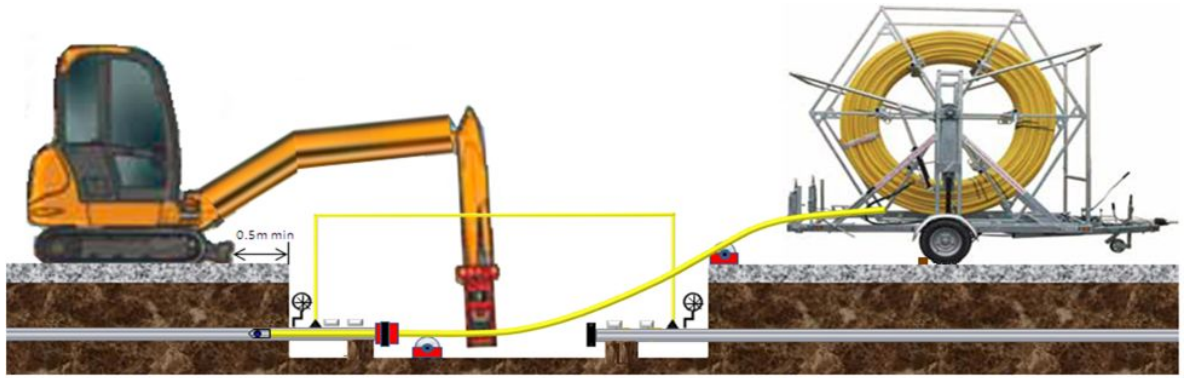


Figure 14 - One Excavation Live Mains Insertion

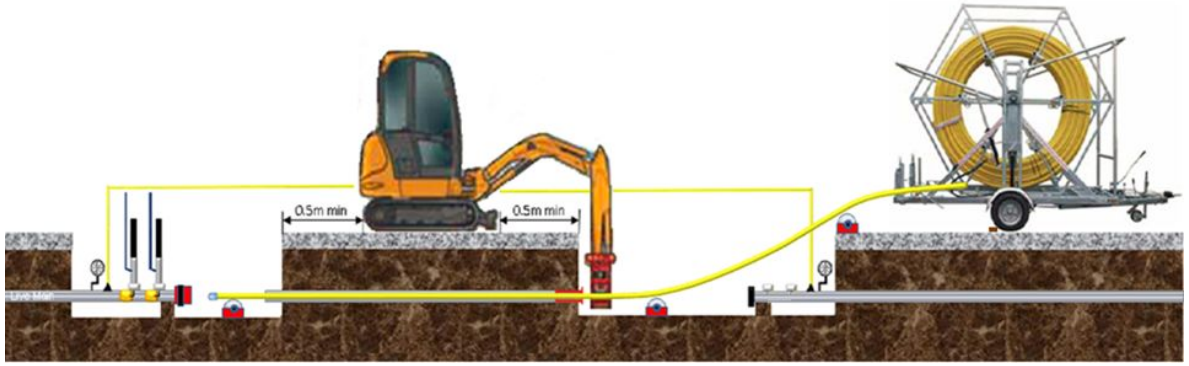


Figure 13 - Two Excavation Live Insertion Site Layout

PROCEDURE FOR TRANSFER OF SERVICE CONNECTIONS

Reference must be made to the Work Instruction for Service Laying, SGN/WI/SL/1 for the renewal/reconnection of the service onto the PE main.

1. Identify number of services to be transferred and insertion seal foam off positions excavate on the main at these locations.
   Note: The number of services to be transferred in one transaction will be dependent upon site conditions and available resources.
2. Begin the transfer of services from the gland box towards the live head.
   Note: In Figure 16 this would be at position 'B' the furthest service location to the live head.
3. On completion of service transfer, fit End Seal kit.
   Note: An End seal is required at the insertion seal point and then at each subsequent transfer position. The main should be sealed with either an end seal or an appropriate material, for example denso-mastic putty and tape as stated in SGN/WI/SL/1.

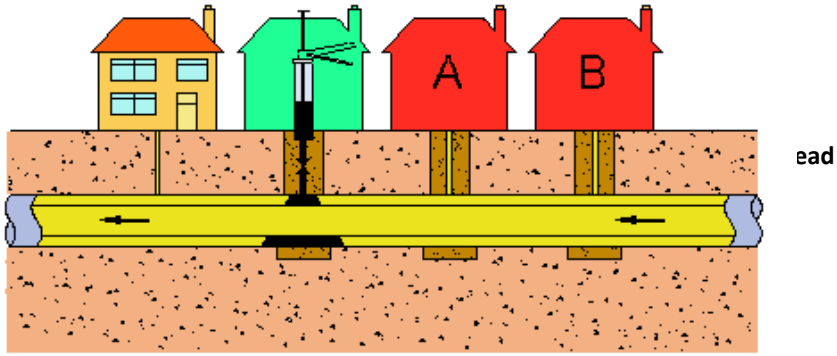
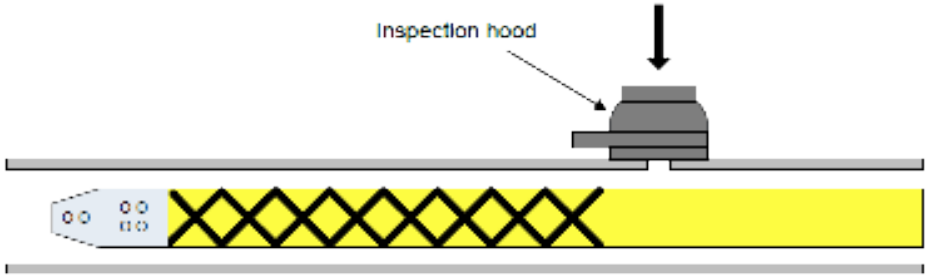


Figure 16- Mains Foam Off Allowing Service Transfer

DECOMMISSIONING OF HOST MAIN

A Routine Operational Procedure is not required for this activity if the procedure described below is followed unless requested by your Manager.

1. Make an excavation with an adequate work area.
2. Identify foam seal off point.
3. Set up a pressure point using the Emergency Control Valve on the service furthest from the foam off position.
4. A service connection position may be used for the foam insertion point.
5. Alternatively, drill (the blind drill and tap) and tap main using a specially



designed drill care being taking not to damage the inserted PE.

6. At the proposed point of foam injection, the inspection hood MUST be used to be certain that there is an inserted PE main and not too close to the live head.
7. If the markings can be seen through the inspection hood then the final foam off position is too close to the live head and the location must be moved until no pipe markings can be seen.
8. Install foam injection equipment.
9. Select the correct size of foam kit suitable for the combination the old main and the replacement PE main size, refer to manufacturer's tables.

10. Mix and inject foam following the manufacturer's instructions.
11. Check for isolation of the annulus of the main section being worked on by carrying out a decay test by reducing the pressure in this section and monitoring the pressure for an increase.
12. Should the pressure rise on the gauge, a second foam kit at a second location must be used and a further decay test conducted.
13. If the pressure continues to rise, then there could be an unknown backfeed into the isolated section – contact your Operational Manager to determine course of action to be taken.
14. If gas seal is satisfactory, purge the annular section of host carrier main to be abandoned, in accordance with Section H3 by safely venting to atmosphere from existing services or service connections in the intervening space.

    NOTE: There is no requirement to follow Section H3 in this instance if:
    - ***the pipe length to be worked on is less than 40m and***
    - ***there are no sources of ignition present and***
    - ***three cuts are made which are 2mm wide or greater and protective clothing is worn.***
    - ***The pipe is allowed to vent for 20 minutes at the cuts.***

15. Cut out the main at the service connection points upstream of the insertion seal point.
16. Before removing the section of main around the service connections, carry out an atmosphere check using an approved gas detection instrument ensuring there is no more than 20% LEL near the proposed breakout.

    Note: Under no circumstances must the main be cut on the live side of the injection hole.

17. Install continuity bond around break out position.
18. Follow the procedures in Appendix H for mains breakout.
19. When breaking out the main nearest the foam off position, the cut nearest the foam off you must use rotation wheel cutters in three places to prevent longitudinal cracks and ease of removal.
20. You must always fit an end seal kit nearest the foam off position.
21. Complete service work in accordance with SGN/WI/SL/1.
22. Seal the annulus between the new and old main at the insertion seal point and then at each subsequent transfer position. The main should be sealed with either an end seal or an appropriate material, for example denso-mastic putty and tape as stated in SGN/WI/SL/1.

    Note: The Annulus between the carrier pipe and the new main must be sealed to prevent ingress of gas and water. Always follow the manufacturer's instructions.

LIVE HEAD RECOVERY

When all the service transfers have been completed, the live head assembly must be removed.

The location of the live head should have been accurately recorded during the insertion process. This will make sure that the annular space is foamed off in a suitable position and that there is no risk that the live head will be foamed off as well.

1. A length of pipe from the live head must have been adequately marked see Preparation Section B3-2 see also Figure 15.
2. You must refer to the manufacturer's instructions to confirm the expected length of travel of foam and that the correct amount of foam is injected for the combination of carrier pipe and inserted PE main sizes
3. Make an excavation with an adequate work area.
4. A service connection position may be used for the foam insertion point.
5. Alternatively, drill (the blind drill and tap) and tap main using a specially designed drill care being taking not to damage the inserted PE.
6. Check that you have located the position of the live head.

7. At the final proposed point of foam injection, the inspection hood MUST be used to be certain that there is an inserted PE main at this location prior to live head recovery.
8. Even when the inspection hood shows the presence of an inserted main, there is a risk that this position may be too close to the live head.
9. If the markings can be seen through the inspection hood, then the final foam off position is too close to the live head and the location must be moved until no pipe markings can be seen.
10. Where a service connection point is not available, drill (using a blind drill and tap main using a specially designed drill. Take care not to damage the inserted PE.
11. Use the inspection hood to confirm that no pipe markings can be seen.
12. Install reversible stand pipe fitting.
13. Fit End Seal and mix, inject foam and allow to cure following the manufacturer's instructions.
14. Inject foam and allow to cure following the manufacturer's instruction.
15. Decommission host main – refer to Decommissioning of host main above 11-17.
16. Break out section of existing main upstream of the foam. Refer to Appendix H and install End seal.
17. Install a bypass from the new PE main to a position downstream of the proposed flow stop position to make sure continuity of supply.
18. Purge and commission the bypass following Section D.

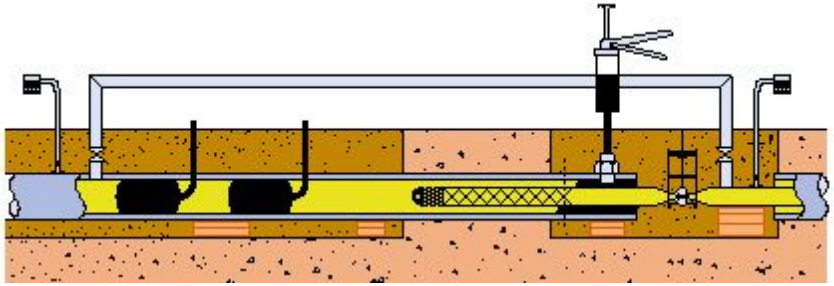


Figure 17- Insertion of Flow Stop Equipment on a Section of Main to be Either Further Inserted or Connected to Existing System or is Two-Way Fed

19. Insert flow stop equipment between live head and the downstream by-pass connection, see Figure 17.
20. Squeeze off new PE main, seeFigure 17.
21. Slowly vent the annular space (the pressure should fall to zero).
22. Turn off the vent, there should be no pressure build up.
23. A pressure increase would indicate a failure of the flow stop equipment; check equipment and re-apply flow stopping equipment as necessary.
24. If no pressure builds up, fit continuity bond and break out the host pipe between the flow stop equipment and the foam off kit.
25. Recover the live head and either connect the new PE pipe to the existing main and remove flow stopping and by-pass equipment or if the insertion is to continue, temporarily cap off PE main, fit gland box assembly to existing main ready for the next insertion.

LIVE HEAD RECOVERY AT END OF SYSTEM

Where the live insertion project has reached the end of a section of pipe, the live head will need to be recovered at the host main cap end as follows.

1. Make an excavation with an adequate work area at the final proposed point of foam injection.
2. Where a service connection point is not available, drill (using a blind drill and tap main using a specially designed drill. Take care not to damage the inserted PE.
3. Use the inspection hood to confirm that no pipe markings can be seen to be certain that there is an inserted PE main at this location prior to live head recovery.
4. Install reversible stand pipe fitting.
5. The pressure points must be in place and the bypass open
6. Inject foam into the annular space at the point selected, whilst monitoring pressures.
7. Apply the squeeze off(s)
8. Carry out a decay test following procedure in Section H5.

9. If satisfactory slowly close the bypass valves and vent down the bypass and isolate section of pipe to the live head.

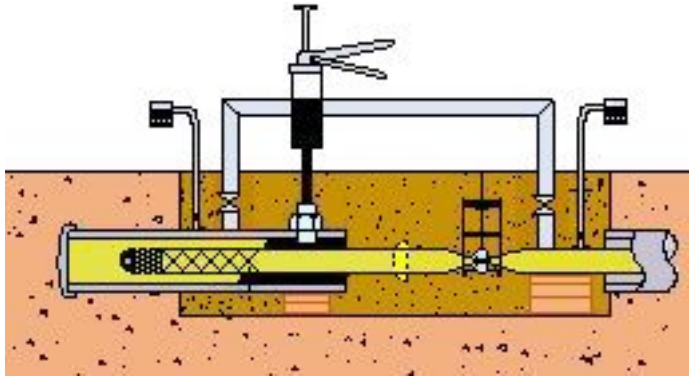


Figure 18 - Recovery of Live Head at End of System

10. Cut PE main and cap pipe
11. Remove fittings on old main and recover live head
12. Fit end seal
13. Release and remove squeeze off(s) and apply squeeze marking tape.

REINSTATEMENT

Reinstate the excavations by following guidance in Section A1-Reinstatement

B4 Work Instruction for PE Mainlaying by Live insertion – Low Pressure mains above 180mm

This Section describes the procedure to be followed for the Live insertion of one or two-way fed systems for low pressure mains greater than 180mm diameter. For two way fed mains the launch excavation should be used for insertion in both directions by installing a gland box on either side of the cut out main.

Live insertion on mains above 180mm up to and including 500mm does not use a live insertion head, otherwise it follows the same general procedure for below 180mm ***see Section B3***.

On D.I. and steel systems specialist window cutters must be used to cut out for main and service connections. This Live insertion technique is not advisable on DI and steel systems where there are multiple service connections.

1. Suitable sizes are given in Table 9 below.

Size of main to be replaced	Size of PE main that can be inserted for various mains sizes														
	55 mm	63 mm	75 mm	90 mm	110 mm	125 mm	140 mm	180 mm	250 mm	268 mm	315 mm	355 mm	400 mm	450 mm	500 mm
3"	√														
4"	√	√	√	√											
5"	√	√	√	√	√										
6"	√	√	√	√	√	√									
8”	√	√	√	√	√	√	√	√							
10”	√	√	√	√	√	√	√	√							
12”	√	√	√	√	√	√	√	√	√						
16”	√	√	√	√	√	√	√	√	√	√	√	√			
18”	√	√	√	√	√	√	√	√	√	√	√	√	√		
24”	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Table 9- Acceptable PE Insertion Diameters for Metallic Carrier Pipes

This section describes the procedure to be followed when using a pushing machine. When large diameter mains (above 180mm) are to be inserted using an excavator mounted clamping device then the procedure in Section B3 should be followed.

SITE SURVEY

Complete a site survey see Section A1.

SITE PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. All excavations must be completed following guidance in Section A1.
4. A camera survey must be carried out prior to the mains isolation for any insertion technique.

   Note: The camera survey will identify dust and other debris which may obstruct the insertion or block the live insertion head.
5. Prior to the day of the isolation and insertion operation check that:

- All excavations have been completed see Section A1.
- See Table 6, for length of ground to be removed when bends are found.
- That replacement of gas services on the section of main affected has been planned.
- Check that the insertion will not be obstructed by valves, syphons and bends.
- If you identify any obstruction inform your Operational Manager.
- Access will be available to the entire site.
- That the Routine Operation procedure & Network Analysis is available on site.
- Consider the need for additional rollers, and to ensuring that the pipe coil trailer is securely anchored and won't move should the pipe snag during roll out.

MULTILAYER PIPE

The additional outer coating (skin) of the pipe is approximately 0.6 to 1.5mm thick and should have little bearing on the ability to use equipment for pushing operations but equipment should be checked to make sure that the clamping and shells are suitable for use.

INTEGRITY TEST OF PIPE FOR INSERTION

1. Cap the pipe string and allow to cool.
2. A string of pipes must be butt fused jointing in accordance with Appendix E.
3. Remove the external weld beads of any butt fused joints.
4. Visually inspect the pipe before insertion see Section B1 Pipe Inspection.
5. Prior to inserting, the pipe coil or string should be subjected to an integrity test. See Section G1.

PREPARATION – PIPE FOR INSERTION

1. After a successful test a standard PE cap must be fitted to the pipe string.

   Note: Live head nozzles are not fitted to pipes greater than 180mm dia.
2. Refer to the End Seal manufacturer's instruction to confirm the expected length of travel of the foam.
3. **YOU MUST cross hatch the PE pipe using a marker pen for the length of the foam travel at the cap end which will be inserted. Allow a factor of safety which is 3 X Diameters**.

   Notye: This process will provide a visual indication when the time comes for the locating the Capped head.
4. Remove the external weld beads of any butt fused joints.
5. Visually inspect the pipe before insertion.

PE Diameter to be inserted mm)	Recommended distance between temporary end cap and gland box for excavation up to 1m cover Distance 'A'
250	5m
315 & 355mm	6m
400	9m
500	10m

Table 10 - Recommended Distances Between Temporary End Caps and Gland Box (above 180mm) Where Bag-stop Equipment is being Used.

PROCEDURE – MAINS ISOLATION FOR LIVE INSERTION

1. Carry out the flow stop operation on the section of main to be inserted as per Section E3 and up to 8" (200mm) diameter see also Section E4. Also, refer to Table 20 for details of large diameter operations. If isolations are to be made by Iris stop or Large diameter Bag-stop refer to SGN/PM/MSL/1 Part 2.
   Use twin sets of equipment at either end, that is 8 bags in total.
2. See Table 10 for recommended distances between temporary end caps and gland box
3. Decommission the short isolated section of main following procedure in Section H3.
   Note: For live insertion using an excavator mounted pushing machine and using two excavations an additional section of main will need to be decommissioned.
4. Cut out sections of main at either end ensuring the pipe is cut square.
5. Fit cap end and where necessary with anchorage on the remaining live end(s). (see SGN/WI/DIS/4.2.2).
6. Install: (see Figure 19)
   - a retrievable gland box incorporating a valve may be installed, or
   - alternatively, a disposable gland box incorporating a plastic seal, which acts as a valve until the PE is inserted through it.

   Note: Refer the manufacturer's instructions for the correct installation procedure.
7. Make sure that the exposed carrier pipe is supported throughout its length during the preparation and insertion process.
8. Remove bag stop equipment from the main.
9. The bypass must remain in position.

ISOLATIONS AFTER INITIAL SECTION HAS BEEN INSERTED

1. Following insertion of the 1st section of main subsequent sections will require isolation on the side to be inserted using Section E3 or Section E4 for up to 8"/200mm and the side to be reconnected using squeeze off equipment see Section E1 or Section E2.

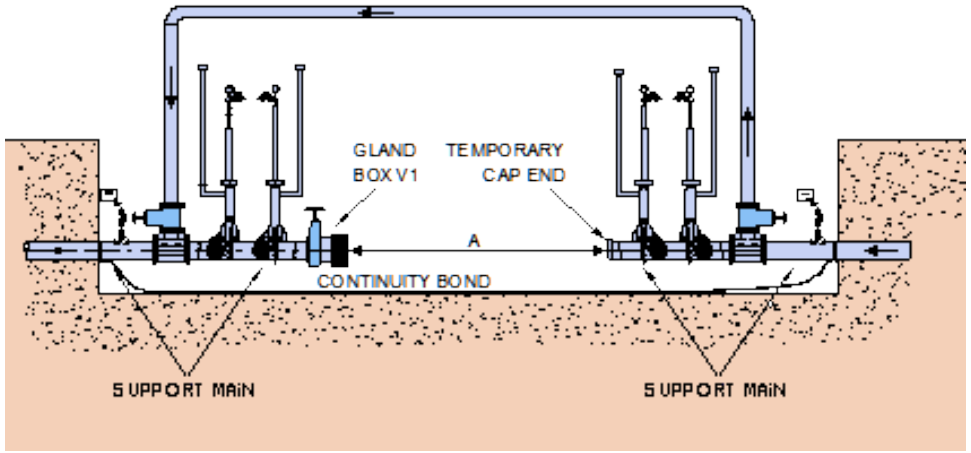


Figure 19- Launch Excavation

PREPARING FOR INSERTION BY PUSHING MACHINE

Only use an SGN approved pushing machine.

1. Locate the pushing machine in either:
   - the launch excavation.
   - Alternatively, it can be positioned above the trench or
   - on a slope leading into the launch excavation. (See Figure 20)
2. Before anchoring by pining down the machine, check that the area below is free of other utilities plant using an approved cable locator.
3. A concrete slab should be constructed to support the pushing machine due to the extra weight for large diameter operations.
4. Set up the correctly sized pipe rollers or other suitable packing both at road level and in the launch excavation as necessary to guide the inserted main into the existing main.

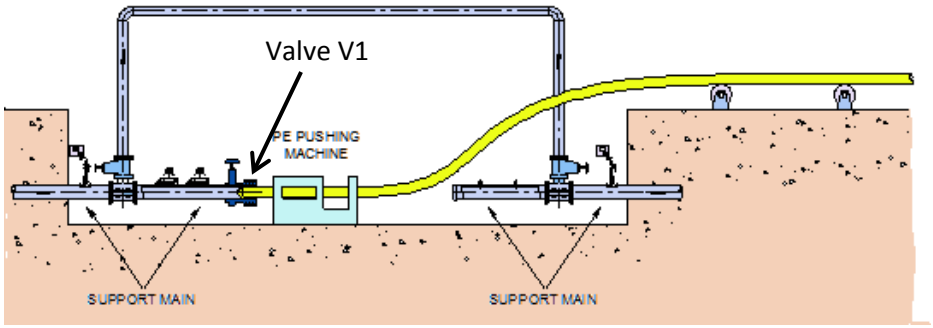


Figure 20- PE Insertion

PROCEDURE – INSERTION OF PIPE USING PUSHING MACHINE

1. Insert the capped end into the gland until it meets Valve V1, plastic seal see Figure 20.
2. Start pushing the PE pipe string into the host main, you must monitor the pressures.
3. Monitor pressures continually during this operation.
   Note: Pressure must not be allowed to drop below that stated on the routine operational procedure.
4. Should pressures fall below the stated minimum the new PE pipe must be reversed from the host main and you must inform your Operational Manager.
5. Record the length of new pipe pushed in as it passes into the gland box, in order that the position of the live head is known for future retrieval.
6. Install a purge vent pipe (for the size of main) to the end of the PE pipe string in accordance with Section G1.

PROCEDURE – INSERTION COMPLETION

1. When the new PE pipe has been 'pushed' in to the required length, stop the pushing machine.
2. Excavate at the cap end location of the newly inserted PE main.
   A camera survey can be used to locate the cap end if the position cannot be determined.
3. Mark the measured position of the location of the PE cap on the host main.
4. Carry out a test drilling and using an inspection dome to confirm the location of the PE cap.
5. Install a bypass in preparation of the new connection position as shown in Figure 21, allowing for any foam travel as determined by the manufacturer's instructions.
6. Bypass installation must follow guidance in Section E0 Bypass and Rider
7. Flow stop the host main following Section E3 (up to 12" diameter or using alternative methods using SGN/PM/MSL/1 Part 2.
8. Allowing for the travel of foam, inject foam into the annulus using a hole drilled in the host main.
   Note: Travel of foam information can be obtained from the Manufacturers. Foam bags over 10" will usually be inserted by a specialist contractor.

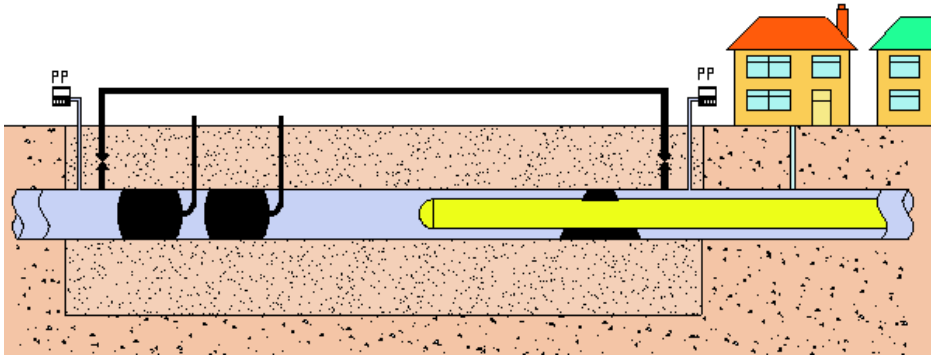


Figure 21- Exit Excavation

9. Reduce the pressure of the gas between the secondary bag and the foam bag and check for any inter connection. Use the secondary bag vent.
   If satisfactory reduce to the pressure to zero and check for the quality of the seal.

10. If pressure rises a second foam bags must be installed and /or the bag stop reset.
11. If the seal is satisfactory the main can be cut out, take care not to damage the inserted pipe.
12. Fit a temporary cap to the end of the metallic pipe.
    Note: You will need to cut out sufficient of the host pipe to fit a two bypasses, two squeeze offs and room for connecting couplings see Figure 21.
13. Fit an End Seal to the inserted pipe and host main at the exit excavation.
14. Leave bypass in place - See Bypass and Rider construction.

INSERTION COMPLETION – LAUNCH EXCAVATION

1. At the launch excavation, cut the inserted pipe allowing enough pipe for double squeeze off connection.
2. Cap PE pipe.
3. Remove pushing machine
   Note: For excavator mounted attachments, if operatives must enter the excavation to undertake this operation the excavator must be switched off.
4. Install insertion seal either at the first service or 5 metres away whichever is the furtherest away.
5. Breakout the main and install end seal at this point.
   Note: The purpose of this is to abandon the section of main that could have been disturbed during the insertion process.
6. If the valve gland box and seal is to be recovered an additional insertion seal must be inserted in the bag hole nearest the glandbox.
7. The valve and glandbox can then be slid away from the inserted pipe.

TESTING AND COMMISSIONING OF INSERTED PIPE

1. Install a vent pipe on to the inserted PE pipe in the launch excavation See Bypass and Rider construction
2. Install a rider at the exit excavation between the metallic main and the inserted PE pipe.
3. Using the rider purge the PE main venting at the launch excavation following the procedure in Section H2 Commissioning by Direct purging.
4. Once the purge has been completed close the vent at the launch excavation.
5. Remove squeeze off unit.
6. Install a pressure gauge onto the new PE pipe.
7. Anchor the pipe and fittings in accordance with SGN/WI/DIS/4.2.2
8. Allow the pressure to rise to normal operating pressure.
9. Test all visible new joints with approved leak detection solution, washing off the solution with clean water on the PE main.
10. Physically isolate the purge rider.
11. Using a natural gas bottle attached to the new PE main slowly pressurise the main to 350mbar.

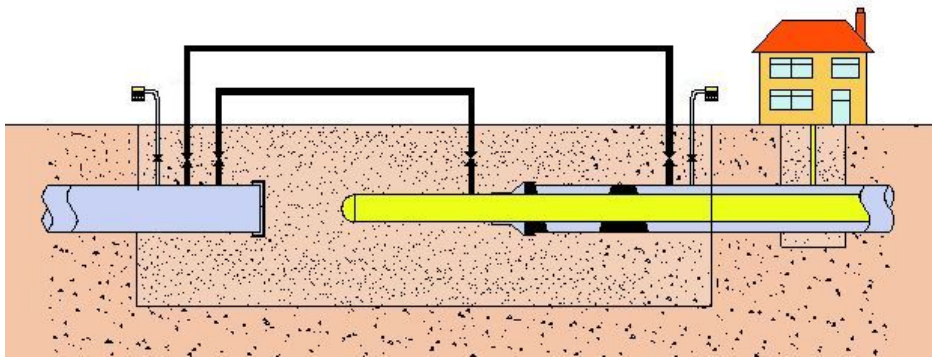


Figure 22- Exit Excavation - Commissioning PE Pipe

12. Monitor the pressure point for any fall in pressure.
13. Allow a 2-hour stabilisation period.
14. Follow the procedure in Section G2 Testing of buried pipes to test the pipe.
15. Complete the test documents.
16. If the test is successful, the pressure in the new PE pipe can be slowly let down to the normal district operating pressure by reopening the rider at the exit excavation.
17. Leave the rider commissioned at this stage.

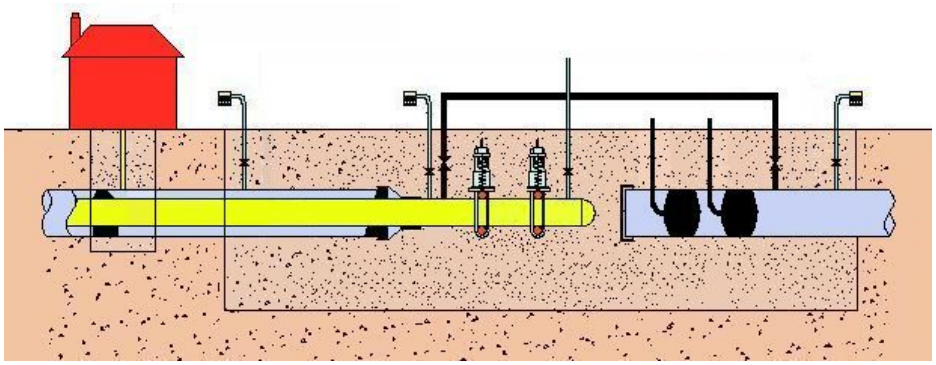


Figure 23- Launch Excavation - Commissioning PE pipe

RECONNECTIONS

1. Once the pressure in the newly inserted pipe has equalised the reconnection work can commence.
   Note: Connections will be a combination of PE squeeze-offs, PE, and metallic bags/ iris stops as required.
2. Following the procedures in Section E0 or for specialist equipment SGN/PM/MSL/1 Part 2, commence the connection at the launch excavation see Figure 23.
3. Once complete make the connections at the exit excavations.
4. On completion bypasses and rider between the metallic and PE pipe can be removed at the launch excavation.
   The bypass connection to the host lined main at the exit location must remain in place until the services has been transferred.

PROCEDURE FOR TRANSFER OF SERVICE CONNECTIONS

Follow the procedure in Section B3 Service Connections to transfer the service connections.

DECOMMISSIONING OF HOST MAIN

1. Identify foam injection positions.
2. Set up a pressure point using the Emergency Control Valve on the service furthest from the foam off position.
3. A service connection position may be used for the foam insertion point.
4. Alternatively, drill (the blind drill and tap) and tap main using a specially designed drill care being taking not to damage the inserted PE.
5. Install foam injection equipment.
6. Select the correct size of foam kit suitable for the combination the old main and the replacement PE main size, refer to manufacturer's tables.
7. Mix and inject foam following the manufacturer's instructions.
8. Check for isolation of the annulus of the main section being worked on by carrying out a decay test by reducing the pressure in this section and monitoring the pressure for an increase.
9. Should the pressure rise on the gauge, a second foam kit at a second location must be used and a further decay test conducted.
10. If the pressure continues to rise, then there could be an unknown backfeed into the isolated section – contact your Operational Manager to determine course of action to be taken.
11. If gas seal is satisfactory, purge the annular section of host carrier main to be abandoned, in accordance with Section H3 by safely venting to atmosphere from existing services or service connections in the intervening space.
    Note: Refer to Table 50 to determine if there is a requirement to follow Section H3. ***The following must also be in place:***
    - ***there are no sources of ignition present and***
    - ***three cuts are made which are 2mm wide or greater .***
    - ***The pipe is allowed to vent for 20 minutes at the cuts.***
    - ***If seal is not satisfactory you must inform your Operations Manager.***
    - ***Before removing the section of main around the service connections, carry out an atmosphere check using an approved gas detection instrument ensuring there is no more than 20% LEL near the proposed breakout. Follow the procedures in*** Appendix H ***for mains breakout.***

    Under no circumstances must the main be cut on the live side of the injection hole.

REINSTATEMENT

Reinstate the excavations by following guidance in Section A1-Reinstatement

B5 Work Instruction for PE Mainlaying by Impact Moling Technique

This section describes the procedure to be followed when laying mains using impact moling.

SITE SURVEY

Complete a site survey see Section A1

SITE PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. All excavations must be completed following guidance in Section A1
4. Additionally, when undertaking impact moling operations electrically insulated PPE must also be worn (typically insulating gloves and boots of with a rating of 20kV) when in contact with the equipment.
   Electrical insulating PPE must only be used by personnel that have received correct training, instruction and briefing on its correct use, storage, maintenance and cleaning requirements.
   DO NOT USE THE ELECTRICALLY INSULATED WELLINGTON BOOT FOR EXCAVATING
5. Excessive contact with the lubricant must be avoided and PVC or disposable gloves and goggles must always be worn when undertaking maintenance checks or filling the lubricator with the oil.
   Note: Working and safety instructions for use of particular types of equipment must be obtained from the manufacturer and referred to.
6. An approved gauze facemask (A1P2 half mask SGN stock code 950014) must be worn when working within 1m of the exhaust from the impact mole.
7. Complete pre-moling check sheet.
8. Where you cannot guarantee the safe passage of the impact mole beneath any cable, then:
   a) Excavate launch and receive holes either side of the cable and
   b) Lay the pipe under the cable by open cut techniques.
      or
   c) Use an alternative means to lay the pipe.

Pre-Moling Checklist		Safe to Continue YES/NO
1	Have you undertaken a site-specific risk assessment?	
2	Have you studied and understood the Utility drawings provided?	
3	Have you checked for visual indications of buried services?	
4	Have you traced the entire area to be moled, using the CAT & Genny on Power, Radio and Genny Modes?	
5	Have you used the plug connector to trace the electricity service from the property to the main?	
6	Have you used the street light clamp to trace the street lighting cable?	
7	Have you excavated on and exposed all buried utilities on site including electric, gas street lighting, cable TV, BT, water, or any other known street furniture, and others?	
8	Have you excavated and exposed the entire route in the footpath that will be affected by the route of the mole?	
9	Have you identified a safe moling route leaving at least 300mm clearance from parallel electric cables and 250mm clearance from other parallel services?	
10	Have you identified in which direction to bore, such as towards the lowest risk area?	
11	Do you have all appropriate correct and tested (where applicable) PPE and are you wearing it?	
12	Have you accurately marked the distance to be bored on the nonconductive hose?	

Table 11-Pre-moling Check ist

9. If traces of plant are found, or if the location is too congested for the use of the launch cradle, consider:
   a) Launching from a different location.
   b) Use an alternative means to lay the pipe.

   Note: Longer bores may require a slit trench, which is later, expanded into a reception pit when the exit point of the impact mole is known. At all times make sure the reception pit is in full view of the launch pit
10. Review the pre-moling checklist (Table 11).

EQUIPMENT SELECTION

The performance of the equipment to be used can be affected by certain ground conditions. Table 12 recommends ancillary equipment that will aid the travel of the equipment in various soil types.

1. PE pipe can be used as an air supply hose can be used provided a water-based lubricant is used. Check with the manufacturer's instructions.

Soil Condition	Recommended Equipment	Recommended method of Inserting pipe.
Clay Ground	Slip on sleeve, and oversized cone.	No preference
Compacted – sand, sandstone, chalk	Smooth cone to eliminate friction and lateral movement	No preference
Loose Shingle, sand, loose ground	Pulls the pipe in behind it at the same time as the boring takes place to stop bore collapse. Install a duct or sleeve in behind the impact mole at the same time as the boring takes place to stop the bore collapse	Towing attachment Rear fitting duct towing attachment

Table 12- Equipment Selection for Different Conditions

2. Select the correct type of equipment that will suit the PE pipe to be inserted due to an average of 10% bore shrinkage that will occur with each size of impact mole, Table 13 sets out minimum requirements).

Note: Always use the maximum size PE pipe when moling – Minimum bore is typically 90% of the mole size.

PROCEDURE – POSITIONING THE LAUNCH CRADLE

1. Inspect the moling equipment before use.
2. You must always use a non-electrical conductive hose.
3. Identify the launch excavation so that you launch the impact mole from cables and never towards them.

   Note: Whenever possible, launch the impact mole from the most congested side of the road to minimize the risk of damage to underground plant. Avoid impact moling towards cables. Boring towards other utility plant should always be avoided, unless a site survey is carried out first to establish their location.
4. Recheck the base and sides of the launch excavation for cables and other plant.
5. The launching cradle should be used in all circumstances; the launching pit needs to be large enough to accommodate the cradle.

PE pipe to be inserted (mm)	Min Bore diameter (mm) [1]	Standard impact mole size (mm)
20,25,32	45	45
40	52	55
55	61	65
63	70	75
75	85	95
90	99	110
110	117	130
125	130	145
180	130	180 or 145mm with expander

Table 13- Equipment Size Range

6. Position the cradle in the launch excavation approximately 150mm (6”) from the front face of the pit or horizontal supports.
7. Secure the cradle in position using the securing pins.
   See Table 14 and Figure 24.
8. The length of the impact mole operation needs to be considered for each section.
9. Make sure where possible there is a clear line of sight.

ASSEMBLY OF EQUIPMENT

1. Attach the non-conductive airline to a suitable compressor.
2. Air delivery pressure from the compressor should be a maximum of 6-7 bar (85 – 100 psig).
3. Holding the airline and directing the end away from people or property switch on the compressor in a controlled manner to remove any residual dust or moisture by blowing the line.
4. Make sure that a water separator is fitted prior to the attachment to the lubricator.
   Note: All hose connections must be supported with whip checks.
5. Use that the correct lubricant in the lubricator as per manufacturer’s instructions.
6. Attach the air hose to the oil bath noting the direction of operation.
   Notes:
   Failure to operate the impact mole through a lubricator will cause machine wear and damage.
   In extreme circumstances the air will cause freezing and prevent operation.

   This will usually happen after a period of operation.

   Do not pour any non-recommended lubricant, such as diesel, petrol, antifreeze, oil down the air hose as this will cause seals to be damaged, reduce performance and in extreme circumstances the tool will cease operation and could be irrevocably damaged.

7. On top of the lubricator, are two screws, one with a tee and one with a ring.

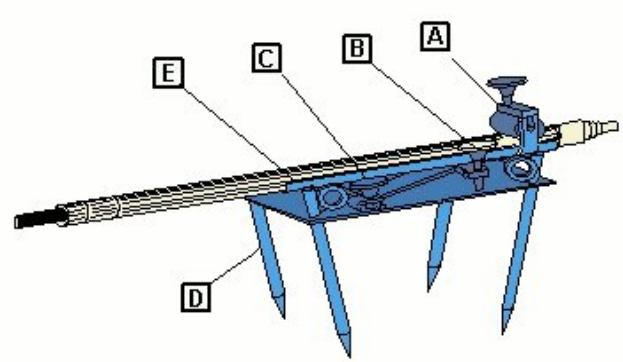


Figure 24- Launch Cradle

	Item
A	Friction roller
B	Vertical height Adjustor
C	Horizontal adjustor
D	Securing pins
E	Cradle

Table 14- Launch Ccradle

8. Opening these will allow access for topping up levels and access to the feed screw.
   Note: Do not attempt to gain access to these locations if the system is under pressure.
9. Using the integral screwdriver adjust the lubricant oil feed screw until it is open ¼ of a turn anticlockwise. Max of ½ turn.
   Note: Max–of 1 - 2 turn for winter operations (refer to manufacturer’s instructions).
10. Securely replace the screw caps.

11. Attach the impact mole airline to the oil bottle lubricator and mole respectively.
12. Take the impact mole to the receive pit with the hose following the proposed new installation.
13. At the launch pit end, mark the hose.
    Note: Additional marks may be added to indicate the expected location of other utilities in line of the proposed route.
14. Lift the impact mole so the piston can be heard to slide to the rear of the machine.
    Note: Failure to do so will result in the machine not starting correctly.
15. Return to the launch pit, lay the hose out towards the bore direction beware of creating a tripping hazard.

SIGHTING THE IMPACT MOLE

1. Check that the impact mole is in the forward position.
2. Place the nose of the impact mole in the cradle and secure it in position using rubber friction one way feed roller.
3. Position at the desired depth and in the required direction.
4. A sighting rod must be used to be sure that an accurate launch will take place.
5. Place the sighting rod in the receive pit where the impact mole is expected to appear.
6. Place the rod/staff in the base of receive pit where the want the machine to exit.
7. Measure a distance of 1.6m (1.0m) 1.5m (0.9m) if the scope is kept in the closed position) and mark the target stick.
8. This mark is the height of the scope plus 100mm (the 100 mm allows for the height of the cradle from the bottom of the excavation). Refer to Figure 25.
9. Where the launch depth is deeper adjust measurements accordingly.
10. This mark is the height of the scope to the centre of the impact mole. Refer to Figure 25.
    Note: Where the launch depth is deeper, adjust measurements accordingly.
11. Place the scope on the impact mole [a] 1/3rd of the mole length from the bore wall.
12. Adjust the position of the impact mole with the adjustable screws on the starting cradle so that the cross hairs in the scope line up with the site target stick.
    Note: The impact mole is ready to be launched. The impact mole should be aligned to give the maximum clearance from other underground plant, but not less than 250 mm clearance for bore lengths up to 8 metres- refer to Figure 25- Sighting Impact Mole Equipment.

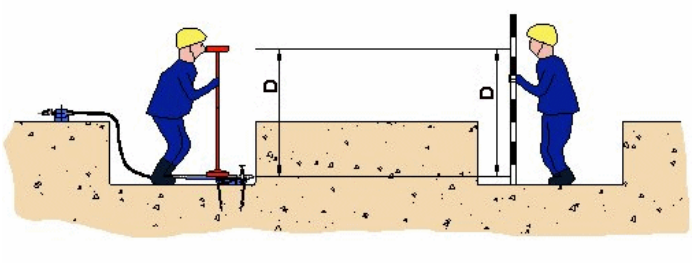


Figure 25- Sighting Impact Mole Equipment

For dimension D see Table 2

USE OF THE IMPACT MOLE

1. Stand clear of the excavation when launching.
   Note: Do not stand directly behind the exhaust of the impact mole at any time.
2. You must not allow the impact mole to be in contact with any plant when it is launched.
   Note: Maintain a minimum distance of 250mm between the gas pipe and other known locations of buried utilities.

3. **DO NOT** make direct contact with the air hose/ impact mole during operations.
4. If during the operation, it becomes necessary to be in direct contact with the equipment, insulating gloves and boots of a rating no less than 20 kV must be used.
5. Switch on the air, no more than a ¼ turn of the lubricator so that the piston starts reciprocating. This will give a reduced hammer action and allow a controlled entry into the ground.
   Note: Any resistance encountered during the flight of the impact mole (particularly during launching) should be investigated.
6. When the impact mole has entered the ground approximately 200mm, the air should be turned off and the line of site should be checked to be sure the direction has not changed.
7. This process should be repeated until the mole is ⅔ of its length into the bore, after this the direction of the impact mole cannot be changed and a new launch will be required if the direction is not correct.
8. Gently increase the air supply, the safest speed for the operation is a maximum of (0.5 metre/minute).
9. Monitor the progress of the impact mole by standing above the line of route (where reasonably practicable and safe) to follow its line and depth, whilst in operation. DO NOT stand in the excavation.
   Note: This should be done in conjunction with marking the air hose, to determine the length of travel; and the vibration would normally indicate the satisfactory depth of cover.
10. When the moling operation is nearing completion, indicated by the marks on the hose, one operator should stand by but not in the receive pit and observe ground movement of the impact mole emerging into the pit.
11. The operative should signal to the mole operator controlling the operation to reduce the air supply to a gentle hammer action. Do not allow anyone to stand in the reception pit when the impact mole is entering the reception pit see Figure 26.

Note: There is a risk of being struck by the impact mole or, in deeper pits, because of the risk of ground collapsing as the impact mole enters the pit. There must be two operatives on-site throughout the moling operation and at no time must an operating impact mole be left unattended.

12. If you suspect that the impact mole is deviating from the line or has met an obstruction, stop the machine and investigate the cause.
13. DO NOT remove the launch cradle until the operation is complete and it is safe to re-enter the excavation.

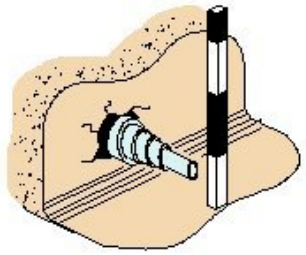


Figure 26- Impact Mole Head Appearing in Receiving Pit

IMPACT MOLING OPERATIONS ACROSS THE LINE OF EXISTING GAS MAINS OR SERVICES

1. Where you must impact mole across the line of an existing main or service, locate the main or service by trial holes prior to using the impact mole.
2. The building lines of the properties near should be leakage surveyed using an approved LEL/% gas volume detection instrument or tested.

MOLING OPERATION COMPLETION

1. After completion of the impact mole operation make the following checks.
   a) Check the bore of the mole hole with an approved gas detector for gas readings.
   b) Make a visual check for any signs of damage to other plant such as water seepage from storm or waste water pipes.
2. Impact moles must be regularly maintained and never stored vertically.

INSERTING THE PE PIPE

1. Depending on the type of ground conditions, check that the pipe is inserted/towed or pushed in accordance with the manufacturer's instructions.
2. Use an approved towing head or nose cone and follow the manufacturer's instructions to make sure that the correct attachment of the PE pipe.
3. Make a visual check of the inserted pipe for evidence of damage.
4. If the damage is found and is greater than 10% of the wall thickness, the damaged pipe must be removed.
5. Insert enough pipe to make the connection to the main.

PROCEDURE INSTALLING PIPE

1. Join the pipe following the guidance in Appendix D (Electrofusion) or Appendix E (butt fusion).
   Note: ***Butt fusion is the preferred method.***
2. If required restrain the pipe in accordance with SGN/WI/DIS4.2.2. to protect against movement effects of thermal expansion.
3. Pressure test main in accordance with Section G 2.
4. Record details of pressure test on test certificate.
5. If the test fails, contact your Operational Manager for further guidance.
6. If the test is passed, continue by making final connections following Section E.
7. Commissioning of the pipe should be carried out in accordance with Section H2.
8. Complete reinstatement of the excavations.

POINTS TO REMEMBER

1. ***The impact mole should normally progress at 0.5m/min 7-8m per Hour. as per manufacturers' instructions.***
2. ***The average bore shrinks by 10%.***
3. ***10x diameter of mole for the required depth of launch & receive pits. For minimum ground cover***
4. ***Launch the impact mole at a reduced speed 0.25 – 0.5 m/min.***
5. ***Always check for correct alignment.***
6. ***Use launch cradle, aiming frame and surveyor's staff.***
7. ***More preparation and time taken at launch will result in a more accurate and successful boring operation.***
8. ***Compressor should deliver 7bar (85-100 PSI).***
9. ***Electrically insulated PPE must be insulated to 20kV minimum together with the leather outer gloves when in contact with the impact mole.***
10. ***Always monitor the progress of the impact mole throughout the boring operation.***
11. ***The greater the bore length the greater the bore diameter required.***
12. ***After use, store the impact mole away correctly.***
13. ***Regularly maintain the impact mole.***
14. ***Never store the impact mole vertically as it can seize the mole, always store horizontally.***
15. ***Regularly maintain the impact mole every 4 months or 150 machine running hours.***
16. ***Always store the impact mole horizontally in the van or tool store, ensuring the dust cap is fitted to the correction airline to stop.***
17. ***Crossing under exposed cables should be witnessed and the speed of the impact mole should be reduced as it passes under the exposed cable.***

B6 Work Instruction for PE Mainlaying by Open Cut

GENERAL

When excavating using open cut technique it is important to minimise both the width and depth of excavation.

The reasons for minimising excavation are: -

- *Minimises time and effort required for excavation.*
- *Minimises reinstatement effort and materials.*
- *Less waste material to be disposed.*
- *Less vehicular movements associated with reinstatement and tipping.*
- *Reduces risk of subsidence.*

SITE SURVEY

Complete a site survey see Section A1.

SITE PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.

DEPTH OF COVER

1. Minimum depths of cover are stated in SGN/WI/ML/1 - Table 9.
2. Use this table and add the diameter of the pipe to work out the minimum depth of your excavation.
   Note: For example, a 250mm PE main in a carriageway requires a minimum excavation of 750mm + 250mm = 1000mm (1 metre) Additional depth may be required to negotiate under obstructions and where fine fill materials must be added to the bed of the trench.
3. If you encounter situations where the required depth of cover cannot be achieved, then contact your Operations Manager.
   Note: Where PE 100 SDR 26 is being laid then an alternative material must be selected.

MANUAL EXCAVATION

1. All excavations must be completed following guidance in Section A1.
2. Where the proposed route has been surfaced with bituminous materials or concrete, use either
   - A road breaker fitted with an asphalt cutter
   - Road saw

   Note: This will reduce the associated reinstatement costs and make the reinstatement tidier and more effective.
3. If the excavations become deeper due to obstructions or the pipe size, you will require more room to work.
4. A risk assessment should be undertaken whenever a person enters a trench and ground / weather conditions must be considered, as rain could weaken the trench walls.

MECHANICAL EXCAVATION

The use of mechanical excavators with a narrow trencher can be used as they can excavate to greater depths at a reduced excavation width.
Deeper excavations become more liable to collapse and trench support systems will be required see SGN/PR/SW/1 for advice.

1. Cut the road surfaces using either a road breaker fitted with an asphalt cutter or a road saw.
2. Keep the trench width to a minimum to minimise the reinstatement costs.
   Note: A variety of bucket widths from 150mm – 900mm are available (wider ones can be obtained if required).
3. DO NOT allow any Operatives to be working in the trench when a mechanical excavator is being used to dig out the excavation.
4. If the machine operator is unable to see the excavation, a banksman must be employed to guide the operator.
   Note: Allow for excavated spoil material to be positioned at a minimum distance equal to the excavation depth away from the trench.

EXCAVATION GENERAL

1. Excavate a trench to the depth previously determined.
   Note: Follow guidance in SGN/PR/SW/1.
2. Remove all sharp stones and hard or abrasive objects from the base of the excavation.
3. Level and compact the trench bed.
4. If a suitable bed cannot be achieved in given ground conditions, excavate the trench by a further 75mm and lay a bed of sand (or other suitable material) 75mm deep for the pipe to rest upon.
5. Maintain a minimum distance of 250mm between the gas pipe and other buried utilities.
6. PE Pipe jointing must be in accordance with Appendix D (Electrofusion) or Appendix E (butt fusion).
   Note: Butt fusion is the preferred method. When installed, the pipe should come to a natural rest on the trench bed.
7. Restrain the pipe in following SGN/WI/DIS 4.2.2 to protect against movement effects of thermal expansion.
8. Cover the pipe with sand or suitable fine fill material to a maximum depth of 250mm above crown of the pipe.
9. Lay gas marker tape on top of fine fill.
10. Pressure testing of the main must be undertaken in accordance with Section G2.
11. Once the test has successfully passed, the connections can be made see Section D (UPT and branch saddles) or Section E (other connections).
12. Commissioning of the pipe should be carried out in accordance with Section H.

DITCH AND SPECIAL CROSSINGS

1. If you must lay the main under ditches, maintain a minimum depth of cover (below the true bed of the ditch) of not less than 1.1 m.
2. Place concrete slabs or concrete filled bags 300 mm above the crown of the pipe.
   Note: This will avoid the possibility of interference damage to the pipe during ditch clearing operations.
3. Erect marker posts on both sides of such crossings.
   Note: In the case of special crossings (such as crossing railways, rivers, canals, motorways), Seek specialist advice from your Operational Manager. He or she may seek advice from the pipe manufacturer. Additionally, there may be special legislative requirements or conditions specified by third parties.

MARKER TAPE FOR HDPE PIPES

1. For HDPE pipes, place marker tape incorporating a single insulated tracing wire between the backfill and sub-base layers in road or footpath constructions, or 250 mm above the crown of the main in open ground.

NOTES:

This type of marker tape enables the position of the main to be determined using a cable locator during pre-excavation surveys, and to provide a visual indication of the presence of a buried main during excavation.

The vertical separation between the main and the marker tape gives sufficient margin for a mechanical excavator to be stopped before striking the main once the marker tape has been exposed.

Where foamed concrete backfill is used, an open mesh type of marker tape, incorporating a single insulated wire, should be placed between the foamed concrete and the surfacing.

Additionally, in the public highway a yellow 3.5 mm thick PE strip, of width not less than the diameter of the HDPE pipe, should be installed 75 mm above the crown of the main.

The purpose of the PE strip is to provide a secondary visual warning of the presence of buried pipe, and to provide a measure of physical protection to the main where mechanical excavation takes place.

2. Join individual lengths of the detectable type of marker tape in order to maintain electrical continuity.
3. Bring the wires from the marker tape to the surface and terminate in a marker post.
4. Place marker posts at each end of the main and at regular intervals no less than 1km along the line of the main positioned at convenient points such as boundary fences and walls.
   Note: The detectable marker tape should normally be connected to earth at each marker post (for detection by induced methods), but provision should also be made for it to be isolated from earth and a direct electrical connection made to it (for detection by direct connection or continuity testing).
5. Joints between lengths of the tracing wire should be insulated from the ground.
   Note: Detectable marker tapes should be able to be detected with commercially available pipe and cable locators, which operate at frequencies in the range 8 kHz to 43 kHz inclusive.
   Detection is possible by induced methods, but the range of tracing is likely to be short.
   Detection by direct connection, at a marker post, makes tracing over a greater range possible.

MARKER POSTS

1. Suitable places for marker posts are as follows:
   a) to indicate the line of the main at:
      - field edges,
      - along hedgerows,
      - adjacent to fences

   b) special crossings
   c) valve sites
   d) changes in direction of the main.
   e) branch connection

2. For HDPE mains, if helicopter surveys are to be carried out the necessary aerial marker posts should be installed in accordance with normal transmission practice.
3. The line of the main should be recorded on digital records information systems.
4. The record should include detailed dimensions at field edges, special crossings and in the public highway.

REINSTATEMENT

Reinstate all excavations in public and private roads in accordance with the Specification for Reinstatement on Highways. See Section A1.

Note: Further information is available in the Excavation and reinstatement documents.

C1 Work Instruction for Steel Mainlaying by Open Cut

MATERIALS

1. Check all steel pipe, fittings and bolts have been purchased from SGN approved suppliers.
   Note: See SGN/SP/DAT/6 for guidance on approval standards. All steel products such as: steel sections, structural bolts, welding consumables and fabricated steel components must meet the requirements of BS EN 1090-1.
2. Do not use any locally purchased materials.
   Locally purchased material* MUST NOT *be used on the SGN Network.
3. If you are laying steel pipe which is to be operated above 2 bar, the pipe, fittings and bolting used must comply with the requirement of the approved SGN/PM/PS/5 documentation.

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.

DEPTH OF COVER

1. Minimum depths of cover are stated in SGN/WI/ML/1 - Table 9.
2. Use table 9 and add the diameter of the pipe to work out the minimum depth of your excavation.

For example

A 300mm (324mm o/s diameter) Steel main in a carriageway requires a minimum excavation of 750mm + 324mm = 1074mm.

3. Additional depth may be required to negotiate under obstructions and where fine fill materials must be added to the bed of the trench.
4. If you encounter situations where the required depth of cover cannot be achieved, then refer to SGN/WI/ML/1.

PROXIMITY TO BUILDINGS

Steel proximity distances are stated in SGN/WI/ML/1.

PIPE HANDLING

Extra care must be taken when handling steel pipe and fittings refer to SGN/WI/ML/1 for guidance.

EXCAVATION

1. Follow the guidance in Section A1, Section B6 and SGN/PR/SW/1.
2. If jointing must take place within the excavation it may be necessary to widen the trench at that point (bell hole) to create enough space.
3. Additional “bell holes” may be required to navigate under obstructions.
   Note: Steel pipelines must not be laid so that the pipeline comes into direct contact with another utilities apparatus, steel structure or any other gas pipe or fitting.

GRADIENT AND LEVEL

1. If you need to lay pipes under services or if low points are created, then you may need to install syphons or dip pipes where the risk of water ingress is thought a possibility.
   Note:Ask your Operational Manager if this is required.

SLEEVING

1. When steel mains must cross railways, motorways, major roads and rivers and others situations, the wall thickness chosen for the pipe should be increased in preference to sleeving.
2. Sleeves should be used for construction purposes only.
   Seek guidance from your manager.

PIPE JOINTING

1. Do not install any unrestrained mechanical joints up to and including the point of pressure testing on new steel mains.
2. Jointing of steel pipe can be achieved by:

a). Welding Pipes and fittings

1. Select a suitable location where you can to carry out welding of pipe and fittings safely.
2. Obtain a gas free certificate issued by a competent person to confirm that it is safe to continue work.
   Note: Welding should be completed above ground wherever possible, so that welds and joint wrapping may be inspected easily.
3. Erect screens to protect the public and those not involved the welding operation from the arc flashes.
   Note: Consider additional protection when working locally to high rise building.
4. Check that adequate ventilation is available to remove the fumes generated.
5. Clean and dry all pipe surfaces to be joined.
6. Pipe and fittings must have the appropriate end preparation.
7. Line up pipes for welding and support adequately on timber skids suitably cushioned with sufficient clearance around the pipe to allow welding.
8. Take care to avoid damage to the pipe and coating.
9. Remove a minimum of 150mm of the coating from the end of each pipe to prepare the pipe for welding
10. Have the cut ends checked for laminations.
11. Have the pipe ends bevelled.
12. Pipe reference numbers must be transferred to cut pipes at each cut end.
13. Welding of steel pipelines must be in accordance with SGN/SP/P/1
    Qualified inspectors must be used to examine the welded pipe.
14. Fit night caps or plugs at the end of each day's work or when each section of work is completed.
15. You must follow the inspection requirements stated in SGN/SP/P/1.
    These involve
    - Ultrasonic testing,
    - dye penetration,
    - radio graphics
16. The minimum inspection requirements are stated in Table 15:

Inspection/Examination type	Girth Welds	Fillet Welds
Visual Examination	100%	100%
Radiography	10%*	100%
Magnetic Particle Examination	-	100%

Table 15 - Inspection and Examination Requirements

****At special locations, such as "A" road, motorway, river/stream and rail crossings 100% radiography should be applied.***

Special arrangements must be provided when X-raying of welds.
The welding inspector must prepare a daily report of the work undertaken. This report must detail each weld.
The report must be handed to the Operational Manager.

b). Bolted Flanged Joints

1. Make bolted flanged joints using approved gaskets.
2. Protect the metallic flange against corrosion.
3. Make the pipework so that mating flanges are aligned and abutted squarely.
4. Only use flanges to PN16 unless making a connection onto an existing flange typically Table D or Table E flanges.
5. Where joints are to be bolted together see Appendix F.
6. You must fit an insulating joint (see SGN/SP/E/56) where:
   - The steel pipeline is to be connected to any other metal pipe.
   - Where a steel pipeline being connected to an existing cathodically protected pipeline. Unless its CP system is to used for the new pipeline.

Note: There is no requirement for an insulating joint between PE and steel. However, the exposed metal joint itself must protected again corrosion.

c). Screwed joints – Up to 2" /63mm

1. You can use screwed fittings on connections to steel mains for small diameter services, bypasses and pressure points up to and including 2" / 63mm diameter and up to and including 2 bar.
   Note: This type of connection is subject to the pipe wall thickness being at least 6mm.
2. You must make welded connections (Weldolet) to steel mains for Intermediate Pressure (IP) (2 to 7 bar.
   These works are subject to a SGN/PM/PS/5 approval process.

CONNECTIONS – LARGE DIAMETER (GREATER THAN 2"/63MM)

When these connections are required refer to ***SGN/PM/MSL/1 Part 2***.

1. Branch connections will usually be either:
   - Weldolet connections (see specification SGN/SP/F/4)
     Welded split tees (see specification SGN/SP/F/4) with outlet or branch flanges to GIS/F7.
   - Grouted tees (see specification GIS/F12)
   - Mechanical Under pressure tee meeting the requirements of GIS/LC8 Part 4.
2. Where connections are welded, these must comply with the requirements of SGN/SP/P/9.

CORROSION PROTECTION

It is essential that new steel pipelines are provided with a corrosion protection system.

Note: Reference should be made to SGN/PM/ECP/2***.***

The first level of any corrosion protection is to check that all existing pipeline coatings are sound.

1. Inspect the existing coating for pin holes and other damage both visually and using a Holiday Detector.
2. Repair all coatings defects however small see SGN/SP/CW/5.
3. Prime and either wrap or paint the exposed newly made joints.
   Note: Ask you Operational Manager which system is to be used
4. You must complete any painting in accordance with SGN/SP/PA/10.
   Notes:
   On short lengths of steel corrosion protection will normally be achieved using magnesium anode bags attached to the pipeline.
   On long lengths steel pipes the use of an impressed current system must be considered.
   Advice should be obtained from SGN's pipeline section.
   CP systems must be appropriately commissioned and validated. This must be undertaken by CP staff.

C1 Work Instruction for Steel Mainlaying by Open Cut

ANCHORAGE

1. On completion, the pipe must be restrained in accordance with SGN/WI/DIS 4.2.2 to protect against movement.

PRESSURE TESTING

1. Pressure testing of the main must be undertaken in accordance with Section G2.
2. Once a test has successfully passed, the connections can be made see Section E0

REINSTATEMENT

Reinstate the excavation, if appropriate to do so.
See Section A1- reinstatement

COMMISSIONING

Commission the pipe in accordance with Section H2.

DITCH AND SPECIAL CROSSINGS

Where you have to lay steel pipe across ditch and special crossings follow the advice for PE mains in Section B5

PIPELINE PROTECTIVE MEASURES

1. Where there is a likelihood of pipeline damage, your Operational Manager may require protective measures to be installed.
2. Concrete protection slabs can be used as an effective means of mitigating damage at road crossings and other sensitive locations.
   Note: For steel systems, additional protection can affect the efficiency of above ground coating surveys, such as Pearson and Close Interval Potential Surveys (CIPS).
3. The design of any protection should be selected from SGN/SP/CE/12 to suit the circumstances.

MARKER POSTS

Follow the requirements for marker posts for PE installations at Section B5 with the following additional requirements.

1. Special M28 posts will be required where Cathodic Protection system testing is to be carried out.
2. For steel mains operating at 7 barg, if helicopter surveys are to be carried out the necessary aerial marker posts should be installed in accordance with normal transmission practice.

D1 Under Pressure Branch Connection (Metallic)

This Section details the procedures involved in undertaking metallic mains connections up to 15"/375mm and pressures up to 2 bar.

The fitting and drilling of welded connections and metallic branch connections larger than 15"/375mm and connections between 2 and 7 bar are a specialist activity and reference must be made to SGN/PM/MSL/1 Part 2 for details.
The fitting and drilling of grouted tees manufactuered to GIS/F12 are a specialist activity and covered in SGN/PR/P/19.

ANCHORAGE OF CONNECTIONS

Further information on the procedures to be adopted for anchorage can be found in SGN/WI/DIS/4.2.2 or from your Operational Manager.

MATERIALS

1. All Under Pressure Tees (UPTs), fittings and bolts and other materials must be purchased from SGN approved suppliers.
2. Materials obtained using local purchase orders **MUST NOT** be used on the SGN Network.
3. Tees, Valves and other Fittings which are to be operated above 2 bar, must be as specified in the approved SGN/PM/PS/5 documentation.

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Complete a site-specific hazard assessment see Section A1
2. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
3. PPE must be worn appropriate to the task being undertaken.
4. Excavate on to the pipe at the planned connection point following guidance in Section A1.

Note: For Hot tap connections, excavations must be much larger to allow for concrete/stone flooring, escape ramps and the working height for welding. See SGN/PM/MSL/1 Part 2.

5. Prior to removing the wrapping check the main with a Volt stick as detailed in SGN/WI/ML/1.
6. Clear the main around the full circumference of the pipe.
7. Check for potential obstructions to the fitting of an UPT fitting.

PIPE & FITTINGS PREPARATION

On mains systems, which have cathodic protection system applied the system should be switched off before work starts.

1. Using an approved drilling machine, drill and tap the main to one side of the proposed under pressure drilling.
2. Fit a pressure gauge and confirm the mains pressure.
3. Record the pressure.
4. Remove pipe wrapping, and clean the metallic main with a wire brush.
5. Check mains diameter with callipers to confirm main size.
6. Check that you have the correct size of under pressure tee and that it is rated for the pressure you have recorded.
7. Select a full bore valve to suit the outlet of the Under-Pressure Tee connection.
8. Check that a minimum distance of 200mm is maintained from existing fittings/joints and allow 250mm clearance from other utilities plant.
Where ductile iron mains are encountered with corrosion plugs present, these plugs can significantly affect the integrity of the pipe wall. You must follow the advice in SGN/WI/ML/1 Section B3

Note: Your Operational Manager must be informed and a risk assessment undertaken. Steel/Ductile iron mains of diameters up to and including 150mm/6" operating at medium pressure will require full encirclement fitting.

D1 Under Pressure Branch Connection (Metallic) Page 2 of 5

PREPARATION OF UPT CONNECTION

1. Check the UPT for damage that the correct nuts, bolts and washers are available and seals are in sound order.
2. Thoroughly clean the valve and UPT flanges.
3. Fully open and close the slide valve or gate valve (if used), note the number of turns from fully open to fully closed position.
4. Select the pressure testing equipment applicable to pressure test to be carried out.
5. Check that the under-pressure drilling machine is in good condition; the correct size of cup drill is available and the pilot drill has a coupon retention device that is working.
6. The drilling machine must be suitable for the maximum operating pressure of the main to be drilled.
7. Check that the cup drill will pass through the branch outlet and valve without impingement.
8. Mark the two halves of the Tee to make sure that when reassembled they are bolted back the same way around.
9. Separate the two halves of the UPT (if it is a split tee type), otherwise unbolt the stainless-steel section.

ASSEMBLY OF METALLIC UPT CONNECTION

1. Make sure there is sufficient clearance around the main to fit the two sections of the UPT connection together.
2. Carefully lift the two halves of the UPT into the excavation.
   Note: When lifting of equipment adjacent to, or near pressurised gas pipes, it is important that the correct lifting equipment is used and that precautions are taken to protect the pipes.
   All lifting operations over live plant are subject to SCO Procedures, Permits to Work and a Written Plan being produced and authorised. A competent person in accordance with the requirements of LOLER 1998 should implement this plan on site.
3. Install the correct sized rubber seals onto the UPT and lubricate where appropriate.
4. Apply the flange end of the UPT connection to the top of the main.
5. Bring the other half to the underside of the main and loosely fit together using nuts and bolts.
6. Slowly rotate the UPT connection to the correct position for the off take, see Figure 27.

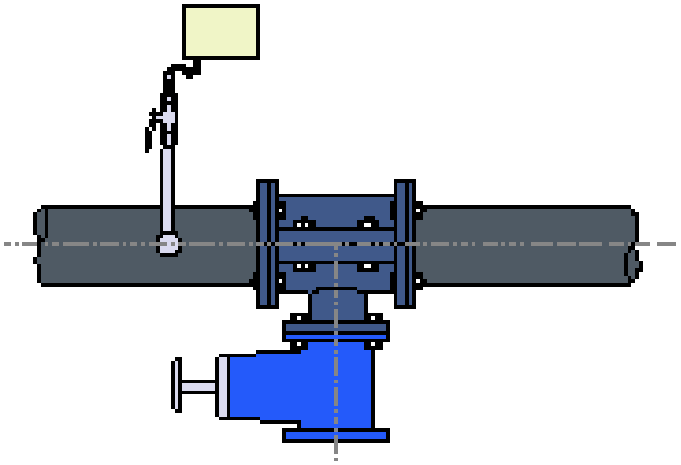


Figure 27- Under Pressure Tee and Valve

Note: Construction valves should be positioned as shown

7. If a stainless steel UPT is used:
8. Slacken the bolts and remove on one side only.
9. Position onto the main and turn in direction of arrow to tighten securely onto the main.
10. If the UPT is to be installed in the vertical plane for flow stopping purposes, the height above the valve to the surface must be checked to make sure that correct depths of cover are achieved.
    Norte: If this is not possible the Operational Manager must be informed before continuing with the operation.

D1 Under Pressure Branch Connection (Metallic) Page 3 of 5

11. Record the position and depth of cover of the fitting.
    Note: These details should be shown on the graphical record system and additional plant protection measures used once the operation has been completed, such as heavy duty marker tiles, concrete slab, and steel plate.
12. Tighten the bolts on the UPT to the correct torque following manufacturer's instructions using a torque wrench.

ASSEMBLY OF VALVE AND DRILLING EQUIPMENT

1. Check the size and condition of the drill and that the correct pilot drill is in place.
2. Check that the valve is a full-bore valve and that it is fully operable.
3. Note the number of valve turns from the fully closed to fully open position.
4. Leave the valve in the fully open position.
5. Fit the slide/gate valve to the flange on the UPT with a gasket between the faces of the two flanges.
6. Tighten all flanged bolts to the correct torque.
7. Make sure that the saddle and valve is adequately supported.

PRESSURE TEST PROCEDURE

See Section G5

LET BY VALVE TEST

See Section G5

INCONCLUSIVE PRESSURE TEST

See Section G5

FAILED PRESSURE TEST

See Section G5

CONNECTING THE DRILL

1. Remove testing flange.
2. Calculate measurements as per Figure 28 and Figure 29 of A, B, C, D & X and record in Table 16.
3. Lubricate cup and pilot drill with grease and attach the drilling machine onto the valve.
4. Check that the drilling machine and valve are adequately supported using timber and wedges.
5. Check valve closes and opens full number of turns.
6. Repeat pressure test in item above for the UP connection, valve and drilling machine, again no pressure loss allowed.
   Note: Only repeat if the drilling machine was not included in the first test procedure.

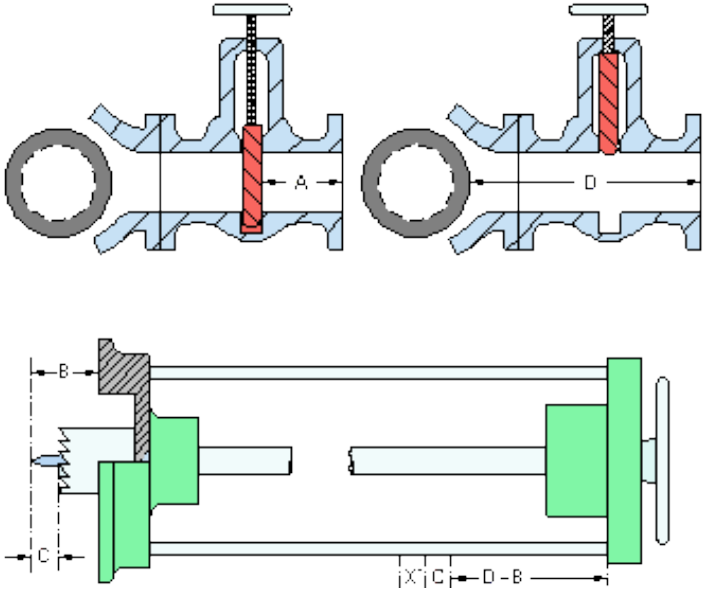


Figure 28- Drilling Machine Set Up

D1 Under Pressure Branch Connection (Metallic) Page 4 of 5

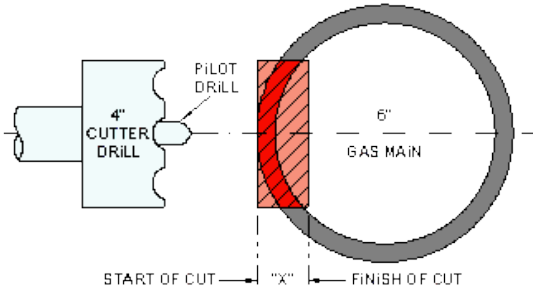


Figure 29- Measurements for Metallic Branch Drilling

A - D Travel Length Measurements

DISTANCE 'A' From face of valve flange to valve plate.
DISTANCE 'B' From face of change head to tip of pilot drill.
DISTANCE 'C' From tip of pilot drill to face of cutter.
DISTANCE 'D' From face of valve flange to gas main.
DISTANCE 'X' Required Length of travel to drill through main
DISTANCE 'Y' 1/2 of the internal diameter of main

Notes:

1. *Distance 'A' must be greater than 'B' or the valve plate will not shut. If this is the case a spool piece must be inserted.*
2. *Distance D less B is the distance of travel from the fully retracted position to when the tip of the pilot drill contacts the parent main.*
3. *Distance C is the depth of drilling required to penetrate the parent main with the pilot drill. The purpose of the pilot drill is to centralize the cup drill and enable retention of the parent main coupon.*
4. *Distance 'X' is the required length of travel to indicate the 'cup' drill has completely penetrated the parent main compensating for the radius of curvature. (See note below **Table 17** for sizes > 150mm/6").*
5. *A further measurement 'Y' is taken in addition to the travel distance. Half the parent mains diameter is added to provide the maximum distance the drill can be permitted to travel without damaging the bottom/opposite side of the main.*

Table 16 - Calculation of Dimensions "X" in mm	Drilling Dimensions (mm)
'A'	
'B'	
'C'	
'D'	
'X'	
(D-B) or (D+B)	
'Y' 0.5 x Main Dia.	
TOTAL TRAVEL	

	Diameter of Main			
Bore of Branch	80mm / 3"	100mm / 4"	5"	150mm / 6"
80 mm / 3"	25	23	19	19
100mm / 4"		32	28	23
125mm / 5"			38	32
150mm / 6"				44

Table 17- Drilling Dimensions

Note: For above 150mm, reference must be made to manufacturer's instructions. Depending on the type of valve or drilling machine used a spool piece may be required to enable the drill to be fully retracted.

D1 Under Pressure Branch Connection (Metallic) Page 5 of 5

DRILLING THE BRANCH CONNECTION

1. Advance the drill until the pilot touches the main.
2. Mark dimension (D less B) on stay bar of drilling machine with chalk see Figure 30.
3. Measure and mark dimension “C”.
4. Measure and mark dimension “X”.
5. If using a hand operated machine, using the short ratchet handle, drill pilot hole.
6. Fit the extension handle and drill main with cup drill, feeding gently. If using an air driven motor carryout item 5 gently until pilot has been drilled, then open the air supply fully.
7. Upon reaching mark of dimension “X”, stop drilling and check free running by advancing feed screw.
8. Fully extract drill, then close valve fully making note of the number of turns.

REMOVAL OF DRILLING MACHINE

1. Release the pressure between the valve and the drilling machine through the test point on the machine and vent to zero.
2. Attach test assembly
3. Monitor the pressure gauge for 1 minute and check for let by.
4. There must be no increase or decrease in pressure on the gauge.
5. If valve is passing, attempt to reseal valve by opening, closing and retest for let by.

   Note: You must not attempt to remove the drilling machine and open the valve to remove any possible debris from the valve seat.

   If the valve continues to let by, contact your Operational Manager.
6. Remove the drilling machine and either fit a blank flange or connect the new main to the valve see Figure 31.
7. On MP and IP mains the blank flange must have a pressure relief facility.
8. If a blank is fitted, open the valve and test with leak detection fluid.
9. If sound close valve.
10. Remove coupon from the drill and pass to your Operational Manager.
11. Clean and store equipment.

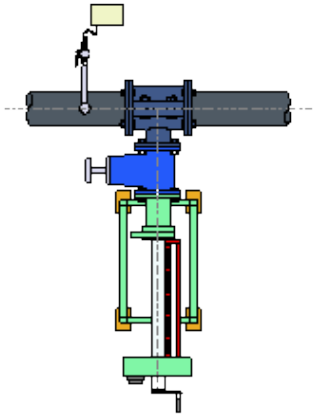


Figure 30 - Drilling Operation

12. Using no gas techniques remove the pressure test points, plug off and check with leak detection fluid.
13. Remove any wooden supports below the UPT and drill.
14. Apply anti-corrosion primer, profiling putty and tape to the UPT, valve and bolts ensuring a 55% tape overlap (see SGN/SP/CW/5).

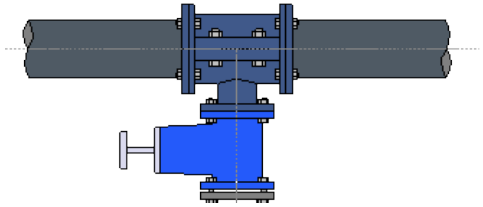


Figure 31- Drilled Main Showing Valve Flange Blanked

D2 Branch Connections (PE)

This Section details the procedure involved in undertaking PE electrofusion branch saddles on mains operating at pressures up to 2 bar. Pressure between 2 and 7 bar and connections greater than 200mm are a specialist activity and you must refer to SGN/PM/MSL/1 Part 2.

ANCHORAGE OF CONNECTIONS

Further information on the procedures to be adopted for anchorage can be found in SGN/WI/DIS/4.2.2 or from your Operational Manager.

MATERIALS

1. All branch saddles must be purchased from SGN approved suppliers.
2. Fittings must meet the requirements of GIS/PL2 Part 4* and for Intermediate pressure to GIS/PL2 Part 8 or approved to BS EN 1555 **AND** be approved by SGN Engineering Policy for use on the SGN Network.
3. Materials obtained using local purchase orders **MUST NOT** be used on the SGN Network.
4. Fittings which are to be operated above 2 bar, must comply with the requirement of the approved SGN/PM/PS/5 documentation.
   Note: Fittings to GIS/PL2 Part 4 can be used for connections up to 5.5 bar MOP. Checks should be made with the supplier before use on IP mains. Saddles may be supplied for installation with a flanged outlet. Some fittings may also incorporate an integral under-clamped saddle base.

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Complete a site-specific hazard assessment see Section A1
2. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
3. PPE must be worn appropriate to the task being undertaken.

Main Diameter (in / mm)	Flanged Outlet Size (mm)					Spigot Outlet (mm) 7 bar	
	80	100	150	250	300	90	125
4”	-	Y	-	-	-	-	-
6”	-	Y	-	-	-	-	-
8”	-	-	Y	-	-	-	-
90	-	-	-	-	-	Y	-
125	Y	-		-	-	Y	-
180	Y	Y	Y	-	-	Y	Y
200	-	Y	-	-	-	-	-
225	-	Y	-	-	-	-	-
250	Y	Y	Y	Y	-	Y	-
268	Y	-	Y	-	-	-	-
280	Y	Y	Y	Y	-	-	-
315	Y	Y	Y	Y	-	Y	-
355	Y	Y	Y	Y	Y	Y	-
400	Y	Y	Y	Y	Y	Y	-
440	Y	-	Y	y	Y		
450	Y	Y	Y	Y	Y	-	-
469	Y	-	y	y	y	-	-
500	Y	Y	Y	Y	Y	-	-
560	Y	Y	Y	Y	Y	-	-
630	Y	Y	Y	Y	Y	-	-
710	-	Y	Y	Y	Y	-	-
800	-	Y	Y	Y	Y	-	-
900	-	Y	Y	Y	Y	-	-
1000	-	Y	Y	Y	Y	-	-

Table 18 - PE Branch Saddle Connections

Note: Greyed out area in Table 18 ***indicates fittings which some suppliers will only supply on a “supply & install” basis. Some companies will supply only.***

4. Excavate on to the pipe at the planned connection point, follow guidance in Section A1.
5. Clear the main around the full circumference of the pipe.
6. Check for potential obstructions to the fitting of an under-pressure fitting.

PIPE, FITTINGS & BRANCH SADDLE PREPARATION

1. Confirm mains diameter, SDR and material type and follow the requirements for PE jointing See Appendix B.
2. Prepare the pipe for fusion of a small diameter top tee to be used as a pressure point see Appendix C.
3. Fit a pressure gauge to confirm the mains pressure.
4. Record the pressure.
   Note: Check that you have the correct size of Branch Saddle for the SDR rating and diameter of the main. This is very important in the case of connections to mains of SDR 26. For pressures greater than 2 bar, the details of the branch saddle and valve will be stated in the SGN/PM/PS/5 paperwork.
5. Select the full-bore valve to suit the outlet of the Under-Pressure Tee connection.
6. Confirm the proposed location of the branch saddle will maintain the minimum proximity from other fittings, joints or squeeze offs and that it is free from damage – see Section B1.
7. Fit re-rounding clamps either side of the branch saddle.
   Note: This will aid good quality fusion. These should be fitted and left in position either side of the branch saddle, for a period recommended by the manufacturer, usually a minimum of 10 minutes.

PREPARING THE PIPE SURFACE:

1. Using water thoroughly clean the polyethylene pipe across the area where the weld is to be made.
2. Dry the area with a lint free cloth.
3. Position the branch saddle still in its protective bag or packaging and draw around the fitting with a marker pen allow an overlap of 25mm.

The branch saddle must be stored in its protective bag or packaging until it is ready to be fused.

For PE 80 pipes:

a) By scraping the marked area thoroughly using a hand scraper.
b) Care should be taken to avoid gouging or scoring the surface of the pipe.
c) If the surface is subsequently contaminated, then the whole area should be remarked and scraped.

For PE100 multilayer pipe:

a) By using the PET tool (do not use a 'Stanley' knife or similar bladed tool) and peeling back the skin.
b) Care must be taken to avoid gouging or scoring the surface of the pipe.
c) If the surface is subsequently contaminated, then the whole area should be remarked and scraped.

The scraping of the pipe or removal of the skin must not be undertaken until the branch saddle is ready to be immediately fitted. This reduces the risk of pipe contamination.

ASSEMBLY OF PE SADDLE.

Branch saddle fittings vary in their design. Fittings will either have:
an under clamp fitting or top loading tool to generate the pressure required during the welding process.

1. Remove the branch saddle from its protective bag or packaging.
2. Remove the saddle base protective cover.
3. Do not handle the saddle base of the fitting as this contains the heating coil, as this will contaminate the saddle.
4. Fit the branch saddle fitting to the manufacturer's instructions.
5. Check that the top load pressure is applied or the backing strap is tightened to the correct torque settings depending on the type of branch saddle used.
6. Check that the fitting is in correct contact with the pipe surface.

You may find it helpful to mark the fusion and cooling times on the pipe adjacent to the connection point to make it easier when inputting the details into the Electrofusion Control Unit (ECU).

FUSION OF SADDLE

1. Make sure that the branch saddle is adequately supported.
2. Connect the control box to the terminal pins, making sure that they will not be dislodged during the fusion process.
3. Follow the menu of questions on the control box ECU and when prompted input the predetermined fusion time or scan the fusion time barcode found on the fitting label.
4. Start the fusion process
5. When the fusion cycle is completed allow the fitting to cool for at least the time marked on the fitting.
6. If fitted, check that the fusion indicators have risen.
7. Do not remove the under clamp or top loading mechanisms until the fitting has cooled for the specified time on the fitting.

   NOTE: For some types of branch saddles, re-rounding clamps must be used for the installation. These should be fitted and left in position either side of the branch saddle, for a period recommended by the manufacturer.

   NOTE: If the fusion does not complete its full cycle, then the installation must be voided. **DO NOT REHEAT THE FITTING.** ***The fitting must be cut near the base of the branch saddle to prevent any future connection onto the assembly. A new branch saddle must be fused to the main at least 250 mm from the original position.***

ASSEMBLY OF VALVE & DRILLING EQUIPMENT

1. Check the size and condition of the cutter and that the correct pilot drill is in place
2. Check that the valve is a full-bore valve and that it is fully operable.
3. If a gate valve is used, note the number of turns from the fully closed to fully open position.
4. Leave the valve in the fully open position.
5. Fit the slide/gate valve to the flange on the branch saddle outlet flange with a gasket between the faces of the two flanges
6. Tighten all flanged bolts to the correct torque.
7. Make sure that the saddle and valve is adequately supported.

PRESSURE TEST PROCEDURE

See Section G5

LET BY VALVE TEST

See Section G5

INCONCLUSIVE PRESSURE TEST

See Section G5

FAILED PRESSURE TEST

See Section G5

D2 Branch Connections (PE)

CONNECTING THE DRILL

1. Check that the drilling machine is fit for purpose for the correct pressure rating.
2. Check that the drilling machine is securely supported.
3. Check that the correct diameter of PE drill cup is used, it is in good condition and that it will pass through the valve and saddle without causing damage.
4. Check that all drilling equipment is in satisfactory condition.
5. Check that any ancillary equipment is in satisfactory condition such as the correct pilot drill is used.
6. Measure the travel of the drill and be sure that it is of adequate length to drill the front wall of the main without cutting into the rear wall.
   Note: Refer to Figure 32 ***for drilling measurements through valve arrangement) and*** complete ***Table 19***.

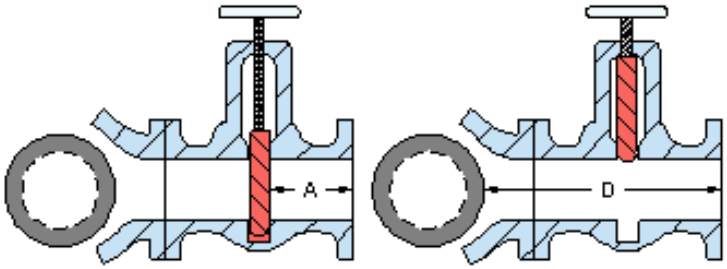


Figure 32- Drilling Machine Dimensions

7. Advance drill until pilot touches the main.
8. Mark dimension (D less B) on stay bar of drilling machine).
9. Measure and mark dimension “C”.
10. Measure and mark dimension “X”.

A - Y Measurements

DISTANCE ‘A’ - From face of valve flange to valve plate.
DISTANCE ‘B’ - From face of change head to tip of pilot drill if used.
DISTANCE ‘C’ - From tip of pilot drill to face of cutter.
DISTANCE ‘D’ - From face of valve flange to gas main.
DISTANCE 'X' - Wall thickness of PE main calculated from SDR.
DISTANCE 'Y' - 1/2 of the internal diameter of the PE.

Notes:

1. *Distance ‘A’ must be greater than ‘B’ or the valve plate will not shut.*
2. *Distance D-B is the distance of travel from the fully retracted position to when the tip of the pilot drill contacts the parent main.*
3. *Distance C is the depth of drilling required to penetrate the parent main with the pilot drill. The purpose of the pilot drill is to centralize the cup drill and enable retention of the parent main coupon.*

	Drilling Dimensions (mm)
‘A’	
‘B’	
‘C’	
‘D’	
‘X’	
(D-B) or (D+B)	
'Y' 0.5 x Main Dia.	
TOTAL TRAVEL	

Table 19 - Drilling Dimension Branch Saddles

D2 Branch Connections (PE)

DRILLING THE BRANCH SADDLE

1. Check that the valve is in the fully open position see Figure 33.
2. Insert and then retract the drill to make sure that the valve can be fully closed.
3. Fit a pressure gauge to the drilling machine to monitor the pressure while drilling the main.
4. Open the valve and drill the main whilst monitoring the mains pressure.
5. If using an air powered motor, gently drill monitoring the pressure and the drill speed, if using a pilot fully open the air motor once the pilot has drilled through the main.
6. When the main has been drilled, retract the drill.
7. Close the valve.

REMOVAL OF DRILLING MACHINE

1. Release the pressure between the valve and the drilling machine through the test point on the machine and vent to zero.
2. Attach test assembly
3. Monitor the pressure gauge for 1 minute and check for let by.
4. There must be no increase or decrease in pressure on the gauge.
5. If valve is passing, attempt to reseal valve by opening, closing and retest for let by.

   Note: You must not attempt to remove the drilling machine and open the valve to remove any possible debris from the valve seat.

   If the valve continues to let by inform your Operational Manager.
6. Remove the drilling machine and either fit a blank flange or connect the new main to the valve.
7. On MP and IP mains the blank flange, must have a pressure relief facility.
8. If a blank is fitted, open the valve and test the blank flange with leak detection fluid.
9. If sound close valve.
10. Remove coupon from the drill and pass to your Operational Manager.
11. Clean & store the equipment.
12. Using no gas techniques close the pressure test point and cap or plug the tee and check with leak detection fluid
13. Remove any wooden supports below the saddle and drill.

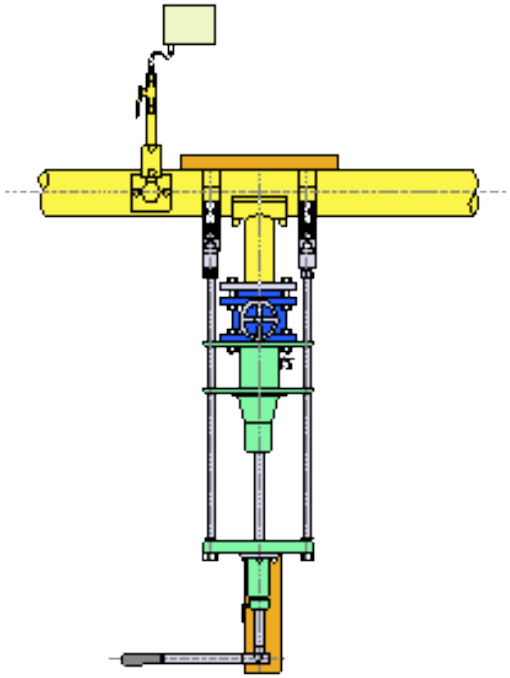


Figure 33- Drilling Operation - Branch Saddle

15. Apply anti-corrosion primer, profiling putty and tape to the valve and bolts ensuring a 55% tape overlap (see SGN/SP/CW/5).

D3 Connections to Inserted mains

CONNECTIONS TO LOOSE FIT INSERTED PE MAINS

You must take the following actions when making a new service or mains connection to an existing gas main which is shown on SGN MAPS as 'inserted PE'.

In this situation you will normally only observe a metallic main in the excavation with no positive evidence that it has been inserted. The actions are required before cutting or breaking out the carrier pipe to determine that the carrier pipe is not a 'live' main.

1. You must never cut or break out a metallic 'carrier' pipe before confirming the 'live/dead' status of the pipe.
2. You must never assume that the information shown on SGN MAPs is correct.

PRELIMINARY ACTIONS

1. When you have exposed a metallic main you must investigate the surrounding area for evidence that the pipe is on the expected line of the gas main.
2. It is possible that the exposed pipe is an unrecorded gas main of unknown pressure or a pipeline belonging to another utility.
3. It may also be a hazardous pipeline which is not recorded on SGN MAPs.
4. Not all hazardous pipelines are shown on SGN MAPs.
5. Further information on hazardous pipelines can be found in Third Party Hazardous Plant (Shaded Bands) and High Pressure (HP) Pipelines.

POSITIVE EVIDENCE

1. To confirm that the main is inserted and not a live pipe you must drill the main before breaking out.
2. You must use an approved drilling machine which can be closed off if the main is found to be a live gas main or a pipeline belonging to another utility.
3. You should use a blind drill, where possible, to minimise the possibility of damage to the inserted PE.
4. You must contact your Team manager if the main is found to be a live gas main or a pipe belonging to another utility.
5. You must not drill the main with any form of hand held drill. This may result in an escape of gas or other liquid which cannot be controlled.
6. If you are able to confirm that the iron main does not contain gas use an inspection hood to identify if it is lined with a PE main.
7. If satisfactory you may proceed to breakout the main using the procedure in Appendix H.
8. Fit end seals either side of the breakout position.
9. Complete the connection following the guidance in either SGN/WI/SL/1 or Section B2 (for dead insertion), B3 (for Live insertion) and D2 (for Branch saddles) as appropriate.

CONNECTIONS TO SWAGELINED MAINS

Specialist cutting equipment may be required when making connections to Swage-lined pipes.

Due to the method of installation, the precise external diameter and profile of the swage-lined pipe may not be known.

32MM AND 63MM CONNECTIONS TO SWAGE-LINED PIPES USING THE UNIFIT TAPPING TEE

1. Choose a range rated tapping tee using the nominal diameter of the pipe before swage-lining as a guide to making the correct choice.
2. Visually inspect the main at the proposed point of connection; it should be free from surface damage and should not show signs of external scoring. See Section B1 .
3. Place the fitting on the pipe and inspect the fit made between the curve of the main and the base of tee.
4. If you find the gap between the surface of main and the mating surface of the tapping tee is uneven, then choose an alternative connection point.

D3 Connections to Inserted mains

5. Where you cannot confirm the diameter of the main at the point of connection, measure the actual diameter using an external circumference tape (PI tape) and Vernier calliper.
6. Carry out the normal fusion preparations see Appendix D but check manufactures instructions for any special requirements for connections onto a swage-lined pipe.
7. On completion of the fusion of the tapping tee to the main, the normal post fusion checks should be made before commissioning the service.

CONNECTIONS TO SWAGE-LINED PIPES USING ELECTROFUSION COUPLERS

1. Visually inspect the main at the proposed point of connection; it should be free from surface damage and should not show signs of external scoring. See Section B1 .
2. Check that inserts are obtained which are specific to the coupler and pipe diameter.
3. When the main has been cut out the PE pipe must be expanded.
4. Place the internal support inserts into the bore of the main.
   Note: This makes sure that the pipe is dimensionally correct for the diameter of coupler to be connected.
5. Carry out the normal fusion preparations see Appendix D but check manufactures instructions for any special requirements for connections onto a swage-lined pipe.
6. Prior to fusing, check it is possible to rotate the coupler on the main.

BRANCH CONNECTIONS TO SWAGE-LINED PIPES

For sizes above 63mm, the input to the electrical element required to fuse joint will significantly reduce the wall thickness and hence strength of thin walled pipes (SDR21) by the creation of molten PE and a heat affected zone.
This creates the potential for the PE to deform and presents a significant risk under live gas conditions.

Therefore, only branch saddles specifically produced for swaged lined gas mains must be used. The use of other branch saddles is prohibited.

For off takes greater than 63mm, the only option is to undertake a flow stop operation at a suitable place in the pipeline.
A section of the pipework should be cut out and a tee inserted into the pipeline, follow instructions above to complete the connection.

E0 Flow stopping - General Information

This introductory section provides general information on the limitations of flow stopping equipment, continuity of supply, venting of gas and the construction of bypasses and riders for activities on mains operating up to and including 7bar
This section also contains information common to most of the techniques to avoid repetition within the main text.
Other flow stopping techniques are available such as mechanical and PE Stopple, large diameter and Intermediate Pressure squeeze off, Iris stop and Large Diameter Bagstop; these are specialist activities and reference must be made to SGN/PM/MSL/1 Part 2.
The Operational Manager will make the decision on whether a specialist technique is required for the operation.

GENERAL

Squeeze-off equipment must not be applied to pipe where squeeze-off has already been applied.

1. Check that the squeeze off tool conforms to Gas Industry Standard GIS/PL2 -7.
2. If the squeeze-off unit maintains a leak proof seal, pipes can be commissioned by the controlled release of the squeeze-off
3. A squeeze-off unit must not be used as a closed end for test purposes.
4. Care must be taken to make sure that the correct tool is used for the size of pipe.
5. Stop settings must be set for both the diameter and SDR of the pipe.
6. Always refer to manufacturer's operating instructions for guidance in the correct use of the equipment.

FLOW STOPPING – MULTILAYER PIPE

1. You must remove the skin (a distance of 0.5D) either side of the squeeze off tool using an approved Pipe Exposure Tool (PET) tool to make the cuts through the skin layer.
   A 'Stanley knife' or similar sharp edge tool must not be used to remove the skin under any circumstances.
2. When making any axial cuts,, these should only be made along the top dead centre of the buried pipe.
3. If you are need to apply more than one squeeze off to a section multilayer pipe, remove the pipe skin at each squeeze off location, rather than removing an increased length between squeeze off locations.
   This will aid future pipeline identification and protection.
   Note:
   The SDR of a multilayer PE pipe is based on the external diameter and wall thickness of the PE core pipe with the skin removed. Where squeeze off equipment is used with multilayer pipe with an SDR of 21, then this applies to the pipe without the external skin. Peelable pipe should not be squeezed off with the skin intact as this could cause catastrophic failure of the pipeline

FLOW STOPPING SWAGELINED SDR 26 PIPE

If squeeze-off operations are to be carried out on SDR 26 pipe, which has been used for slip or swage lining then all work must be the subject of a non-routine operation as specialist equipment and pipe access systems will be required. Reference must be made to SGN/PM/MSL/1 Part 2.

FLOW STOPPING – PE 80 & 100

Squeeze off operations can usually be carried out on PE 80 and PE100 pipes of all SDR values from SDR11 to SDR 26. However, squeeze offs units for diameters above 355mm and pipes operating at pressures above 2 bar require specialist equipment and reference must be made to SGN/PM/MSL/1 Part 2 for further information.

LIMITATIONS OF USE FOR FLOW STOPPING EQUIPMENT

The maximum operating pressures of the system, when using the various methods of flow stopping the flow of gas are shown in Table 20 and Table 21.

For mains operating at Medium Pressure (MP), you should (where possible) reduce pressure to the network minimum.

The preferred methods of flow stopping PE pipes between 180mm - 355mm is the use of semi supported bags, although pressure limitations apply when used on MP system – see Table 20. Alternatively, squeeze off up to 500 mm can be used.

For flow stopping metallic mains up to 12"/315mm semi supported bag stop is used, although pressure limitations apply when using on the MP system, refer to Table 20.

The Large diameter Bagstop system can be used for PE and metallic mains up to and including 24inch/630mm at low pressure only. See SGN/PM/MSL/1 Part 2.
The use of Foam Plugs on metallic mains can only be used when the section of main is being permanently stopped off.

Mains Maximum Operating Pressure			
PE 80/100 Diameter (mm)	Bag stop	Single Squeeze off (1)	Double squeeze off
40	-	2 bar	2 bar
55	-	2 bar	2 bar
63	-	2 bar	2 bar
75	-	75 mbar	2 bar
90	-	75 mbar	2 bar
110	-	75 mbar	2 bar
125	0.28 bar	75 mbar	2 bar
140	-	75 mbar	2 bar
160/162	-	75 mbar	2 bar
180	0.28 bar	75 mbar	2 bar
250	0.2 bar	-	2 bar
315	0.1 bar	-	2 bar
355	40mbar*	-	2 bar
400	40mbar*	-	2 bar
500	40mbar*	-	2 bar
630	40mbar*	-	-

This set of data is for the large diameter bag stop system see SGN/PM/MSL/1 Part 2 for more details.

Table 20 - Limitations of use on PE mains - Mains operating pressure

	Mains Maximum Operating Pressure			
Mains Dia Inches	**Bagstop**	**Single hole Bagstop**	**Foam Off Single**	**Foam Off Double**
3	0.34 bar	-	75 mbar	2 bar
4	0.34 bar	0.35 bar	75 mbar	2 bar
5	0.28 bar	-	75 mbar	2 bar
6	0.28 bar	0.30 bar	75 mbar	2 bar
7/8	0.28 bar	0.30 bar	75 mbar	2 bar
9/10	0.20 bar	-	75 mbar	1 bar
12	0.10 bar	-	75 mbar	1 bar
14/15	40mbar [3]	-	-	0.34 bar
16	40mbar [3]	-	-	0.34 bar
18	40mbar [3]	-	-	0.34 bar
20	40mbar [3]	-	-	0.14 bar
24	40mbar [3]	-	-	0.14 bar
27	40mbar [3]	-	-	0.05bar
30	40mbar [3]	-	-	0.05bar
36	40mbar [3]	-	-	0.05bar
42	40mbar [3]	-	-	-
48	40mbar [3]	-	-	-

Table 21- Limitations of Use on Metallic / PVC Mains - Maximum Operating Pressure

Notes:
1) PVC mains are limited to 75mbar maximum
2) Foam plugs can be used on 1, 1½ and 2" diameter pipes up to 75mbar
3) This set of data is for the large diameter bag stop system see SGN/PM/MSL/1 Part 2 for more details.

CONTINUITY OF SUPPLY

1. All flow stop operations must include a bypass to maintain supplies to consumers unless its omission is authorised by your Operational Manager.

Note: Network analysis must be used to:
- ***determine the need for and size of any bypass, (unless it is sized to match the existing main to be replaced).***
- ***to indicate the minimum pressure at the worksite which will support the Network extremity.***

For some two way fed systems, it may be possible to maintain supplies by elevating governor outlet pressures or carrying out the work at times of low gas demand.
Some networks are controlled by a 'pressure management system', which should be able to compensate for the temporary removal of the pipe and maintain pressures throughout the operation.

2. Check with your Operational Manager, to find out if the part of the network you are working on has a specially managed system.
3. While carrying out your work, it is important to check that pressures elsewhere remain unaffected by the operation.
   Note: These points may be some distance away from the operation. There is, therefore, no standard minimum pressure at the work site.
4. Make sure that the pressure determined by network analysis and stated on the Routine or Non-routine procedure is met or exceeded for the duration of the job. If not inform your Operational Manager.
   Note: Before starting any cutting operations or foaming off of mains, verify that the information obtained via network analysis, is valid for your operational site. This will check that the required minimum pressures can be maintained, especially during periods of high gas demand.
5. Do this by either:

- By allowing a stabilisation period following the flow stop operation to be sure the bypass maintains adequate pressure in the system.
- Carry out a practice run at the same time/day the cut-out operation is proposed can achieve this.

VENTING OF GAS

Vents pipes construction is similar to purge vent pipes as covered in Section H1. Purge saddles should be used as these saddles have a larger diameter hole.

1. Vent pipes on flow stopping operations must have flame traps installed on top of the vent pipe.
2. For intermediate Pressure (IP) venting purposes, PE purge saddles should be used with metallic vent pipe and flame trap.
3. Position marker tape on the top of the main.
   Note: This will reduce the risk of third party damage to these tees which are on the top quadrant of the pipe.
4. Weather caps must not be fitted to these flame traps.
5. Flame traps must not be installed on purge vent pipes when purging (commissioning/decommissioning) systems as per Section H1.
6. Remove all possible sources of ignition to a safe distance.
   Note: Typically, 5 metres up wind of the site.
7. No smoking notices must be displayed on all routes to the sites.
8. To reduce the risk of static charges by:

- Fitting continuity bonds, earthing straps/rods as required
- Making use of wet cloths

9. Check that venting gas does not enter adjacent properties through windows, doors, ventilation openings, balance flue terminals, tunnels, confined spaces and similar situations .
10. All personnel must wear the appropriate PPE as determined by the onsite risk assessment.
11. Check that proper precautions have been taken to make sure that the possibility of public reported escapes is minimised as far as practicable.
12. If substantial volumes of gas are involved, for example, long lengths of medium pressure mains; consider transferring the gas to an adjacent low pressure system via a governed rider.
    Note: This will minimise the amount of gas to be vented to atmosphere.

BYPASS AND RIDER CONSTRUCTION

Bypass

When a bypass is needed to maintain supplies the following factors must be considered: -

- *The distance over which the bypass must operate.*
- *The gas pressure in the system.*
- *The diameter of the bypass.*
- *The duration for which the bypass is needed.*
- *Attendance on site.*
- *Ability to find a safe and secure route.*
- *Possibility of vandalism or impact.*
- *Fire hazard.*
- *Construction limitations, such as material, number of bends, pressure testing.*

A written procedure (see GDN/PM/SCO/4and GDN/PM/SCO/5) must be available on site. The RO or NRO will identify the site-specific requirements for the bypass.

1. Construct the bypass in the size and material as per the written procedure.
2. If there is a strong possibility of vandalism, you should use a purpos-built steel bypass pipe or temporarily bury a PE bypass.
3. Where the site will be attended throughout the duration of the job and there is little or no danger of interference damage, you can use a PE pipe.
4. As an alternative you can use a metallic flexible bypass.
5. Keep the bypass within the confines of the barriered area.
6. If pipes are laid in gutters, then provision for water to drain away must be maintained.
7. Where the bypass will cross vehicle access to driveways, ask the occupiers if they will agree not to use the drive for temporary period. If this is not possible the pipe you must bury the pipe.

8. For 63mm/2" bypasses on PE mains 63mm, 90mm and 125mm operating up to 2 bar reference should be made to Section E7, which covers the use of a bypass kit with an integral pressure sensor.
9. Steel bypasses up to 2" and 2 bar may be screwed otherwise they must be connected using welded/flanges steel.

RIDER

1. If you need to use a rider, factors considered for bypasses must be used.
2. If the site is attended continuously, throughout the operation, then PE riders are normally acceptable.
3. If a governed rider is used to supply gas from the MP system into the LP system, then it may be convenient for the rider to be partly steel and partly PE.

PROTECTION OF BYPASS AND RIDER POINTS

1. On completion of flow stop operations any the pipework including rider and bypass valves which are positioned on the crown of the pipe must be protected from future excavation activities.
   Note: Make use of marker tape, heavy duty marker tape, steel or concrete slab as appropriate depending on its depth from the surface.
2. Check information related to the pipelines position is appropriately recorded.

TESTING OF BYPASSES

1. The bypass must be pressure tested as follows: (see Figure 34)
   a) Where the bypass is 90mm diameter or less it must be pressurised by opening valve A (do not open both valves A & B together) and all joints tested using leak detection fluid.
   b) Where the bypass is 90mm or less but its length is greater than 14 metres or is being left unattended for a long period then apply the test for greater than 90mm pipes (c - below).
   c) Where the bypass is greater than 90mm diameter it must be tested with air to 350mbar for LP or 3 bar for MP, for 15 minutes.
      i. Close valves A and B and
      ii. either have the body vent opened if using a double block and bleed valves or spaded on their outlet if using a single face valve.
      iii. Cap the vent pipes above the vent valves C and D
      iv. These vent valves must be left in the open position.
      v. No pressure loss is accepted.
      vi. On successful completion of the test the vent valves C and D must be closed and the vent pipes erected.
      vii. Close valves A and B.
2. The main can now be drilled.
3. If the test is unsuccessful, close valve A, rectify leak and retest.
4. On successful completion of this test the bypass must now be commissioned.

Figure 34- Testing the Bypass

COMMISSION BYPASS

It is important that the bypass is confirmed free from blockages by purging both ways.

1. Check all valves are in the closed position and check Network pressures.
2. Open vent valve C, then open bypass valve A.
3. Purge until two independent readings of 90% gas in air has been obtained at purge vent C, and then close valves A & C. See Figure 35.

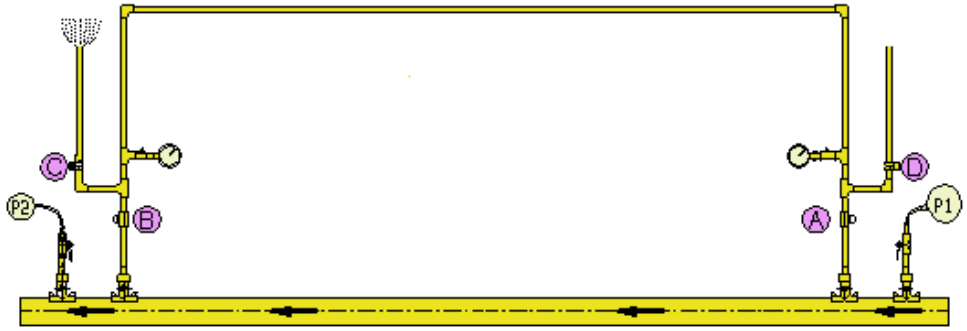


Figure 35- Commission Bypass (1)

4. Open valve D then B and purge until two independent readings of 90% gas in air has been obtained. See Figure 36.
5. Close valve D, open valve A slowly and pressurise to network pressure.
6. Fully open valves A & B.
7. Any fittings not tested must be checked for soundness with approved leakage detection fluid, the pipe and fittings washed with clean water afterwards.
8. The bypass is now fully commissioned.

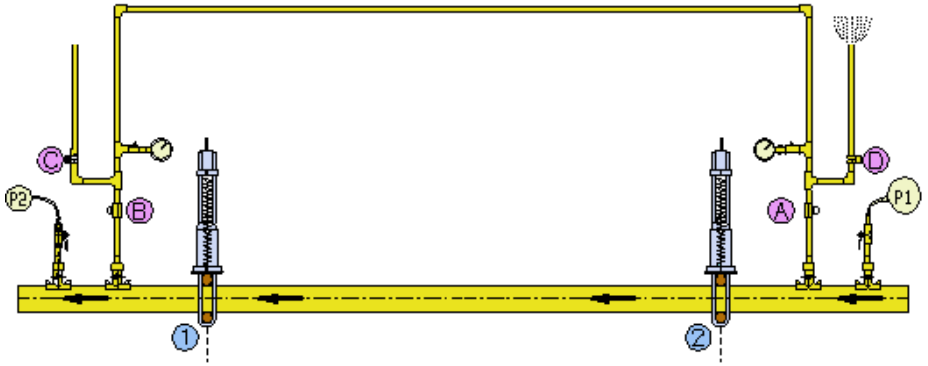


Figure 36- Commission Bypass (2)

Note: If spades have been used in the testing process they must be removed just before commissioning commences. The joints must be tested.

BYPASS AND VENT POINT DE-COMMISSIONING

1. Slowly close valve B whilst monitoring pressure. (see Figure 37)
2. Monitor mains pressure for at least 10 minutes to be certain that the renewed section is supplying gas downstream without any blockages.
3. The routine operational procedure should indicate the actual time required to monitor pressures.
4. Slowly close valve A and vent down bypass through vent valve C, Figure 37.
5. Disconnect vent pipe at valve C.
6. Connect air supply at valve C, open valve D and direct purge to air at vent D.

Note: Air pressure must not exceed ⅓ rd of mains pressure.

7. Remove caps from the top of the top tees and re-insert PE cutter, if removed, into main at bypass, pressure point and vent connections.
8. Check seal using leak detection fluid.
9. Remove caps from the top of the top tees and re-insert PE cutter into main at bypass, pressure point and vent connections.
10. Check seal using leak detection fluid, wash off with clean water.
11. Remove bypass, pressure points and vent, install electrofusion caps on the outlet of the saddle fusion tees.
12. Raise integral PE cutters and fit completion cap.
13. Test electrofusion and completion caps with leak detection fluid.
14. Wash off with clean water.

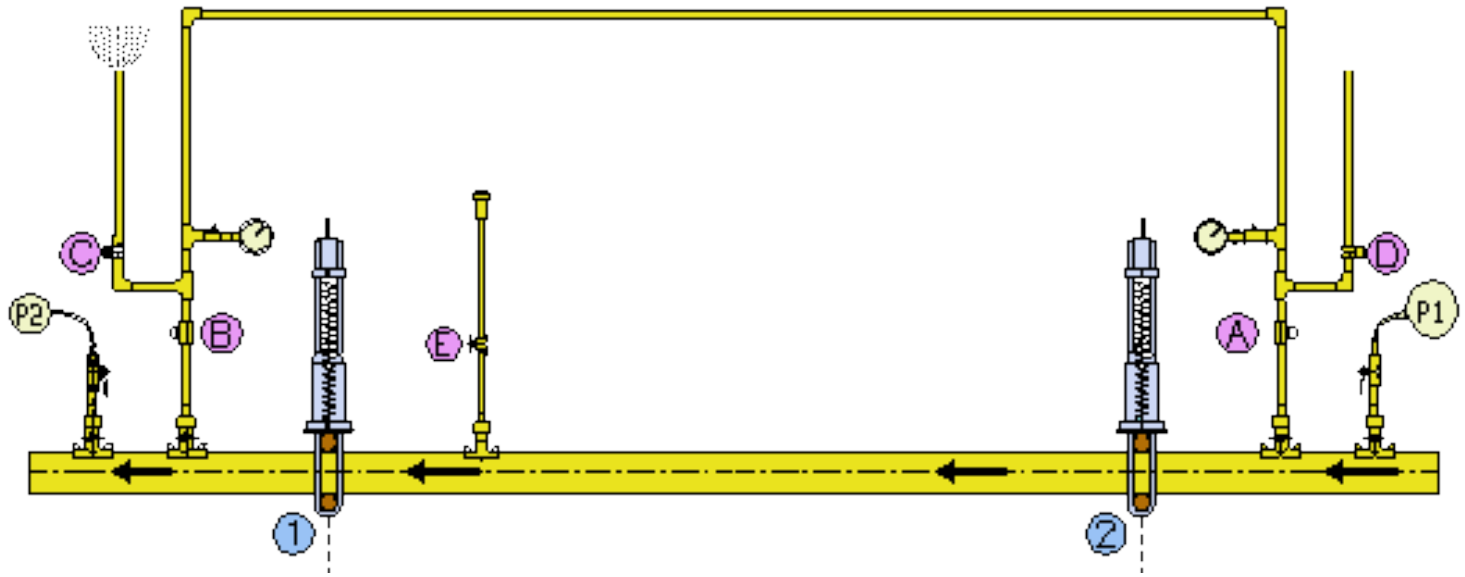


Figure 37- Bypass and Vent Points Decommissioning

E0 Flow stopping - General Information

PVC AND ASBESTOS MAINS

The preference will always be not to work on Asbestos mains whenever possible.

1. If you find an Asbestos main at the connection point you require, seek and alternative location whenever possible.
2. Contact you Operational Manager and inform them of your discovery.
3. Refer to SGN/WI/SHE/81.
   Note: Special wrap around clamps with specifically designed branches are required when working on PVC or Asbestos mains.
   The branch is connected to the 'winged' undercarriage designed for PE bag stop operations.

LOW PIPE TEMPERATURE

1. You must not squeeze off PE pipe if the temperature of the pipe is below 0°C, unless supplementary heating is provided to make sure the temperature of the pipe is not below 0°C while the squeeze off is applied.
   Note: unlike PE fusion jointing where low air temperature (at or below -5°C) criteria require additional precautions such as use of heated tents, for PE squeeze-off operations it is pipe temperature as opposed to air temperature that is a critical factor.
2. In low temperature situations considerations, should be given to the use of an SGN approved pipe warmer. You must follow the manufacturer's instructions.

PE SQUEEZE OFF DISTANCES FOR PE 80 & PE 100 PEELABLE PIPES

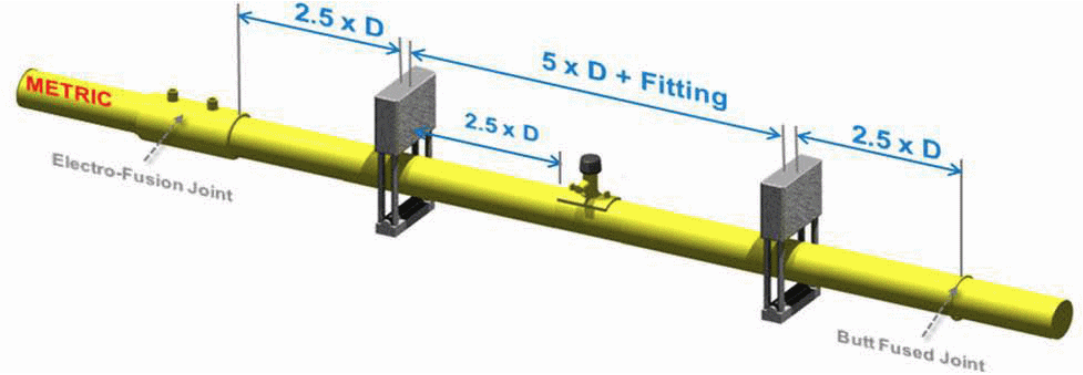


Figure 38- Minimum Squeeze-off Distances Metric Sized Pipes

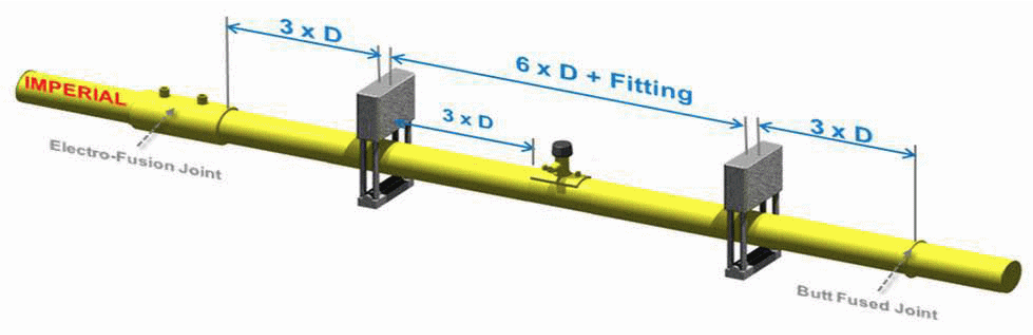


Figure 39- Minimum Squeeze-off Distances Imperial Sized Pipes

IMPERIAL SIZED PE MINIMUM SEPARATION DISTANCES

1. The minimum distance between a squeeze-off tool and a pipeline heat fused fitting, electro-fusion or butt fusion joint weld for imperial sized PE80 pipe remain unchanged as shown in Figure 39.
   Note: The minimum distances shown apply from the closest edge of the squeeze-off compression bar

PE100 SDR 11 (ORANGE COLOURED) AND PE80 PIPELINES OPERATING ABOVE 2 BAR

1. The minimum distances shown in Figure 38 apply from the closest edge of the squeeze-off compression bar.

PIPE INSPECTION

1. Thoroughly wash and clean the exposed pipe around its entire circumference to remove all dirt and debris over a minimum length of 0.5D either side of the squeeze off tools are to be fitted.
   Note: This is to prevent any damage to the pipe that would result from any impingement during the application of the squeeze off.
2. On PE100 peelable pipes, you must only use an approved peeling tool such as the PET tool to remove the skin a distance of 0.5 x D either side of the position of the squeeze off bars.
3. DO NOT Apply a squeeze off tool to the outer skin as this can damage the pipe leading to pipe failure.
4. Inspect the pipe for any damage or evidence of a previous squeeze off having been applied, before you position the squeeze off tool.
   Note: The inspection for damage is particularly important within the 'critical areas' located at the 3 o'clock and 9 o'clock position relative to the squeeze off tool which must be carefully examined for evidence of scoring or scratch type defects. Figure 40 and Figure 41 describes the 'critical area'. The pipe must be free from scores or scratch type defects prior to the squeeze off compression bars being applied.
5. If your inspection identifies pipe damage but it is considered not to exceed a depth of 10% of the wall thickness, then you can remove the damage using a sharp hand scrapper.
6. Scrape the pipe until all evidence of damage in the critical area has been removed prior to the squeeze-off being applied.
7. If your inspection identifies damage that is considered to exceed a depth of 10% of the wall thickness inform your Operational Manager.
   Note: Remedial action is required such as the damaged section of pipe cut-out and replaced.

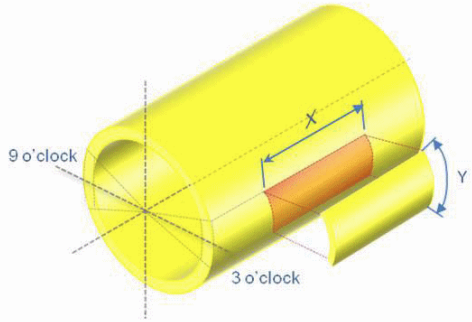


Figure 40- Location of Critical Area for Squeeze Off

Y = 4 x the pipe wall thickness
Located directly under the squeeze-off tool compression bars extending longitudinally 0.5 D either side of the compression bars (shown X) and a distance Y around the pipe circumference.
This area is subject to maximum bending and stress as the pipe is flattened and re-rounded.

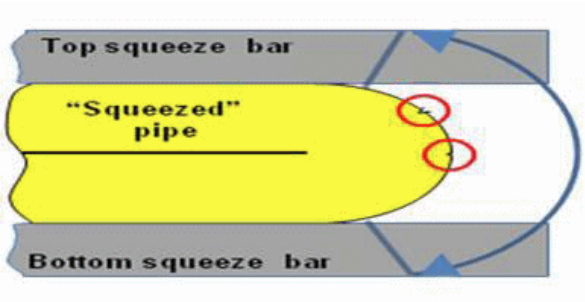


Figure 41- "Critical Area" Squeezed Off Pipe

Note: Pipe wall thicknesses are shown in Table 3 and GIS/PL2-2 & GIS/PL2-7.

8. An alternative location must be chosen for the siting of the squeeze off.
9. After the squeeze off tool has been used, strip down the unit and remove from the excavation.

10. You must re-round the pipe mechanically using a re-rounding tool to restore and protect its structural integrity and flow characteristics.
11. Leave the Re-rounding clamp in-situ for at least 10 minutes before removal.
12. Inspect the squeezed area of pipe for any damage that may have been sustained during the operation.
13. If you identify damage inform your Operational Manager who will advise what remedial action is to be taken.
14. Permanently mark the pipe using an indelible marker and in addition 'squeeze-off applied' marker tape applied.
    Note: This will identify the area of the pipe squeezed off.

WORKING NEAR TO POTENTIALLY DEFECTIVE PE JOINTS

When using squeeze-off equipment adjacent to leaking or potentially defective butt or electro-fusion joints you must consider the risks.

A potentially defective butt joint maybe where:

- ***the external bead is still intact or***
- ***partially de-beaded or***
- ***there are slit defects visible or***
- ***there is significant pipe misalignment***

A potentially defective electro-fusion joint maybe where:

- ***the melt wells/ indicators have not risen or are over-melted or***
- ***peelable pipe skin is within the joint melt area or there is no evidence of pipe scraping or***
- ***there is significant pipe misalignment***

1. If you believe the items above exist, contact your Operational Manager.
2. They will agree with you suitable precautions to be put into place. Precautions may include.
   a) For potentially defective butt fusion joints where:
      - The butt fusion joints are not leaking, and
      - where the butt fusion joint bead is still intact and
      - subject to site specific risk assessment check bead width/ profile is within permitted parameters and
      - there are no visual signs of slit defects or misalignment.

   b) No further action is needed if the following checks are satisfactory:
      - remove bead and conduct quality checks such as further visual examination, bend back tests.

   c) Consider potential alternative means of flow stopping such as:
      - valve closures,
      - PE bag-stop,
      - Flow stopping on adjacent metallic system rather than PE.

   d) Consider relocating squeeze-off location away from potentially defective joint in separate excavation and position squeeze offs mid-way between pipe stick lengths.

   e) Consider pressure reduction, particularly for pipelines with an Operating Pressure >75 mbar, the proposed operating window (start / finish times) and review pipe bypass sizing.

   f) Consider providing additional pipe restraint.

   g) Subject to site specific risk assessment fit temporary repair clamps or over-wrap leak area/ potentially defective joint with Densomastic tape, supplemented with PVC tape to minimise relaxation on all leaking / potentially defective joints.

   h) Check that a contingency plan is in place and that it identifies the actions to be taken in the event of joint failure.

EARLY IMPERIAL (TAN COLOURED) 'ALDYL A' DUPONT PIPE

1. If you squeeze off imperially sized DuPont Aldyl-A PE pipe material (tan or pink in colour) you must as a precautionary measure fit a mechanical repair clamp over the squeeze-off position. See Figure 42.
   Note: This is to reduce the risk of a subsequent pipe failure resulting from slow crack growth from inside of the pipe wall to outside. Mechanical repair clamps are intended to clamp over the squeezed off section in a single operation if the pipe has been re-rounded after the squeeze off tool is released.

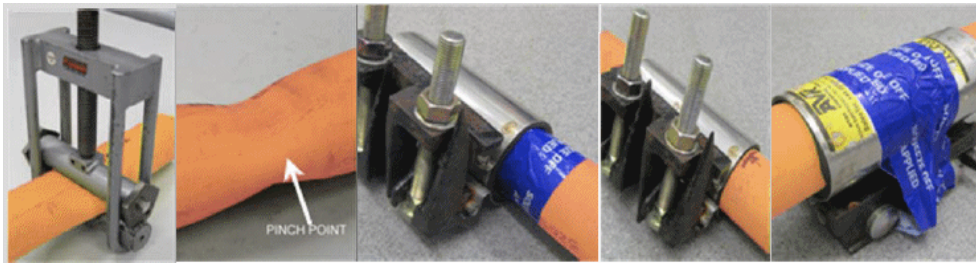


Figure 42- Fitting Mechanical Repair Clamp Over Squeeze-off Pinch Point

2. If the correct size of re-rounding tool is not available for <=2" nominal size pipes, then use a suitable mechanical repair clamp to re-round the pipe.
3. Fit the clamp to one side of the pinch point, re-rounding the pipe in a staged process by moving the clamp along the pipe towards the area of maximum squeeze-off compression until the pinch point on either side of the pipe is centred within the clamp.
4. You should use a hand ratchet to bolt the shells together, taking care to prevent excessive load on any one bolt thread by applying a couple of turns to each bolt in turn to gradually tighten up the clamp.
5. Apply "Squeeze off applied" marker tape to the pipe at the squeeze off location. (see Figure 42)
6. In addition,, apply "Squeeze off applied" place marker tape over the repair clamp. (See Figure 42)
7. Make sure that the bolts are arranged to minimise potential interference damage.
8. Protected the bolts against corrosion.
   Note: Suitable mechanical repair clamps are those fitted with a rubber or polythene layer of minimum 3mm thickness between the pipe and steel shell such as to prevent the steel shell of the clamp from contacting the PE pipe surface.
9. Table 22 provides the dimensions of these pipes, which was imported from the USA until circa 1973 and the associated squeeze off bar and gap dimensions.

Nominal Size	SDR	Outside diameter		Wall Thickness		Minimum gap between squeeze bars	Minimum Diameter of squeeze bar
		Min (mm)	Max (mm)	Min (mm)	Max (mm)		
¾ IPS	11.0	26.6	26.9	2.5	2.8	4.0	26.0
1" IPS	11.0	33.4	33.7	3.1	3.5	5.0	32.0
1¼" IPS	11.0	42.0	42.3	3.8	4.3	6.1	32.0
1½" IPS	11.0	48.2	48.5	4.4	4.9	7.0	32.0
2" IPS	11.0	60.2	60.6	5.5	6.2	8.8	32.0
3" IPS	11.5	88.6	89.6	8.1	9.1	13.0	38.0
4" IPS	11.5	113.9	114.7	10.4	11.7	16.6	38.0
6" IPS	11.5	167.8	168.9	14.7	16.5	23.5	51.0
8" IPS	11.0	219.8	219.8	19.9	22.3	31.8	51.0

Table 22- Tan Coloured DuPont "Aldyl A" Dimensions

E1 PE Single Squeeze-off up to and including 180mm at LP and up to and including 63mm at up to 2 bar. Page 1 of 9

This section details the procedure involved in undertaking PE Single Squeeze-off up to and including 180mm at Low Pressure and up to and including 63mm at up to 2 bar.

Note: *For construction of PE tapping tees, bypass, vent and rider connections refer to Section E0.*

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. Excavate on to the pipe at the planned location. See guidance at Section A1.
4. Clear the main around the full circumference of the pipe.
5. Check for potential obstructions to the fitting of the squeeze off equipment, for example, width of trench and clearance beneath.
6. Inspect the pipe (see guidance B1) and note if any of the following situations exist.

- Pipe damage.
- Defective PE joints are present.
- An Early Imperial "Aldyl A" DUPONT Pipe is present.

7. Follow the advice in Section E0 if required.

PIPE & FITTINGS PREPARATION

1. Check diameter, Standard Dimension Ratio (SDR), and material type - information will be printed along the pipe barrel at 1m intervals on each side of the pipe.
2. Check the pipe for ovality and use re-rounding clamps accordingly.
   Note: If you are unable to verify the pipe SDR refer to Procedure Gas passing. before continuing.
3. All equipment and fittings must be checked, prepared and be available for the work to be undertaken.
4. Check the correct distance is maintained from existing fittings, joints, squeeze-off applied locations and any proposed future joints used for connection purposes. (see Section E0) and Table 23.
5. Set out the squeeze-off operation by marking the exposed pipe with all positions for pressure points, bypass connections, vent point and the location of squeeze-off equipment see Figure 43.

Pipe diameter "D" mm	A		B
	2.5 X D	3 X D	
55	138mm	165mm	Refer to Appendix C
63	158mm	189mm	
75	188mm	225mm	
90	225mm	270mm	
110	275mm	330mm	
125	313mm	375mm	
180	450mm	540mm	

Table 23 - Single Squeeze Off Proximity

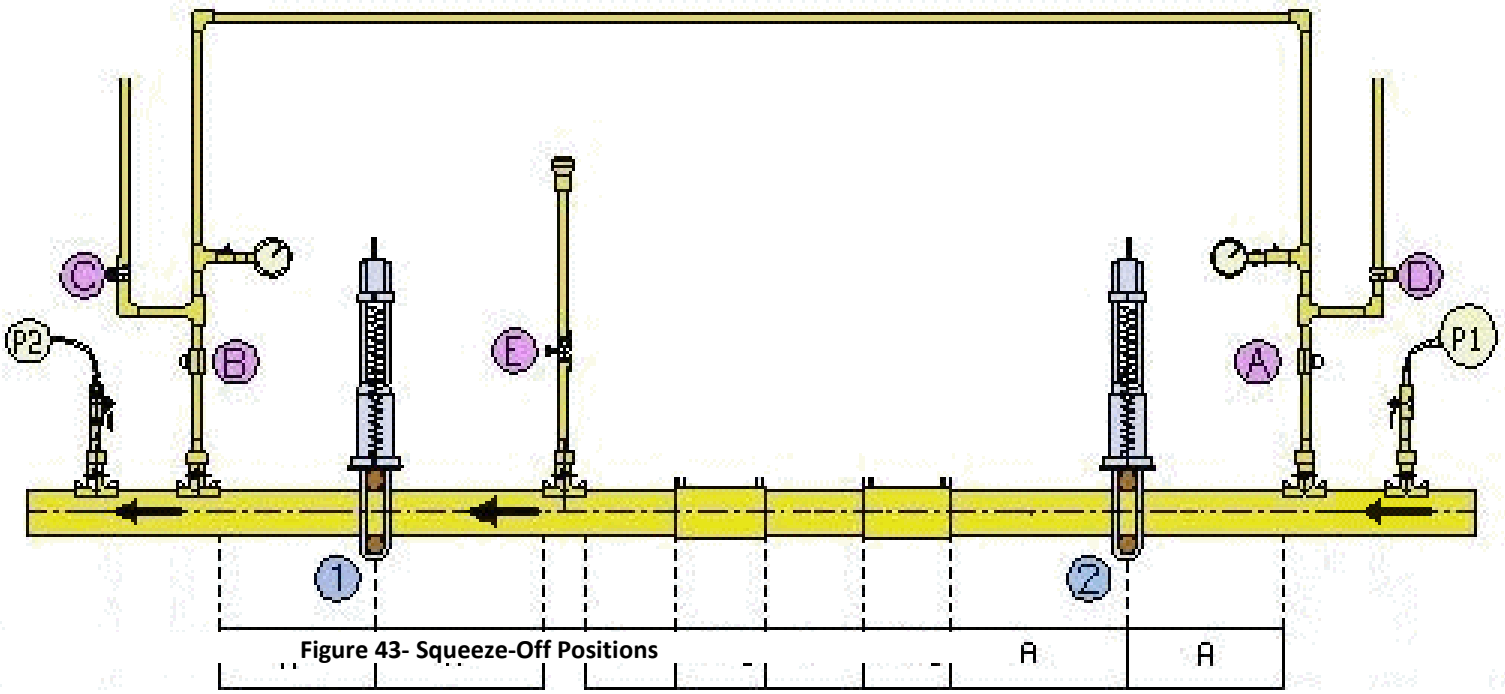


Figure 43- Squeeze-Off Positions

Note: Pressure points on bypass may be installed if requested by the Authorising Engineer

ESTABLISH NETWORK PRESSURE

1. Install two pressure monitor points on the PE main placed outside the location of the bypass points, see Figure 44 .
2. Attach and commission pressure gauges.
3. Confirm Network pressure is within range of single squeeze-off operation:
   - 75mbar for mains up to and including 180mm diameter and
   - 2 bar for mains up to 63mm diameter.
4. If the pressure is above the expected pressure contact your Operational Manager.

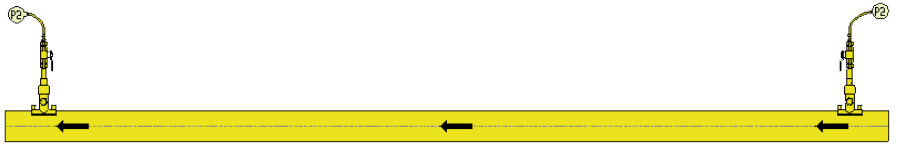


Figure 44- Pressure Gauge Points

E1 PE Single Squeeze-off up to and including 180mm at LP and up to and including 63mm at up to 2 bar. Page 3 of 9

ASSEMBLE BYPASS AND BYPASS AND VENTS

Construct bypass, in size and material as per the written procedure. See Section E0 – Bypass and Rider construction.

TESTING BYPASS

Test the bypass follow instructions at Section E0 – Testing bypass

COMMISSION BYPASS

Follow the procedure in Section E0 – Commission the bypass

SQUEEZE-OFF PREPARATION

1. Check squeeze-off are in good working order.
2. Set stops to the correct pipe size & SDR.
3. If the SDR of the pipe cannot be found, then set the stops to the size of pipe.
4. For 90mm and 125mm SDR 17.6 pipe it is necessary to set the stops to one pipe size below typically 125mm to 90mm and 90mm to 63mm.

Note: Some squeeze-off tools may have stop settings for 75mm pipe, which should not be used for 90mm and 125mm pipe.

5. Place squeeze-off units, 1 and 2, on the parent main at the marked positions see Figure 45.
6. Check that the tool is adequately supported whilst in the open position.

Note: Use chocks to raise the base of the tool up into contact with the underside of the pipe.

7. Support the tool on both sides to prevent it tipping.
8. Fit and connect vent E onto parent main upstream of squeeze-off 1 ensuring minimum distances from squeeze-off position and future tie-ins. See Section E0 and Figure 45.
9. Earth any metallic vent pipes.
10. Make a final check on the assembly to check that no dirt or debris has been picked up during the assembly operation and become trapped between pipe and tool, remove if found.

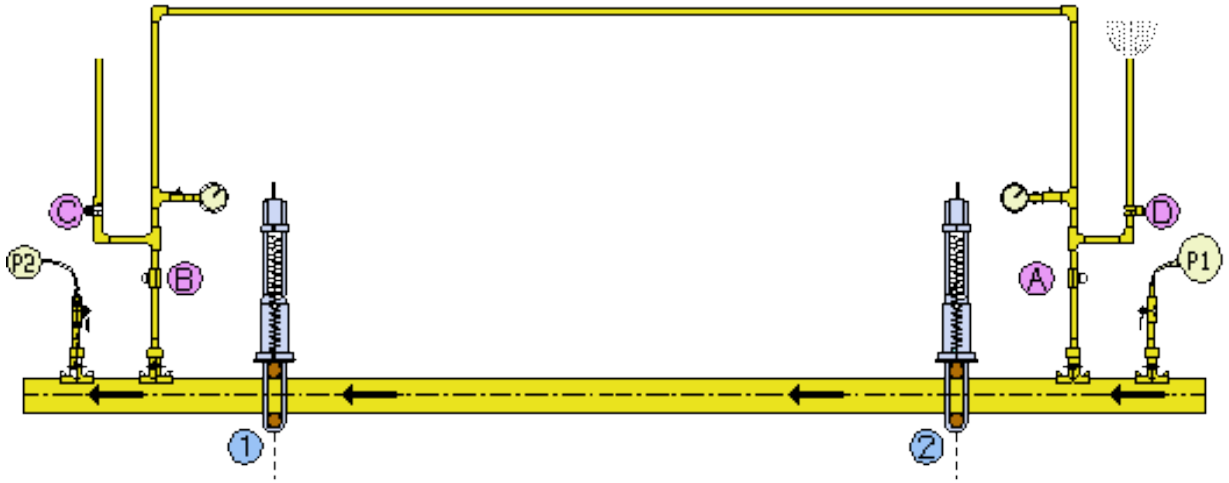


Figure 45- Squeeze-Off Placement

E1 PE Single Squeeze-off up to and including 180mm at LP and up to and including 63mm at up to 2 bar. Page 4 of 9

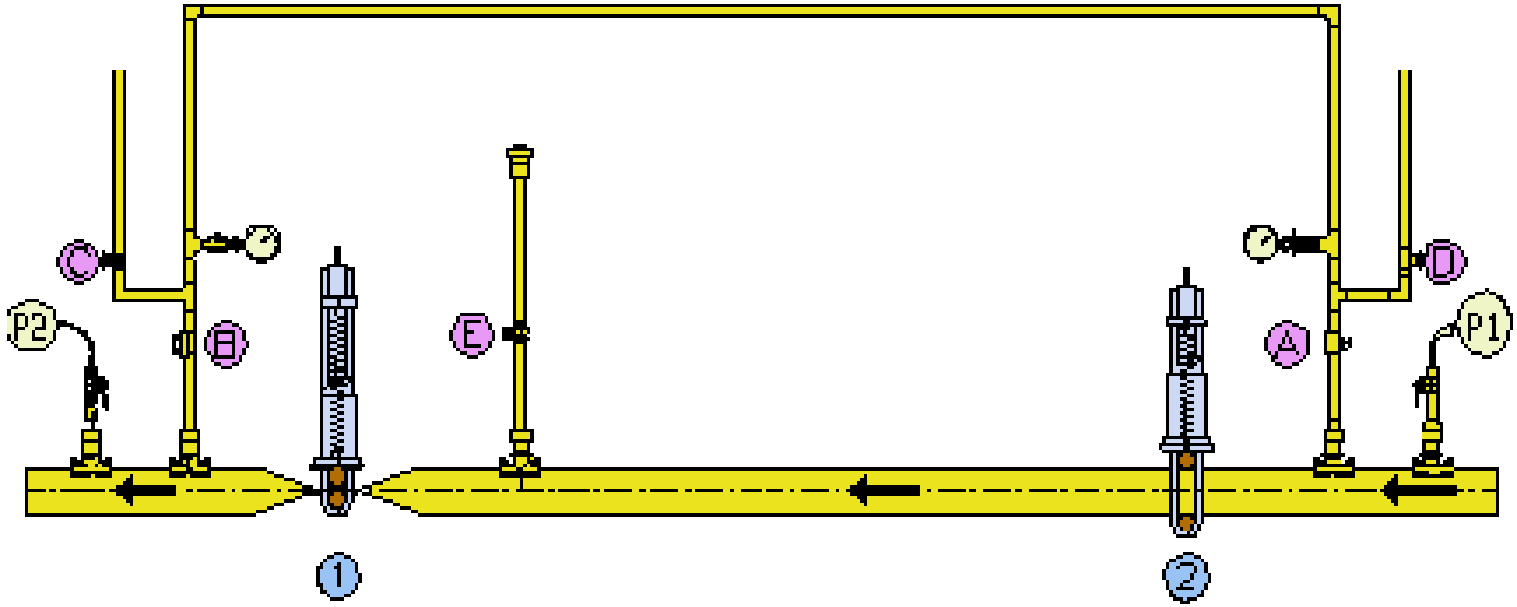


Figure 46- Squeeze-Off (1)

SQUEEZE-OFF PE MAIN

1. Re-check network pressures to confirm mains operating pressure.
2. Re-check bypass is fully open.
   Note: If you are using hydraulically operated squeeze off tools, all personnel should remove themselves from the excavation for the squeeze down operation.
3. Slowly apply downstream squeeze-off unit 1 until it reaches its stop, see Figure 46.
   Note: Follow the manufacturer's instructions to compress the pipe until the tool stops are reached.
4. Monitor the pressure gauges for 10 minutes before proceeding.
5. If pressure starts to fall below minimum pressure stated on routine operation procedure, release squeeze-off and inform your Operational Manager.
6. Apply squeeze-off mechanical interlocks.
7. Inspect the sides of the pipe; see Section E0 – Pipe inspection.
8. Slowly apply upstream squeeze-off unit 2. Continuously monitor pressure at both pressure gauges. See Figure 47.
9. Apply squeeze-off mechanical interlocks.
10. Inspect the sides of the pipe; see Section E0 – Pipe inspection.
11. Open valve E and check at the vent between the squeeze-off units to establish whether there is any gas passing.
12. If no gas is passing continue with the operation.
13. If gas is passing, refer to Section E1.

E1 PE Single Squeeze-off up to and including 180mm at LP and up to and including 63mm at up to 2 bar. Page 5 of 9

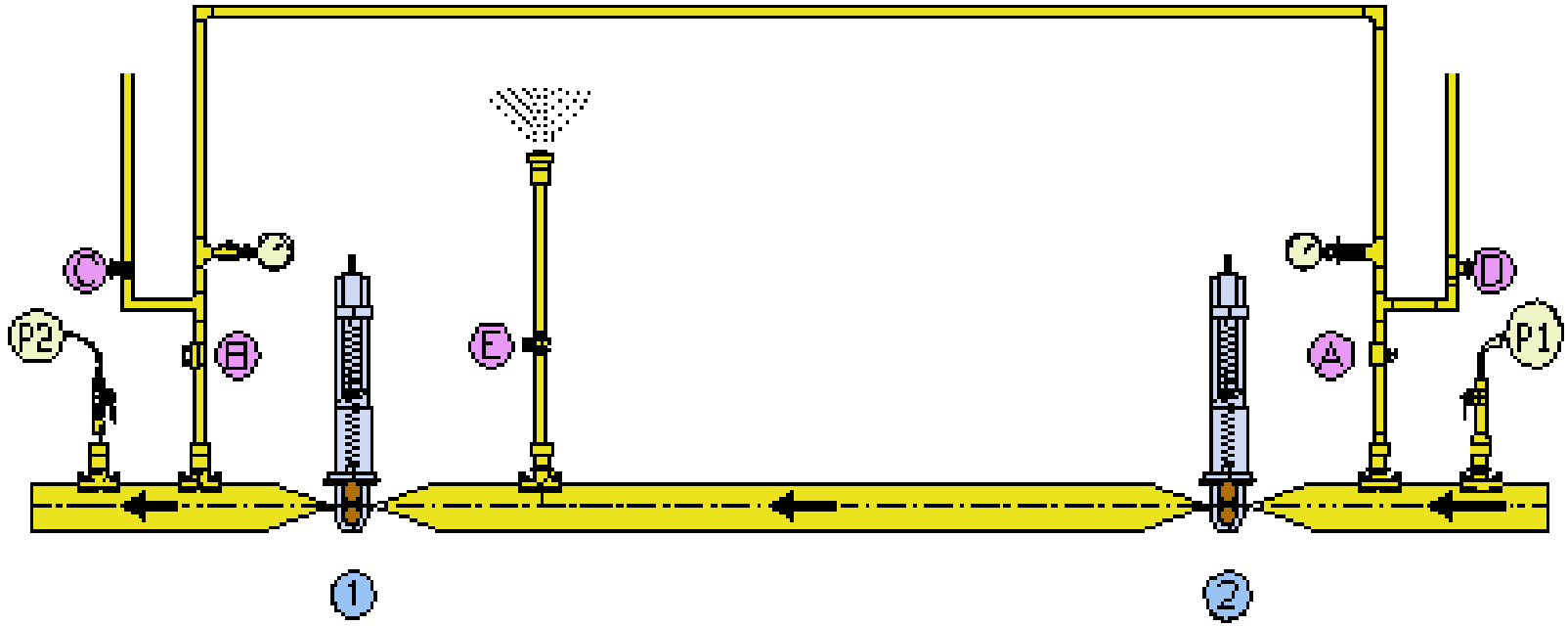


Figure 47- Squeeze-Off (2)

Note: The cutting of PE mains must only be undertaken using approved equipment such as secateurs/shears, handsaws or hacksaws, guillotines, rotating wheel cutters with outboard rollers to keep cutter aligned on pipe to create a square cut and motorised cutter/hacksaws.
DO NOT USE electrically driven tools, chainsaws, disc cutters or similar tools to cut the pipe.

CUT OUT PE MAIN

1. Check that there are:
- no sources of ignition present adjacent to the proposed cut out
- personnel are wearing appropriate PPE
- the pipe is adequately supported

2. Drape damp cloths around the pipe and make sure they are in contact with the ground on each side of the cut to prevent a spark from static electricity.
3. Check the atmosphere in the excavation.
4. Cut pipe section as specified in work instruction, continually monitoring network pressure and the atmosphere within the cut-out area.

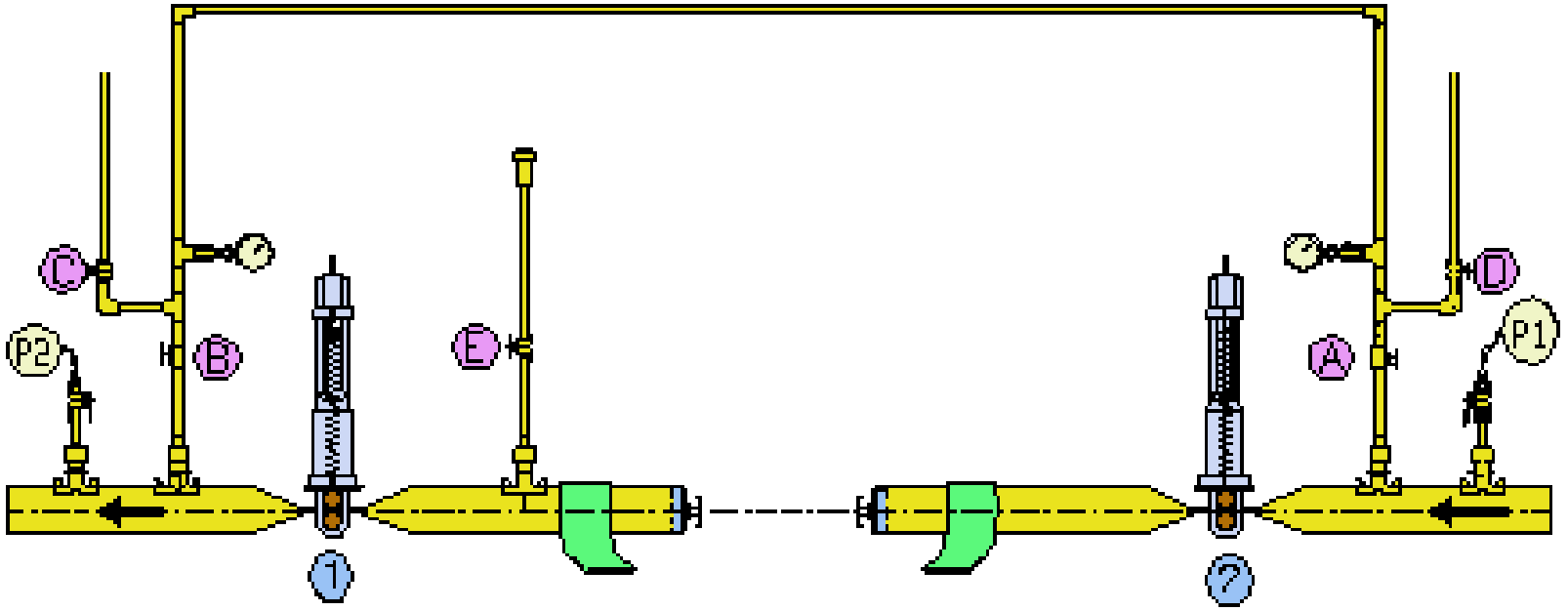


Figure 48- Installation of Expanding Stoppers

5. Should a guillotine be used a re-rounding clamp should be put onto the main prior to joining.
6. Install expanding stoppers whilst preparing fittings for installation see Figure 48.
   Note: Take care not to inhale PE dust created from the cutting process.
7. Remove and bag any PE swarf created.
8. Prepare and install connection fittings in accordance with Appendix D, after first removing the expending stoppers.

RE-COMMISSIONING OF PE MAIN

1. Remove flame trap from the top of vent E.
2. Remove squeeze-off mechanical interlocks.
3. Monitor pressure gauges, open valve E, slowly release upstream squeeze-off 2 in accordance with the manufacturer's instructions.
4. Purge through vent pipe until two independent readings of 90% gas in air is obtained.
5. Turn off valve E and allow section to pressurise to line pressure.
6. Test installed fittings with leak detection fluid and wash off with clean water.
7. Slowly release downstream squeeze-off 1.

REMOVAL OF THE SQUEEZE OFF TOOL AND RE-ROUNDING THE PIPE

1. Once the squeeze off tool is no longer required, remove the squeeze off tools from the pipe.
2. Re-round the pipe to restore its structural integrity and flow characteristics by following the guidance in Section E0 for re rounding.
3. Permanently mark the pipe using an indelible marker pen to indicate that squeeze off has been performed at that location.
4. Place 'Squeeze off applied' marker tape onto the pipe see Figure 49.

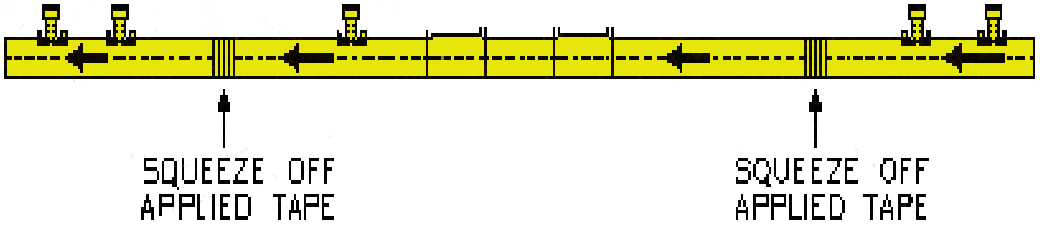


Figure 49- Squeeze-Off Completion

BYPASS AND VENT POINT DE-COMMISSIONING

De-commission bypass and vents follow procedure in Section E0.

PROCEDURE FOR RECTIFYING SQUEEZE-OFF UNITS PASSING GAS - 90/125MM SDR 11 AND 17.6

1. Where the SDR value can be positively identified at all squeeze-off positions.
   a) Set all squeeze-off tool stops to suit the SDR value of the pipe they are to be used on.
   Note: For SDR 11 pipe, set the stops to match the pipe size. For SDR 17.6 pipe, set the stops to 63 mm if working on 90 mm pipe, or set the stops to 90 mm if working on 125 mm pipe.
   b) Squeeze-off the pipes.
2. Where the SDR value cannot be identified and the required squeeze-off positions are on the same pipe without an intervening pipe joint.
   a) Set the stops to the pipe size and squeeze-off the pipe.
   b) Check at the vent E see Figure 48 between the squeeze-offs to establish whether there is any gas passing.
   c) If there is no gas passing, continue with the operation.
   d) If there is gas passing, release both squeeze-off tools only sufficiently to adjust the stops to the next smaller pipe size (typically set stops to 63 mm if working on 90 mm pipe, or set stops to 90 mm if working on 125 mm pipe).
   e) Squeeze-off the pipe again at revised stop setting.
   f) Repeat from step b above.
3. Where the SDR value cannot be identified and the required squeeze-off positions are located either side of one or more pipe joints:
   a) Position both squeeze-offs and a centre vent E (see Figure 48) at the required squeeze-off positions on one of the pipes. Set the stops to the pipe size and then squeeze-off.
   b) Check at vent E (see Figure 48) between the squeeze-off to establish whether there is any gas passing.

c) If there is no gas passing, close vent E see Figure 48 and proceed to step f. below.
d) If there is gas passing, release the upstream squeeze-off sufficiently to adjust stops to next smaller size.
e) Squeeze-off the pipe at the upstream squeeze-off position.
f) Remove the inner squeeze-off tool from the first pipe and reposition on the second pipe with the stop set to the pipe size, and then squeeze-off.
g) If there is no gas passing (using original vent), continue with operation.
h) If there is gas passing, release the second squeeze-off tool sufficiently to adjust stops to the next smaller size Squeeze-off the second pipe again using this stop setting, and continue with the operation.
i) Squeeze-off the second pipe again using this stop setting, check at vent to establish if there is a let by and continue with the operation.
j) Continue with operation if no gas is passing at vent.
k) If the seal still cannot be made contact your Operational Manager.

OTHER FAULT CONDITIONS

This procedure applies to sites where the pipe details have been determined.

1. Check stop settings are correct on upstream unit,
2. Release squeeze-off sufficiently to reset stops if incorrectly set.
   a) Check externally for signs of internal debris preventing an effective seal.
   b) Re apply squeeze-off and check vent E see Figure 48.
3. Continue with operation if no gas is still passing at vent E.
4. If gas is passing at vent E continue with 7 below.
5. Check stop settings are correct on downstream unit.
6. Release squeeze-off sufficiently to reset stops if incorrectly set.
7. Check externally for signs of internal debris preventing an effective seal, with the squeeze-off compressed.
8. Look for signs of large debris at the pipe wall.
9. Re-apply squeeze-off and check vent E.
10. Continue with operation if no gas is passing at vent.
11. If the seal still cannot be made contact your Operational Manager.

E2 PE Double Squeeze-off

This section details the procedure involved in undertaking PE Double Squeeze-off up to and up to355mm diameter and 2 bar operating pressure. All Medium pressure PE pipe squeeze-off operations above 63mm diameter and Low pressure squeeze-off operations above 180mm diameter must be undertaken with two squeeze-off units at each side of the cut out site and be commissioned by a rider from the upstream side.
For Intermediate pressure and pipe diameters 400mm and over refer to SGN/PM/MSL/1 Part 2.
Should a commissioning purge with inert gas be specified at the cut- out position, then an additional tapping tee will be required downstream of squeeze-off 2, to provide the entry. An additional distance allowance of 250mm (plus fitting width) must be added.

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. Excavate on to the pipe at the planned location. See guidance at Section A1.
4. Clear the main around the full circumference of the pipe.
5. Check for potential obstructions to the fitting of the squeeze off equipment, for example, the width of trench and clearance beneath.
6. Inspect the pipe (see guidance Section B1) and note if any of the following situations exist.
   - Pipe damage.
   - Defective PE joints are present.
   - An Early Imperial “Aldyl A” DUPONT Pipe is present.
7. Follow the advice in Section E0.

PIPE & FITTINGS PREPARATION

1. Check diameter, Standard Dimension Ratio (SDR), and material type - information will be printed along the pipe barrel at 1m intervals on each side of the pipe.
2. Check the pipe for ovality and use re-rounding clamps accordingly.
   Note: If you are unable to verify the pipe SDR refer to Procedure Gas passing before continuing.
3. All equipment and fittings must be checked, prepared and be available for the work to be undertaken.
4. Check the correct distance is maintained from existing fittings, joints, squeeze-off applied locations and any proposed future joints used for connection purposes. (see Section E0)and Table 24.
5. Set out the squeeze-off operation by marking the exposed pipe with all positions for pressure points, bypass connections, vent point and the location of squeeze-off equipment see Figure 50.
6. Carryout the procedure for pipe inspection Section E0.
7. For construction of PE tapping tees, bypass, vent and rider connections refer to Section E0.

E2 PE Double Squeeze-off

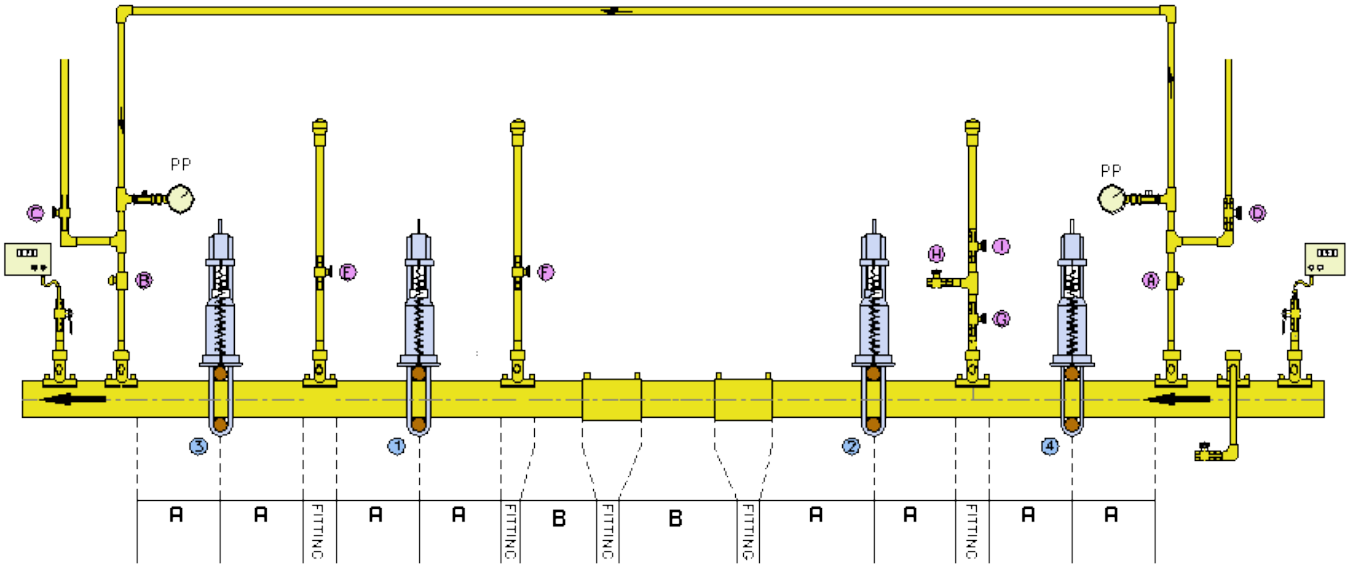


Figure 50- Original Double Squeeze-Off Positions

Pipe diameter "D" mm	A		B
	2.5 X D Metric	3 X D Imperial	
55	138mm	165mm	Refer to Appendix C
63	158mm	189mm	
75	188mm	225mm	
90	225mm	270mm	
110	275mm	330mm	
125	313mm	375mm	
180	450mm	540mm	
250	625mm	750mm	
315	788mm	945mm	
355	888mm	-	

Table 24 - Double Squeeze off Proximity

Note: Should a commissioning purge with inert gas be specified at the cut-out position, then an additional tapping tee will be required downstream of squeeze-off 2, to provide the entry.

Figure 51- Pressure Gauge Points

ESTABLISH NETWORK PRESSURE

1. Install two pressure monitor points on the PE main placed outside the location of bypass points see Figure 51.
2. Attach and commission pressure gauges.
3. Confirm Network pressure
4. If the pressure is above the expected pressure, contact your Operational Manager.

E2 PE Double Squeeze-off

ASSEMBLE BYPASS AND BYPASS VENTS

Construct bypass, in size and material as per the written procedure. See Section E0 – Bypass and Rider construction.

TESTING BYPASS

Test the bypass follow instructions at Section E0 – Testing bypass

COMMISSION BYPASS

Follow the procedure in Section E0 – Commission the bypass

SQUEEZE-OFF PREPARATION

1. Check squeeze-off are in good working order.
2. Set stops to the correct pipe size & SDR.
3. If the SDR of the pipe cannot be found, then set the stops to the size of pipe.
4. For 90mm and 125mm SDR 17.6 pipe, set the stops to one pipe size below typically 125mm to 90mm and 90mm to 63mm.
   Note: Some squeeze-off tools may have stop settings for 75mm pipe, which should not be used for 90mm and 125mm pipe.
5. Place squeeze-off units, on the parent main at the marked positions. See Figure 52.
6. Check that the squeeze off tools are adequately supported whilst in the open position
   Note: Use chocks to raise the base of the tool up into contact with the underside of the pipe.

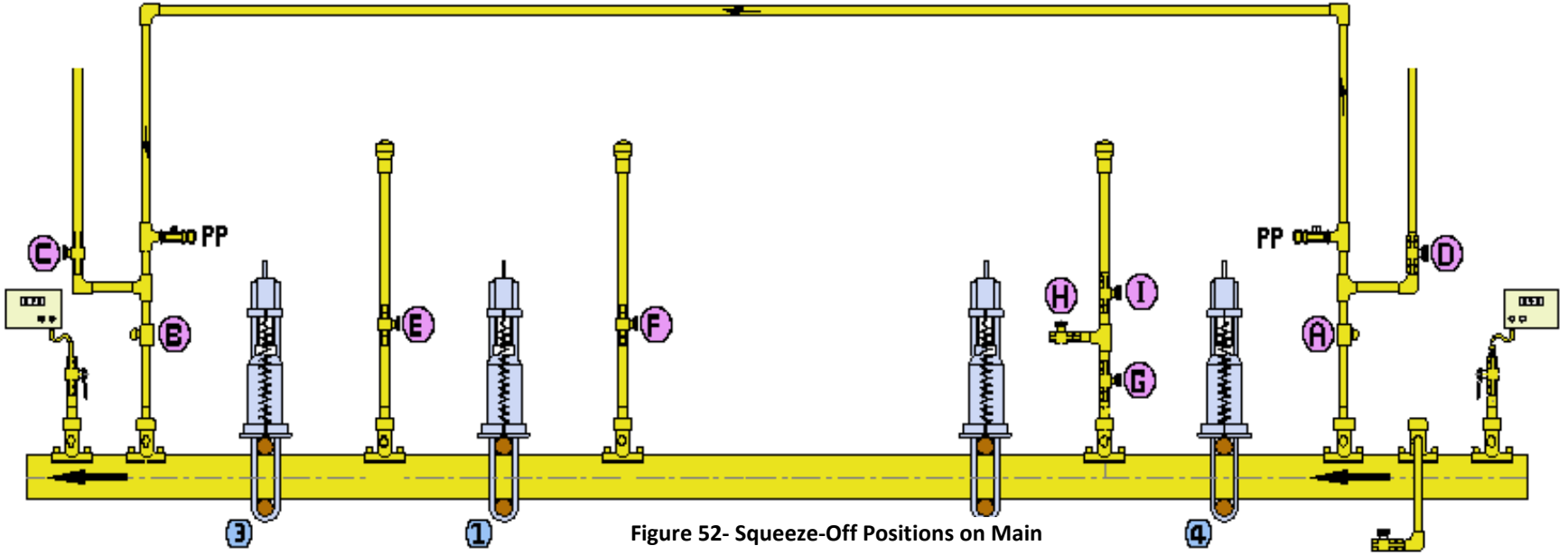


Figure 52- Squeeze-Off Positions on Main

E2 PE Double Squeeze-off

7. Support the tool on both sides to prevent it tipping.
8. Attach all vent pipes and the purge riders onto main see Figure 52.
9. Earth any metallic vent pipes.
10. Fit and connect vent E onto parent main upstream of squeeze-off 1 ensuring minimum distances from squeeze-off position and future tie-ins. See Figure 52.
11. Make a final check on the assembly to check that no dirt or debris has been picked up during the assembly operation and become trapped between pipe and tool, remove if found.

    Note: For larger diameter pipes the squeeze-offs manufacturers operating instructions should be consulted for correct use of the equipment. Vent pipe ´K` is optional

SQUEEZE-OFF PE MAIN

1. Re-check Network pressure to confirm mains operating pressure.
2. Re-check bypass is fully open.

   Note: If you are using hydraulically operated squeeze off tools, all personnel should remove themselves from the excavation for the squeeze down operation.
3. Slowly apply downstream squeeze-off unit 1 until it reaches its stop. see Figure 53.

   Note: Follow the manufacturer's instructions to compress the pipe until the tool stops are reached.

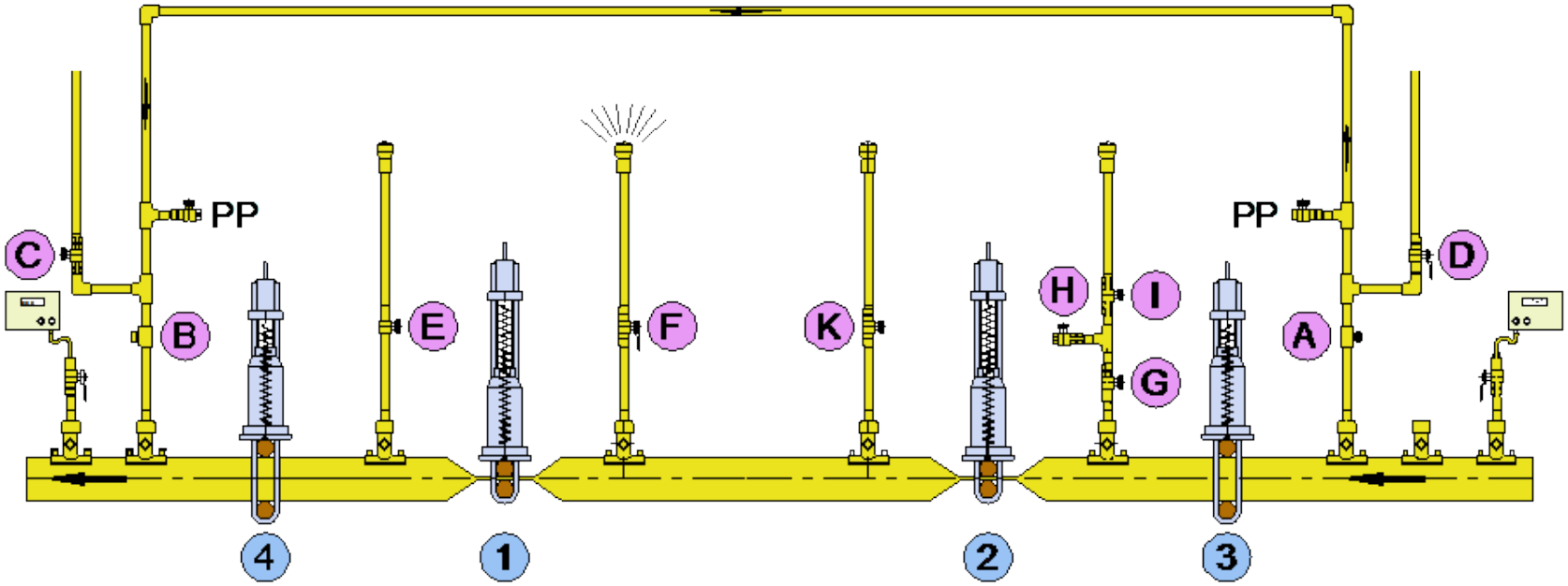


Figure 53- Squeeze-Off 1 & 2

4. Monitor the pressure gauges for 10 minutes before proceeding.
5. If pressure starts to fall below minimum pressure stated on routine operation procedure, release squeeze-off and inform your Operational Manager.
6. Apply squeeze-off mechanical interlock.
7. Inspect the sides of the pipe; see Section E0 – Pipe inspection.
8. Slowly apply upstream squeeze off unit 2 until it reaches its stop.
   Note: Follow the manufacturer's instructions to compress the pipe until the tool stops are reached.
9. Monitor pressures.
10. Apply squeeze-off mechanical interlock.
11. Inspect the sides of the pipe, see Section E0 – Pipe inspection.
12. E2 Open vent valve F (or K optional) and check for let by between the squeeze-off units 1&2.
13. If gas is passing, refer to Section E1.
14. If no gas is passing continue with the operation, leave vent pipe F and/or K open.
15. Slowly apply upstream squeeze-off 3, until it reaches its stop see Figure 54.
16. Monitoring Network pressure.
17. Apply mechanical interlock on squeeze-off 3.
18. Inspect the sides of the pipe, see Section E0 – Pipe inspection.
19. Vent between the squeeze-off units 2 & 3 by opening valves G and I, leave valve H closed, and check for let by.
20. If gas is passing, Section E1

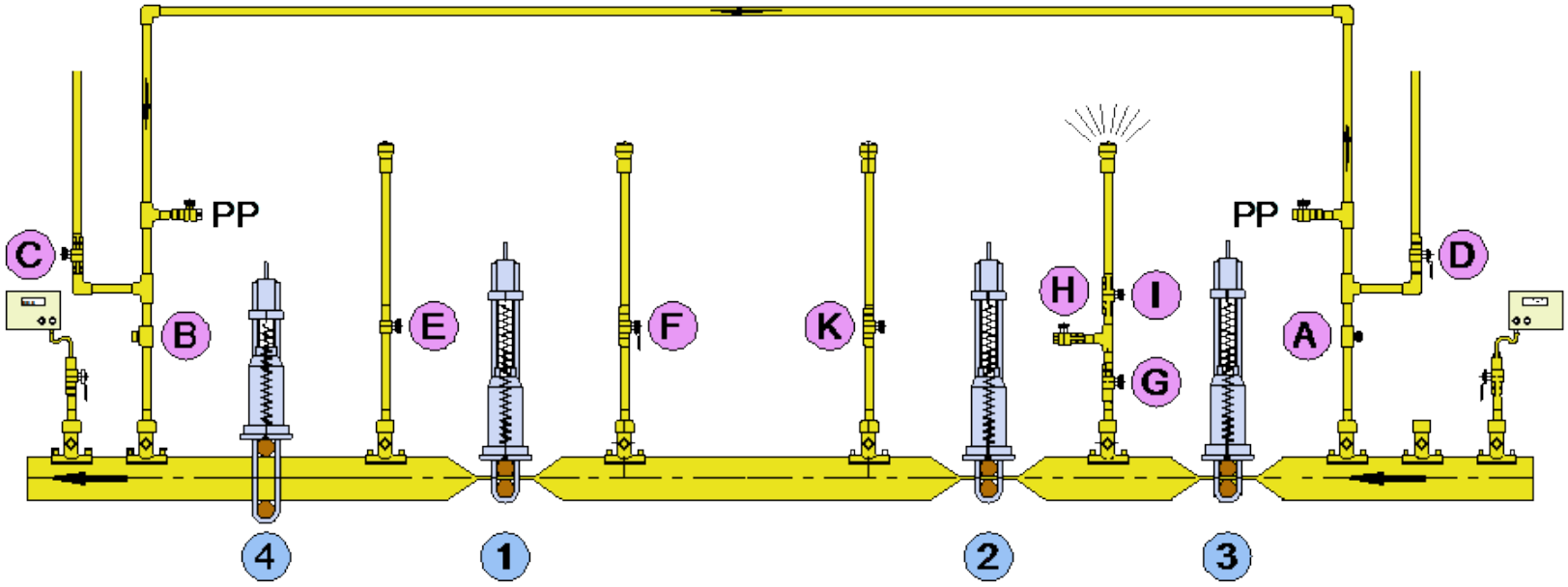


Figure 54- Squeeze-off 3

21. If no gas is passing continue with the operation, leave vent pipe between squeeze-offs 2 and 3 open.
22. Slowly apply downstream squeeze-off 4, until it reaches it stop.
23. Monitoring Network pressure.
24. Apply squeeze-off mechanical interlocks.
25. Inspect the sides of the pipe; see Section E0 – Pipe inspection.
26. Open vent at E (see Figure 55.) and check for let by.
27. If gas is passing, see Section E1.
28. If no gas is passing continue with the operation, leave vent pipe E open.
29. If required, your Operational Manager may instruct you to purge the section of main between squeeze off 1 & 2, with an inert gas.
30. If this is required introduce nitrogen at point K, and vent at F.
31. Check that the nitrogen (inert) gas pressure does not exceed one third of the pressure in the live main.

CUT OUT PE MAIN

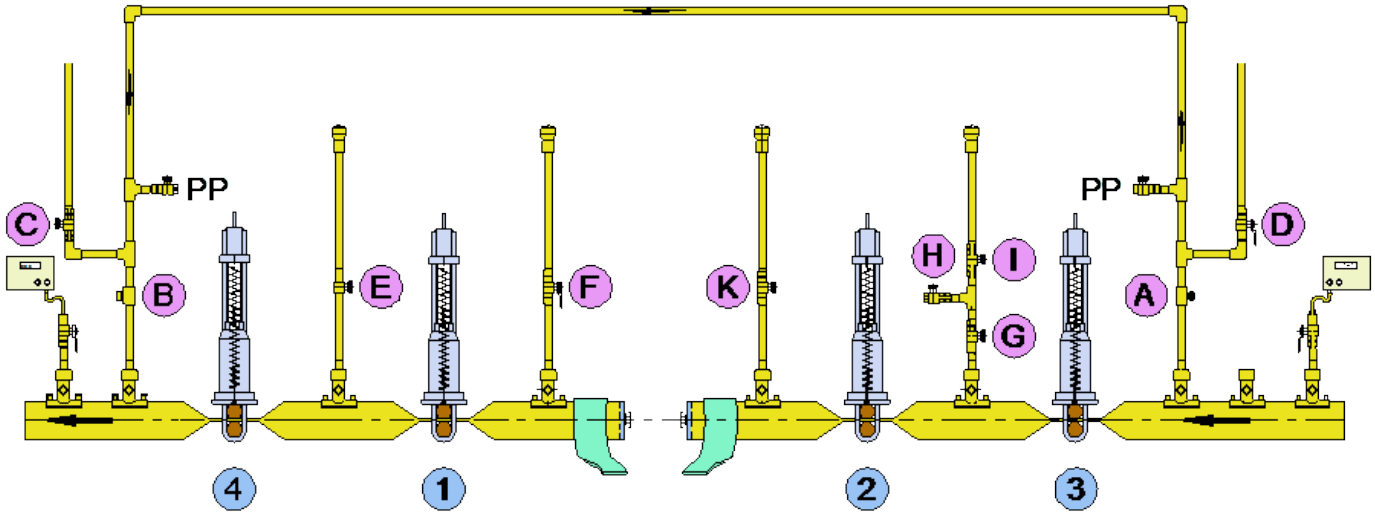


Figure 55- Cut Out Section

1. Check that there are:
   • no sources of ignition present adjacent to the proposed cut out
   • personnel are wearing appropriate PPE
   • the pipe is adequately supported
2. Drape damp cloths around the pipe and make sure they are in contact with the ground on each side of the cut to prevent a spark from static electricity see Figure 55.
3. Check the atmosphere in the excavation.
4. Cut pipe section as specified in work instruction, continually monitoring network pressure and the atmosphere within the cut-out area.
   Note: DO NOT USE electrically driven tools, chainsaws, disc cutters or similar tools to cut the pipe
5. The cutting of PE mains must only be undertaken using approved equipment such as secateurs/shears, handsaws or hacksaws, guillotines, rotating wheel cutters with outboard rollers to keep cutter aligned on pipe to create a square cut and motorised cutter/hacksaws.
6. Should a guillotine be used a re-rounding clamp should be put onto the main prior to joining.
7. Avoid pipe sagging which makes cutting more difficult.
   Note: Support the pipe so that a slight upward arc is made in the pipe which will help keep the cut open as you cut and so avoid jamming the blade.
8. Install expanding stoppers whilst preparing fittings for installation see Figure 55.
   Note: Take care not to inhale PE dust created from the cutting process.
9. Remove and bag any PE swarf created.
10. Prepare and install connection fittings in accordance with Appendix D, after first removing the expending stoppers.

RE-COMMISSIONING OF PE MAIN

Re-commissioning of the PE main can be carried out either by using a rider or the controlled release of squeeze-offs.

For medium & intermediate pressure mains a Governed rider should be used to enable the pressure in the newly connected section of main to be raised in stages allowing leakage test to be undertaken using leak detection fluid.

RE-COMMISSIONING PE MAIN BY USE OF A RIDER

1. Remove flame trap from vent pipe E see Figure 56.
2. Connect purge rider through valve J to closed vent point H.
3. The construction of riders is detailed within Section E0.
4. Close valve G, Open valve J & H and purge rider until two independent readings of 90% gas in air has been obtained at vent.
5. Close valve I.
6. Remove safety stops mechanical interlocks and release downstream squeeze-off 1.
7. Remove safety stops mechanical interlocks and release upstream squeeze-off 2.
8. Close valve E & K.
9. Open valve G and purge through vent pipe E until two independent readings of 90% gas in air is obtained at vent pipe E.
10. Close valve F, K & I (valve K where applicable),
11. Open valves G, H and J and purge through vent pipe E until two independent readings of above 90% gas in air is obtained.
12. When purge is complete, turn off valve E.
13. Pressuring the section to line pressure.
14. Test installed fittings with leakage detection fluid, wash off with clean water.
15. While carefully monitoring pressure gauges, remove safety stops mechanical interlocks and slowly release upstream squeeze-off 3.
16. Remove mechanical interlocks
17. Whilst monitoring pressures, slowly release downstream squeeze-off 4.
18. Close valve G.
19. Isolate purge rider at valves H and J and remove rider.

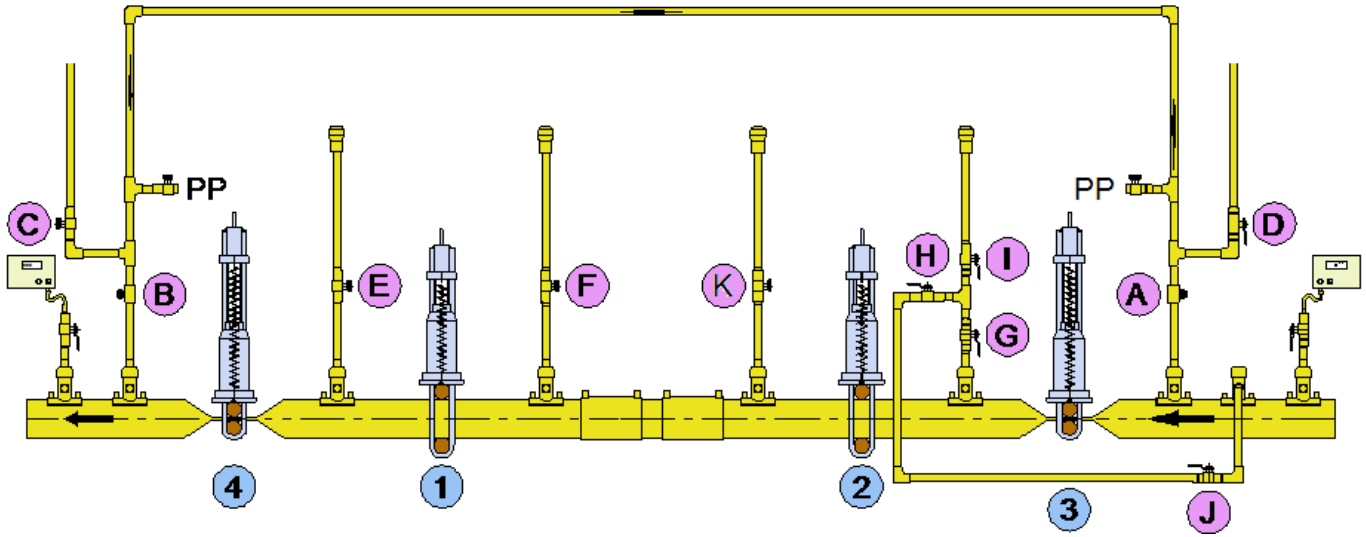


Figure 56- Removal of Squeeze-Offs 1 & 2

RE COMMISSIONING PE MAIN BY CONTROLLED RELEASE OF A SQUEEZE-OFF

1. Remove flame trap on the top of vent E, see Figure 57.
2. Close valves G and I, valve H must be in the closed position.
3. Remove mechanical interlocks and release squeeze-off 1.
4. Remove mechanical interlocks and release squeeze-off 2.
5. Close valve(s) F & where applicable K).
6. While carefully monitoring pressure gauges, remove mechanical interlocks and slowly release squeeze-off 3.
7. Purge through vent E until two independent readings of 90% gas in air are obtained.
8. When purge is complete turn off valve E, pressurising the section to line pressure.
9. Test installed fittings with leakage detection fluid. Wash off with water.
10. While carefully monitoring pressure gauges, remove mechanical interlocks and slowly release squeeze-off 4.

REMOVAL OF SQUEEZE OFF TOOLS AND RE-ROUNDING OF PIPES

1. Once the squeeze off tool is no longer required, remove the squeeze off tools from the pipe.
2. When fully opened, the tool should be stripped down and removed from the excavation.
3. Fit re-rounding clamps to the pipe to restore its structural integrity and flow characteristics.
4. For larger pipe sizes, initially place 2 clamps, one either side of the squeeze off position and as near as possible to the pinch point.
5. Leave in place for 10 minutes.
6. After 10mins slacken the bolts on one clamp and slide the clamp closer to the pinch point (squeeze off position).
7. After 10 mins slacken the bolts on the 2nd clamp and slide the clamp closer to the pinch point (squeeze off position).
8. Repeat this procedure until one clamp can be position directly over the pinch point.
9. For larger pipes (≥315mm) where available fit hydraulic rams.
10. Fit the half shells so that the pipe pinch point is centred in the middle of the half shell.
11. Do not overtighten clamps, follow manufacturer's instructions.
12. After removal of the clamps
13. Permanently mark the pipe using an indelible marker pen to indicate that squeeze off has been performed at that location

Place 'Squeeze off applied' marker tape onto the pipe see Figure 57.

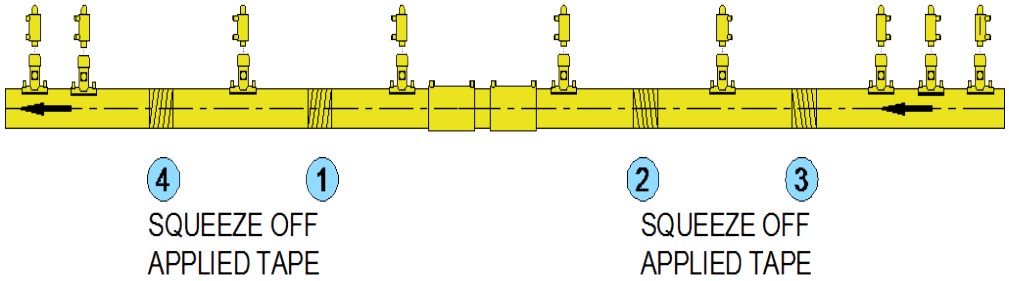


Figure 57-Squeeze-Off Tape

BYPASS AND VENT POINT DE-COMMISSIONING

De-commission bypass and vents follow procedure in Section E0.

PROCEDURE FOR RECTIFYING SQUEEZE-OFF UNITS PASSING GAS

Follow guidance in Section E1 – Procedure for rectifying squeeze off units passing gas

OTHER FAULT CONDITIONS

Follow guidance in Section E1 – Other faults Conditions

E3 Metallic Flow Stopping up to 12”/300mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Semi-Supported Bags on LP and Restricted use on MP

This section details flow stopping using semi-supported bag tube equipment, in metallic mains up to 12”/300mm diameter.

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. Excavate on to the pipe at the planned location - See guidance at Section A1.
4. Clear the main around the full circumference of the pipe.
5. Check for potential obstructions to the fitting of the bag tube and cutting equipment, for example the width of trench and clearance beneath.

BAG STOP PREPARATORY WORK – GENERAL

1. If you are working on a steel main which has impressed current for corrosion protection check that it has been switched off.
2. Check main with a Volt stick.
3. Drill and tap a small diameter pressure point.
4. Fit a pressure point connection on the extremity of the proposed bag stop operation.
5. Confirm the mains pressure.
6. Inform your Operational Manager if the pressure is higher than the figures stated in Table 25.

   Note: Where pressures are higher than those shown in of Table 23 arrangements must be made to lower the operating pressure or to use an alternative method to stop the flow of gas.

   See SGN/PM/MSL/1 Part 2 for alternative methods of stopping the gas supply such as iris stop, stopple, valve operation.
7. Confirm the wall thickness of the main. If the wall thickness is less than 4mm you must inform your Operational Manager.
8. Fit another pressure point at the other extremity of the proposed bag stop operation.

Nominal Size of main Ferrous		Max. mains Operating Pressure
(in)	(mm)	m bar
3	80	340(350)
4	100	340(350)
5	-	280(300)
6	150	280(300)
7	200	280(300)
8	200	280(300)
9	250	200(200)
10	250	200(200)
12	300	100(100)

Table 25- Pressure Limitations of Mains for Bag Tube Equipment up to 300mm/12" Diameter

9. Ask your Operational Manager to confirm the direction of gas flow.
10. From the RO/NRO confirm the size of bypass and the type of connection to be used, bypass kit or Under Pressure Tee (UPT).
11. Ref to Figure 58 and Table 26 and mark the positions of the drillings on the main.
12. Allow at least 200mm from the face of any socket or split collar for the drilling position and when existing connections are found.

    Note: This distance measured from the centre of the drilling.

E3 Metallic Flow Stopping up to 12”/300mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Semi-Supported Bags on LP and Restricted use on MP

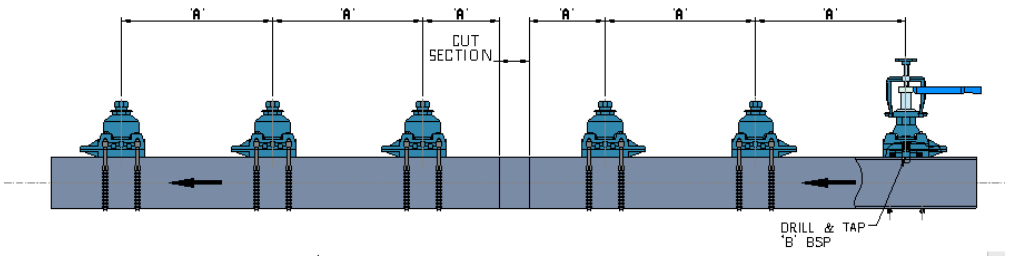


Figure 58- Drilling Separation Distances and Tapping Sizes

Nominal bore of main		Spacing dimension 'A' (mm)	Drill & tap dimension 'B' (inches)
mm	ins		
80	3	250	1″ (see note 1 below)
100	4	250	1”/ 1 ¼″
	5	350	1½″
150	6	350	1½”/2”
	7	400	1½”/2”
200	8	400	2
	9	450	2
250	10	450	2
300	12	500	2

Table 26- Bag Tube Set Up Dimensions and Access Hole Sizes for Metallic Mains up to 300mm/12"

The upstream side of the operation is the side where the gas has come from, whilst the downstream side is where the gas is going.

Primary bags are those bags furthest away from the proposed cut-out section and are the first bags that stop the flow of gas into the cut- out area.

Secondary bags are those bags nearest the proposed cut out section and are the secondary protection measure to stop the flow of gas getting into the cut out area.

Note 1: On 3” mains the size of drilling required is 1" to allow insertion of the bag tube shoe. After the drilling operation, an under-pressure clip must be fitted over the plugged hole.

Note 2: For hot works on steel mains the separation distance must between the secondary bags and the cut out section be increased to at least 10m on both sides.

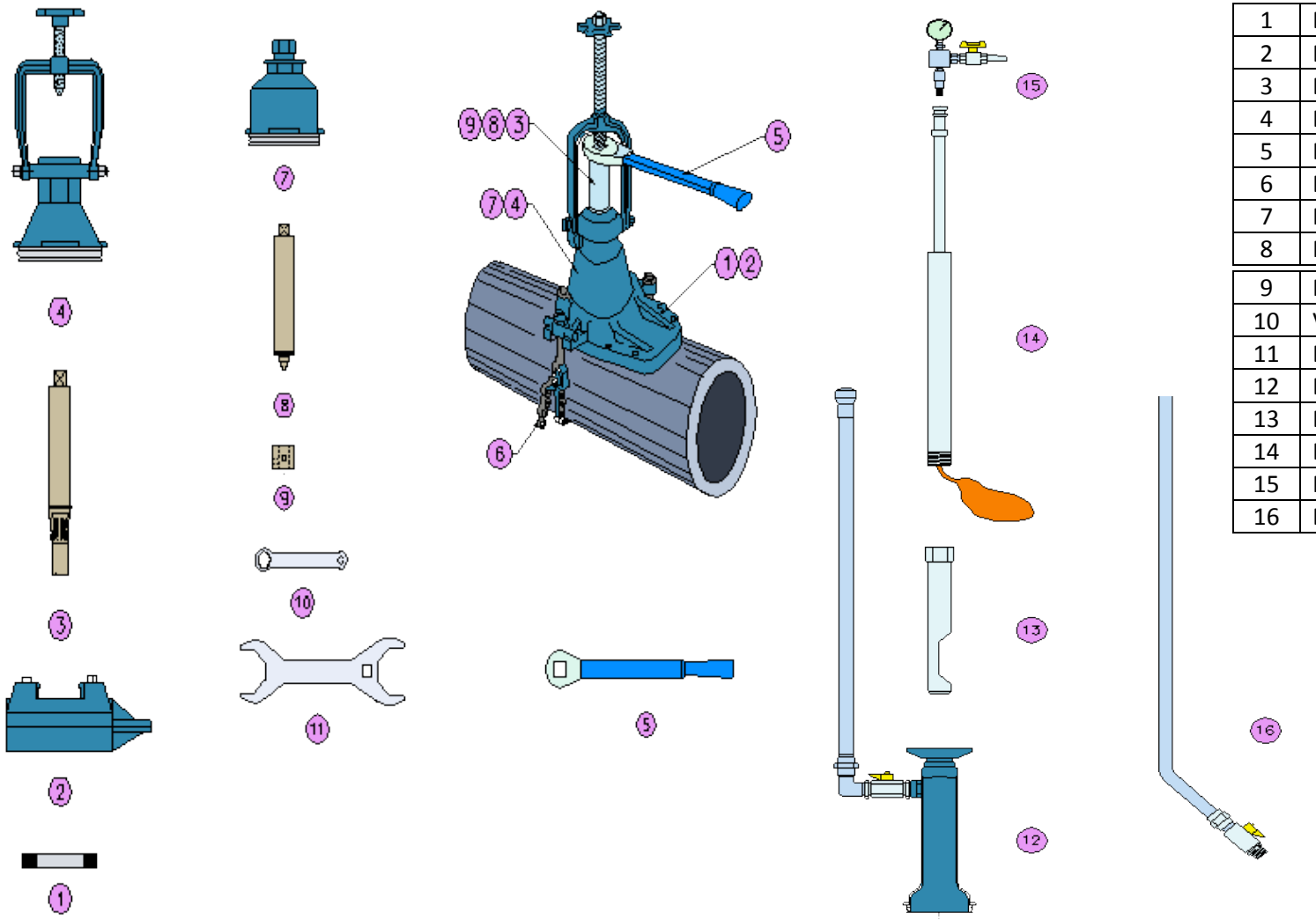
NOTE: Previously a nitrogen trickle was also used. This is no longer considered a suitable procedure. Nitrogen trickle feeds must not be used during hot works.

Refer to SGN/PM/MSL/1 Part 2, for further information on welding operations.

Note 3: Under pressure tees can be used to replace the bag stop equipment used for the bypass to provide a larger diameter bypass when required.

Bagstop equipment is shown in Figure 59.

E3 Metallic Flow Stopping up to 12”/300mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Semi-Supported Bags on LP and Restricted use on MP



1	Bag Stop Base Seal
2	Bag Stop Base
3	Bag stop Drilling Spindle
4	Bag Stop Drilling Head
5	Bag Stop Ratchet Handle
6	Bag Stop Base Chains
7	Plugging Housing
8	Plugging Spindle
9	Plug Carrier
10	Valve Handle
11	Drilling and Plug Housing Spanner
12	Bag Tube Housing (Outer)
13	Bag Tube Foot
14	Bag Tube Housing (Centre)
15	Pressure Gauges
16	Bag Tube Vent Pipe

Figure 59- Bag Stop Equipment

THE USE OF CHAINS ON BAG STOP AND BYPASS ASSEMBLIES.
The following arrangements must be followed:

- LP mains up to 12”/300mm and (315mm for PE) diameter – single chain assembly.
- All LP above 12”/300mm and up to and including 16”/400mm and all MP mains up to and including 16”/400mm – double chain assemblies must be used for drilling operations
- All LP & MP mains from 18”/450mm up to and including 24”/600mm – double chain assemblies must be used plus anchor bridge which fits over base unit.
  Note: Chain yokes are attached to lugs of anchor bridge.
- All LP & MP mains over 24”/600mm up to and including 48”1200mm – double chain assemblies must be used plus two extension chains and chain extension lugs.
  Note: These fit onto the chain extension bridge to receive the yokes chain anchor bridge which fits over base unit plus two extension chain lugs also required. Chain yokes are attached to lugs of anchor bridge.

PREPARATORY WORK – MAINS PREPARATION AND DRILLING

1. Select a position on the main where there are no large corrosion defects or hard encrustations.
2. Clean the main by scraping and wire brushing.
3. If necessary, wash the main with clean water to secure seal at machine saddle.
4. On ductile mains if fitted remove any plastic sleeving
5. For steel mains remove the plastic or other coatings.
6. Make sure that the main is supported throughout the operation.
   Note: Wooden blocks should be used to support the pipe.
7. Calliper the main to confirm the size.
8. Select the correct machine saddle and seal.
9. Check its condition and fit following manufacturer’s instructions.
10. The fixing chain nuts must be tightened evenly, apply torque settings given by the manufacturer.
11. The level of the machine should be checked regularly.
12. Inspect the drill tap and lubricate with oil or grease.
13. Fit the drill tap to the chuck and insert into the machine.
14. In the case of double spindle machines the fitting spindle and fitting must also be assembled to the machine.
15. Refer to Table 26 for maximum tapping sizes when drilling hole.
16. If it is necessary to drill and tap a hole more than that given above inform your Operational Manager.
17. An alternative method for drilling the main using an encirclement fitting to support the main must be used, refer to Section D1.
18. An air test at a pressure of 1.5 times the maximum working pressure in the main or 350 mbar whichever is the greater must be applied with the drilling machine gate valve in the OPEN position.
19. No leakage must be visible during the test duration of 5 minutes.
20. Check the machine seal with an approved leak detection fluid solution.
21. If leakage is observed inspect the machine for the leakage path.
22. If a seal cannot be achieved without tightening the fixing chains beyond moderate hand torque, remove the base and clean the main again, or exchange the equipment.
23. Following a satisfactory test, release the pressure.
24. Leave the test pressure gauge connected, and use it to monitor the mains pressure whilst drilling the main using a hand ratchet or air motor.

25. The main should be tapped using a hand ratchet.
26. If excessive force is needed this should be investigated.
27. The drill tap should be withdrawn and, for single spindle machines, the valve closed.
28. Retain the coupon for inspection.
29. Repeat the above process for each drilling location.
30. Connect an electrical continuity bond across the full section of the main to be isolated.
31. Install pressure gauges and/or recorders at either end of the main.
    Note: Your Operations Manager will confirm the need for a recorder.

EQUIPMENT SET UP

1. Layout and inspect the bag stop equipment as per the manufacturer’s instructions.
2. Check all bags for damage and are within their "use by date".
3. Check the bag will withstand the pressure to which they are to be subjected.
   Note: Pressures and use by dates are normally written on the side of the bags.
4. Check bag inflation gauges that they are within the pressure range and are not damaged.
5. You must pressure test each bag and spare bags as per Table 27 for 5 minutes.
   Note: At least one spare bag per bag tube must be available on site.
6. During this time the rest of the connections on the housing should be tested with leakage detection fluid.
7. Where the mains operating pressure is above 75mbar the bags must be inflated with an inert gas.
8. Your Operational Manager will check that all safety precautions have been taken and an appropriate risk assessment for the procedure completed.

Nominal Size main		Maximum Bag inflation pressure (primary and secondary bags)
inches	mm	mbar
3	80	680
4	100	680
5		550
6	150	550
7		550
8	200	550
9		340
10	250	340
12	300	280

Table 27- Maximum Inflation Pressure for Bags up to 300mm/12"

Note: The nitrogen bottles used for the bags must be separate to that used for purging purposes and one bottle supplying each bag.

9. Any bags that fail must be checked for damage or defects and then destroyed.
10. If you or your Operational Manager suspect oils may be found inside the main, then the bags must be protected by either covering with an impervious cover or by sealing the stitching with a suitable sealant.
    Note: Use an inspection canopy to view inside the main before the operation.
11. On completion of the bag stop operation all bags that have been subjected to oils and similar substances within the main must be destroyed.
12. After checking and testing withdraw the bags into the bag tube assemblies, ensuring that the natural bag curvature lines up with the direction indicator marked on the top of the bag tube assembly.

13. Attach the bag tube foot and make correct alignment with the direction indicator.
14. Assemble the bag stop equipment as shown in Figure 60.
15. The correct foot size can be checked by reference to the manufacturer’s instructions. See Figure 61.

BYPASS CONSTRUCTION

1. Follow the guidance in Section E0 – Bypass and rider construction
2. For medium pressure mains abandonment, a governed bypass may be installed if stated in the Routine or Non-Routine procedure.

TESTING BYPASS

Test the bypass follow instructions at Section E0 – Testing bypass

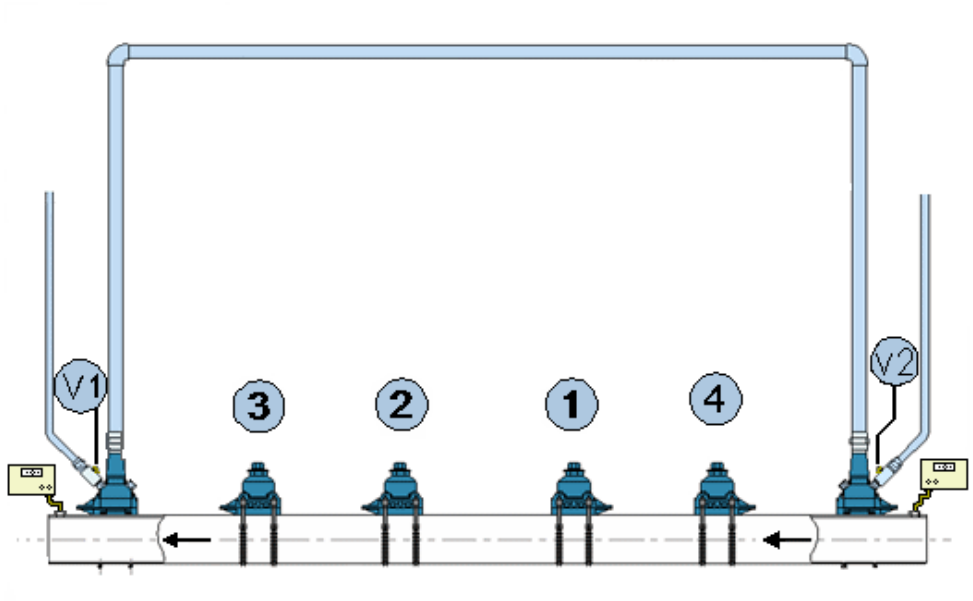


Figure 60- Assembly of Bypass and Bag Stop Equipment

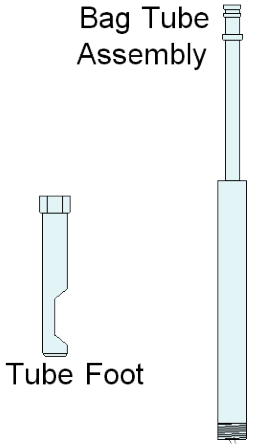


Figure 61- Bag Tube Foot and Bag Tube Assembly

COMMISSION BYPASS

See Figure 62, follow the procedure in Section E0 – Commission the bypass

Note: Where larger diameter bypasses are used appropriate under pressure drilling arrangements must be followed see Section D1.

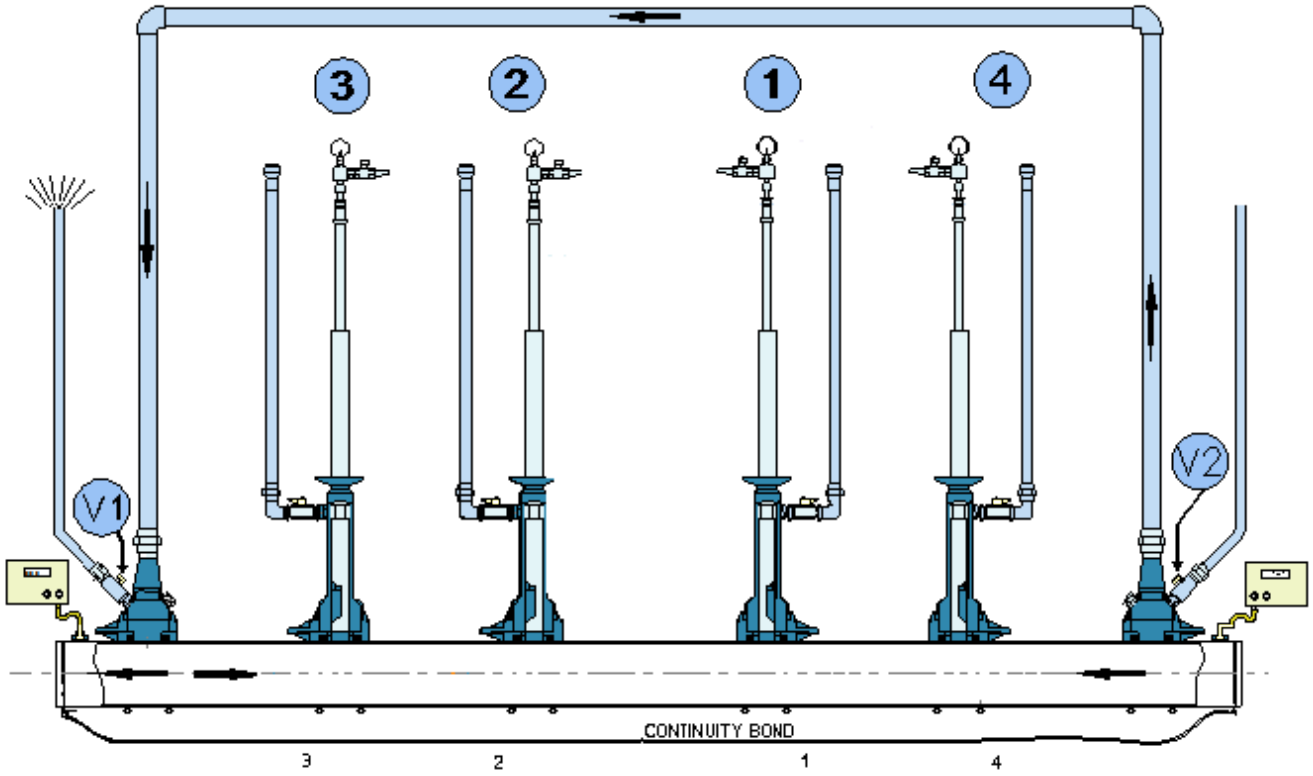


Figure 62- Commission Bypass

Whenever welding is to be carried out on the isolated section of main, the following additional precautions are required:

- ***Assembly of the bag tube equipment and bypass will probably be in remote excavations from the proposed hot works.***
- ***Check that the main to be hot worked is the one that has been isolated.***
- ***Bag stoppers must be positioned at least 10m from any potential source of ignition.***
- ***Bags must be inflated with an inert gas regardless of diameter***
- ***The section of main between the two secondary bags must be purged with an inert gas and a continuous bleed of inert gas must be maintained throughout the operation.***
- ***The atmosphere adjacent to the cut out must be monitored continuously using a gas detection instrument.***

E3 Metallic Flow Stopping up to 12”/300mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Semi-Supported Bags on LP and Restricted use on MP

BAG STOP MAIN

1. Fit a metallic vent to all bag tube assemblies.

The top of the vent must be a minimum of 2.5m above ground level.

2. The vent stacks must be adequately supported.

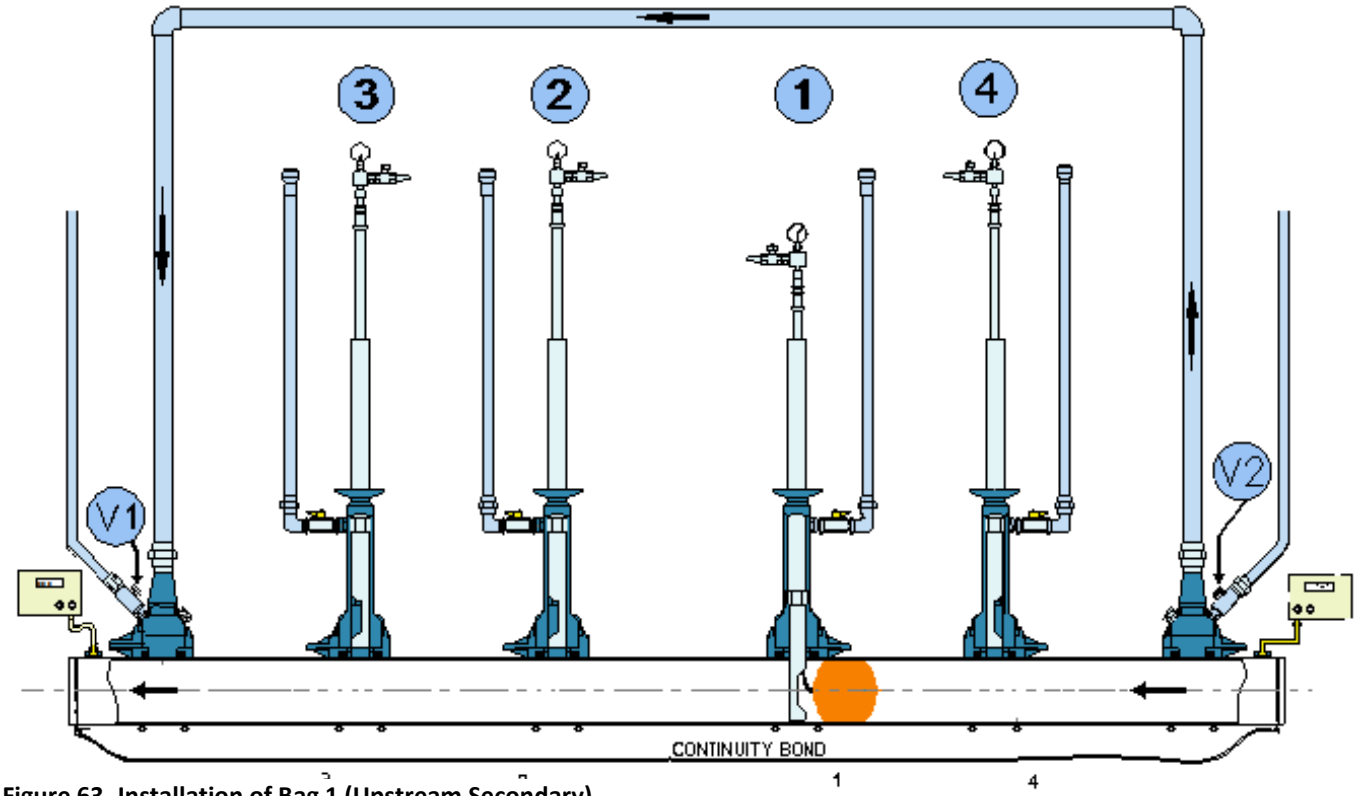


Figure 63- Installation of Bag 1 (Upstream Secondary)

3. Make sure that the bag tube direction indicators, on the bag tube assemblies, are facing away from the section to be cut out.
4. The pressure gauges must be monitored continuously to check that the pressure downstream of the operation remains stable.

Should the pressure start to fall below the minimum pressure stated on the written procedure the operation must be stopped immediately and the Operational Manager informed.

5. Check all vents are closed and the bypass is commissioned.
6. As shown in Figure 63 open the gate on bag 1.
7. Insert bag 1 into the main, make sure that the bag is facing away from the cut-out section.
8. Inflate the bag gradually to required pressure (Table 27).
9. Recheck all pressures
10. Insert bag 2 into the main, see Figure 64, make sure that the bag is facing away from the cut out section.
11. As shown in Figure 64 once the pressure has stabilised on the gauges, insert bag and inflate to the required pressure. (Table 27)
12. Vent the area between the two bags by opening the valve on the vent stack of bag tube 1 or 2 or both.
13. Check that an adequate seal between the bags has been achieved.
14. If there is still a large volume of gas passing between the two bags, close the vent, deflate the bags and then re-inflate and re-open intermediate vent between the bags.

15. When the Competent Person, under the Safe Control of Operation Procedures is satisfied that the seal between bags 1 and 2 is acceptable, the operation should re-commence see Figure 65.
16. Insert bag 3 and inflate to the required pressure.
17. Open the vent on bag 3 and check the seal between bag 2 and 3.
18. Should a seal not be achieved the process as described in 15 above.
19. Insert bag 4 and inflate.
20. Check the seal between bags 1 & 4 by opening the vent on bag tube 4.
21. Should a seal not be achieved the process as described in step 15 above must be repeated.

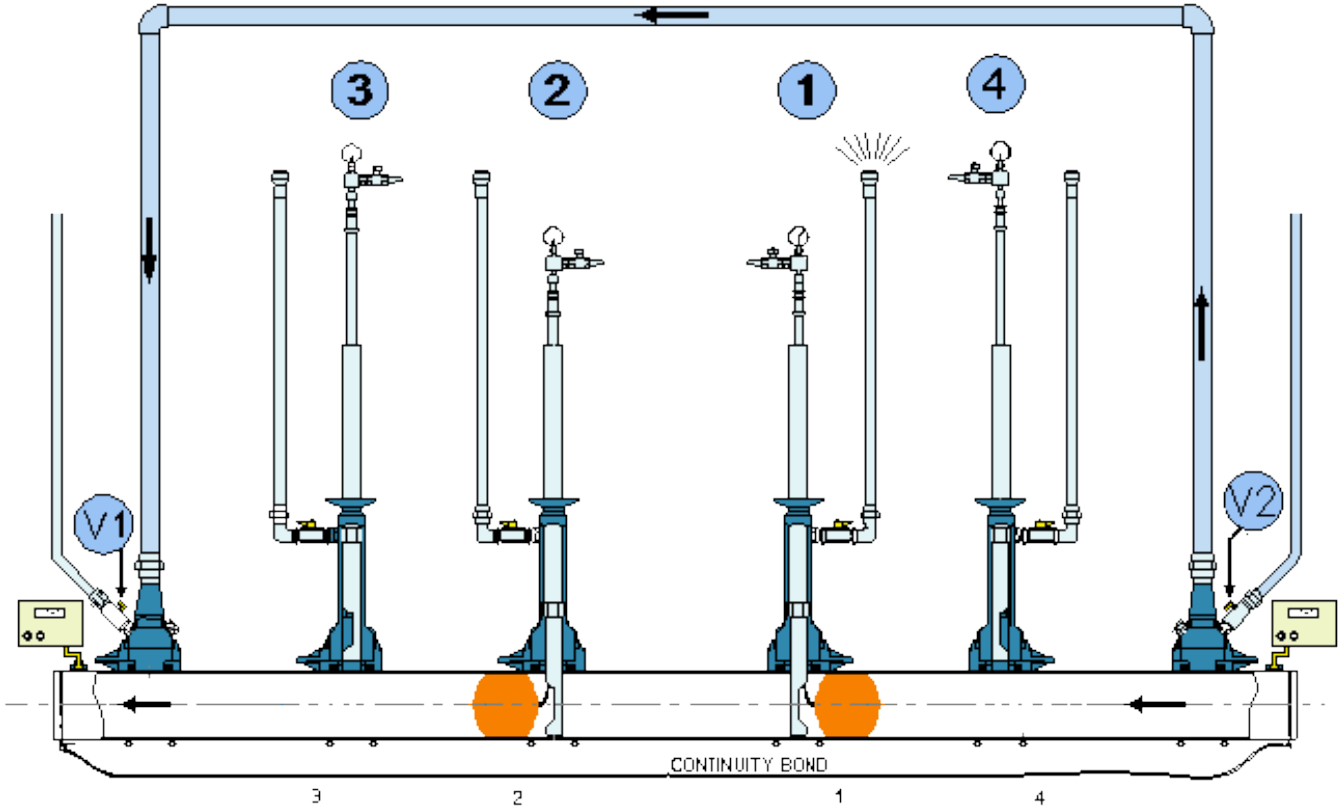


Figure 64- Installation of Bag 2 (Downstream Secondary)

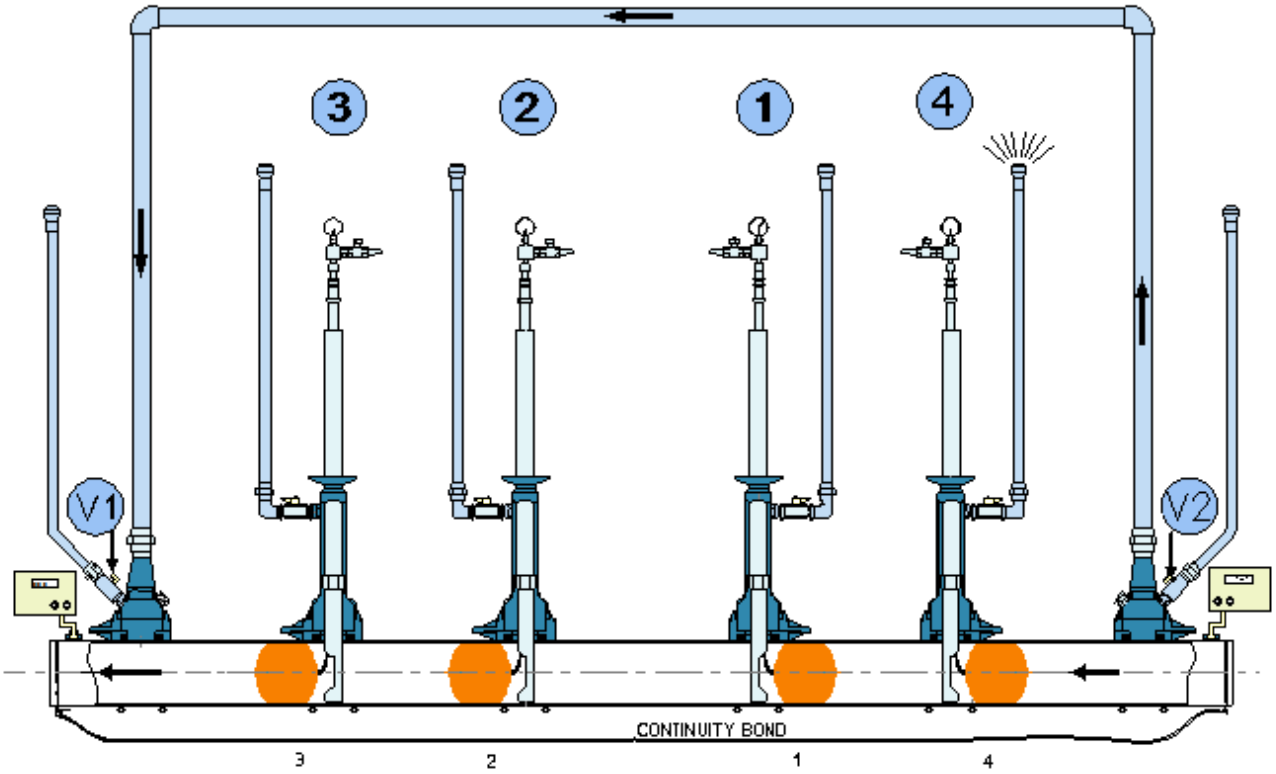


Figure 65- Installation of Bags 3 & 4 (Downstream & Upstream Primary)

22. The pressure gauges on the bags should be monitored continuously.
23. Should the pressure gauges on the downstream side of the operation start to fall, the operation must be stopped immediately and further investigation completed by the competent person.
24. Should the pressure on a bag tube gauge fall follow the bag failure procedures below.
25. All bag tube vents must remain in the open position.
26. Prior to carrying out any further work the system must be allowed a “holding period” of 10 minutes to prove that a satisfactory seal has been achieved and pressures are maintained both within the Network and in the bags.

If this procedure is to abandon a section of main and leave it capped off, then you must complete a Decay before continuing with the operation.
See Section H5.

27. If the results of the decay test are as expected then continue with the operation.
28. If they are not as expected contact your Operational Manager.

E3	Metallic Flow Stopping up to 12”/300mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Semi-Supported Bags on LP and Restricted use on MP	Page 11 of 18

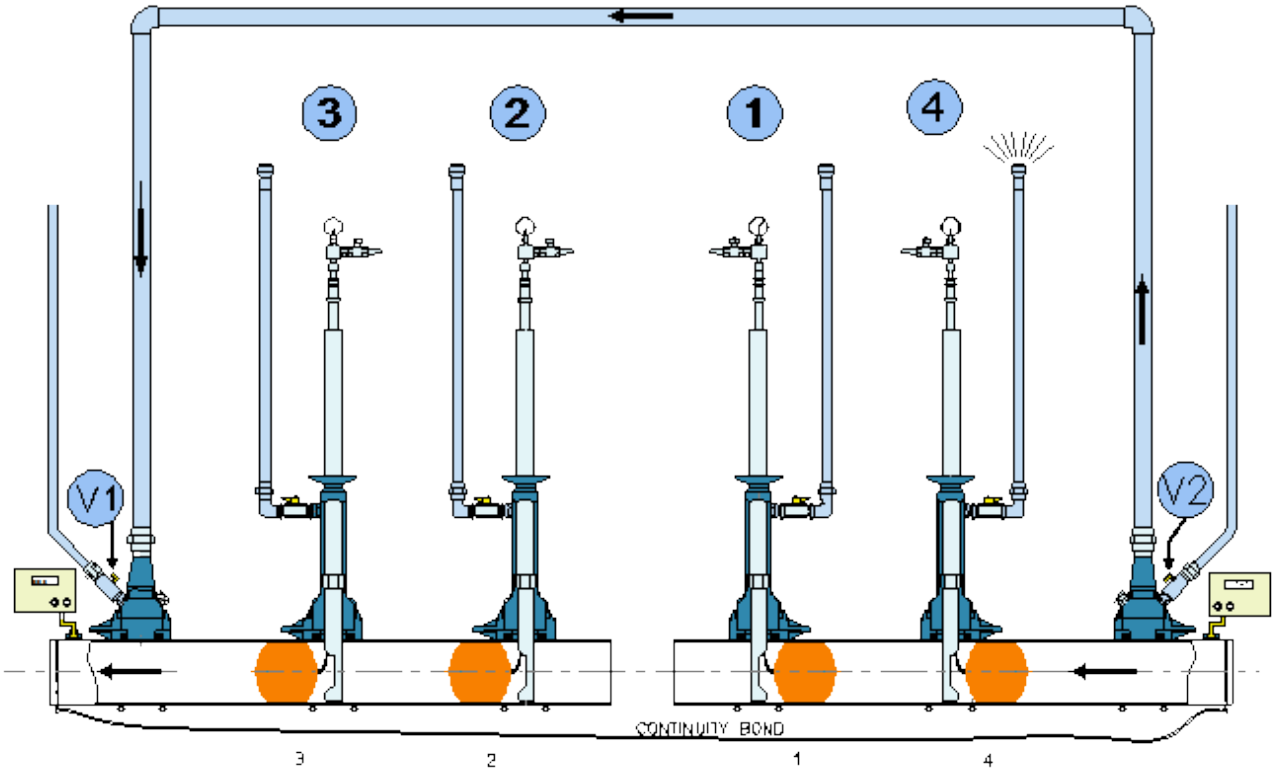


Figure 66- Cut Out Operation

CUTTING OPERATION

1. The main can now be cut out and the work carried out.
2. Continue to monitor the pressures in the main and the bags. Accurately measure and mark the section of pipe to be cut see Figure 66.
3. Remove any sources of ignition to at least 5 metres upwind of the proposed cut out.
4. Check that the continuity bond is fixed correctly.
5. Place timber and wedges under the main to support it.
6. Before cutting refer to Section H4 for inert gas purging requirements.
7. At least 3 cuts should be made to remove the section of pipe.
8. The method used will normally be either mechanical or hand reed cutters depending on the diameter and material of the pipe.
9. You must NOT use any type of Crush Cutters.
10. If required, make additional cuts to remove the section of pipe with the minimum of effort.
11. When breaking out a main using an approved percussion tool cover the pipe with damp rags to minimise ignition source. See Appendix H
12. The open ends of the pipe must be sealed with expanding stoppers or cap ends installed.
13. Anchorage of the cap must be carried out as per SGN/WI/DIS/4.2.2.

FAULTS - BAG FAILURE

Should a bag fail it can normally be observed by a reduction in the bag tube inflation gauge and in the case of primary bag failure, gas will be venting through one of the primary tube vent stacks.
Regardless of venting gas or not, the first consideration when a bag has been suspected of failing, is the safety of personnel on site.
The following steps should be undertaken to bring the situation under control.

1. Try to re-inflate the bag, if unsuccessful then.
   - Consider if it is safe to replace the damaged bag.
   - If this is considered a high risk, then suspend the work and refer to the Authorising Engineer of the RO/NRO or your Operational Manager.
2. During the emergency action to rectify the situation, the pressure in the remaining bags must be monitored to check that their pressure does not fall and the action in Table 28 carried out.

CONTINGENCY PLAN

Depending on the stage of the operation the following actions must be undertaken in event of a bag failure:

a) Table 29 shows the procedure to be followed should it be suspected that the possible deflation of the bag is caused by faulty inflation equipment.

b) Once the bag has been successfully re-inflated, a period of 5 minutes should be allowed to check that no further deflation occurs, before proceeding with the operation.

Stage of Operation	Action
First cut not completed	Stop cutting main. If considered necessary remove cutting machine and, dependant on mains operating pressure, either clamp or wrap the cut. Proceed to Table 29.
Several cuts completed. Section of main not removed.	Stop cutting main. Preferably previous cuts will have been protected. If not, and dependant on mains operating pressure, either clamp or wrap completed cuts. If considered necessary, remove the cutting machine and protect the cut. Proceed to Table 29.
Section of main removed	Preferably the open ends of the main will have been protected. If not, insert a stopper or end cap to close the end. Securely anchor any stop end device. Proceed to Table 29

Table 28- Emergency Procedures

Check	Remedy
If a high-pressure source is used for bag inflation: i. Check source pressure ii. Check supply pressure lines for damage, crushing or blockage iii. Check high pressure regulator	Check the nitrogen bottle, replace if necessary and re-inflate the bag. Check the pressure lines, replace if necessary re-inflate the bag. Check regulator on spare bag, replace if necessary and re-inflate bag in main.
Check pressure gauge	Replace the gauge or inflation head control and attempt to re-inflate the bag.
If bag has not been inflated using nitrogen	Attempt to re-inflate the bag using a hand pump.

Table 29- Check Procedure for Suspect Inflation Equipment

3. If it confirmed that the inflation equipment or pressure source is not the cause of the bag deflation, follow the procedure in Table 30 to replace the faulty bag or damaged bag.
4. The faulty bags must be passed to your Operational Manager once retrieved from the main.

Mode of failure	Action
Primary or secondary bag failure	Close the vent, withdraw and replace the defective bag. Open the vent, in the case of a primary bag having been replaced. Check that a seal is achieved. Allow 5 minutes to check that no further deflation occurs before proceeding with the operation.
Primary and secondary bag failure (both on same side of cut out)	Replace the secondary bag and prove a seal, then replace the primary bag. Allow 5 minutes to check that no further deflation occurs before proceeding with the operation.

Table 30- Procedure to Replace Faulty Bags

5. Should all or part of the bag be missing when removed the Operational Manager must be informed immediately.
6. When the fault has been rectified the operation can re-commence.
7. Before the new section of pipe/fitting is placed into position a check must be made to make sure tools, stoppers or other materials have not been left in the ends of the main.

RE-COMMISSION MAIN USING A PURGE RIDER

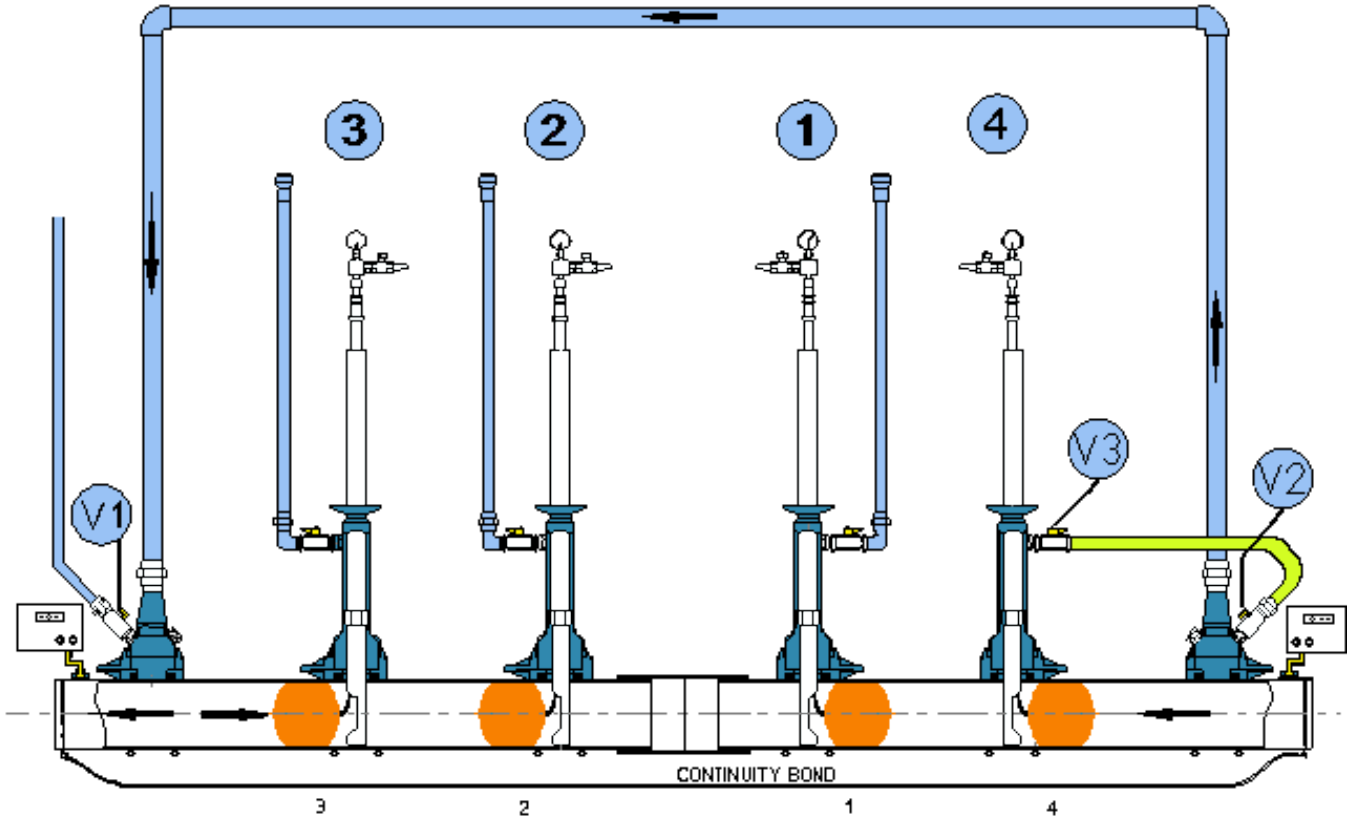


Figure 67- Recommission Main (Using a Purging Rider)

Nitrogen gas may be used to purge the section of main between bags 1 &2.

1. Stop any nitrogen gas purge and removed connections prior to the natural gas purge commencing.
   Note: The pressure of nitrogen gas should be 1/3rd of the mains operating pressure.
2. Close the vent valve on bag 4 and remove vent stack with flame trap.
3. Remove the vent stack with flame trap from the upstream bypass connection.
4. A suitably sized rider, as stated in the written procedure, should be connected between the vent assembly on bag tube 4, see Figure 67 and connected to the upstream bypass vent valve.
5. Test for leakage with leak detection fluid by opening vent valve on upstream bypass connection ensuring that the vent valve on bag 4 remains in the closed position.
6. The vents on bag 1and 2 should be closed and bag 2 deflated, followed by bag 1. Figure 67
7. Leave the deflated bags in the main at this point in case the replaced section is leaking and the bags need to be re-inflated.

8. Introduce Natural gas slowly through the rider by opening the upstream bypass vent valve and the vent valve on bag 4, venting out of the vent on bag 3. see Figure 68.
9. When two readings greater than 90% GIA are observed, close the vent valve on bag 3 and allow the renewed section to pressurise to line pressure.
10. Test the renewed section with approved leak detection fluid.
11. If a leak is discovered stop the re-commissioning operation immediately by closing off the rider to bag tube 4.
12. Ask all personnel to exit the excavation.
13. Determine the cause of the leak.
14. You must cure the leak before continuing with the purging operation.

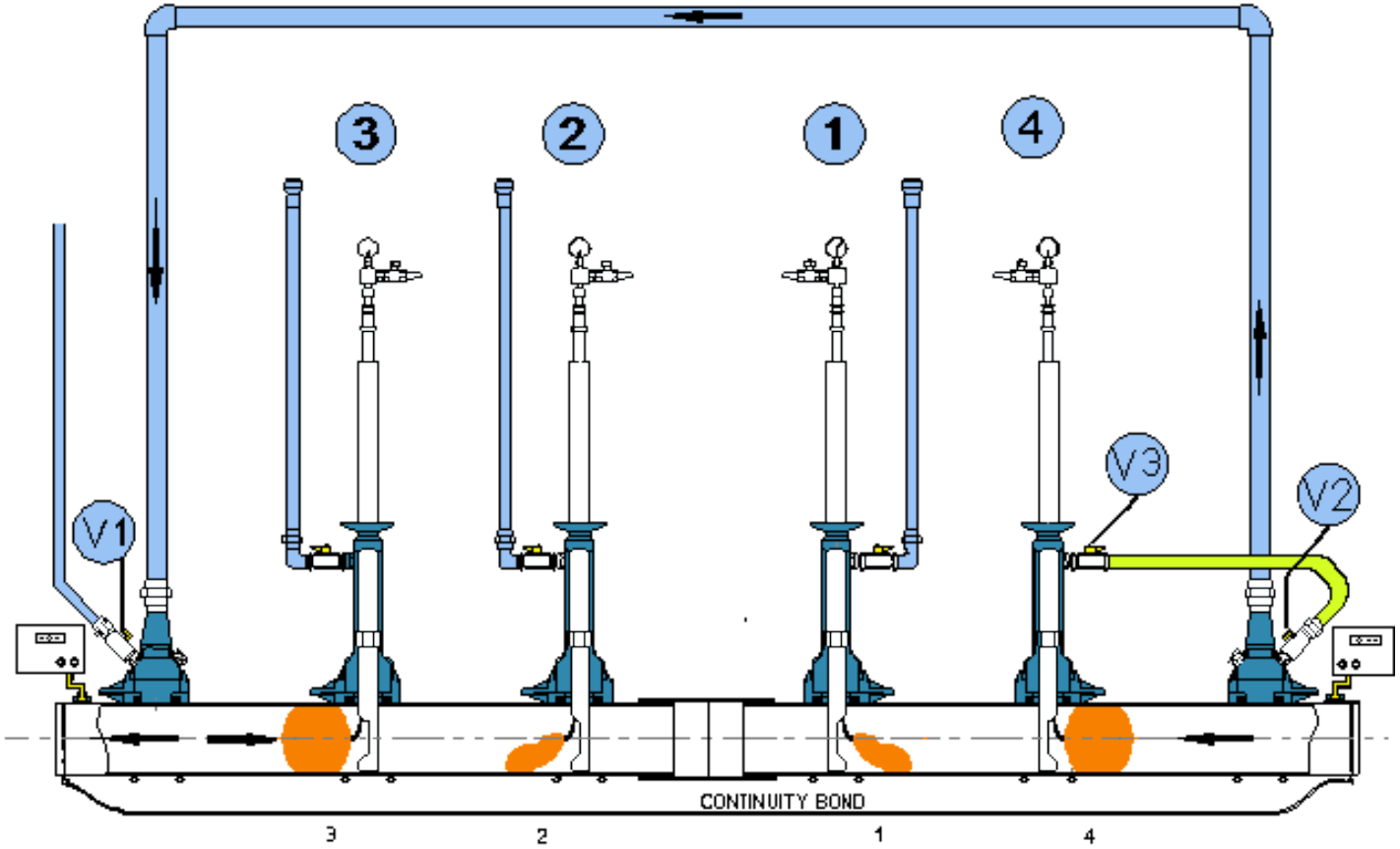


Figure 68- Deflation of Bags 1 & 2 (Secondary Bags)

15. Withdraw bags 1 & 2 into their assemblies.
16. Deflation and remove of bag 3
17. Deflate and remove bag 4. See Figure 69.
18. Monitor the pressure in the main at both ends.
19. Isolate the rider supply at the vent assembly on the upstream bypass and on bag tube 4.
20. Remove the bag tube assemblies.
21. Plug the tappings in the main and test plugs for soundness.

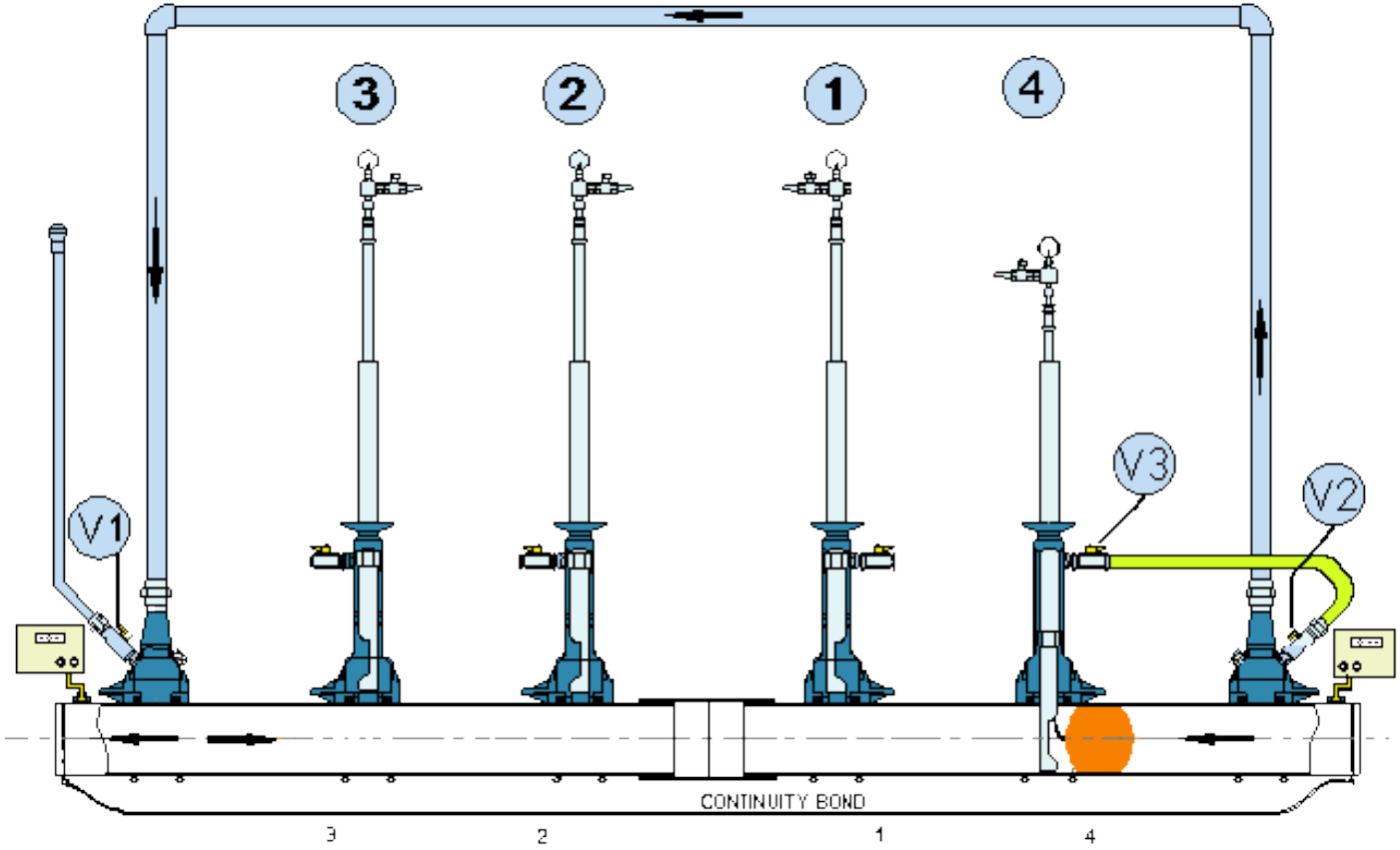


Figure 69- Deflation of Bag 3 (Primary)

RE-COMMISSIONING WITH-OUT USING A PURGE RIDER

Nitrogen (Inert) gas may be used to purge the section of main between bags 1 & 2.

1. Stop any inert gas purge and removed connections prior to the natural gas purge commencing.
   Note: The pressure of Inert gas should be 1/3rd of the mains operating pressure.
2. Close the vent on bag tube 2 see Figure 70.

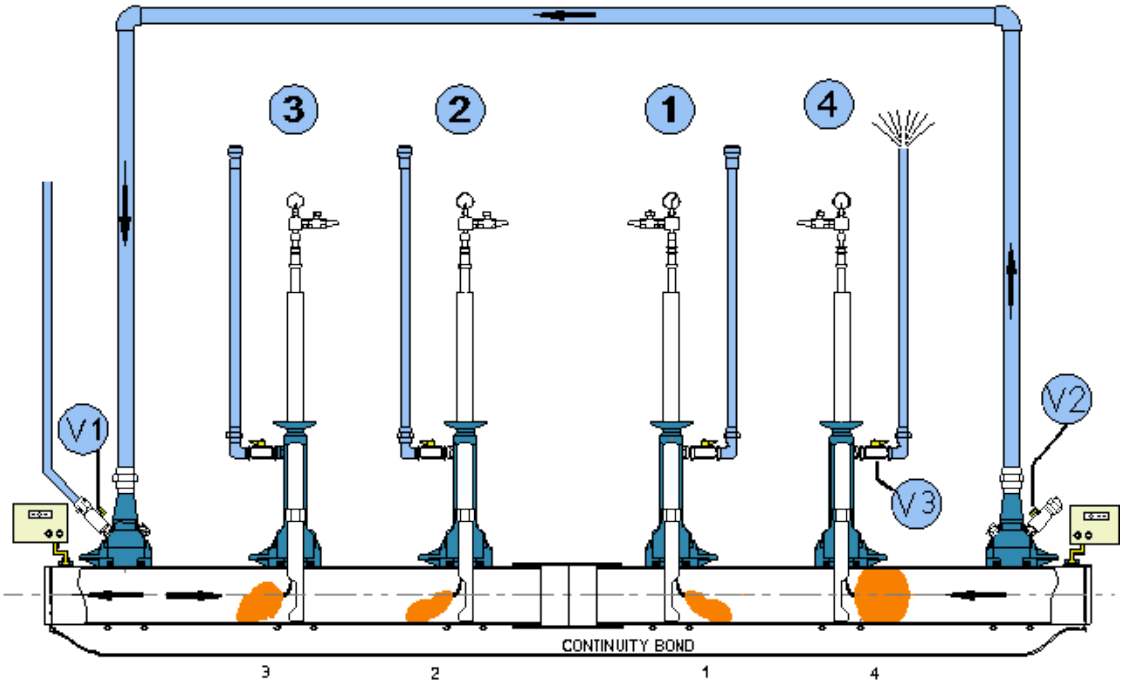


Figure 70- Purging Without Using the Purging Rider

3. Deflate bag 2
4. Close the vent on bag tube 1
5. Deflate bag 1
6. Leave the deflated bags in the main at this point in case the renewed section is leaking and the bags need to be re-inflated.
7. Close the vent on bag tube 3
8. Slowly deflate bag 3.
9. Control the rate of flow to avoid the downstream gas supply being affected.
10. Vent the purged natural gas out of the vent stack on bag tube 4 until two readings of greater than 90% GIA are observed.
11. Close the vent on bag tube 4.
12. Allow the section of main to pressurise to line pressure.
13. Test the renewed section with leak detection fluid.
14. If a leak be detected, ask all personnel to exit the excavation.
15. Assess the situation.
16. If the situation is satisfactory re-inflate the bags and vent the areas between them.
17. Any leakage discovered must be rectified before continuing.
18. Once the mains pressure has equalised, bags 1 & 2 may be withdrawn followed by bag 3.
19. Deflate bag 4 and withdrawn into its assembly.
20. Monitor the pressure in the main at both ends.
21. Remove the bag tube assemblies.
22. Plug the tappings.
23. Test all plugs for soundness with leak detection fluid.

REMOVAL OF BYPASS

Once the section of main has been re-commissioned and bag tube assemblies removed and main plugged the bypass can be removed.

1. Refer to Figure 71, monitor the mains pressure either side of the flow stopping operation.
2. Close the valve on the upstream bypass position.
3. Should the mains pressure start to fall immediately reopen on the bypass valve.
4. Close the downstream bypass valve.
5. Open the vent on the downstream bypass position.
6. If nitrogen or regulated compressed air is to be used, this must be introduced at the upstream bypass vent position. (Valves D or E)
   Note: The pressure of the purge must not exceed 1/3 that of the mains pressure.
7. When two consecutive samples taken at the downstream vent are less than 10% LEL close the vent.
8. Dismantle the bypass and plug the main.
9. Tested all plugs and fittings left on the main for soundness with leak detection fluid.
10. The continuity bond can now be removed.
11. All equipment should be checked for damage.

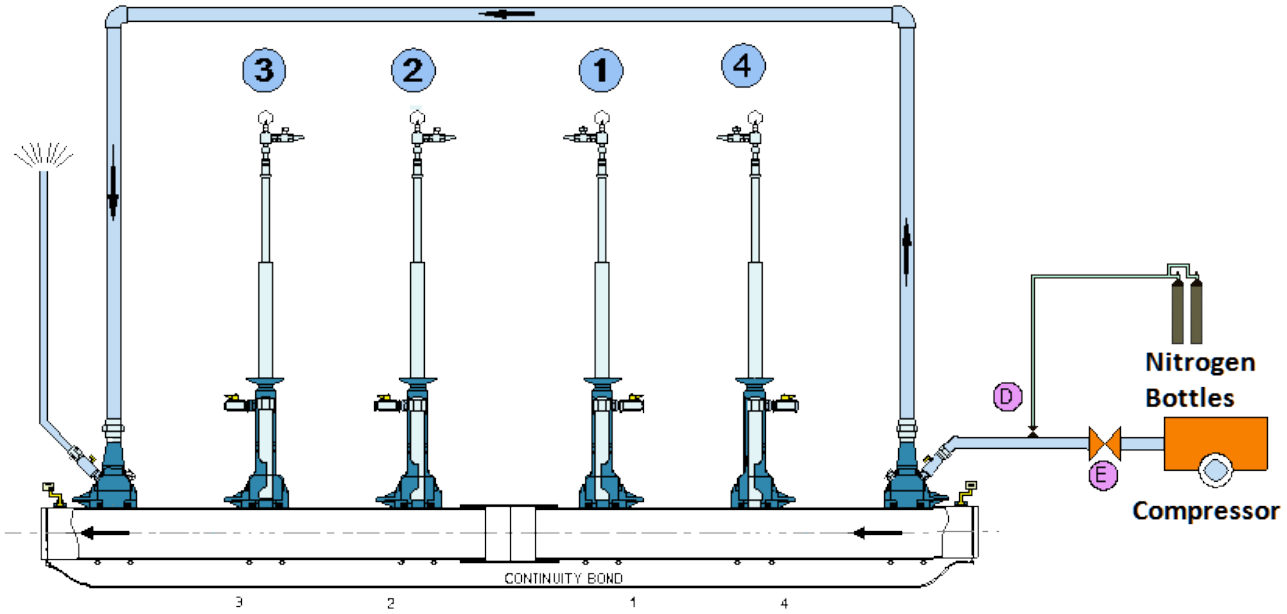


Figure 71- Decommission the Bypass

E4 Metallic Flow Stopping up to 8”/200mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Single Hole Bag Off System on LP mains

This section details flow stopping using single hole bag off equipment, in metallic mains up to 8”/200mm diameter.

SITE SURVEY

Complete a site survey see Section A1

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. Excavate on to the pipe at the planned location - See guidance at Section A1.
4. Clear the main around the full circumference of the pipe.
5. Check for potential obstructions to the fitting of the bag tube and cutting equipment, for example the width of trench and clearance beneath.

BAG STOP PREPARATORY WORK – GENERAL

1. If you are working on a steel main which has impressed current for corrosion protection check that it has been switched off.
2. Check main with a Volt stick.
3. Drill and tap a small diameter pressure point.
4. Fit a pressure point connection on the extremity of the proposed bag stop operation.
5. Confirm the mains pressure.
6. Inform your Operational Manager if the pressure is higher than the figures stated in Table 31.
   Note: Where pressures are higher than those shown in of Table 31 arrangements must be made to lower the operating pressure or to use an alternative method to stop the flow of gas.
   See SGN/PM/MSL/1 Part 2 for alternative methods of stopping the gas supply such as iris stop, stopple, valve operation.
7. Confirm the wall thickness of the main. If the wall thickness is less than 4mm you must inform your Operational Manager.
8. Fit another pressure point at the other extremity of the proposed bag stop operation.

Nominal Size of main Ferrous		Max. mains Operating Pressure
(in)	(mm)	m bar
4	100	350
6	150	300
8	200	300

Table 31– Maximum Operating Pressures

9. Ask your Operational Manager to confirm the direction of gas flow.
10. From the RO/NRO confirm the size of bypass and the type of connection to be used, bypass kit or Under Pressure Tee (UPT).
11. Ref to Figure 72 and Table 32 and mark the positions of the drillings on the main.
12. Allow at least 200mm from the face of any socket or split collar for the drilling position and when existing connections are found.
    Note: This distance measured from the centre of the drilling.

E4 Metallic Flow Stopping up to 8”/200mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Single Hole Bag Off System on LP mains

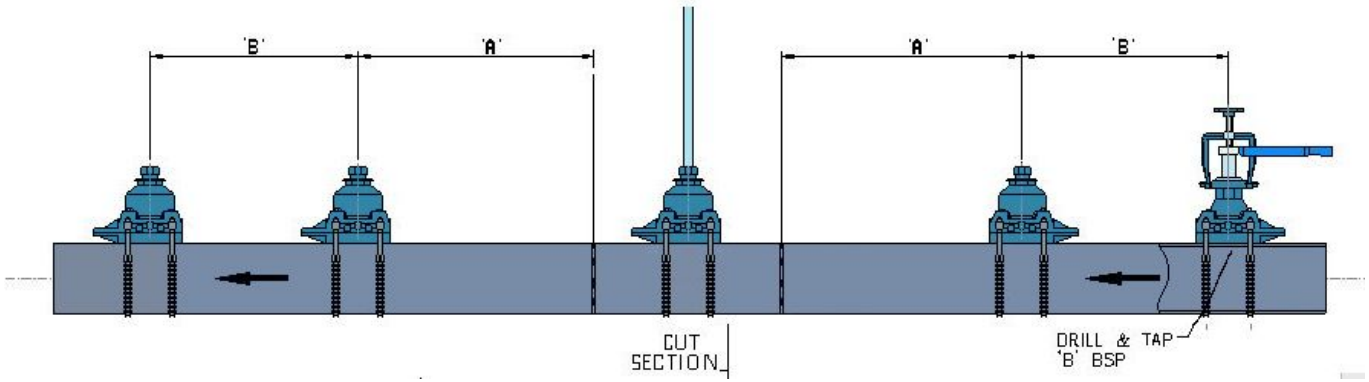


Figure 72 - Drilling Separation Distances and Tapping Sizes

The upstream side of the operation is the side where the gas has come from, whilst the downstream side is where the gas is going.
Primary bags are those bags furthest away from the proposed cut-out section and are the first bags that stop the flow of gas into the cut- out area.
Secondary bags are those bags nearest the proposed cut out section and are the secondary protection measure to stop the flow of gas getting into the cut out area.
Note 1: On 3” mains the size of drilling required is 1" to allow insertion of the bag tube shoe. After the drilling operation, an under-pressure clip must be fitted over the plugged hole.
Note 2: For hot works on steel mains the separation distance must between the secondary bags and the cut out section be increased to at least 10m on both sides.
Note 3: Under pressure tees can be used to replace the bag stop equipment used for the bypass to provide a larger diameter bypass when required.

NOTE: Previously a nitrogen trickle was also used. This is no longer considered a suitable procedure. Nitrogen trickle feeds must not be used during hot works.
Refer to SGN/PM/MSL/1 Part 2, for further information on welding operations.
Bagstop equipment is shown in Figure 73.

Nominal bore of main		Spacing dimension 'A' (mm)	Spacing dimension 'B' (mm)	Drill & tap dimension inches
mm	ins			
100	4	400	400	1 ¼″
150	6	450	450	1 ½
200	8	500	500	2

Table 32 – Drilling Spacing and Access Hole Sizes

E4 Metallic Flow Stopping up to 8”/200mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Single Hole Bag Off System on LP mains

Figure 73- Wask Single Hole Bag Kit Parts

PREPARATORY WORK – MAINS PREPARATION AND DRILLING

1. Select a position on the main where there are no large corrosion defects or hard encrustations.
2. Ensure that there is sufficient work area when handling the equipment due to the height of the kit
3. Clean the main by scraping and wire brushing.
4. If necessary, wash the main with clean water to secure seal at machine saddle.
5. On ductile mains if fitted remove any plastic sleeving
6. For steel mains remove the plastic or other coatings.
7. Make sure that the main is supported throughout the operation.
   Note: Wooden blocks should be used to support the pipe.
8. Calliper the main to confirm the size.
9. Select the correct machine saddle and seal.
   Note: The Single Bagging Kits are specifically designed for use with individual manufacturer’s base units. You must not try to mix drilling base units with bagging kit from another manufacturer.
10. Check its condition and fit following manufacturer’s instructions.
11. If the equipment shows signs of damage which could cause personal injury or affect the flow stopping procedure – DO NOT USE
12. The fixing chain nuts must be tightened evenly, apply torque settings given by the manufacturer.
13. The level of the machine should be checked regularly.
14. Inspect the drill tap and lubricate with oil or grease.
15. Fit the drill tap to the chuck and insert into the machine.
16. In the case of double spindle machines the fitting spindle and fitting must also be assembled to the machine.
17. Refer to Table 32 for maximum tapping sizes when drilling hole.
18. If it is necessary to drill and tap a hole more than that given above inform your Operational Manager.

E4 Metallic Flow Stopping up to 8”/200mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Single Hole Bag Off System on LP mains

19. An alternative method for drilling the main using an encirclement fitting to support the main must be used, refer to Section D1.
20. An air test at a pressure of 1.5 times the maximum working pressure in the main or 350 mbar whichever is the greater must be applied with the drilling machine gate valve in the OPEN position.
21. No leakage must be visible during the test duration of 5 minutes.
22. Check the machine seal with an approved leak detection fluid solution.
23. If leakage is observed inspect the machine for the leakage path.
24. If a seal cannot be achieved without tightening the fixing chains beyond moderate hand torque, remove the base and clean the main again, or exchange the equipment.
25. Following a satisfactory test, release the pressure.
26. Leave the test pressure gauge connected, and use it to monitor the mains pressure whilst drilling the main using a hand ratchet or air motor.
27. The main should be tapped using a hand ratchet.
28. If excessive force is needed this should be investigated.
29. The drill tap should be withdrawn and, for single spindle machines, the valve closed.
30. Retain the coupon for inspection.
31. Repeat the above process for each drilling location.
32. Connect an electrical continuity bond across the full section of the main to be isolated.
33. Install pressure gauges and/or recorders at either end of the main.
    Note: Your Operations Manager will confirm the need for a recorder.

EQUIPMENT SET UP

1. Layout and inspect the bag stop equipment as per the manufacturer’s instructions.
2. Check all bags for damage and are within their "use by date".
3. Check the bag will withstand the pressure to which they are to be subjected.
   Note: Pressures and use by dates are normally written on the side of the bags***.***
4. Correctly assemble the equipment following the manufacturer’s instructions.
5. Set the bags by carrying out a trial launch using the launch handle.
6. Check bag inflation gauges that they are within the pressure range and are not damaged.
7. Using an Air Pump connected to the Control Head inflate each Bag in turn to 0.2 bar (3 psi) max. Close the Valve.
8. Inspect the Bag for damage i.e. loose thread, tear, oil contamination etc. Hold on test for 5 minutes.
9. You must pressure test each bag and spare bags.
   Note: At least one spare bag per bag tube must be available on site.
10. Remove the Air Pump and open the Valve to deflate the Bag. Leave the Bag in its launched position.
11. Leave the first Bag launched will check that the second Bag can pass and exit the Nose in the opposite direction.
12. On completion of the pressure test fully withdraw the Bags one at a time into their corresponding Bag Tubes. Use the Launch Handle attached to the appropriate Direction Indicator to aid this process.
    Important: Avoid excess force on withdrawal. Allow time to expel air from the Bag Bladder.
13. Unclamp the Bag Canopy and slide it over the Nose assembly, re-clamp.
14. The Bagging Head is now ready! Repeat steps for additional Heads to be used i.e. two for a two way stop, three for a three way stop.
15. During this time the rest of the connections on the housing should be tested with leakage detection fluid.
16. Your Operational Manager will check that all safety precautions have been taken and an appropriate risk assessment for the procedure completed.

Nominal Size main		Maximum Bag inflation pressure (primary & secondary bags)
inches	mm	mbar
4	100	700
6	150	600
8	200	600

Table 33 - Bag Inflation Pressures

17. Any bags that fail must be checked for damage or defects and then destroyed.
18. If you or your Operational Manager suspect oils may be found inside the main, then the bags must be protected by either covering with an impervious cover or by sealing the stitching with a suitable sealant.
    Note: Use an inspection canopy to view inside the main before the operation.
19. On completion of the bag stop operation all bags that have been subjected to oils and similar substances within the main must be destroyed.
    Note: If nitrogen bottles are used for the bags they must be separate to that used for purging purposes and one bottle supplying each bag.

ADDITIONAL VENT POINT

1. An additional Vent point is required when using this system which should be located within the Section of Main to be cut out see Figure 75.
2. Use an additional Base, Undercarriages and securing chains.

BYPASS CONSTRUCTION

1. Follow the guidance in Section E0 – Bypass and rider construction
2. For medium pressure mains abandonment, a governed bypass may be installed if stated in the Routine or Non-Routine procedure.

TESTING BYPASS

Test the bypass follow instructions at Section E0 – Testing bypass

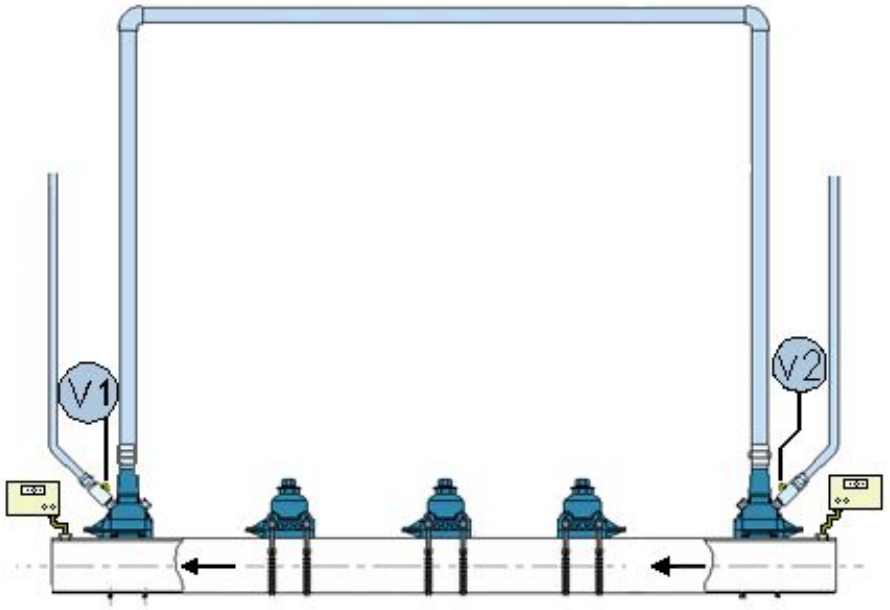


Figure 74– Assembly of Bypass and Bagstop Equipment

COMMISSION BYPASS

See Figure 74, follow the procedure in Section E0 – Commission the bypass

Note: Where larger diameter bypasses are used appropriate under pressure drilling arrangements must be followed see Section D1.

BAG STOP MAIN

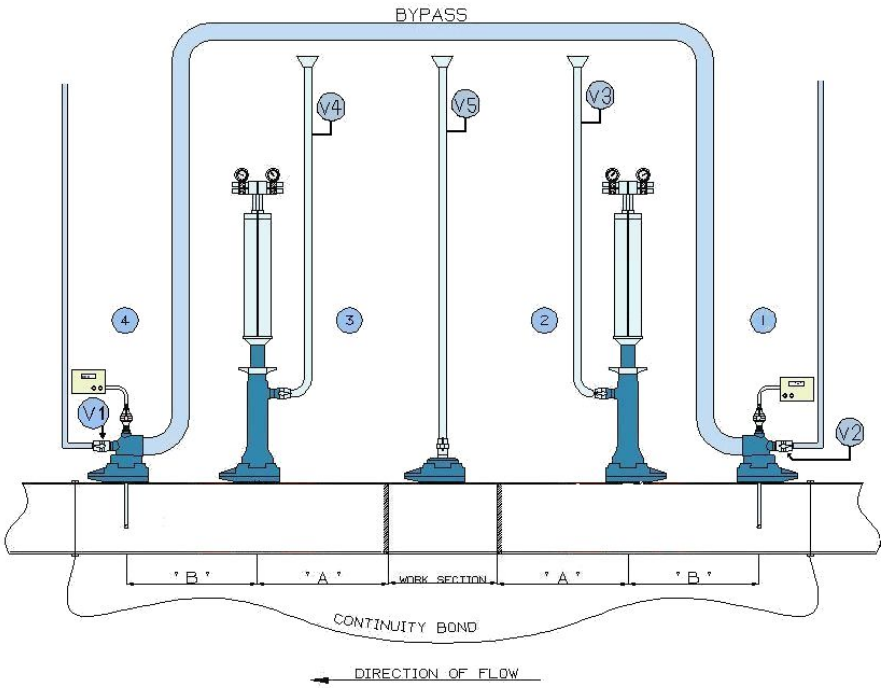


Figure 75– Initial Arrangement for Bagstop

Whenever welding is to be carried out on the isolated section of main, the following additional precautions are required:
Assembly of the bag tube equipment and bypass will probably be in remote excavations from the proposed hot works.
Check that the main to be hot worked is the one that has been isolated.
Bag stoppers must be positioned at least 10m from any potential source of ignition.
Bags must be inflated with an inert gas regardless of diameter
The section of main between the two secondary bags must be purged with an inert gas and a continuous bleed of inert gas must be maintained throughout the operation.
The atmosphere adjacent to the cut out must be monitored continuously using a gas detection instrument.

1. Locate the Bag Canopy into the Base, rotate clockwise to engage Bayonets. The Vent/Lock Button will auto-depress and then Pop back up locking the Bag Canopy in position.
2. Check Canopy security by attempting to rotate Anti-clockwise if the Canopy is correctly seated dis-engagement of the Bayonets will not be possible.
3. If the Bag Canopy does not lock in to place, examine the unit for any foreign objects and remove where necessary.
4. Ensure that the 1” Ball Valve on the Canopy is in the closed position.
5. With the Small Spanner engage the Valve Plate Square on the Base. Open the Valve Plate.
   Note! The top of the square is marked to indicate the Valve Plate position.
6. Loosen the Canopy Wing Nut Clamp and insert the Bag Tube Assembly into the Main to a stop.
7. Rotate the Bag Tube Assembly to align the Upper Bag Tubes with the axis of the Main. Re-clamp.
8. Repeat steps 1 to 6 for each Bagging Head position.
9. Fit a metallic vent to bag tube assemblies and make sure they are adequately supported.
   The top of the vent must be a minimum of 2.5m above ground level.
10. The insertion of the Bags must be done in a controlled manner and in the correct sequence.
11. The pressure gauges must be monitored continuously to check that the pressure downstream of the operation remains stable.

Should the pressure start to fall below the minimum pressure stated on the written procedure the operation must be stopped immediately and the Operational Manager informed.

12. Insert the upstream Secondary Bag no.1 (refer to Figure 76). The Bag will be facing the cut out section.
13. Inflate the Bag gradually to the required pressure (Table 33).
14. Recheck all pressures.
15. Insert the downstream Secondary Bag no.2.(refer to Figure 76). The Bag will be facing the cut out section. Inflate to the required pressure (Table 33).
16. Vent the space between the two Bags by opening the (Valve V5) on the Centre Vent Stack. This is required to ensure that an adequate seal between the Bags has been achieved.
    Important! If the Gas being vented is excessive then the Vent must be closed, the Bags deflated, re-seated and re-inflated.
17. With an acceptable seal being established. Insert downstream Primary Bag no.3 (Figure 76) inflating to the required pressure (Table 33). Open the Vent on downstream Bag Head (V4) and check that there is an acceptable seal between Bag no.2 and no.3. If the gas passing is excessive then the Vent must be closed and Primary Bag re-seated.
18. With an acceptable seal being established. Insert upstream Primary Bag no.4(Figure 76) inflating to the required pressure (Table 33).
19. Open the Vent (V3) on upstream Bag Head and check that there is an acceptable seal between Bag no.1 and no.4.
20. If the gas passing is excessive then the Vent must be closed and Primary Bag re-seated.
21. Both Bag Head Vents (V3 & V4) and the Centre Vent (V5) must remain open.
22. Prior to any further work being carried out. Allow a period of 10 minutes for stabilisation to ensure that satisfactory Bag sealing has been achieved and that upstream and downstream pressures are stable.

If this procedure is to abandon a section of main and leave it capped off, then you must complete a Decay before continuing with the operation.

The decay test is intended to confirm if there is a back feed supplying the pipe or not and if there are supplies connected downstream or not.

23. See Section H5 – Decay Testing
24. If the results of the decay test are as expected then continue with the operation.
25. If they are not as expected contact your Operational Manager.

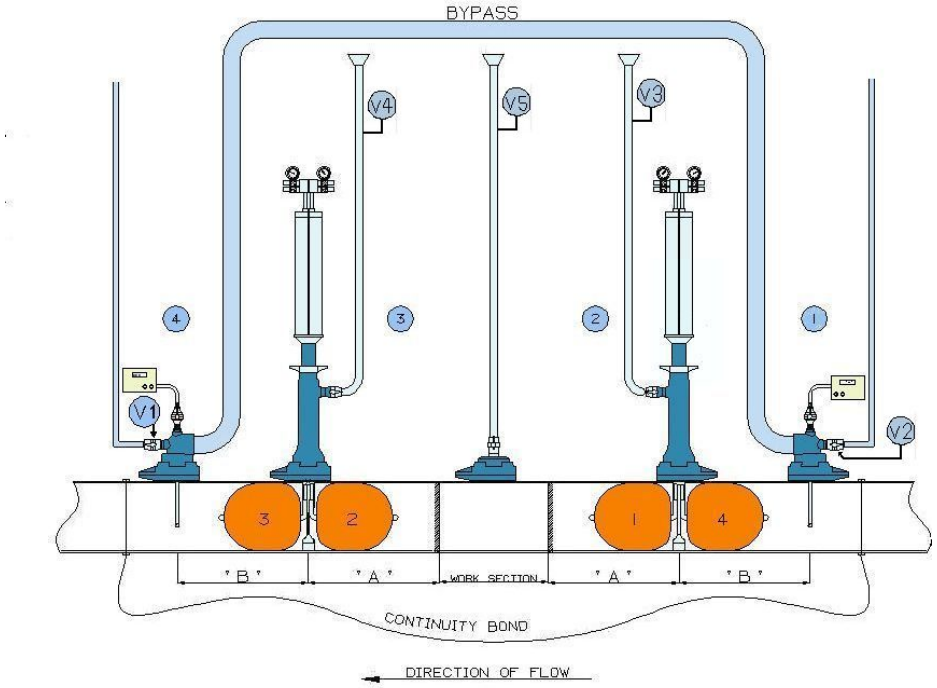


Figure 76– The Bagstop Sequence

CUTTING OPERATION

1. The main can now be cut out and the work carried out.
2. Continue to monitor the pressures in the main and the bags. Accurately measure and mark the section of pipe to be cut.
3. Remove any sources of ignition to at least 5 metres upwind of the proposed cut out.
4. Check that the continuity bond is fixed correctly.
5. Place timber and wedges under the main to support it.
6. Before cutting refer to Section H4 for inert gas purging requirements.
7. At least 3 cuts should be made to remove the section of pipe.
8. The method used will normally be either mechanical or hand reed cutters depending on the diameter and material of the pipe.
9. You must NOT use any type of Crush Cutters.
10. If required, make additional cuts to remove the section of pipe with the minimum of effort.
11. When breaking out a main using an approved percussion tool cover the pipe with damp rags to minimise ignition source. See Appendix H.
12. The open ends of the pipe must be sealed with expanding stoppers or cap ends installed.
13. Anchorage of the cap must be carried out as per SGN/WI/DIS/4.2.2.

BAG FAILURE

Should a bag fail it can normally be observed by a reduction in the bag tube inflation gauge and in the case of primary bag failure, gas will be venting through one of the primary tube vent stacks.
Regardless of venting gas or not, the first consideration when a bag has been suspected of failing, is the safety of personnel on site.
The following steps should be undertaken to bring the situation under control.

1. Try to re-inflate the bag, if unsuccessful then.
   - Consider if it is safe to replace the damaged bag.
   - If this is considered a high risk, then suspend the work and refer to the Authorising Engineer of the RO/NRO or your Operational Manager.
2. Refer to Figure 76. If either of the Primary Bags is to be replaced, shut off the relevant Vent, to stop full mains pressure being released.
3. Refer to Figure 76. If either of the Secondary Bags are to be replaced it may be necessary to shut off one of the Vents i.e. the relevant Bag Canopy Vent or the Centre Vent. Refer to your Operational Manager.
   Note: When replacing a Secondary Bag it may be necessary to deflate the relevant Primary Bag to ensure that the Secondary Bag has achieved an acceptable seal. Refer to the Operational Manager.
4. Withdraw the failed Bag by raising the relevant Inflation Tube which should be fully retracted to a stop. Take Care not to disturb the other Inflation Tube, hold down if required.
5. Remove the Dirt Seal from its recess in the Body. This will allow access for the Spatula which, can now be inserted to isolate the appropriate Upper Bag Tube sliding it fully into the Sealing Slot.
6. Rotate the Vent/Lock Handle anti-clockwise to vent the Upper Bag Tube.
7. To check the Spatula Seal close the Valve and re-open after a few seconds to check that there is no increase in pressure.
8. With the Vent/Lock Handle open rotate the Bag Tube anti-clockwise to dis-engage it from the Bagging Head and remove complete with Bag and Control Handle. Place to one side for investigation later.
9. Remove the Control Handle from the withdrawn Bag Tube and attach it to the replacement Bag Tube which has been previously prepared with a sound Bag. Refer to ‘Setting the Bags’.
10. With the Vent/Lock Handle open insert the Bag Tube and rotate it clockwise to a stop. Close the Valve to lock in position.
11. Remove the Spatula from the Sealing Slot.
12. Launch the replacement Bag into the Main and inflate (refer to Table 31).

13. Monitor pressures and vent stacks, when conditions have stabilised continue operations.
14. During the emergency action to rectify the situation, the pressure in the remaining bags must be monitored to check that their pressure does not fall and the action in Table 28 carried out.

CONTINGENCY PLAN

Depending on the stage of the operation the follow the actions in Section E3 – Contingency Plan.

RE-COMMISSIONING USING A PURGING RIDER

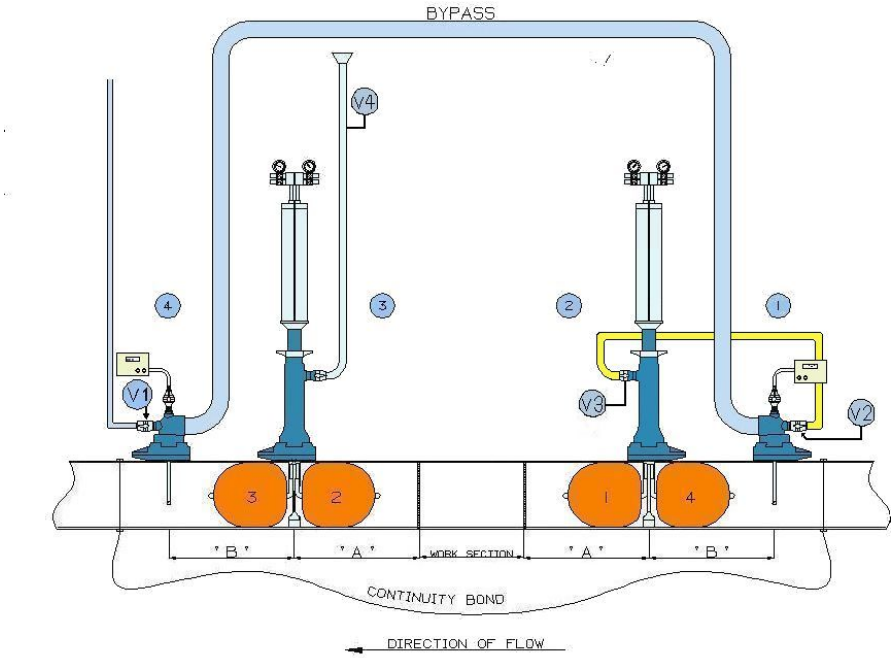


Figure 77– Recommission Main (Using Purging Rider)

1. Close the vent V3 and remove vent stack with flame trap.
2. Remove the vent stack with flame trap from the upstream bypass connection V2.
3. A suitably sized rider, as stated in the written procedure, should be connected between V2 and v3. see Figure 77
4. Test for leakage with leak detection fluid by opening valve V2 ensuring that the valve V3 remains in the closed position.
5. Close the vent V4 and deflate bag 2, followed by bag 1 see Figure 78
6. Leave the deflated bags in the main at this point in case the replaced section is leaking and the bags need to be re-inflated.
7. Introduce Natural gas slowly through the rider by opening the valve V3 and reopen the vent V3.

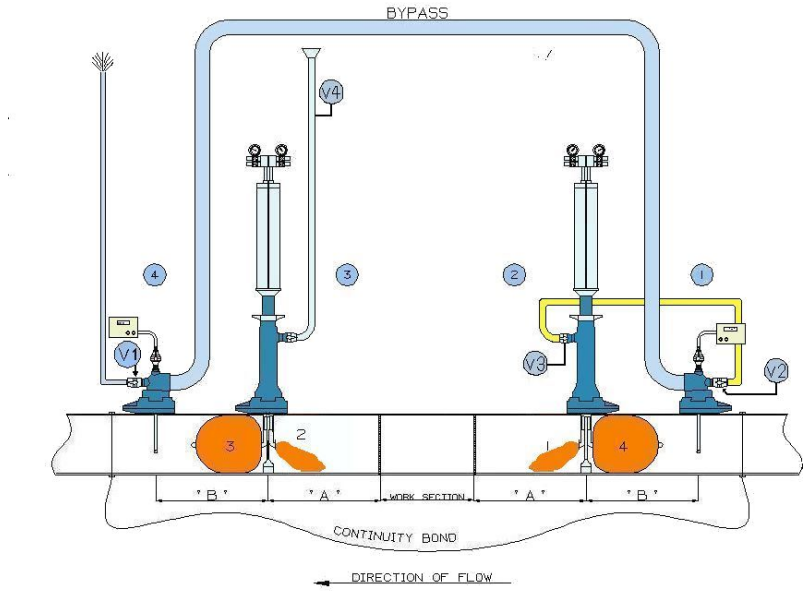


Figure 78– Purging with Rider – Secondary Bags Deflated

8. When two readings greater than 90% GIA are observed, close the vent valve V3 and allow the renewed section to pressurise to line pressure.
9. Test the renewed section with approved leak detection fluid.
10. If a leak is discovered stop the re-commissioning operation immediately by closing off the rider to bag tube 4.
11. Ask all personnel to exit the excavation.
12. Determine the cause of the leak.
13. You must cure the leak before continuing with the purging operation.
14. Withdraw bags 1 & 2 into their assemblies.
15. Deflate and remove of bag 3
16. Deflate and remove bag 4.
17. Monitor the pressure in the main at both ends.
18. Isolate the rider supply at the valves V2 and V3.
19. Remove the bag tube assemblies.
20. Plug the tappings in the main and test plugs for soundness with leak detection fluid.

RECOMMISSIONING WITHOUT USING A PURGE RIDER

1. The Centre Vent should have been removed during the 'cutting out' operation. If it is still present close the Vent Valve V5.
2. Deflate the upstream Secondary Bag no.1 (refer to Figure 79).
3. Close Vent Valve at the downstream Bag Canopy V4 and deflate the downstream Secondary Bag no.2 (refer to Figure 79).
   Note: It is important to leave the deflated bags in the main at this point in case the renewed section is leaking and the bags need to be re-inflated.

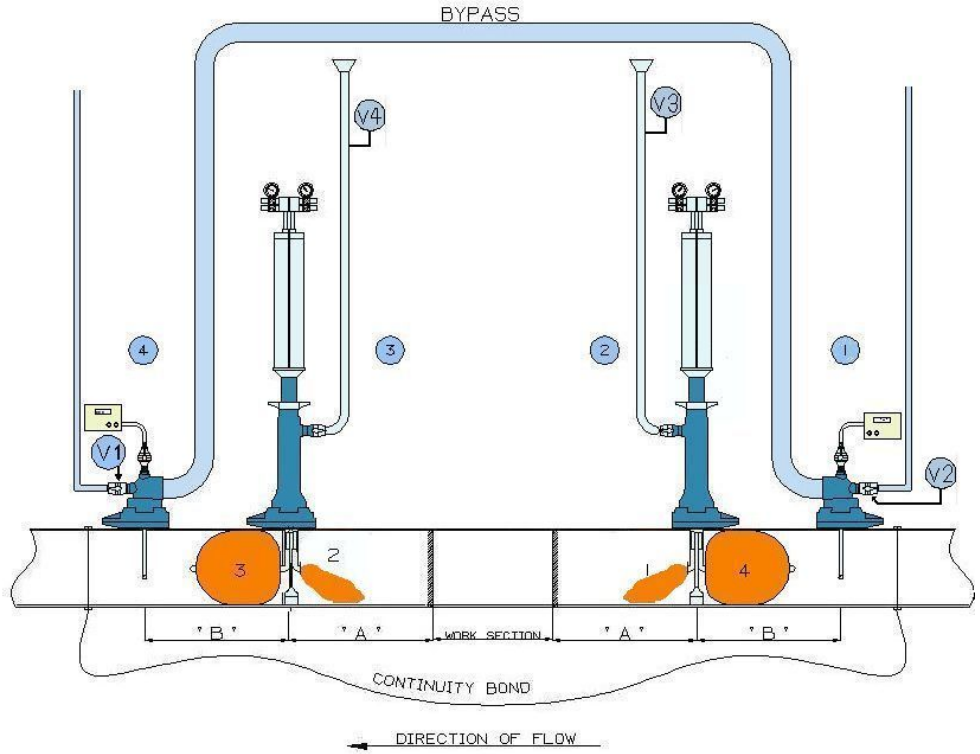


Figure 79–Purging Without Using the Purging Rider

E4 Metallic Flow Stopping up to 8”/200mm Diameter in Ductile Iron, Cast Iron & Steel Mains by Use of Single Hole Bag Off System on LP mains

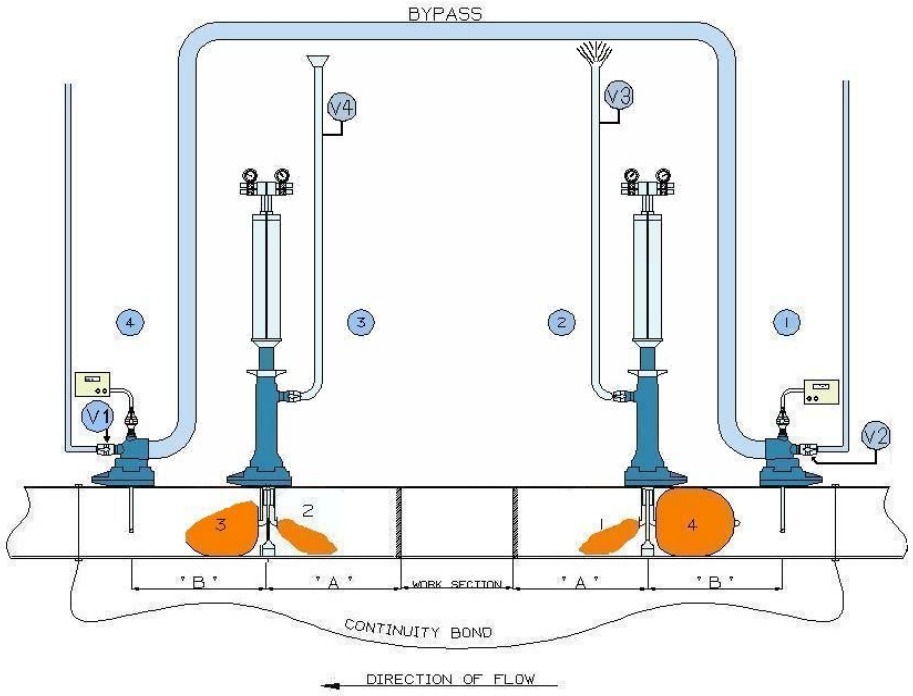


Figure 80– Purging With Primary Bag Partly Deflated

4. In a controlled manner deflate the downstream Primary Bag no.3. The rate of flow should be controlled such that the downstream gas supply is not affected. (Refer to Figure 80).
5. Monitor the upstream Vent Stack V3 as gas purging of the work section takes place. The purged natural gas must be allowed to vent out of the vent stack until two readings of greater than 90% GIA are observed.
6. Close the Vent Valve allowing the working section to pressurise to line pressure.
7. The renewed section must now be tested with leak detection fluid.
8. Should a leak be detected all personnel must exit the excavation and the situation assessed. Where deemed satisfactory re-inflate the bags and vent the areas between them. The leak must be rectified before continuing.
9. On the successful completion of a pressure test, bags 1, 2 and 3 can be withdrawn.
10. Bag 4 can then be deflated and withdrawn (Refer to Figure 80).
11. Monitor the pressure in the main at both ends.
12. Remove both Bag Canopies and the two tapped holes plugged.
13. Test both plugs for soundness with leak detection fluid.

REMOVAL OF BYPASS.

1. Close valves on bypass positions.
2. Monitor the mains pressure either side of the flow stopping operation.
3. Close the valve on the upstream bypass position.
4. Should the mains pressure start to fall immediately reopen on the bypass valve.
5. Close the downstream bypass valve.
6. Open the vent V1 on the downstream bypass position.
7. When two consecutive samples taken at the downstream vent are less than 10% LEL close the vent.
8. Dismantle the bypass and plug the main.
9. Tested all plugs and fittings left on the main for soundness with leak detection fluid.
10. The continuity bond can now be removed.
11. All equipment should be checked for damage.

E5 PE Flow Stop, for 125mm to 355mm diameter SDR 11 and 17.6, pipe LP and restricted use on MP using semi-supported bags PE bag stop

This section details the procedure to be followed for PE flow stopping of mains up to and including 355mm diameter by the use of semi-supported bags.

1. This procedure is the same as that contained within Section E3, Metallic flow stopping up to and including 300mm/12”diameter in Ductile Iron, Cast Iron and Steel mains by the use of semi-supported bags with the following difference see Figure 81.
   a) The drill assembly and drilling of the PE main.
   b) The plugging of the PE main and removal of equipment.

2. Table 34 defines the pressure limitations for its use.

Nominal Diameter of Main	Max. Mains Operating Pressure
Polyethylene (mm)	**mbar**
125	280
180	280
250	200
315	100
355	100

Table 34- Maximum Mains Operating Pressure for Bag Tube Equipment 125mm to 355mm Diameter

BAG STOP PREPARATORY WORK – GENERAL

The dimensions and pressures stated in Figure 81 and Table 35, Table 36, must be followed.

1. Check that the Proximity distances referred to in Appendix B are followed
2. Follow procedures in Appendix C & D for electrofusion operations.
3. Electro fuse a top tee onto the main at the far end of the planned operation.
4. Fit a pressure point
5. Confirm the mains pressure
6. Confirm the mains diameter.
7. If mains pressure is within the limits in Table 34 fit another pressure point at the other end of the operation.
8. Inform your Operational Manager if the pressure is outside the limits stated in Table 34.
9. The operational Manager must make arrangements to lower it to pressure within Table 34 or alternatively another method must be used to stop the flow of gas seeTable 20.
10. Ask your Operational Manager to confirm the direction of gas flow.
11. From the Routine or Non-Routine Procedure confirm the size of bypass.
12. Refer to Figure 81 and mark the positions of the drillings.

E5 PE Flow Stop, for 125mm to 355mm diameter SDR 11 and 17.6, pipe LP and restricted use on MP by the use of semi-supported bags PE bag stop

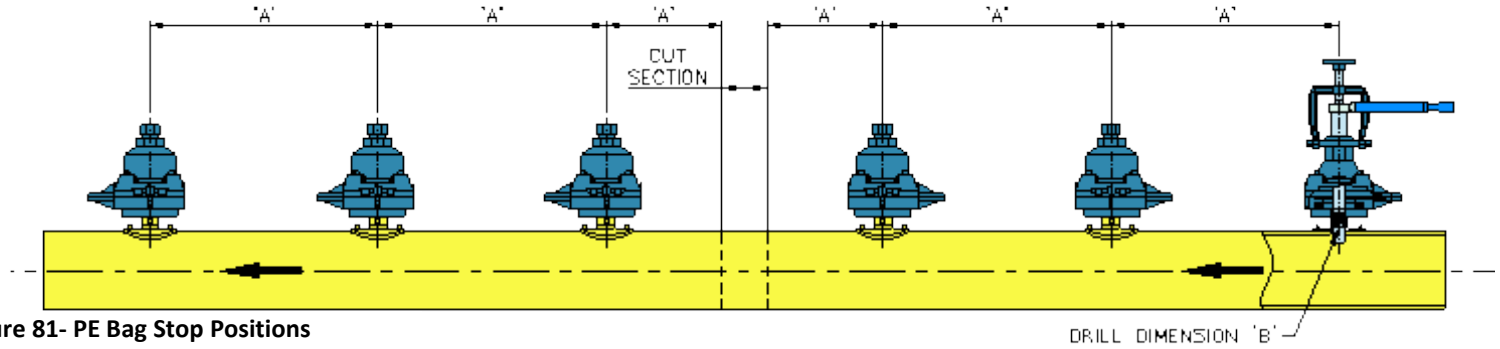


Figure 81- PE Bag Stop Positions

Diameter of Main mm	Dimension A Minimum mm	Dimension B (Drilling) mm
125	350	56
180	400	56
250	450	56
315	500	56
355	600	56

Table 35- Bag Tube Set Up Dimensions and Access Hole Size

Diameter of Main Mm	Bag inflation pressure (Primary & Secondary bags) mbar
125	550
180	550
250	340
315	280
355	300

Table 36- Maximum Inflation Pressures for Bags

BAG STOP EQUIPMENT

1. PE Bag tube equipment is shown in Figure 82.
2. Set up equipment to dimensions Table 35.

PREPARATORY WORK – MAINS PREPARATION

3. Select a position on the main and clean with clean water.
4. The position of the electrofusion saddles should be marked and the main prepared for fusion see Appendix C.
5. Complete the electrofusion of the bagging saddles.
   Bagging saddle caps must NOT be removed at pressures above 75mbar, pressures must be lowered for removing the cap.
6. Position the tee set undercarriage attachment and fix to the saddle.
7. Where branch saddles are used for the bypass these should be installed on the side of the main to reduce the possibility of 3rd party interference damage.
8. Clamp the tee set base to the undercarriage following manufacturer's instructions.

E5	PE Flow Stop, for 125mm to 355mm diameter SDR 11 and 17.6, pipe LP and restricted use on MP by the use of semi-supported bags PE bag stop	Page 3 of 4

9. Select a PE drill spindle for use (this is a longer spindle compared to the metallic drill spindle).
10. Fit a PE drill cutter to the PE drill spindle.
11. Complete an air test at a pressure of 1.5 times the maximum working pressure in the main or 350 mbar whichever is the greater.
12. The drilling machine gate valve must be in the OPEN position and the machine seal checked with an approved leak detection fluid.
13. No leakage must be visible during the test duration of 5 minutes.
14. If leakage is observed inspect the machine for the leakage path.
15. If the seal cannot be achieved without tightening the attachment nuts beyond a moderate hand torque the base must be removed and checked for damage, or the equipment exchanged.
16. Leave the test pressure connected, and use it to monitor the mains pressure whilst drilling.
17. You must drill the main using a hand ratchet. Do not use excessive force.
18. The drill should be withdrawn and the drilling base gate closed.
19. The drill process must be repeated at each of the proposed drillings.
20. Complete all drillings and retain the coupons.

PE BAGGING PROCEDURE

1. Follow the procedure in Section E3 (metallic bag stop procedure) for the remainder of the flow stopping operation up to point of plugging the main and removing the equipment see below.
2. Maximum inflation pressures are stated inTable 36.

PLUGGING PE BRANCHES AND REMOVAL OF EQUIPMENT

1. Once the section of main has been re-commissioned, the bypass decommissioned and the bag stop housings removed the PE branch connections can be plugged off.
2. Fit the non-tap plug onto the plugging off spindle and install through the tee-set housing and into the tee-set base.
3. Push the plugging spindle into the branch fitting and expand the non-tap plug into place.
4. Confirm a seal by venting off gas through the bleed facility on the tee set base.
5. If a seal is not achieved, re-set the non-tap plug.
6. Once a seal is achieved, remove the tee set housing from the tee-set base.
7. Remove the plugging spindle from the plug and remove the tee set base from the branch fitting.
8. Fit the branch cap onto the branch outlet and test for soundness with approved leak detection solution.
   Caps should initially be tested at low pressure and if the pressures are increased then the test repeated in stages as pressures increase.
9. Make sure that the solution is washed off with water.
10. Clean all equipment and return to stores.
11. Any defective equipment must be reported to the Operational Manager.

E5 PE Flow Stop, for 125mm to 355mm diameter SDR 11 and 17.6, pipe LP and restricted use on MP by the use of semi-supported bags PE bag stop

1	Bag Stop Base Seal
2	Bag Stop Base
3	Bag Stop Drilling Spindle with 52mm drill bit.
4	Bag Stop Drilling Head
5	Bag Stop Ratchet Handle
6	Plugging Housing
7	Plugging Spindle
8	Plug Carrier
9	Valve Handle
10	Drilling & Plug Housing Spanner
11	Bag Tube Housing (Outer)
12	Bag Tube Foot
13	Bag Tube Housing (Centre)
14	Pressure Gauge (Bags)
15	Bag Tube Vent Pipe
16	Tee Set Undercarriage attachment
17	PE Saddle Fitting
18	PE Plug carrier

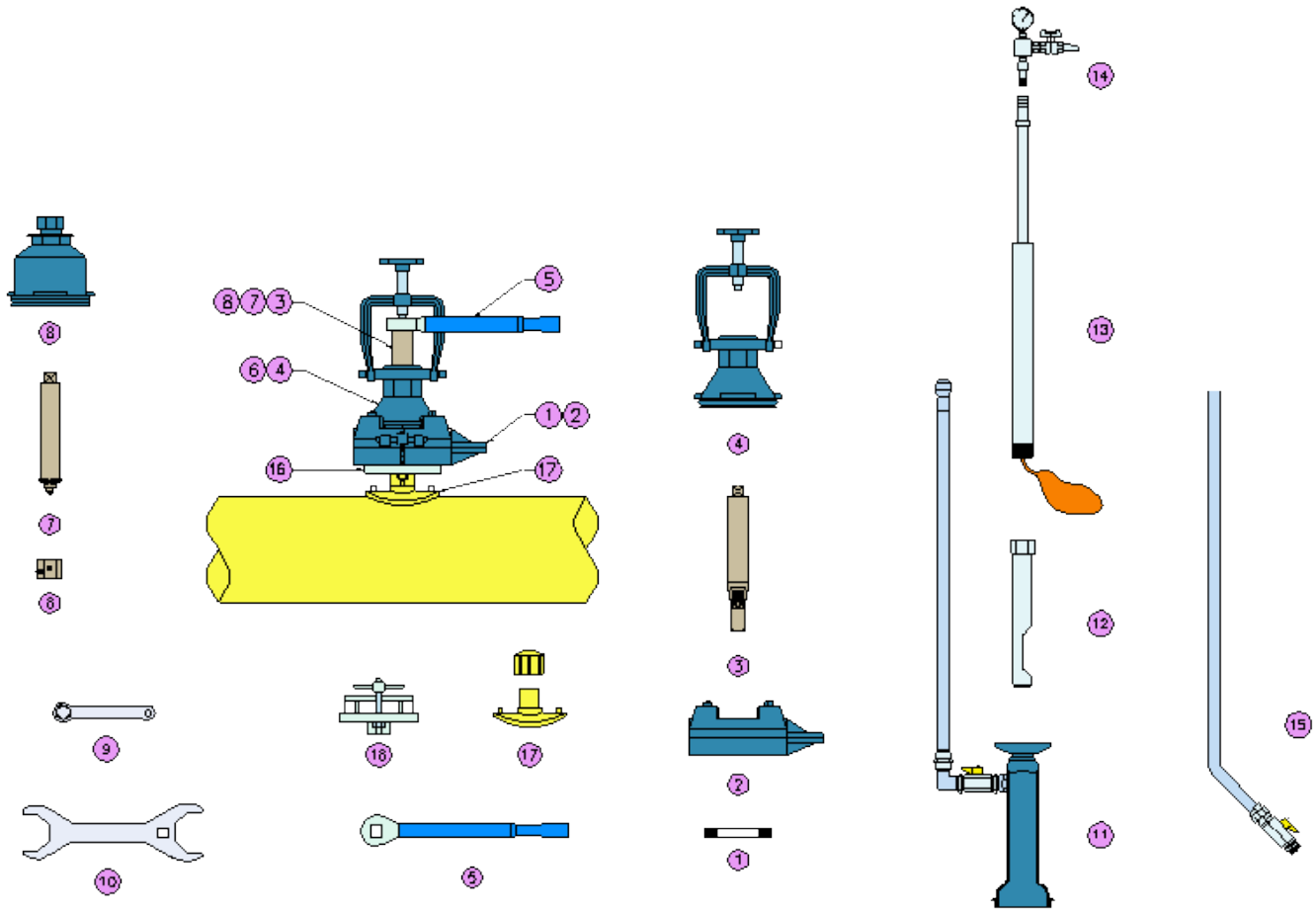


Figure 82- PE Semi-supported Bag Tube Equipment

E6 Flow Stop – Foam Plugging on LP mains from 80mm/3” to 250mm/ 10” Diameter

This section deals with the use of foam plug kits on 80mm/3" to 250mm/10" metallic mains operating at pressures up to and including 75mbar. For foam plugging of low pressure mains above 10”/250mm and medium pressure mains of all diameter up to and including 2bar, reference should be made to SGN/PM/MSL/1 Part 2.

SITE SURVEY

Complete a site survey see Section A1.

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. Excavate on to the pipe at the planned location. See guidance at Section A1.
4. Clear the main around the full circumference of the pipe.
5. Check for potential obstructions to the fitting of the bag tube and cutting equipment. (for example, the width of trench and clearance beneath).

FOAM PLUG PREPARATORY WORK – GENERAL

1. If you are working on a steel main which has impressed current for corrosion protection check that it has been switched off.
2. Check main with a Volt stick.
3. Drill and tap a small diameter pressure point.
4. Fit dome glass to drilling base and view the inside of the main to check that it is not inserted.
   Note: If the main is inserted inform your Operational Manager.
5. Fit a pressure point connection on the extremity of the proposed bag stop operation.
6. Confirm the mains pressure.
7. Inform your Operational Manager if the pressure is outside the limits stated in Table 34.

Nominal Dia. of Main (ins)	Nominal Dia. of Main (mm)	Maximum Foam Length (mm)	Tapping Hole Size BSP (in)
3	(80)	450	1 (See note below)
4	(100)	450	1
5	(125)	450	1
6	(150)	450	1
8	(200)	450	1½
10	(250)	450	1½

Table 37- Details of Foam Lengths and Tapping Hole Sizes for LP Mains of 75mm/32 to 300mm/12" Diameter

Note: On 3” mains the size of drilling required is 1" to allow insertion of the foam tube. After the drilling operation, an unde-pressure clip must be fitted over the plugged hole.

8. Ask your Operational Manager to confirm the direction of gas flow.
9. From the Routine or Non-Routine Procedure confirm the size of bypass and the type of connection to be used, for example bypass kit or UPT.
10. Ref to Figure 83 and mark the positions of the drillings on the main.
11. Allow at least 200mm from the face of any socket or split collar for the drilling position and when existing connections are found.
12. This distance is measured from the centre of the drilling

E6 | Flow Stop – Foam Plugging on LP mains from 80mm/3” to 250mm/ 10” Diameter | Page 2 of 7

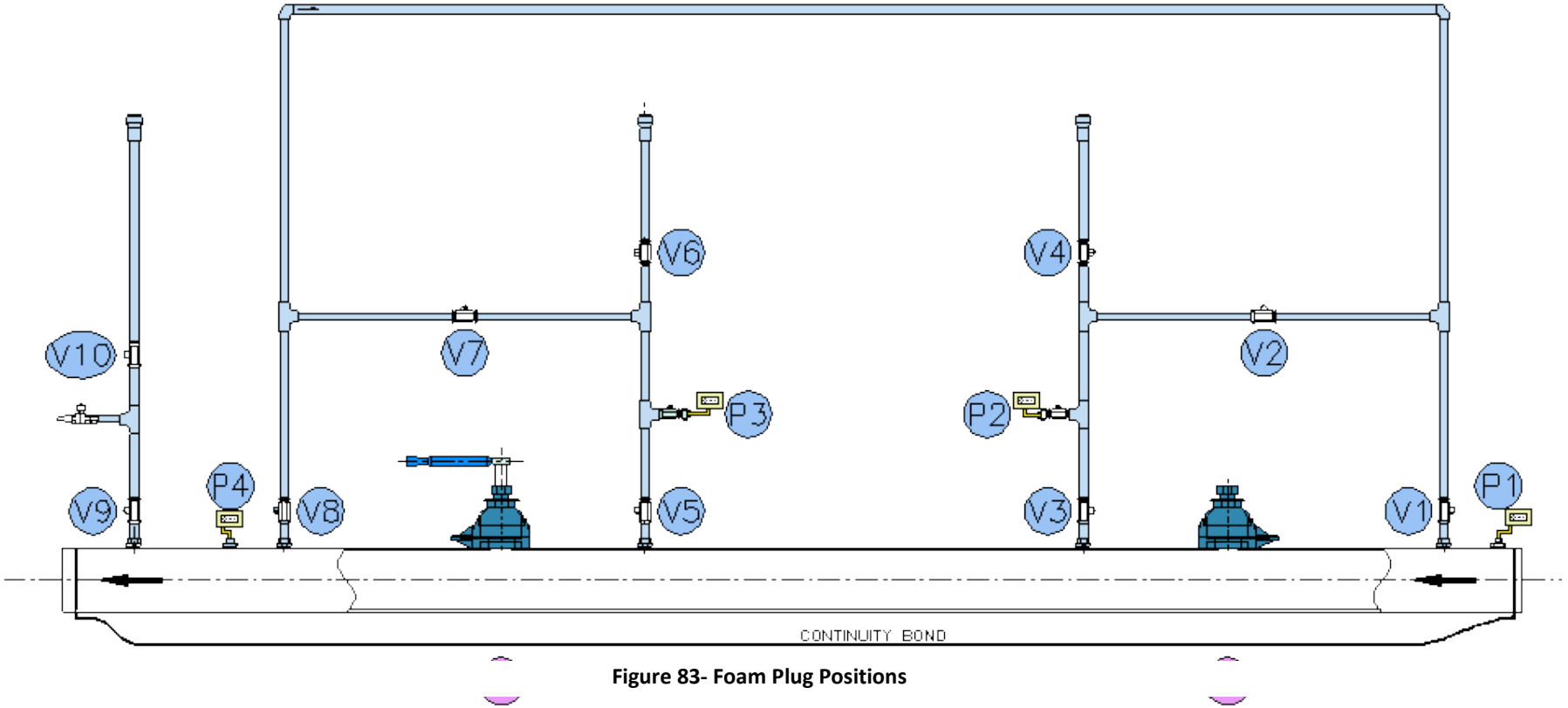


Figure 83- Foam Plug Positions

Note: (Minimum dimensions from Foam Plugs)
Dimension between Foam Plug 1 and bypass point V1 = 800mm.
Dimension between Foam Plug 1 and Vent point V3 = 300mm.
Dimension between Foam Plug 2 and bypass point V8 = 800mm.
Dimension between Foam Plug 2 and Vent point V5 = 300mm.
(The distance of 800mm allows for an additional foam plug to be installed if the first one fails).

E6 Flow Stop – Foam Plugging on LP mains from 80mm/3" to 250mm/ 10" Diameter

PREPARATORY WORK – MAIN PREPARATION AND DRILLING

1. Select a position on the main where there are no large corrosion defects or hard encrustations.
2. Clean the main by scraping and wire brushing.
3. If necessary, wash the main with clean water to make sure a secure seal on the machine saddle.
4. On ductile and steel mains, if fitted remove any plastic sleeving or other coatings.
   For work on Ductile iron mains refer to SGN/WI/ML/1 for guidance.
5. Make sure that the main is supported throughout the operation.
   Wooden blocks should be used to support the pipe.
6. Calliper the main to confirm the size.
7. Select the correct machine saddle and seal.
8. Check its condition and fit following manufacturer's instructions.
9. The fixing chain nuts must be tightened evenly, apply torque settings given by the manufacturer.
10. Check the level of the machine regularly.
11. Inspect the drill tap and lubricate with oil or grease.
12. Fit the drill to the chuck and insert into the machine.
    In the case of double spindle machines the fitting spindle and fitting must also be assembled to the machine.
13. Refer to Table 37 for maximum tapping sizes when drilling hole.
14. If you need to drill and tap a hole larger than that given above inform your Operational Manager.
    An alternative method for drilling the main is to use an encirclement fitting, refer to Section D1.
15. An air test at a pressure of 1.5 times the maximum working pressure in the main or 350 mbar whichever is the greater must be applied with the drilling machine gate valve in the OPEN position.
16. No leakage must be visible during the test duration of 5 minutes.
17. Check the machine seal with an approved leak detection fluid solution.
18. If leakage is observed inspect the machine for the leakage path.
19. If you cannot make a seal without tightening the fixing chains beyond the manufacturer's advised limit, remove the base and clean the main again or exchange the equipment.
20. Following a satisfactory test, release the pressure.
21. Leave the test pressure gauge connected, and use it to monitor the mains pressure whilst drilling.
22. Drill the main using a hand ratchet only.
23. If excessive force is needed this should be investigated.
24. The drill tap should be withdrawn and for single spindle machines, the valve closed.
25. Retain the coupon for inspection.
26. Repeat the above process for each drilling location.
27. Connect an electrical continuity bond across the full section of the main to be isolated.
28. Install pressure gauges and/or recorders at either end of the main.
    Your Operations Manager will confirm the need for a recorder.

ASSEMBLE AND TEST BYPASS AND VENTS

Construct bypass, in size and material as per the written procedure. See Section E0 – Bypass and Rider construction.

TESTING BYPASS

Test the bypass follow instructions at Section E0 – Testing bypass

COMMISSION BYPASS

Follow the procedure in Section E0 – Commission the bypass

EQUIPMENT SET-UP

1. Install metallic vent stacks with flame traps as per Figure 83.
2. Fit the vent stacks so that they all protrude above the top of the excavation by a minimum of 2.5m.
3. Check all valves other than bypass valves V1 & V8 are in the closed position and the vent stacks are adequately supported.
4. Load the foam bag into the foam bag injection standpipe following manufacturer’s instructions.
5. Insert the assembly into main via the drilling machine base.
6. Make sure that the non-return valve in the neck of the foam bag prevents gas escaping through the injection tube.
7. If gas starts to pass through the injection tube stop the procedure immediately, withdraw the injection tube and close the under-pressure valve.
8. Inspect the faulty tube for damage and replace.
9. Repeat the procedure from 4 above.
10. Fit cartridge to gun and attach to installed foam plug tube.

FOAM PLUGGING MAIN

1. Mix the resin and hardener to the manufacturer’s instructions and pour the contents into the cartridge gun and dispense the foam into the bag 1 see Figure 84.
2. Mains pressures at P1 and P4 must be monitored to make sure that there is no drop-in pressure.
3. Repeat the process for bag 2.
4. The surplus foam left within the mixing container must be monitored to confirm the foam in the bag has cured.
5. Once the foam has cured, open the vent stack valves V3 &V4 upstream and V5 & V6 downstream to make sure an adequate seal.
6. Confirm the seal by attaching a pressure gauges P2 & P3, close the vent V4 & V6 and check for let by through the foam bag Figure 84.
7. If satisfactory re-open V4 and V6.
8. Check Table 50 for guidance on purging requirements.

SHOULD A FOAM BAG FAIL TO SEAL A SECOND STOPPING OFF OPERATION USING AN ADDITIONAL FOAM BAG VIA AN ADDITIONAL TAPPING MUST BE CARRIED OUT BEFORE CONTINUING WITH THE OPERATION.

CUT OUT OPERATION

1. Before proceeding further complete a satisfactory decay test following procedure at Section H5.
2. Reduce the pressure in the main to be abandoned by 5mbar by venting the gas through the vent valves V9 and V10.
3. Allow the pressure in the main to stabilise.
4. Observe the gauge for a rise in pressure.
5. If the pressure starts to rise inform your Operational Manager.
6. Arrangements must be made to investigate the cause of the back feed.
7. If it is safe to continue proceed as follows.
8. Accurately mark the section of main to be cut.
9. Remove any sources of ignition present adjacent to the proposed cut out.
10. Check that the continuity bond is fixed correctly.
11. Place timber and wedges under the main to support it.
12. At least 3 cuts should be made to remove the section of pipe.
13. The method used will normally be either mechanical or hand reed cutters depending on the diameter and material of the pipe.
14. Whilst cutting the main avoid unnecessary vibration that may cause the foam bags to pass.
15. Make additional cuts to remove the section of pipe with the minimum of effort.
16. When breaking out a main using an approved breakout tool, cover the pipe with damp rags to minimise ignition source. See APPENDIX H.
17. The open ends of the pipe must be sealed with expanding stoppers or cap ends installed.
18. Anchorage of the cap must be carried out as per SGN/WI/DIS/4.2.2.

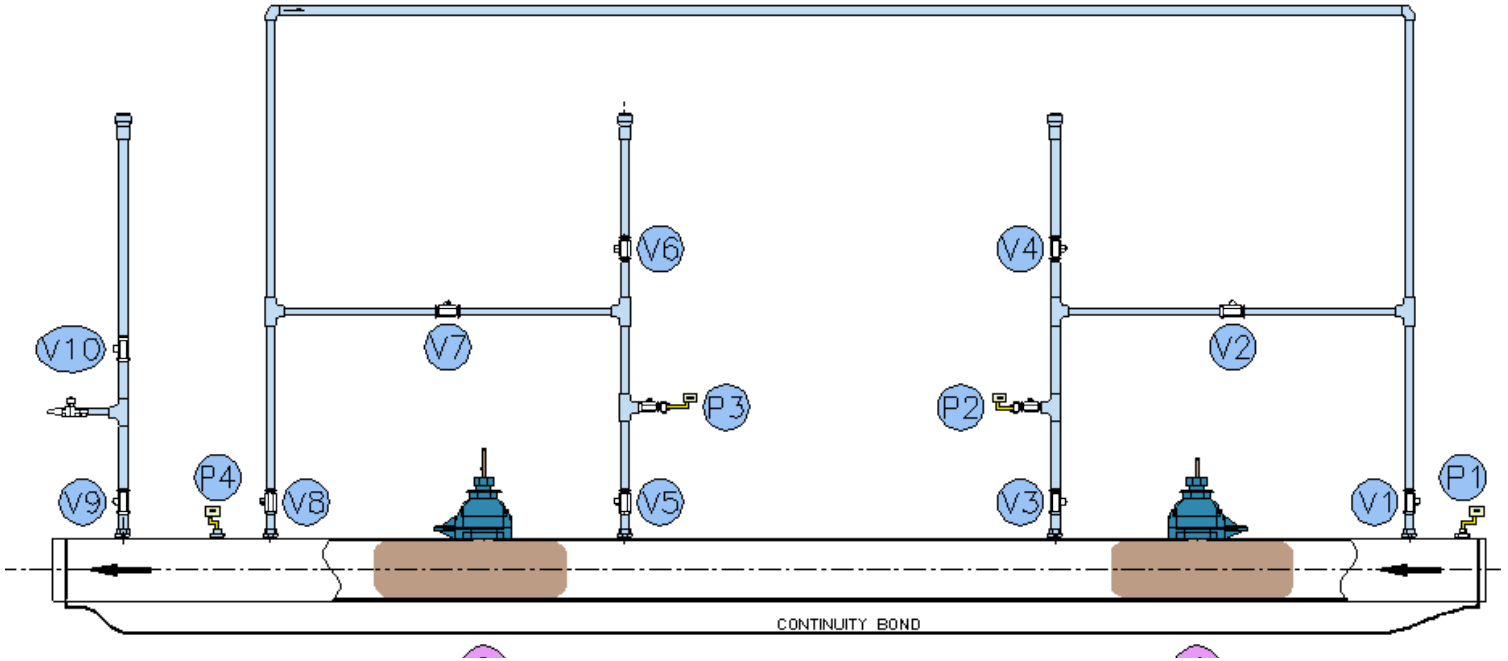


Figure 84- Foam Plug Insertion

CONTINGENCY ACTION

1. If there is a failure to achieve a satisfactory seal or there is a loss of seal, gas will be noticed passing bags1 and/or 2.
2. The first consideration when this occurs is to the safety of personnel on site.
3. Prior to attempting to deal with the fault due consideration must be given to the protection of supplies as shown below.
4. Once confirmation that protection of supplies has been undertaken the remedial action listed in Table 38 must be followed.
5. Install a second foam bag into the main upstream of the existing foam bag position, on the side, which is passing, and install a vent.
6. If a good seal is obtained and confirmed by a 10-minute hold period during which no build-up of gas is observed, the operation may continue.
7. Should leakage still occur inform your Authorising Engineer or Operational Manager before continuing with the cut-out operation.

Stage of Operation	Action
First cut not completed	Stop cutting main. If considered necessary remove machine and, dependant on mains operating pressure, either clamp or wrap the cut. Proceed to Contingency Action item 5.
Several cuts completed	Stop cutting the main. Preferably previous cuts will have been wrapped
Section of main not removed	If not, and dependant on mains operating pressure, either clamp or wrap completed cuts. If considered necessary, remove the machine and protect the cut. Proceed to Contingency Action item 5.
Section of main removed	Preferably the open ends of the main will have been protected. If not, insert a stopper or similar device and close the end. Securely anchor any stop end device used. Proceed to Contingency Action item 5.

Table 38- Emergency Procedure

TEST END CAPS

1. The end caps must now be tested for gas tightness as follows:
2. Refer to Figure 85, open valves V2 & V3 and valves V5 & V7 check that valves V4 & V6 are closed.
3. Test the cap ends for soundness with leak detection fluid.
4. Should the cap(s) show leakage, Close valve V2 and/or V7, vent the section between the cap and foam bag by opening V4 and/or V6,
5. Retighten the cap.
6. Close valves V4 and/or V6 and open valves V2 and/or V7 and retest the cap end(s) for soundness with leak detection fluid.
7. Remove the foam injection tubes and test with leak detection fluid.
8. Once caps and plugs have been deemed satisfactory close valves V2 and V7 and open valves V4 and V6 and vent between the cap ends. Close valves V3 and V5.

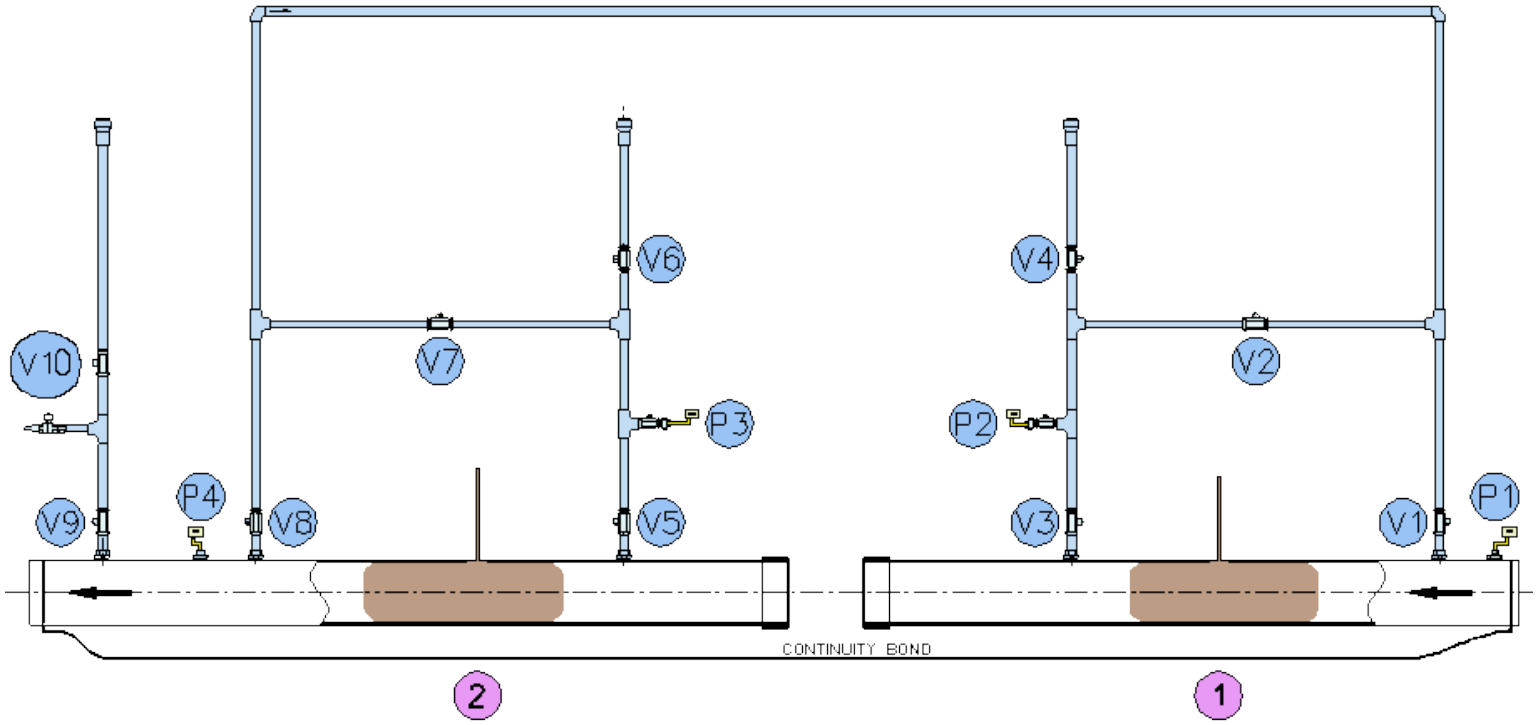


Figure 85- Cut & Capped Main

REMOVAL OF EQUIPMENT

1. Close bypass valves V1 and V8.
2. Open V2 & V7 and vent the bypass to zero pressure.
3. Disconnect V2 and attach an air supply and direct purge the bypass with air at no more than ⅓ rd. of the main operating pressure.
4. Dismantle the bypass
5. Use the drilling machine plug off under no gas conditions the connection points for the bypass and vents.
6. Remove the pressure gauges and check the plugged off holes with leak detection solution.
7. Remove the continuity bond.
8. Dispose of the applicator, foam cartridge and containers as per the manufacturer’s instructions, COSHH and the Risk Assessment.
9. Apply leak detection fluid must be applied to the plugs at least 24 hours after the foam off operation.
10. This is to check that the plugs screwed into the foam bag injection points are not leaking.
11. If the plugs show leakage the plugs must be tightened and retested withsoap leakdetection fluid.

E7 Isolation and decommissioning of one-way fed metallic mains

*This section details the Procedure for Isolation and decommissioning of one-way fed metallic mains (and services) from 3" /80mm to and including 6"/150m diameter operating at low pressure, using semi-supported bags. See **Figure 86**.*

Figure 86- Illustration of a Typical Example of a 'One-Way' Fed System with Downstream Section to be Abandoned.

MINIMUM CONDITIONS TO BE MET

1. This procedure can only be used if the following conditions have been met:

- It can be reasonably proved that no customers remain connected to the section being abandoned.
- It can be reasonably proved that no back feeds exist into the section being abandoned.
- Hot works are not involved

2. Follow the procedures in Section E3 for:

- Site Survey
- Preparation.
- Bag stop preparatory work – general
  Note: Table 25 does not apply, this procedure only applies to Low Pressure systems. Figure 58 must be replaced by Figure 87 and Table 26 by Table 39.
- Preparatory work – Mains preparation & drilling
- Equipment set
- Assemble bypass/set up bag stop equipment onto main
- Reference should be made to Figure 88.
- Commission Bypass
- Reference should be made to Figure 89.
- The atmosphere in the excavation must be monitored throughout the Bag Stopping operation.

Nominal bore of main		Minimum spacing Dimensions	Drill & Tap dimension B
(in)	(mm)	(mm)	(inches)
3	80	250	1(see note)
4	100	250	1
5	-	250	1.5
6	150	350	1.5

Table 39- Bag Tube Set Up Dimensions and Access Hole Sizes for Metallic Mains up to 6"/150mm

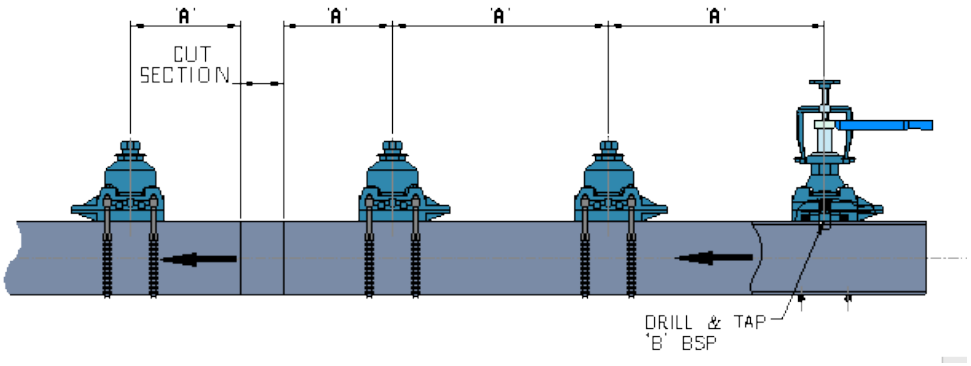


Figure 87– Drilling Separation Distances and Tapping Sizes.

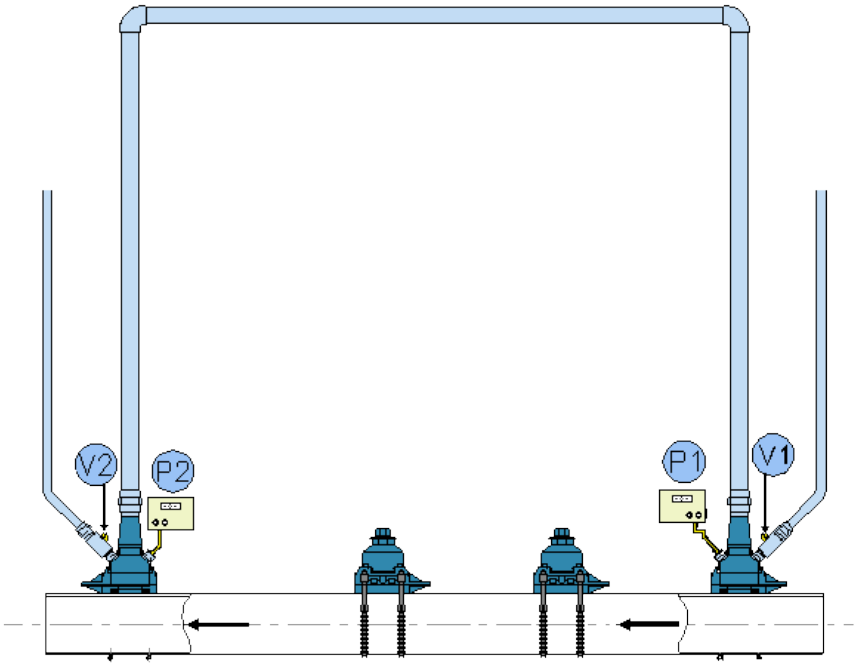


Figure 88- Assembly of Bypass and Bag Stop Equipment

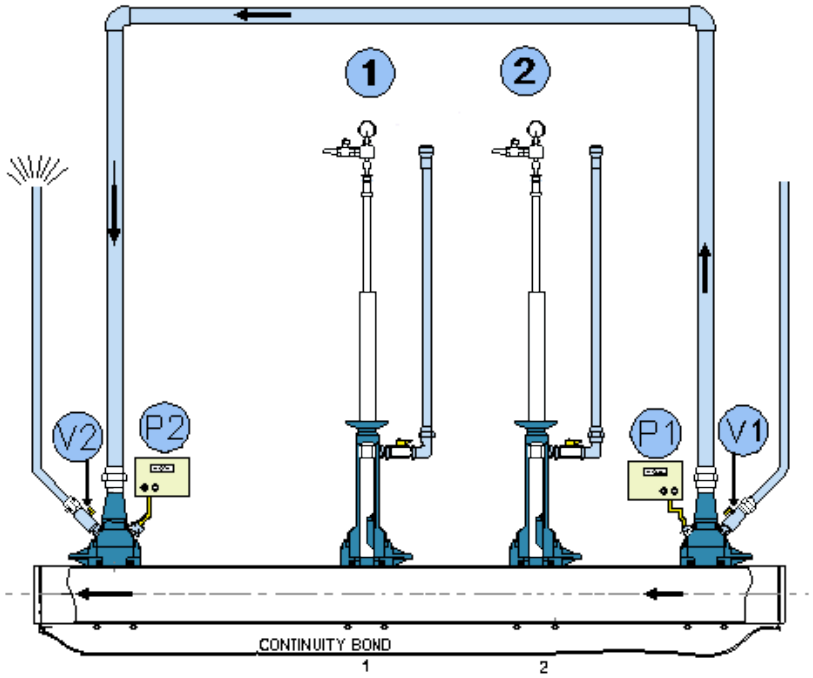


Figure 89- Commission Bypass

BAG STOP MAIN

1. Fit a metallic vent to all bag tube assemblies refer to Figure 90.
   Note: The top of the vent must be a minimum of 2.5m above ground level.
2. Support the vent stacks.
3. Make sure that the bag tube direction indicators, on the bag tube assemblies, are facing away from the section to be cut out.
4. Monitor the pressure gauges continuously to make sure that the pressure downstream of the operation remains stable.
5. Should the pressure start to fall below the minimum pressure stated on the written procedure the operation must be stopped immediately and your Operational Manager informed.
6. Check all vents are closed and the bypass is commissioned.
7. Open the gate on bag tube.
8. Insert Bag No1 into the main.
9. Check that bag is facing away from the proposed cut out section.
10. Inflate bag gradually to required pressure (refer to Table 40).

Nominal bore of main		Maximum bag inflation pressures (Primary and secondary bags)
(in)	(mm)	mbar
3	80	680
4	100	680
5	-	550
6	150	550

Table 40- Maximum Inflation Pressures for Bags Up To and Including 6" / 150mm

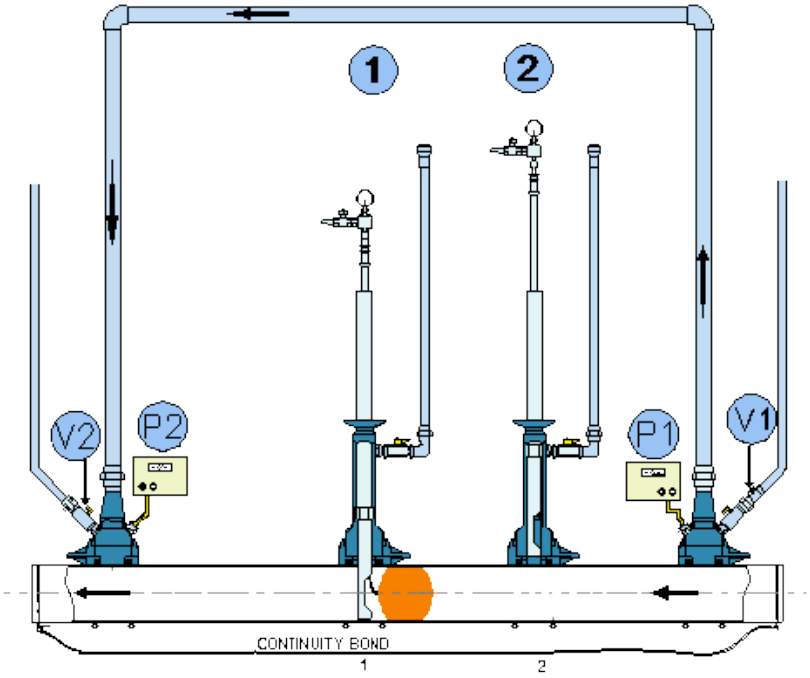


Figure 90- Installation of Bag 1

11. Check pressures at P1 and P2 are stable and then insert Bag No2. (see Figure 91)
12. Check that the bag is facing away from the proposed cut out section.
13. Inflate bag gradually to required pressure (refer to Table 40).
14. Once inserted open the bag tube vent 'A' and vent section between the bags to check the seal between the primary and secondary bags has been achieved.
15. If there is no discernible gas venting from vent 'A' move to item 16.

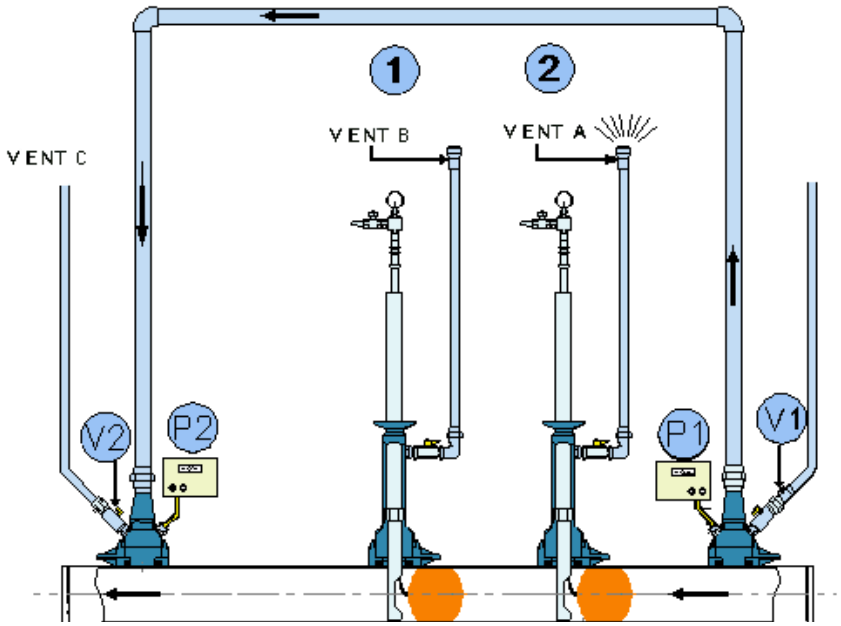


Figure 91- Installation of Bag2 (Upstream Primary) and Venting Between Bag No1 and Bag no 2

16. If gas is noticeably venting from vent 'A' carry out the following steps until no discernible gas is venting: -

- Remove both bags and clean the bag sealing area with cleaning brush or scraper.
- For 3" and 4" mains inflate both bags in 68 mbar (1 PSI) increments up to the maximum inflation pressure of 680mbar (10 PSI).
- For 5" and 6" mains inflate both bags in 55mbar (0.8 PSI) increments up to the maximum inflation pressure of 550mbar (8PSI).
- If there is still no seal, then inform you Operational Manager.

17. When the Competent Person is satisfied that the seal between the Bag 1 and Bag 2 is acceptable proceed with the mains decay test see Section H5.
18. Once it is confirmed that:

- The 2 bags are sealed satisfactorily
- No customers remain connected to the section being abandoned.
- No back feeds exist into the section being abandoned.

19. The section of main to be abandoned may now be decommissioned.

DECOMMISSIONING.

1. Close the Bypass valves.
2. Recheck pressures either side of the Bags.
3. Confirm pressures are satisfactory.
4. Vent at a downstream location the section of main to be abandoned to atmospheric pressure.
5. Close the vent(s) and check that the pressure in the vented section does not increase.
6. On completion of these checks Open Vent C and decommission the bypass.
7. Remove the bypass.
8. Insert and inflate Bag 3 (safety bag) through bypass drilling on the dead section of main (see Figure 92).

Note: This is to contain any residual gas that may be present.

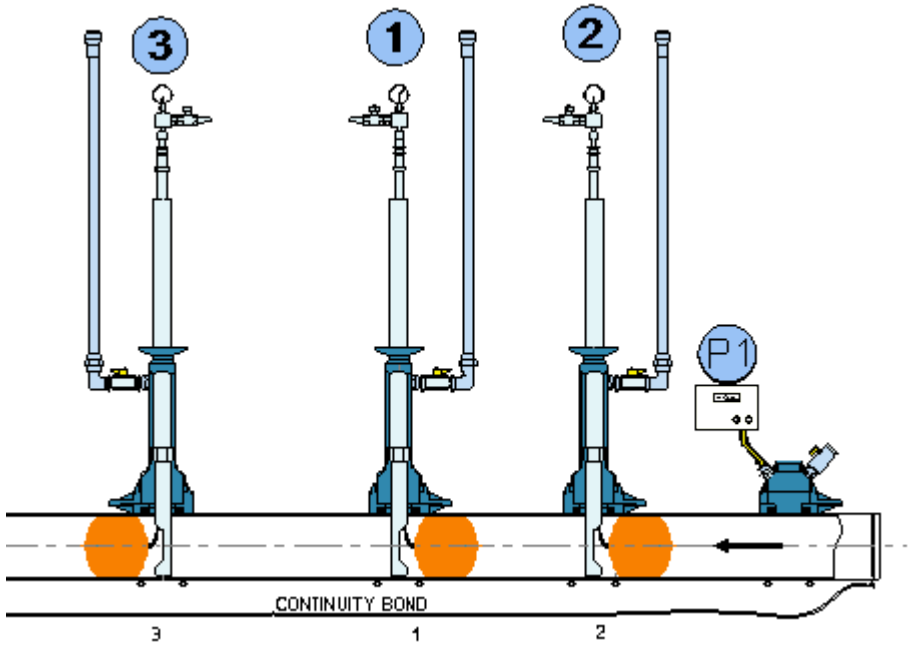


Figure 92- Decommissioning, Removal of Bypass and Insertion of Bag no 3

CUTTING OPERATION.

1. Provide good support with timber and wedges to the section of main to be removed. See Figure 93.
   Note: Make sure that these do not obstruct the cut-out operation or the installation and assemble of new fittings.
2. The method of cutting will be determined by the material and diameter of the main and should contain a minimum of three cuts as detailed the work procedures.
3. Always use additional cuts to be sure that the section of pipe is removed with the minimum of effort.
4. The open end of the live pipe must be sealed with a cap end and anchored see SGN/WI/DIS/4.2.2.
5. Deflate and with draw bag No 2.
6. Check that the vent on bag no 1 is open.
7. Purge main until two consecutive readings of 90% GIA are detected
8. Close vent on bag no1
9. Deflate and with draw bag no 1
10. Test cap end for soundness with leak detection fluid.
11. If sound remove bag tubes 1 & 2 and plug main.
12. Remove pressure points and plug main.
13. Test all plugs for soundness with leak detection fluid.
14. Purge and abandon the dead section of pipe see Section H2.
15. If the abandoned main is to be 'Dead Inserted' then this work can continue see Section B2.
16. If the abandoned main is not being inserted a cap end must be placed on the pipe end to seal the pipe.

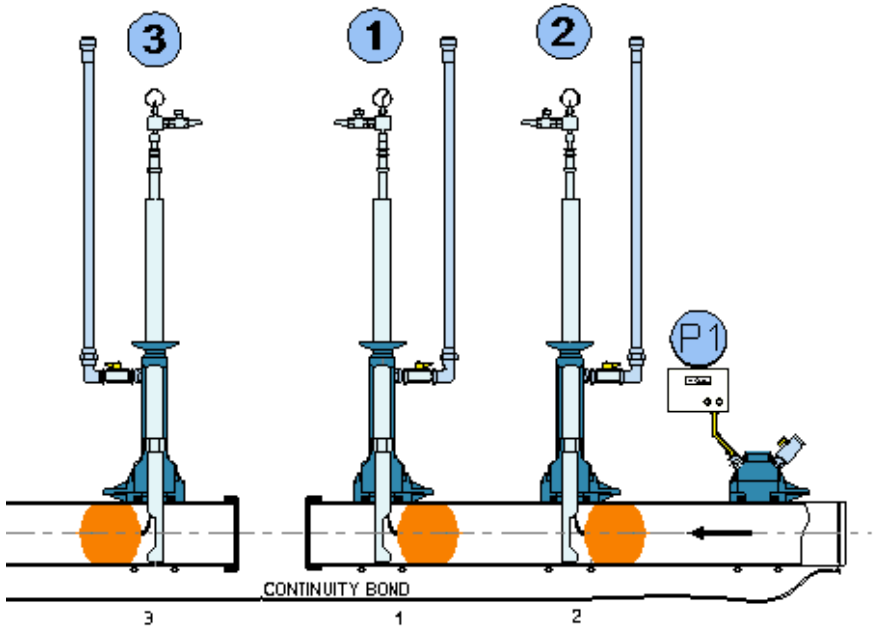


Figure 93- Cut Out Operation

E8 Bypass with integral Pressure Sensor

This Section details the use of the Bypass Kit with Integral Pressure Sensor which was designed solely for use with the Radius Systems 63mm Top Tee. Other manufacturers tops tees must not be used.

RESTRICTIONS ON USE

1. *Equipment for use on direct purging or temporary bypass operations.*
2. *Maximum Operating Pressure (MOP) of 2bar.*
3. *Maximum size of 63mm/2" bypass on 63mm, 90mm or 125mm diameter mains.*
4. *Equipment must not be left permanently on the pipe.*

EQUIPMENT SET-UP & BYPASS PRESSURE TEST

1. Electrofuse a 63mm X 63 mm tapping tee onto the main following guidance in Appendix C & D. Figure 94.
2. Cap the outlet of the 63mm top tee by electrofusion.
3. Remove the completion cap from the tee.
4. Separate the tool at the union joint so that the ball valve assembly (V1 or V3), comprising tee adaptor, ball valve and union connection, can be screwed on to the top tee in place of the completion cap.
5. Attached the remainder of the tool to the ball valve.
   Note: This two-stage assembly procedure reduces the risk of thread damage to the tee.
6. Repeat steps 1 to 5 at the other tapping tee location.
7. Remove the blanking caps then connect the 2” stainless steel flexible rider to each of the tools and tighten the union nuts to seal.
8. Check valves V1, V2 & V3 are fully open.
9. Attach pressure test equipment to the top of the tee assemblies.
10. You must pressure test the bypass following instructions at Section E0 – Testing Bypasses.
11. No pressure loss is accepted.

Note: The 6m stainless steel bypass hose is supplied in two 3m lengths which are joined using the appropriate union coupling. The bypass can be extended to a maximum of 12m using standard 2” BS1387 threaded steel tube and the male union adaptors supplied in the bypass hose kit.

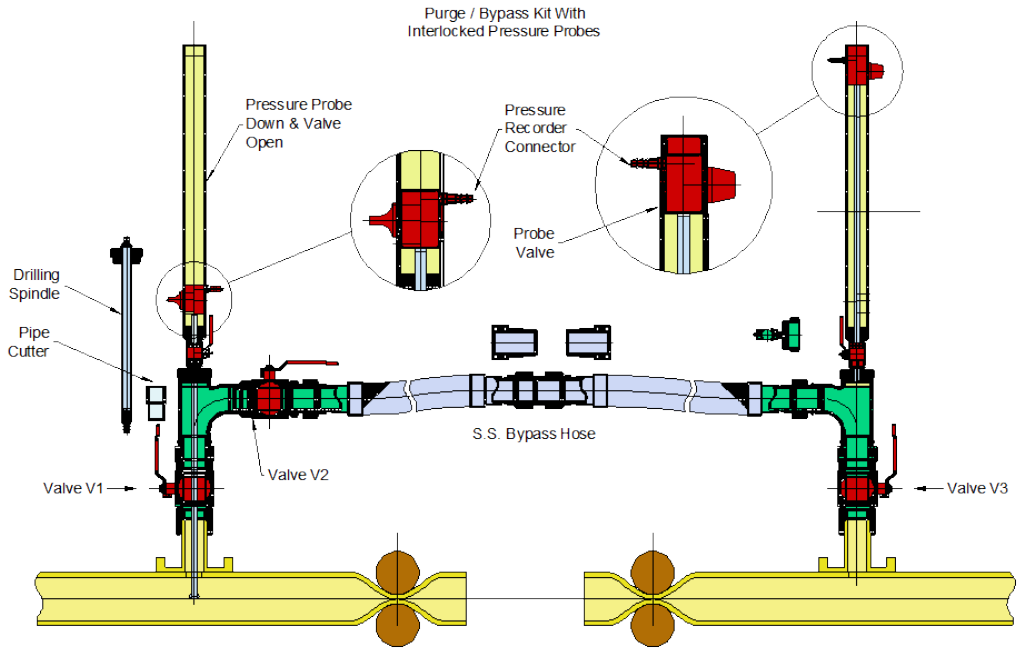


Figure 94- Bypass Kit with Integral Pressure Sensor

12. On successful completion of the pressure test connect the drill spindle assembly to the body and lowered through the open ball valve (V1 or V3) so that the hexagonal end is located into the integral punch cutter.
13. Hand tighten the assembly to create a seal.
14. Check Valve V2 is in the closed position.
15. Using a ratchet spanner on the ½" square drive at the top of the drill spindle, rotate in a clockwise direction until the main has been pierced completely through.
16. The manufacturers' instructions must be observed during the drilling of the main through the top tee.
17. Unscrew the drill spindle/cutter completely until it is free from the tee body threads, and then raise the drill spindle to its stop position.
18. Close ball valve (V1 or V3).
19. Repeat steps 12 to 17 on the other tee at the opposite end of the bypass location.
20. Detach the drill spindle with the cutter and pipe coupon.

BYPASS COMMISSIONING

1. Attach vent pipes to the top of the tee housings at V1 and V3 position.
2. Open the vent valve on the vent pipe at the V3 location to commence purging of the bypass.
3. Open valve V1 and purge until 2 successive readings of above 90% gas in air is obtained at the vent pipe above valve V3.
4. Close valve V1 then close vent valve located above valve V3.
5. Open vent valve on vent pipe located above valve V1.
6. Open valve V3 and purge until 2 successive readings of above 90% gas in air is obtained at the vent pipe above valve V1.
7. Close off vent valve and open Valve V1.
8. Bypass is now fully commissioned.
9. Remove the vent pipes and install the pressure probe assemblies to both ends of the bypass, ensuring the probes are in the up position.
10. Fit the pressure recording equipment to the pressure probe valves.
11. Open the pressure probe cap valves and lower the probe assemblies into the pipe to the position appropriate to the size of main.
    Note: V1 and V3 must be open to allow this operation.
12. Open the probe valves.
    Note: Only in the lowered position can the probe valves be opened to allow mains pressure to be passed to the recording equipment. The bypass is now in operation and flow stopping operation can now commence between the two tapping points.
13. After completion of the work on the main and removal of the squeeze-off tools, Test the main for obstructions by closing the downstream bypass valve (V3) and monitoring the up & down stream pressures.
14. If a significant drop in pressure is registered, then the bypass valve (V3) should be immediately reopened and the cause investigated.

EQUIPMENT REMOVAL

1. Having confirmed that the main is free from obstructions, the equipment can be removed.
2. Close and then raise both pressure probes.
3. Remove one of the pressure probe assemblies and replace with a vent pipe.
4. Close ball valves (V1 and V3) and depressurise the bypass hose by opening the valve on the vent pipe assembly.
5. Disconnect and remove the bypass hose,
6. Fit the protective caps to the union ends and replace in the equipment box.
7. Remove the remaining pressure probe assembly and close the pressure probe cap valves.
8. Refit and tighten the blanking cap assemblies to both branch outlets.
9. Remove the probe cap then refit the drill spindle assembly complete with the PE cutter and coupon to one of the ball valves (V1 or V3).

E8 Bypass with integral Pressure Sensor

10. Open the ball valve (V1 or V3) and lower the drill spindle to engage the cutter into the tee body.
11. Screw the cutter into the body and make sure that it has entered the main to plug the hole in the main.
12. Vent the headworks and check that the cutter has stopped the flow of gas.
13. Tighten the cutter down further if necessary to create a seal and recheck.
14. Disengage the drill spindle hexagon from the cutter and raise the spindle fully to the stop.
15. Remove the tool completely by unscrewing from the tee and refit the tee completion cap to the tee.
16. Check for soundness.
17. Repeat operations items 2 to 15 at the other ball valve location.
18. The operation is now complete and all equipment can be returned to its toolbox, make sure all thread protectors are refitted to bypass hoses and blanking caps to be sure threads are not damaged during storage.

F1 Anchorage

Anchorage refer to SGN/WI/DIS/4.2.2– Work Instruction for anchorage of systems operating up to 7 bar - Operatives

G1 Testing – Mains air pressure testing – Coils and Pipe strings for insertion

The Section details the procedure for the testing of coils for live insertion.

SITE AND PIPE PRECHECK BEFORE TESTING – PIPE COILS

The following checks must be made:

1. The PE pipe **MUST** be contained in a pipe coil trailer.
2. The PE coil **MUST** be fully banded whilst undertaking the pressure test.
3. If the pipe being tested is a partially used coil, the remaining banding must be in place otherwise it **MUST NOT** be tested.
4. **NO** mechanical fittings can be used on the pipe under test.
5. Warning signs advising that pressure testing is in progress **MUST** be placed at each end of the site.
6. This type of pressure test **MUST NOT** be undertaken in crowded locations. such as near schools, markets and halls.
7. Testing **MUST** always be conducted in an area cordoned off by secure fencing/barriers.
8. The same test instrument **MUST** be used for both (on & off) readings.

PROCEDURE – INTEGRITY TEST

1. Electrofuse caps to the pipe coil following guidance in Appendix C and D.
2. Electrofuse a small diameter tapping tee to a suitable location on the pipe coil to be tested. See guidance Appendix C and D.
3. Apply an air test of not greater than 40mbar to the pipe initially.
4. Allow 15mins to settle.
5. All joints must be tested immediately using an approved leakage detection solution, which must be washed off with clean water.
6. Take an initial reading.
7. Allow a further 15mins
8. Take a second reading
9. If the test is successful the dead insertion may proceed.
10. If a pressure loss is observed the pipe/fittings must be checked to locate the source of leak.
11. Once the source of the leak has been found and rectified the pressure test must be repeated.

ALTERNATIVE TEST METHOD FOR LIVE INSERTION OF PIPE GREATER THAN 180MM

The use of this method must be approved by the Operational Manager.

1. Insert the capped end of the pipe into the host main.
2. Make a Butt fusion connection to the next pipe.
3. After cooling debead and inspect the joint.
4. Securely attach a flexible stopper to the open end of the 2nd pipe.
   Note: The stopper must have a ½" purge point.
5. Insert half of the length of the 2nd string into the host main.
6. Monitor the purge point on the flexible cap with an approved gas detector.
7. Keep a record of the atmosphere tests.
8. If gas is detected retrieve the pipe and re-examine the joint.
9. Continue to add pipes and repeating steps 5 to 8.

PROCEDURE – STRENGTH TEST

1. If the pipe is to be live inserted and further testing is required.
2. Raise the air pressure in the pipe to 350mbar.
   Note: The pressure test duration is found in of Section G2***.***
3. A stabilisation period of 1 hour is required and no pressure loss is allowed.
   Note: Because there is temperature effect on the pressure test, due to direct sunlight, the pipe string/coil should be tested when the temperature will remain constant or protect the pipe by shrouding with a suitable cover.
4. If a pressure loss is observed the pipe/fittings must be checked to locate the source of leak.
5. Once the source of the leak has been found and rectified the repeat the pressure test.

G2 Testing – Mains air pressure testing – buried pipework

This Section details the methods that can be used to test mains up to 7 bar.

GENERAL

1. The testing of low-pressure mains up to and including 355mm diameter can be undertaken by the Operative.
2. Low Pressure mains above 355mm diameter and all medium and intermediate pressure mains must be undertaken by an Operational Manager
3. Your Operational Manager will confirm the need for an NRO/RO procedure for mains testing.
4. The effect of temperature and pipe 'creep' for MP PE pipes must be considered.
5. Allow a stabilisation period to permit creep expansion to diminish prior to the tightness test.
6. For pipework of MOP not exceeding 2bar, integrity must be proved by a combined strength and tightness pneumatic test.
7. For pipework of MOP exceeding 75mbar but not exceeding 7bar, the risk of a pipework failure (with the potential consequences associated with a sudden release of a large volume of air) should be assessed.
8. The assessment should consider such factors as location, pipework material, method of construction, quality control procedures, depth of cover applied to the pipework.
9. Resulting from the assessment, a hydrostatic strength test may be required, this must be completed before the pneumatic tightness test.

PREPARATION

1. The following factors must be considered before and during testing.
2. New welded steel and fused PE systems must not incorporate any flexible joints whilst pneumatic or hydrostatic pressure testing is being carried out.
3. Such joints are permitted for final connection purposes onto existing LP or MP systems only.

- Carefully select the location of pressure tests ends and test equipment, in order to minimise hazards resulting from a potential pipe or test fitting failure.
- All caps, bends, tees and other fittings on mains incorporating mechanical flexible joints must be restrained against movement. ***The Note: NRO/RO procedure should state the requirements for anchorage including the requirements for a permit to work. See GDN/PM/SCO/1.***
- Mains must not be subjected to any form of shock loading or work of any description whilst a pressure test is ongoing.
- Check the soundness of all testing equipment and eliminate leakage prior to testing.
- The full number of appropriate studs or bolts provided for test end flanges and under pressure-drilling equipment must always be used.
- Any studs or bolts with worn or damaged threads must be replaced.
- The same calibrated test instrument must be used for the initial, intermediate (where applicable) and final pressure readings.
- Do not wrap or paint flanged or screwed joints in the main prior to test.
- Never test against a closed valve.
- Do not proceed with pressurising the main until the conditioning time, (where applicable), test duration and acceptable pressure loss has been determined and is detailed within the NRO/RO procedure.
- All new mains, including diversions and alterations must be pressure tested.
- All new mains, including diversions and alterations must be physically isolated or spaded prior to pressure testing.

4. Precautions should be taken to make sure that items such as mobile phones and radios, are not operated near digital test instruments as the pressure readings may become erratic.

SUITABLE TEST GAUGES

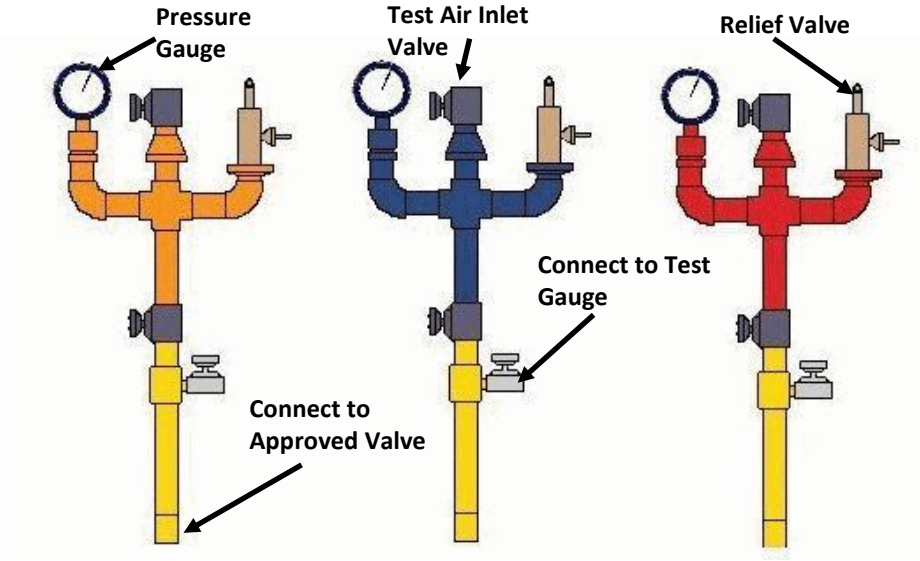
1. For Low Pressure, Medium and Intermediate Pressure, use a suitable calibrated electronic test instrument.
   Note: Suitable Gauges/instruments must have a range beyond the test pressure to allow for any over pressurisation and be accurate to less 3 mbar.
   Calibrated bourdon gauges are no longer accepted as testing gauges.
2. Only approved test instruments can be used for testing.

INSTALLATION OF STANDPIPES & PRESSURE GAUGES

1. Standpipes and gauges must be connected in accordance with

Low Pressure Orange	Medium Pressure Blue	Intermediate Pressure Red

   Figure 95 and the following must be carried out: -
   a. Standpipes must be located at all extremities of the new main and incorporate a relief valve set lift at a pressure 10% above the specified test pressure.
   b. Pressure test instruments must be installed so that they can be read and operated without entering the trench or standing in line with the end of the main.
   c. Pipe systems under test must be restrained against movement.
   d. For all fused systems, it is sufficient to backfill the pipe under test.
      Note: Test standpipes must be of all welded construction, have a current calibrated test certificate and be tested for soundness immediately prior to testing the pipeline or main.
   e. The test standpipe must comply with the appropriate specification and have a valid certificate or certification of calibration.
      Note: It must be tested for soundness and have the pressure relief device tested prior to testing the pipeline or main.
   f. Warning notices must be prominently displayed to warn that pressure testing is being carried out.
   g. Where pipework under test is left unattended an on-site risk assessment must be completed to check that no interference with the pipework or test standpipe can take place.



Low Pressure Orange	Medium Pressure Blue	Intermediate Pressure Red

Figure 95- Pressure Test Standpipes to GIS/TE/6.3

Note:The pressure gauge shown above is usually a dry bourdon gauge which is used to provide Indicative pressure within the main under test, it must not be used as the test instrument. Refer to 'Suitable test gauges'.

TEST REQUIREMENTS

1. Table 41 gives the requirements of the appropriate test specification for hydrostatic testing of mains and for pneumatic testing of mains.
2. The following must be checked before pressurising the main: -
   - To minimize the effect of temperature variation; the main under test must be backfilled as much as possible and if the effects of temperature are to be considered, this will be detailed in the NRO/RO procedure.
   - Both LP and MP mains must be maintained at 350mbar air pressure, post testing, if purging and commissioning is delayed.
   - Test the pressure relief valves on the standpipes to make sure that they are set to operate correctly.
   - All valves must be tested in the open position and sealed with a blank flange.
   - All persons on site must be briefed on the test process.
   - The same test instrument must be used for all the test readings.

TEST REQUIREMENTS FOR MAINS

1. Consider the impact and possible mitigation of the noise levels whilst pressure testing.
2. If a hydrostatic test is deemed necessary, then this can be undertaken in accordance with SGN/PM/MSL/1 Part 2.
   - Remember to account for Creep occurring in PE pipe.
   - Where creep allowances are to be applied it is important that the exact conditioning time is established by recording the time of commencing pressurisation and the time at which the first test reading is taken.
3. Conditioning time includes the effects of the 2h stabilisation period.
   Note: IP mains > 4.6bar MOP must also be hydrostatically tested to 1.5 times MOP, e.g. 5.5bar MOP to 8.25bar and 7 bar MOP to 10.5bar.

Installation	MOP (gauge)	Test pressure (gauge)	Test period	Maximum pressure loss
LP main	75 mbar	350 mbar	Minimum of 2 hours	5% of test pressure per hour
MP main	2 bar	3 bar		
IP main	4 bar	6 bar		
IP main	5.5 bar	8.25 bar		
IP main	7 bar	10.5 bar		

Table 41- Strength Tests on Mains – Hydrostatic

Note: For hydrostatic testing see SGN/PM/MSL/1 Part 2.

Table 42- Tightness Tests on Mains - Pneumatic

Installation	MOP (gauge)	Test pressure (gauge)	Test period (see Note 2)	Maximum pressure loss
LP main See Note 1	75 mbar	350 mbar	t= 0.3 x V t= 1.0 x V	3 mbar 10 mbar
MP main	2 bar	3 bar	t = 0.88xV	3 mbar
IP main	4 bar	6 bar	t = 0.84xV	3 mbar
IP main	5.5 bar *	7 bar	t=1.12xV	3 mbar
IP main	7 bar*	7 bar	t=1.75xV	3 mbar

Notes:

1. ***Where a formula is given, the required test period t is in hours, and V (the pipe internal volume) is required in m^3. To calculate V, use $V = \pi d^2 L/4$, where π = 3.142, d is the internal diameter (metres), L is the test length (metres).***
2. ***For PE note that SDR= outer diameter/wall thickness provides a simpler way of calculating the test period for common PE installation for PE80 and PE100 pipes at LP and MP.***
3. ***For all PE mains at MP there is an additional creep pressure drop allowance during the test period. This depends on the conditioning period before the test period, the pipe material and the test pressures. The Operational Manager will inform the Operative of this extra allowance.***

Mains Dia	LP SDR 11	LP SDR 13.6	LP SDR 17.6	LP SDR 21	LP SDR 26		MP SDR 11	MP SDR 13.6	MP SDR 17.6	MP SDR 21	MP SDR 26		IP SDR 11 4 bar	IP SDR 13.6 4 bar	IP SDR 17.6 4 bar	IP SDR 11 5.5 bar	IP SDR 11 7 bar	Mains Dia
55	0.0004	-	0.0005	0.0006	-		0.0014	-	0.0016	0.0017	-		0.0013	-	0.0016	0.0018	0.0028	55
63	0.0006	0.0006	0.0007	0.0008	0.0008		0.0018	0.0020	0.0022	0.0022	0.0023		0.0018	0.0019	0.0021	0.0023	0.0037	63
75	0.0009	0.0009	0.0010	0.0011	0.0011		0.0026	0.0028	0.0031	0.0032	0.0033		0.0025	0.0027	0.0029	0.0033	0.0052	75
90	0.0012	-	0.0015	0.0016	0.0016		0.0037	-	0.0044	0.0046	0.0048		0.0036	-	0.0042	0.0048	0.0075	90
110	0.0019	-	0.0022	0.0023	0.0024		0.0056	-	0.0066	0.0068	0.0071		0.0053	-	0.0063	0.0071	0.0111	110
125	0.0024	-	0.0028	0.0030	0.0031		0.0072	-	0.0085	0.0088	0.0092		0.0069	-	0.0081	0.0092	0.0144	125
140	0.0031	-	0.0036	0.0038	0.0039		0.0091	-	0.0106	0.0111	0.0115		0.0087	-	0.0102	0.0115	0.0180	140
160	0.0040	-	0.0047	0.0049	0.0051		0.0118	-	0.0139	0.0145	0.0151		0.0113	-	0.0133	0.0151	0.0236	160
180	0.0051	-	0.0059	0.0062	0.0065		0.0150	-	0.0176	0.0183	0.0191		0.0143	-	0.0168	0.0191	0.0298	180
200	0.0063	-	0.0074	0.0077	0.0080		0.0185	-	0.0217	0.0226	0.0236		0.0177	-	0.0207	0.0236	0.0368	200
213	0.0071	-	0.0083	0.0088	0.0091		0.0210	-	0.0246	0.0257	0.0267		0.0200	-	0.0235	0.0267	0.0417	213
225	-	-	0.0094	0.0098	0.0102		-		0.0275	0.0286	0.0298		-	-	0.0262	-	-	225
250	0.0098	-	0.0115	0.0120	0.0125		0.0289	-	0.0339	0.0354	0.0368		0.0276	-	0.0324	0.0368	0.0575	250
268	0.0113	-	0.0132	0.0138	0.0144		0.0332	-	0.0390	0.0406	0.0423		0.0317	-	0.0372	0.0423	0.0661	268
280	0.0123	-	0.0145	0.0151	0.0157		0.0363	-	0.0426	0.0444	0.0462		0.0346	-	0.0406	0.0462	0.0721	280
296	-	-	-	-	0.0176		-	-	-	-	0.0516		-	-	-	-	-	296
315	0.0156	-	0.0183	0.0191	0.0199		0.0459	-	0.0539	0.0561	0.0584		0.0438	-	0.0514	0.0584	0.0913	315
355	0.0198	-	0.0233	0.0243	0.0253		0.0583	-	0.0684	0.0713	0.0742		0.0557	-	0.0653	0.0742	0.1160	355
400	0.0252	-	0.0296	0.0308	0.0321		0.0740	-	0.0869	0.0905	0.0942		0.0707	-	0.0829	0.0942	0.1472	400
440	-	-	-	-	0.0388		-	-	-	-	0.1140		-	-	-	-	-	440
450	0.0319	-	0.0374	0.0390	0.0406		0.0937	-	0.1100	0.1146	0.1193		0.0894	-	0.1050	0.1192	0.1863	450
469	0.0346	-	0.0407	0.0424	0.0441		0.1018	-	0.1194	0.1244	0.1295		0.0971	-	0.1140	0.1295	0.2024	469
500	0.0394	-	0.0462	0.0482	0.0501		0.1157	-	0.1357	0.1414	0.1472		0.1104	-	0.1296	0.1472	0.2300	500
560	0.0495	-	0.0581	0.0605	0.0629		0.1451	-	0.1703	0.1774	0.1847		0.1385	-	0.1625	0.1847	0.2885	560
630	0.0626	-	0.0734	0.0765	0.0797		0.1836	-	0.2155	0.2246	0.2337		0.1753	-	0.2057	0.2337	0.3652	630
710	0.0795	-	0.0933	0.0972	0.1012		0.2332	-	0.2737	0.2852	0.2969		0.2226	-	0.2613	0.2968	0.4638	710
800	0.1009	-	0.1184	0.1234	0.1285		0.2961	-	0.3475	0.3621	0.3769		0.2826	-	0.3317	0.3769	0.5889	800

Table 43- Test Period Table for PE 80 & PE 100 on LP, MP & IP Mains

Note: Highligthed values correspond to examples 1 to 3 on page G. 5.

Example 1:
To calculate the test period, using a calibrated electronic test gauge, for a 350m length of 90mm diameter LP SDR 17.6 PE main.
From Table 42 test period = 0.3 x Volume.
From Table 43 multiply 0.0015 x 350 = 0.525 hours
To convert hours to minutes multiply the decimals by 60 and round down, 0.525 x 60 = 31.5 minutes = 31 minutes.
Therefore, test duration is 31 minutes.
Refer back to for maximum permitted pressure loss, which is 3mbar in this case.

Example 2:
To calculate the test period, using a calibrated electronic test instrument, for a 250m length of 180mm diameter LP SDR17.6 PE main.
From Table 42 test period = 0.3 x Volume.
From Table 43 multiply 0.0059 x 0.250 =1.475
To convert 0.475 hours to minutes multiply the decimals by 60 and round down, 0.475 x 60 = 28.5 =28 minutes.
Therefore, test duration is 1 hour and 28 minutes.
Refer back to for maximum permitted pressure loss, which is 3mbar in this case.

Example 3:
To calculate the test period, using a calibrated electronic test instrument, for a 250m length of 400mm diameter MP SDR21 PE main.
From Table 42 test period is 0.88 x Volume.
From Table 43 multiply 0.0905 x 250m length = 22.625 hours
To convert the 0.625 hours to minutes multiply the decimals by 60 and round down, 0.625 x 60 = 37.5 = 37 minutes.
Therefore, test duration is 22 hour and 37 minutes.

Refer back to for maximum permitted pressure loss, which is 3mbar in this case plus an additional creep pressure drop allowance that will be calculated by the Operational Manager.

Nominal Mains Dia	LP 75 mbar	MP 2 bar	IP 4 bar	IP 5.5 bar	IP 7 bar
2" (50mm)	0.0006	0.0018	0.0017	0.0023	0.0036
3" (75mm)	0.0015	0.0043	0.0041	0.0055	0.0086
4" (100mm)	0.0025	0.0074	0.0071	0.0094	0.0147
6" (150mm)	0.0058	0.0171	0.0164	0.0218	0.0341
8" (200mm)	0.0100	0.0295	0.0281	0.0375	0.0586
10" (250mm)	0.0160	0.0469	0.0447	0.0597	0.0932
12" (300mm)	0.0228	0.0670	0.0639	0.0853	0.1332
16" (400mm)	0.0359	0.1054	0.1066	0.1341	0.2095
18" (450mm)	0.0458	0.1344	0.1283	0.1711	0.2673
24"(600mm)	0.0831	0.2439	0.2328	0.3104	0.4850
30" (750mm)	0.1301	0.3816	0.3642	0.4856	0.7588
36"(900mm)	0.1867	0.5478	0.5229	0.8972	1.0893
42" (1050mm)	0.2556	0.7499	0.7159	0.9545	1.4914
48" (1200)	0.3339	0.9795	0.9350	1.2467	1.9479

Table 44- Test Period for Steel Mains – ***Highlighted value used in example 4***

Example 4:
To calculate the test period, using a calibrated electronic test instrument for a 520m length of 8" diameter steel main to operate at 4 bar.
From Table 42 test period is 0.84 X Volume.
From Table 44 multiply 0.0281 X 520 = 14.612 hours.
To convert the 0.612 hours to minutes multiply the decimals by 60 and round down, 0.612 x 60 = 36.72 = 36 minutes. Therefore, test duration is 14 hours and 36 minutes. Refer back to for maximum permitted pressure loss, which is 3mbar in this case.

PRESSURISATION OF MAIN

1. Examine flexible pipes, hoses and their connections prior to use. They must be in good condition, secured and anchored by a secondary restraining device, (whip check) to prevent movement as a precaution in the event of failure.
2. A visual check must be carried out before pressurisation to check that the pipe under test is secure.
   Important: DO NOT allow any person to enter the designated test area or interfere with the pipe work whilst the pressure is being raised.
3. A Competent Operative must on site at the pressurising point during the pressurisation period to make sure that the necessary safety requirements are met.
4. A single or twin tool compressor (80cfm to 100cfm) with an inline filter or a foot pump is adequate for pressurising most pipe systems.
5. Introduce air under controlled conditions into the main until the appropriate test pressure as given in is reached.
6. Do not over pressurise the main.

PRESSURE TEST

1. Allow the temperature of the air in the main to stabilise before the test period is commenced.
2. For metallic mains and low-pressure PE mains, this will normally occur within 2 h, and will be indicated by a stable pressure reading.
3. For Medium Pressure PE mains, the effects of creep must be considered and the conditioning time allowed as specified by your Operational Manager.
4. Test all exposed mechanical joints on the test standpipe connections to the mains testing equipment for leakage with an approved leak detection fluid.

   Important: DO NOT ALLOW ANYONE TO ENTER EXCAVATIONS WHERE THE TESTING OF PIPEWORK IS IN PROGRESS.
5. Once the temperature stabilisation has taken place, record the initial pressure reading.
6. For PE mains at MP (where the effect of creep is considered) the first test readings must be taken at the end of the conditioning period.
7. Take a further pressure reading at the end of the test period.
8. Where the test period is of a long duration pressure (such as over 24 hrs), your Operational Manager may specify intermediate pressure readings.
9. This enables the test to be assessed and aborted at an early stage if there is an indication that the test will ultimately fail.
10. The test certificate must be completed by either the Operative or Your Operational Manager (or nominated person).
11. The person responsible for the pressure test must be on site at the end of the test to witness de-pressurisation, and this must be recorded on the test certificate.

TEST FAILURE

1. Where the pressure loss is greater than the allowable pressure drop, allowing for any variation in barometric pressure and the effects of creep (in PE systems), inform your Operational Manager.
2. An investigation to find the source of the leakage will be carried out.
3. You must reduce the test pressure before carrying out an examination of the pipe work.
4. All exposed connections, plugs and external fittings must be re-examined for possible leakages by leak detection fluid.
5. Care must be taken to undertake any repairs with the appropriate tools without applying excessive force.

6. Where no obvious cause can be found to a pressure test failure and the test conditions have not altered, Your Operational Manager can decide to extend the test.
7. If the test is restarted use the final or an intermediate test reading as the starting point for the new test period.
8. If the mains pressure had been reduced, then the main must be re-pressurised to the test pressure and test procedure carried out as above.
9. Where an MP PE main is to be retested following de-pressurisation, it must remain at atmospheric pressure for a minimum of three hours prior to re-pressurisation, to allow creep from the original test to relax.
10. Ask your Operational Manager to recalculate the creep allowance for the retest from the appropriate table.
11. Where a test has failed, further investigations using tracing techniques or sectioning of the main may be approved by your Operational Manager.

DE-PRESSURISATION OF MAIN

1. When the pressure test has been passed, the air pressure should be released in a controlled manner through the test standpipe vents as follows: -
2. Open the vents on the pressure test standpipes or vent pipe situated on the extremities of the main until atmospheric pressure within the main is achieved.
3. This makes sure that the entire system under test has been included in the test.
4. Due to the noise of the venting air, ear protection may be required.
5. Measures must be taken to minimise noise generated during de-pressurising and its impact of the public.
6. Confirm, by checking the gauges installed at all extremities, that the pressure within the whole of the main has been reduced to atmospheric.
7. The Competent Operative responsible for the pressure test must record this information on the test certificate before authorising further construction work to proceed.

TEST RECORDS

1. The test certificate must be completed and passed to your Operational Manager and placed in the project file on completion of the works.

G3 Testing – Hydrostatic Pressure Testing

This section outlines the requirements for Hydrostatic testing for more details see SGN/PM/MSL/1 Part 2.

1. Hydrostatic pressure testing may be used for the proving of MP mains, where a risk assessment has identified that a pneumatic test presents unacceptable risks.
2. The hydrostatic pressure test is a proving test applied prior to a pneumatic pressure test that demonstrates the mechanical integrity of a main, requiring the system under test to be filled and pressurised with water.
3. The application of this test should also allow significant leakage to be identified.
4. The appropriate test certificate for hydrostatic testing must be completed and passed to your Operational Manager or returned in the project file on completion of the works.
5. Your Operational Manager will determine if there is a requirement for a hydrostatic test.
6. Hydrostatic testing is covered in SGN/PM/MSL/1 Part 2.

G4 Testing – Advanced (Acoustic) Pressure Testing - APT

This section outlines the requirements for APT testing for more details see SGN/PM/MSL/1 Part 2.

1. The use of APT can significantly reduce test durations for medium pressure mains with large volumes.
2. The APT technique uses a loudspeaker to send out a sound wave in the pressurised main, from which an echo is received by a microphone.
3. A computer attached to the microphone calculates the pressure drop curve against that of a predicted creep and leak curve.
4. From this information a pass or fail result is obtained.
5. The application of APT methods can be found in SGN/PM/MSL/1 Part 2.
6. The test information from the computer must be printed and passed to your Operational Manager and placed in the project file on completion of the works.
7. Your Operational Manager will determine if there is a requirement for APT testing.
8. APT testing is covered in SGN/PM/MSL/1 Part 2.

PRESSURE TESTING OF FITTINGS & EQUIPMENT - GENERAL REQUIREMENTS

The test volume of branch saddles is small in comparison to testing pipes. Experience has shown that the pressure can fluctuate by up to 25mbar due to temperature and creep effects.

The pressure test can be undertaken with or without the drilling machine connected.

A permit to work, Routine or Non-Routine operations may be required for testing operations. Seek guidance from your Operational Manager

1. You may test the branch connection with the drilling machine as one operation. If so you must complete the parts of Sections D1 and D2 for connecting the drill below before continuing.
2. You must make sure that all personnel engaged on testing work, or any work associated with testing, are aware of the possible consequences of the fitting failing under test pressure conditions.
3. You must take all necessary precautions:
   - before pressurisation;
   - during pressurisation;
   - during depressurisation and before dismantling the equipment;
   - after depressurisation and during dismantling the equipment.
4. Restrain and support all fittings and associated equipment against movement during the test.
5. The full number of appropriate studs or bolts provided for blanking flanges must always be used.
6. Before pressurisation commences make a final visual check that the test section is secure.
7. Prominently display near the excavation warning notices that pressure testing is in progress.
8. Whilst the pressure is being raised no unauthorised person must enter the test area or interfere with the pipe work.

	Pressure test regimes	Test pressure	Test Instrument	Stabilisation time	Test Period	Pressure loss due to instruments (maximum)
1	LP Under pressure tee	350 mbar Air	Electronic tester	10mins	15mins	Nil
2	MP Under pressure tee	3 bar Air		10mins	15 mins	
3	IP Under Pressure tee	1.5 X MOP Nitrogen		10 mins	15 mins	

Table 45- Pressure Test Period for Under Pressure Tees and Branch Saddles

Note: The same equipment should be used for test on and off readings.

PRESSURE TEST PROCEDURE.

1. The valve, if part of the installation must be left in the open position.
2. Fit test flange and testing assembly to outlet of valve.
   Note: The test standpipe must incorporate a pressure relief set to operate at 10% above the test pressure.
3. Pressurise using a hand or foot pump into the fitting through apparatus attached to the under-pressure tee / branch saddle or the drilling machine attachment.
   Note: An air compressor must not be used due to the potential to over pressurise.
4. The pressure in the installation should be increased to 350 mbar for LP mains and 3bar for MP mains.
5. On MP/IP mains the air/nitrogen should be introduced in 0.5 bar increments.
6. Test the fitting with an approved leak detection fluid to provide an early indication if the fitting is leaking.
7. Wash the fitting with clean water after using leakage detection fluid.

G5 Testing – Metallic Under Pressure Tees and PE Branch Saddles

8. The connection to the branch saddle or drilling machine must be isolated, and a stabilization period in accordance with Table 45 must be allowed.
   Note: Covering the installation will minimise the effects of temperature.
9. Take precautions to be sure that items such as mobile telephones and radios are not operated near digital test instruments, as the pressure indications may become erratic.
10. After the stabilisation period in Table 45, take the first reading using approved test instrument.
    Note: During the pressure test no person must be in the excavation.
11. After the test period duration (15 minutes) has elapsed take a second reading using the same test instrument.
12. There should be no loss in pressure see Table 45.
13. If the test is passed you can commence fitting the drilling equipment, Mechanical under pressure tee Section D1, or PE branch saddle drill Section D2.
14. If the test is unsuccessful try to determine the cause and if possible rectify the leakage.

LET BY VALVE TEST

1. If a valve is fitted, initial let by test on the valve must be conducted after the under-pressure fitting, valve and machine has been pressure tested.
2. Close the valve and release the test pressure between the valve and the test flange or drilling machine in a controlled manner.
3. Check that the gauge is reading zero and watch the pressure for 1 minute.
   Note: There must be no increase in pressure on the gauge.
4. If there is an increase in pressure on gauge, the valve is passing.
5. The valve must be opened and shut to check that there is no debris in the valve housing and the 'let by test' must be repeated.
6. Further investigations on the valve housing must be made.
7. If the valve cannot hold a 'let by test' then the valve must be replaced with another valve and the whole pressure test process and let by test repeated.
8. On completion of a successful pressure and let by test open the valve and release the pressure in a controlled manner.
9. Recheck the valve opens and closes correctly.
10. The results of the test must be recorded on a test certificate and passed to your Operational Manager.
11. Remove the test apparatus and fit a blank flange to the branch saddle outlet unless the drilling operation is to begin immediately.
12. For MP and IP mains, the blank flange must incorporate a pressure relief facility.

INCONCLUSIVE PRESSURE TEST - BRANCHING SADDLE ONLY

1. If the pressure drop is greater than the maximum allowed, the test must be repeated with a longer test time of 30minutes.
2. The pressure drop must not exceed 25mbar.

FAILED PRESSURE TEST - MECHANICAL UNDER PRESSURE TEES

1. If leakage is detected from the installed fitting then the fitting must either be refitted, joints/bolts tightened or the fitting replaced.
2. If the leakage is evident from another source the drilling machine, then this must be rectified and another pressure test undertaken.

FAILED PRESSURE TEST –BRANCH SADDLE TEES

1. If leakage is detected from the installed fitting, then the fitting must not be used.
2. **DO NOT REHEAT PE FITTINGS**.
3. The fitting must be left in place and the spigot must be cut near the base of the branch saddle to prevent any future connection onto the fitting.
4. If the leakage is evident from another source such as flanges or drilling machine, then this must be rectified and another pressure test undertaken.

H1 Commissioning & Decommissioning – Commissioning by Direct Purging

This section details the commissioning of mains by Direct Purging 7 bar maximum operating pressure, by using direct purging. For the re-commissioning of pipes which have been flow stopped refer to Section H3.

INTRODUCTION

1. Direct purging of new mains systems can be undertaken by one of the following methods:
   a) Use of a suitably sized rider and purge vent pipe(s)
   b) Release of squeeze off equipment and purge vent pipe(s)
   c) Opening of double block and bleed valves and purge vent pipe(s).
   d) Opening of double block and bleed systems, for example a single faced valve and squeeze off with a intermediate vent.

   Damper plates and slide valves are not classed as valves for the purposes in c) and d) above.

   Commissioning of new pipelines and mains by the deflating and removal of bags is forbidden.

   However, when making up final tie in connections between existing systems and new PE/steel mains that have already been commissioned it is acceptable for a pair of semi supported bag stops with an intermediate vent to be used for isolation to permit the commissioning of the tie in section using a purge rider or release of squeeze off.
2. The length of such commissioning operations should be kept as short as reasonably practicable.
3. Where such lengths exceed 10m a Senior Operational Manager must give their authority as the risk of bag failure creating a large gas/air mixture within the main needs to be risk assessed.

   Note: Commissioning of pipelines and mains using a purge ejector is forbidden.
4. New mains can only be commissioned after a successful pressure test and completion of the test certificate.

   Under exceptional circumstances following an emergency situation existing mains and services may be re-commissioned without pressure testing; a Senior Operational Manager must carry out a suitable and sufficient risk assessment.

   This is to determine the need for a post-commissioning flame ionization detection (FID) survey taking place following re-commission.

   This must consider the construction and operating conditions of the gas system, (material, diameter, joint type, operating pressure) its leakage history, presence of cellars or underground voids, vicinity of occupied properties, position of the main and the amount of open ground, number of customers connected, type of customer, such as domestic/industrial/commercials and whether they are in multi occupancy premises.

   Pipelines and mains that have been hydrostatically pressure tested should be dried before commissioning to prevent the formation of ice at pressure reducing stations, or the formation of hydrate in the system.
5. Where a Non Routine Operation or Routine Operation procedure is required for the operations it must be available on site.

SAFETY

1. The new main must either:
   a) be physically disconnected from the feeder / parent main or
   b) it can be physically connected provided the new main remains isolated from the live gas supply in one of the following ways:

- Low pressure PE mains not greater than 180mm diameter or Medium Pressure PE mains not greater than 63mm can be isolated by a single squeeze-off if the isolation is sound and verified by a let by check.
- The branch of an under-pressure tee with a maximum branch outlet of up to and including 6”/355mm/300mm on LP/MP mains can be isolated by a single face valve if the isolation is sound and verified by a let by `check.
- Other mains must be isolated from the parent main by a double block and bleed system.
- This system may be a valve with a double block and bleed facility or
  - alternatively, a double squeeze-off system with intermediate vent.
  - stopple equipment with a secondary bag with intermediate vent (the secondary bag and intermediate vent is subsequently removed prior to the commissioning operation (refer to specific stopple procedure for details)

2. Complete a risk assessment to assess the possible noise levels generated during commissioning. The effects on the surrounding environment must be identified and stipulate any precautions to be taken.
3. Hearing protection must be available and used by all operational personnel as required by the risk assessment.
4. Consider the strength and direction of the prevailing wind and take action to prevent the purged gas entering building or areas of public assembly, where possible ignition sources may exist.
5. Venting gas in populated areas or on major transport routes may give rise to increases reported Public Reported Escapes. Consider increasing the height of vents, additional signage or decanting gas into other mains to mitigate this issue.
6. Display NO SMOKING signs and check that no smoking, naked lights or other sources of ignition are present,
7. Maintain vigilance to make sure that no Operatives or members of the public contravene the ‘No Smoking’ instruction.
8. Position fire extinguishers on site and ready for immediate use.
9. All riders and vent pipes must be manned throughout live operations.

PREPARATORY WORK - PURGE VELOCITY

1. To avoid a mixture of air and gas in the purging operation the purge velocity must always be above the minimum velocities shown in Table 46.
2. You will not be required to measure velocity provided the riders and vents are constructed with full bore fittings to the sizes detailed in Table 46.
3. The table shows PE pipe rider and purge vent pipe(s) diameters; these are substituted for equivalent steel pipe diameters as necessary.
4. All purge vent pipes must be of metallic construction.
5. Purging operations can be undertaken with the controlled release of the squeeze-off where squeeze-off units can be set to open at the minimum distances shown in Table 46.
6. Where this cannot be achieved, then you must rider over the squeeze-off.
7. The NRO/RO procedure will confirm the rider diameters to maintain the minimum purge velocities and flow rates.
8. The Operational Manager will confirm when the commissioning of the main must be carried out by indirect purging.
9. The purge duration in seconds must be stated in the NRO/RO procedure. ***Note: Duration is calculated by dividing the length of the main by the typical purge velocity.*****Once a purge has started, it must continue without interruption until completed.**

Nominal pipe diameter or metric equivalent diameter	Recommended rider and vent diameters (mm) for riders inlet pressures of					Minimum distance for release of squeeze-off from the fully closed position (mm)
	21 mbar	30 mbar	75 mbar	350 mbar	2 bar	
0-150mm (0-180mm PE) (0-6in)	32	32	32	32	32	15
151-200mm (8in)	63	63	63	32	32	15
201-250mm (10in)	63	63	63	63	63	30
251- 301mm (12in)	63	63	63	63	63	30
301-450mm (18in)	90	90	90 (2X63)	63	63	45
451-600mm (24in)	180	180 (2X125)	125 (2X90)	90 (2X63)	63	60 see Note1
601 -900mm (36in)	180	180 (2X125)	180 (2X125)	125 (2X90)	90 (2X63)	-
901 – 1200mm(48in)	250	250 (2X180)	250 (2X180)	180 (2X125)	90 (2X63	-

Table 46- Commissioning Mains by Direct Purging

Note 1: Squeeze-off equipment is not currently available for above 500mm diameter.

Flow rates are a minimum of velocity of 0.6 m/s and Min Flow rate 0.7 m^3/min.

COMMUNICATIONS AND EXTERNAL LIAISON

1. Establish a suitable system of communication.
2. The person in charge must be able to communicate with personnel operating the purge vents pipe(s) and riders.
3. Test the communications prior to starting.

   Notes:

   The system must be able to overcome any noise generated through the commissioning operation.

   All Communication systems used within the work area must be intrinsically safe.

   If the equipment is not intrinsically safe, such as mobile phones, the equipment can only be used outside of the designated hazardous areas at least 5m upwind of any possible source of purging gas.
4. For major purging operations your Operational Manager will inform the necessary authorities and this will be recorded on the NRO procedure.
5. For all purging operations, you should advise residents that purging is being undertaken and advise them in respect to noise, smell and fire hazard.
6. Where necessary, request residents to close windows and doors during purging operation.

BRANCHED SYSTEMS

1. Branched systems may be directly purged either simultaneously or sequentially.
2. Loops must be isolated by valves or stopping off equipment (squeeze-offs) and then treated as branches.
3. Short stubs, whose length is less than eight diameters, are not classed as branches and will automatically be purged by natural convection.

SEQUENTIAL PURGING

1. Sequential purging involves purging each branch in turn.
2. Start with the largest diameter branch.
3. Sequential purging must be used if the minimum velocities cannot be achieved in each branch during simultaneous purging.

SIMULTANEOUS PURGING

1. Simultaneous purging is quicker than sequential purging.
2. Purge vents must be opened all together and purging all the branches at the same time.
3. Where branches are to be purged simultaneously the riders and purge vents must be sized for a pipe diameter equivalent to the sum of the cross-sectional areas of all the pipes being purged.
4. Your Operational Manager will advise you when simultaneous purging is to be carried out and will prepare the calculations.
5. Calculations must be stated in the authorised NRO/RO procedure.

RIDERS

1. An on-site risk assessment must be carried out to determine the construction and location of the rider. (See Section EO – Bypasses and Riders.
2. The NRO/RO should detail the materials from which the rider is to be constructed determined by the risk assessment.
3. For purging MP mains, a governed rider operated by a competent person may be used to bring the main up to the operating pressure in stages.
4. This will enable testing of the final tie-in connections with leak detection fluid a lower pressure.
5. Riders must: -

- Be constructed from metallic tube, approved flexible steel pipes, PE or a combination of those.
- Be no more than 14m in length.
- Have no more than six bends.
- Use full bore valves.
- Have connections to the main that are full bore (typically purge tees or saddles.

  Note: Service tapping tees should not be used.
- The vent point on the rider must be metallic and have an earthing strap.

6. The rider must be tested for soundness by applying leak detection fluid to all exposed joints.

PURGE VENTS PIPES

1. Prior to starting work, an on-site risk assessment must carried out, this must identify the potential impact on the environment of:

- noise
- the purge vent location
- the possibility of mechanical damage
- interference or fire hazard

2. The choice of location must also consider wind speed and direction

- potential for contact with areas of public assembly,
- open fires or other possible ignition sources,
- major transport routes
- flight paths.
- The prevention of vented gas is drifting into buildings through air intake grilles, air conditioning units, open doorways and windows.

3. Purge Vent pipes must be fitted at the far end of the main to be commissioned and must be manned whilst venting.
4. Purge Vents must be: -
   - Constructed from metallic tube or approved flexible steel pipes.
   - Include a full-bore control valve and a sample test point.
   - Connected to the pipeline or main with a full-bore fitting.
   - The vent must be adequately supported and sited a minimum of 2.5 m above ground level and a minimum of 5.0 m downwind of any ignition source.
   - Be adequately earthed if connected to a PE main to prevent the build-up of static electricity in plastics pipes.
   - Adequate protection must be given for the public within the designated hazardous areas, at least 5.0m upwind of any vent.
5. Purge vents must not include a flame trap.

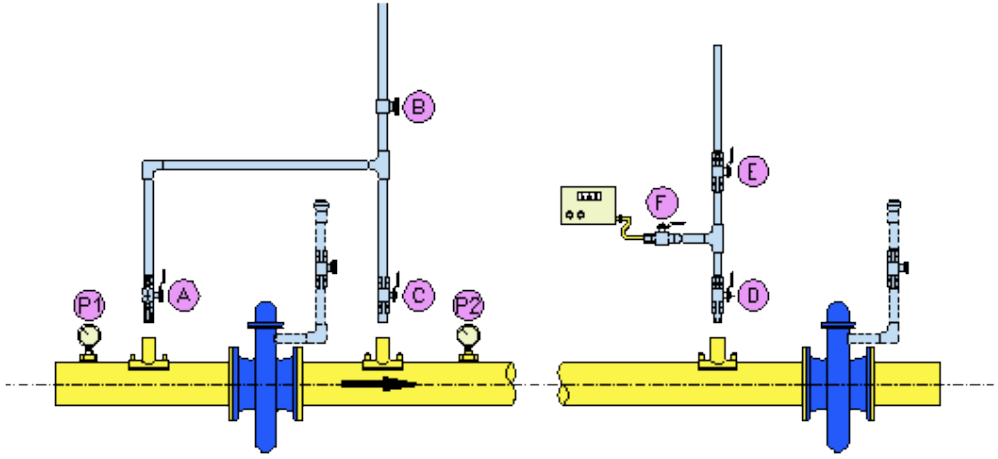


Figure 96- Direct Purge - Block and Bleed System

Note: Valve shown may be replaced by other block and bleed systems.

COMMISSIONING PROCEDURE USING A RIDER (SEE FIGURE 96)

1. Confirm that the valve or other isolation method is sound.
2. Open the intermediate bleed vent pipe.
3. Fit rider and purge vent pipes see Figure 96.
4. Check that valves A, B, C, D, and E in the closed positions.
5. Fit pressure points P1and P2.
6. Check that P1 indicates pressure greater than minimum stated in the authorised NRO/RO.
7. If P1 is lower than the minimum allowed, then stop operations and advise your Operational Manager.
8. Establish communications between personnel at rider and purge vent pipe(s) position(s).
9. Partially open rider valve A
10. Open Valve B and purge until two consecutive readings are confirmed at vent B.
11. Close valve B and fully open valve A to pressurise rider.
12. Check the all joints for soundness with leak detection fluid.
13. Open vent valves D and E.
14. Continually monitor P1 and fully open rider valve B commencing purge.
15. If the pressure at P1 drops below the minimum stated in the NRO/RO close rider valve A and report this to your Operational Manager.
    Note: A commissioned rider must not be left unattended.
16. Continue venting until the expected time for purging has passed.
17. Open Valve F on the purge vent pipe and continue purge until two successive readings above 90% gas in air (GIA) is obtained at the vent.
    Note: If the purge velocity fluctuates at the purge vent point as the purge is in progress this could indicate a blockage within the main. Do not stop the purge in such cases. On completion of the purge close Valve D and attach a suitable pressure gauge to Valve E. Turn on Valve D and monitor the pressure in the main. Where the pressure oscillates inform your Operational Manager.

18. Close purge vent valves D, E and F.
19. In the case of branch systems, close each purge vent pipe(s) when two successive readings above 90% gas in air (GIA) is obtained at that vent.
20. Pressurise the new main equal that at P1.
21. For MP systems the main should be taken up in stages therefore a governed rider is required to pressurise the new main.
22. Check pressures at the extremities by attaching a suitable pressure gauge to valve F and then open valve D to confirm that the pressure has equalised in the new main with that in the existing source main, then close valves D and F.
23. Check exposed sections with approved leakage detection fluid and washed off with clean water.
24. Should leakage be detected the pressurisation must be stopped until the cause of the leakage has been rectified.
25. Once P1 and P2 are equalised close the intermediate bleed vent pipe.
26. Slowly open the main line valve or remove isolation equipment.
27. Close rider valves A and B and decommission the rider and purge vent pipe(s) points.
28. Make sure all tappings are correctly plugged/sealed off.
29. Check all plugs/seals for soundness with approved leak detection fluid and wash off with clean water.
30. Where necessary apply corrosion protection.

COMMISSIONING USING AN IN-LINE DOUBLE BLOCK AND BLEED VALVE UP TO 250MM DIAMETER. (SEE FIGURE 97)

1. Follow steps in the procedure for commissioning using a rider from step 1 to step 8 .
2. Open Valve D and E.
3. Whilst monitoring P1 partially open the in-line valve in accordance with the manufacturers guidance for diameter and mains operating pressure to commence purging operation.

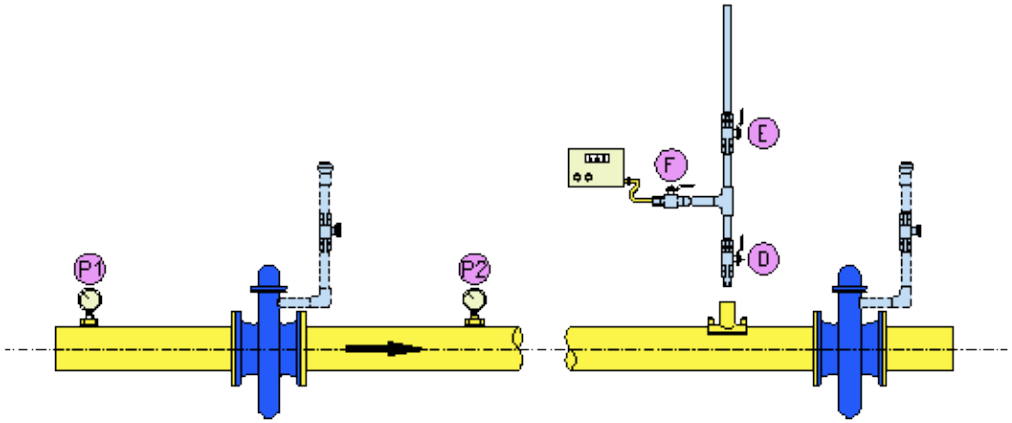


Figure 97- Direct Purge - Using Valve (up to 180mm)

Note: Purge rider is not present

4. Continually monitor P1 during purge to be sure that it does not fall to less than the minimum stated in the NRO/RO.
5. If pressure drops to the minimum pressure at P1, close in-line valve and report this to your Operational Manager.
6. A valve used for commissioning must not be left unattended.
7. Follow steps in the procedure for commissioning using a rider from step 16 to step 25.
8. Close purge vent valves C, D, and E.
9. Once P1 and P2 are equalised completely open the in-line valve.
10. Close purge vent valves C, D, and E.
11. Once P1 and P2 are equalised completely open the in-line valve.
12. Close purge vent valves C, D, and E.
13. Once P1 and P2 are equalised completely open the in-line valve.
14. Close purge vent valves C, D, and E.
15. Once P1 and P2 are equalised completely open the in-line valve.

16. Close purge vent valves C, D, and E.
17. Once P1 and P2 are equalised completely open the in-line valve.
18. Decommission and remove purge vent pipe(s).
19. Check all tappings are correctly plugged/sealed off.
20. Check all plugs/seals for soundness with approved leak detection fluid and wash off with clean water.
21. Where necessary apply corrosion protection.

NOTE:
For operations using Stopples and IRIS Stop equipment refer to separate specialist techniques in ***SGN/PM/MSL/1 Part 2.***

H2 Commissioning & Decommissioning – Commissioning by Direct Purging – using squeeze offs

This section details the commissioning of Low pressure mains up to 180mm and medium pressure mains up 63mm by the release of a single squeeze off.

PROCEDURE USING SINGLE SQUEEZE OFFS

1. Confirm that the squeeze off isolation is sound.
2. Fit purge vent pipe(s) as shown in Figure 98.
3. Check that valves C, D, and E are in the closed positions.
4. Fit pressure points P1and P2
5. Check that P1 indicates a pressure greater than the minimum allowed in the authorised NRO/RO procedure.

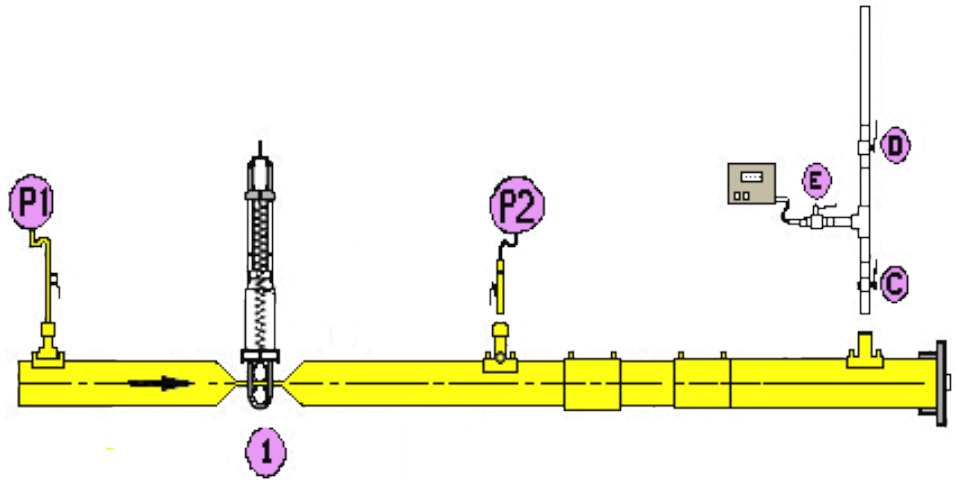


Figure 98- Commissioning by Release of Single Squeeze Off

Note: A rider may be used as an alternative method

6. If P1 is lower than the minimum stated in the NRO/RO inform your Operational Manager.
7. Confirm adequate communications between personnel at the squeeze off location and purge vent pipe(s) position(s).
8. Open purge vent valves C and D.
9. Whilst monitoring P1 remove safety stops and release squeeze off a minimum of 15mm from the fully closed position to commence purging operation.
10. Continue to monitor P1 during purge to make sure that it does not fall to less than the minimum stated in the NRO/RO.
11. If pressure drops to below the minimum pressure at P1, apply squeeze off and safety stops and report this to your Operational Manager. **A squeeze off unit used for commissioning must not be left unattended.**
12. Continue venting until the expected time for purging has passed and then open Valve E on the purge vent pipe and continue purge until two successive readings above 90% gas in air (GIA) is obtained at the vent. ***Note: If the purge velocity fluctuates at the purge vent point as the purge is in progress this could indicate a blockage within the main. Do not stop the purge in such cases.***
13. On completion of the purge, close Valve C and attach a suitable pressure gauge to Valve E.
14. Turn on Valve C and monitor the pressure in the main.
15. If the pressure oscillates inform your Operational Manager.
16. Close purge vent valves C, D, and E.
17. Where you are purging branch systems, close each purge vent pipe(s) when two successive readings above 90% gas in air (GIA) is obtained at that vent.
18. Pressurise the main to the pressure at P1.

19. Check pressures at the extremities by attaching a suitable pressure gauge to valve E and then open valve C to confirm that the pressure has equalised in the new main with that in the existing source main, then close valves C and D.
20. Exposed sections must be checked with approved leakage detection fluid and the leak detection fluid washed off with clean water.
21. Should leakage be detected stop the pressurisation until the cause of the leakage has been rectified.
22. Once P1 and P2 are equalised completely release the squeeze off unit.
23. Decommission and remove purge vent pipe(s).
24. Plug and seal all tappings.
25. Check all plugs/seals for soundness with approved leak detection fluid and wash off with clean water.
26. Where necessary apply corrosion protection.
27. Remove squeeze off unit and apply re-rounding clamp for a period of 10 minutes, following which remove clamp and apply 'squeeze off applied' tape.
28. Complete NRO/RO procedure, tidy site.

PROCEDURE USING DOUBLE SQUEEZE OFFS

1. Confirm that the squeeze off isolation is sound and that the intermediate vent is open.
2. Fit purge vent pipe(s) in accordance with Figure 99.
3. Check valves C, D, and E in the closed positions.
4. Fit pressure points P1 and P2.
5. Check that P1 indicates pressure greater than the minimum stated in the authorised NRO/RO procedure.
6. If P1 is lower than the minimum stated in the NRO/RO inform your Operational Manager.
7. Confirm adequate communications between personnel at the squeeze off location and purge vent pipe(s) position(s).
8. Open purge vent valves C and D.
9. Remove safety stops on squeeze off No.1 and release squeeze off from the fully closed position to the minimum distance as specified in Table 46 for the pipe diameter.
10. Whilst monitoring P1 remove safety stops and release squeeze off No.2 from the fully closed position to the minimum specified in Table 46 for the pipe diameter.
11. Continue to monitor P1 during purge to make sure that it does not fall to less than the minimum stated in the NRO/RO.
12. If pressure drops to the minimum pressure at P1, apply squeeze off and safety stops and report this to your Operational Manager.

A squeeze off unit used for commissioning must not be left unattended.

13. Continue venting until the expected time for purging has passed and then open Valve E on the purge vent pipe and continue purge until two successive readings above 90% gas in air (GIA) is obtained at the vent.
14. On completion of the purge close Valve C and attach a suitable pressure gauge to Valve E.
15. Turn on Valve C and monitor the pressure in the main.
16. If the pressure oscillates inform your Operational Manager.
17. Close purge vent valves C, D, and E.
18. Where you are purging branch systems, close each purge vent pipe(s) when two successive readings above 90% gas in air (GIA) is obtained at that vent.
19. Pressurise the main to the pressure at P1.

    ***Note**: If the purge velocity fluctuates at the purge vent point as the purge is in progress this could indicate a blockage within the main. Do not stop the purge in such cases.*
20. Check pressures at the extremities by attaching a suitable pressure gauge to valve E and then open valve C to confirm that the pressure has equalised in the new main with that in the existing source main, then close valves C and D.

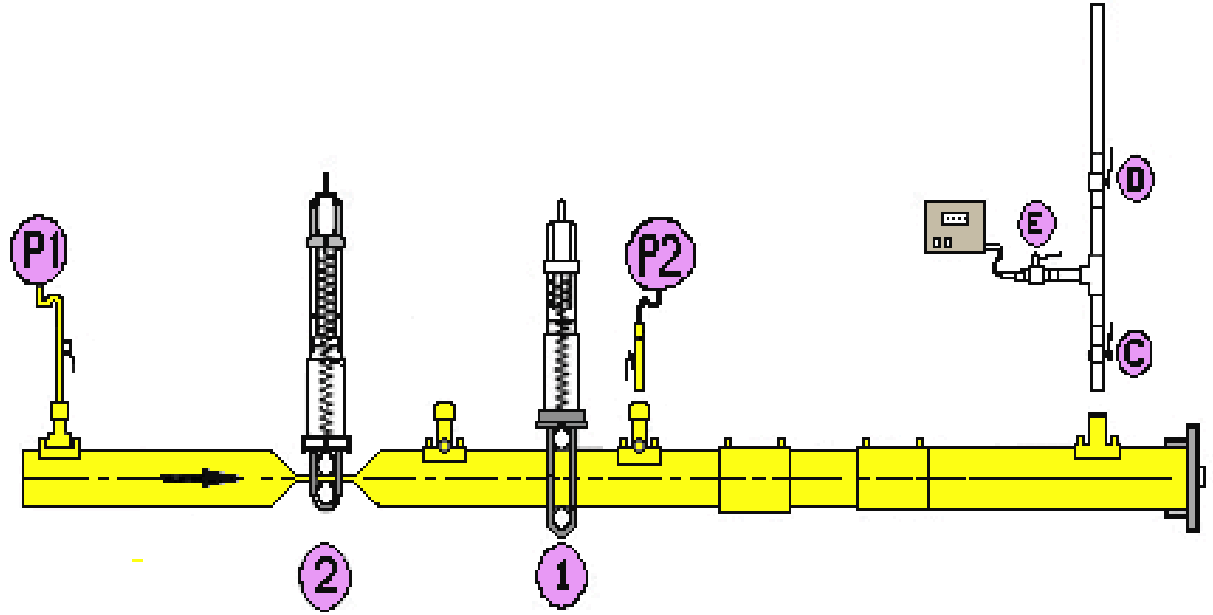


Figure 99- Commissioning Main by the Use of Double Squeeze Off

21. Exposed sections must be checked with approved leakage detection fluid and the leak detection fluid washed off with clean water.
22. Should leakage be detected stop the pressurisation until the cause of the leakage has been rectified.
23. Once P1 and P2 are equalised completely release the squeeze off unit.
24. Decommission and remove purge vent pipe(s).
25. Plug and seal all tappings.
26. Check all plugs/seals for soundness with approved leak detection fluid and wash off with clean water.
27. Where necessary apply corrosion protection.
28. Remove squeeze off unit and apply re-rounding clamp for a period of 10 minutes, following which remove clamp and apply ‘squeeze off applied’ tape.
29. Complete NRO/RO procedure, tidy site.

H3 Commissioning & Decommissioning – Decommissioning by Direct Purging

This Section details the de-commissioning of mains up to 2 bar operating pressure by using direct purging. Direct purging is the complete displacement of natural gas by air.

The de-commissioning of mains by indirect purging requires specialist training; please refer to SGN/PM/MSL/1 Part 1. Indirect purging should only be used if the criteria for direct purging cannot be achieved.
When de-commissioning a medium pressure main, every effort should be made to reduce gas venting, by passing gas in a controlled manner into a system operating at a lower pressure.

DIRECT DECOMMISSIONING TECHNIQUES

Direct decommissioning of mains can be undertaken using the following displacement techniques:

- Using a compressor to push the gas out of the main
- using an air supply regulated to 1/3rd of mains operating pressure provided the minimum velocity can be achieved
- using a purge ejector, (including the 2" mini purge ejector and the 6" and 10" ejectors).

PREPARATION

De-commissioning must not be undertaken unless a satisfactory mains decay test has been completed.

1. The main to be de-commissioned must be isolated from the live system by a method described in the Table 47.
2. Complete a risk assessment to establish the effects of noise on the surrounding environment.
3. Any precautions to be taken identified by the risk assessment must be written in the NRO/RO.
4. Display NO SMOKING signs and remove naked lights or other sources of ignition from the site.
5. If required display signs warning of sudden noise.
6. For major purging operations, the following may need to be informed the:
   a) Operations Call Centre and Gas Control Centre;
   b) local authority environmental officers;
   c) Civil Aviation Authority (CAA);
   d) local Police and Fire Brigade;
   e) residents;
   f) other affected parties.

SAFETY

1. Make sure that all open vents during the operation are not left unattended
2. Take extra vigilance so that no Operatives or members of the public smoke or have naked lights during the decommissioning operation.
3. Fire extinguishers must be available on site and positioned for immediate use.
4. Take account of the wind direction to eliminate purged gas entering building through windows and doors ventilation systems flues, tunnels and other similar situations.

Technique	Approved Isolation Methods
A compressor is used to push the gas out of the main	The main must be physically isolated from any live pipework
An air supply regulated to 1/3rd of mains operating pressure provided the minimum velocity can be achieved	The main can be physically isolated from any live pipework
	For Low Pressure PE mains, not greater than 180mm diameter or Medium Pressure PE mains not greater than 63mm a single squeeze-off can be used if the isolation is sound and verified by a let by check
	A double block and bleed valve with the bleed point correctly venting to atmosphere
	A double squeeze-off system with intermediate vent pipe
	Other mains must be isolated by a double block and bleed system. This system may be: • a single face valve with a secondary bag and intermediate vent pipe provided there is no leakage past the secondary device • stopple equipment with a secondary bag and intermediate vent pipe provided there is no leakage past the secondary device
Using a purge ejector, (including the mini purge ejector, 6" and 10")	The main can be physically isolated from any live pipework
	Low Pressure PE mains not greater than 180mm diameter or Medium Pressure PE mains not greater than 63mm can be isolated using a single squeeze-off if the isolation is sound and verified by a let by check.
	One way fed Low Pressure mains (capped at one end) not greater than 6"/150mm diameter may be isolated by two semi-supported bags provided the release of gas from the intermediate vent is indiscernible
	Low pressure mains not greater than 6"/150mm diameter may be isolated by a single faced valve provided the isolation is sound and verified by a let by check.
	Other mains must be isolated from the parent main by a proven double block and bleed system. This system may be: a) a valve with a double block and bleed facility b) two valves with an intermediate vent. c) a double squeeze-off with intermediate vent.
	Stopple equipment with a secondary bag and intermediate vent pipe provided there is no leakage past the secondary device
	When using bagging off or IRIS Stop equipment the main must be physically disconnected and capped between two double sets of bags or double IRIS Stops, (at each end when applicable, requiring 8 bags in total - 4 bags each end). Exception permitted when using 2 bags and the mini purge ejector See Section H4.
	When using foam plugs (single or double) the main must be physically disconnected and capped.

Table 47- Approved Methods of Isolation of Direct Purging Operations

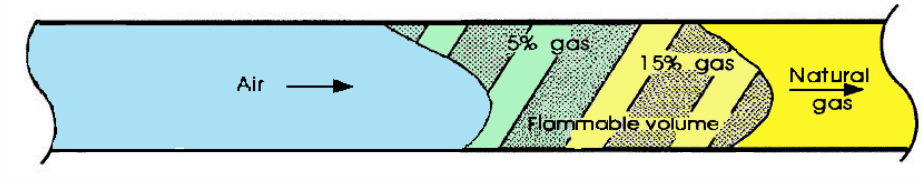


Figure 100- Purging at Correct Velocities Causes Minimal Mixing

PURGE VELOCITY

1. Refer to Table 48 to identify the correct minimum purge velocity for the purge.
2. The correct purge velocity will be achieved by using the correct air inlet holes and vent diameters together with the minimum size and number of compressor from Table 48 and the gas will be safely removed Figure 100.
3. Using the correct velocity will prevent stratification see Figure 101.

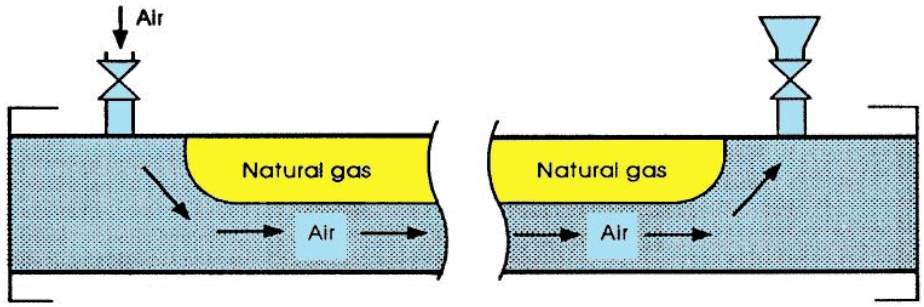


Figure 101- Slow Air Purging Causes Stratification and a Poor Purge

***Note:** Where sequential purging is to take place the sum of the cross-sectional area may be equivalent to a pipe size greater than 180mm PE, hence the additional two rows in **Table 48**. Your Operational Manager will advise you of the equivalent size of main.*

4. The estimated purge duration is made by dividing the length of the main by the typical purge velocity in Table 48.
   Example: Length to be purges 100m of 6" main / velocity = 100m/0.6 = 166.6 secs = 2 minutes 47 secs.
5. Direct purging should be undertaken whenever the criteria for minimum purge velocities can be achieved when minimum purge and vent diameters and inlet pressures are available, and the main is isolated by physical isolation.
   For example, when separated from the parent main by caps, or through the closure of appropriate valves or squeeze-off units.
6. Where indirect purging is required then this should be with reference to an Operational Manager, and carried out in accordance with SGN/PM/MSL/1 Part 1.
7. The purge may be carried out using a compressor to push the gas out of a purge vent pipe (see Figure 101) or using a purge ejector to draw the gas out, see Figure 103.
   Once a purge has started, it must continue without interruption until complete.

COMMUNICATIONS AND EXTERNAL LIAISON

1. Establish a suitable system of communication
2. The person in charge must be able to communicate with personnel operating the vents and riders.
3. Test the communications prior to starting.
   Note: The system must be able to overcome any noise generated through the commissioning operation.
4. Communication equipment utilised within the work area must be intrinsically safe.
5. If the equipment is not intrinsically safe, such as mobile phones, the equipment can only be used outside of the designated hazardous areas at least 5m upwind of any possible source of purged gas.

6. For major purging operations, your Operational Manager will inform the necessary authorities and this will be recorded on the NRO/RO.
7. For all purging operations, you should advise residents that purging is being undertaken and advise them in respect to noise, smell and fire hazard.
8. Where necessary, request residents to close windows and doors during the purging operation.

BRANCHED SYSTEMS

1. Branched systems may be directly purged either simultaneously or sequentially.
2. Any loops must be isolated by valves or stopping off equipment (squeeze-offs) and then treated as branches.
3. Short stubs, whose length is less than eight diameters, are not classed as branches and will automatically be purged by natural convection.

SIMULTANEOUS PURGING

1. Simultaneous purging is quicker than sequential purging. It involves opening all the vents purge vent pipes together and purging all the branches at the same time.
2. This requires each of the purge vents being manned with appropriate gas detection instruments and communication equipment.
3. Where branches are to be purged simultaneously the riders and vents the purge vent pipes and compressor must be sized for a pipe diameter equivalent to the sum of the cross-sectional areas of all the pipes being purged see Table 48.
4. Your Operational Manager will advise you when simultaneous purging is to be carried out and will prepare these calculations and advise diameters of the vents.
5. This information must be provided in the authorised NRO/RO.

SEQUENTIAL PURGING

1. Sequential purging involves purging each branch in turn, starting with the largest diameter branch.
2. It must be used if the workforce is limited or the minimum velocities cannot be achieved in each branch during simultaneous purging.
3. When sequentially purging, start with the largest diameter branch first with the purge vent pipe sized for that branch and the compressor sized for the largest pipe diameter.
4. The next largest branch should then be purged and the sequence continued until all the branches have been purged.

C. Riders

Refer to Section E0 - Riders.

D. Vents

Refer to Section H1 – Purge Vents.

Nominal pipe dia or equivalent pipe dia. D	Min. purge velocity m/s	Typical purge velocity m/s	Min air inlet hole & vent/ejector diameters		Min. size of compressor used on inlet		or	Min. size of compressor used on ejector		Ejector size mm
			PE mm	Met. In.	m^3/ min	ft3/ min		m^3/ min	ft^3/ min	
0 to 150mm / 0 to 180mm PE (0 to 6in)	0.6	1.5	32	1	1.9	(70)	-	2 x 2.0	(2 x 70)	50
151 to 200mm (8in)	0.7	1.4	63	1.5	2.8	(100)	or	2 x 2.0	(2 x 70)	50 or 150
201 to 250mm (10in)	0.8	1.2	63	2	3.9	(140)	or	2 x 2.8	(2 x 100)	50 or150
251 to 315mm / (315mmPE) (12in)	0.9	1.1	63	2	N/A		-	2 x 2.8	(2x100)	50 or 150
316-400mm / 400mm PE (14-16in)	1.0	1.5	90 or 2 X 63	3			-	2 X 2.8	(2x140)	150
401-450mm / 450-469mm PE (18in)	1.0	2.0	-	4			-	2 X 3.9	(2x140)	150
451 – 500mm / 500mm PE (20in)	1.0	2.0	-	5			-	2 X 3.9	(2x140)	250
501-600mm / 630mm PE (24in)	1.1	2.0	-	6			-	2 X 3.9	(2x275)	250
601-750mm (30in)	1.2	1.7	-	6			-	2 X 7.8	(2x275)	250
751 – 900mm (36in)	1.5	2.0	-	6 inlet 8 ejector			-	2 X 7.8	(2x275)	250
901 – 1050 mm (42in)	1.5	1.8	-	8			-	2 X 7.8	(2x275)	250
1051 – 1200mm (48in)	1.7	1.8	-	12 inlet 8 ejector			-	2 X 7.8	(2x275)	250

Table 48- Decommissioning by Direct Purging

Notes:

1. For use of the 50mm (2") mini purge ejector for purging mains up to and including 12" refer to Table 49.

2. Single tool compressors use 1.9m^3/min to 2.8m^3/min (70ft^3/min to 100ft^3/min)

3. Two tool compressors deliver 3.9m^3/min (140ft^3/min)

3. On completion of service transfer, fit End Seal kit.
4. ***An End seal is required at the insertion seal point and then at each subsequent transfer position. The main should be sealed with either an end seal or an appropriate material, for example denso-matic putty and tape as stated in SGN/WI/SL/1.***

PROCEDURE FOR THE DECOMMISSIONING BY DIRECT PURGE USING A COMPRESSOR

1. Check that the main has been physically isolated.
2. Check that a successful decay test has been completed in accordance with Section H5.
3. Check that the decommissioning and removal of any bypass (es) has been completed. Refer to Figure 102, and decommission all bypasses by closing valves A and C and opening valve B.
4. Check all joints on live capped ends with leak detection fluid and wash off with clean water.
5. Vent the main to atmospheric pressure by opening valve G on vent at extremity of the mains system to be decommissioned.
6. Close vent and check that the pressure in the main does not increase.
7. If there is no pressure increase, fully open valve G.

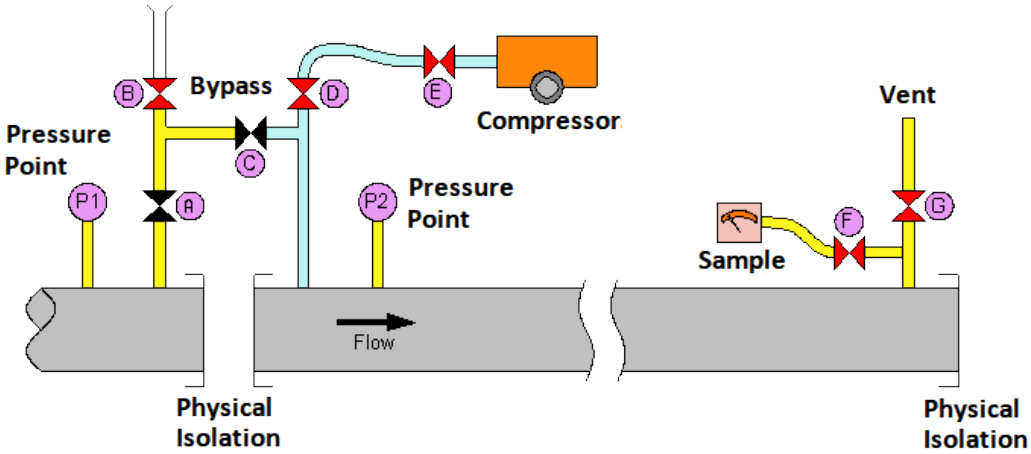


Figure 102- De-commissioning a Main Using a Compressor

8. Connect compressor(s) to main via valves D and E, valve E being on the compressor outlet and valve D on the connection to the main.
9. Start compressor and allow compressed air into the main by opening valve D, check that valve E is fully open.
10. Monitor pressure at P2, if this exceeds the design pressure of the system, 75mbar for LP and 2 bar for MP, throttle back the compressed air supply, check purge vent pipe is the correct diameter and the valve is fully open.
    Note: Stop the purge and investigate the reasons causing this excess pressure, for example vent not fully open or undersized.
11. Continue purge until two successive checks confirm via sample point at valve F, indications of 10% LEL or less at each vent.
12. Turn off compressor vent down main to atmospheric pressure and close valves D & E.
13. Remove compressor inlet and purge vent pipe and install plugs.
14. Close all vents and inlet valves remove all bypasses and install plugs.
15. All openings to the abandoned main must be securely sealed to prevent the egress of residual gas and the ingress of water or possible leakage from the mains systems.
16. You must check all plugs and caps on the live mains using leak detection fluid.

    The same procedure on the following page can also be used when using compressed air regulated to 1/3rd of the mains operation pressure using the isolation methods as described in see ***Table 48- Decommissioning by Direct Purging.***

DECOMMISSIONING BRANCHED SYSTEMS USING A COMPRESSOR

1. Connect the compressor to the largest diameter pipe in the network.
2. Where branches are to be purged simultaneously the vents and compressor, must be sized for a pipe diameter equivalent to the sum of the cross-sectional areas of all the pipes being purged.
3. Your Operational Manager will prepare these calculations and information in respect to these will be given as part of the NRO/RO.
4. If the system is to be sequentially purged, the largest diameter branch must be purged first with the vents sized for that branch and the compressor sized for the largest pipe diameter.
5. The next largest branch must then be purged and the sequence continued until all the branches have been purged.

DECOMMISSIONING DIRECT PURGE OPERATION USING THE 6” OR 10" PURGE EJECTOR

1. Check that the main has either physically isolated or an approved method of isolation has been used in accordance with Table 47.
2. Check that a decay test as detailed in Section H5 has been completed.
3. Close and decommission the bypass by closing valves A and B and opening valve C, see Figure 103.
4. Check all joints on live capped ends with leak detection fluid and wash off with clean water.
5. Fit the purge ejector to main to be abandoned ensuring the top of the purge ejector vent stack is a minimum of 2.5m above ground level.
6. Check that there is an air inlet hole equivalent to that shown in Table 48 at the opposite end of the main from the purge ejector where air is to be drawn in.
7. Arrange for the air inlet hole to be continually monitored throughout the decommissioning operation to make sure that it does not get blocked.
8. Check that the valves from the compressor to the ejector are closed, start up the compressor.

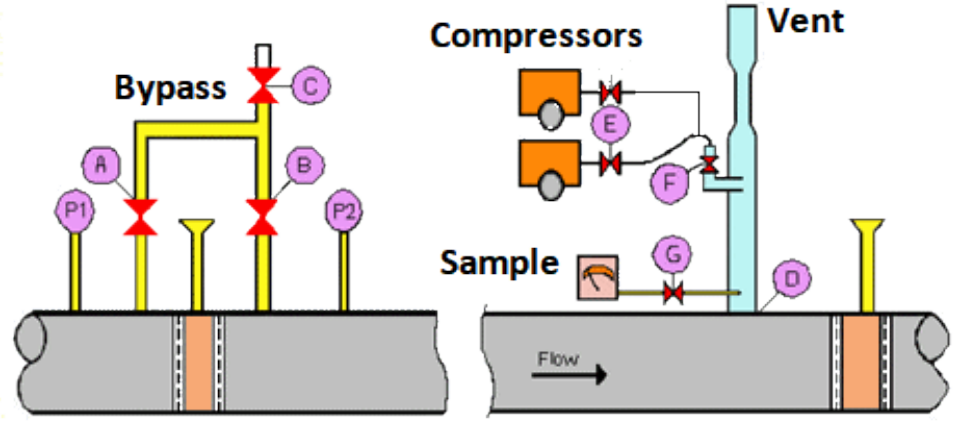


Figure 103- De-commissioning Using a 6" or 10" Purge Ejector

9. Check the main is vented to atmospheric pressure by opening valve D on the ejector.
10. Open the air inlet valve (F where fitted) to vent main to atmosphere.
11. Open the compressor valves (E) to admit compressed air to the purge ejector to start the decommissioning operation.
12. Monitor pressure at P2, typical negative pressure should be in the region of -15 to -30mbar.
13. If the negative pressure exceeds -100mbar, stop the purge operation and investigate the determine the cause
    Note: This may be due to purge vent not fully open, undersized drillings or air inlet hole blocked.
14. The duration of the purging operation must be monitored and when the estimated purge duration is up, check the gas reading at G.
15. Continue purge until two successive checks confirm indications of 10% LEL or less.
16. Turn off the compressors, remove purge ejector and test inside the main at the top and bottom that gas readings are less than 10% LEL.

17. Remove all equipment from the abandoned main.
18. All openings to the abandoned main must be securely sealed to prevent the egress of residual gas and the ingress of water or possible leak path from live mains systems.
19. You must check all plugs and caps on the live mains using leak detection fluid.

DECOMMISSIONING BRANCHED SYSTEMS USING A PURGE EJECTOR

1. Sequential purging of branched systems is the preferred method when using an ejector.
2. Where branches are to be purged sequentially the vent holes must be sized for that of the largest pipe diameter.
3. The ejector must be fitted to the end of the largest diameter pipe and the other branches purged in descending order.
4. The next largest branch must then be purged and the sequence continued until all the branches have been purged.
5. If sequential purging is impracticable, simultaneous purging may be carried out if approved by your Operational Manager.

Nominal Pipe Dia	Min. Purge velocity m/s	Typical purge velocity m/s	Min air Inlet hole	Min Ejector hole	Max size of compressor	
					m^3/min	ft^3/min
3”/ 75mm	0.6	11.0*	1”	1”	2.8	100
4”/100mm	0.6	7.0*	1”	1”	2.8	100
6”/150mm	0.6	3.5	1½	1½	2.8	100
8”/200mm	0.7	2.1	2”	2”	2.8	100
10”/250mm	0.8	2.0	2X2”	2”	2.8	100
12”/315mm	0.9	1.1	2X2”	2”	2.8	100

Table 49- Decommissioning Mains by Direct Purging Using a 2" Mini Purge Ejector

DIRECT PURGE OPERATIONS ON MAINS IN SIZE RANGE 3” / 75MM TO 12” / 315MM DIAMETER - USING LIGHT WEIGHT EJECTOR EQUIPMENT.

Note: Table 48 will not be applicable for direct purging using lightweight ejector equipment – See Table 49.

1. Check that the air inlet hole size and minimum quantity comply with the details shown in Table 49.
   Note: The minimum compressor to be used must not deliver less than 70 ft3/min (1.9 m^3/min).
2. Decommission all riders by closing valves A and B and opening valve C on bypass see Figure 104.
3. Check all joints on live capped ends with leak detection fluid and wash off with clean water.
4. Ensuring that the valves E and F from the compressor to the ejector are closed, start up the compressor
5. Vent the main system to atmospheric pressure by opening valve D (on the drill base at the bottom of the ejector) - at the extremity of the mains system to be decommissioned, then close valve D.
6. Check that the pressure in the main does not increase.
7. If there is no pressure increase, fully open valves B and C on bypass and open valve D.
8. Simultaneously open the air inlet valve F and compressor valve E to purge the main.
9. Check both valves are fully open.
10. Monitor pressure at P2, typical pressure experienced during purge should be in the region of -15 to -30 mbar.
    If the negative pressures exceeds -100 mbar, stop the purge and determine the cause.
    Note: This may be due to vent not fully open or undersized drilling.
11. Monitor bag pressures to check that they remain at adequate pressures. (Refer to Section E3).

12. If a bag fails then close vent at the L.H.S and purge until a reading of 90% gas in air is obtained, then reverse vent and purge positions and purge until a reading of 90% gas in air is obtained.
13. Close valves.
14. Investigate before re-commencing the procedure from step 7.
15. Continue to purge until two successive indications of 10% LEL or less checks are recorded at the sample valve at G.
16. Turn off the compressor and close valves E and F.
17. Re-confirm via the sample valve G indications of 10% LEL or less.
18. Close valves B and C and slide valve on drill base D.
19. Remove the ejector.
20. Remove the bypasses, all valves and the drill base, and install mains plugs.
21. All openings to the abandoned main must be securely sealed to prevent the egress of residual gas and the ingress of water or possible leakage from the mains systems.
22. You must check all plugs and caps on the live mains using leak detection fluid.

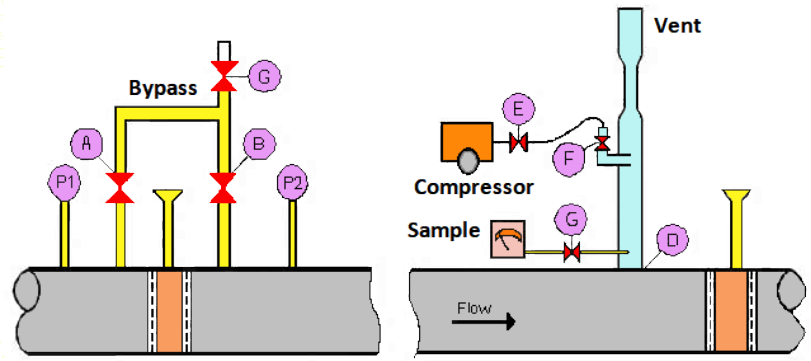


Figure 104- De-commissioning Using a Light Weight Purge Ejector

H4 Purging Short sections during flow stop Operations up to and including 7 bar

This section details the requirements for the purging and venting of short sections of pipe during Flow Stop/Cut and Cap Operations on all metallic and PE pipe diameters 3"-48" (80mm/1200mm), up to 7bar.

SAFETY

The risk of ignition or asphyxiation must always be considered during planning and execution of live gas operations.

1. Follow the guidance in Section H1, H2 and H3 to minimise any potential risks from purging and venting activities.
2. Use Table 50 for Medium and Low pressure operations to determine requirements for diameter and length:
   - Purging
   - Venting
   - breathing apparatus
   - Risk Assessment
3. All necessary PPE and Personal Atmosphere Monitor must be worn.
4. Test Breathing Apparatus (BA) Sets and make them ready for use.
5. Lay out a minimum of 2 Fire Extinguishers, check their fitness for use.
6. Identify and remove potential sources of ignition.
7. For metallic pipe put cross bonding in place.
8. For PE pipe earth with wet cloths to prevent static sparks.
   Note: Where appropriate wet down of the work area and the use of Non-Spark tools.
9. Where purging of Asbestos sections is required, then this must be supported by your manager and a site-specific risk assessment compliant with Regulation 7 of CAR 20006 Approved Code of Practice, and carried out in accordance with SGN/PM/MSL/1 Part 1 and SGN/WI/SHE/81.

Length of purge	Mains Diameter									
	<6"		6" – 8"		8"-10"		10" – 12"		>12"	
<1m	RA	V	RA	V	RA	V	RA	V	BA	P
1-2m	RA	V	RA	V	RA	V	BA	V	BA	P
2-5m	RA	V	RA	V	BA	V	BA	P	BA	P
>5m	BA	V	BA	V	BA	V	BA	P	BA	P

Table 50- Guidance Chart on Short Length Purging & Venting Activities

• V = Venting only • P = Purge required • BA = BA set to be worn.
• RA = Risk Assessment dictates, (Wear BA if confined space, difficult ingress/egress or deep trench).

For Table 50 length of pipe work refers to distance between bags or between bags and end cap of short section.
For all work on MP and IP a Non-Routine Operation should detail specific purge requirements, and for IP work, purge requirements should be included within a SGN/PM/PS/5 method statement.
For >12" diameter, it may not be possible to achieve flow rates for a full purge and a trickle purge technique should be adopted.

H4 Purging Short sections during flow stop Operations up to and including 7 bar

PROCEDURE

1. For a short section of pipe work less than 300mm diameter the isolated section of pipe can be vented (and purged where required) prior to any action to remove the isolated section (see Table 50).
2. You must make a check with approved gas detector to confirm the absence of gas from the pipe and work area.
3. For a short section of pipe work 300mm diameter and above must be vented and purged prior to any action to remove the isolated section.
4. You must make a check with an approved gas detector to confirm the absence of gas from the pipe and work area.
5. You must wear BA equipment during the cut-out operation on 12”/300mm pipes and above, where:
   - a Permit to Work or site specific risk assessment dictates or,
   - when venting/purging pipework more than 5m and
   - on any operations within excavations where ingress/egress is difficult.
6. Only allow necessary operatives, wearing the appropriate BA into the excavation until gas detection readings indicate a safe atmosphere and there is no asphyxiation risk.

   Note: For inert gas purging see SGN/PM/MSL/1 Part 1.

H5 Decay testing of mains

Before decommissioning of a main, the section of main to be abandoned must be subjected to a satisfactory decay test. This test is necessary to prove that:.

a) There are no consumers still connected to the section being abandoned.
b) There is an adequate supply to the surrounding mains system.
c) There are no unknown back feeds to the main to be de-commissioned.

PREPARATORY WORK

1. Before any sites works commence a check should be made of computer systems to confirm that there are no known services connected to the main to be abandoned.
2. Onsite, a street walk should be conducted to visually check for sign of services still being connected to the main to be abandoned.
3. Where possible Decay tests should be carried out when gas demand is at its highest, either between 7.00 am and 8.30 am, noon to 1.00pm or 4.30pm to 6.00pm.
4. Where tests are undertaken outside of these time periods results should be treated with a degree of caution.
5. There is no mandatory requirement to record decay tests with pressure recorders unless requested as part of the RO/NRO by the Authorising Engineer.
6. LP and MP mains decay testing has been standardised into 'mains with unconfirmed backfeeds', and 'Where no backfeed is suspected'. The detail for each test is detailed in the following sections
7. Your Operational Manager should assess the network configuration and confirm within the NRO/RO the duration and timing of the proposed decay test.

PROCEDURE FOR SECTION OF MAIN WITH A UNCONFIRMED BACKFEED (TWO WAY FED)

1. Install, text, purge and commission pressure points P1,P2, vents points V1,V2 and bypass 1 (see Figure 105).
   Note: Vents V1 and V2 can either be separate or incorporated into the bypass.
2. Install two way flow stop equipment at Location "X" using procedure in Section E, .
3. Allow the pressure to stabilise, and note the initial pressure readings at P1 and P2.

Figure 105- Schematic for Mains With Known Backfeed

4. Whilst monitoring pressures at P1 and P2, slowly close off bypass 1.
5. Monitor pressures at P1 and P2 for a minimum of 5 minutes, they should remain stable.
   Note: The monitorring period will be determined by a number of factors, including time of day, time of year, volume/size of the main, and operating pressure. Therefore, this observation period will be determined by the Authorising Engineer and documented on the RO/NRO.
6. If the pressure at P1 or P2 falls:

- by 5 mbar or more below the initial operating pressure on a LP system.
- below 20 mabr on a LP system
- below the minimum pressure stated on the NRO/RO
- by more than 5% below the initial operating pressure on a MP system.

Open the bypass valve BV1 immediately and inform your Operational Manager.

7. If the pressure at P1holds, continue to monitor and slowly open vent V1 to vent section of main that is to be decommissioned.
8. The pressure at P1 should fall slightly and then recover, but if it cannot maintain a stable working pressure, close the vent V1 and immediately open the bypass 1. Suspend the RO/NRO, and Inform your Operational Manager.
9. If the pressure falls close the vent and **open the bypass valve BV1 immediately**. Inform your Operational Manager and investigate the cause.
10. If mains pressure at P1 maintains a stable working pressure, then the backfeed supply is considered acceptable.
11. Close vent V1.
12. Repeat steps 7-9 replacing P1 with P2, V1 with V2 and bypass 1 with bypass 2.
13. Close vent V2.
14. Reopen bypass 1.
15. Cut and cap the main at location 'X', and remove the flow stop.
16. Repeat steps 3-6, but allow a minimum of 15 minutes at step 5, the pressure should remain stable.
17. If the bypass and pressure/vent points are no longer needed, they can be decommissioned, purged and removed at location 'X'.
18. Move to location 'Y' and follow section - Procedure 'Where no backfeed is suspected'.

PROCEDURE - WHERE NO BACKFEED IS SUSPECTED:

1. Install purge and commission pressure points P3, P4, vent points V3, V4 and bypass 2. (See Figure 106).
   Note vent V3 and V4 can be incorporated into bypass BP2.
2. Turn off any services on the section of main to be decommissioned.
3. Install two way flow stop equipment at location "Y" using procedure in Section E.
4. Allow the pressures to stabilise, and note the initial readings at at P3 and P4.
5. Whilst monitorring pressures at P3 and P4, slowly close the bypass valve BV2.
6. Monitor pressures for a minimum of 5 minutes, it should remain stable.
   Note: The monitoring period will be determined by a number of factors, including time of day, time of year, size/volume of main, and operating pressure. Therefore, this observation period will be determined by the Authorising Engineer and documented on the RO/NRO.

Figure 106 Schematic For Mains With No Known Backfeed

7. If the pressures at P3 or P4 falls:

- by 5 mbar ore more below the initial operating pressure on a LP system.
- Below 20mbar on a LP system
- Below the minimum stated on the RO/NRO.
- By more than 5% below the initial operating pressure on a MP system.

Immediately open the bypass valve BV2, inform your Operational Manager/Authorising Engineer and do NOT proceed with the operation as it is likely that supplies are still connected.

8. You must check that the upstream pressure to confirm the source feed, in this case the pressure at P4.
9. If the pressure at P4 is stable, continue to monitor, but slowly open vent V4 to vent section.

10. The pressure at P4 should fall slightly and then recover, but if the pressure at P4 falls and cannot maintain a stable working pressure, close the vent V4 and **immediately open the bypass 2**. Suspend the RO/NRO, and Inform your Operational Manager/Authoring Engineer.
11. If pressure at P4 maintains a stable working pressure, then the backfeed source is considered acceptable.
12. Close vent V4
13. Whilst monitoring P3, slowly open vent V3.
14. If the pressure at P3 maintain a stable working pressure, this proves a backfeed exists on the main to be abandoned. Close vent V3, and immediately open the bypass 2. Suspend the RO/NRO, and Inform your Operational Manager.
15. If the pressure starts to decrease, allow the pressure to fall by 5 mbar below the initial operating pressure on a LP system or by 5% on a MP system and close vent V3. If the pressure does not recover, no backfeed is present on the main to be abandoned.
16. Reopen bypass 2.
17. Cut and cap the main at location 'Y' and remove the flow stop.
18. Whilst monitoring pressures at P3 and P4, close bypass 2.
19. Open vent V3 and reduce pressure to:
    - 5 mbar below the initial operating pressure on a LP system.
    - 10% below the initial operating pressure on a MP system.
20. Monitor for 15 minutes and providing the pressure remain stable, then proceed to decommission and purge the main as detailed in Section H3.

TEST FAILURE

1. Test failures will indicate several possibilities:
    - consumers are still connected to the section that is to be abandoned or
    - on the section that is believed to be supplied from the local network there is no backfeed.
    - There is excessive mains or service leakage.
    - there is a backfeed (indicated by a rise of pressure to the level initially observed).
2. If a backfeed is detected investigations may be required to locate the backfeed through the interrogation of the mains plans, trial hole excavations, camera survey. Your Operational Manager will decide what actions to take.
3. If consumers are still thought to be connected, check records and premises within the confines of the abandonment to identify any supplies still connected to the main.
4. If leakage is thought to be the cause of the pressure loss on the section to be abandoned, a survey of the area using gas detection equipment/bar holing should be conducted to locate the source of the gas leakage.
5. Your Operational Manager will decide either to make repairs or abandon the main.

H6 Commissioning Pipe coils by Direct purging

This short section details the procedure to be followed when direct purging a pipe coil during Live mains insertion.

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. The purging operation must take place within an area appropriately signed and guarded in accordance with NRSWA guidance D4.
4. Breathing apparatus and fire extinguishers must be assembled, ready for use and easily accessible, alongside the excavation.
5. Display NO SMOKING signs and check that no smoking, naked lights or other sources of ignition are present,
6. Maintain vigilance to make sure that no Operatives or members of the public contravene the No Smoking instruction.
7. Vent pipes must be manned throughout the purging operation.
8. Consider the strength and direction of the prevailing wind and take action to prevent the purged gas entering building or areas of public assembly, where possible ignition sources may present.
9. Venting gas can in populated areas or major transport routes may give rise to increases in reported Public Reported Escapes. Consider increasing the height of vents, additional signage or decanting gas into other mains to mitigate this issue.

PROCEDURE

1. Fit a metallic vent pipe to the end of the coil.
2. Gently push the PE through the plastic seal or opening valve V1 in the gland box.
3. Open the valve on the vent pipe at the end of the PE coil.
4. Check for two readings of greater than 90% G.I.A at purge vent pipe position.
5. When full purge has been achieved, close the vent pipe.
6. Disconnect the vent
7. Continue with the insertion operation by removing the bags in the main to be inserted. (return to operational procedure)

APPENDIX - A References & Definitions

This Work Instruction refers to the documents listed below

A.1. Internal Documents

SGN/PM/DIS/3.6	-	Management Procedure for Lifting Operations
SGN/PM/DR/2	-	Management Procedure for Recording and Maintenance of Non-Maintained Pipe Asset Records
SGN/PM/ECP/2	-	Management Procedure for Cathodic Protection of Buried Steel Systems
SGN/PM/MSL/1 Part 2	-	Works Instruction for Pipe System Construction – Specialist Activities
SGN/PM/MSL/1 Part 1	-	Management Procedures for Mainlaying & Service Laying
SGN/PM/PS/5	-	Management Procedure for The Management of New Works, Modifications and Repairs
SGN/PM/SHE/15	-	Management Procedure for Manual Handling
SGN/PM/SW/3	-	Management Procedure for Use of Mechanical Plant in Close Proximity to Utility Apparatus
SGN/PM/V/1	-	Management Procedure for Mains Valves Up to and Including 7 Bar Operation
SGN/PR/EM/72	-	Work Procedure for Dealing with Gas Escapes and Other Emergencies
SGN/PR/EM/74B	-	Work Procedure for Locating and Repairing Gas Escapes on the Network Operating at Pressures not exceeding 7 bar Part B- Repair Techniques.
SGN/PR/SW/1	-	Work procedure For Excavations
SGN/PR/TE/P6.2	-	Work Procedure for the use of mini-excavators & trailers
SGN/SEI/557	-	Instruction and Guidance on the use of PVC shoring

A1 – Internal Documents continued

SGN/SP/CE/5	-	Specification for the Design, Construction and Testing of Civil and Structural Works Roads
SGN/SP/CE/12	-	Specification for The Design, Construction and Testing of Civil and Structural Works. Part Twelve: Pipeline Protection Slabs
SGN/SP/CW/5	-	Specification for field applied external coatings for buried pipework and systems
SGN/SP/DAT/6	-	Specification for Standard Sizes of Carbon and Carbon Manganese Steel Pipe for Operating Pressures Greater Than 7 Bar
SGN/SP/E/56	-	Specification for ancillary pipeline equipment
SGN/SP/ECE/3	-	Specification for transportable electricity generator sets, including generators combined with compressors.
SGN/SP/F/4	-	Specification for hot tap and stopping off connections (for operating pressures 7 bar to 70 bar inclusive)
SGN/SP/P/1	-	Specification for Welding of Steel Pipe Operating at Pressures Not Greater Than 7 bar
SGN/SP/P/9		Specification for The Welding of Fittings to Pipelines Operating Under Pressure (Supplementary to BS 6990).
SGN/SP/PA/10	-	Specification for new and maintenance painting at works and site for above ground pipeline and plant installations.
SGN/WI/D/4	-	Safety at Street works and Road Works
SGN/WI/DIS/4.2.2	-	Work Instruction for anchorage of systems operating up to 7 bar – Operatives
SGN/WI/EL/15005	-	Work Procedure for The Use Of Radio detection Cat & Genny Locator
SGN/PR/P/19	-	Work Instruction for the Installation of Grouted Tees
SGN/WI/ML/1	-	Work Instruction for Pipe System Construction - Module 1 - General Requirements
SGN/WI/SL/1	-	Work Instruction for service laying Up to and including 63mm diameter at pressures up to and including 7 bar
SGN/WI/SW/2	-	Work Instruction for Safe Working and Development in The Vicinity of SGN Gas Pipelines and Associated Installations - Requirements For SGN
SGN/WI/SHE/81	-	Work Procedure for Working with Asbestos
SGN Safety Handbook	-	SGN's guidance document

A.2. External Documents

BS 21	-	Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions) Now replaced by BS EN 10226-1 but still in common use.
BS EN 682	-	Elastomeric seals. Materials requirements for seals used in pipes and fittings carrying gas and hydrocarbon fluids
BS EN 1090-1	-	Execution of steel structures – Part 1: Requirements for conformity assessment of structural components
BS EN 1555	-	Plastics piping systems for the supply of gaseous fuels. Polyethylene (PE). Fittings
BS EN 10226-1	-	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
GDN/PM/SCO/1	-	Gas Distribution Networks Management Procedure for the Safe Control of Operations
GDN/PM/SCO/2	-	Gas Distribution Networks Management Procedure for the Safe Control of Operations, Issue of Permits to Work and Forms of Authority on The Network
GDN/PM/SCO/4	-	Gas Distribution Networks Management Procedure for the Safe Control of Operations The Control of Non-Routine Gas Supply Operations
GDN/PM/SCO/5	-	Gas Distribution Networks Management Procedure for the Safe Control of Operations The Control of Routine Gas Supply Operations
GIS/E58:2006	-	Gland seals for insertion of polyethylene pipe into low pressure metallic gas mains
GIS/ECE1:2017	-	Specification for electrofusion control boxes
GIS/F7:2006	-	Specification for steel welding pipe fittings 15mm to 450mm inclusive nominal size for operating pressures not greater than 7 bar
GIS/F12:2007	-	Specification for Grouted Tee Connections for Metallic Mains Operating at Pressures up to 7 Bar
GIS/LC8 Part 4:2006	-	Specification for methods of repairing leaking ferrous gas mains. Part 4 - Pipe repair clamps. Split collars and under pressure branch connections

A2 - External Documents - Continued

GIS/PL2: Part1	-	Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 1: General & PE compounds for use in PE pipes and fittings.
GIS/PL2: Part 2	-	Specification for Polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 2: Pipes for use at pressures up to 5.5 bar
GIS/PL2:Part 3	-	Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas - Part 3 Butt fusion tooling and ancillary equipment
GIS/PL2: Part 4	-	Specification for Polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 4: Fusion fittings with integral heating element(s)
GIS/PL2: Part 5	-	Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 5: Electrofusion ancillary tooling
GIS/PL2: Part 6	-	Specification for Polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 6: Spigot end fittings for electrofusion and/or butt fusion purposes
GIS/PL2: Part 7	-	Specification for Polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 7: Squeeze-off tools and equipment
GIS/PL2: Part 8	-	Specification for polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 8: Pipes for use at pressures up to 7 bar
GIS/PL3	-	Specification for self-anchoring mechanical fittings for natural gas and suitable manufactured gas
GIS/V4	-	Specification for service isolation valves up to 50 mm diameter for use up to 2 bar maximum working pressures
HSG47	-	Health and Safety Executive guidance “Avoiding damage from underground services”

A.3. The definitions applying to this Work Instruction

Anchorage	-	Fixing of pipe ends, bends, valves and tees to prevent movement.
Annulus	-	The space between a carrier pipe and sleeve
Bagging Off	-	The technique of stopping off the flow through a main, by inserting and inflating bags in the main.
Butt Fusion	-	A method of jointing PE pipes and fittings, where the two pipe ends are heated and brought together to be fused without the use of a separate fitting
Bypass	-	A configuration of pipes and valves used to provide temporary continuity of gas supplies during a flow stop operation
Carrier Pipe	-	The existing pipe into which another pipe is inserted.
Competence	-	A competent person having the ability, appropriate training, knowledge and experience to supervise and/or carry out the work being undertaken in a safe and proper manner.
Dead Insertion	-	Installation of a replacement pipe into an existing pipe, whilst the host pipe is dead and not in use.
Electro Fusion	-	Method of jointing PE pipes, using fittings having integral heating coils.
Flow stop	-	The technique of stopping the flow of gas in a live gas main.
Gauging	-	Method of checking for size and suitability of the pipe into which insertion is to take place.
Host Pipe	-	A pipe into which another live pipe has been inserted
Live Insertion	-	Installation of a replacement pipe into an existing pipe, whilst the host pipe remains live and in use.
Operational Manager (First line)	-	A direct subordinate of an Operational Manager (Senior), responsible for “day to day” activities undertaken by operatives.
Operative	-	All persons engaged in the construction, testing, commissioning and decommissioning of mains and related plant must be competent to carry out such work. Operatives must not attempt to undertake any activity for which they have not been trained, assessed and certified as competent. When working in the highway at least 1 operative must hold a current NRSWA operative card.
Rider	-	A configuration of pipes and valves used to purge a section of main to gas
Slip Lining	-	Insertion of a new pipe by pulling or pushing it into the existing decommissioned pipe.
Squeeze Off	-	Squeezing a pipe to close the bore and stop the flow of gas.
SSRA	-	Site Specific Risk Assessment
SDR	-	Standard dimension ratio: The ratio of the outside diameter of a PE pipe to the minimum specified wall thickness.

APPENDIX - B | Minimum distances between fittings and other joints | Page 1 of 1

W = 100mm or the minimum distance required to fit an alignment clamp, whichever is the greater.

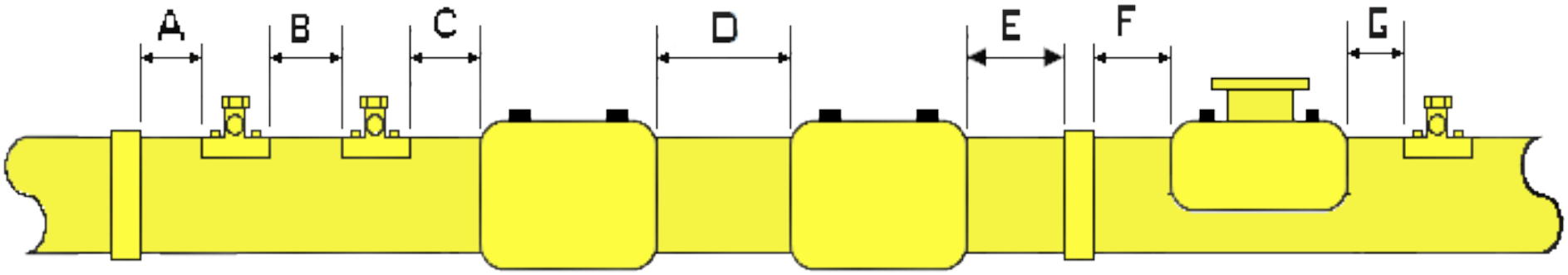


Figure B1 – PE Minimum Fitting Separation Distances for PE Pipes

REF	Description	Pre-1976 (1)	Post 1976
A	Butt weld to Tapping Tee	250mm	50mm
B	Tapping Tee to Tapping Tee	100mm	50mm
C	Tapping tee to Coupling	100mm or W	50mm or Z
D	Coupling to Coupling	4 X o/s dia	50mm or Z
E	Coupling to Butt Weld	4 X o/s dia	50mm or Z
F	Butt Weld to Branch saddle	250mm	250mm
G	Branch saddle to Tapping Tee	250mm	250mm

Table B1- Separation Distances

[1] - For all pipe manufactured before 1976 and all imperially sized PE pipes including DuPont Aldyl-A, Muntz Barwell, Hoechst and others operating at up to and including 2bar.

Z = 50mm or the minimum distance required to fit an alignment clamp,

When placing fittings alongside each other the first fitting must be allowed to cool for the complete cooling cycle prior to any adjacent fitting being electro fused.

1. Measurements are edge to edge of fittings and/or joints.
2. Where the date of manufacture for a pipe cannot be determined then the use the dimension must be assumed as pre-1976 for that date.

APPENDIX - C | Preparation of PE pipe for Electrofusion connection | Page 1 of 3

This Appendix covers the preparation of PE pipe for the electrofusion technique.

GENERAL

1. Existing Electrofusion fittings are normally suitable for multi-layer pipes of SDR 21 rating and many are rated for SDR 26 pipe.
2. You should check their suitability with the fittings supplier.

SUMMARY CAUSES OF PE JOINTS FAILURE

Most joint failures fall into the following categories:

- Contamination of joint
- Alignment clamps not fitted or not fitted correctly
- Re-rounding tools not used where pipe shows ovality
- Using incorrect tool or poorly maintained tool to scrape the pipe
- Excessive scraping of the pipe
- Under scraping of the pipe
- Pipe ends not cut square
- Incorrect fusion time
- Inadequate pressure applied to the joint during the jointing process
- Joint stressed during cooling as a result of not using an alignment clamp.

PE POLYMERS AND MATERIALS

Various polymers have been used in the manufacture of PE pipes, these are commonly known as "A", "S" or "X". Information of which polymer the pipe is made from should be found on the pipe legend written on the pipe wall.
Pipes of the same polymer, diameter and wall thickness can be joined by the butt fusion technique.

1. If you are joining pipes which are of different types, you must use Electrofusion or Flanged methods for jointing.

Note: The industry now uses only metric pipes but imperial pipes will still be encountered (identified from the pipe legend on the pipe wall). Early imperially sized PE pipes, known as DuPont Aldyl-A that were tan in colour can be found in diameters from ¾" to 8".

2. Imperial pipes must be joined using electrofusion or mechanical fittings.
3. Early swagelined operations used SDR 21 & 26 and connections to these are a specialist operation. See SGN/PM/MSL/1 Part 2.
Note: The range of PE pipes is quite wide as is the range of SDR's available.

THE STANDARD DIMENSIONAL RATIO (SDR)

1. ***The SDR is calculated by dividing the specified outside diameter of the pipe by the minimum specified wall thickness.***
2. ***The common range of SDRs used for PE gas pipes are: 11, 13.6, 17.6, 21 and 26, (the higher the SDR value the thinner the pipe wall thickness) and hence the lower operating pressure rating.***

MATERIAL GRADES

1. ***In the United Kingdom Gas Industry, PE pipe is currently available in two grades of pipe, PE 80 (Medium Density) and PE100 (High Density).***
2. ***PE 80 is a single layer pipe but PE 100 is available as a multilayer pipe with various brand names depending on the manufacturer. The inner core of the pipe can be white or black.***
3. ***Pipes can be co-extruded (one pipe with two layers) or with a peelable outer layer.***

APPENDIX C	Preparation of PE pipe for Electrofusion connection	Page 2 of 3

FUNDAMENTALS OF PE PIPE JOINTING

1. You must not install PE pipes underground locations where the temperature of the ground surrounding the pipe is expected to exceed 20°C.
2. You must not install live PE pipe above ground unless fitted into a purpose designed sleeve to protect it from sunlight.
   Note: The pipe manufacturer will stipulate acceptance of the sleeving system.
3. You should take precautions when carrying out pipe jointing when the air temperature is below -5°C or above 40°C.
4. You must use a heated tent when fusion jointing at or below -5°C.
5. When fusion jointing at or above 40°C, extra cooling time must be allowed prior to removal of alignment clamps.
   Note: In addition, in such extremes of temperature, written advice should be sought from the equipment and pipe manufacturer before commencing fusion jointing under such conditions.
6. You must make PE pipe jointing a continuous process, pipe preparation must be followed by immediate fusing and then cooling; there should be no delay in fusing once the pipe has been prepared.
7. Check the manufacturer's instructions for correct preparation of pipes.
8. Key points:

- When fusing pipes by either Butt or Electrofusion keep all pipe joints and fittings dry.
- Once surface preparations has taken place do not touch the surface.
- You must support the pipe and fittings with approved restraining clamps throughout the fusion and cooling process.
- You must allow the complete system to cool down to ambient temperature before to pressure testing.
- Always maintain the dimensions given in Appendix B when jointing PE pipe.

  This will help to maintain the integrity of the system.

- Fittings MUST be kept in their protective bags to prevent contamination and minimise further oxidation until immediately ready for fitting and fusing.
- Fittings that have been removed from their protective bag for an extended period of time before fusing or where the protective bag has been damaged or punctured should not be used.

9. Maintain fusion proximity distances as stated in Appendix B and proximity from squeeze off positions as stated in Section E0.
10. The fusing of saddles and top tees across butt fusion joints is not allowed.
    These distances are required to make sure that:
    a. ***The heat introduced into the pipe when fusing is taking place does not affect the 'heat affected zone' of adjacent fittings/joints***
    b. ***To provide sufficient room for the pipe to be properly scraped/peeled***
    c. ***To enable inspection of the pipe surface to make sure there are no gouges that could act as leak path from fittings***
    d. ***When squeezing off the distances are required to be sure any adjacent joint/fitting is not affected by the stresses introduced into the pipe which could cause the joint/fitting to fail.***
11. Pipe and fittings must be supported with approved alignment clamps throughout the fusion and cooling process.
12. In very exceptional circumstances, such as large diameter tie-in connections in excavations, the use of alignment clamps may be impracticable due to site restrictions/conditions, however in such cases every effort must be made to make sure joints are correctly aligned.
13. The complete system must be allowed to cool down to ambient temperature prior to pressure testing.
14. **Reheating of fittings is not allowed, unless specifically permitted by the manufacturer.**
15. If there is any evidence that the joint is substandard, then the joint must be cut out and your Operational Manager informed.

16. Existing Electrofusion fittings are normally suitable for multi-layer pipes of SDR 21 rating.
17. Fittings for use on SDR 26 should be checked for suitability with the fittings supplier.
18. You do not need steel liners when jointing PE 100 SDR 26 pipe using electrofusion couplings providing the fittings are rated for use on PE 100 SDR 26 pipe and of the same diameter.
    Note: Please check with the manufacturer's instructions.
    Profuse pipe in some diameters including 296mm and 440mm are jointed using an expansion technique and these pipes will require a liner.
    Jointing of old PE 80 SDR 26 may require the use of steel liners check with manufacturers.
19. Only approved PE Branch saddles can be used for Swage lined pipes and pipes with an SDR of 26, as the fusing process may melt through the pipe wall.
20. PE 80 pipe and PE CAT adapters can be joined with PE 100 pipe using electrofusion couplings
    Fittings used on the PE system should manufactured to *GIS/PL2: Part 4* and be BSI kite marked or approved by SGN Engineering Policy.
21. Where non-standard PE pipe is encountered contact your Operations Manager before work is started. They will agree a method of work.

EQUIPMENT

You must check that:

- the control box you are using for electrofusion jointing meets the requirements of GIS/ECE1 and is connected to a 110 V mobile district supply conforming to SGN/SP/ECE/3. Or
- a combined electrofusion control and power unit conforming to GIS/ECE1 may be used.
- any extension cables, if required, are of the correct power rating
- extension leads are fitted to the power input side of the electrofusion control box.
- the power rating of the extension cable is compatible with the power source.
- All electrofusion ancillary tooling complies with GIS/PL2: Part 5.
- The electrofusion control box has a data retrieval system fitted.

POWER SOURCE

1. Select the correct power source for each electrofusion control box.
2. Check that the generator is of sufficient quality and power for the electrofusion control boxes and fittings.
3. Use Table C1 to select the correct generator.
   Note: There are differing requirements of 40Volt controllers according to whether they are transformer based or are of the 'transformer less' type.
   Transformer less units favoured because of their compact, lower weight, construction.
   However, because of the way they use power it is necessary to match them to a larger generator of much higher power output.

Generator Continuous Power Rating (Minimum)	Electrofusion Control Box Type and Voltage	Maximum Fitting Current (Power)
3KVA	40V Transformer	62A (2.5kW)
6.5KVA	40V 'Transformer less'	62A (2.5kW)
6.5KVA	80V 'Transformer less'	62A (5kW)

Table C1 - Matching Electrofusion Control Unit, Power Source (Generator) and Fittings

APPENDIX - D | Electrofusion jointing of PE pipe and fittings | Page 1 of 13

ELECTROFUSION - PREPARATION

1. PE electrofusion fittings will usually be marked with a variety of information depending on the manufacturer as follows:
   a) Manufacturer's name
   b) Fusion heating time(s) & the power requirements, typically 40 Volts or 80 Volts
   c) Cooling time
   d) Material (PE80 or PE100)
   e) Range of pipe SDRs the fitting can be used on
   f) Dimensions, such as Pipe diameter range
   g) Batch Number and/or Product Code
   h) Bar Code
   i) The protective bags may have labels to indicate the type of fitting.
2. Fittings can either be black or yellow.
3. Check using an approved gas detector at the start and during the operation to confirm that gas readings are, and will remain below 20% L.E.L.
4. If a gaseous atmosphere exists or is suspected the electrofusion technique must not be used.
5. Do not take the electrofusion control box into the trench or a gaseous atmosphere.
6. Select a suitable location, which should be flat and dry,to carryout the operation.
7. If there is likely to be a problem with contamination due to Rain, Snow, air borne dust or wind chill, an appropriate shelter around the machine must be used.
8. Standing water should be removed from the trench.
9. ALWAYS use the correct size of electrofusion saddle and coupler on PE Mains.
10. Check that fittings remain in their protective bag until immediately prior to use.
11. DO NOT scrape any surface containing a heating element.
12. Select a suitable location for the connection.
13. For distances between fittings refer to Appendix B
14. Clean the jointing area of the pipe to remove all dirt and debris with a clean, damp, non-synthetic cloth or paper toweling.
15. If using soapy water this must be washed off with clean water and dried.
16. Inspect the pipe for any defects or damage. See B1_Surface_Damage
17. Check the PE pipe for ovality.
18. Check that the fitting fits correctly on the pipe and if not check to see if the fitting has been incorrectly labelled.
    Note: If the fitting has been incorrectly labelled place it back in the protective bag and follow the returns procedure, see Appendix I.
19. Use a re-rounding tool where necessary.
20. Alignment clamps should be used unless exceptional conditions exist. Such as large diameter tie-in connections in excavations the use of alignment clamps may be impracticable due to site restrictions/conditions
21. Write the fusion and heating times for the fitting being fused on the fitting or the main near to where you are going to make the connection.
    Note: This will act as a cross-check and record of the joint.
22. Should the fusion stop in mid process, allow the fitting and pipe to cool down, cut off /out the fitting and start again.
    Note: DO NOT ATTEMPT TO RE-FUSE ANY FITTINGS.
23. Check the compatability of the electrofusion box, the generator and the fittings power requirements.
24. Always keep electrofusion fittings in their bags until the last possible moment.
25. Never touch the prepared surfaces or of surface of the tapping tee containing the electrical filament coils which have been prepared for the fusion process.

ELECTROFUSION TAPPING TEE PREPARATION

1. Firstly prepare any pipe to be connected to the tapping tee.
2. Cut the pipe to length.
3. Check that the pipe ends are cut square.
4. Create a chamfered edge where required to aid fitting insertion onto the pipe end and the removal of all burrs and swarf from both inside and outside of the pipe.
5. Prepare the tapping tee loading tool for use, fit adapters if required.
6. Check that there is sufficient clearance around the pipe to fit the tool.
7. Clean and inspect the pipe as stated in general requirements.
8. With the fitting still in protective bag, place the fitting on the proposed installation point.
9. With a marker pen, roughly mark a line around the base area of the fitting plus 25mm excess all round.
10. For Multilayer/peelable pipe use the PET tool to score through the skin around the outside of the marked area.
11. Only peel off the skin when ready to assemble the electrofusion fitting onto the pipe.

Pipe Exposure Tool (PET)

12. For PE 80 pipe mark the area with diagonal lines.
13. This is the area to be scraped. Figures D1 & D2.

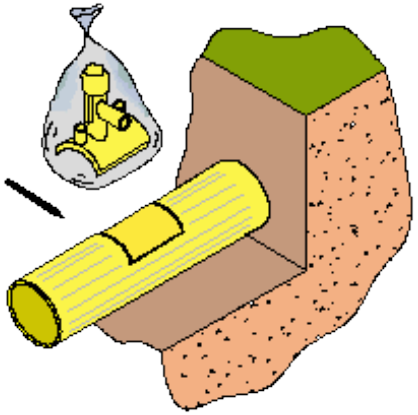


Figure D1 – Marking Round Fitting

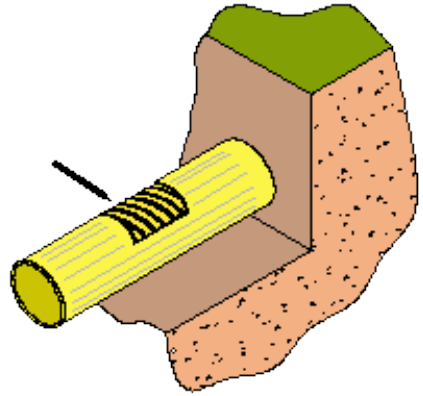
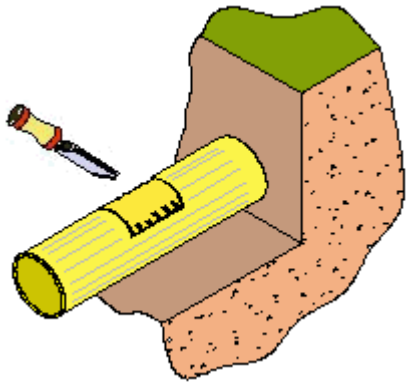


Figure D2 - Hatching Area to be Scraped –

14. For PE 100 mulitlayer pipes mark the pipe as in 12 above
15. Using PET remove the outer layer (skin) of the pipe.
16. On PE 80 pipe thoroughly scrape the whole area outlined using a sharp approved scraper Figure D3.
17. Remove the fitting from its protective bag.
18. Leave the protective cover over the heating element on tapping tees and carry out item . to clean the outlet connection.
19. Mark spiral lines for a distance of half the proposed coupler length plus 25mm.
20. Scrape the outlet of the tapping tee spigot. Figure D4.



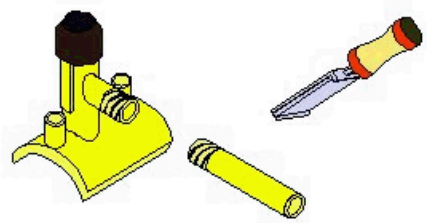


Figure D3 – Scraping of PE80 pipe Figure D4 – Scraping of Spigot

Note:
Take care must not to handle or contaminate prepared surfaces or the surface of the tapping tee containing the electrical filament wires.
If the pipe (including multilayer pipe) is subsequently contaminated the only approved method for removing the contamination is to use a scrapping tool.
If the contamination is heavy, such as spoil/mud/liquid wipe off excess contamination with paper towelling or a non-synthetic cloth and ensuring the pipe is dry followed by scrapping.
DO NOT use alcohol wipes.

21. Remove the fitting cap and store carefully in the protective bag.

You may find it helpful to mark the heating and cooling times on the PE main adjacent to the fitting.

ELECTROFUSION TAPPING TEE FUSION PROCESS

1. Place the fitting into the top loading clamp.
2. Remove the protective cover from the base of the fitting.
3. Place the fitting and loading tool centrally over the scraped pipe or peeled pipe.
4. Assemble the loading tool on to the main.
5. Apply the correct loading pressure on the fitting (1.0 to 1.5 kN), this will displayed by the indicator on the tool. Figure D5.
6. Prepare tee outlet in accordance with Electrofusion Coupler Section, fit coupler and secure with restraining clamp.

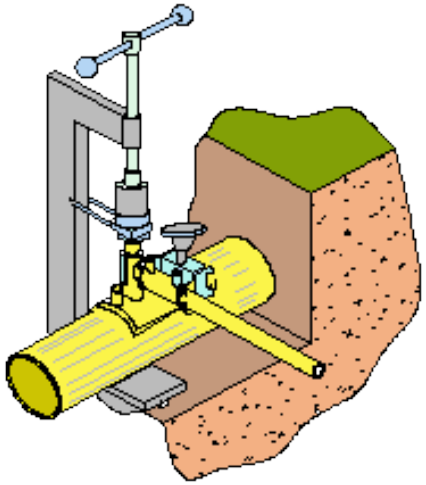


Figure D5 – Clamping Fitting to Main & Coupler to Tee/Pipe

7. Connect the terminal leads from the control box to the electrofusion tapping tee.
   NOTE – Use only approved terminal connector leads.
8. For manual fittings, set the control box timer to the fusion time marked on the fitting and press start.
9. For automatic fittings check the time fitting corresponds with the time on the control box.
   NOTE - It is always important to check the time marked on the fitting even for automatic fusion time selection.

10. Inform all personnel that the electrofusion is about to start ask them to do nothing to disrupt the process.
11. Start the generator and connect the control leads to the generator.
12. Stand clear of the fitting when fusion is in progress.
13. Do not adjust the saddle loading during the fusion process.
14. When the control box indicates fusion is complete, check the fusion indicators have risen. Where this does not occur at the end of the fusion cycle, the fitting must be removed and discarded and a new joint made.

Note:
The fusion indictors or fusion wells only provide a guide to the fusion process having taken place. Where indicators have not popped up or where the fusion well(s) have not started to fill or there is significant difference between each side of the fitting, this indicates a probable poor joint, which must be cut off.

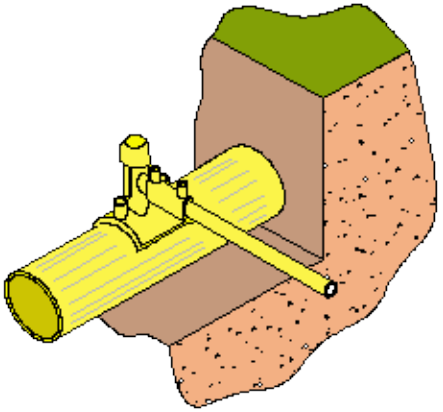


Figure D6 – Completed Connection

15. Carefully disconnect the terminal leads from the fittings taking care not to distrub the fitting.
16. Allow the joint to cool for the given cooling time.
17. Once the time has elapsed remove the top-loading tool Figure D.6.
18. Fuse coupler in accordance with Electrofusion Coupler Section.
19. Pressure test pipe and fitting in accordance with Section G2.
20. If the pressure test is successful, turn down the integral cutter to cut a hole in the main.
21. If the pressure test shows failure of the tapping tee or saddle, cut off the fitting stack and select a new position for the new tapping tee not less than 100 mm away.
22. Repeat the preparation and fusion operation.

ELECTROFUSION COUPLER PREPARATION

1. Check the pipe for ovality, it can be common particularly on coils.
2. Where pipes show signs of ovality re-rounding clamps must be used for a minimum period of 10 minutes prior to pipe preparation and fusing taking place.
   Note: This will make sure it is possible to insert the pipe into the coupler with ease and without damage to the coupler.
3. You can use alignment clamps on the larger diameter PE pipes to re-round the pipe.
4. Pipes to be joined must be aligned and supported so that they are unstressed when assembled into the coupler body.
5. For both MDPE and HDPE, re-rounding clamps must be used on all pipe diameters greater than 400 mm.
6. The pipe ends must be re-rounded for at least 10 minutes prior to jointing.
7. Fit adapters shells if required.
8. Provide sufficient clearance around the main to fit the restraining clamp.
9. Clean the jointing area of the pipe with a clean, damp non-synthetic cloth or paper towelling.
10. If using soapy water this must be cleaned off with clean water and the joint area dried.

Figure D7 – Marking Area to be Scraped

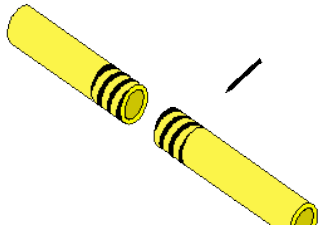


Figure D8 – Spiral Marking of PE

11. With the fitting still in its protective bag, place the fitting on to the pipe and, with a felt-tip marker pen, roughly mark a spiral line around the main.
12. Use the coupler and its centre register as a depth gauge and mark the pipe for one third of its circumference with a felt-tip marker pen.
13. The length to be scraped must be at least half the coupler length plus 25mm. This is the area to be scraped.
    For fixed pipes always start with the underside of the pipe to avoid contamination.
14. Repeat for second pipe to be joined. Figures D7 & D8.
    Note: DO NOT start to scrape the pipe unless you can immediately continue with the fitting and fusing of the coupler.
15. When joining two fixed end pipes together, for example following a cut out operation, at one end of the pipe mark it circumferentially a full length of the coupler plus 25mm.
    Note: This will enable the coupler to be fully inserted onto one side of the cut out and then withdrawn back over the other section of pipe without contaminating the heating element.
    For such operations remove the central stop register inside the coupler.
16. You must cut pipe ends square using suitable tooling and any burrs removed.
    Note: Up to 315mm diameter a guillotine cutter will be acceptable. For pipe in the size range 355mm to 630mm powered mechanical cutters will be necessary.
17. Prepare the pipe surface for the whole area outlined.
18. For standard (non peelable) PE, thoroughly scrape for a distance of 25 mm in excess of half the coupling length.
19. Adequate scraping is judged by removing a spiral line marked on the pipe with a felt-tip marker pen.
20. In the case of fittings with a moulded spigot, the entire spigot must be scraped.
21. It will be easier to scrape all pipe ends outside the trench, whenever possible, and then protect the pipe ends.
22. When pipe is to be scraped in the trench, a mirror should be used to confirm that the underside has been thoroughly scraped.
23. Where Peelable pipe is used, using the Pipe Exposure Tool (PET), score through the skin around the outside of the marked area on each pipe for a distance 25 mm in excess of half the coupling length.
24. Peel the skin off the pipe when ready to position the electrofusion fitting onto the pipe.
25. If the joint is not made immediately protect newly prepared surfaces from contamination.
    Note: Fusion will not occur if the pipe is inadequately scraped and this will lead to failure of the joint. Joint failure can also occur if small diameter pipes are scraped excessively. If the pipe is subsequently contaminated the only approved method for removing the contamination is to use a scrapping tool.

If the contamination is heavy, such as spoil/mud/liquid it is acceptable to wipe off excess contamination with paper towelling or a non-synthetic cloth and ensuring the pipe is dry followed by scrapping.

DO NOT use alcohol wipes.

You may find it helpful to write the heating and cooling times on the PE main with a marker pen adjacent to the fitting.

26. Remove the fitting from its protective bag.
27. Take care not to handle or contaminate the surface of the fitting containing the heating coil or the sections of scraped pipe.
28. Place the fitting over the scraped area of main.
29. Slide the fitting on to the pipe until the centre register or the mark on the pipe is reached.
30. DO NOT force or hammer fittings on to the pipe.
31. Rotate the fitting so that the electrical connections are pinting upwards.
32. Check the main touches the central stop register in the coupler.
33. The fitting must be centralized between the pipe markings.
34. Mark the penetration depth on the side of the pipe at either end of the coupler.

    Note: This provides a visual warning if the fitting moves in relation to the mark prior to fusion taking place.
35. If the coupler(s) are to be installed in a cut out section “knock out” the central stop registers.
36. For a repair, cut out a length of pipe equal to at least four pipe diameters on each side of the damage. Cut a new length of pipe 5 mm shorter than the gap.
37. For connections, cut out a length of existing pipe 5 mm longer than the overall length of the new pipe/fitting to be installed.
38. Push the two couplers fully onto the newly prepared section of PE pipe.
39. With the section of pipe placed in the cut out area pull the couplers back over the prepared existing pipe and apply the restraining clamp.
40. Assemble the alignment clamp on to the main, visually check pipe alignment in all planes and where applicable check free rotation of the coupler to create a stress free joint. Figure D9.
41. Pipe clamps must be fitted for end restraint in all cases.
42. Check the penetration depth again.
43. You should not be able to move the coupler along the pipe.

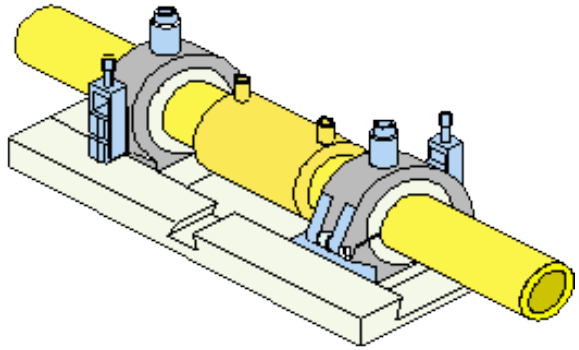


Figure D9 – PE Clamped Prior to Fusion

ELECTROFUSION COUPLER FUSION PROCESS

1. Temporary end caps must be installed to avoid the fitting becoming chilled due to draughts passing through the inside of the pipe,
2. In wet or windy conditions a tent must erected over the Fusion area to avoid cooling and contaminating the fusion joints.
3. Connect the terminal leads from the control box to the electrofusion coupler.

   Note: Use only approved terminal connector leads.
4. Inform all personnel that the electrofusion is about to start ask them to do nothing to disrupt the process.
5. Start the generator.
6. For manual fittings, set the control box timer to the fusion time marked on the fitting and press start.

7. For automatic fittings check the time fitting corresponds with the time on the control box.
8. Stand clear of the fitting when fusion is in progress.
9. Do not adjust the restraining clamps during the fusion process.
10. When the control box indicates fusion is complete, make the quality checks.
11. Carefully disconnect the terminal leads from the fitting taking care not to disturb the fitting.
12. Allow the joint to cool for the given cooling time prior to removing the alignment clamps. Figure D10.

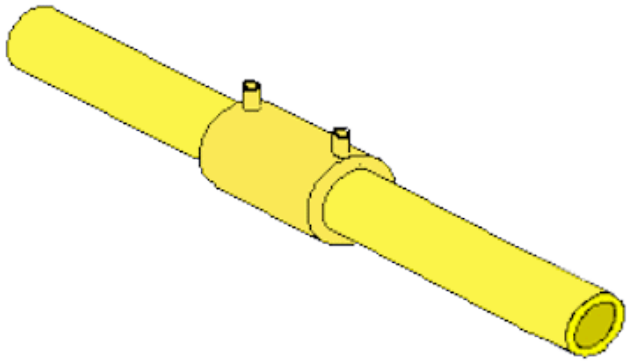


Figure D10 – Completed Joint

QUALITY CHECKS

1. Check that the fusion indicators have risen or the melt wells have filled.
2. Check that no melted material or wire has extruded from the ends of the fitting.
3. Check that the pipe has not moved during welding, fusion heating / cooling time.
4. Check for cleanliness around the joint area.
5. Check for evidence of scraping.
6. If a print facility is available, print out from the control box and check the result. Figure D11.

Serial Number: 65Z102

Date: 20/05/2003 Time: 14:00:00

Ambient Temperature: 15.0°C
Joint No: 46
Operator code: ST
-- AUTOMATIC fitting --
Target Fusion Time: 80.0 seconds
Achieved Time: 80.0 seconds

Joint Status: COMPLETE

********** POWER PROFILE **********

Time (S)	Output Voltage (V)	Output Current (A)	Output Energy (kJ)
2.0	39.7	22.1	0.0
8.0	39.7	19.2	5.6
16.0	39.7	17.7	11.4
24.0	39.7	16.8	16.9
32.0	39.7	16.1	22.1
40.0	39.7	15.5	27.2
48.0	39.7	15.1	32.1
56.0	39.7	14.8	36.8
64.0	39.8	14.3	41.5
72.0	39.8	14.0	46.0
80.0	39.8	13.8	49.9

Figure D11 - Electrofusion Joint Record Print Out

LARGE DIAMETER ELECTROFUSION COUPLERS

There are currently two different suppliers of large diameter electrofusion couplers – Radius EasiGrip and the Frialen. Each fusion process is described separately in b) below.

ELECTROFUSION COUPLER PREPARATION 400MM TO 630MM.

POSITIONING PIPES

1. Check that when the pipe is positioned so that the two faces of the pipe to be joined are square to each other
2. The excavation must be large enough to facilitate the removal of the re-rounding tools after the joint has been assembled.
3. The excavation must be large enough to facilitate the fitting and removal of the electrofusion restraint clamps.

PIPE OVALITY

1. Select a hydraulic re-rounding clamp suited to the diameter of the pipe being used.
2. The width of the clamp should be at least equal to half the
3. width of the coupler being joined.
4. Place clamps onto each pipe end to be joined. The clamp should be fitted flush with the end of the pipe and the skin should remain ON the pipe.
5. Compress the clamps shut and leave for a period of 10 minutes.
6. Release the clamps and reposition them at a distance approximately equal to half the coupler width plus100mm from end of the pipe.
7. Close clamps again.

REMOVAL OF MULTI-LAYERED PIPE SKIN

1. The outer pipe skin should only be removed when it is necessary to assemble the joint, in this way, the skin continues to protect the pipe from contamination for the maximum duration.
2. To remove the skin requires it to be scored using the Pipe Exposure Tool. (PET).
3. Using the re-rounding clamp as a guide, pierce the skin using the
4. PET tool and score around the entire circumference of the pipe.
5. Using the PET tool to score across the top of the pipe from the end to the circumferential cut.

   Note: It is permissible to do (i) and (ii) in reverse order if this is found to be easier.
6. Lift the skin and peel from the pipe by hand wearing suitable protective gloves.
7. The skin should be easily removed from the pipe in one piece.
8. If there is any dirt contamination on the section of exposed pipe, or on the very end of the pipe due to skin delamination, this can be removed using the conventional scraping technique.
9. Do not use alcohol wipes.

ELECTROFUSION COUPLER FUSION - RADIUS COUPLERS

1. The Electrofusion Control Unit (ECU) to be used with Radius couplers for 450mm up to and including 630mm diameter must be suitable for use on 80V fittings and display a label stating, 'This equipment approved for use with Radius Easigrip'.
2. For 450mm to 630mm pipe sizes the ECU must be of a type that allows programming for multiple cycles and for 630mm pipe set up to allow 4 digit weld times to be input. A suitably match generator must also be available.

PREPARING THE PIPE

1. Check the P.E. pipes to be jointed can be aligned and supported so that they are unstressed hen assembled into the coupler body.
2. Keep jointing area/ assemblies/ equipment clean and dry during these installation processes.

3. Check the pipe (pipe skin on multi-layer pipe) for any cuts, deep scratches, abrasions or impact damage that may provide detrimental effect to the performance of the coupler.
4. Check the pipe end is cut square checking with the aid of a set square, or equivalent method on cutting tool, and remove any pipe burrs.
5. Create a chamfered edge to help pipe insertion into coupler and remove all swarf from pipe.
6. Use re-rounding clamps on large diameter pipes and round the ends for at least 10 minutes.

ON PE80 SDR 17.6 PIPE:

1. Measure the pipe dimension (outside diameter), which will help when trying to assess how much of the oxidised material needs to be scraped off the pipe
   Note that removal of an excessively large amount of material can leave a large annular gap which cannot be closed, or completely closed, during fusion.
2. Before scraping takes place, clean the surface of the pipe to remove as much as grease, oil or surface dirt as possible.
   Do not use Alcohol Wipes.
3. Once it has been established how much material is required to be taken off, mark the pipe end for couplers insertion depth (half coupler length).
4. Reposition the clamp, scrape the end using an approved scraping tool.
5. Slide the coupler on by hand, keeping checking the fit into the socket during scraping until the satisfactory fit is obtained.
6. The maximum air gap between pipe and fitting should be no more than 2mm, check with a feeler gauge.
7. Repeat this process to prepare the second pipe-end to be jointed.

ON MULTI-LAYERED PE100 SDR21 PIPE:

1. Before the outer skin is removed, clean the surface of the pipe to remove as much as grease, oil or surface dirt as possible.
   Do not use Alcohol Wipes.
2. Mark the pipe end for couplers insertion depth (half coupler length).
3. Reposition the clamp, remove skin from pipe end up to the marked length.
4. Slide the coupler on by hand, keeping checking the fit into the socket ensuring a satisfactory fit is obtained. (If using the re-rounding clamps then the fitting should slide on with no excessive required.)
   (The easy grip coupler is not an interference fit, the only interference coupler is the Frialen).
5. The maximum air gap between pipe and fitting should be no more than 2mm.
6. Repeat this process to prepare the second pipe-end to be jointed.

ELECTROFUSION PROCESS

1. Using the appropriate lifting aids, slide the two pipes to be joined together, check pipes line up with markings at edge of coupler and that the coupler body is unstressed.
2. Fit the joint immobilisation clamps, connect the electrofusion box & generator and prepare to carry out fusion process using timings in Table D.1 below.
3. Follow the appropriate instructions on the ECU, Coupler Label and Table D.1 to carry out the fusion process to weld the fitting.
4. Allow cool time after weld time completed as shown in Table D.1.
5. Once cooled, remove all assembly aids and the welded pipe now suitable for handling

Details	450mm	500mm	630mm
Warm-up Time	180 seconds	180 seconds	300 seconds
Soak Time	600 seconds	600 seconds	900 seconds
Weld Time	700 seconds	700 seconds	950 seconds
Cool Time	45 minutes	40 minutes	40 minutes

Table D 1 - Radius Easigrip Coupler Electrofusion Process Times

FRIALEN COUPLERS

ELECTROFUSION COUPLER ELECTRICAL CHECK (FRIALEN ONLY)

1. Need to check coupler is okay by running fusion cycle for 10-12 seconds.
2. Before starting this process, start the generator and leave to settle for approximately 1 minute.
3. Check that Frialen ECU is switched OFF before connecting power supply lead to generator.
4. Connect power supply lead to the generator and switch ON.
5. Connect leads of the Electrofusion Control Unit to one side of the coupler.
6. Once connected, swipe the WHITE Bar Code on the fitting and press START on the ECU.
7. Once 10-12 seconds elapsed, press STOP button.
   Note: This procedure checks the heating element.
8. If the coupler cuts-out during these 10-12 seconds, check the ECU for any error messages and try checking the generator output or another coupler.
9. If coupler is found to be faulty, mark it and return it to the Operational Manager.

PREPARING THE PIPE

1. Check the P.E. pipes to be jointed can be aligned and supported so that they are unstressed when assembled into the coupler body.
2. Keep jointing area/ assemblies/ equipment clean and dry during these installation processes.
3. Check the pipe, (pipe skin on multi-layer pipe) for any cuts, deep scratches, abrasions or impact damage that may provide detrimental effect to the performance of the coupler.
4. Check the pipe end is cut square checking with the aid of a set-square or equivalent method on cutting tool, and remove any pipe burrs.
5. Create a chamfered edge to help pipe insertion into coupler and remove all swarf from pipe.
6. Use re-rounding clamps to reduce ovality on large diameter pipes and round the ends for at least 10 minutes.
7. Mark the insertion depth of coupler. Half depth for usual installation and full depth for slideover +25mm to indicate scraping has taken place.

ON PE80 SDR 17.6 PIPE:

1. Using the Pi-Tape, measure around the circumference of the pipe to and read off the exact outside diameter. This measurement should be made at least 25mm from the pipe end due to possible end reversion.
2. The amount of scraping can now be calculated.
   Note: By establishing the actual dia. of the pipe the decision can be made as to how many scrapes are required. Mechanical scraping is recommended as it removes between (0.2mm - 0.4mm per scrape) Hand scraping is inconsistent and the results may be irregular.
3. Use the mechanical scraper to remove the oxidised layer and any additional layers off the pipe
   Note that removal of an excessively large amount of material can leave a large annular gap which cannot be closed, or completely closed, during fusion.
4. Before scraping takes place, clean the surface of the pipe to remove as much as grease, oil or surface dirt as possible.
   Note: This can be done by using Alcohol Wipes as recommended in the installation instructions by Frialen only for the large diameter Frialen 400mm to 630mm Electrofusion Couplers on Standard PE 80 SDR 17.6 pipe.
5. Established how much material is required to be taken off, then mark the pipe end for couplers insertion depth (half coupler length).
6. Reposition the clamp, scrape the end using Frialen Mechanical Scraper or an equivalent tool.
7. Slide the coupler on by hand.

By employing the above procedure, the need for additional force is greatly reduced however, on occasions it may be necessary. A dead blow / soft faced hammer will not cause any damage to the coupler as long as it is not applied directly in line with the terminals. Additional force is more likely to be required on larger diameter fittings due to their weight and size.

8. The maximum air gap between pipe and fitting should be no more than 2mm.
9. Repeat this process to prepare the second pipe-end to be jointed.

ELECTROFUSION PROCESS

1. Using the appropriate lifting aids, slide the two pipes to be joined together, check pipes line up with markings at edge of coupler and that the coupler body is unstressed.
2. Fit the joint immobilisation clamps, connect the electrofusion box & generator and prepare to carry out fusion process using timings in Table D2 below.
3. Swipe the YELLOW Bar code which initiates the preheat cycle of the coupler.
4. Confirm the details on the Frialen Electrofusion Box and press START button. This preheat cycle should allow the pipe enough time to expand inside the coupler. It may be necessary to pre-heat more than once up to a maximum of 3 times to alleviate any gaps so that the weld fusion process can proceed.

Details	400mm	450mm	500mm	630mm
Preheat Time	870 seconds	870 seconds	870 seconds	870 seconds
Weld Time	750 seconds	870 seconds	720 seconds	850 seconds
Cool Time	35 minutes	40 minutes	40 minutes	40 minutes

Table D.2 Frialen Coupler Electrofusion Process Times

5. To begin weld fusion, swipe the WHITE BAR CODE, confirm the details and press and press Green START Button on ECU.
6. Allow Cool Time as shown in table below
7. Repeat this for other side of the coupler
8. Once cooled, remove all assembly aids and the welded pipe now suitable for handling.

QUALITY CHECKS

1. Check that the fusion indicators have risen and that no melted material or wire has exuded from the ends of the fitting.
2. Check that the pipe has not moved during welding
3. Check for cleanliness around the joint area
4. Check got evidence of scraping
5. If a print facility is available, print out from the control box and check the result, Figure D.12.

Serial Number: 65Z102
Date: 20/05/2003 Time: 14:00:00
Ambient Temperature: 15.0°C
Joint No: 46
Operator code: ST
-- AUTOMATIC fitting --
Target Fusion Time: 80.0 seconds
Achieved Time: 80.0 seconds
Joint Status: COMPLETE
********** POWER PROFILE **********

Time (S)	Output Voltage (V)	Output Current (A)	Output Energy (kJ)
2.0	39.7	22.1	0.0
8.0	39.7	19.2	5.6
16.0	39.7	17.7	11.4
24.0	39.7	16.8	16.9
32.0	39.7	16.1	22.1
40.0	39.7	15.5	27.2
48.0	39.7	15.1	32.1
56.0	39.7	14.8	36.8
64.0	39.8	14.3	41.5
72.0	39.8	14.0	46.0
80.0	39.8	13.8	49.9

****

Figure D 12 – Specimen Large Diameter Print Out

OTHER ELECTROFUSION FITTINGS

When assembling socketed fittings such as in-line tees, reducers and elbows. The fusion procedures for electrofusion couplers should be followed when (These will not rotate when clamped)

1. Specialized tooling may be required to accommodate such fittings.
2. Some electrofusion equal tees have an electrofusion body with a short integral spigot leg to enable connection via an electrofusion socket. See Figure D13.

Figure D 13- Short Spigot Fitting

3. Where this type of tee is to be fitted a multi clamp must be used see Figure D 14 & D 15.
4. This clamp will restrain all three legs of the joint from axial and rotational movement and enable the sockets to be aligned correctly during the jointing/cooling process, but should not preclude free movement of the electrofusion fitting. (Two examples of multi clamps are shown below).
5. Electrofusion must not completed without the correct use of an appropriate restraining clamp.
6. If a multi clamp is not available for use with a short spigotted tee, then an alternative fitting or method of constructing the tee must be used.

BRANCH CONNECTIONS

1. New Electrofusion fittings are normally suitable for multilayer pipes of SDR 21 rating; fittings for SDR 26 should be checked for suitability with the fittings supplier. See Section D2.

Figure D 14 – Multi Clamp

Figure D 15- Clamp

BLACK CORE PIPE

1. PE pipe suppliers (Radius and GPS) are now producing multilayer pipes using a black PE core with a standard yellow shell coating or yellow peelable skin.

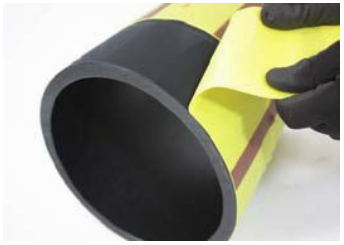


Figure D16 – Black Core Multilayer Pipe

2. These pipes are made to the same dimensions PE80 and PE100 and BSI Kitemark approved to gas industry standards (GIS/PL2-2).
3. The change is limited to visual impact only - work procedures, jointing techniques and tooling are unaffected.
4. It is important however to note that the innner black core is not a means to identify that you have scraped enough pipe. It is not a “scrape to marker”.
5. You must not over scrape and expose the inner black core.

Figure D17 – Electrofusion

Figure D18 – DO NOT Scrape Over

6. Using standard pipe scrape exposing the black Preparation tools core Marker pens.
7. Frialen marker pens can be used.

Figure D19 - Frialen Marker Pens

APPENDIX - E | Butt fusion jointing of PE pipe and fittings | Page 1 of 10

GENERAL REQUIREMENTS

1. All butt fusion equipment must be of the fully automatic type with a data retrival facility and approved to GIS/PL2 Part 3. Preference should be given to butt fusion machines with GPS location and down loadable record systems.
2. When butt fusing Multilayer pipe check that the Butt-fusion machines has been either chipped to accommodate Multilayer pipe (such as Profuse pipe) or have a provision to enter the diameter and SDR of the pipe to be butt-fused.
3. Only pipe of the same diameter, polymer grade and Standard Dimension Ratio (SDR) can be jointed using butt fusion, dissimilar polymers and SDRs, can only be jointed using electro fusion, mechanical or flanged methods.
4. All joints must be made by a suitably qualified and competent operator.
5. For Intermediate Pressure (>2bar) projects:
    a) A competent person (who should not be the operator) must observe sufficient joints being constructed on site to make sure that fusion procedures are correct.
    b) The frequency of these observations should be as follows:

- prior to the commencement of the project;
- on a weekly basis for the duration of the project.

6. Before the first joint of the day, or any change of pipe size and after any washing, do the following:
    a) Place the hotplate in the machine
    b) Bring the pipe up to form a weld bead.
    c) Do not fuse this joint.
    d) Remove the hotplate,
    e) allow the melt to cool for a few minutes,
    f) trim back beyond the bead.
    g) Normal jointing procedure should then continue.
7. The PE pipe ends must then be re-prepared before making the joint.
8. Retain all butt fusion joint data retrieval printouts in the project file.
9. Only PE 100 of 125mm diameter and above can be butt Fused, details of the butt fusion times can be found at the end of this section.

BUTT FUSION PREPARATION

1. Choose a suitable location, which should be flat and dry to carryout the operation.
2. If you consider there is likely to be a problem with contamination due to air borne dust or wind chill, you must use an appropriate shelter around the machine.
3. Use a machine that has been regularly serviced and in good condition.
4. Select an appropriate power source, (check that the generator has sufficient fuel to complete the butt fusion cycle).
   Note: Butt fusion machines are not intrinsically safe and must not be used in gaseous or potentially gaseous atmospheres.
5. Before attempting to fuse any joints check that the generator is the correct voltage and power output. Reference must be made to manufacturer's instructions.
   Note: For pipe sizes of 315mm a 4.2kw generator will be required whilst for pipes sizes of 400mm a 6kw generator is required.
6. If you suspect that a gaseous atmosphere exists this must be checked using an approved gas detector at the start and during the operation to confirm that gas readings are, and will remain below 20% L.E.L.
7. Where circumstances change you will need to reassess and seek authority to proceed from your Operational Manager.
8. Not all gaseous atmospheres are the result of leaking gas pipes they can also result from collection of gases in defective sewer systems.

BUTT FUSION EQUIPMENT CHECK

1. Before using the machine make the following checks:
    a) That the butt fusion machine control unit is configured for the wall thickness to be fused. (for example SDR 21 or SDR 26).
    b) Neither the heating plate nor its non-stick coating is damaged.

c) The hydraulic hoses and connections are not be leaking and in good condition.
d) The fusion faces do not have any gouges or dents.
e) The temperature indicators are not be damaged.
f) That electrical cables are not damaged and have no loose connections.
g) The machine guide bars are free from corrosion and the clamps move freely.
h) The frame of the machine is sound and all the guides are secure, in place and not distorted.

2. Before connecting the machine to the power supply you must check the heating plate and trimmer for cleanliness.
3. If the heater plate is contaminated with mud and other site debris clean the plate using clean water and a bristle brush, and lint free cloth or paper towel which will not damage the non-stick coating.
4. You should remove any PE melt with a piece of wood to avoid surface damage.
5. If a surface cannot be cleaned by these methods, inform your Operational Manager.
6. Clean the trimming tool using water and a lint free cloth or paper towel all trapped plastic deposits must be removed.
7. Your Operational Managers may grant permission for aluminium cleaner or scouring powder, followed by a water wash, to be used to remove oily deposits.
8. If any of these are unsatisfactory the your Operational Manager must be informed and the machine labelled as faulty and returned for repair.

BUTT FUSION OPERATION – FULLY AUTOMATIC

1. After completing the checks the machine is suitable for use the machine and its component parts may be connected together, Figure E.1
2. If required enter the following parameters into the butt fusion machine.

- SDR,
- Mains Diameter and Type (gas), for main to be fused together,
- Operators code, this will identify who fused this joint together,
- Job details.

Refer to the manufacturer's instruction booklet to learn how enter the above information.

BUTT FUSION SEQUENCE

1. Check that the pipes to be Butt Fused are of the same diameter, SDR and pipe grade.
2. Inspect the pipe for any damage or cuts. See Section B1, If they are present this section of pipe must be cut out.
3. You must clean the pipe ends and dry them inside and out using a clean non-synthetic cloth or paper towelling.
4. You must remove any tarry deposits and writing by scraping using an approved scraper for a distance of at least 25mm from the pipe end.
5. Increase this distance if a large amount of trimming is required.
6. Secure the trimmer into the machine.
7. Peelable pipe can be Butt fused using a standard butt fusion machine; there is no requirement to remove the skin in order to clamp the pipe in the machine.
8. You must use a PET tool to score a strip around the end of the pipe for the butt fusion operation.
9. Remove a circumferential strip a minimum length of 25mm from the ends of the pipe to be jointed.
   Note: A wider strip of the peelable layer needs to be removed, when making a dummy joint.
10. Where extra trimming is required, remove the side plate adaptor fitted to the PET.
11. If the peelable layer shows evidence of disbonding prior to removal, the core should be lightly scraped in order to remove any possible contamination.
12. Extra trimming is required where the pipe end is out of square.

13. The distance for pipe end preparation should be increased to make a gap of approximately 25mm remains once the pipe ends have been trimmed.
14. Fit the correctly sized shells to the pipe clamps.
15. To reduce pipe drag always fit the new pipe which is being added to the pipe string to side of the butt fusion machine which has the greatest amount of travel.
16. Place the pipe onto correctly sized rollers to support the pipe and aide alignment in the machine.
17. Place the ends of the pipes to be fused into the machine against the trimmer.
18. Rotate the new pipe so that the pipe legend is facing upperwards.
19. Clamp the pipe in place. Figure E.1
20. Place clean card or cloth beneath the machine to make sure that dirt or dust is not picked up as the trimmer rotates.
    Note: This reduces the chances of contamination.

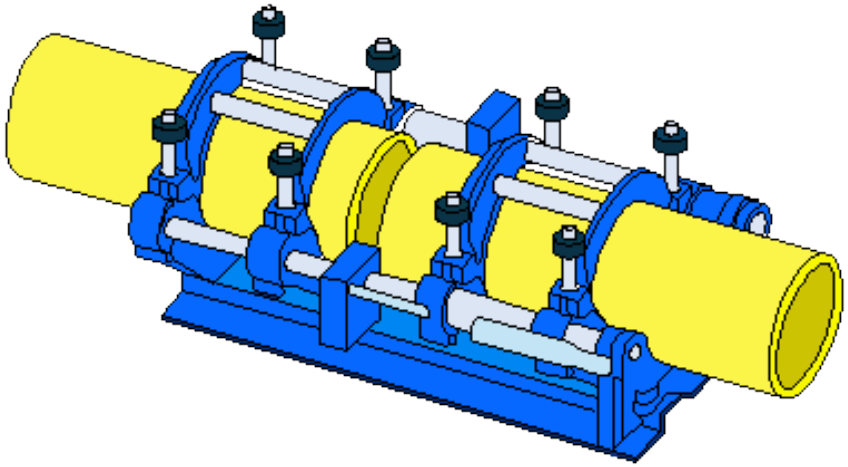


Figure E.1 – Butt Fusion Machine

21. Install temporary end caps or expanding stoppers to avoid the heater plate becoming chilled due to draughts passing through the inside of the pipe.
22. In wet or windy conditions you must erect a tent or cover over the Butt Fusion machine.
23. Refer to manufacturers instructions to operate the “auto trim” cycle and continue the trimming until an even swarf of PE is shaved off from both ends of the pipe.
24. At this stage trimming can be discontinued. Figure E.2.
25. On multilayer/peelable pipe check that there is a gap of approximately 25mm between the trimmed end and the skin.
26. If not remove pipes from machine; peel back additional skin and restart trimming cycle.

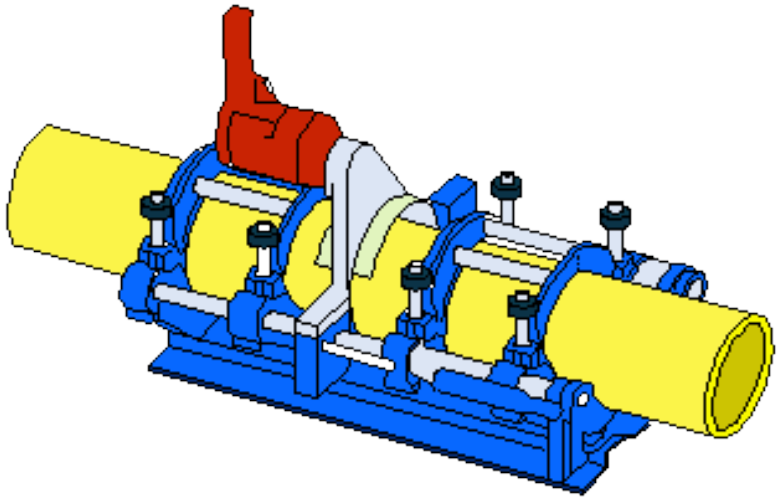


Figure E.2 – Trimming of PE Main

27. When the machine has pulled the pipe apart remove the trimmer and avoiding contact with the trimmed ends remove the swarf from around and inside the pipe avoiding contact with the trimmed ends, see Figure E.3.

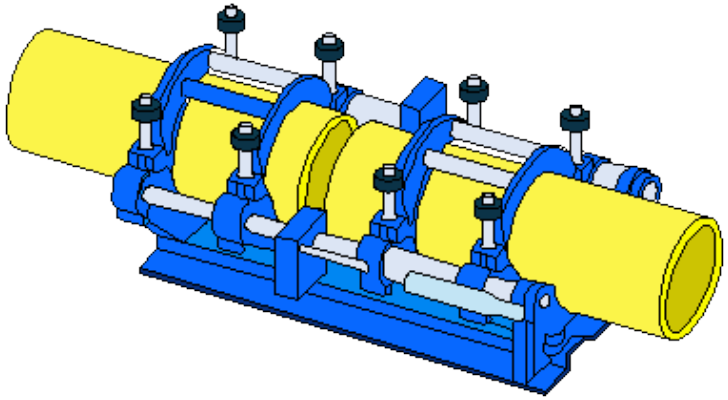


Figure E.3 – Butt Fusion Check Cycle

28. Referring to manufacturer's instructions operate the 'check' cycle.
29. Make a visual check to confirm pipe misalignment is not greater than 1mm. For pipe sizes larger than 180 mm diameter, end offset of up to 10% of the pipe wall thickness is allowable.
30. Once the alignment check is complete and the pipe has been separated the heater plate can be installed between the pipes and secured.
31. Make a check to be sure that the thermostatically controlled heater plate is at the correct temperature.
32. This can be confirmed by ensuring that the heater pointer is in the green quadrant of the heater gauge or indicated on the LED display.
33. Should the heater plate not be up to temperature keep the pipe ends together to minimise any contamination until the correct heating temperature has been reached.
34. Referring to manufacturer's instructions operate the 'fusion' cycle.
    - The pipe ends will be pulled up against the heater plate for the appropriate length of time under controlled pressure.
    - The pressure is then released and the pipes moved away from the heater plate.
    - the heater plate removed and the molten ends of the PE pipes are then pulled together under controlled pressure to create the joint. Figure E.4.
35. During the bead up cycle you should check that an even molten bead is being produced on each pipe end.

Note; If this is the first joint of the day, a change in pipe diameter to be fused or if the heating plate has been washed the fusion cycle must be cancelled after the bead up sequence is complete. The machine must then be opened up, the heater plate removed and the melted pipe allowed to cool. This process must be completed twice on mains sizes above 180mm diameter. This process cleans the heater plate and must be repeated if the heater plate is:

- ***switched off and allowed to cool or***
- ***a different size pipe is used or***
- ***a different SDR is used.***

Retrim the pipe ends as stated above and repeat the trimming and check cycles.

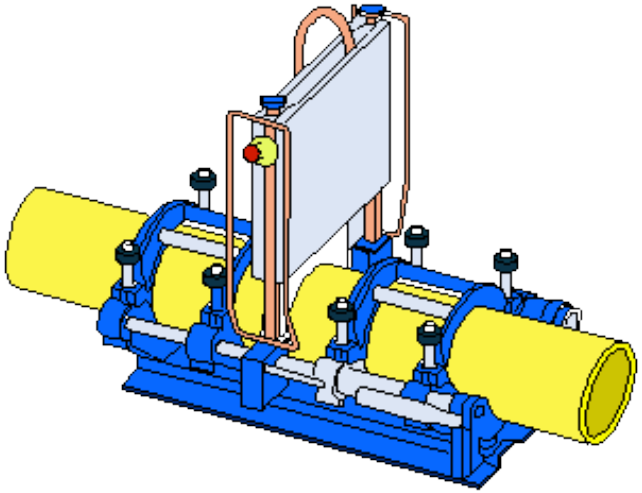


Figure E.4 – Fusion Cycle

36. When the automated fusion cycle is complete and the cooling time, as indicated on the machine, has elapsed, carefully remove the section of pipe containing the joint from the butt fusion machine see Figure E.5. **Fusion cooling times must not be aborted unless the joint is to be discarded.**
37. All external weld beads must be removed with an approved tool and inspected (see Figure E8) Following "Debeading" items 1 to 8).

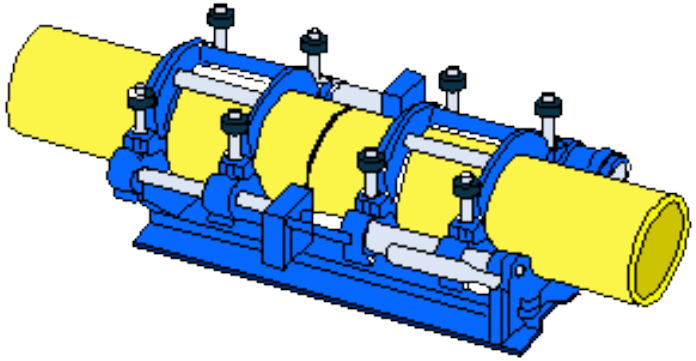


Figure E.5 – Cooling Period

38. You must number and date each butt fusion joint on the top of the pipe with a marker pen so it corresponds with the information on the control unit of the machine.
    Note: This aids identification.
39. For intermediate pressure mains, the pipe joints must be numbered and the information recorded on the layout drawings.
40. The removed beads must be kept for inspection by your Operational Manager or their representative and must be numbered with its corresponding joint number.
41. Retain the numbered beads at least until the PE pipe has been successfully pressure tested and commissioned.

QUALITY CHECKS

1. The 1st joint (or 1st and 2nd joints on pipes above 180mm) shown on the print out or electronic copy must be a fail at the fusion cycle to indicate that the first joint was a 'dummy' joint to clean the heater plate. Figure E.6.
2. Check the complete weld bead for evenness as per Figure E.7.
3. Visually inspect the weld bead.
4. The external weld bead width must be checked with the correct weld bead gauge, before removal, to confirm it is within acceptable limits, check for pipe misalignment and make sure that it is satisfactory, see Figure E.7 or refer to manufacturer's guidelines
   Note: The evenness of the bead with a slightly greater bead width on the underside of the joint can be expected.
5. Where a bead inspection indicates a faulty joint, the joint must be cut out and the pipe re-jointed using the above procedure.
6. A verbal report must be given to your Operational Manager as to the cause of the joint failure.
7. A record of all joint(s) must be provided, a portable data printer may be attached to the Butt Fusion machine and a print taken off of all of the joints. Alternatively an electronic copy may be downloaded.
   Note: Refer to the manufacturer's instructions to operate the printer. Only those printers designed for that make and model of machine may be used.
8. All butt fusion joint data retrieval printouts must be retained and these printouts must be kept in the project file.
9. Where bead inspection identifies a faulty joint, you must cut out the joint and the jointing operation repeated according to the procedure detailed above.
10. Any problems must be reported to your Operational Manager or their representative.
    Note: As part of a quality control programme, your Operational Manager may require destructive testing of both butt and electrofusion joints made for checking fusion procedures prior to the project start, or selected as cut out samples from an ongoing project.

DEBEADING

1. Using an approved external bead remover remove the external bead and carry out visual checks on the underside of the bead for contamination.
2. You must complete a bend back test to identify any slit defects and lack of fusion.
3. It is important that all beads and pipe joints are numbered and the beads passed to your Operational Manager.
4. The bead must then be rechecked with a bead gauge and carry out an immediate check of the underside of the beads for evidence of offset, slit defects, and contamination. Figure E8.
5. An unsatisfactory joint must be cut out immediately and discarded.
6. Where operational needs require the internal bead to be removed, approved tools should be used and the internal bead should be subject to the same inspection procedure as shown in Figure E8.
7. Your Operational Manager or their representative must also inspect all beads.
8. Each of the numbered beads must be retained at least until the PE pipe has been successfully pressure tested and commissioned.

JOINT RECORDING FOR INTERMEDIATE PRESSURE MAINS

1. The butt fusion machine data logger will automatically allocate a number to each joint: these numbers must be used as a reference for joint recording.
2. Each joint must have its reference number written on and this information recorded on the layout drawings.
3. The corresponding beads must be labelled in a similar way.
4. The numbered joints must be recorded in such a way as to facilitate the location of buried joints at any subsequent time.
5. The data logger display will give details of a satisfactory fusion joint: it should be checked each time a joint is made.

Figure E.6 - Butt Fusion Joint Print Out

Machine type: BF3

Serial number : 145Z0696 V98 C005/I

Time : 10:45:18 Date : 14/08/2003

Ambient temperature = 25 Deg C

Joint number : 201

Job Number : FUS1

Operator Code : DEMO1

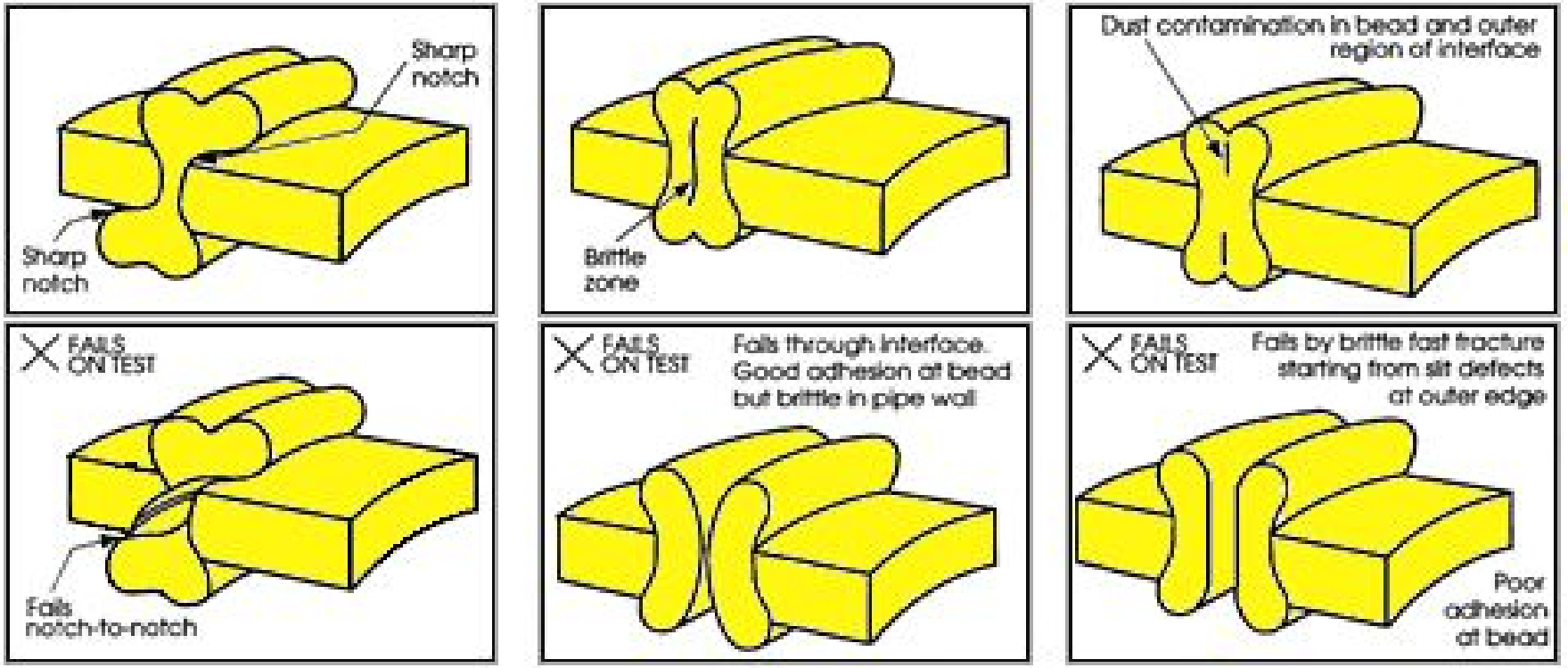
Pipe selected

PE-X, Diam 180

Target heater temp. : 233 Deg C

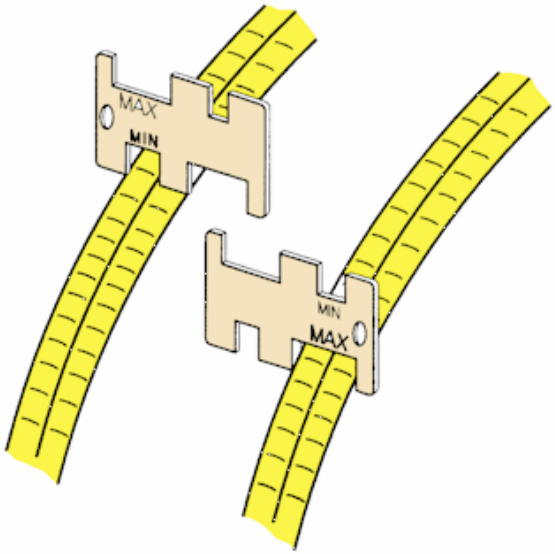
Joint Cycle : COMPLETE

Parameter title	Value
Bead Pr. (no drag)	20.0 Bar
Join Pr. (no drag)	20.0 Bar
Dynamic Drag	14.9 Bar
Peak Drag	14.9 Bar
Heater temperature	231 Deg C
Bead up pressure	35.1 Bar
Bead travel	250
Heat soak pressure	1.6 Bar
Heat soak time	140 Seconds
Dwell time	1.9 Seconds
Fusion Pressure	34.6 Bar
Cooled time	600 Seconds



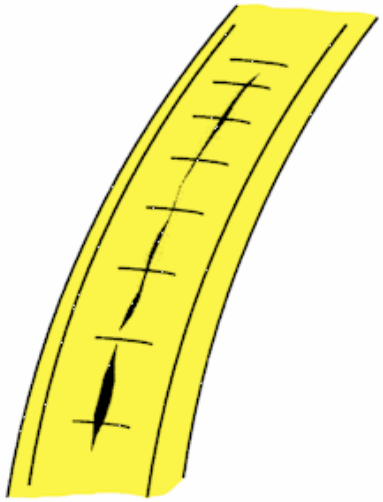
Pipe misaligment, combined with high fusion pressure, creates an excessively sharp weld bead notch. This can cause premature stress crack failure and reduced impact resistance. Bead removal will reveal th eoffset. Pipes meeting SGN's specification will tolerate a 10% wall thickness offset.	Re-cystallization of melt surface, due to excessive cooling before fusion, gives a low bond strength brittle region at the interface. The weld bead interface can be good, but the weld bead may be small. This causes a joint with poor impact strength and brittleness in bending. Strees crack resistance may be adequate.	In an otherwise well made joint, contamination from a dusty hotplate may be retained at the interface. Butt fusion is not fully self-cleaning. Weld bead removal will reveal a slit defect. The weld bead interface is weak. This causes very poor properties in bending or impact when the very sharp slit crack can grow. Pressure tests may fail to detect poor stress crack resistance.
a) Pipe misalignment	a) Melt cooling	a) Interface contamination

Figure E.7 - Butt Fusion Visual Inspection of Bead



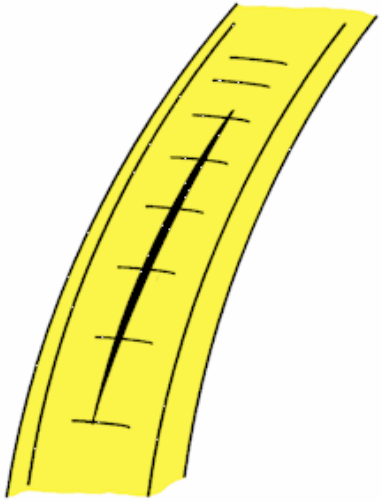
1. Bead width

Run the max/min bead gauge along the bead to check that it is within the specified limit. At the same time check for areas of distortion in the bead.



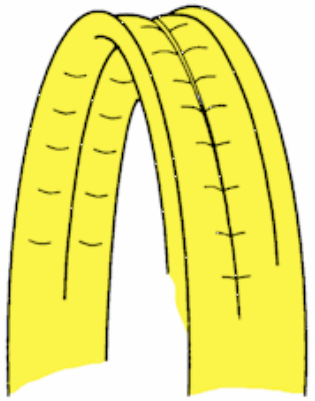
2. Contamination

Examine the underside of the bead over its complete length for contamination at the interface and, if found, confirm on the joint.



3. Slit defects

Examine the underside of the bead over its complete length for any separation caused by lack of fusion. This will be seen as a slit at the interface.



4. Lack of fusion

Confirm lack of fusion in the bead by bending it backwards on itself along its complete length. If faulty a clear separation will be seen. Locate the lack of fusion in the joint.

Figure E.8 - Butt fusion Visual Inspection of Bead

BUTT FUSION TIMES FOR PE 80 PIPE – SDR 17.6

Outside Diameter	SDR	Wall thickness (minimum)	Bead-up interface stress	Initial size (approx.)	Soak Time	Maximum Plate removal time	Fusion and cooling interface stress	Cooling time in clamps	Cooling time out of clamps
mm		mm	MPa	mm	secs	secs	MPa	mins	mins
180	17.6	10.3	0.15	2	134	4	0.15	7	16

PE 100 – SDR 21

315	21	15.0	0.15	3	177	4	0.15	9	20-
355	21	16.9	0.15	4	188	8	0.15	10	20
400	21	19.0	0.15	4	200	8	0.15	10	20
440	21	Not supplied							
450	21	21.4	0.15	4	212	8	0.15	11	20
500	21	23.8	0.15	4	224	8	0.15	12	20
630	21	30.0	0.15	4	251	8	0.15	13	20

Outside Diameter	SDR	Wall thickness (minimum)	Bead-up interface stress	Initial size (approx.)	Soak Time	Maximum Plate removal time	Fusion and cooling interface stress	Cooling time in clamps	Cooling time out of clamps
mm		mm	MPa	mm	secs	secs	MPa	mins	mins
125	21	6.0	0.15	2	112	4	0.15	6	9
140	21	6.7	0.15	2	118	4	0.15	6	10
180	21	not supplied	to SGN						
200	21	9.5	0.15	3	141	4	0.15	8	15
250	21	11.9	0.15	3	158	4	0.15	8	18
280	21	13.3	0.15	3	167	4	0.15	9	20
296	21	Not supplied							
315	21	15.0	0.15	3	177	4	0.15	9	20
355	21	16.9	0.15	4	188	8	0.15	10	20
400	21	19.0	0.15	4	200	8	0.15	10	20
440	21	Not supplied							
450	21	21.4	0.15	4	212	8	0.15	11	20
500	21	23.8	0.15	4	224	8	0.15	12	20
630	21	30.0	0.15	4	251	8	0.15	13	20

PE 100 – SDR 26

Outside Diameter (mm)	SDR	Min (mm)	Max (mm)	SDR	Min (mm)	Max (mm)
250	21	10	17	26	8	16
280	21	11	18	26	12	22
296	21	-	-	26	12	22
315	21	12	20	26	12	22
355	21	12	20	26	12	22
400	21	12	20	26	14	23
440	21	-	-	26	14	23
450	21	15	24	26	14	23
500	21	15	24	26	15	24
560	21	-	-	26	15	24
630	21	17	28	26	15	24

Weldbead dimensions for Multilayer pipe

Outside Diameter	SDR	Wall thickness (minimum)	Bead-up interface stress	Initial size (approx.)	Soak Time	Maximum Plate removal time	Fusion and cooling interface stress	Cooling time in clamps	Cooling time out of clamps
mm		mm	MPa	mm	Secs	secs	MPa	mins	mins
250	26	9.6	0.15	3	158	4	0.15	8	15
280	26	10.7	0.15	3	167	4	0.15	9	17
296	26	11.4	0.15	3	172	4	0.15	9	18
315	26	12.1	0.15	3	177	4	0.15	9	19
355	26	13.7	0.15	4	188	8	0.15	10	20
400	26	15.4	0.15	4	200	8	0.15	10	20
440	26	16.9	0.15	4	210	8	0.15	11	20
450	26	17.3	0.15	4	212	8	0.15	11	20
500	26	19.2	0.15	4	224	8	0.15	12	20
560	26	21.5	0.15	4	237	8	0.15	12	20
630	26	24.2	0.15	4	251	8	0.15	13	20

APPENDIX - F | Mechanical Jointing | Page 1 of 4

MECHANICAL FITTINGS

1. The use of mechanical fittings and couplers in mainlaying activities should be restricted to joining metal to metal, metal to PE and connections to valves, underpressure tees and repairs situations.
   PE pipe must never be threaded.
2. The use of mechanical couplings should be kept to a minimum.
3. Mechanical fittings should conform to GIS/PL3.
   Note: This requires the PE joint to be end load resistant and PE/metallic transition fittings, particularly on services, should provide a similar end load resistant metallic joint.
4. All mechanical fittings should be assembled in accordance with the manufacturer's instructions and must be protected against corrosion.
5. When tightening or untightening a joint, it is essential that movement is not transmitted to PE pipes.
6. During pressure testing, or where unrestrained mechanical fittings are used, restraint against pressure-induced thrust must be applied.
7. Any permanent or temporary anchorage must be constructed in accordance with SGN/WI/DIS/4.2.2.
8. There are two main types of mechanical jointing:
   - End loaded: These fittings prevent pipe separation from the thrust force induced on the inside of the pipe wall by the pressure within the pipe.
     Note: Examples of end loaded fittings include flanged and screwed joints or joints with internal circlips.
   - Non-end loaded: These fittings have no resistance to prevent pipe separation from thrust forces applied due to the internal pressure within the pipe.
     Note: Examples of non-end loaded fittings include compression type couplers, cap ends.
9. When connecting PE to metallic mains by use of in-line couplings it is important that prior to installing, the metallic main is cleaned and where appropriate wrapping removed.
10. Anchorage must be applied as necessary, refer to SGN/WI/DIS/4.2.2.
11. If you have concerns over the engagement length of the fitting onto the metallic main raise the issue with your Operational Manager.
12. Once the coupling has been installed and exposed the joint tested with approved leak detection fluid.
13. Dry off the fitting.
14. You must protect the joint from corrosion by wrapping following the guidance in SGN/SP/CW5.

FLANGED JOINTS

1. Make flanged joints using the correct jointing material or gasket.
2. You must protect all metallic flanges against corrosion.
3. Flanged joints must be made using the gaskets stated below, with the metallic flange, bolts, nuts and washers being protected against corrosion.
4. Flange faces must be thoroughly cleaned and inspected. Surface marks extending across the joint face or heavy pitting are unacceptable.
5. Pipe work must be fabricated so that mating flanges are aligned and abutted squarely.
6. The type of flanges to be used must be to PN16 specification.
   Note: Unless making connections to existing different buried flanges, typically Table 'D' flanges.
7. Flange connections must not be connected to reducer fittings as part of a field installation, only flanges supplied by an approved manufacturer and badged as suitable for connection to the diameter and SDR of pipe being laid can be used.
8. Protect PE flanges against damage to the sealing faces before assembly.
9. PE flange connections are approved for use as a connection to a corresponding metallic flange.
10. They must not be used for making PE flange to PE flange connections.
11. The preferred gasket and bolt kits to complete the connection should be sourced with the stub flange.

12. The preferred design of PE stub flange adaptor is a size for szie flange adaptor as shown in Figure F.1.

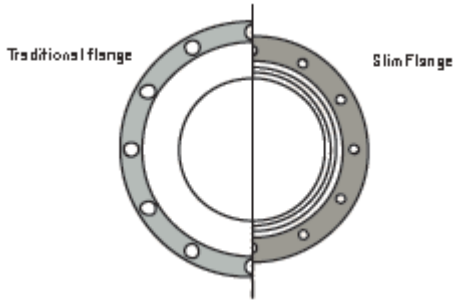


Figure F1 – Size for Size Flange

BOLTING PROCEDURE – FLANGES JOINTS

1. Use only 3mm thick, one piece, 80 hardness Nitrile rubber gaskets to EN681-1 and to suit flange rating.
2. Lubricate bolt threads and all mating surfaces of nuts, washers and flanges using an automotive grade of oil or grease.
3. Use only undamaged rust free bolts, nuts and washers
4. Inspect the gasket or sealing ring immediately before use.
5. Some relaxation of the gasket will be experienced.
6. For larger raised face flanges three stud bolts should first be inserted to centralise the gasket.
7. Make a sufficient number of circuits to be sure that the bolt torques are achieved as shown in Figure F2 and Table F1.
8. Acceptable tightening sequences are shown in Figure F2.
9. For flanges having 12 bolts or more it is recommended that two Operatives work at same time on diametrically opposite bolts.
10. Each Operative tightens the first nut in the quadrant, then the first nut in the second quadrant, returns to the second nut in the first quadrant and so on.
11. Throughout the stud bolt tightening sequence frequent checks should be made to be sure parallel 'pull-up' of the flanges.
12. Final tightening should be carried out by torque measurement to the values supplied by the manufacturer.
13. To make sure its accuracy the torque wrench should be calibrated regularly.
14. Check and, if necessary, re-tighten bolts immediately before pressure testing.

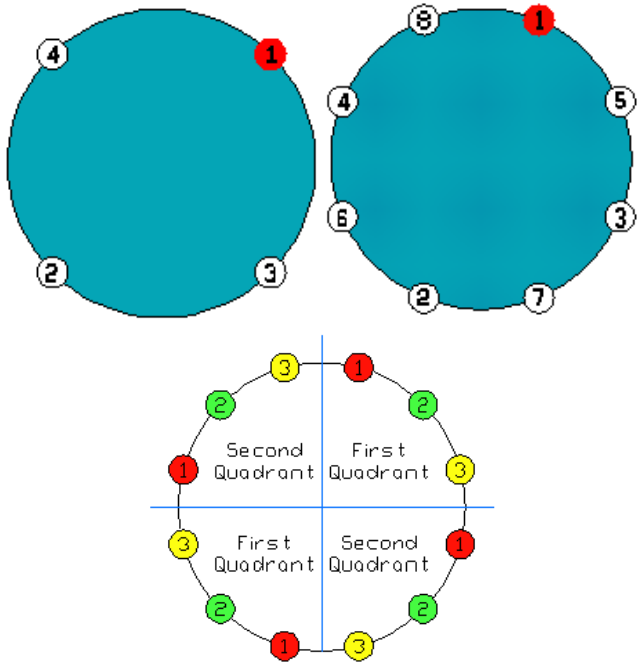


Figure F2 – Bolt Tightening Sequence 4, 8 and 12 Bolts or More

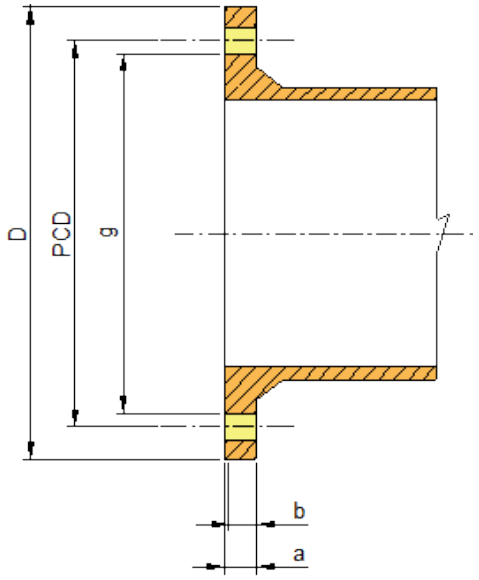


Figure F3 - Flange Dimensions

GASKETS MATERIALS

Gaskets materials should meet the requirements of BS EN 682:2002
Grade G – Nitrile (NBR) Type G (silver colour)
Grade C – Epichlorhydrin (white with "ECO" superimposed)
Grade O - Fluoroelastomer (blue colour)

STORAGE

Stored correctly, gaskets maintain full operational performance and maximum life expectancy.
Observe the following storage conditions: -

- Store in a cool dark place, and where possible, in black polyethylene sacks which exclude light, especially ultraviolet.
- Store away from electrical discharges and sparking electric motors.
- Storage temperature should be below 20°C and preferably below 15°C.
- Always store gaskets in an unstressed condition – never hang on hooks, nails, handrails even for a short time.

Nominal Size (mm)	No. Bolts Reqd.	Bolt Dia.	Bolt Length (mm)	Spanner Size Reqd. (mm)	Sealing Torque N m	Bolt Hole Dia. (mm)	Hole PCD (mm)	Flange Dimensions (mm)			
								D	g	a	b
80	8	M16	65	24	*See Note 1	19	160	200	132	19	16
100	8	M16	65	24		19	180	220	156	19	16
150	8	M20	70	30		23	240	285	211	19	16
200	12	M20	70	30		23	295	340	266	20	17
250	12	M24	85	36		28	355	400	319	22	19
300	12	M24	85	36		28	410	455	370	24.	20.5
350	16	M24	85	36		28	470	520	429	26.	22.5
400	16	M27	100	41		31	525	580	480	28	24
450	20	M27	100	41		31	585	640	548	30	26
500	20	M30	110	46		34	650	715	609	31.	27.5
600	20	M33	120	50		37	770	840	720	36	31
700	24	M33	130	50		37	840	910	794	39.	34.5
800	24	M36	140	55		41	950	1025	901	43	38
900	28	M36	140	55		41	1050	1125	1001	46.	41.5
1000	28	M39	160	60		44	1170	1250	1112	50	45
1200	32	M45	180	70		50	1390	1485	1328	57	52

Table F.1 – Bolt References

Note1: Refer to guidance issued by Manufacturers for torque settings.

Note1: Refer to guidance issued by Manufacturers for torque settings.

EXISTING BOLTS ON LIVE MAINS

1. Where work is to be undertaken on or near to bolts of exposed mechanical joints the condition of the bolts must be assessed.
2. It must be established if the bolts are leaking and their condition.
3. If the bolts are in poor condition and or leaking inform your Operational Manager.
4. SGN's gas escape procedures must be followed as appropriate.
5. Protect all exposed bolts against corrosion by wrapping following guidance in SGN/SP/CW/5.

SAFETY NOTE

1. Rubber gaskets should never be disposed of by burning, as harmful by-products can be produced.
2. DO NOT handle incinerated or fire-damaged gaskets without proper protective clothing.

THREADED JOINTS

1. Threaded joints must only be made on steel pipe work, which will operate at a pressure of less than or equal to 2 bar and pipe diameters not exceeding 50mm nominal bore.
2. Taper to taper, or taper (male) to parallel (female) threads may be used.
3. Pipe threads must comply with BS 21 or BS EN 10226-1.
4. Only use approved jointing material when assembling threaded joints.
   Note: Further information on cutting and threading steel pipe is available in SGN/WI/SL/1***.***
5. Following successful completion of an appropriate pressure test, protect all metallic pipe work from corrosion by applying anti-corrosion tape or other coating, Refer to Section C1.

ELECTRICAL INSULATION JOINTS

1. Install insulating joints when a steel main is to be connected to another metallic main, which is either of different material, or not cathodically protected. Refer to Section C1.

WELDED JOINTS

1. The jointing of steel mains together by welding or the welding of fittings to steel mains referenced in Section C1.

CORROSION PROTECTION OF MECHANICAL JOINTS

1. Following successful completion of a pressure test, all sections of pipe and fittings, which do not have a factory applied protective coating, must be protected with an approved anti-corrosion tape or other coating.
2. Apply primer and tapes to all bare sections of pipe giving a 55% overlap in all cases.
3. You must give particularattention to fittings, such as valves, flanged joints and other items where tapes require moulding to the profile of the fitting during application.
4. Where difficulty is encountered in providing adequate protection, the Operational Manager must be informed to provide guidance on a suitable coating.
   Note: Further guidance can be found in SGN/SP/CW/5.

APPENDIX - G | Installation of Valves and Valve Chambers | Page 1 of 4

Valves are installed for 3 main reasons:

1) To isolate control equipment,

2) To facilitate construction,

3) To improve the overall security of the network during breakdown of plant.

Valves should be installed to facilitate new connections to the existing network or to maintain or safeguard supplies during maintenance or in anticipation of having to manage supply emergencies.

VALVE MATERIALS

1. Steel bodied valves must be used when installing a valve on a steel system*.
2. Cast iron valves must not be used on steel systems since this creates a brittle / ductile interface and a high risk of failure.
3. When installing a valve on a PE system then a choice of CI/DI/steel/PE valve may be used.
4. For mains up to and including 180mm the use of PE valves in a PE system can be used, although it should be noted that these are normally ¼ turn only valves.

****Note: A steel system consists of any main constructed from steel on both sides of a valve. The inlet isolation valve (fire valve) to a governor installation could form part of a steel pipe system. However, the stream valves that form an integral part of the governor installation is not included in this requirement.***

DESIGNATIONS OF VALVES

1. There are 5 main designations of valves:
   a) Strategic (M1)
   b) Pressure Reduction Installation Inlet/Outlet Valves (M2)
   c) Maintained Mains Valves (M3)
   d) Accessible Mains Valves (M4)
   e) Unclassified Valves
2. Your Operational Manager, will normally advise you the classification of valve to be installed.

STRATEGIC VALVES – CLASS M1

Are those valves considered to be the most critical to the satisfactory operation of the supply system. These valves will usually be installed on MP or IP systems and have significant influence on critical supply mains.

PRESSURE REDUCTION INSTALLATION INLET/OUTLET VALVES – CLASS M2

Are Pressure Reduction Installation (PRI) inlet and outlet isolation valves.

MAINTAINED MAINS VALVES- CLASS M3

Are valves that allow smaller sections of the supply system to be isolated in an incident or local emergency.

ACCESSIBLE MAINS VALVES – CLASS M4

Are non-maintained accessible valves that typically influence below 200 customers, but also include any new valve installed on the MP/IP system that has not been designated as M1 or M3 by Network Planning.

UNCLASSIFIED VALVES

Are those valves installed purely to facilitate the construction of a project (for example to facilitate a connection or as a construction valve) and/or are exempt from M1-M4 designation due to suitable M1-M4 valves nearby.

INSTALLATION OF VALVES ON SYSTEMS PIPE SIZES 75 MM AND ABOVE

1. Valves should be installed in line with the main at operationally desirable locations.
2. The location of valves should be determined at the planning stage.

INSTALLATION OF (CLASS M1 TO M4)

1. Before fitting, operate the valve from the **FULLY OPENED** to the **FULLY CLOSED** and record the number of turns and direction.
2. Check the valve for internal cleanliness and freedom of operation.
3. A typical valve installation is shown Figure G.1.
4. Support the valve on a bed of firmly compacted fine fill or other suitable material, to be sure a degree of support that matches the adjacent pipe.

- Sleeving should protect the valve spindle.
- The top of the valve spindle extension or pressure / rider points should terminate 100mm below the underside of the surface box lid, allowing sufficient room to operate the valve and to open valves that have been fitted to the top of the pressure or rider points.

  Valves must be of double block and bleed construction and fitted with a body vent.
- 1”/32mm diameter pressure points must be fitted either side of the valve.
- 2”/63mm diameter rider points (unless the main diameter is 6”/150mm/180mm or below when a 1”/32mm rider points will suffice) must be fitted either side of the valve.
- Plugged valve fitted to the body vent.
- Body vents should not normally be piped to the surface unless an operational requirement is identified.
- Extension spindle where a valve spindle is more than 450mm below ground level.
- These points must be extended to surface boxes and terminate with a valve and use made of a “Frog” to support and anchor the pipe in position.
- Marker disc over the spindle or cover marked ‘Gas’
- Electrofusion saddles should be installed on PE mains when installing pressure and rider points either side of the valve.

5. The valve must be accessible, for example not located in the middle of a carriageway.

- Valve covers to be set in concrete surround if the valve installation is in unsurfaced ground.
- Marker plates fitted to posts, or adjacent wall/building;
- Bypass and pressure points to be PE if MOP of the system is less than or equal to 4bar, steel if greater than 4bar.
- Cathodic Protection to be fitted, together with a CP test point, where required, in accordance with SGN/PM/ECP/2, When pressure points are installed in the same surface box as the valve spindle there must be sufficient room to use the points and operate the spindle.

  Note: Preference must be given to the fitting of electrofusion saddles for pressure and rider points. Tapping tees have a reduced bore.

6. If a valve is on a main or service which:
   a) operates at above 75 mbar, or
   b) has an outside diameter greater than 300 mm and operates at 75 mbar or less.

   is to be blanked temporarily or permanently, you must fit a drilled and tapped flange which includes a pressure relief facility such as a valve to enable the pressure to be measured between the blank flange and closed valve.
7. Any valve that is blanked off must be left in the **CLOSED** position.
   1. ***For Main ≥ 180mm Rider Pipe diameter = 63mm.***
   2. ***For Main < 180mm Rider Pipe diameter = 32mm.***
   3. ***Pressure Points diameter = 32mm and constructed of PE.***
   4. ***Body Vent to seal with plugged valve. Not normally piped to surface.***
   5. ***No levers or wheels are to be left on valves below ground.***
   6. ***The top of the valve spindle extension or pressure / rider points should terminate 100mm below the underside of the surface box lid.***

INSTALLATION OF UNCLASSIFIED VALVES

1. These valves will typically be construction valves, riser valves and abandoned valves.
2. Newly constructed unclassified valves are usually buried once installed with no visible signs of its presence showing at ground level.
3. Construction valves **DO NOT** require:

- Permanent pressure points.
- Permanent rider points.
- A body vent (where double block and bleed valves have been used).
- A facility from the surface to open and close the valve.

4. They must be firmly supported.
5. For single faced valves the correct orientation of the valve is critical to safe working.

CORROSION CONTROL

1. Following a successful pressure test, all parts of a metallic valve and its flanges, must be protected against corrosion with tapes or other coatings.
2. Mould valves and flanged joints to the profile of the fitting with an approved putty before apply tapes.
3. Refer to manufacturer's instructions and to SGN/SP/CW/5 for advice on the application of corrosion protection measures.
4. Tape should be applied using a 55% overlap in all cases.
5. Where you experience difficulty in providing adequate coverage, seek advice from your Operational Manager.

RECORDING OF VALVES

A record of valves must be made to the requirements stated in SGN/PM/V/1 and it must include the following information.

a) unique valve number;
b) dimensional sketch of the valve location;
c) Ordnance Survey map reference;
d) address of the site;
e) size and safe operating limit;
f) make and type of valve;
g) Final position of valve either open or closed valve;
h) date fitted;
i) details of pressure and rider points fitted;
j) number of turns and direction of rotation;
k) function of valve;
l) maintenance history;
m) Identification of each valve by a disc or cap secured to the valve spindle or non-interchangeable surface box, as appropriate.
n) A marker plate/post should be fitted.

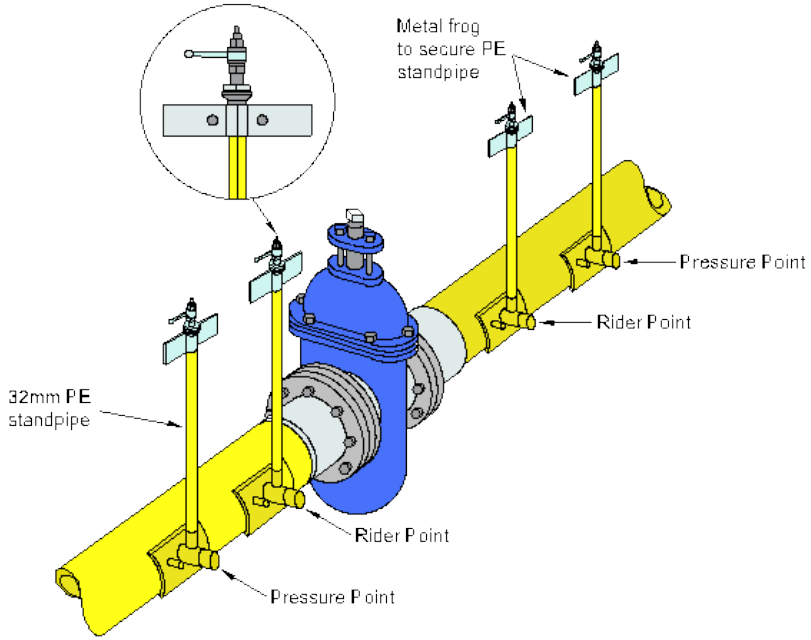


Figure G.1 Typical Strategic Valve Installation

Note: For rider standpipes <63mm/2" use branch saddle connections on the top of the main.

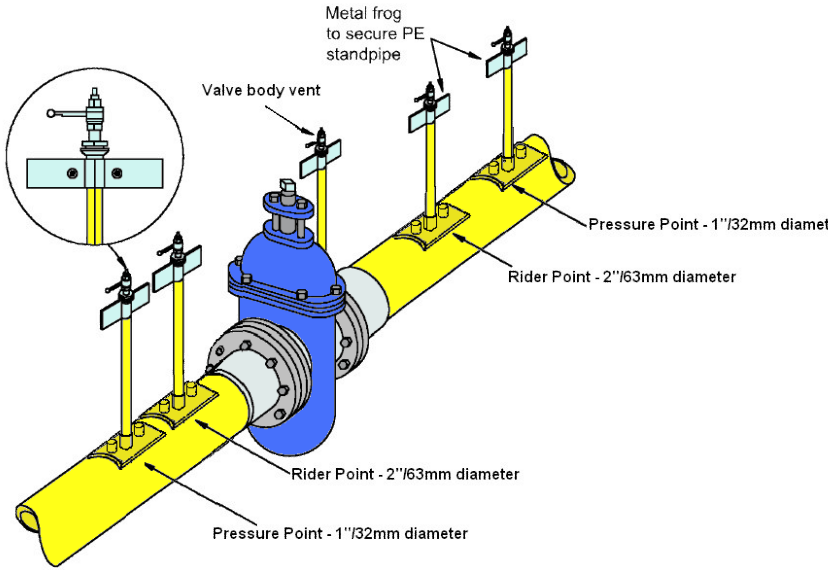


Figure G.2 Typical PE Pipeline Strategic Valve Installation Using Branch Saddles

OPERATION OF VALVES

1. Position valves to make sure unrestricted accessis available for their operation and maintenance.
2. Mains valves must not be operated unless there is a pressure gauge on the main either side of it.
3. If pressure points do not exist, they must be installed prior to valve operations.
4. All such valve operations must be authorised and be subject of a approved written procedure. See GDN/PM/SCO/1, GDN/PM/SCO/2, GDN/PM/SCO/4 & GDN/PM/SCO/5.
5. Copies of valve records for all valves affected by the operation must be available on site, or the relevant details included within the written procedure.

REDUNDANT VALVES

1. Where a valve is on a main is abandoned, or where a valve is no longer required for future operational use, the surface boxes and marker posts should be removed.
2. Notification must be provided to remove the valve record from the valve record database.

APPENDIX - H | Mains Break out Tools | Page 1 of 2

BREAKING OUT MAINS

1. Every effort must be taken to avoid the need to breakout mains by making additional hand or machine cuts.
2. There will be some circumstances where this is not possible particularly during replacement activities or for service connections on inserted PE mains.
3. In these circumstances only the “mains breakout tool” is approved for use.
4. The use of a sledge hammer is **NOT** to be used to break out mains.
5. The use of the mains breakout tool is fully explained in Sgn’s Safety Handbook under the 'Mains Break Out' heading.
6. Damp sacking or equivalent should be arranged over the pipe to be broken out.
7. Damp sacking or rag will help to contain metal splinters and protect the operative.
8. You must make sure:

- The tool is not used near cables and other plant where damage may occur.
- Adjacent buried plant should be protected.
- The approved hand held tool is insulated, weighs 16.5kg, and has a minimum overall length of 2.2 metres.
- When breaking out mains make sure a damp cloth or equivalent is used to cover the striking area.
- A continuity bond must be fitted to the gas main.
- When using the hand held mains break out tool, stand at the top of the trench and drop the tool vertically onto the main.
- Do not use undue force or throw the tool downwards.
- Regularly check and remove metallic splinters and fragments to avoid causing damage to the inserted PE pipe.
- Check the PE pipe for damage when the break out is complete and if necessary report damage to a team manager.
- Wear the appropriate PPE for the task.

PPE REQUIREMENTS

1. Any operative using a mains breakout tool must wear the appropriate PPE which includes the mandatory use of a full face visor [as shown in the photo].
2. The tool must not be used unless a full face visor is worn and the work requirements detailed in “Breaking out mains” can be met.
3. Other team members and the general public must be protected by adequate guarding from the potential of flying metal fragments.

HYDRAULIC MAINS CRACKER – 'CLICKSTICK'

The 'Clickstick' is a portable hydraulic mains cracking tool, operated by either battery power or a hand pump. The tool is remotely controlled allowing the operator to stand clear of the excavation whilst the mains cracking takes place.

The tool can be preset to pressure thresholds to avoid damage to inserted PE mains, and break data extracted from the pump to provide an audit trail.

This is an alternative tool to the existing mains breaking tool or 'Podger Bar'.
The tool is approved for use on mains which have been Live Inserted, when the PE main is not a 'close fit'. See Table H1 below for suitability.

Mains with Live Insertion PE - Suitable for using Clickstick							
6"	140	125	110	90	75	63	55
4"	-	-		90	75	63	55

Table H1: Suitable Use of the Clickstick on Inserted Mains

1. The existing PPE requirements for the mains breakout tool remain the same for the 'Click stick'.
2. To use the hydraulic mains cracking tool you must:

- be trained and be competent in the operation and features of the tool
- have a full set of manufacturer's instruction on site.
- undertake site preparation in accordance with Section A.1.
- include the method of mains break out on the Site Risk Assessment
- avoid damage to other plant
- be out of the excavation when the tool is in operation.

'CLICKSTICK' OPERATION

1. Install continuity bond around the breakout section.
2. Cut the main using rotation wheel cutters in three places to prevent longitudinal cracks and ease of removal.
3. You should place the clamp on the main with the long vertical handle.
4. If the tool is required to be used with the vertical handle removed a manager must be informed and the reasons for removing the handle recorded on the SSRA.
5. You and other operatives must get out of the excavation once the machine is set in position.
6. You and other operatives must also stand clear of the vertical handle, as this can kick when the main cracks.
7. Apply pressure to the tool and crack the main.
8. The clamp pressure must be released as soon as the main cracks.
9. A number of cracks may be required to fully break the main.

Figure H.1 Clickstick in Operation

APPENDIX - I | PE Fittings & Pipe Faults – Reporting Arrangements | Page 1 of 2

Fault reporting is an integral part of SGN's overall safety management system.

1. For PE pipes and fittings it is essential to report any incidents of non-conformance or failure.
2. By making the report, the cause can be identified.
3. If pipe, fittings or tooling are found to be at fault, contact can be made with the manufacturer to enable corrective action.
4. If the manner of installation is identified as the root cause; retraining, updating of procedures and warnings can be issued as appropriate.
5. The form shown (Figure I.1) must be used for all products received from company stores found to be unsuitable for use before installation.
6. Typical situations for reporting of non-conformance PE faults could include:-

- PE pipe received in a damaged condition
- PE electro-fusion fittings received with no heating element
- PE fittings received with no 'O' ring seal
- PE fitting has been incorrectly labelled.

7. All cases where a PE pipe or fitting is discovered to be unsuitable for use, either during installation or after commissioning, the PE fault form attached must be completed as soon as possible.
8. Typical "in service" faults could include:-

- Pipe out of round or unable to re-round pipe from a coil for jointing
- Difficulty in removing or peeling the "multilayer skin"
- Difficulty in re-rounding after squeeze off operation
- Pipe kinking
- Top tees coming away from the main after fusion when cutting the tee

9. Non-conformance report forms should be returned with the fittings to either Euro Central or Thatcham stores.
10. The pipe and/or fittings quarantined and held at the local depot for collection or inspection.

Note: Where an electro-fusion joint has failed, manufacturers require both pipe and fitting to be returned to carry out an investigation. Without both a comprehensive test cannot be completed.

PE Fault Report Form

This form must be completed for PE pipes and fittings where the fault is discovered at the time of installation or after commissioning.

To enable complaints to be managed correctly the following information should be supplied:

Contact name					
Contact tel. number					
Date of delivery		Date of installation			
Site address					
Pipe / Fitting Manufacturer					
Pipe / Fitting Description					
Pipe / Fitting Diameter		Material		SDR	
ID/Ref/Serial number					
Straight Pipe *Yes/No*		Coiled Pipe *Yes/No*			
Product batch details					
Print line details (pipes)					
Date screw details (fittings)					

Details of fault

Any additional relevant observations

Note: Where an electro-fusion joint has failed manufacturers require both pipe and fitting to be returned in order to carry out an investigation. Without both a comprehensive test cannot be completed.

This form must be returned to:-

Colin Manning
Scotia Gas Networks
2 Leesons Hill
Orpington
Kent
BR5 2TN

Figure I.1 – PE Fault Report Form

APPENDIX - J Abandoned Pipe Record Requirements

Correct and accurate pipe records are essential to the safe operation of the SGN's gas network. Pipe records describe the fundamental assets of SGN.

1. The quality of information is essential to all operational and network investment decisions.
2. More details are available in SGN's Management Procedure for Recording and Maintenance of Non Maintained Pipe Asset Records SGN/PM/DR/2.
3. Accurately recording the lengths of main abandoned and date physical decommissioning takes place is very important.
4. Where this date varies from that planned, the record must be updated before it is declared as abandoned.

ALL ABOVE GROUND PIPE - RISER AND SERVICES

1. All above ground pipe - riser and services - must be recorded; irrespective of pressure range (this includes all abandoned pipes).
2. For abandoned riser/service pipes, the full details recorded on Maximo is sufficient.
3. There is no requirement to record abandoned risers/services on GIS.
4. For example, a 'main' abandoned from the parent main to the base of the riser, must be recorded on Maximo but there is usually no requirement to record on GIS.

EXAMPLES OF ABANDONED PIPES THAT MUST BE RECORDED ON MAXIMO AND GIS FOR SAFETY REASONS

1. Asbestos see SGN/PM/DR/2 (4.2.3.4 and Appendix E).
2. For pipes that have been inserted with new PE, it is essential that the location of the carrier pipe is known for both mains and services to mitigate the risk of interference damage. See SGN/PM/DR/2 (4.2.3.9 and Appendix E).
3. Pipes that may be usuable in the future to insert as part of a major road crossing or replacement project.

TIMELINESS

1. Following commissioning new or modified assets or the abandonment of redundant assets the associated records must be updated within the following timelines
   a). Graphical records - D + 30 days

Alphanumeric records - Emergency/Repair related - D + 5 days

RISK ANALYSIS

1. Where it is not possible to resolve a records issue, inform your Operational Manager.
2. A risk analysis must be undertaken, evaluating and detailing the hazard associated with retaining the incorrect record.
3. That process should inform your Operational Manager of the relative priority with which the error must be processed.

APPENDIX - K | Pneumatic Pressure test certificate | Page 1 of 1

SGN	Network reference Number	Pneumatic Test Certificate Number
	.....	.....

GENERAL DETAILS

Project title: .....

.....

Project reference: .....Drawing No.: .....

Start location: .....End location: .....

Pipe work details (SDR-Pipe diameter- Length): .....

Design pressure (MOP):.....bar Test pressure: .....bar

Test specification: .....

Associated Hydrostatic pressure test certificate No: .....

INITIAL PRESSURISATION

Witnessed by: .....Designation: .....

Date: ..... Time: .....

.....

Witnessed by: ..... Designation: .....

Date ..... Time .....

TEST COMMENCED

Witnessed by: ..... Designation: .....

Date: ..... Time: .....

Conditioning time: ..... hours Test Period: ..... hours

Creep allowance: .....mbar

PNEUMATIC REPORT	**Test on**	**INTERMEDIATE READINGS**		**TEST OFF**
Date / Time				
Absolute pressure				
Ground/skin Temperature				
Pressure correction				
Corrected pressure				

Gauge type: .....Serial number:.....

Calibration date: .....Calibration expiry date:.....

Permissible loss: ..... mbar Actual variance: ..... mbar

Test Pass / Fail (Delete as appropriate)	**PASS**	**FAIL**

Test accepted by: .....

Designation: .....Date: .....

TEST DEPRESSURISATION

Witnessed by: .....Designation: .....

Date: ..... Time: .....

APPENDIX - L Using CCTV systems

This Appendix describes the procedures for the internal inspection of live and de-commissioned gas mains using optical inspection systems such as closed circuit television systems (CCTV).

1. The systems should not be used on live gas networks operating at pressures greater than 2 bar.
2. The procedures include the following systems:
   a) Push rod systems.
   b) Motor driven systems (tractors/crawlers).
   c) Endoscopes

USE OF SYSTEMS

1. Optical inspection systems may be used to:
   a) Investigate the ingress of water into the Network.
   b) Investigate causes of poor pressure due to blockages and obstructions.
   c) Identify the location of connections/ tees/branches.
   d) Inspect mains prior to and after undertaking internal repairs.
   e) Inspect mains prior to lining/insertion operations.

Note: It is essential that only competent personnel undertake operations using CCTV equipment.

SAFETY

There is a possibility of a low volume release of gas throughout the operation of CCTV equipment from the gland assemblies of the camera launch equipment; therefore, you must make an assessment as to the possible sources of ignition including the correct siting of vehicles and plant. CCTV systems may NOT be intrinsically safe therefore switch on and off the cameras in a gas free atmosphere or an atmosphere purged of distributed gas.

2. You should refer to manufacturer's guidance on the requirement to pressurise tractors/crawlers with inert gas, such as nitrogen, to prevent ingress of distributed gas or water into the equipment, before commencement of the survey.
3. The camera operator will require:
   a. Breathing Apparatus (BA) and assisted air blower.
      Note: The camera operator must have his/her own individual BA mask, and must comply with the face fit testing arrangements.
   b. volt stick
   c. 2 x 9kg Dry powder fire extinguishers
   d. gascoseeker
4. Safety equipment must be used and maintained in accordance with manufacturer's instructions. A Pre-use check / inspection must be carried out by the user to confirm the equipment is within service inspection date, and is fit for use. Any defective or out of date equipment must not be used and the camera inspection must be postponed until suitable equipment is available onsite.

TRAINING AND COMPETENCE

Camera operators must only undertake tasks, which they have been trained and assessed as competent to carry out. Live gas working can only be completed by operatives that hold the appropriate accreditation or assessed as competent through SGN's Competence Assurance System (CAS).

The camera operator may hold relevant live gas qualifications / competencies that enable him to carry out mains drilling or electrofusions and form part of the 2 person team.

TRAINING REQUIREMENTS

As a minimum, the camera operator must be trained and deemed competent:

a. to operate the camera system in accordance with the manufacturers instruction
b. in the use of the BA, fire extinguisher, PAM and voltstick

c. hold the SHEA gas qualification or equivalent accreditation

Additional minimum competency requirements maybe required depending on the site circumstances, for example deep excavation, confined spaces working.

SITE INDUCTION/REQUIREMENTS

1. If the camera operator is a visitor to the site, he/she must be inducted into the site and made aware of any site risk assessments and site rules. The camera operator and team leader must update or complete an additional site risk assessment to incorporate the camera operation.
2. CCTV camera operations require a minimum of two persons trained and competent in live gas working to be present at all times during the operation, although this number may increase if determined by the site risk assessment and/or manufacturer's instructions. The team leader on site must be one of these persons.
3. Live gas camera surveys must be carried out under the control and supervision of a competent Team leader or the Competent Person if being controlled under SCO. During camera operations at least two operatives competent in live gas working must be onsite at all times. This can include the camera operator if they hold the relevant qualifications or competencies. Whilst the camera operator is within the excavation, at least one operative competent in live gas working must act as a guard.

ROUTINE/NON-ROUTINE OPERATING PROCEDURES (RO/NRO)

1. The use of CCTV camera equipment into live mains may require the completion of an RO or NRO.
2. Camera systems that do not affect the flow of gas, normally inserted through a top tee or drilling equipment should not require an RO/NRO. However, the camera operator must consider the pipe size, the system
3. type, limitations of the equipment and the potential effects on the flow of gas.
4. Where this is in doubt, the camera operator must contact their Operational Manager before proceeding.
5. All other types of camera system that require some form of flow stopping must be controlled by an RO/NRO.

SITE SET UP & SURVEY

1. Complete a site risk assessment and survey see Section A1.
2. Ongoing risk assessment and atmospheric monitoring must continue during the camera operation to ensure the excavation/work area remains gas free. Where gas is detected either via the PAM, Gascoseeker or through smell, work must stop immediately and the camera operator must exit the excavation.

PREPARATION

1. Refer to Pre-requisites and make sure that all tools and equipment to complete this task are available on site.
2. PPE must be worn appropriate to the task being undertaken.
3. You must make provision for the correct manual handling of the equipment. Provision of lifting equipment may be necessary.
4. If the pipe is suspended, provide adequate support to both pipe and equipment to make sure that their combined weights do not cause damage to the pipe.
5. Prepare for the end of the operation by having a means to dispose of any gloves and cleaning materials which have been contaminated with liquid deposits from the main.
6. They must be placed into sealable plastic bags for return to the depot for safe disposal.
7. The CCTV must be set up, installation and maintenance in accordance with the manufacturer's instructions.
8. The drilling or electro-fusion of fittings onto our live mains, must be in accordance with SGN/WI/SL/1 Section B6 (drilling) or Appendix D of this procedure (electrofusion).

MAXIMUM DRILLING SIZES FOR METALLIC MAINS

1. The maximum BSP tapping sizes stated in the table below must not be exceeded when undertaking drilling of mains to enable CCTV surveys.
2. The over drilling of cast iron mains could cause sudden fracture failure of the pipe.

Nominal Bore of Main		Maximum Tapping Diameter
(mm)	(Inches)	(Inches BSP)
	3	¾
100	4	1¼
	5	1½
150	6	2
	7	2

Table L1 - Maximum Tapping Diameter in Metallic Main Less Than 200mm (8 inches) Nominal Bore

3. Where there is a requirement to exceed the maximum tapping sizes as shown in the table above, a full, encirclement clamp must be fitted and the main supported.
4. The main is then drilled through the clamp.
5. The maximum drilling size allowed through an encirclement clamp for 3”–5” mains is 2”.
6. The drilling through the clamp must be a minimum of 200mm from the face of any existing socket, collar or drilling. The main/encirclement clamp must not be tapped.
7. For over drilling in a 3” main the encirclement clamp should be 400mm in length. For other diameters, the clamp should be 300mm long.
8. The fitting of an encirclement clamp is designed to give the cast iron main additional structural support where drilling sizes exceed those shown in the table above.
9. A 2” drilling in an unsupported 4” cast/spun iron main significantly reduces the strength of the pipe at the point of drilling by approximately 40%.
10. In addition to the reduction in strength, the main is also subjected to a point load at its weakest point by the drilling machine and any other ancillary equipment, and is also likely to be unsupported within the excavation.
11. Therefore, following an oversize drilling, the encirclement clamp must not be loosened or removed from a live gas main, even for a short period of time, as this significantly increases the risk of a fracture failure of the main at this point.
12. Where it is proposed to abandon the main following the camera survey and the excavation is to remain open, the drilling pot should be left on the encirclement clamp with a night cap fitted. The pot can be safely retrieved when the main is finally abandoned.
13. Where it is not proposed to abandon the main following the camera survey, it is not permitted to plug the encirclement clamp/main with an Emid plug, non-tap plug or any other unapproved fitting. A flow stop operation must be undertaken to remove the drilled encirclement clamp and replace it with a new clamp.

FLEXIBLE PUSH ROD SYSTEMS

1. Cameras must be inserted into live ferrous mains via an under-pressure launch head fitted to under pressure drilling equipment.
2. Distances of 40 -100 metres each way (depending upon system used) can be achieved from a single-entry point.

a) **Mini systems**

1. The mini-flexi probe system is a self-contained 12-volt DC battery operated unit; connections to mains or vehicle battery power supplies are also available as standard options.
2. The rod cassette coiler contains approximately 60 metres of 7mm diameter semi-flexible push rod.

3. The system is available with different light heads, 24mm, 30mm and 70 mm, and centring devices making the system suitable to inspect or survey pipes with diameters in the range 25mm to 150mm.
4. Usually a display screen is an integral part of the system and outputs are provided for video recorders and printers.

b) **Flexi-probe systems**

1. Flexible push rod systems require a 110-volt AC supply.
2. The coiler contains 150 metres 11mm diameter semi-flexible push rod.
3. The control unit includes a display screen, a keyboard for inputting text onto the video output and various controls for the operation of the equipment.

c) **Outputs are provided for video recorders and printers.**

1. The system is available with different light heads and centring devices making the system suitable to inspect or survey pipes with diameters in the range 50mm (2inch) to 600mm (24 inch).
2. It is possible to insert the camera with the 50 mm light head into live mains, however, cameras incorporating the larger light heads and skids for centring should only be introduced into the main via a special glanded cap end or pup piece.
3. Cameras incorporating the larger light heads and skids may be towed through de-commissioned pipe using previously introduced draw rope.
4. A draw rope may be introduced into the pipe under investigation either by the “flying bag” method or by making use of a push rod.

MOTOR DRIVEN SYSTEMS (TRACTORS/CRAWLERS)

1. Variable speed, motor driven camera tractors require a 110-volt AC supply.
2. The power is supplied to the tractor via 300 metre umbilical cable.
3. A range of tractors is available to accommodate inspection or survey of pipes with diameters in the range of 150 mm (6inch) to 2000mm (80inch).
4. The control unit includes display screen, a keyboard for inputting text onto the video output and controls for the operation of the camera equipment and tractor.
5. Outputs are provided for video recorders and printers.
6. Tractors may be used for insertion either into de-commissioned mains or live mains via a special glanded end cap or pup piece.

ENDOSCOPES

1. Endoscopes are either flexible (fibre scopes) or rigid (borescopes).
2. Both types require a means of illumination, and this may be supplied by either integral or remote light sources.
3. The image is transmitted along the length of the viewing instrument to the operator.
4. Extendable endoscopes with integral lamp illumination may be employed for the inspection of larger diameter pipework where greater illumination is provided by a range of interchangeable quartz halogen lamps (6, 12 and 24 volt).
5. Power is normally supplied via a transformer; however, it is possible to power the light head from a battery supply but there is a high current consumption and batteries of sufficient capacity are required.
6. A borescope is used for direct straight line access into the main whereas fibre scopes are used for access around pipe bends.
7. Light sources can be operated from a variety of power supplies.
8. Careful selection of the light source is important for the application intended as adequate illumination, particularly in large diameter pipework, is a limitation when employing this technique.
9. Light sources and power supply transformers to endoscopes with lamp illumination may not be intrinsically safe and should therefore NOT be sited in a gaseous or potentially gaseous atmosphere.
10. A variety of optical outputs are available depending on type of endoscope system used.
11. You must insert endoscopes into de-commissioned mains or live mains via a special glanded fitting.

LIVE LAUNCHING PROCEDURES

1. There are several options available for the insertion of a range of camera sizes into live cast iron, ductile iron, and steel mains.
2. Generally, smaller cameras may be inserted into the main via a single drilling in the main, however, this may not be possible with larger camera sizes and a double drilling will be necessary using a special camera insertion tee.
3. Skid mounted cameras or motor driven tractors/crawlers may be inserted into live mains via a special glanded cap end or pup-piece.
4. Specialist equipment is available to inspect live large diameter pipework through either 4-inch tapping for skid mounted camera insertion or 6 inch tapping for small tractor mounted camera insertion via flow stop equipment.
5. Mains diameters of 12 – 36 inch may be inspected using these techniques.
6. Reference must be made to the manufacturer's instructions on the use of under pressure drilling equipment.

a) **Double Drilling using the Camera Insertion Tee**

i. Equipment

1. The maximum working pressure of the main during the survey should be restricted to 2 bar.
2. The camera insertion procedures must be undertaken in accordance with the instructions detailed below, departing from these procedures could present a hazardous situation to both personnel and equipment.
3. To enable a CCTV survey to be carried out the following equipment is required:

- A camera insertion tee including the completion plug and blank plate. Camera insertion tees are available for 4, 6, and 8inch diameter main sizes. (see Figures L.1., L.2 and L.3.)
- Launch equipment including drilling equipment and completion plug placing equipment.
- CCTV equipment and ancillaries.

ii. Camera Insertion Tee Installation

1. Clean the pipe in the area where the gland ring seal will fit.
2. Remove the gland rings and gland ring seals from the tee.
3. Care must be taken to keep the gland ring seal rubbers clean.
4. The seals have been lubricated during factory assembly.
5. This is an important feature of the design and if the seals get dirty during the fitting operation then they must be wiped clean and re-lubricated with Stanton lubricant.
6. If the seals become dry, particularly after periods of storage, then they must be re-lubricated before installation.
7. Separate the two halves of the fitting. Do not remove the side flange seals from their grooves.
8. Re-assemble the two halves around the pipe at the desired position, with side flange opposing.
9. Insert the side flange bolts and align the two halves.
10. Care must be taken at this stage to make sure that the two halves are aligned such that there are no "steps" at the joints in the recesses for the gland ring seals.
    Note: Maximum torque for the side flange bolts is 85 Nm (63 lb.ft.).
11. The fitting must now be rotated until the branch is at the desired attitude relative to the pipe and then held in this position by suitable packing.
12. Complete the assembly by re-inserting the gland seals and fitting the gland rings.
13. You must take care when inserting the seals ensuring that the seal joints are not near to either the gland ring joints, or the fitting joints. Maximum torque for the gland ring end bolts is 65 Nm (50lbf.ft.).
14. Remove the blank flange. Studs should remain in the flange.
15. Unscrew the plug from the neck of the tee.
16. Take care to keep the plug threads and the internal tee threads clean.

iii. Camera Insertion Tee Testing

1. The test plate provided with the launching equipment must be fitted to the flange face of the tee.
2. A test pressure is induced into the tee and monitored as per Section G2.
3. If the RO /NRO requires pressure monitoring then a pressure point must installed on the main either side of the camera insertion tee.

iv. Launch Equipment

1. Bolt the camera insertion head complete with valve onto the camera insertion tee using the gasket provided.
2. Place the launching horns in line with the pipe axis. Check that the two ball valves are in the closed position.
3. A trial must be made before drilling the main to check that the completion plug can be placed into its final position.
4. To enable this, assemble the completion plug into the plug carrier of the plug placing apparatus, first check that the threads of the plug are clean and that the 'O'ring is well lubricated with grease.
5. Assemble the apparatus (with plug), onto the top flange face of the main valve.
6. Open the valve and lower the completion plug through the valve and into thread engagement with the tee.
7. Check that the thread engage and that the plug can screw into the tee.
8. If successful, unscrew the plug, withdraw into the plug carrier, and remove both from the launching equipment.

v. Drilling the Main

1. Fit the drill assembly with a pilot drill and shell cutter.
2. A 3⅛ inch shell cutter is required for 4 inch/100mm mains, and a 3⅜ inch shell cutter for 6inch/150mm and 8 inch/200mm mains.
3. The pilot drill must be fitted with a coupon retention device. The coupon must be removed between drillings.
4. A pneumatic powered hand wrench may be used to power the drilling shaft for drilling.
5. Close the main valve before removing the drill assembly.
6. Bolt the drill assembly, with the feed screw fully retracted, to the valve.
7. The drill is made off-centre to the bolting flange, and a two drilling for operation is required to produce a figure-of-eight cut out.
8. This is achieved by initially attaching the drilling assembly with the offset at its extreme axial position, drilling, turning through 180 degrees and re-drilling.

vi. Camera Insertion

1. The CCTV camera can be inserted in either direction, and is first installed into the launch tube.
2. Insert the launch tube assembly into the launch apparatus, and then the camera can be launched from the tube into the main.
3. To load the camera into the launch tube, it is detached from the cable by unscrewing the slip ring connector.
4. Take care to keep the connector (and threads) clean.
5. Lay the insertion launch tube horizontally and the seal adjustment gland ring, together with the gland bushes and gland seals removed.
6. Pass the camera cable with the slip ring connector through the seal adjusting gland ring and then through the launch tube.
7. Secure the camera to the slip ring connector and the spring carrier placed onto the camera body.
8. Retract the camera into the launch tube.
9. Now assemble the seal packing into the top of the launch tube taking care to place the elements in the correct order, this being - nylon, metal, rubber, foam, rubber, metal, nylon. (Variations exist in the type and number of sealing components in the sealing gland, however, whichever the arrangement, it is important that the components are re-assembled in the correct order).
10. When assembled, keep the seals in place by screwing the gland nut to the top of the launch tube.

11. Energise the seal packing and adjust by means of the gland nut.
12. Bolt the launch tube assembly (fully retracted) to either of the insertion head flanges and purged by opening the ball valve below the launch tube and opening the bleed valve at the top of the launch tube.
13. Close the bleed valve when all the air has been purged - check with an approved gas detector.
14. The CCTV camera can now be powered electrically.
15. Lower the launch tube into the base of the main by pushing down on the launch tube horns, ensuring that the tube is correctly aligned (the "TOP" mark on the tube should be uppermost).
16. Fit a security device when fully inserted between the insertion tube and the launch tube to hold the tube in position.
17. After setting up the CCTV monitoring equipment, commence the survey by advancing the CCTV camera along the main by pushing the camera cable into the launch tube.
18. When the survey is complete in this direction, retract the camera by pulling the camera cable out through the launch tube.
19. The camera should re-enter the launch tube, but if difficulty is encountered, it may be necessary to slightly withdraw the launch tube from the base of the main to allow easier entry.
20. When the camera is fully retracted into the launch tube, isolate the camera from the electrical supply, close the ball valve and remove the launch tube.
21. Re-position on the opposite launch horn to survey in the opposite direction and repeat the operation.

vii. Completion

1. When the survey is complete, place the completion plug in the neck of the tee, recover the insertion head and install a blank flange on to the flange face of the tee.
2. To place the completion plug, the already assembled plug carrier and plug is bolted to the main valve flange.
3. Open the valve and lower the plug until it rests on the tee.
4. Check for thread location and cross threading the spindle nut by slowly rotated 360° anti-clockwise whilst applying a slight downward force, and the thread engaged by then turning the spindle nut clockwise.
5. Fully tighten the plug it should disengage from the carrier.
6. Remove the carrier from the insertion head
7. Remove the insertion head.
8. Check that the top face of the completion plug is level or slightly lower than the raised face part of the tee flange.
9. If it is higher, it must be tightened further until it is level.
10. The blank flange should now be fitted to the flange face of the tee.

b) **Single Drilling**

i. Equipment

1. The maximum working pressure of the main during the survey should be restricted to maximum of 2 bar.
2. The camera insertion procedures must be undertaken in accordance with the instructions detailed below, departing from these procedures could present a hazardous situation to both personnel and equipment.
3. To enable a CCTV survey to be carried out the following equipment is required:
4. A camera insertion equipment. (see Figure L.4.)
5. Launch equipment including drilling equipment and completion plug placing equipment.
6. CCTV equipment and ancillaries.

II. **Site preparation**

1. Make excavations of a sufficient size to leave the main fully exposed with sufficient space below the pipe to enable the fitment of the drilling equipment and camera insertion equipment.

iii. Camera Insertion

There are several commercially available types of launch equipment, all varying to some degree in their application, therefore a generic description of the camera insertion technique is described.

1. Clean the pipe in the area where the under-pressure drilling equipment will fit.
2. Fit drilling equipment.
3. Drill and tap appropriate hole size in main suitable for the camera diameter.
4. It may be possible to insert a camera with the 24 mm light head through a one inch BSP tapping, however, the inner camera launch tube (if present) would not pass through the hole and therefore no protection is afforded to the push rod when introduced into the pipe.
5. The push rod could be damaged on the sharp edges of the entry hole.
6. When using a camera with a 24mm light head a 1½ inch BSP tapping should allow the inner camera launch tube to be inserted through the tapping which will protect the push rod from damage.
7. A special bush which screws into a single 2 inch BSP tapping is required to protect the push rod when using the flexi probe system.
   Note: Reference must be made to SGN/PM/MSL/1 Part 1 to determine the maximum hole size which may be directly drilled into a metallic main without the requirement of a split fitting.
8. Before removing the drill assembly check that the main valve is in the closed position.
9. The CCTV camera can be inserted in either direction, therefore when locking the camera insertion head onto the under-pressure drilling base, check that the launch tube is correctly positioned for the required direction of survey/inspection.
10. Unscrew the gland head assembly from the top of the launch tube and carefully remove the gland arrangement.
    Note: Variations exist in the type and number of sealing components in the sealing gland, `however, whichever the arrangement, it is important that the components are re-assembled in the correct order).
11. Insert the cable rod through the gland assembly.
12. Connect the camera to cable and load into the launch insertion tube and re-assemble the gland head assembly and screw onto the top of the launch insertion tube.
13. On some systems, a retractable inner camera launch insertion tube may be incorporated into the insertion head and for these systems the camera and inner tube must be in a fully retracted position.
14. Open the main valve and purge the insertion head of air by venting through the pressure release button on drilling base.
15. Check with an approved gas detector that the purge is complete, and make sure that a satisfactory seal has been obtained at the gland seal.
16. The camera can now be powered electrically.
17. Check that the camera is functioning correctly and is ready for insertion into the main.
18. Introduce the camera into main either directly or via the inner launch tube, whichever is applicable.
19. Commence survey by advancing the camera along the main by pushing the push rod into the launch tube.
20. When survey is complete in this direction withdraw the camera.
21. The camera should re-enter the launch tube and when fully retracted, isolated from the electrical supply, the main valve closed and the insertion head removed from the under pressure drilling base.
22. To survey in the opposite direction, the operation is repeated.

iv. Completion

When the survey is complete remove the camera insertion head, refit the drilling machine head and place a completion plug in the main. Remove the drilling equipment from the main.

c) **Special cap end or pup-piece**

i. Equipment

Note: In most cases this technique should only be used on live mains up to 12-inch (300 mm) diameter and operating at a maximum working pressure of 100 mbar or where bag stop equipment can be used to cut out a section of main to allow the fitment of the cap end or pup-piece.

1. The camera insertion procedures must be undertaken in accordance with the instructions detailed below, departing from these procedures could present a hazardous situation to both personnel and equipment.
2. To enable a CCTV survey to be carried out the following equipment is required:
   a) A special glanded cap end or pup-piece (see Figures L.5. and L.6.)
   b) CCTV equipment and ancillaries.

ii. Site preparation

1. The excavation must be of a sufficient size to accommodate the bag stop arrangement, bypass connections if appropriate, the special cap end or pup-piece, and clearance for the push rod.
2. The flow stopping and cut out operation must be undertaken in accordance with Section E3 or Section E4.

Note: The system can be used with Iris Stop operations your Operations manager will advise if this is the case.

iii. Camera Insertion

1. Unscrew the gland head assembly from the cap end or pup piece and carefully remove the gland arrangement.
2. (The gland arrangement will usually consist of several split seals - upon reinstallation it is important that the seals are replaced in the correct order.)
3. Insert the cable rod through the gland assembly and re-assemble
4. screw gland assembly into cap end or pup piece.
5. Connect the camera to the cable and position camera either directly into main if using a cap end or within the pup-piece.
6. Fit and secure cap end or pup-piece onto main and apply an end restraint in accordance with SGN/WI/DIS/4.2.2.
7. Deflate and withdraw bags into the bag tubes and purge the section of main to natural gas by means of the purge valve in the cap end.
8. The camera can now be powered electrically.
9. Check that the camera is functioning correctly and is ready to commence the survey.
10. Commence survey by advancing the camera along the main by pushing the push rod through the gland assembly.
11. When survey is complete in this direction withdraw the camera to the cap end and isolate from the electrical supply.
12. Re-introduce the bags into the main, vent the section of main, and remove cap end or pup-piece.
13. Fit temporary stopper.
14. To survey in the opposite direction, the operation is repeated.
15. When survey has been completed re-commission the main in accordance with SGN Procedures (See Section E3 or Section E4).

iv. Motor Driven Systems

1. Where tractors/crawlers are used for the inspection of live mains, the procedures detailed in c.i., c.ii., and c.iii. must be observed and adequate space in the main or the pup-piece to accommodate the tractor/crawler unit allowed.
2. The tractor/crawler is driven along the main, the power being supplied via an umbilical cable as opposed to a push rod as detailed in c). Special cap end or pup-piece. Item iii above.

d) **Endoscopes**

i. Equipment

1. Endoscopes can be inserted into de-commissioned pipework without any special preparation requirements other than to observe that the light sources, unless intrinsically safe, are NOT sited in gaseous or potentially gaseous atmospheres.
2. The maximum working pressure of the live main during the inspection should be restricted to 2 bar.
3. The insertion procedures must be undertaken in accordance with the instructions detailed below.

4. To enable an inspection to be carried out the following equipment is required:
   a) A special glanded fitting which will allow the borescope or fibre scope to be inserted into the main.
   b) A 1 inch BSP full bore valve conforming to GIS/V4 Specification and suitable for use with under pressure drilling equipment.
   c) Endoscope and ancillary equipment.

ii. Site preparation

1. Excavation must be of a sufficient size to leave the main fully exposed with sufficient space below the pipe to enable the fitment of the drilling equipment.

iii. **Endoscope Insertion**

1. Clean the pipe in the area where the under-pressure drilling equipment will fit.
2. Fit drilling equipment.
3. Drill and tap 1 inch BSP hole in main.
4. Fit the 1 inch BSP full bore valve under no gas conditions.
5. Screw special glanded fitting to the top of the 1 inch full bore valve.
6. Carefully insert endoscope into the glanded fitting.
7. Open valve and carefully push endoscope into the main viewing its progress during the operation.
8. On completion of the inspection withdraw the endoscope into the glanded fitting and carefully close the full-bore valve.
9. If any resistance is apparent when closing the valve check that the endoscope has been fully withdrawn into the glanded fitting.
10. The valve may be left on the main or replaced with a completion plug, again under no gas conditions.

INSPECTION OF DE-COMMISSIONED MAINS

a) **General**

1. Undertake an atmosphere check using an approved gas detector to check that the main is free of gas.
2. If satisfactory the CCTV equipment can be inserted into a de-commissioned main.

Note: CCTV systems may NOT be intrinsically safe.

b) **Equipment**

1. Provide covering or purpose built cable guides over the ends of pipes to avoid abrasion or scarring to the Push rods and umbilical cables.
2. When the protection is in place the camera equipment / crawler may be launched.

c) **Camera Insertion**

1. No special techniques are required for launching camera equipment into de-commissioned mains.
2. Cameras may be towed through de-commissioned mains pipe using a previously introduced draw rope.
3. This method allows greater lengths of main to be surveyed in preference to push rod techniques.

EQUIPMENT MAINTENANCE

All equipment used in this procedure must be maintained /serviced in accordance with the manufacturer's recommendations.

PRECAUTIONS

1. When introducing and/or pushing the camera system into the main, do not use excessive force as this can cause damage to the push rods.
2. Take care when approaching and negotiating obstructions in the main to avoid the camera system becoming jammed in the pipe - do not use excessive force.
3. Do not allow the camera system to become jammed in the pipe or drop into a syphon as it may not be retrieved without excavation.

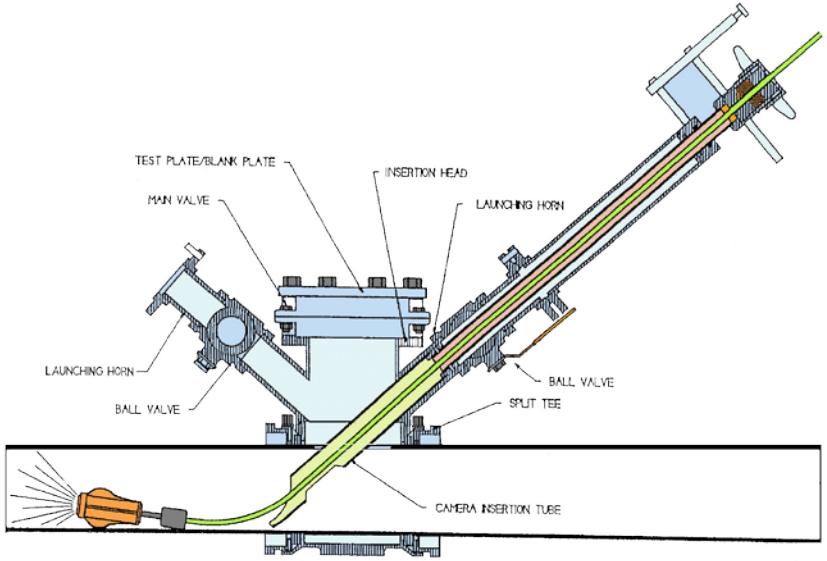


Figure L.1 – Camera Insertion Tee

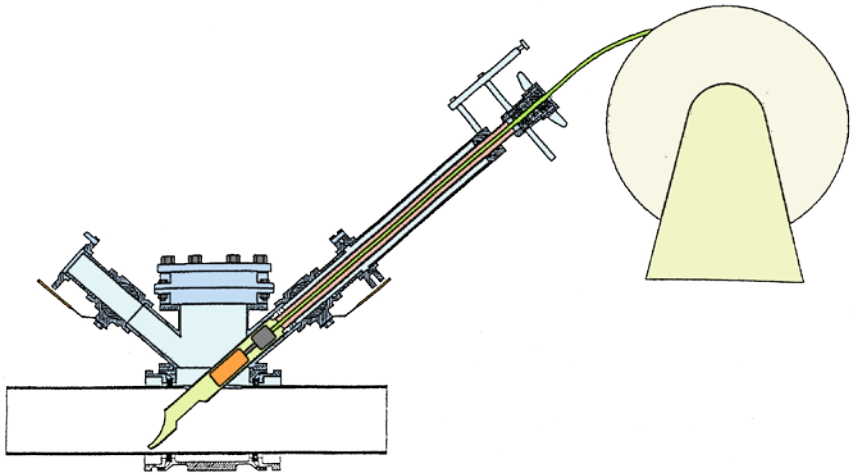


Figure L2 Camera in Position in Launch Tube Prior to Insertion into the Main

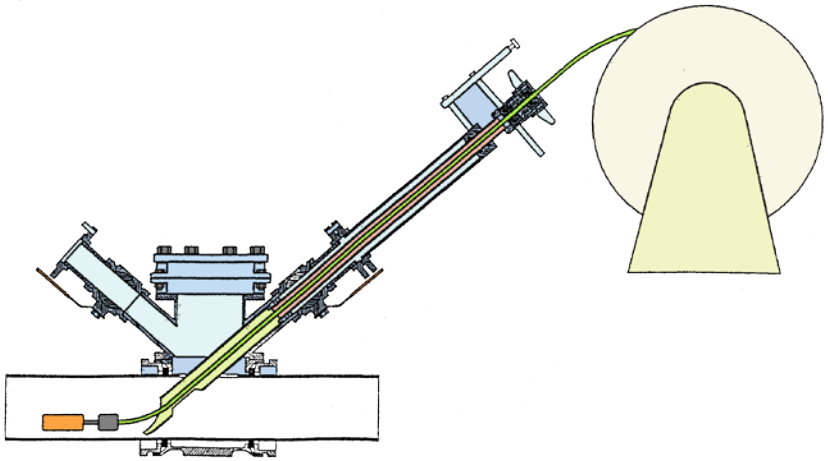


Figure L3 – Camera Inserted into the Main

RECORDS

1. Records both written and visual, of the inspection must be retained.
2. A more detailed examination of the visual record of the inspection may be made at a later date.
3. Details of the main, such as diameter, type, operating pressure must be recorded inclusion into computerised databases.

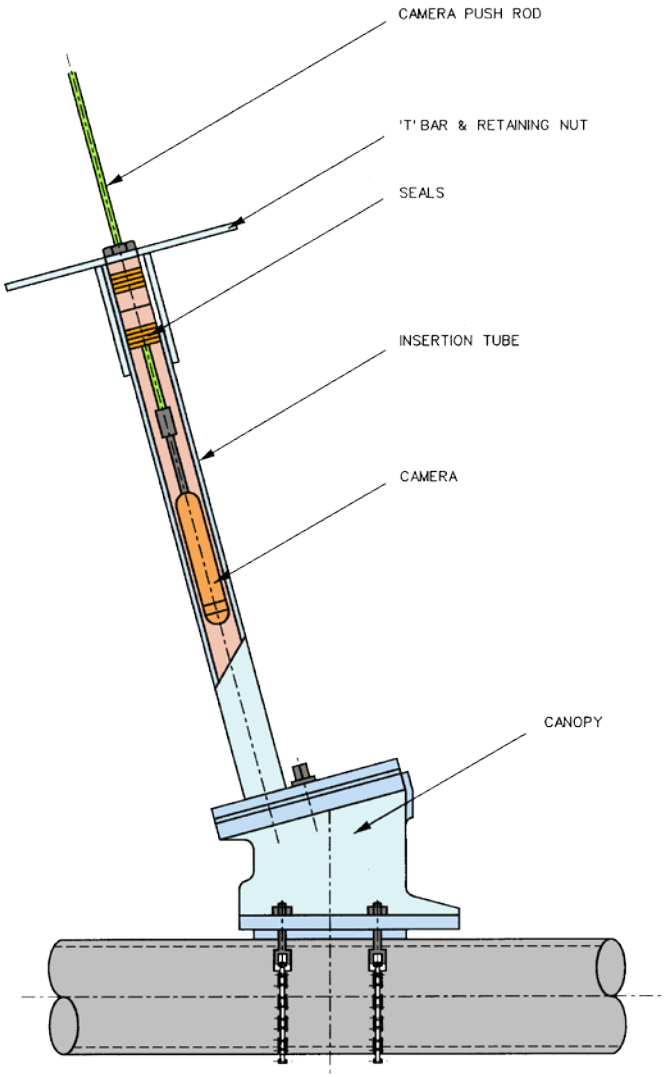


Figure L.4 – Under Pressure Insertion Head

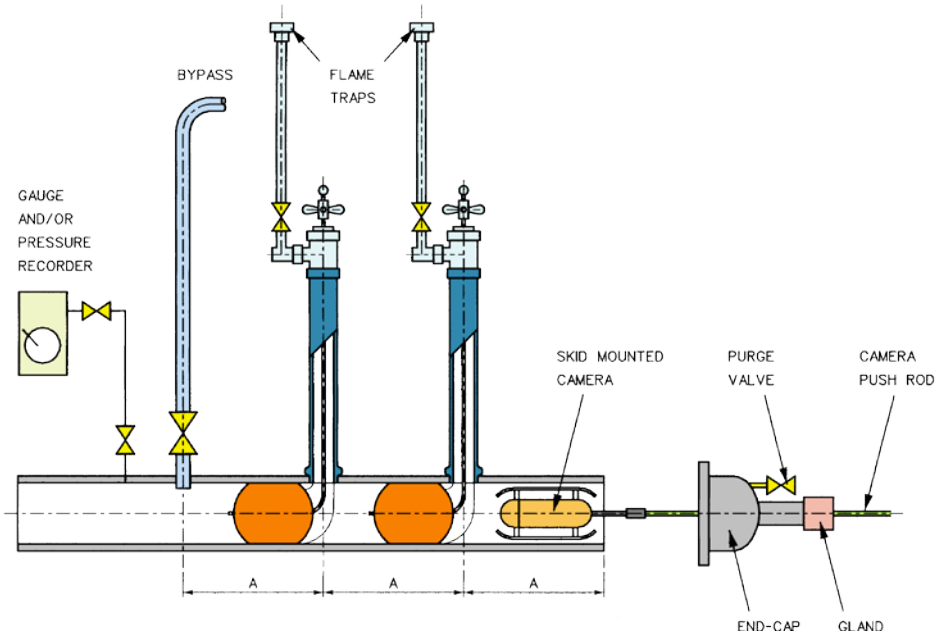


Figure L.5 – Camera Insertion Using Glanded End-Cap

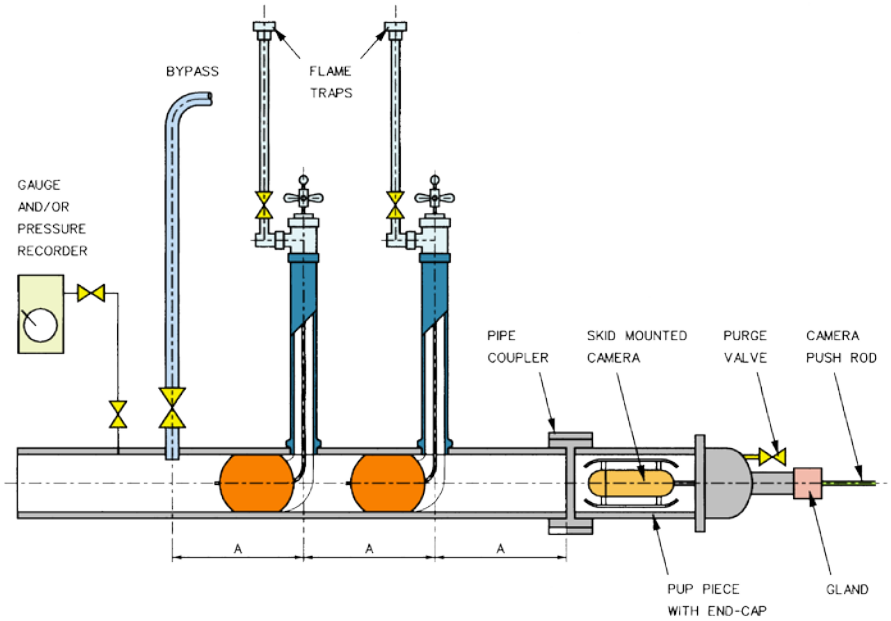


Figure L.6 – Camera Insertion Using Pup Piece

APPENDIX -M | Risk Assessment for the use of the Mini Pipe Handler (MPH) | Page 1 of 2

Event	Severity	Probability	Risk Factor	Mitigation
Damage to PE pipe with pusher jaws	2	2	4	Pre-check of closing jaws on PE pipe before operations commence
Finger/Limb trap/crush in pusher jaws	3	2	6	Pusher operated by excavator driver from cab operation under control of banks man. All other operatives to keep away from pusher
Finger/Limb trap/crush between swiveling Parts of pusher	3	2	6	Pusher operated by excavator driver from cab operation under control of banks man. All other operatives to keep away from pusher
PE slips from jaws	2	1	2	Check that jaws are locked before attempting any further operations. Banks man and other operatives to maintain suitable distance from PE pipe.
Pusher slips/falls from excavator	3	1	3	Check that pusher is locked to excavator arm before attempting any operations. Banks man and other operatives to maintain suitable distance from pusher.
Operative/MOP Hit by excavator	3	2	6	Keep operation within cordoned-off area to protect public. All operatives to keep clear of excavator when it is being moved or operated.
Operative/MOP hit by PE	5	2	10	Keep operation within cordoned-off area to protect public. All operatives to keep clear of PE and excavator arm when it is being moved or operated.
Displace/disturb host main	3	1	3	Banks man to oversee. Training and competency required of digger driver to minimize vertical motion imparted from excavator arm to PE pipe.
Displace/disturb 3rd party equipment in trench	2	2	4	Check that there is sufficient clearance before start of operation. Protect any plant/equipment as required with suitable boarding. Banks man to oversee operation
Excessive compression of Pipe during insertion	2	1	2	Insert PE pipe in small increments. Monitor spring back of PE pipe during insertion. If PE pipe insertion is obstructed stop operation, release jaws and monitor any pipe spring back. Investigate blockage before resuming operations.
PE pipe skin damage during entry to host main	2	2	4	Protect edge of host main. Minimize vertical motion of excavator arm, check trench and required footprint is sufficient to make sure that there is no excessive bending/displacement of PE pipe during insertion.

APPENDIX -M | Risk Assessment for the use of the Mini Pipe Handler (MPH) | Page 2 of 2

Digger becomes unstable due to loading	2	2	4	Stop operation and investigate problem.
Hydraulic fluid leaks when making/breaking connections	3	1	3	Stop operation and use spill kit.
Pusher impacts host main + flying fragments	2	2	4	Banks man to oversee. Training and competency required of digger driver to make sure pusher is kept away from host main.
PE impacts upon ground during handling	2	2	4	Correctly position trailer and use rollers to guide coil.
Too much vertical motion imparted to PE during horizontal push	2	2	4	Banks man to oversee. Training and competency required of digger driver to minimize vertical motion imparted from digger arm to PE pipe.

APPENDIX - N Conversions Imperial and metric

PSI(pounds per square inch) to bar

PSI	Bar	Psi	Bar
1.0	0.07	21.0	1.45
2.0	0.14	22.0	1.52
3.0	0.21	23.0	1.59
4.0	0.28	24.0	1.65
5.0	0.34	25.0	1.72
6.0	0.41	26.0	1.79
7.0	0.48	27.0	1.86
8.0	0.55	28.0	1.93
9.0	0.62	29.0	2.0
10.0	0.69	30.0	2.07
11.0	0.76	31.0	2.14
12.0	0.83	32.0	2.21
13.0	0.90	33.0	2.28
14.0	0.97	34.0	2.34
15.0	1.03	35.0	2.41
16.0	1.10	36.0	2.48
17.0	1.17	37.0	2.55
18.0	1.24	38.0	2.62
19.0	1.31	39.0	2.69
20.0	1.38	40.0	2.76

Inches water gauge to millibar

In wg	mbar	In Wg	mbar
1.0	2.49	21.0	52.26
2.0	4.98	22.0	54.74
3.0	7.47	23.0	57.23
4.0	9.95	24.0	59.72
5.0	12.44	25.0	62.21
6.0	14.93	26.0	64.70
7.0	17.42	27.0	67.19
8.0	19.91	28.0	69.68
9.0	22.40	29.0	72.16
10.0	24.88	30.0	74.65
11.0	27.37	31.0	77.14
12.0	29.86	32.0	79.63
13.0	32.35	33.0	82.12
14.0	34.84	34.0	94.61
15.0	37.33	35.0	87.09
16.0	39.81	36.0	89.58
17.0	42.30	37.0	92.07
18.0	44.79	38.0	94.56
19.0	47.28	39.0	97.05
20.0	49.77	40.0	99.54

Specific values

mbar	In wg
40	16.1
75	30.1
bar	PSI
0.05	0.73
0.1	1.45
0.14	2.03
0.2	2.9
0.28	4.06
0.34	4.93
2.0	29.01

APPROVAL

This Work Instruction was approved by Bob Hipkiss on 14/05/2018 for use by managers, engineers and supervisors throughout Scotia Gas Networks (SGN).

SGN documents are revised, when necessary, by the issue of new editions. Users should make sure that they are in possession of the latest edition by referring to the SHE & Engineering Document Library available on SGNnet.

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

BRIEF HISTORY

SGN/WI/ML/2 is a full revision of T/PR/ML/2: July 2004, T/PR/ML/3:June 2004 and T/PR/ML/4:June2004 into SGN's new SMF format. The revision has taken account and merged information from the following procedures, instructions and bulletins which are now withdrawn. T/PR/D7:June 2002 T/PR/D8:August 2002 T/PR/D10:October 2004 T/PR/ML/2:July 2004 T/PR/ML/3:June 2004 T/PR/ML/4:June 2004 SGN/PR/DIS/5.3.1 SGN/PR/DIS/5.100.5 SGN/PR/DIS/5.100.6 SGN/WI/DIS/5.200.1 SGN/SEI/184 SGN/SEI/533 SGN/SEI/535 SGN/SEI/592 SGN/SEI/600 SGN/SEI/602 SGN/SEI/617	May 2018	DESC-1733-24052016

SGN/SEB/724 SGN/SEB/728 SGN/SEB/731 SGN/SEB/736 SGN/SEB/750		

KEY CHANGES

Section	Amendments
ALL	Mainlaying document suite T/PR/ML/2, ML/3 and ML/4 have been combined into one single document to reduce duplication of text.
All	Style of document revised into SGN's new SMF format.
All	Order of subject matter amended, internal links provided to increase usability and allow quick reference to sections.
All	All drawings and diagrams throughout updated and coloured to aid clarity
All	Throughout the work instruction options for Intermediate Pressure mains has been added.
A1	General site setup introduced as a single section and duplication removed from construction sections.
B1	Sections on surface damage to PE and Multilayer pipe disbondment and containment added.
B1	Table 3 extended for SDR 13.6 and 296mm, 710mm & 800mm
B1	Additional text for the uses of Multilayer pipe added with Table 5 extended
B1	Depths of cover and Proximity referenced to SGN/WI/ML/1
B2	Dead insertion section revised, winching is now a specialist technique.
B2	Pipe integrity text now moved to testing section
B2	Section added to provide procedure when using an excavator mounted pushing machine from SGN/PR/DIS/5.200.1
B3	Section substantially revised as B2
B3	Pipe integrity text now moved to testing section
B3	Section added to provide procedure when using an excavator mounted pushing machine from SGN/PR/DIS/5.200.1
B3	New requirements for the recovery of the live head added
B4	Integrity testing requirements added
B4	New arrangements for live head recovery inserted
B5	Pre-moling checklist added
B5	Layout and text revised and reordered
B5	Term "Soil displacement hammer" replaced with "Impact mole"
B5	Section on the requirements for marker and aerial posts revised

B5	Section on Helicopter surveillance deleted
B5	Reinstatement section added
C1	New section specific to steel Mainlaying added
D	Testing sections moved to a combined testing at section G to remove duplication
D	Removal of drilling machine section
D2	Table for PE branch saddles added
D3	New section on connections to swagelined mains added
E0	New section added to provide general information for flow stopping to remove duplicated text in subsequent sections
E0	Flow stopping Table 21 extended to add foam off and large diameter bag stop operations
E0	Requirements for the testing & commissioning of bypasses added
E0	New requirements for proximity of PE squeeze off distances added (from SEI/592)
E0	New requirements for inspection of pipe when squeezing off PE pipe added
E1	Text relating Site survey and preparation referenced to section A1 & pre-requisites
E1	PE squeeze off general requirements removed and placed in section E0, remainder of text reworded and reordered.
E2	Text relating Site survey and preparation referenced to section A1 & pre-requisites
E2	PE squeeze off general requirements removed and placed in section E0, remainder of text reworded and reordered.
E2	Table 24 revised
E3	Text relating Site survey and preparation referenced to section A1 & pre-requisites
E3	Text relating to bypass construction and testing linked to general requirements at E0
E3	Text added for the requirements when live metallic welding is carried out.
E3	Decay testing moved to its own section at H5
E3	Cutting Operations - Requirement NOT to use crush cutters added
E4	New section on single hole bag stop system added
E5	The Text has been re-ordered and rearranged
E6	Text relating Site survey and preparation referenced to section A1 & pre-requisites
E6	The Text has been re-ordered and rearranged
E6	Text relating to bypass construction and testing linked to general requirements at E0
E7	New Section for the One way fed bagging system added from SGN/PR/DIS/5.100.6

E8	The use of the Bypass with integral pressure sensor has now been placed into a single section.
F1	Anchorage Section makes reference to SGN/WI/DIS/4.2.2 with no additional text
G1	New section for the testing of PE pipe on coils added
G2	Section on testing of mains now includes IP mains Table 38 has been updated.
G2	Identification of strength and tightness testing has been made in the text.
G2	Text re-organised
G2	Table 40 revised, checked and extended
G2	Test examples revised
G2	Additional data provided from SGN/PR/DIS/5.100.5
G3	Reference made to hydrostatic testing as a specialist technique
G4	Reference made to A(A)PT testing as a specialist technique
G5	New Section added for testing of under pressure tees and branch saddles
H1	Section updated and reworded. Identification of purge and vent pipe/points
H2	Section updated and reworded.
H3	Section updated and reworded.
H3	Purging isolation table44 rewording to allow double block and bleed to be two valves with intermediate vent.
H3	Text from T/PR/D10 for direct purge operations added
H4	New section from SEI/550 added for purging during flow stop operations
H5	Text moved from mains isolations to this location for decay testing
H6	New section provided for commissioning of coils by direct purging
Appendix B	Proximity of between fittings new requirements added from SGN/SEI/535
Appendix C	New section for the preparation of PE pipe for electrofusion added to provide a central linked location to remove duplication of text
Appendix D	The electrofusion of PE pipes and fittings has been moved to this position with new processes added for multilayer PE and SDR 21 & 26 pipe. For new black core pipe and fittings from SGN/SEI/579
Appendix E	The Butt fusion of PE pipes has been moved to this position with new processes & tables added for multilayer PE and SDR 21 & 26 pipe.
Appendix E	Text re-affirms the requirement of SGN to use only fully automatic butt fusion machines
Appendix F	New location for mechanical jointing
Appendix G	Installation of valves is added to this appendix with two options for the strategic valve set up.

Appendix H	New requirements for the mains breakout operation from SGN/SEI/617 & SGN/SEB/724
Appendix I	New requirements form SGN/SEI/533 for the reporting of PE faults
Appendix j	New requirements for recording of abandoned pipes taken from SGN/SEI/602
Appendix L	Text from BGE/D/7 Using CCTV added with some additional text from SGN/SEI/600 on competency, safety and PPE requirements
Appendix M	Risk assessment added for the mini pipe handler
Appendix N	Conversion tables extended

DISCLAIMER

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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:
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