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Προδιαγραφή εργασίας αντικατάστασης κυρίων αγωγών με την μέθοδο της ένθεσης σωλήνα PE σε ανενεργό μεταλλικό αγωγό (Dead mains insertion)

ΣΥΝΤΑΞΗ:	ΕΛΕΓΧΟΣ:	ΕΓΚΡΙΣΗ:
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PROCEDURE FOR MAINS REPLACEMENT- DEAD MAINS INSERTION (PE. LIFE)

1. SCOPE

This Procedure gives guidance for operational personnel, directly engaged on the replacement of existing mains by “dead” insertion of PE (polyethylene) pipe and should be used in conjunction with the corresponding Code of Practice.

2. REFERENCES

Unless otherwise specified this document shall be used with reference to the latest editions (and revisions) of related procedures, standards and specifications dealing with safety, traffic management, excavations, reinstatements and materials, plant and equipment, PE pipe system construction, testing and commissioning.

3. DESIGN

3.1 Selection of insertion pipe

3.1.1 There shall be sufficient annular clearance to avoid damage to the insertion pipe. This clearance may have been reduced by corrosion products or by fittings protruding into the main and by other factors. The internal condition of the main should be assessed for its suitability for insertion. For example, debris or contaminated waste material which may require removal and disposal to a special waste facility.

3.1.2 For pipes with SDR higher than SDR17.6, with thinner pipe walls considered for installation within a flood plain area, the effects of external hydrostatic head may require whole length annular sealing following installation, to protect the pipe.

3.4 Location of excavations

3.2.1 A thorough examination should be made of all records of the existing main, together with details of other Utilities plant along the route. Additionally, a survey of the existing main should be made using a pipe location instrument and the position of the existing main and of any changes in direction should be both recorded and marked on the highway surface. It should be noted that any changes in depth are equally important and where there are any doubts about the accuracy of information, trial hole excavations should be made.

3.2.2 The route of the main should be assessed for traffic conditions, vehicle and pedestrian crossings and access points, bus and school stops and any other features along the route which may affect the selection of excavations for launch, reception and intermediate pits. Wherever possible, the dual use of excavations should be made for the removal of obstructions, bends, tees, etc; or the installation of new connections as well as for use during the insertion process.

3.2.3 When the largest size of insertion pipe is used, it is usually necessary to remove all bends and installed plant before insertion takes place. Where long lengths of main are to

be inserted, additional intermediate excavations may be required. However, particularly when the insertion pipe is considerably smaller than the carrier pipe, it may be possible for some minor degree bends to be retained, provided that the radius of curvature stress limits of the inserted pipe are not exceeded.

3.2.4 The length of main which can be inserted will be affected by the insertion pipe size and material selected, gradient, changes in direction, annular clearance, the number of services connected etc; and it is not possible to specify maximum lengths.

3.2.5 The location of all excavations should be indicated clearly on project drawings and also where possible on the highway surface.

3.3 Selection of pipe storage sites (pipe dumps)

3.3.1 Where straight pipe lengths are to be used for insertion, a storage site or sites should be selected:

a) to provide, so far as possible, security and protection from impact damage and vandalism; and

b) to permit pre-assembly of lengths of pipe to form pipe strings in safety and with a minimum of obstruction to pedestrians and other road users.

Where radiography is employed, the working area shall be fenced off and all safety precautions recommended by the Engineer shall be implemented.

3.4 Maintenance of supplies

3.4.1 Where supplies to customers are to be interrupted, consideration should be given to maintaining supplies by a temporary bypass or other suitable means.

3.4.2 Unless its omission is specifically authorised by the Engineer, a bypass shall be fitted over every cut-out or operation which stops or reduces the flow of gas in a low pressure main. The size of the bypass will be at the discretion of the Engineer. In the case of a metallic main and bypass pipes, low resistance electrical continuity bonds shall be fitted to prevent "sparking", both across the cut-out and on any bypass pipe connections.

3.4.3 Generally, bypasses should be constructed from rigid or approved flexible steel pipes. Where the Engineer is satisfied that no undue fire hazard exists and that the bypass is safe from interference and accidental damage, flexible bypasses constructed of PE (polyethylene) materials may be used. The bypass should be tested and checked for leakage before purging and commissioning slowly until it achieves full line pressure, ensuring safety of pipework and fittings.

3.4.4 Where appropriate, the bypass connections to the main may be in the same excavation as other site works. Exposed "live" PE bypasses shall not be left unattended and unprotected without the authority of the Engineer.

3.5 Relaxation, temperature effects and anchorage

3.5.1 During and immediately after the insertion of a PE main, its length may change due to:

a) a change in temperature between above and below ground ambient conditions.

b) recovery from tensile forces applied during insertion which only apply when the main is pulled in.

When the insertion pipe is pushed in, the problems of change due to recovery of inserted compression loads can be ignored.

3.5.2 A one-hour (minimum) stabilisation period should always be allowed for ambient and atmospheric temperature variation effects. In extreme cases, with ground temperatures in excess of 20°C, subject to the Engineer's discretion, an overnight temperature stabilisation period is recommended.

3.5.3 Where the insertion pipe is pulled in by winching, sufficient time shall be allowed for the tensile stresses induced to recover before tie-in connections are made.
Minimum relaxation times in this case are detailed in Item 7.1 and may run concurrently with the 1 hour (min) or overnight temperature stabilisation period

3.5.4 For long term protection of the PE pipe from the effects of ground temperature changes, local anchorage of the pipe is necessary as detailed in Item 7.4.

3.6 Sealing of annular openings

3.6.1 Consideration shall be given to sealing the annular space, to minimise the migration of leaking gas.

4. WORK PLANNING AND CONSTRUCTION PROGRAMME

4.1 It is essential, in order to avoid delays and disruption whilst the work is in progress, that in liaison with the Engineer, a construction programme is prepared.

4.2 Due attention should be given to site inspection and survey including existing main details and expected positions of other utilities plant, road closure and traffic diversionary requirements, materials procurement, and expected production rates.

4.3 Local highway authority notices, acquisition of records from other Utilities and customer notifications and requirements should all be considered.

4.4 Table 1 is indicative of typical production rates normally expected from a fully equipped main-lining/insertion team, for small diameter mains. However, where it is considered for more than one team working in the same area, on a street by street basis, to avoid conflict regarding gas supplies and traffic considerations, careful planning will be necessary in preparation of the final construction programme.

TABLE 1 – Typical daily production rates for small diameter main insertions

Existing main Nominal bore ins/mm	Insertion PE pipe size outside diameter (mm)						
	25/32	63	90	125	180	225	250
	Mains insertion outputs (metres/week)						
2/50	500						
3/80	1000	750					
4/100	1000	700	500				
5/127		850	700				
6/153			700	500			
7/178				500			
8/206					500		
9/232					500		
10/258						280	
12/303							250

5. SITE PREPARATION

5.1 Site survey

5.1.1 Before excavation work commences, a survey of the site should be made using cable location equipment and the position of cables in the vicinity of proposed excavations and trial holes should be marked on the surface.

5.1.2 Attention shall also be made to protect overhead cables using warning tapes and "goal posts", particularly when loading/handling pipe at selected pipe storage sites.

5.2 Plant, tools and equipment

5.2.1 In addition to the tools and equipment regularly used for mainlaying, arrangements should be made for specialist plant and equipment to be available, as appropriate.

5.2.2 Safety requirements (Appendices A and B) of this procedure, concerning the use of this special equipment, as detailed in the Code of Practice, shall be observed.

5.3 Excavations

5.3.1 General

5.3.1.1 Excavations should be made in accordance with the relevant procedure specific to this operation.

5.3.1.2 To minimise on the number of excavations, wherever possible, they shall have multipurpose use for trial holes, removal of obstructions, bends, tees, etc; and for temporary bypass connections as well as for launch and reception pits.

5.3.2 Launch/reception excavation

5.3.2.1 The “feed-in” launch excavation should allow continuous pipes to be inserted with a slope of approximately 20 degrees.

5.3.2.2 The size of the excavation at the launch and reception pits shall be kept to a minimum. As a guide, Table 2 gives the length of excavation of the launch pit. It may not be necessary for the whole length of the excavation to be the same width as shown in Figure 1.

TABLE 2 – Total length of launch excavation

PE Pipe diameter mm	Minimum total length (metres) See Figure 1		
	Up to 1 metre of cover	1 metre to 2 metre of cover	2 metre to 3 metre of cover
55/63/75/90	2	3	3
125/140	4	5	6
180/200	5	6	7
250/280	6	8	9
315/355	7	9	11
400	8	10	11
500	9	11	13

5.3.3 Intermediate excavations

Excavations at bends, siphons, valves or other intermediate points shall be long enough to enable the fitting to be cut out, and for the inserted pipe to negotiate any bends. (See Table 3)

5.3.4 Service connections

At each service connection, an excavation should be made to enable the service to be transferred when the new main has been inserted. The existing main shall be exposed so that a piece can be removed and saddle fusion equipment fitted to the PE main when it has been inserted.

5.4 Installation of bypass

5.4.1 Where a bypass is to be used for maintenance of gas supplies during the insertion process, it shall be installed in such away as to maintain access and minimise obstruction to pedestrians and traffic and such that it is not vulnerable to impact damage by vehicles.

5.4.2 It may be necessary to place all or part of the bypass just below the surface, as determined by the Engineer. (See Code of Practice)

TABLE 3 - Minimum length of main to be removed at bends

Bend type	Minimum lengths (L) to be removed at bends in terms of insertion pipe outside diameter "D"			
	Coiled pipe	Pipe with joints		
	SDR 11 or 17	SDR 11	SDR 17	SDR 26
45 °	6 D	10 D	18 D	25 D
22 ½ °	4 D	6 D	9 D	12 D
11 ¼ °	2 D	3 D	4 D	6 D

5.5 Transfer of services

All new or transferred services shall be pressure tested in accordance with the testing procedure designated for this purpose.

5.6 Jointing of pipe strings

5.6.1 The launch site should be selected near the launch excavation. Where straight pipe lengths are to be used for insertion, pipe strings should be made up in advance but site conditions usually dictate the maximum length. A pull-through shall be used before the assembly of pipe strings and the ends of each string shall be temporarily sealed. It is particularly important for strings to be stored carefully on site to minimise the obstruction to pedestrians and vehicular traffic.

5.6.2 Where coiled pipe is to be used for insertion, a straight 6 m length may be fused to the leading end to reduce resistance during insertion. Butt jointing on coiled pipe should be avoided wherever possible, and therefore the leading straight length should be removed before connection. Butt jointing between coils should also be avoided.

A coil dispenser should be used whenever possible, but if one is not available, the pipe should be uncoiled prior to insertion.

5.6.3 Butt fusion bead removal shall be done with the correct tool, without damage to the pipe. Bead and joint inspection shall be undertaken in accordance with the PE pipe fusion welding procedure designated for this purpose.

5.6.4 Unless specified by the Engineer, butt jointing on coiled pipe should be avoided wherever possible, due to the difficulty of adequately re-rounding and straightening which may otherwise require the use of additional specialist equipment.

5.7 Testing of pipe strings

5.7.1 In some cases, the Engineer may decide to test individual pipe strings or coils before insertion.

5.7.2 The pipe string being tested shall be anchored temporarily because the pipe may straighten or snake when pressurised. Warning signs advising that pressure testing is in progress shall be placed at each end of the site.

5.7.3 An air test of not greater than 40mbar shall be applied. All joints must be tested immediately using an approved leakage detection solution, which must be washed off with clean water.

5.7.4 Following successful air testing, the air pressure should be released slowly, the test ends or caps removed and the ends temporarily sealed using expanding stoppers or other suitable means. To avoid confusion, pipe strings which have been tested may be marked.

5.7.5 Where the Engineer requires radiographic examination, the working area must be fenced off and the special safety precautions recommended by the Test Engineer must be observed.

5.8 Isolation, proving and purging of existing main

The existing main shall be isolated, proved and purged in accordance with the de-commissioning procedure designated for this purpose.

5.9 Cleaning of existing main

5.9.1 After intermediate fittings have been removed, the main should be cleared of scale or contaminated chemical deposits using cleaning rods or wire cable pull throughs, with scraper pigs attached.

5.9.2 A suitably protected operative wearing eye protectors/dust mask, and positioned at the end of the main or intermediate excavation should:

a) display warning notices, and

b) take steps to protect pedestrians and passing vehicles from any loose material which may be discharged from the main

c) any discharged dust and debris should be collected for disposal to a specially registered waste tip.

6. INSERTION INSTALLATION PROCEDURE.

6.1 Gauging of existing main

6.1.1 To confirm that the existing main is clear of obstructions and sharp edges, a proving length of the main to be inserted should be pulled through after cleaning operations. For mains larger than 180mm, and where multiple bends are involved, this length should not be less than the minimum length stipulated in Table 3.

6.1.2 This proving pipe should be carefully examined for deep scratching or scoring. Examination of the pipe surface at each intermediate excavation as the pipe is pulled through will help to pinpoint unacceptable damage. The position, secure mounting and adequacy of guide rollers to assist the pipe to negotiate any bends should be checked at this stage.

6.1.3 Surface scratching is inevitable, but where deep scratching or scoring of the pipe occurs, the Engineer or his representative shall be notified. Further investigation of the existing main will then be necessary before proceeding with the insertion operation.

6.2 Preparation for insertion of first pipe string

6.2.1 A nose cone should be fitted to the leading edge of the pipe.

6.2.2 The inserted pipe should be protected from the sharp edge of the existing main in the launch pit and intermediate excavations using an insertion trumpet or other means. For example, as shown in Figure 2.

6.2.3 Rollers or other suitable packing should be set both at road level and in the launch excavation to guide the inserted main into the existing main as shown in Figure 1.

6.3 Winching

6.3.1 The preferred method is for the pipe to be inserted under controlled conditions by "pushing" from the launch end. Alternatively, the pipe may be inserted by pulling from the receive end.

6.3.2 Wherever possible, hand winching should be chosen in preference to powered winching and a steel wire cable should be used in preference to natural fibre ropes. Ropes made from man-made fibres shall not be used. A current test certificate must be available for the steel wire cable.

6.3.3 All cables to be used during the insertion process must be approved by the Engineer and examined before and during use for signs of damage. Any damage must be reported before the work proceeds. Damaged cables shall not be used.

6.3.4 The safe working load (SWL) of the rope or cable shall be equal to or greater than the load capacity of the winch.

6.3.5 The winch should be fitted with a suitable means of control to limit the maximum allowable "pull-in" force on the PE pipe, to that shown in table 3.

6.3.6 All winches must be securely anchored. During winching operations no one should stand in the direct failure path of the cable. To minimise the possibility of accidents arising from a failure of cables, timber shoring may be securely fitted across the trench width, above and below the line of cable. Protective gloves shall be worn at all times when handling cables.

6.4 Insertion - general

6.4.1 The PE main should be entered carefully and each pipe length should be marked with a number or total length of pipe inserted, so that the nose cone may be easily located in the event of obstruction.

6.4.2 When each new pipe string is added, the new joint must be allowed to cool before the PE main is handled or subjected to a pressure test in accordance with 5.7.

6.4.3 During the insertion process, the passage of the pipe should be checked at the intermediate excavations. The pipe surface should be examined for signs of deep scratching or scoring as detailed in 6.1.

6.4.4 Where the inserted pipe is required to change direction, e.g. where a bend has been removed, the leading end should be slowly and carefully guided into the main opening, rollers or sand bags having been positioned to assist the pipe to negotiate the bend.

6.4.5 On completion of the insertion process, the surface of the leading pipe should once again be examined and the Engineer notified of any deep scoring or scratching.

6.5 Insertion by pushing

6.5.1 The inserted main is said to be "pushed in" when the effort required to insert the main is applied from the launch end of the existing main as opposed to the receive end. This may be achieved:

a) by hand (very light duty application only);

b) Static mechanical excavator with lifter capacity.(medium duty only);

c) pusher machine (medium duty);

d) the use of a winch (heavy duty)

6.5.2 Care shall be exercised when the free end of the inserted pipe is close to the launch trench, the pipe may whip or bow and no persons shall be permitted to enter both the launch and reception pits during insertion, until pushing operations have ceased.

6.5.3 When using an excavator/loader mechanical assistance to push in the insertion pipe, safety measures as detailed in Appendix A shall be observed.

6.6 Insertion by pulling

6.6.1 The inserted main is said to be "pulled in" when the effort required to insert the main is applied from the receive end.

6.6.2 A winch and pulley assembly should be set-up and anchored at the receive end of the existing main. The cable should be passed from the winch (using a flex-probe rod), through the existing main and secured to the pulling head assembly of the pipe to be inserted.

6.6.3 The winch operator at the receive end must maintain contact with personnel at the launch trench, by radio contact if necessary. The inserted pipe must not be allowed to drag over rough surfaces or sharp edges. Rollers or a coil dispenser should be used to enable the pipe to enter the existing main at a slow walking pace.

6.6.4 When using a powered winch (usually for heavier duty applications), the operator must not exceed the pull in force that will be stated by the Engineer. If the tension in the cable rises suddenly, the winch shall be stopped immediately and the tension shall be released before any attempt is made to enter excavations or to investigate the obstruction.

6.6.5 When hand or powered winching is used, safety measures as detailed in Appendix B shall be observed.

TABLE 4 – Maximum allowable pull-in force (F) for MDPE pipe in kg.f

Pipe outside diameter mm	MDPE pipe (SDR) and maximum allowable pull-in force (F) in kg.f		
	SDR 11	SDR 17.6	SDR 26
	(F) kg.f	(F) kg.f	(F) kg.f
20	80	52	-
25	125	81	-
32	205	133	-
63	794	514	-
75	1125	728	-
90	1619	1048	-
125	3123	2022	-
140	3918	2536	-
162	-	-	2250
180	6478	4193	-
200	7997	5176	-
213	-	-	3900
250	12446	8088	-
268	-	-	6150
280	15674	10145	-
315	19836	12839	8490
355	25196	16308	-
400	31988	20704	-
450	38255	24301	-
500	49911	32350	-

7. COMPLETION

7.1 Relaxation period

When a main is pulled in, a relaxation time shall be allowed.

Minimum relaxation times are:

a) 2 hours for mains designed to operate at less than 75 mbar;

b) 12 hours for mains designed to operate at 4 bar.

Pressure testing may be carried out during this relaxation period provided a stable pressure condition is achieved.

7.2 Final pressure test

Sufficient surplus pipe must be left at each end for final connections, the ends of the inserted main should be capped and a final pressure test applied as for all new mains in accordance with the testing procedure approved for this purpose.

7.3 Lateral connections to the inserted main

A piece of existing main should be removed to enable suitable tools to be fitted to the inserted main for making connections. This piece is most easily removed before insertion takes place. Where this is not possible, or where connections are to be added subsequently, it is important to recognise that the inserted main may be in contact with the existing main at any point, not necessarily the bottom. Particular care is needed where the existing main is steel to avoid damage by wheel cutters to the inserted main.

Annular spaces between the inserted main and the existing main should be sealed as determined by the Engineer. Pipework must be adequately supported.

7.4 Anchorage

7.4.1 Where the inserted main connects to the existing metallic system, provision must be made to protect the existing mains from end loads imposed by the inserted PE main.

7.4.2 In the case of welded steel mains, an end loading transition fitting will suffice.

7.4.3 The casing pipe (i.e. the old main) should preferably be used for anchorage. Where the PE main size is such that an electrofusion coupler exists, this can be fused over a scraped area of pipe adjacent to the exit of the PE main from the carrier pipe, sandwiching a flange between the coupler and the end of the casing pipe. A 3-metre length of undisturbed main should be left at the dead pipe end. Figure 3 shows a typical arrangement.

7.4.4 For larger sizes, it will be necessary to provide anchorage by other methods; a flanged fitting is suitable. This arrangement must transmit the load to the end of the carrier pipe (See Figure 4). If the end of the carrier pipe cannot be used to react to the end load, a ground anchor can be used, giving due consideration to the ground conditions prevailing on site.

APPENDIX A

SAFETY OF LIFTING/PIPE PUSHING OPERATIONS USING MECHANICAL EXCAVATOR/LOADERS AND PIPE SLINGS

A1 COMBINED EXCAVATOR/FRONT LOADERS USED AS CRANES

1. INTRODUCTION

Due to the versatility of these machines (originally developed by the JCB Company), they have become sufficiently developed over many years for static lifting and short length pulling operations on site. The static pulling operation is restricted to the radius of curvature of the excavator dipper arm, which is usually a hydraulically operated, extendable arm that retracts as apparatus is pulled via slings or chains. Consequently, for mains insertion purposes, the slings or chains and pipe-restraining clamp used, need to be continuously extended in the launch pit to back haul the inserted pipe (in effect "pushing"), section by section, until the entire pipe string has been successfully inserted.

The main constraint is the specified safe working load limits (SWL) of the lifting and pulling capacities of both the machine and all associated lifting and pulling tackle used for this purpose. Generally, this technique was initially used to mechanically assist "hand-pushing" from the launch pit for small diameter, short length mains renewals. However, it is now in common use where the SWL lifting limits of the machine and tackle are not exceeded, although this will vary between different types of machine and tackle used.

The following precautions must be observed when considering the use of such machines for slip-lining/mains insertion and applies to wheeled (not tracked) excavators used in surfaced road and pedestrian carriageways only.

2. GENERAL

2.1 To avoid the machine pulling itself into the launch pit, this method of mains insertion using an excavator must not be used under the following circumstances:

a) In any un-made, un-surfaced ground, unstable ground such as waste infill, clay/subsoil/gravel or grassed surfaces including lawns, verges, pasture or agricultural land or in any other surface which has a low frictional resistance.

b) In any flexible carriageway or surfaced area of low "skid" resistance value, This will include concrete sets, brick paving and modular or gravelled pavement construction but shall generally exclude solid concrete, hot rolled asphalt or dense bitumen macadam materials that are stable and not liable to movement.

c) Where it is evident that there has been a spillage of oil, diesel or other solvent substance on the carriageway surface or other slippery conditions caused by adverse weather, such as rain, snow or ice.

2.2 Further safety precautions are as follows:

a) The excavator machine must be rendered static, as is the case with all pipe pulling/pushing equipment. The wheeled excavator/loader must be capable of self-supporting itself, with its wheels elevated from the ground, using hydraulically operated outrigger side support stanchions and the front loader bucket supporting the machine. Ground augers or anchors, attached to the machine can also be used where considered necessary by the Engineer. If the excavator machine is not designed or capable of performing these functions, then it shall not be used.

b) To both grip and avoid "scarring" to the carriageway surface, proprietary steel mesh reinforced, high friction resistance, neoprene rubber feet and mats must be used between the road surface and the base of the support stanchions and front loader bucket. Vehicle tyres are not recommended for this purpose.

c) The safe working loads (SWL) limits of the machine, shackles, swivels, chains, slings, pipe clamps or any other equipment used, must not be exceeded. The use of a mechanical fuse is recommended but rated at the lowest SWL value of whatever plant or tackle is used to ensure that this does not occur.

d) The excavator/loader must not be used at the reception pit in order to pull a pipe and/or cable from the launch pit; only proprietary designed winches fitted with suitable dynamometers are permitted for this purpose.

e) The sides of the launch excavation must be suitably supported, to prevent ground collapse, preferably with inter-linked steel sheet piles, protruding at least 300mm above surface level at the machine side of the launch pit.

f) No persons must be allowed to enter either launch or reception pits during the mechanically assisted pipe pushing operation using an excavator/loader.

3. EXCAVATOR/LOADER SAFETY REQUIREMENTS

3.1 The machine must be certified, tested and approved for lifting use and have a valid certificate of insurance for this purpose and a copy must be kept available for inspection on the site of the operation of the works.

3.2 The hydraulically operated machine must be fitted with check valves on the hydraulic lifting cylinders, or some other suitable device, to prevent a gravity fall of the lifting arm in the event of a hydraulic failure. Check valves must be also fitted to the main boom cylinders and on the outward reach side of the dipper stick.

3.3 Before a combined excavator/loader is first used as a crane, a Competent Person appointed by the owner must specify the safe working loads relevant to the machine and those jibs or booms which it is intended to use. The operator/driver of the machine must be trained, qualified and conversant in its use and its SWL limitations.

3.4 The safe working loads (SWL) should also be specified in both positions where used with outriggers fully extended and blocked and also when on wheels only, for each length of jib or boom it is intended to use.

3.5 The safe working load must be the same for all radii at which the jib or boom is operated and shall not be greater than the load which the machine in its least stable configuration is designed to lift with that jib or boom.

3.6 The specified safe working loads and the outrigger position and the length of the jib or boom, to which the safe working load relates, must be plainly marked on the machine. Alternatively or in addition to, a copy of the table of safe working loads must be affixed in a clearly visible position in the drivers cab.

3.7 The machine must be regularly maintained and tested and must be thoroughly examined by a Competent Person within the previous 14 months.

3.8 The adaptation of an Excavator/ Loader for use as a lifting appliance must solely be by securely attaching lifting tackle to the purpose built and designed lifting eye and shackle at the end of the dipper arm/jib. This means that slings must not be hooked over the teeth of the excavator bucket nor attached in any other make shift way without the use of the properly designed and mounted point of attachment on the machine. Consequently, it is recommended that the bucket is detached from the machine, when used as a lifting appliance.

A2 SAFE USE OF FLAT WOVEN WEBBING SLINGS

4. SLING SELECTION

4.1 Belt slings are available in a range of materials, widths, thickness and length sizes. Polypropylene slings are preferred, as unlike nylon or polyester slings, they are little adversely affected by acids or alkalis, but could however be damaged by some solvents including tars and paints. It is therefore important that they are checked regularly for such contamination and discarded as required.

4.2 The sling must be both long enough and strong enough for the load and the pipe slinging method used. The safe working load (SWL) capacity should be marked on the sling. An estimate of the maximum weight of the anticipated load should be established (for insertion lengths and sizes of pipes considered) to ensure this SWL value is not exceeded.

4.3 To prevent abrasion (fraying) from any sharp edges or corners, it is recommended to select a sling fitted with protective sleeves or use other suitable means to avoid the sling making contact with any sharp projections.

5. STORING AND HANDLING BELT SLINGS

5.1 Slings made from textile materials such as polypropylene are susceptible to damage from heat and should not be used or stored at temperatures exceeding 80°C.

5.2 Never return wet, damaged or contaminated slings back to storage. They should be cleaned with clear water and dried naturally. Never force-dry belt slings using heating equipment.

5.3 Store belt slings from non-rusting pegs, which allow the free circulation of air. The storage area should be dry, clean, free of any contaminates and shaded from direct sunlight.

5.4 Do not alter, modify, repair or paint a belt sling but refer such matters to a Competent Person, usually a person appointed by the manufacturer.

6. INSPECTION AND MAINTENANCE OF BELT SLINGS

6.1 Regularly inspect belt slings and, in the event of the following defects, refer the sling to a Competent Person for thorough examination, or else discard it and obtain a new sling. Defects include illegible markings; damaged, chaffed, frayed or cut webbing; damaged or loose stitching; heat damage; burns or chemical damage or contamination; solar degradation; damaged and/or deformed end fittings.

6.2 The material, from which a sling is manufactured, may usually be identified by the colour of the label or printing on the label. Polyester (blue), polyamide or nylon (green), polypropylene (brown) and the sling may also be dyed with a colour code to indicate its SWL. Refer to the source supplier/manufacturers instructions in this case.

6.3 Maintenance requirements are minimal. Belt slings may be cleaned with clear water. However it must be remembered, that if weak cleaning chemical solutions are used, they will become increasingly stronger by evaporation and must be immediately washed-off with clean, cold water.

6.4 Apart from day to day checks, regular planned maintenance and inspection periods are dependent upon usage. Generally it is recommended that this is could be undertaken at anytime between 3 to 6 month intervals. A system of colour coding can be adopted, using an approved (possibly biodegradable) coloured spot dye or stamped “ID” label to indicate the date when last inspected and maintained or when the next inspection is due or has expired.

7. SAFE PIPE SLINGING PRACTICE

7.1 The following practices generally cover the main points for single sling usage, and for mains insertion purposes only. They do not include for multiple-leg sling usage for loading or unloading pipes in or out of trenches or above ground or for any other use.

7.2 When using a sling in a choke hitch mode (i.e. by passing one end of the sling through the loop at the other end), multiply the marked SWL value by 0.8 to obtain the reduced maximum load the sling may accept i.e. reduce the SWL by 20%.

When estimating the load (i.e. the weight of the pipe to be inserted), increase this by 20%, to allow for frictional effects, to become the actual working load.

7.4 The actual working load shall not exceed the reduced safe working load (SWL).

7.5 In light duty applications, equivalent to or slightly greater than hand–pushing operations, using a choke hitch instead of a pipe-restraining clamp may be sufficient, subject to the Engineers approval. However, in this instance, the choke angle (i.e. the angle of the pipe sling between the jib of the lifting machine, and the other end attached to the insertion pipe being hauled into the host main), should not be less than 60° to the horizontal plane to avoid slippage. Obviously, as the pipe is hauled in, this choke angle will increase to almost 90°, the effect of which will tend to have a greater grip on the insertion pipe.

7.6 Using an approved pipe-restraining clamp on the end of the pipe string being hauled-in, can reduce the choke angle to less than 60°, but will possibly mean an increase in the length of the launch pit excavation.

7.7 Good slinging practice must ensure that no harm is done to the load, lifting equipment, site operatives, or other property or persons. The launch and reception excavations shall be properly signed and safeguarded and no persons shall be allowed in those excavations whilst pipe sling/hauling is in progress.

7.8 Before commencing operations using slings, shackles and any other attachments, they should be inspected for obvious defects and that they are rated and approved for the purpose for which they are intended. Follow any specific instructions from the suppliers of such equipment

7.9 When in use the sling must not be twisted, tied, knotted throughout its length or attempts made to try and shorten it in any way.

7.10 Use packing; pipe insertion trumpets or any other means to prevent both the insertion pipe and the sling chaffing on sharp edges during the insertion operation.

7.11 Do not hammer, force or wedge slings or accessories into position; they must fit freely. Keep fingers, toes etc; clear when tensioning loads.

7.12 Do not allow anyone to be under or ride upon the inserted pipe load.

7.13 Ensure the insertion pipe is free to be back hauled into the host main and check that there are no overhead obstacles such as power lines. Use an established code of signals to instruct the machine driver to take the load steadily, avoid shock loads and commence insertion operations.

7.14 Once the first length of PE pipe has been inserted, relocate the sling and pipe clamp and continue to repeat the process until the entire pipe string has been inserted.

8. OPERATIVE TRAINING

Slings should only be used by trained operatives who fully understand the methods of rating concerning safe working loads, their safe application and mode of operation involving the mains insertion process.

APPENDIX B

SAFETY OF WINCHING OPERATIONS

1. INTRODUCTION

Winching operations are an integral part of gas distribution, trenchless technology activities associated with dead mains insertion, swagelining and guided moling or mains "stitching" techniques.

The provision of suitable equipment and correct procedures for use on site are essential to ensure the safety of operatives and the general public.

2. GENERAL

2.1 The requirement and necessity for a winch to be utilised in the job activity should be established.

2.2 The use of a tractor mounted winch or a moving vehicle must not be used to "tow" a pipe into a sleeve. All winching operations must be carried out by a static, purpose built and designed machine, preferably a capstan winch, as this gives a constant rate of pull and tension which will not vary as the cable is wound in, as is the case with a drum winch.

2.3 If the winching operations could affect the activities of others (i.e. members of the public or other employees), consideration should be given to the issue of a work permit or a written procedure, to be approved by the Engineer.

3. EQUIPMENT

3.1 All equipment used during the winching operation must be approved as "fit for purpose" by the Engineer or Engineer's representative. This equipment will include:

a) Winch.

b) Winch cable.

c) Anchor plates and/or pins.

d) Anchor chains.

e) Shackles and swivels.

f) Towing heads.

g) Block and pulley assemblies.

3.2 All equipment must be checked before use by the Engineer or Engineer's representative and replaced if necessary.

3.3 Winches should preferably be fitted with a dynamometer or calibrated load indicator. They must be free from defects and properly maintained. A load cell may also be installed in the winch cable to provide additional monitoring facilities.

3.4 The winch cable should be of the correct construction. The safe working load (SWL) must be equal to or greater than the load capacity of the winch. A current test certificate should be available for steel wire cables (see clause 5).

3.5 Steel wire cables with fibre core should be used in preference to natural or textile fibre ropes.

3.6 Shackles, swivels, block and pulley assemblies, and towing eyes must be clearly stamped with SWL details and identification number. Insurance test certificates must also be available.

3.7 Winches must be so designed as to prevent over-stressing of cables. This can be achieved by installing relief valves in the hydraulic system and these can be inspected when the load cell is being checked.

3.8 Each winch must have a designated towing capacity and a suitable size cable must be fitted. This cable must not be replaced with one of a smaller capacity.

3.9 Appropriate protective clothing, including safety helmets, goggles, gloves, footwear, etc; should be worn by all personnel working on, or in the vicinity of, the winching operation.

4. WINCHING SAFETY

4.1 All personnel engaged in the winching operation should be properly trained in the safe and correct use of the equipment.

4.2 The Engineer, prior to commencing the operation must approve the proposed method of winching. Thereafter an Engineer or Engineer's representative must be on site to approve and control the winching operation.

4.3 For mains relining operations, depending upon the type of winch used, can either be located in the reception pit or alternatively a "drop leg" type winch can be used above the reception pit incorporating pipe end bracing struts.

4.4 When using a powered operated winch, the operator should not exceed the maximum allowable pull-in force stated by the Engineer or Engineers representative. If the tension in the cable rises suddenly, as indicated by the load cell or load indicator, the winch must be stopped immediately and the tension slowly released before any attempt is made to investigate the obstruction.

4.5 The operator at the reception pit should remain with the winch control at all times during the winching operation and should maintain contact with personnel at the launch trench, by radio communications if necessary.

4.6 All winches should be securely anchored. If anchor pins are to be used, a cable locator should be used to ensure that damage is not inflicted on any plant buried in the vicinity.

4.7 Excessive movement of the winch, and possible damage to the winch cable due to contact with the carrier pipe, must be prevented by ensuring that the winch system is aligned with the carrier pipe.

4.8 Wherever possible, the length of exposed cables should be limited and contained below ground. To minimise the possibility of accidents arising from a failure of cables, timber shoring may be securely fitted across the trench width, above and below the line of the cable. All exposed cable above ground must be contained by a suitable retaining device such as metallic safety mesh guards or a protective sleeve. The method of cable restraint must be agreed by the Engineer or Engineer's representative.

4.9 Pedestrians should be excluded from the footpath area when passing the exposed cable under tension by the use of physical barriers and signs warning of **NO ENTRY**.

4.10 When taking up the "slack" in a winch cable, care must be taken to ensure that nothing can get trapped at "pinch points" and that all operatives are clear of these areas.

4.11 Protective gloves should be worn at all times when handling cables.

4.12 All anchor points must be monitored whilst winching is in progress.

5.SAFETY OF ROPES AND LIFTING TACKLE

The use in industry of chains, ropes, and lifting tackle is governed by legislative provisions that must be complied with by law.

The following is a brief outline of the provisions of the regulations applying to every chain, rope or item of lifting tackle:

a) All chains, ropes and lifting tackle must be of good construction, sound material, adequate strength and free from patent defect.

b) A table showing the SWL of all tackle in use must be posted in the store in which tackle is kept and in prominent positions in site offices, depots or premises. Additionally, the SWL and identification mark must be stamped clearly on the tackle.

c) No chain, rope or lifting tackle must be used for a load exceeding its SWL.

d) All chain, rope or lifting tackle must be presented for independent examination by a Competent Person at least once every six months.

e) No chain, rope or lifting tackle (except a fibre rope) may be used for the first time unless it has been tested by an approved authority and issued with a certificate of test showing the SWL.

f) A register of all chains, ropes and lifting tackle must be kept (except fibre rope slings).

6.SUMMARY

To summarise, all tackle must be in good condition, must be tested before being used for the first time and must be clearly marked with the SWL and a reference number.

At regular intervals all such equipment must be examined by a Competent Person and details of the examination entered in a Register of Lifting Tackle.

It is a legal requirement that a wire rope must be taken out of use if the number of visibly broken wires in any length of 10 diameters exceeds 5% of the total number of wires in the rope.

Further guidance on rope selection and examination can be found in British Standards BS 302: Parts 1 and 5 and BS 6570.

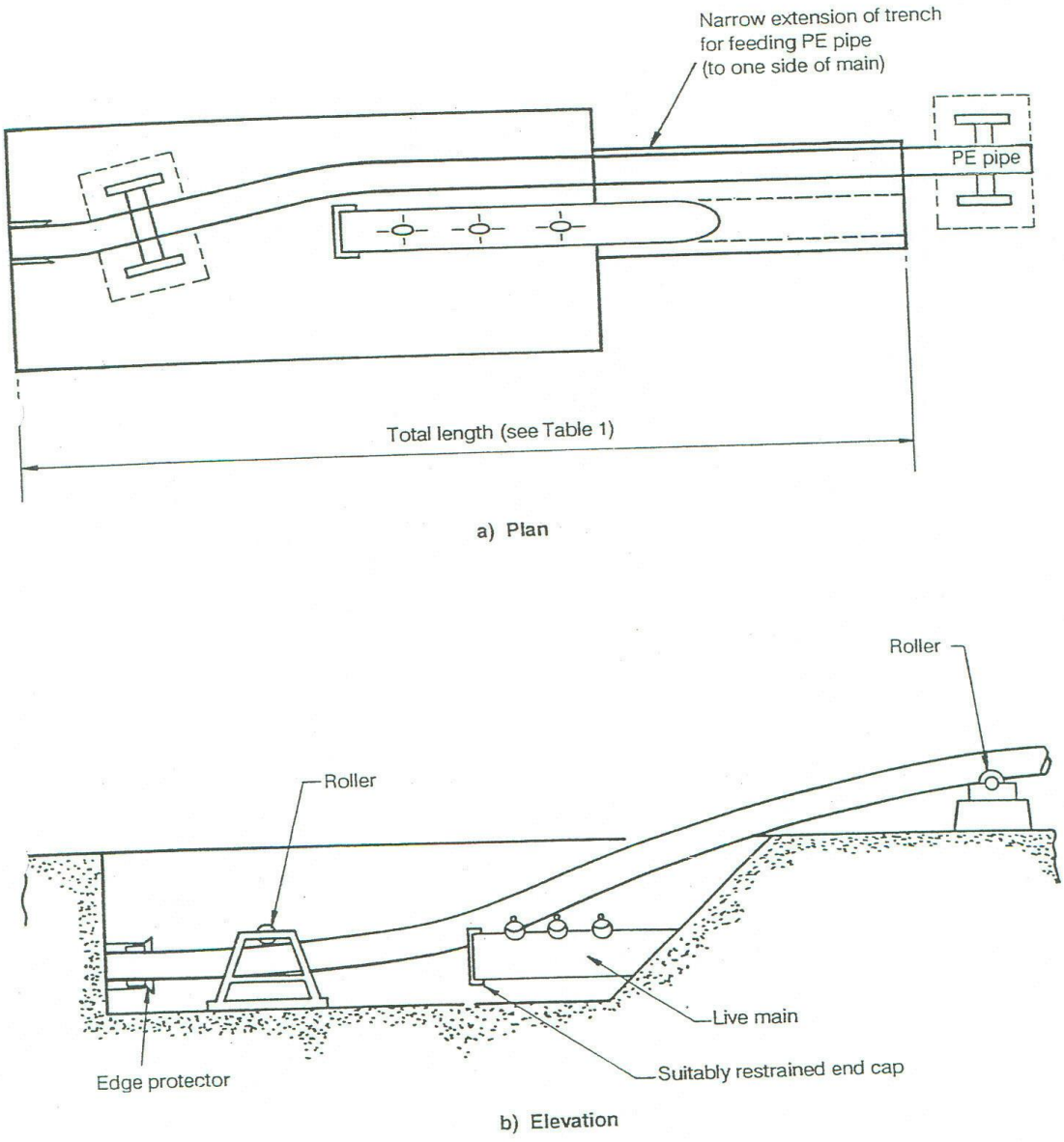

Figure 1 - Typical insertion layout

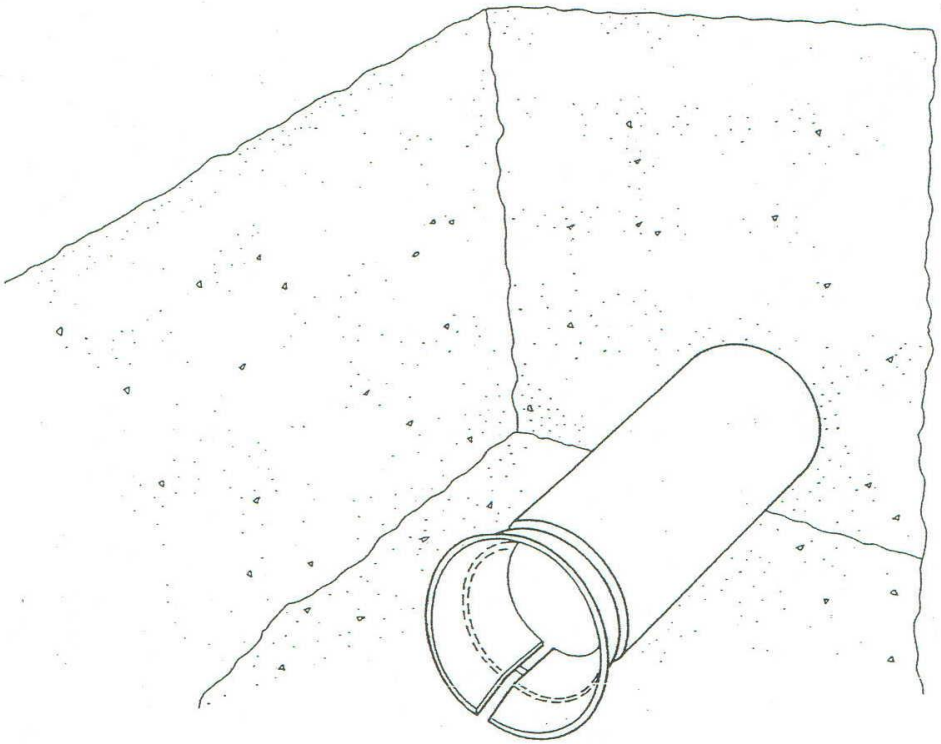

Figure 2 - Protection of inspection pipe against scoring at entry to existing pipe

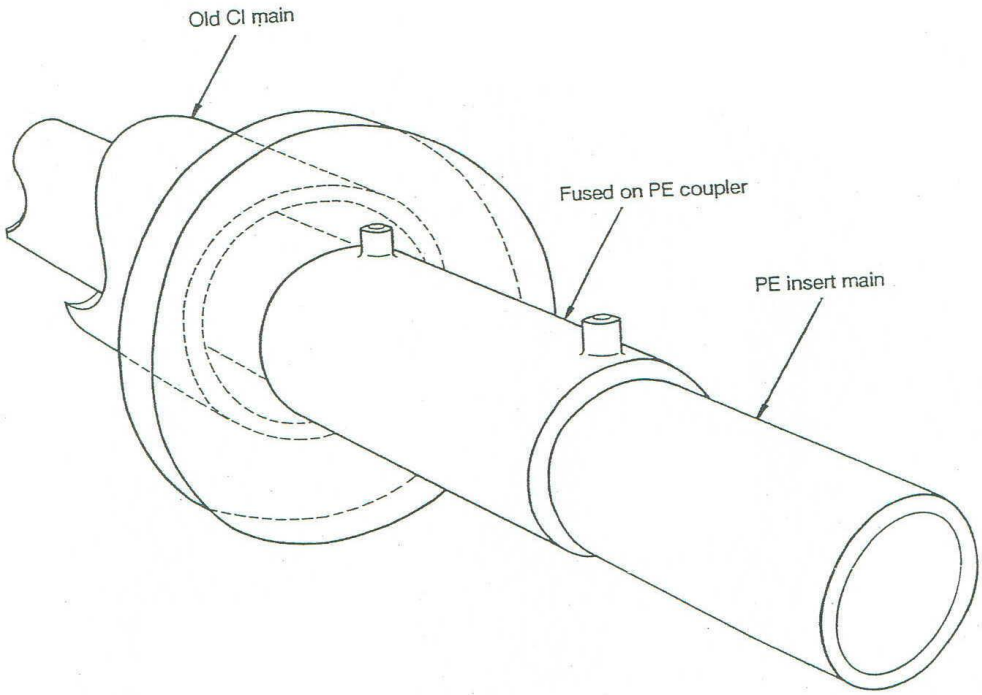

Figure 3 - Anchorage with electrofusion coupler and flange

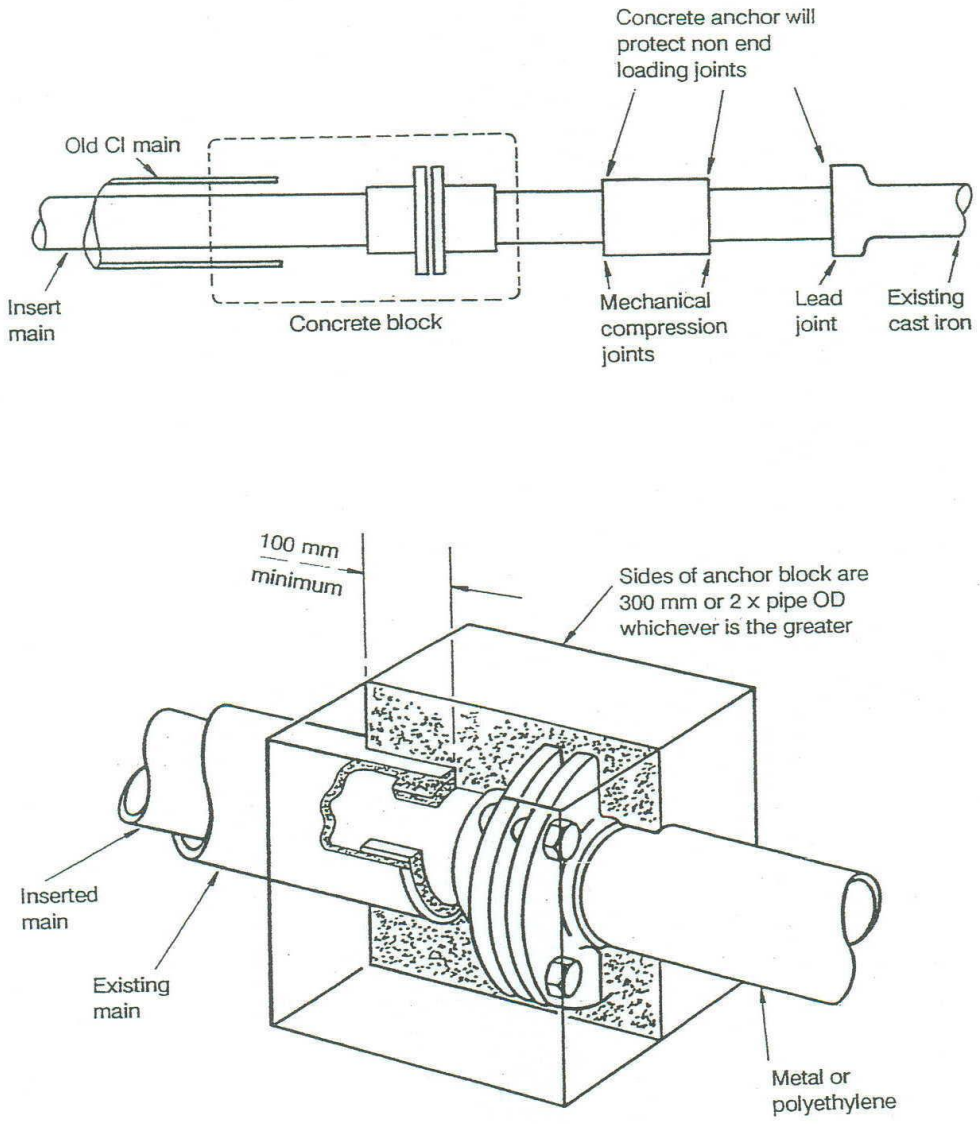

Figure 4 - Anchorage of larger sizes