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Information and Guidance Note

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OPERATIONAL GUIDELINES FOR THE LOOSE POLYETHYLENE SLEEVING OF UNDERGROUND IRON MAINS

1. INTRODUCTION

Loose polyethylene sleeving is the principal method used by the Water Industry for reducing the risk of external corrosion on underground iron mains. It functions by:

i) preventing contact between the pipeline and the surrounding backfill; direct contact between unprotected iron mains and corrosive soils (notably clays) can lead to extremely intense and highly localised attack (pitting),
ii) promoting the formation of a relatively uniform aqueous environment between the pipe surface and the sleeving film (note that some water inevitably collects in this space during service); this ensures that any corrosion which might occur tends to be distributed reasonably uniformly over the surface concerned, rather than being concentrated in localised areas as pitting, thereby restricting the depth of attack on sleeved iron mains. This effect is maximised if the sleeving is installed so as to fit snugly around the pipe,
iii) restricting the access of oxygen (essential for the aqueous corrosion of iron in non-acidic aerobic electrolytes) and of nutrients (necessary to sustain the activity of sulphate-reducing bacteria which can stimulate corrosion of iron in anaerobic environments), which in turn minimises the rate of attack on sleeved iron mains.

The zinc coating system now applied to all standard production pipes up to 800mm nominal diameter provides useful supplementary protection and can help reduce the incidence of damage induced corrosion in the short term. However the zinc coating is very thin (c.20μm) which when combined with its sacrificial protection action means that the zinc coating alone cannot be relied upon to provide long term protection. (For further information on the zinc coating system see IGN No. 4-51-01).

2. GENERAL COMMENTS

Certain elementary precautions must be observed if the effectiveness of loose polyethylene sleeving is not to be compromised by errors which may occur during installation.

Firstly, it is clear that damage to the polyethylene film must be avoided at all stages during the sleeving process, i.e.

(a) when opening the layflat tubular film which is normally supplied for sleeving iron mains
(b) while drawing the sleeve over the pipe or fitting
(c) during pipelaying
(d) during backfilling.

Sleeved pipe must be lifted into the trench using padded slings or other lifting tackle which will not damage the sleeving. Any damage to the sleeving must be repaired before backfilling e.g. using self-adhesive plastic tape for small punctures and additional layers of film taped in place over larger areas of damage. Care should also be taken during the placing of backfill materials to avoid sleeving damage.

Secondly, it is essential to ensure that soil clods and other foreign materials are removed from the pipe (or fitting) surface prior to sleeving; it has been found that intense corrosion can occur beneath soil clods attached to the pipe (or fitting) surface which have been overwrapped during sleeving.

Finally, loose polyethylene sleeving may fail to provide adequate protection if the pipe invert becomes exposed to flowing (ground) water, since this provides an effectively unlimited supply of fresh corrodent to sustain the corrosion reaction. This highlights the importance of sealing the ends of the sleeving and also the need to repair any sleeving damage incurred during installation.

Close conformity of the sleeving around the pipe barrel is very important for ensuring maximum performance of the sleeving system. In the event of the sleeving being damaged allowing moisture ingress, a snug fit helps promote thin film conditions which reduces the effect of any corrosion cells which might be established.

Where fittings are incorporated in a pipeline and these are surrounded wholly or partially by concrete anchor blocks, it is most important that the sleeving is continued under the concrete and no areas of metal are left exposed to the surrounding backfill.

Note that joints on polyethylene sleeved iron mains should not be electrically overbonded (e.g. as for cathodic protection) since this can stimulate localised galvanic corrosion at areas of bare metal, such as ground spigot faces.

3. LIMITATIONS OF USE

It follows from the previous general comments that loose polyethylene sleeving may not be sufficiently robust to provide adequate corrosion protection in:

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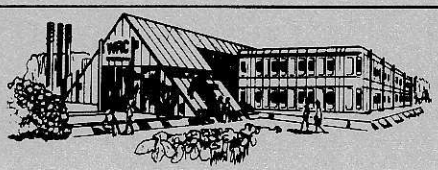


i) soils containing relatively large (e.g. > 30mm side) hard and sharp edged objects, e.g. clay soils containing large flints, some shaley soils, etc. (unless the pipe is bedded and surrounded in suitable selected/imported backfill material).
ii) contaminated soils where ash, clinker, domestic and/or industrial waste may be present (unless the pipe is bedded and surrounded in suitable imported backfill material), and
iii) where there is a risk of stray (interference) currents from adjacent cathodic protection systems, DC railway operations, etc.

Furthermore, where the quality of site-applied sleeving cannot be assured or may be uncertain (e.g. due to limitations of available supervision), polyethylene sleeved pipe may also be at risk in:

iv) highly acidic (pH ≤5) soils and highly alkaline (pH ≥9) soils.
v) soils where the water table level is either intermittently or continuously above the pipe invert, particularly if the groundwater conductivity is greater than about 1S/m (i.e. resistivity <1ohm.m) and/or its chloride content is greater than about 300mg/l (ppm)(e.g. in peat marsh, salt marsh, waterlogged heavy clays and alluvial soils).
vi) situations where the pipe trench may act as a drain for groundwater.

In addition loose polyethylene sleeving is not recommended for use in conjunction with pipeline cathodic protection systems, owing to the difficulties in defining true pipe potentials through the film.

Factory applied sleeving may prove to be less susceptible to problems (iv), (v) and (vi) above. However both site-sleeved and factory-sleeved pipe may fail in any of the above soil conditions where there is also a high risk of sleeving damage due to interference after installation. In any of the risk situations given above consideration should be given to the specification of a high performance external protection system such as polymeric coating, tape wrapping, etc., either alone or (preferably) in conjunction with a properly designed, installed and maintained cathodic protection system.

4. MATERIALS AND APPLICATION

Polyethylene sleeving is fitted on site and no special equipment is required.

Two basic methods of fitting the sleeving are recommended. The difference between these two methods is in the manner in which the continuity of protection at pipe joints and fittings is maintained. In Method 1, polyethylene sleeving and plastic adhesive tape are used to provide this continuity, and in Method 2, waterproof wrapping tape (a carrier tape of synthetic cloth impregnated with a neutral petrolatum based compound) is employed. These methods may be varied to suit individual conditions providing that the end result is a snug fitting and continuous protective enclosure for both pipes and fittings.

Method 1 has an economic advantage on material costs; although in wet conditions adhesion of the plastic adhesive tape to the polyethylene sleeving is poor. The waterproof wrapping tape used to provide protection continuity at joints in Method 2, however, has very good adhesion characteristics in all conditions, but is considerably more expensive.

Polyethylene sleeving for the external corrosion protection of underground iron mains is normally supplied in the form of layflat tubular film. Table 1 gives the recommended layflat widths for the standard ductile iron pipe diameters according to the pipeline jointing system, together with information on the weight and approximate length of sleeving per standard roll. Polyethylene sleeving for underground iron mains must comply with the requirements of BS6076 (Tubular polyethylene film for use as protective sleeving for buried iron pipes and fittings). Tables 2, 3, 4, 5 and 6 give the approximate quantities of sleeving, plastic adhesive tape or waterproof wrapping tape required according to the type of joint and the method used to complete the protection at joints and fittings.

Table 1 – Size of sleeving

Pipes and fittings with push-fit flexible joints				Pipes and fittings with bolted gland joints or flanged joints		
Nominal pipe size DN	Layflat width mm	Length of sleeving on roll (approx) m	Weight of roll (approx) kg	Layflat width mm	Length of sleeving on roll (approx) m	Weight of roll (approx) kg
80	280	87	14	–	–	–
100	280	87	14	450	87	18
150	400	87	18	550	87	22
200	550	87	22	650	87	26
250	650	87	26	700	87	28
300	700	87	28	800	87	33
350	800	87	33	–	–	–
400	1100	87	45	1100	87	45
450	1100	87	45	1100	87	45
500	1350	44	28	–	–	–
600	1350	44	28	1350	44	28
700	1750	44	36	–	–	–
800	1750	44	36	–	–	–
900	2000	44	41	–	–	–
1000	2000	44	41	–	–	–
1100	2500	44	51	–	–	–
1200	2500	44	51	–	–	–
1400	3500	44	71	–	–	–
1600	3500	44	71	–	–	–

of joint and the method used to complete the protection at joints and fittings.

The quantities shown in the tables are for guidance and it is suggested that allowances be made for wastage, etc.

Polyethylene sleeving in tubular form is not readily available for ductile iron pipes of 1400mm and 1600mm nominal diameter. For these sizes wrapping the pipes with polyethylene sheets may be considered, the procedure for which is described in 5.4.

It is strongly recommended that coloured PE sleeving should be used for buried iron mains, to facilitate subsequent identification. The sleeving colour should be selected on the basis of intended pipeline application as follows:

Potable water	**Blue**
Sewage and drainage	**Black**

METHOD 1 – Installation using plastic adhesive tape.

Approximate quantities of sleeving and tape required.

Table 2 – Sleeving for pipes and fittings with push-fit flexible joints

Nominal pipe size DN	Per metre of pipe m	Per fitting m
80 – 250	1.09	1.5
300 – 450	1.09	2.0
500 – 800	1.09	3.0
900 – 1000	1.06	4.0

Table 3 – Sleeving for pipes and fittings with bolted gland joints or flanged joints

Nominal pipe size DN	Per metre of pipe m	Per fitting m
80 – 250	1.27	4.0
300 – 450	1.33	5.5
500 – 600	1.36	6.9

Table 4 – Plastic adhesive tape

Nominal pipe size DN	50mm wide plastic adhesive tape	
	per m of pipe m	per fitting m
80	0.70	4.6
100	0.77	5.2
150	0.95	6.8
200	1.12	8.5
250	1.30	10.1
300	1.48	11.7
350	1.66	14.0
400	1.83	15.5
450	2.01	17.5
500	2.19	19.0
600	2.54	22.0
700	2.89	25.5
800	3.25	28.5
900	2.50	32.0
1000	2.75	35.0
1100	2.99	38.5
1200	3.24	42.0
1400	3.73	49.0
1600	4.23	55.0

METHOD 2 – Installation using waterproof wrapping tape.

Approximate quantities of sleeving and tape required.

Table 5 – Sleeving for pipes and fittings with push-fit flexible joints

Nominal pipe size DN	Per metre of pipe m	Per fitting m
80 – 250	0.97	–
300 – 450	0.97	1.0
500 – 800	0.97	1.5
900 – 1600	0.97	2.0

Table 6 – Waterproof wrapping tape

Nominal pipe size DN	150mm wide waterproof wrapping tape	
	Per m of pipe m	Per fitting m
80	0.41	4.5
100	0.47	5.2
150	0.63	6.9
200	0.79	8.7
250	0.94	10.5
300	1.32	14.5
350	1.50	16.5
400	1.70	18.5
450	1.87	20.5
500	2.42	26.5
600	2.85	31.5
700	3.29	36.0
800	3.71	41.0
900	3.30	52.5
1000	3.66	58.0
1100	4.02	63.5
1200	4.37	69.5
1400	5.02	81.5
1600	5.71	92.5

5. SLEEVING PROCEDURE

5.1 Precautions (see also Clause 2)

1. Remove all soil and foreign matter from the external surface of the pipe/fitting before sleeving.
2. If necessary, repair damaged areas on the works-applied bitumen coating. Wire brush damaged area and paint over with a material compatible with the original coating.
3. Avoid damaging the polyethylene sleeving.
4. Ensure the sleeving is fitted snugly to the pipe barrel.
5. Repair any damage to the sleeving before backfilling.
6. Ensure that the trench base is free of any material likely to damage the sleeving.
7. Use backfill which is free of any material likely to damage the sleeving.
8. Backfill carefully to avoid damage to the sleeving.

NOTE Do not electrically overbond pipelines which are going to be polyethylene sleeved. Do not use polyethylene sleeving in conjunction with pipeline cathodic protection systems.

5.2 METHOD 1 – Using sleeving and plastic adhesive tape

Suitable for pipes with push-fit flexible joints and for pipes with bolted gland or flanged joints.

PIPES

1. Support the pipe on two timbers, one under the socket, the other approximately 2m from the spigot, use wedge to prevent the pipe rolling.
2. Cut a piece of sleeving approx 0.5 metre longer than the effective length of the pipe; i.e. 6m for 5.5m pipes, 8.5m for 8m pipes.
3. Slide the sleeving onto the spigot end and bunch up behind spigot timber (Figure 1) taking care not to damage the sleeving on the end of the pipe.
4. Reposition the spigot timber at the extreme spigot end and pull the sleeving over the full length of the pipe (Figure 2).
5. Ensure that the sleeving is correctly positioned relative to the spigot end. Pull the sleeving tightly around the pipe and fold the excess to form a triple thickness pleat of film over the pipe crown.
6. Secure the fold in position using short strips of plastic adhesive tape at a maximum spacing of 1 metre. At the spigot end of the pipe tape the end of the sleeve to the pipe body around the whole circumference ensuring that the tape overlaps the end of the sleeve and onto the pipe (Figure 3).

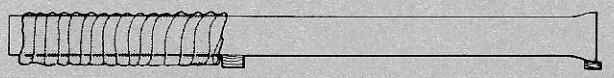
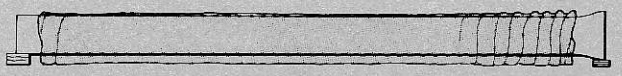


Figure 1



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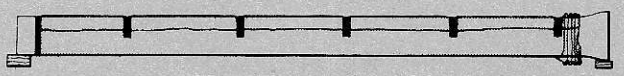
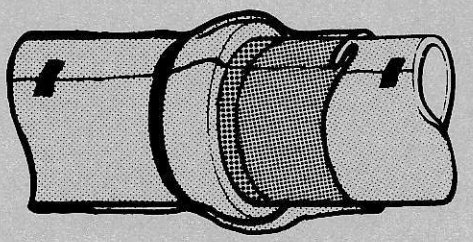


Figure 3

7. The excess sleeve at the socket end may be left pulled back from the socket or alternatively it may be temporarily folded into the mouth of the socket to keep out extraneous material while positioning the pipe in the trench.
8. Lift the sleeved pipe using padded slings or other lifting tackle which will not damage the sleeving film. Lay the pipe in the trench with the triple thickness layer of film on the crown to provide a cushioning effect during backfilling and make the joint in the recommended manner. (Ensure that if the sleeving has been folded into the socket this is removed prior to jointing).

   If hydraulic jointing tackle is being used an extra piece of sleeving draped loosely over the pipe underneath the tackle will protect the sleeving around the pipe from damage.
9. After completion of the joint, any exposed portion of the spigot end between the sleeving and the face of the adjoining socket should be taped over using plastic adhesive tape. Care should be taken to ensure that sleeving or tape at the spigot end is not trapped under the gasket as this could impair the seal of the joint.
10. Draw the excess sleeve over the joint, fold neatly and tape around the circumference of the pipe at the back of the socket (Figure 4). Make a second pass with the tape around the circumference immediately in front of the socket (Figure 5). These two bindings ensure a reasonable snug fit of sleeving in the joint area. Finally, tape the end of the sleeve around the full circumference making sure that the tape overlaps onto the sleeve of the adjacent pipe to effect a seal (Figure 6).
11. In the case of bolted gland or flanged joints, a pad of some four film thicknesses should be placed around the circumference of the joint before the sleeve is secured in position to provide protection over any sharp edges (Figures 7 and 8).



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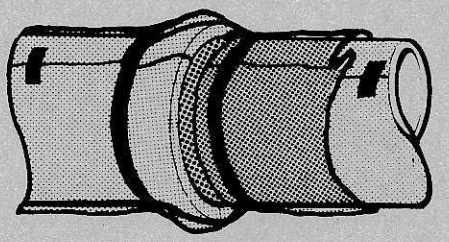

Figure 5

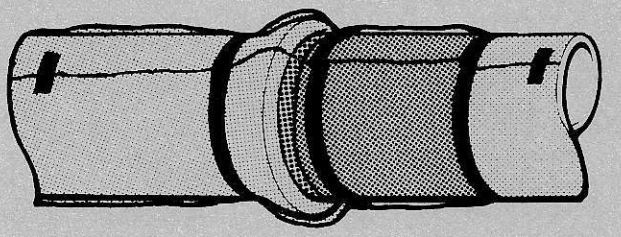

Figure 6

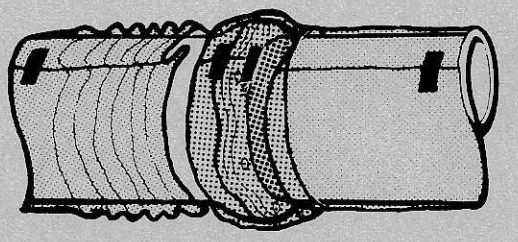

Figure 7

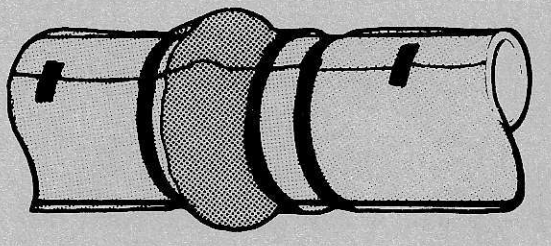

Figure 8

BENDS

12. Where the body of a bend is to be sleeved, cut a piece of sleeving to extend along the length of the bend beyond the socket faces to overlap onto the barrels of the pipes on either side. For the larger angled bends it is suggested that the sleeving is cut to suit the angle of the bend.
13. Make the joint at one side of the bend. Slide the short length of sleeving loosely onto the spigot end of the next pipe to be jointed and make the joint. Alternatively dependant upon the size of the bend and laying techniques employed, it may be preferable to position the sleeving loosely on the bend itself prior to jointing.
14. After completion of the joints any exposed portion of the spigot ends between the sleeving and the bend socket faces should be taped over using plastic adhesive tape as in sub-clause 9 (of 5.2).
15. For bolted gland or flanged joints, form and position pads around the sockets as in sub-clause 11.
16. Draw the short length of sleeving over the fitting with an equal amount projecting beyond each socket face. Pull this sleeve tightly around the body of the bend and fold the surplus neatly, taping around the circumference behind each socket (Figure 9). On large diameter fittings a further turn of tape around the centre of the bend may be beneficial in assisting the sleeving to achieve a snug fit.
17. Tape around the circumference of the pipes to complete the protection. See sub-clause 10 (of 5.2) (Figures 5 and 6).

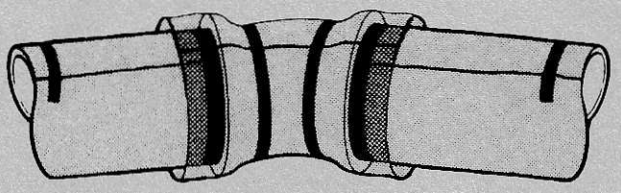

Figure 9

TEES

18. Cut two pieces of sleeving approximately 300mm longer than the overall length of the tee.
19. Slide one length onto the spigot end of each of the adjacent pipes to which the tee is to be connected and make the joints in the normal manner.
20. After completion of the joints any exposed portion of the spigot ends between the sleeving and the tee socket faces should be taped over using plastic adhesive tape in sub-clause 9 (of 5.2).
21. Cut one piece of sleeving part way along its length on the branch side, sufficient that the sleeve can be pulled over the tee body (Figure 10).
22. Pull the sleeve tightly around the body of the tee and fold the surplus neatly at the crown. Tape around the circumference of the tee immediately behind the socket (Figure 11).
23. Make a second pass with the tape around the circumference of the tee at the end of the sleeve overlapping onto the body (Figure 12). Complete the securing of the sleeve by taping around the circumference of the pipe in front of the socket and finally at the end of the sleeve ensuring that the tape overlaps onto the adjacent sleeving to provide a seal (Figure 13).
24. Repeat the above process with the second sleeve.
25. Where the sleeving overlaps onto the branch, fold to the contours of the fitting and tape around the circumference of the branch (Figure 14).
26. Cut a length of sleeving sufficient to cover the branch and overlap onto the spigot of the adjacent pipe. Slip this onto the spigot of the pipe to be jointed into the branch socket and make the joint in the normal manner.
27. Tape over any exposed portion of the spigot end between sleeving and socket face using plastic adhesive tape in sub-clause 9 (of 5.2).
28. Pull the sleeve tight around the branch and fold neatly on the crown. Tape around the circumference at the end of the sleeve, overlapping onto the body of the tee. Make a second pass around the branch in front of the socket and complete the fixing of the sleeve by taping around the circumference of the pipe at the end of the sleeving (Figure 15).
29. Any parts of the tee left exposed – perhaps in the radius area between body and branch – should be covered with plastic adhesive tape.

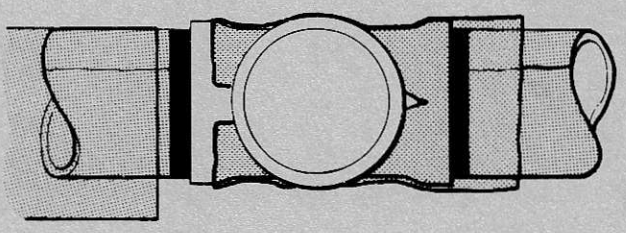

Figure 10

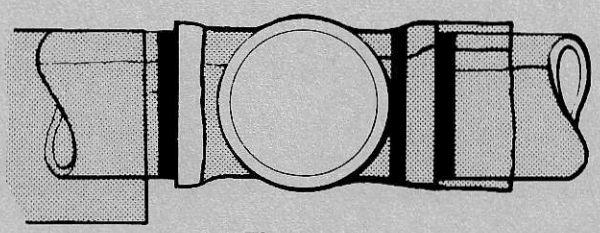

Figure 11

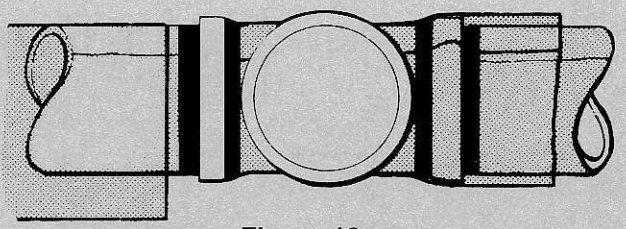

Figure 12

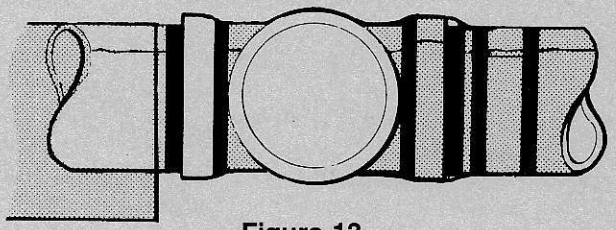

Figure 13

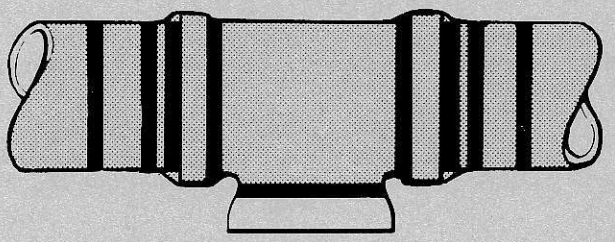

Figure 14

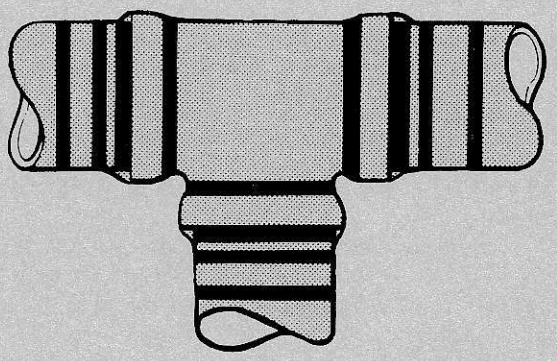

Figure 15

5.3 METHOD 2 – Using sleeving and waterproof wrapping tape

Suitable for pipelines with push-fit flexible joints. However, if this method is used for pipes with bolted gland or flanged joints, a suitable mastic filler should be used to smooth out the joint profile before application of the waterproof wrapping tape.

PIPES

A. Support the pipe on two timbers, one under the socket, the other approximately 2m from the spigot, and use wedges to prevent the pipe rolling.

B. Cut a piece of sleeving of sufficient length to cover the pipe barrel from a point immediately behind the socket to a point at the spigot end which will allow only enough exposed spigot to fully enter the socket of the adjoining pipe.

C. Slide the sleeving onto the spigot end and bunch up behind the spigot timber (Figure 1).

D. Reposition the spigot timber at the extreme spigot end and pull the sleeving over the full length of the pipe (Figure 2).

E. Ensure that the sleeving is correctly positioned relative to the spigot end. Pull the sleeving tightly around the pipe barrel and fold the surplus over the crown of the pipe to form a triple thickness layer of film.

F. Secure the fold in position using string tied around the pipe at several positions along the length of the fold. Wrap 150mm wide waterproof wrapping tape around the ends of the sleeve with half the tape width over the sleeving and the other half onto the pipe barrel (Figure 16).

G. Lift the sleeved pipe using padded slings or other lifting tackle which will not damage the sleeving film. Lay the pipe in the trench with the triple thickness layer of film on the crown to provide a cushioning effect during backfilling and make the joint in the recommended manner.

H. Wrap waterproof wrapping tape around all exposed metal at the joint (Figure 17).

J. It may be advisable depending on the nature of the backfill, to protect the waterproof wrapping tape. Cut a length of sleeving to cover the waterproof wrapping tape, and thread loosely onto the spigot end prior to jointing. Locate over the completed joint with string (Figure 18).

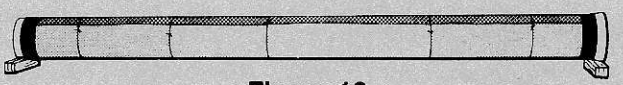

Figure 16

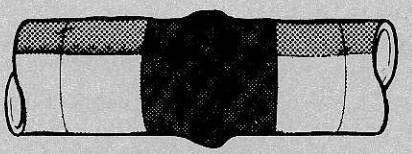

Figure 17

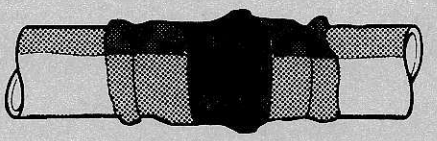

Figure 18

BENDS

K. Protection of small diameter bends may be completed by wrapping which must overlap the sleeving on the barrels of the pipes at either side of the bend (Figure 19).

L. Where the diameter of the bend is such that complete wrapping with waterproof tape would be impractical, the body should be sleeved as follows. Cut a length of polyethylene to cover the body, the polyethylene being cut at an angle to suit the angle of the bend. Fold the surplus to lie on the crown of the bend and tape the two ends to the body of the fitting around the circumference using waterproof tape (Figure 20).

M. After jointing the protection should be completed by wrapping the exposed metal surfaces with waterproof tape (Figure 21).

NOTE The exposed waterproof tape may be protected with polyethylene sleeving where necessary. See sub-clause J (of 5.3).

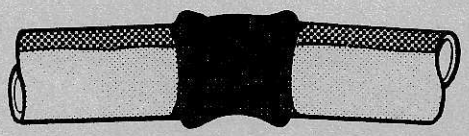

Figure 19

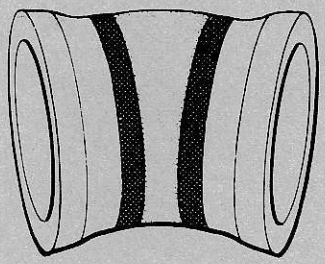

Figure 20

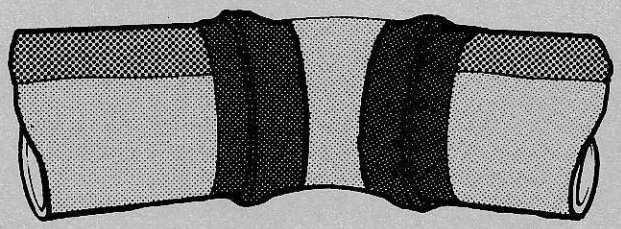

Figure 21

TEES

N. Cut and slit a length of sleeving to form a flat sheet.

O. Trim the sheet so that when pulled tightly around the body of the tee all the edges terminate just behind the sockets.

P. Secure the three ends of the sleeving to the casting with waperproof wrapping tape (Figure 22).

Q. Joint the tee, completing the protection at the joints as described in sub-clauses H and J (of 5.3).

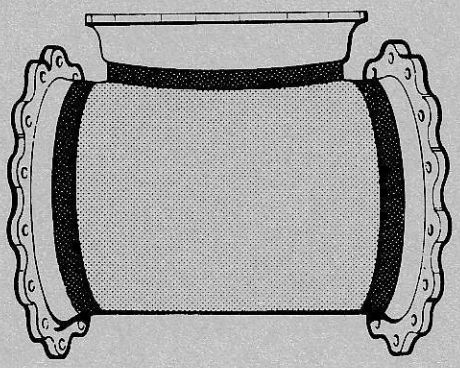

Figure 22

5.4 Installing polyethylene sheet on 1400mm and 1600mm diameter pipes

As with the application of tubular sleeving, this is done out of the trench with the pipe ends supported on wooden battens to raise the pipe off the ground. The sleeving is applied in such a manner that its length lies circumferentially around the pipe.

1. Cut sheeting into lengths approximately 1m longer than the circumference of the pipe.
2. Position first length on the pipe and fasten one end to the pipe with adhesive tape.
3. Pull sheet tightly around the pipe and seal the overlapping end with adhesive tape.
4. Apply subsequent pieces in a similar manner, each overlapping its neighbour by approximately 0.5m, until the pipe is protected from the back of the socket to a point sufficiently far back from the spigot to allow for subsequent jointing.
5. Seal all circumferential joints – including the ones at each end – with adhesive tape.
6. Once the pipe has been laid, protect the exposed joint area either by wrapping with sleeving in a similar manner to that described above, ensuring that all edges are sealed, or by the use of waterproof tape as for Method 2 (see 5.3).

5.5 Service connections

Fitting service connections to polyethylene sleeved pipes is a simple operation.

1. Using the locating saddle of the drilling machine as a template, remove the polyethylene sleeving over a corresponding area to reveal the pipe surface. This ensures that the machine can be located directly onto the pipe, an important consideration when a seal is required for under pressure operation (Figure 23).

   Where a service connection is to be made through a triple thickness pleat of sleeving film, it is recommended that strips of plastic adhesive tape should be run around the full circumference of the pipe on either side of the tapping point before cutting the film, in order to hold the folded sleeve in place.
2. Carry out the drilling and tapping operation in the normal way and make the connection (Figure 24).
3. Complete the protection by the application of waterproof wrapping tape over all exposed metal surfaces (Figure 25).

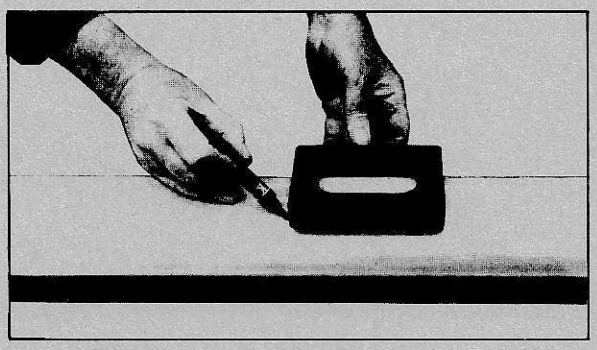

Figure 23

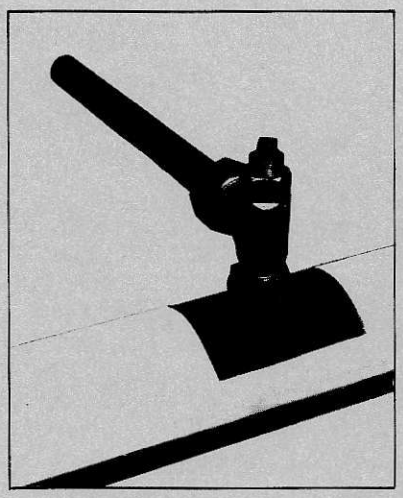

Figure 24

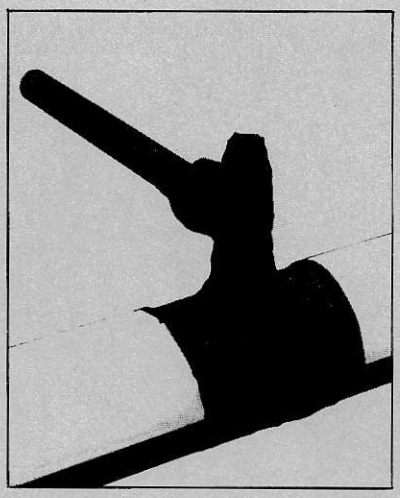

Figure 25

5.6 Minor repairs

Should the polyethylene sleeving be damaged during pipe handling or installation, it can readily be repaired by wrapping a sheet of the polyethylene film of sufficient size around the pipe to ensure a minimum overlap of 200mm past each side of the puncture. Plastic adhesive tape or waterproof wrapping tape should be applied circumferentially to form a seal at both ends of the repair, and to the longitudinal seam at the overlap.

Small punctures may be repaired with self adhesive plastic tape.