HDPE Conduit & Duct Handling Guide

TN-58

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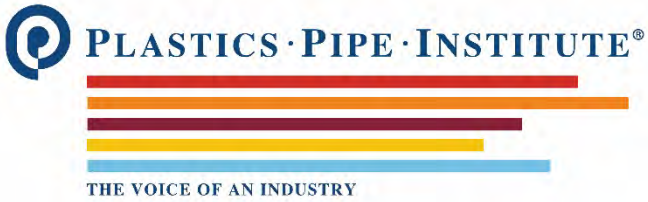

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Foreword

This technical note was developed and published with the technical help and financial support of the members of the Plastics Pipe Institute (PPI). These members have shown their commitment to developing and improving quality products by assisting standards development organizations in the development of standards, and also by developing design aids and reports to help engineers, code officials, specifying groups, contractors and users.

The purpose of this technical note is to provide information about general handling guidelines for reels and coils of high-density polyethylene (HDPE) conduit and duct, including the potential risks when cutting open such reels and coils.

The PPI has prepared this technical note as a service to the industry. The information in this report is offered in good faith and believed to be accurate at the time of its preparation, but is offered “as is” without any express or implied warranty, including WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Additional information may be needed in some areas, especially with regard to unusual or special applications. Consult the manufacturer or material supplier for more detailed information. A list of member manufacturers is available on the PPI website. PPI does not endorse the proprietary products or processes of any manufacturer and assumes no responsibility for compliance with applicable laws and regulations.

PPI intends to revise this technical note within five years, or sooner if required, from the date of its publication, in response to comments and suggestions from users of the document. Please send suggestions of improvements to the address below. Information on other publications can be obtained by contacting PPI directly or visiting our website.

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HDPE CONDUIT & DUCT HANDLING GUIDE

1.0 INTRODUCTION

This Handling Guide covers a limited range of safety issues regarding the handling, unwinding, straightening and cutting of polyethylene conduit and duct. These products are also known as high-density polyethylene (HDPE) conduit and duct, or PE conduit or duct. This Guide will use the term PE conduit to represent these various industry descriptions for the same types of products.

PE conduit is typically shipped on metal, wooden, or plastic reels, and may also be shipped in coils without a reel.

Figure 1. Typical HDPE Conduit on reels, loaded on a trailer

PE conduit has been used safely in thousands of applications. Still, there are precautions that should be adhered to when handling and transporting any product, and PE conduit is no exception.

Jobsite safety, transportation, storage guidelines, unloading guidelines, heat fusion joining and installation guidelines are some of the important topics *not covered* in this guide. Readers are referred to PPI's **Material Handling Guide for HDPE Pipe & Fittings** for a wider range of guidance covering those topics. Please visit www.plasticpipe.org.

As valuable as this Guide may be, it does not purport to address all of the product applications or construction practices that could be used, nor all of the safety practices necessary to protect persons and property.

It is the responsibility of the users of this Guide and the installers of PE conduit systems to establish appropriate safety and health practices, and to determine the applicability of regulatory limitations before any use or installation.

For more information about HDPE conduit materials, design methods, and installation techniques please refer to other PPI publications on our website, including Ch. 14 of the *Handbook of PE Pipe*.

2.0 PERSONAL SAFETY

Field working conditions can be dangerous. Each worker should take responsibility for his or her own personal safety. This includes wearing personal protective equipment (PPE) and being aware of the potential hazards involved with a given task and work environment.

Potential hazards of the operation, materials, equipment and environment should be defined before work begins, and plans should be made to minimize these hazards. In addition, workers must be aware of and follow all applicable regulations regarding jobsite safety.

2.1. Personal Protective Equipment

When handling PE conduit, wear adequate personal protective equipment such as hard hats, safety shoes, gloves, and eye protection to help prevent injuries when handling product.

Hard hats should always be worn when loading, unloading or handling PE conduit. Hard hats not only protect your head, but also give motorists and equipment operators an eye-level warning of your presence.

As a general rule, steel-toed safety shoes should be worn at all times. They are especially important if there is any possibility that falling objects could land on your feet. Work gloves help prevent cuts and bruises from sharp or rough edges on conduit and other objects. When moving coils, reels, straight lengths and other heavy items, place your hands carefully to avoid getting them pinched or caught.

Eye protection shall be worn at all times, especially when operating cutting and joining equipment. Protective eyewear shall meet minimum requirements of ANSI Z87.1.

Long-sleeved shirts and trousers or coveralls can minimize cuts, bruises, and abrasions, while also protecting against sunburn and/or hazards such as poison ivy. Wear high-visibility vests when working at or near a public street or highway or when working at night. This reduces your chance of being hit by a motor vehicle or equipment while on the job site.

3.0 GENERAL GUIDELINES FOR FORKLIFT SAFETY

Following are general safety guidelines regarding forklift safety.

The use of forklift trucks necessitates observing a number of OSHA standards. Defective forklifts must be taken out of service until they have been repaired to a safe operating condition. 29 C.F.R. § 178(p)(1). When a load of conduit presents a hazard to the operator, forklift trucks shall be equipped with vertical-load backrest extensions. While loading conduit, the brakes of trucks and trailers shall be set and wheel chocks placed under the rear wheels to prevent movement while loading or unloading. 29 C.F.R. § 178(m)(7). OSHA governs the periodic training and retraining of forklift operators, and the certification process for establishing that training was performed. 29 C.F.R. § 178(1)(4)(i).

The proper and safe use of forklifts is the responsibility of the operator. As with all power lifting equipment, the manufacturer provides a complete set of instructions relating to the operation of its equipment. Those operating instructions must be observed at all times. The following list represents some instructions that must also be followed:

- Carry all loads close to the ground.
- When carrying loads large enough to block view, travel in reverse with load close to the ground.
- Forklift safety rules are to be observed during all phases of the unloading process.
- Never leave forklift running or an overhead load suspended if the lift is unattended.
- Check the forks for jagged edges or burrs. If the forks are marred, cover them with a suitable protective covering to prevent gouging of the conduit.
- Adjust the forks to transport product safely without damaging it, as described in sections below.
- Lift straight lengths of conduit (a.k.a. “sticks”) with the length of conduit centered on the forks.
- Be aware of and never exceed the rated capacity of the forklift.
- Always slowly enter the forks underneath the conduit; never jerk or ram them in.
- Tilt back the load only enough to stabilize the load.
- All forklifts have a maximum lift height. Never exceed these heights or the forklift can become unstable
- Forklifts are made for only one driver. No riders.

- Never allow workers to be lifted on the forks without the use of a safety pallet, along with appropriate and approved fall protection equipment or devices.
- Operate as close to the ground as possible when moving conduit from one location to the other. Do not, however, allow the conduit to drag or scrape along the ground.
- Use salt on the forks when winter weather makes them icy or slippery. Also use salt and sand around the lifting area to prevent sliding of lifting equipment.
- When not in use, the forks should be completely lowered to the ground, the control put into neutral, the power turned off and the brakes set.
- Use extreme caution if it becomes necessary to carry loads over existing equipment or structures. Never transport a load over any worker or individual who happens to be on job site.

4.0 GENERAL GUIDELINES FOR FRONT END LOADERS

When equipped with forks, front-end loaders can be operated as forklifts and the same procedures must be followed as indicated above and below.

5.0 UNLOADING PE CONDUIT IN FREE-STANDING REELS

Following are general safety guidelines regarding unloading typical free-standing reels of PE conduit from open trucks and trailers. Reels should be shipped and handled in the vertical orientation. Workers should apply these guidelines as relevant to various types of products and vehicles.

It is recommended to inspect all delivered PE conduit for shipping damage before unloading.

Several of these guidelines are general statements and reminders about workplace safety and are not intended to take the place of formal jobsite training or local safety regulations.

Figure 2. Flatbed truck being unloaded on level ground

5.1. Preparing the truck for unloading

1. Make sure truck or trailer is parked on level ground. If not, have driver move vehicle to a level area. Engage hand brakes and chock wheels.
2. People not involved in the unloading of a truck, including its driver, should remain clear of the unloading area.
3. The trucker's chains or straps should be removed from the load only after checking that the load has not shifted and will remain stable. Use caution when straightening shifted loads.
4. Chocks should never be removed before unloading the truck.

5.2. Unloading the reels – flatbed truck or trailer

1. It is suggested that reels be unloaded from the side of the trailer with a forklift having a capacity rating sufficient to handle the load. The equipment should be inspected for good condition prior to use.
2. Ensure that reels are chocked or otherwise restrained while on the truck or trailer to prevent rolling before and during unloading (See Figure 3).

Figure 3. PE conduit on a typical steel reel with temporary blocking to prevent movement during loading/unloading

3. To prevent conduit damage, ensure that lifting forks are long enough to reach under both flanges on reels so that the entire weight is supported by the flanges, and not by the conduit itself. Fork extenders are available to extend the fork length when needed.

4. Do not push or pull reels of PE conduit, as this can deform the reel and damage the product.
5. **Chains should not be applied directly to PE conduit** unless special precautions are used to prevent damage to the conduit. Chains should be properly rated for the loads being lifted.
6. When lifting reels with chains, **do not lift by the flange rings.** Thread the chain through the arbor holes.
7. **Nylon straps should never be threaded through the arbor holes for the purpose of lifting a reel,** because the strap may be damaged by the arbor plate, resulting in failure of the strap and loss of control of the reel.
8. For lifting reels,
   a) Cradle reel flanges from below with the forks (See Figure 4), or
   b) Lift the reel by the spokes through the center of the drum/hub of the reel, as long as the forks are close enough together so as not to damage the conduit, and long enough to engage the other side of the spokes (See Figures 5 - 7).
9. After reels are off the truck, place the load on level ground and chock reel to prevent moving before removing forks or slings (See Figure 8 – 10).
10. **Do not roll or drop reels off the truck!** This is a hazard to nearby personnel, and is likely to damage the reel, as well as the PE conduit on the reel.
11. **Do not use backhoes, end loaders, or other material handling equipment to push or pull reels off the truck or trailer. This is dangerous to personnel and may damage the PE conduit.**

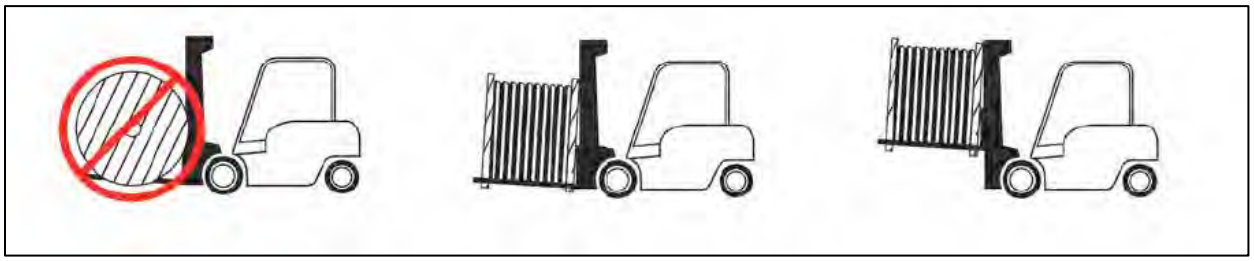

Figure 4. Improper and Proper handling of reels with a forklift. To prevent PE conduit damage, ensure that lifting forks are long enough to reach under both flanges of the reel so that all the weight of the reel is supported by the Flanges and not by the conduit itself.

Figure 5. Lifting a reel by the spokes through the center of its drum/hub.

Figure 6. Lifting a reel by the spokes through the center of its drum/hub.

Figure 7. Lifting a reel by the spokes through the center of its drum/hub.

Figure 8. Reels stored vertically on jobsite. Note curbs to prevent rolling.

Figure 9. Reels stored vertically on flat, level jobsite.

Figure 10. Reels stored vertically on flat, level jobsite.

6.0 UNLOADING PALLETIZED COILS OF PE CONDUIT

Following are general safety guidelines regarding unloading typical coils of packaged PE conduit from open trucks and trailers. Workers should apply these guidelines as relevant to various types of products and vehicles.

It is recommended to inspect all delivered PE conduit for shipping damage before unloading.

Several of these guidelines are general statements and reminders about workplace safety and are not intended to take the place of formal jobsite training or local safety regulations.

6.1. Preparing the truck for unloading

1. Make sure truck or trailer is parked on level ground. If not, have driver move vehicle to a level area. Engage hand brakes and chock wheels.
2. People not involved in the unloading of a truck, including its driver, should remain clear of the unloading area.
3. The trucker's chains or straps should be removed from the load only after checking that the load has not shifted and will remain stable. Use caution when straightening shifted loads.

6.2. Unloading coils

1. It is suggested that palletized coils be unloaded from the side of the trailer with a forklift having a capacity rating sufficient to handle the load. The equipment should be inspected for good condition prior to use.
2. To prevent conduit damage, ensure that lifting forks are long enough to reach through the entire pallet. Fork extenders are available to extend the fork length when needed.
3. Before lifting, loads should be centered.
4. Ensure pallets are placed on level ground (see Figure 11).

Figure 11. Palletized coils stored horizontally on level ground.

7.0 RELEASING THE OUTSIDE WRAP[1] OF REELS OR COILS OF PE CONDUIT AND CUTTING THE STRAPPING

All PE conduit, especially larger diameter conduit in nominal diameters of 3 inch and above, is wound or coiled using considerable bending force, which is released when the straps or ropes are cut (See Figure 12 - 13).

Therefore, installers must exercise caution when cutting off the straps from reels or coils of PE conduit, as it may suddenly spring open when cut, possibly leading to injury of nearby personnel being struck by the moving conduit. This sudden springing-open is often referred to as “spring back” (see Figure 13). Workers must stand clear when straps or ropes are cut from the PE conduit (see Figure 14).

While all wound conduit can be potentially dangerous, the speed, distance, and force of PE conduit spring-back are dependent on several factors, such as:

- The diameter and wall thickness of the conduit, since larger diameter and wall thickness products can have greater spring-back forces and speeds.
- The delivery, coiling, and strapping methods used for a particular shipment of PE conduit.
- The amount of time that the PE conduit has been wound, since conduit that has been recently coiled may have more sudden spring-back.

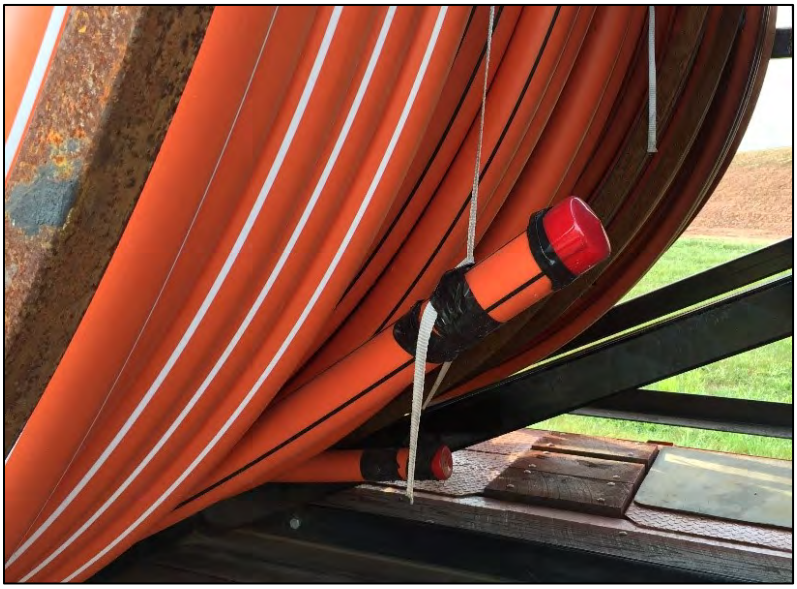

Figure 12. End of PE conduit reel strapped in place before being released.

[1] *Also known as the Free or Bitter End of the conduit coil*

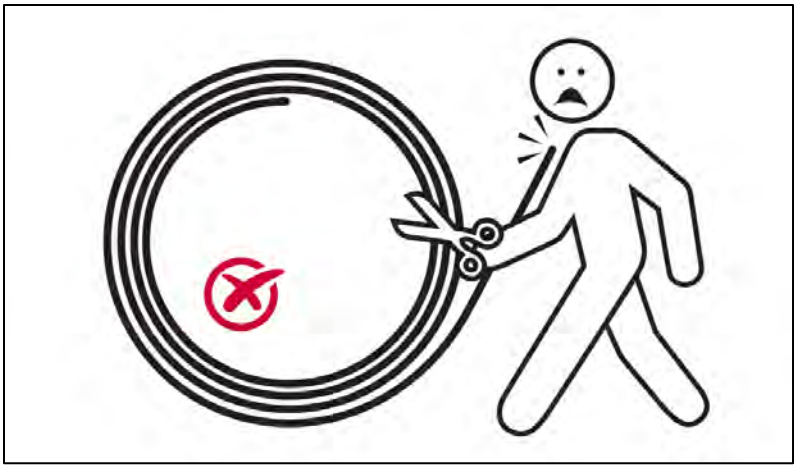

Figure 13. Incorrectly standing in front of the coil of PE conduit while cutting, exposed to injury for rapid unwinding (spring-back) of the coil. Worker is exposed to potential for injury due to sudden spring-back of a reel of PE conduit.

WARNING! Wrapped PE conduit on a reel or coil can suddenly spring-back or expand open with enough speed and force to cause injury. See Figure 13 as an example of potential injury from conduit spring-back when not standing clear of the reel or coil. See Figure 14 as an example of standing clear to avoid this injury.

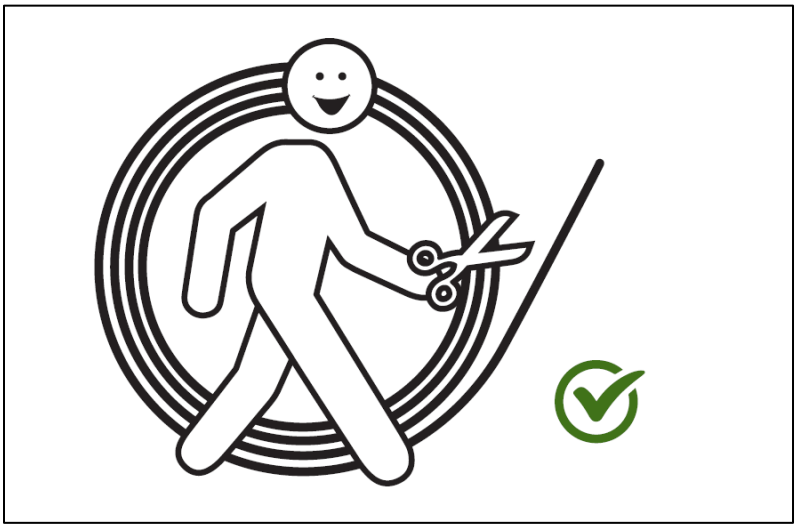

Figure 14. Standing to the side of the reel or coil of PE conduit while cutting it open to prevent injury

WARNING! To prevent serious injury from sudden spring back or opening of conduit reels and coils, stand clear when straps or ropes are cut from the PE conduit. See Figure 13 as an example of potential injury from conduit spring-back when not standing clear of the reel or coil. See Figure 14 as an example of standing clear to avoid this injury.

7.1. Preventing Unanticipated Movement of Reels

When straps or ropes on PE conduit reels are cut, the wound conduit can suddenly or slowly unwind and straighten, potentially causing the reel to rotate or roll, and move position. The likelihood and extent of this reel movement depends on which direction the free end of the coil is pointing when it is released.

Note: To prevent unanticipated movement of reels, restrain the reel using chocks if it is on the ground or via a mechanical restraint if it is on a pay-off stand or uncoiler.

7.2. Avoiding Entanglement of Conduit on Reels or Coils

If the reel or coil of PE conduit is wrapped, banded, strapped, or tied in multiple depths and locations of the product, installers should cut the strapping on the outer roll first, allowing the rest of the reel or coil to stay intact. This also helps to prevent entanglement of the product when unwinding it.

8.0 OVALITY

Ovality is a packaging condition that occurs when roundable conduit is wound into a coil. Larger diameter conduit may have significant ovality.

Within ASTM Standard Specification F2160-16[2], Note 3 says “Ovality is corrected when joining equipment is applied to roundable conduit, or by field processing roundable conduit through re-rounding and straightening equipment during installation.” Installers can also employ a re-rounder and straightening device for coiled conduit (See Figure 15).

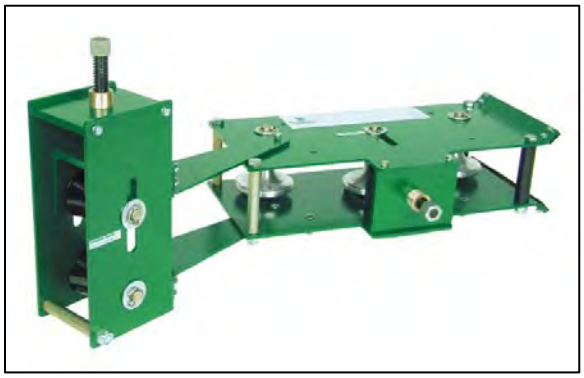

Figure 15. Device for re-rounding and straightening HDPE conduit on reel or coils. This type of device is typically attached to a trailer with the pay-out reel

[2] ASTM F2160-16 “Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)”

8.1. Straightening Coiled PE Conduit

The amount of time and force it will take to straighten coiled PE conduit depends on several factors, including:

- The diameter and wall thickness of the conduit
- Ambient temperature of the product on the worksite
- The length of time that the PE conduit has been wound or coiled

When dispensing PE conduit from a reel, installers should gradually and carefully extend the conduit, allowing it to straighten slowly if there is resistance. This will likely take more time in colder weather, with larger or thicker conduit, or if the conduit has been coiled a long time.

Unreeling or paying-off the PE conduit from the bottom of the reel will make it easier to straighten it while pulling it, and to have it lay flat in a trench.

When laying conduit in a trench, it is recommended to anchor the conduit with proper backfill at periodic locations to help the conduit straighten out over time.

9.0 CONDUIT BEND RADIUS

The minimum bend radius of a given diameter and wall thickness of PE conduit is the tightest radius to which the conduit can be bent without crushing, kinking, or mechanically damaging it. For most PE conduit products, the minimum bend radius should be considered to be the static (unloaded) bending radius of the conduit while on the reel or in a coil.

PE conduit manufacturers may publish this information specific to their products.

The bending radius of PE conduit and cables (e.g. fiber optic, power) during the construction process is typically controlled by construction techniques and equipment. To help reduce overall pulling tension when installing PE conduit, use the largest bend radius possible.

9.1. Dispensing from the Top or Bottom of the Reel

As stated above, when installing PE conduit from a reel it will help to use the largest bend radius possible. Depending on the intended placement of the conduit, this may dictate dispensing or paying-off the conduit from the top or the bottom of the reel, following the natural curvature of the product (See Figure 16 for conduit being dispensed from the top of a 3-way segmented reel).

Figure 16. PE conduit being dispensed from the top of a 3-way segmented reel to minimize the bend radius; conduit is installed using horizontal directional drilling (HDD)

10.0 CUTTING PE CONDUIT TO LENGTH

PE conduit may be cut using several types of equipment, such as a reciprocating saw, hand saw, chain saw, shear cutter or other cutting equipment. Installers should follow manufacturer instructions and all applicable regulations regarding this aspect of jobsite safety.

When cutting PE conduit, workers must keep feet in the clear and block the conduit so it will not move during cutting. Wear protective equipment and never leave tools lying about, to prevent potential injury and damage to the tools.

Regardless of the type of cutter used, it is important that the cut be square and perpendicular to the conduit or duct. Cuts which are not square can interfere with proper operation of pulling equipment, as well as joining equipment and devices such as couplers.

If the cutting tool leaves burrs or frayed edges of material at the cut end, that material should also be cleaned and deburred, leaving a clean surface.

For conduit that is to be joining using fusion, fusion equipment usually includes a facing tool to ensure square ends before fusing.

Cutting shears or guillotine blades are available for nominal pipe diameters 12 and smaller. When used correctly, these tools can provide clean and square cuts on the end of PE conduit.

Hand-held tubing cutters are available for conduit less than or equal to nominal pipe diameters 4 and smaller (See Figures 17a and 17b for such a tubing cutter).

Figure 17a. Tubing cutter for smaller diameter conduit

Figure 17b: Tubing cutter for smaller diameter conduit, in use

10.1. Safety when Cutting PE Conduit

When PE conduit has been laid flat on the ground or in a trench before cutting, there is the potential that cutting the conduit will result in rapid spring-back of either or both cut ends (see Section 7 on spring-back). This is a potentially dangerous situation. This is time- and temperature-dependent.

Larger diameter conduit, in particular, (i.e. nominal diameters of 4 and above) can be under significant tension and may have “coil-set”. Care must be taken to protect workers in these cases by restraining the sections of conduit before they are cut apart.

The best method to prevent this rapid spring-back of the PE conduit is to give it time to relax and straighten out before cutting, and to physically restrain the ends of conduit which are about to be cut free and separated with suitable equipment (See Figure 18 for conduit being laid flat before installation).

Figure 18. Nominal pipe size 8 PE conduit being laid flat before installation

WARNING! To prevent serious injury due to spring-back when cutting PE conduit, deploy enough length of PE conduit, allow enough time for it to relax, and physically restrain the ends of conduit which are about the be cut free and separated with suitable equipment before cutting coiled conduit, to ensure the conduit is relaxed.

11.0 CONCLUSION

For more information about PE conduit and duct materials, design methods, and installation techniques, please refer to other PPI publications on our website www.plasticpipe.org including Chapter 14 of the *Handbook of PE Pipe*.