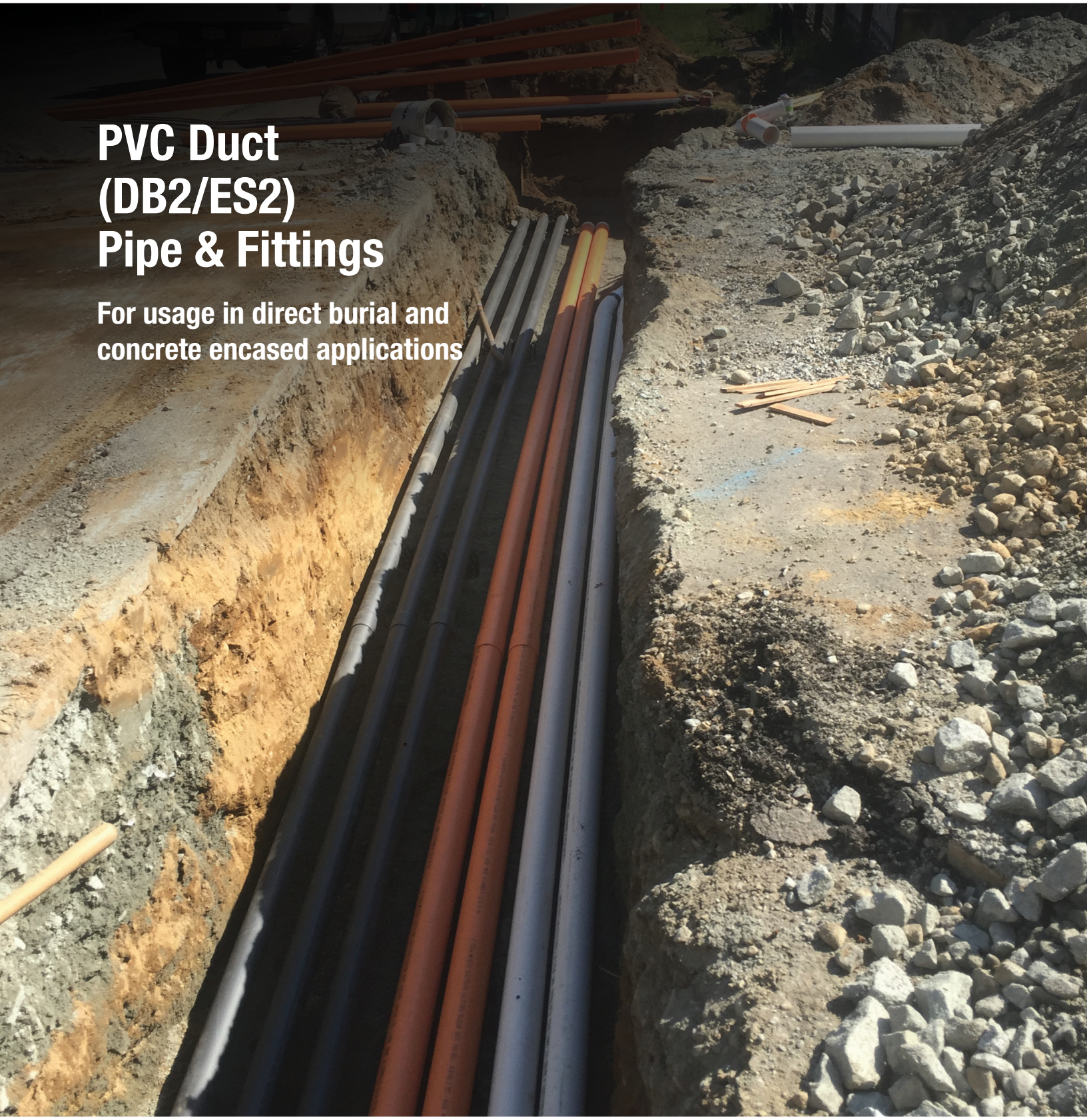
PVC Duct (DB2/ES2) Pipe & Fittings

For usage in direct burial and concrete encased applications



NAPCO
ROYAL PIPE & FITTINGS

PVC DUCT (DB2/ES2) PIPE & FITTINGS

For usage in direct burial and concrete encased applications.

Product Description & Applications
NAPCO manufactures a complete line of PVC Duct pipe and fittings offering two types of duct for direct burial and concrete encasement:

- Solid Wall Duct (DB2/ES2)
- Split Duct (DB2/ES2)

Our PVC Duct products are available in 50 to 150mm (2 to 6 inch) diameters and 3 and 6 metre (10 and 20 foot) lengths with solvent weld bell ends.

Standards and Codes
Duct pipe and fittings are certified to CSA Standard C22.2 No. 211.1. All PVC Duct pipe and fittings shall be installed according to the Canadian Electrical Code (CEC) Part I, Rules 12-1150 - 12-1166.

C22.2 No. 211.1

Features and Benefits

- **Helps Saves Labour** – PVC Duct is simple to cut and join.
- **Easy Wire Pulls** – The smooth interior surface reduces friction when pulling conductors and wires through long runs and 90° bends.
- **Virtually Corrosion Resistant** – PVC Duct is non-metallic, therefore there is virtually no risk of corrosion when exposed to naturally corrosive soil conditions.
- **High Tensile and Impact Strengths** – PVC Duct provides high tensile and impact strengths even in cold weather.
- **Direct Burial** – PVC Duct can be used for direct burial, and requires no additional protection when installed according to the Canadian Electrical Code (CEC).
- **A Choice of Fittings** – NAPCO produces a full range of quality fittings for fast, reliable installations.

Cutting and Joining
Cutting
PVC Duct can easily be cut with a hacksaw or fine-toothed hand saw. To ensure a square cut, use a mitre box or saw guide. Deburr the cut end using a knife or file.

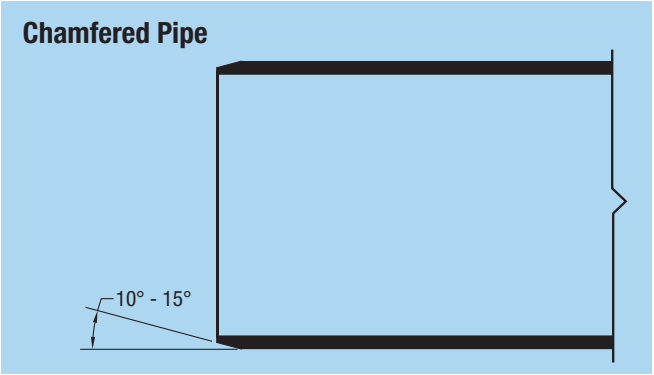
Joining – Solvent Cementing
Solvent cement joints are used to connect lengths of duct and fittings. These joints are strong, permanent, and virtually leak-proof. EcoVoc solvent cement should be used on all PVC-PVC connections.

Note: This brochure is not intended to assume the authority of the Design Engineer. Actual jobsite conditions will vary significantly. The sole responsibility for all design and installation decisions lies with the Design Engineer. All local health and safety regulations must be followed.

Procedure for Solvent Welding Joints

- Use solvent cement and primer prior to expiration date marked on container.
- Above 0° C ambient temperature, joints may be assembled without the use of primer, provided adequate penetration and softening of the pipe/fitting surface can be achieved with solvent cement alone.

1. Assemble materials for the job, including correct solvent cement, primer and correctly sized applicator.
2. Cut pipe as square as possible using a hand saw and miter box or mechanical saw. Do not use a diagonal cut, as it reduces the bonding area in the joint.
3. If plastic tubing cutters are used, care must be taken to remove any raised bead at the end of the pipe, caused by cutting. A file or reamer may be used to remove the bead.
4. Use a knife, file or reamer to remove burrs from the inside and outside of the pipe end, as these will hinder the integrity of the joint. All sharp edges should be removed from the inside and outside edges of the pipe to prevent the pipe from pushing the solvent cement into the fitting socket, thereby causing a weak spot to form. The pipe end should be chamfered, as shown below.



5. All dirt, grease and moisture should be removed from the pipe and socket by thoroughly wiping with a clean, dry cloth.
6. Dry fit pipe and fitting joints prior to cementing. For proper interference fit, the pipe should go easily into the socket approximately 1/3 to 2/3 of the socket depth. If this is not the case, other pipe or fittings should be used.
7. The applicator should be sized according to the size of pipe and fittings being joined. The brush width of the applicator should be equal to approximately ½ of the pipe diameter.
8. Primer is used to penetrate and soften the surfaces so that they will fuse together under a wide variety of conditions. The penetration or softening can be checked by dragging the edge of a knife or sharp object over the coated surface. If a few thousandths of an inch of the primed surface can be scratched or scraped away, proper penetration has occurred. Varying weather conditions affect priming and cementing action and may require more time or repeated applications to either or both surfaces.
9. If using primer, use the correct applicator size (see #7) and aggressively work the primer into the socket, keeping the surface and applicator wet until the surface has softened, re-dipping the applicator as required. When the surface is primed, remove any puddles of primer from the socket.
10. Aggressively work the primer on to the end of the pipe, to a point ½" beyond the depth of the socket.
11. Perform a second application of primer in the socket.
12. While the surfaces are still wet, the appropriate solvent cement should be applied.
13. Using the correct applicator size, aggressively work a full, even layer of cement onto the pipe end to a point equal to the depth of the socket. Do not brush out to a thin paint type layer, as this will dry within a few seconds.
14. Aggressively work a medium layer of cement into the fitting socket; avoid puddling cement in the socket. On the pipe end, do not coat beyond the socket depth or allow cement to run down into the pipe beyond the socket.
15. Apply a second full, even layer of cement on the pipe.
16. Immediately, while the cement is still wet, assemble the joint. Use enough force to ensure that the pipe is fully inserted into the socket. Twist the pipe a ¼ turn as it is being inserted.
17. Hold the joint together for approximately 30 seconds to avoid push out.
18. After assembly, inspect the joint to ensure that there is a ring or bead of cement completely around the juncture of the pipe and socket. If there are voids in this ring, sufficient cement was not applied and the joint may be defective.
19. Remove the excess cement from the pipe and socket (including the ring or bead) using a cloth. Avoid disturbing or moving the joint.
20. Handle newly cemented joints with care until initial set has taken place. Follow set and cure times before handling or testing the system.

Note: EcoVoc solvent cement has a shelf life of 24 months if stored unopened at 22˚C (72˚F). Check the bottom of the can for the date of manufacture before using.

Solvent Cementing
All connections should be made using and applying solvent cement.

Set Times

Average Initial Set Times			
Temperature Range	Pipe Sizes ½" to 1¼"	Pipe Sizes 1½" to 2"	Pipe Sizes 2½" to 6"
15°C to 40°C	2 min.	5 min.	30 min.
5°C to 15°C	5 min.	10 min.	2 hrs.
-16°C to 5°C	10 min.	15 min.	12 hrs.

Joint Cure Schedule

Average Joint Cure Times			
Temperature Range During Assembly & Cure Periods	Pipe Sizes ½" to 1¼"	Pipe Sizes 1½" to 2"	Pipe Sizes 2½" to 6"
15°C to 40°C	2 min.	5 min.	30 min.
5°C to 15°C	5 min.	10 min.	2 hrs.
-16°C to 5°C	10 min.	15 min.	12 hrs.

In damp or humid weather allow 50% more cure time.

Estimated Solvent Cement Requirements

Average Number of Joints per Litre of Solvent Cement									
Pipe/Fitting Diameter	½"	¾"	1"	1½"	2"	2½"	3"	4"	6"
Number of Joints	300	200	125	90	60	40	40	30	10

Estimated Primer Requirements

Average Number of Joints per Litre of Primer									
Pipe/Fitting Diameter	½"	¾"	1"	1½"	2"	2½"	3"	4"	6"
Number of Joints	600	400	250	180	120	80	80	60	20

Solvent Cementing in Cold Weather:
- Store pipe and fittings in a heated area. Prefabricate as much of the system as possible in a heated area.
- When not in use, store sealed solvent cement and primer between 5°C and 21°C. Do not use open flame or electric heaters to warm cements and primers.
- Take care to remove moisture, ice and snow from the mating surfaces.

Solvent Cementing in Hot Weather:
- At the time of assembly, the surface temperature of the mating surfaces should not exceed 45°C. Shade or shelter the joint surfaces from direct sunlight for at least 1 hour prior to joining and during the joining process. If necessary, swab the mating surfaces with clean, wet rags to reduce the surface temperature (thoroughly dry surfaces before applying primer or cement).
- Make joints during the cooler early morning hours.
- Apply cement quickly and join pipe to fitting as quickly as possible after applying the cement.
- Keep solvent cement container closed or covered when not in use, to minimize solvent loss.

Solvent Cementing in Wet Conditions:
- Mating surfaces must be dry when the joint is made.
- Work under a cover or canopy to keep rain off pipe and fittings.
- Work quickly after drying the pipe and fitting to avoid condensation.
- Allow a longer cure time before the system is tested or used.

Storage and Handling of Solvent Cement and Primer:
- Solvent cement and primer contain highly flammable solvents.

Follow all specific safety precautions provided on container label and Material Safety Data Sheet.
- Keep primer and solvent cement away from heat, sparks and open flame.
- Keep containers tightly closed except when in use.
- Ensure proper ventilation of work area and avoid inhaling solvent vapours.
- Where the possibility of splashing exists, wear proper eye protection or a face shield.
- Avoid contact with skin.

Thermal Expansion and Contraction

PVC Duct expands and contracts with extreme variations in temperature. Therefore it is important to allow extra duct footage for contraction at each tie-in when the duct temperature is higher than the surrounding soil temperature. Also allow for expansion when the surrounding soil temperature is higher than the duct temperature. When backfilling, start at the tie-in point and work to the end of the duct run. Use expansion joints if the PVC Duct will be permanently exposed (e.g. bridge crossings).

The coefficient of thermal expansion for NAPCO PVC duct is 5.4 x 10^{-5} mm/mm/˚C (3.0x10^{-5} in/in/˚F). The below charts show approximate change in length for various temperature changes. To calculate the expansion and contraction of a buried or encased system, use 50% of the thermal expansion coefficient.

Δ T (°C)	Expansion/Contraction (mm) per 30.48m Length
10	16.5
20	32.9
30	49.4
40	65.8
50	82.3
60	98.8
70	115.2
80	131.7
90	148.1
100	164.6

Δ T (°F)	Expansion/Contraction (in) per 100 ft Length
20	0.7
40	1.4
60	2.2
80	2.9
100	3.6
120	4.3
140	5.0
160	5.8
180	6.5
200	7.2

Installation Guidelines – Direct Burial

Trench Bottom

The trench bottom should be firm and graded to support the duct bank. Remove all lumps, ridges, depressions and stones on the trench bottom to prevent point loads on the PVC Duct.

When installing a duct bank in rock or shale, excavate an additional 75mm (3 inches) below the desired depth. Place and compact with 75mm (3 inches) of backfill to create a uniform, level bedding surface.

When soil conditions are poor, such as marshy or swampy areas, follow the recommendations of the Design Engineer and/or Soils Consultant.

Direct Burial Application.

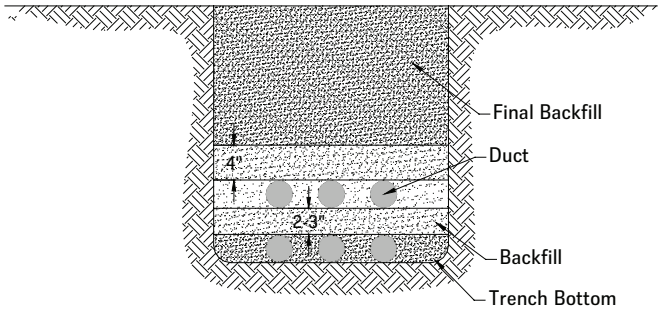
First Tier

Place the first tier of duct in the trench, then backfill and tamp around it. Backfill should not contain any stones larger than 10mm (3/8 inch). Tamp the backfill around ducts to provide maximum supporting strength. Backfill over the duct to the required thickness and tamp with a hand tamper. The thickness of backfill between tiers of duct is determined in the design process. Typically it ranges from 50mm to 75mm (2 to 3 inch). Refer to the project design specifications for details.

Additional Tiers
Place the next tier on top of the first using the procedure outlined above. Repeat until the required number of tiers is reached.

Final Backfill
Once the final tier of duct is placed, place a 100mm (4 inch) thick lift of backfill over the duct banks: stones should be no larger than 10mm (3/8 inch). Tamping this layer is optional. Refer to the design specifications for each installation. Then place backfill in 100mm to 300mm (4 to 12 inch) lifts, compacted with a hand or pneumatic tamper to specified compaction. Apply 300mm (12 inches) of backfill over the duct. At this point the backfill can have some stones in it.

Direct Burial Reference Guide



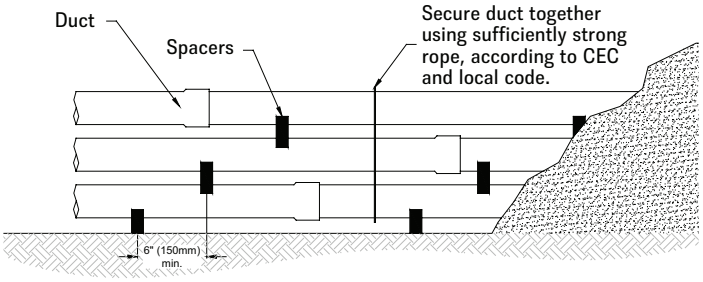
Notes:
Spacers should not be used with duct when it is being direct buried, as they create point supports, not the continuous bedding support required. PVC Duct should not be direct buried in road crossing applications. Consult the project engineer regarding installing duct in road crossing applications.

Installation Guidelines – Concrete Encased (With Spacers)
Trench Bottom
Dig the trench slightly wider than the width of the duct bank. The trench bottom should be firm and graded to support the duct banks. Pour a 75mm (3 inch) thick, graded and smoothed concrete foundation.

Separation of Spacers
When it is essential for spacing to be even horizontally and vertically in the duct bank, use spacers to provide the separation required between runs of duct.

First Tier
Place spacers on the trench bottom and lay the first tier of duct before the concrete foundation has taken its initial set. Place the next layers of spacers and duct on top of the first. Continue in this manner until you reach the required number of ducts. Tie the entire bank of ducts together.

Concrete Encased with Spacers



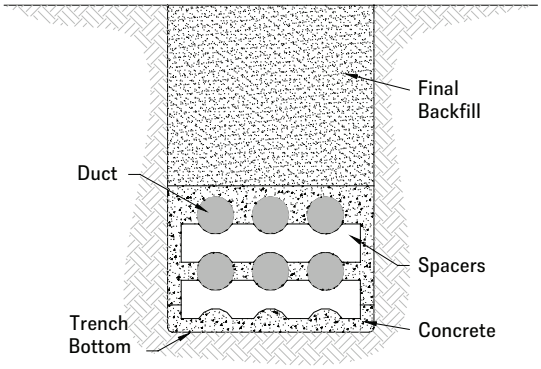
Stagger the spacers on each tier. Maximum spacing for NAPBLOC spacers is 2.4m (8ft). Maximum spacing for Vertical Lock spacers is 1.7 m (5.5 ft).

Pouring the Concrete and Backfill
Use caution when pouring the concrete. Do not allow a large mass of concrete to fall on the duct. Use a plank or board to direct the concrete down the sides of the duct bank to the bottom of the trench. The concrete will flow into the centre of the duct bank and fill up all void spaces. To ensure all voids are eliminated, work a long, flat slicing bar or spatula up and down the vertical rows of duct.

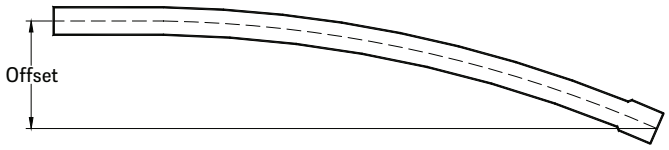
Backfill once the concrete has set. (Minimum 24HR after pouring).

Pressure Grouting
When using pressure grouting to encase duct in concrete, use extreme caution. Excessive pressure and/or high temperatures during pressure grouting can cause the ducts to collapse.

Concrete Encased with Spacers (Duct with Spacers)

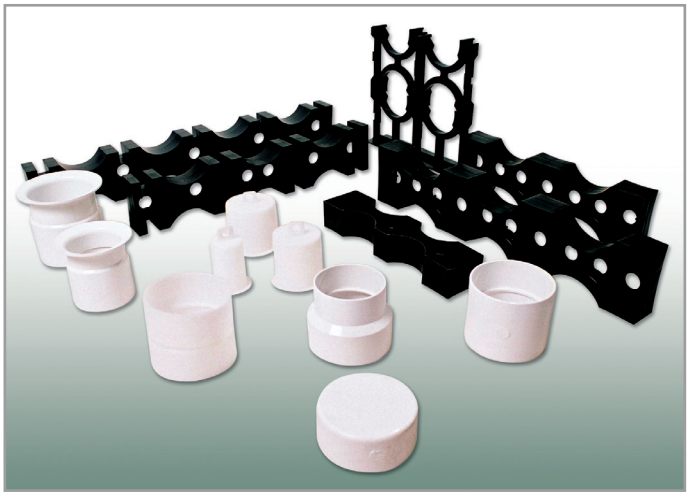


Field Bending
Duct has some flexibility that allows for bending in the field for minor changes in elevation and direction. The table shows the allowable offset for bending PVC Duct.

Allowable Offset		
		
Pipe Size mm (in)	**Max. Allowable Offset For 10' Length mm (in)**	**Max. Allowable Offset For 20' Length mm (in)**
53 (2)	508 (20)	2,007 (79)
78 (3)	356 (14)	1,422 (56)
91 (3½)	305 (12)	1,245 (49)
103 (4)	279 (11)	1,092 (43)
129 (5)	178 (7)	889 (35)
155 (6)	178 (7)	737 (29)

Fittings – Spacers and Push-fit Couplings
NAPCO offers a complete line of fittings for use with our PVC duct pipe.

Spacers
NAPCO product offerings include Vertical Lock, Single Piece NAPBLOC, and Modular NAPBLOC styles of spacers: Vertical Lock and NAPBLOC allow for any number of ways.



Polyethylene Push-Fit Couplings
Use these couplings to rapidly assemble cut lengths of duct pipe being encased in concrete. To install the couplings, push the spigot end of the duct into the coupling socket. Place a piece of wood on the end of the coupling, and hammer lightly until the end of the duct butts up against the inside shoulder of the fitting.

Note: Polyethylene push-fit couplings are not watertight and are only recommended for use with PVC Duct encased in concrete.

Dimensions
CSA DB2/ES2

Nominal Size mm (in)	Avg. Outside Diameter mm (in)	Avg. Inside Diameter mm (in)	Avg. Wall Thickness mm (in)	Approx. Weight lb/100ft (kg/m)
53 (2)	57 (2.250)	53 (2.090)	2 (0.080)	34 (0.506)
78 (3)	83 (3.250)	78 (3.056)	2 (0.097)	60 (0.893)
91 (3½)	95 (3.730)	89 (3.522)	3 (0.104)	80 (1.190)
103 (4)	107 (4.216)	101 (3.978)	3 (0.119)	96 (1.429)
129 (5)	135 (5.299)	127 (4.989)	4 (0.155)	155 (2.307)
155 (6)	159 (6.275)	151 (5.949)	4 (0.163)	216 (3.214)

CSA DB2/ES2 - Split Duct
Split duct can be used to install duct around existing cables and to repair damaged duct without cutting and splicing the cables.

Our various pipe and fittings solutions have been manufactured to meet the need of our customers and their applications. Contact one of the Sales Centres for more information:

Sales & Distribution Centres:

Langley, BC, Canada
T/F 1.800.663.0696
F 1.800.663.6564

Woodbridge, ON, Canada
T/F 1.866.769.7473
F 905.856.3986

Laval, QC, Canada
T/F 1.800.465.9754
F 450.688.6624

Distribution Centres:

Calgary, AB, Canada
T/F 1.800.663.0696
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