

| Section H      | Duct                                      |
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Application

ES54 section H applies to BC Hydro installations on public property. See ES54 section S *Services* for installations on private property.

Revision Notes

Updated *References*. Updated when DB2 ducts may be used in note 1. Updated note 2 to add RTRC suppliers. Updated separation from 150 mm to 75 mm in note 3. Updated burial depths and warning board requirement in note 4. Updated note 5, including Table 1, to specify BC Hydro standard burial depth and add CSA C22.3 No. 7 minimum burial depth. Updated concrete encasement requirement and frictional heat description in note 6. Added asbestos procedure requirement to note 8. Expanded concrete material requirement in note 10.1. Removed description of vibrator from note 10.2. Expanded backfill requirement in note 10.3, including revising depth of single lift backfill over duct bank from 450 mm to 300 mm. Removed duct length measurement process with disposable measuring duct tape from note 11. Substantive changes are marked by green vertical revision lines in the left margin. This revision released concurrently with Standards and Equipment Advisory 2025-044 *Revised ES54 Section H Duct Standards*.

References

BC Hydro Distribution Standards

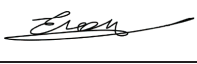
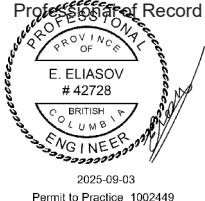
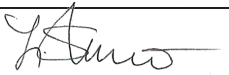
- ES54 W1-05 Construction Materials Concrete
- ES55 B2-02 Clearances for Buried Utilities
- ES55 F2 Customer Build Projects

Other BC Hydro Documents

- COWS 1324 Trenchless Installation of Electrical Conduits by a BC Hydro Contractor
- COWS 1326 Duct Crossing of Bridges
- Specification 106-0420 Twine and Twine Reels

External Documents

- CSA C22.2 No. 211.1 Rigid types EB1 and DB2/ES2 PVC conduit
- CSA C22.2 No. 211.2 Rigid PVC (unplasticized) conduit
- CSA C22.2 No. 2515 Aboveground reinforced thermosetting resin conduit (RTRC) and fittings
- CSA C22.2 No. 2420 Belowground reinforced thermosetting resin conduit (RTRC) and fittings
- CSA C22.3 No. 7 Underground systems

|                                   |                                                                                     |                                                                                     |                                                                                                                   |               |
|-----------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------|
| Designed:<br>E. Eliasov, P.Eng    |  |  | Duct General Notes                                                                                                |               |
| Checked:<br>J. Yang, P.Eng        |  |                                                                                     |                                                                                                                   |               |
| Reviewed:<br>L. Stevanovic, P.Eng |  |                                                                                     |                                                                                                                   |               |
| Approved:<br>H. Giesbrecht, P.Eng |  | Issued: 2025-08-29<br>Effective: 2025-08-29                                         | DISTRIBUTION<br>STANDARDS<br> | ES43 H0-02 R9 |

**Notes****1. Types of Duct**

Installing direct-buried underground distribution cables and supply service cables is not allowed. The following four duct types are allowed for URD/UD and feeder standard installations:

- a. DB2 PVC conduit per CSA C22.2 No. 211.1;
- b. Schedule 40 PVC conduit per CSA C22.2 No. 211.2;
- c. CSA C22.2 No. 2515; and
- d. CSA C22.2 No. 2420.

DB2 ducts may be used in all installations except:

- a. RTRC ducts shall be used for bridge crossings and may be used where high pulling tension is required;
- b. Schedule 40 ducts shall be used in direct-buried feeder duct bank installations; and
- c. See note 6c for RTRC direct-buried elbows.

See class of work specification (COWS) 1324 and 1326 for trenchless duct installation. See COWS 1326 for bridge crossings.

**2. PVC to RTRC Duct**

The following RTRC elbows from suppliers Champion Fiberglass and Atkore come with two PVC DB2 couplings:

- a. Champion Fiberglass:
  - i. Part 30DSW922-DBII, 3" elbow 90° x 36"
  - ii. Part 40DSW922-DBII, 4" elbow 90° x 36"
- b. Atkore:
  - i. Part 10-3030R36-DB2, 3" elbow 90° x 36"
  - ii. Part 10-4030R36-DB2, 4" elbow 90° x 36"
  - iii. Part 10-5030R36-DB2, 5" elbow 90° x 36"

**3. Primary Duct in Proximity to Secondary Service Boxes**

Primary duct should be routed alongside or under secondary service boxes, maintaining the required minimum separation of 75 mm. The primary duct shall not run through a secondary service box.

**4. Warning Tape and Warning Boards**

Warning tape reading "Caution: Buried Electric Line Below" shall be installed a minimum 300 mm above the duct bank and 300 mm below the finished grade at standard burial depth. At reduced burial depth, the distance below finished grade can be reduced to 150 mm minimum. Warning boards (material number 9700-0676) shall be installed instead of warning tape at locations with high safety hazard potential.

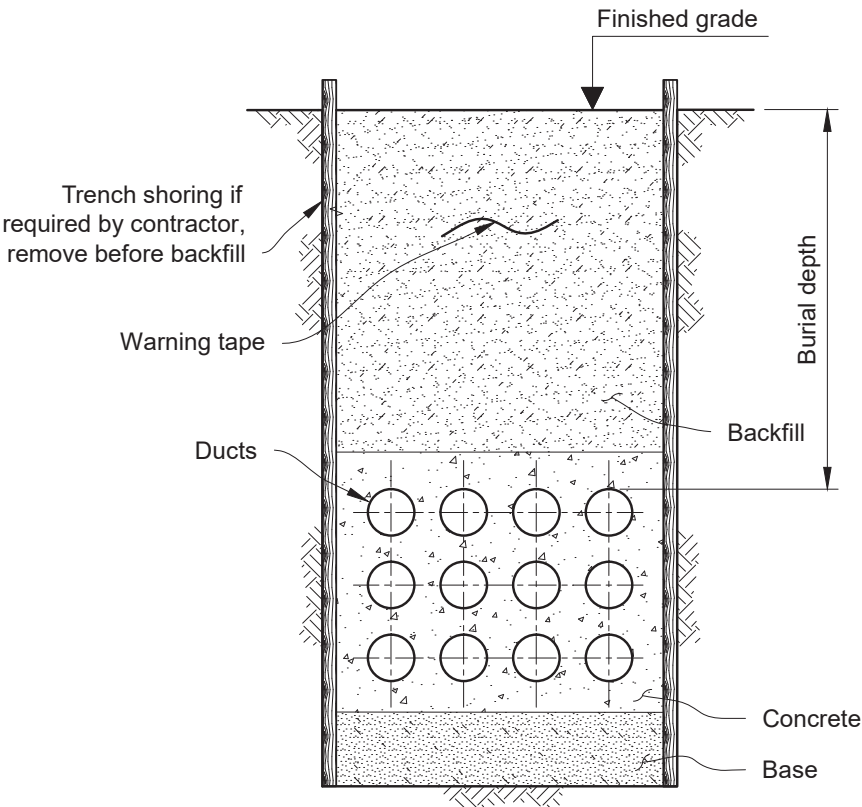


Figure 1 – Warning tape placement

5. Burial Depth

Burial depth measured from the top surface of the ducts to the finished grade shall comply with Table 1. Install ducts at standard burial depth. Burial depth may be reduced where it is necessary for a duct to cross over another underground facility but shall not be less than the minimum specified in CSA C22.3 No. 7.

Table 1 – Burial depth

| Installation location | Standard burial depth (mm) | Minimum burial depth per CSA C22.3 No. 7 (mm) |
|-----------------------|----------------------------|-----------------------------------------------|
| Roadway               | 1000                       | 600                                           |
| Bottom of ditches     | 1000                       | 600                                           |
| Other areas           | 900                        | 450                                           |

6. Concrete Encasement

Concrete encasement of ducts is required for the following:

- a. DB2 feeder ducts (Schedule 40 ducts do not require concrete encasement);
- b. Ducts separated less than 1.0 m from a tree unless root deflectors are installed;
- c. PVC duct elbows when the combination of sidewall bearing pressure and pulling distance exceeds the limitations in Table 2; and
- d. At locations with reduced burial depth below the minimum in Table 1.

**Table 2 – Pulling distance for direct-buried PVC duct straight runs before concrete encasement**

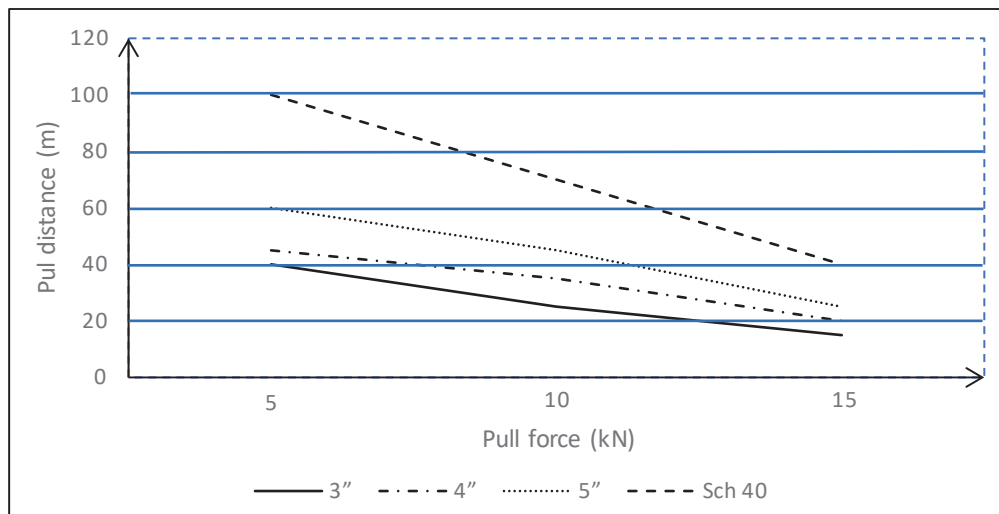
| Duct size and type | Maximum duct length (m) before concrete encasement is required per sidewall bearing pressure (SWBP) based on pull calculation |        |         |         |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------|--------|---------|---------|
|                    | 3 kN/m                                                                                                                        | 5 kN/m | 10 kN/m | 15 kN/m |
| 3" DB2             | 50                                                                                                                            | 35     | 25      | 15      |
| 4" DB2             | 60                                                                                                                            | 45     | 35      | 20      |
| 5" DB2             | 80                                                                                                                            | 60     | 45      | 25      |
| Schedule 40        | 130                                                                                                                           | 100    | 70      | 40      |

For example, if a 4" DB2 duct has a sidewall bearing pressure of 5 kN/m, the elbow can be direct buried without concrete encasement if the duct length from the cable feed does not exceed 45 m. Concrete encasement is required at the subject duct elbow if the duct length exceeds 45 m under the same conditions.

Pulling distance is measured along the duct from the cable feed side to the subjected duct elbow midpoint.

Frictional heat generated during cable pulling can burn the PVC duct wall when passing through an elbow, potentially allowing backfill material to enter and damage the electrical conductor. RTRC ducts do not melt. Concrete encasement of duct elbows is not required when RTRC elbows are used instead of PVC material (either DB2 or Schedule 40).

The PVC abrasion ratio depends on the pulling force, speed, length, and the type of pulling line. Steel pulling line has better heat absorption capabilities than polyester rope and is more efficient at removing frictional heat from the conduit surface. Slower pulling speeds generate less heat than faster speeds. The type of pulling line and the pulling speed are usually unknown during the design process and are not typically controlled as part of the design.


**Figure 2 – Pull distance to pull force limits for PVC duct elbows**

## 7. Separation Between Ducts and Tree Roots

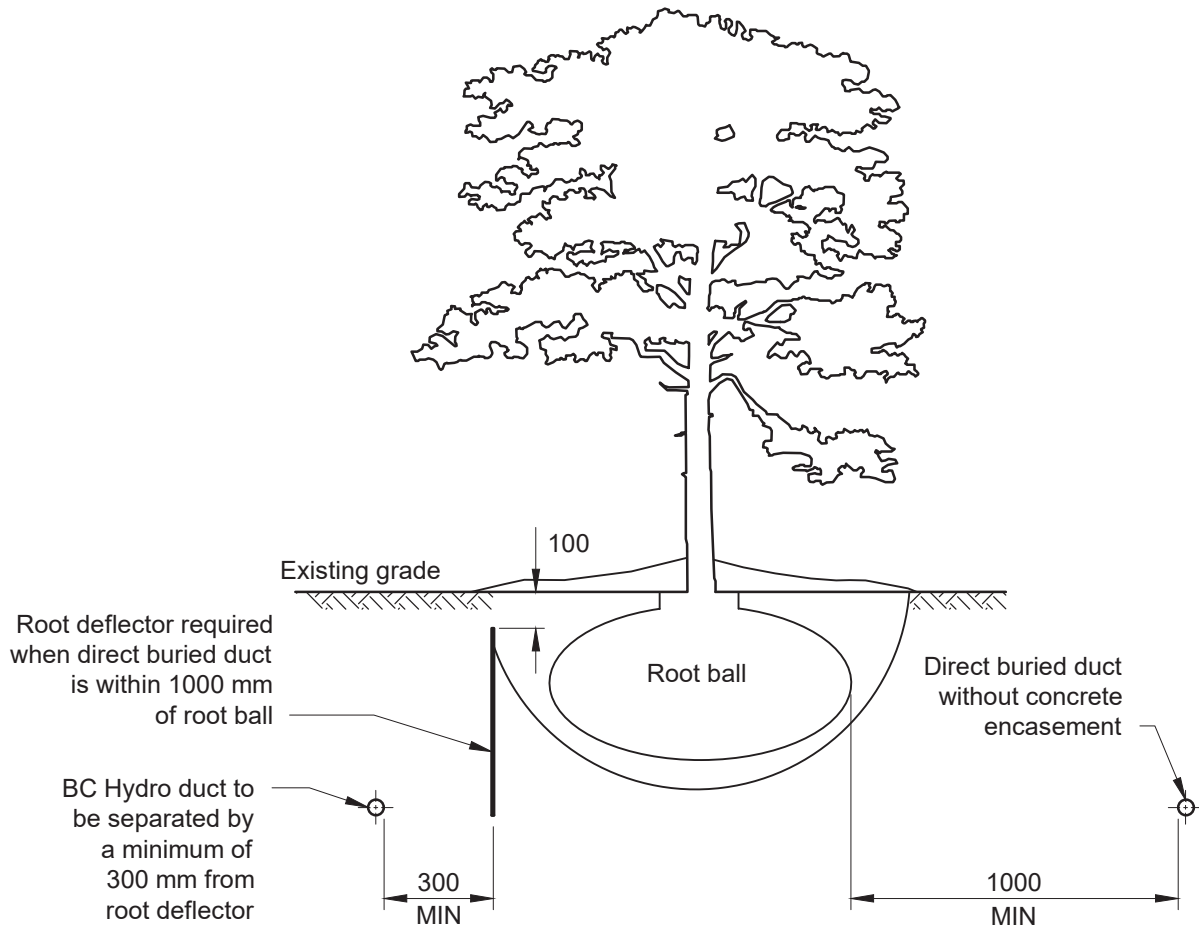
Concrete encased ducts shall be separated by a minimum of 300 mm to the tree root ball. Root deflectors are not required when ducts have been concrete encased.

Root deflectors shall be installed when direct buried ducts are placed in proximity to trees. Root deflectors are required:

- If the duct edge is 1000 mm or less from the tree root ball when installed in soil. If the tree root ball cannot be defined and is pre-existing, a certified arborist should be consulted to determine best practices when working in proximity to the tree; or

- b. If the duct edge is 600 mm or less from the outermost edge of a silva cell structure.

Installed root deflectors shall be placed 100 mm below grade. BC Hydro ducts shall be separated from the root deflector by a minimum of 300 mm.



**Figure 3 – Root deflector placement**

Root deflectors shall be placed per manufacturer's instructions on the duct-bank side of the tree, parallel to the duct bank in both directions. The root deflector shall be polyethylene, minimum 2 mm thick, 25 MPa tensile yield strength at 10% elongation tested per ASTM D638, and hardness shore P66 tested per ASTM D2240.

## 8. Transite Duct Transition

Connection of a PVC duct to an existing transite duct shall follow these steps:

- a. Follow asbestos work procedures;
- b. Cut and square the transite duct;
- c. Rasp the inside of the transite duct;
- d. Butt the ends of the PVC and transite ducts;
- e. Install a mission coupling and secure with hose clamps; and
- f. Apply plastic wrap and secure with concrete.

## 9. PVC Duct Installation

The contractor shall follow all duct manufacturer instructions.

**9.1 Storage**

PVC duct shall not be exposed to sunlight or subzero temperatures and shall be used on a "first-in, first-out" basis.

**9.2 Duct Inspection**

Contractors shall inspect ducts prior to installation to ensure the material is free of defects, the cross-section is a round shape, and the inside edges of the spigot are deburred. Field-cut ducts and elbows shall have their inside edges deburred.

**9.3 Cutting**

Duct shall be cut using a mitre box or saw guide to ensure a square cut. Burrs and ridges left by the cutter shall be deburred, and the inside diameter of the spigot shall be chamfered to 30°. Insert marks shall be added to the spigot at 7½" and 8½" for joining to a bell end, and at 5" and 6" for joining to a coupling.

**9.4 Duct Termination**

Conduit terminations shall be plugged or capped against the ingress of water and any foreign material that may hinder cable removal and pulling. Conduit runs into vaults shall be terminated with preformed bell ends and plugs. Stubbed-off duct sections and ducts into pads and pilasters shall be capped.

**9.5 Duct Transitions**

Special attention shall be given to the transition between concrete-encased and direct-buried sections of duct to address shear stress in the ducts.

**9.6 Duct Joint**

Duct joints shall be staggered a minimum of 150 mm vertically and horizontally. Joined surfaces shall be clean and free from dirt, foreign material, and moisture, including the outside surfaces of the duct spigot and inside surfaces of the duct socket. Duct shall be joined using suitable joining cement in accordance with the manufacturer's recommendations. Solvent cement shall be applied in a heavy and even coating over the entire surface outside of the spigot and inside of the socket. While the solvent is still wet, the duct spigot shall be inserted in the socket with a twisting one-quarter turn until it reaches the socket shoulder. Solvent cement is fast setting and shall be applied quickly to complete the joint assembly shortly after application. If there is any sign of drying of the cement surfaces prior to assembly, the duct spigot shall be recoated. All excess cement shall be removed to prevent dripping onto and weakening of the lower ducts.

More than sufficient cement to fill the loose part of the joint should be applied. Besides filling the gap, adequate cement layers shall penetrate the surfaces and remain wet until the joint is assembled. Immediately insert and rotate the spigot end past the first insertion mark and into the full depth of the fitting socket or bell end. The pipe should be turned 45° to 90° in a twisting motion while inserting.

Joint primer is required for direct-buried Schedule 40 ducts. Apply a first coat of primer to both joining surfaces. When it becomes tacky, apply a second coat of primer on the spigot. When the second coat of primer becomes tacky, apply a smooth coat of cement to the inside of the socket.

As a general rule, ten joints should be spliced per 1 quart or litre of cement, and 20 joints per 1 quart or litre of primer. A typical manufacturer instruction specifies the following procedure:

"Test the layers every 15 seconds or so by a gentle tap with your finger. The thin layer becomes tacky and then dries quickly (probably within 15 seconds), the heavy layer will remain wet much longer. A few minutes after applying these layers check for penetration. Scrape the surface of both with a knife. The thin layer will have achieved little or no penetration; the heavy one will have achieved much more penetration. If the cement coatings on the pipe and fittings are wet and fluid when assembly takes place, they will tend to flow together and become one cement layer. Also, if the cement is wet, the surfaces beneath them will still be soft and these softened surfaces in the tight part of the joint will tend to fuse together. As the solvent dissipates, the cement layer and the softened surfaces will harden with a corresponding increase in joint strength. A good joint will take

the required working pressure long before the joint is fully dry and final joint strength is obtained. In the tight (fused) part of the joint, strength will develop more quickly than in the looser (bonded) part of the joint."

### 9.7 Cold Weather Installation

PVC duct installation below a temperature of -10°C is not permitted due to the high risk of conduit damage and coupling separation. Solvents penetrate and soften the plastic pipe and fitting surfaces more slowly in cold weather than in warm weather. The plastic is also more resistant to solvent attack. It is important to pre-soften surfaces with a primer in cooler weather. A longer cure time is necessary because of slower evaporation. The following procedure shall be followed in cold weather:

- Store cements and primers in a warmer area when not in use and make sure they remain fluid. If possible, store the fittings and valves the same way;
- Take special care to remove moisture, including ice and snow, from the surfaces to be joined, especially from around the ends of the pipe;
- Use the most aggressive primer available to soften the joining surfaces before applying cement. More than one application may be necessary; and
- Vigorously shake or stir cement before using. Allow a longer cure period before the system is tested and used. Use a heat blanket to accelerate set and cure times, if needed.

Table 3 shows the typical time necessary for PVC solvent to set and cure in various ambient temperatures and low humidity. In humid weather, the time increases by 50%.

**Table 3 – Solvent set and cure time per temperature**

| Parameter        | Set and cure time (hours) |             |           |
|------------------|---------------------------|-------------|-----------|
|                  | Over 25°C                 | 5°C to 25°C | Below 5°C |
| Initial set time | 0.5                       | 2           | 12        |
| Joint cure time  | 1.5                       | 4           | 72        |

## 10. Concrete Duct Bank

### 10.1 Concrete Material

Concrete material shall comply with ES54 W1-05. Concrete volume less than 1 m<sup>3</sup> may be made of Quikrete or equivalent bagged concrete mix with a 28-day strength of 27.5 MPa.

### 10.2 Concrete Construction

The duct bank shall be monolithically constructed, and construction joints shall be provided at 45° to the duct alignment. Concrete encasement shall be formed reasonably rectangular in cross-section. Open ends of ducts shall be plugged to prevent any foreign material from entering the ducts. Due to expansion and contraction of ducts during pouring, concrete pours shall originate from the fixed ends of the duct window and proceed toward the free ends. The ducts shall be protected during concrete pouring to prevent the concrete mass from falling directly onto the ducts. Fresh concrete shall be evenly distributed and directed down to the duct bank to fill up all void spaces. Bagged concrete mix shall be prepared and applied in accordance with the manufacturer's instructions.

### 10.3 Backfill

Concrete duct bank shall be installed on a layer of compacted aggregate that extends below the frost depth.

Backfill operation shall not commence until the concrete is completely set. All formwork shall be removed prior to backfilling. The concrete encasement shall be cured with water until the concrete is covered with a minimum 300 mm of backfill. Backfill material within 300 mm over the concrete encasement shall be placed and compacted as a single lift, using only lightweight equipment.

10.4 Mandrelling

A test mandrel shall be drawn through each duct when the duct is completed and the concrete set. The mandrel shall be designed to have dimensions that exactly match the clearance inside the pipe at the deflection limit. The minimum outside diameter of the mandrel shall be 90% of the average inside diameter (ID) of the duct per Table 4.

Table 4 – Mandrel minimum outside diameter

| Duct inner diameter (mm) | Mandrel minimum outer diameter (mm) |
|--------------------------|-------------------------------------|
| 75                       | 69                                  |
| 100                      | 91                                  |
| 125                      | 114                                 |

Acceptable pulling twine shall be left through all ducts after test mandrelling, or as designated by BC Hydro. If a combination of duct diameters is used for a duct run (this may be the case in trenchless undercrossing methods such as jack-and-bore, directional drilling, and bridge crossings) then use the smallest diameter mandrel as per Table 4 for that duct run.

11. Pulling Twine

Ducts shall be fitted with a #8 polypropylene pulling twine (BC Hydro material number 106-0420 per BC Hydro specification 106-0420) and tied to the C-channel or other hardware inside the vault. The pulling twine shall be installed in all ducts and secured for future use in empty ducts. The pulling twine shall be blown in the ducts after completion of the mandrel test or pulled in behind the mandrel.

Application

This standard provides general trenching details for underground residential distribution (URD), underground distribution (UD), and feeder installations.

Revision Notes

Updated note 3 wall penetration to permit rebar cutting in designated areas and clarify coring criteria outside the designated area. Updated Figure 1. Updated description of backfill in Figures 4 and 5 to include authority having jurisdiction. Substantive changes are marked by green vertical revision lines in the left margin. This revision released concurrently with Standards and Equipment Advisory 2025-044 *Revised ES54 Section H Duct Standards*.

References

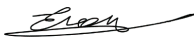
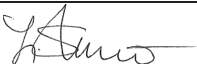
BC Hydro Distribution Standards

|            |                                                |
|------------|------------------------------------------------|
| ES54 H2-01 | Concrete Encasement 3 Inch Duct                |
| ES54 H2-02 | Concrete Encasement 4 Inch Duct                |
| ES54 H2-03 | Concrete Encasement 5 Inch Duct                |
| ES54 H3-01 | Duct Window in Concrete Vaults and Boxes       |
| ES54 W1-01 | Construction Materials Excavation and Backfill |
| ES54 W1-05 | Construction Materials Concrete                |

Notes

1. General

- a. Warning marker boards for direct-buried duct installation (material number 9700-0676) may be placed instead of marking tape at locations with high safety hazard potential, as determined by the BC Hydro designer.
- b. Materials and construction shall comply with ES54 W1-01.
- c. Material placed around and 300 mm above feeder duct banks (cover and base) shall not exceed maximum thermal resistivity of 0.9 m x C / W at 2% moisture content and at constructed compaction proctor density. Thermal resistivity is related to compaction and moisture content. Organic material has very high thermal resistivity regardless of moisture content and is not suitable.
- d. If trenches are cut into existing pavement structures, all structural layers including the surface, base, and subbase, shall be restored to match the existing materials and thickness. Construction shall comply with the standards of the authority having jurisdiction (AHJ).
- e. Direct buried and concrete encased duct spacing shall comply with ES54 H2-01, H2-02, and H2-03.

|                                   |                                                                                     |                                                                                     |                                                                                                                   |               |
|-----------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------|
| Designed:<br>E. Eliasov, P.Eng    |  |  | General Trenching Details URD,<br>UD, and Feeder Installations                                                    |               |
| Checked:<br>J. Yang, P.Eng        |  |                                                                                     |                                                                                                                   |               |
| Reviewed:<br>L. Stevanovic, P.Eng |  |                                                                                     |                                                                                                                   |               |
| Approved:<br>H. Giesbrecht, P.Eng |  | Issued: 2025-08-29<br>Effective: 2025-08-29                                         | DISTRIBUTION<br>STANDARDS<br> | ES43 H1-01 R8 |

2. Duct Inspection

- a. Contractors shall inspect ducts prior to installation to ensure the material is free of defects, the cross-section is a round shape, and the inside edges of the spigot are deburred. Field-cut ducts and bends shall have their inside edges deburred.
- b. Open ends shall be plugged to prevent any foreign material from entering the ducts.

3. Wall Penetration

- a. Proposed wall penetrations shall be marked on the record drawings. The design and number of electrical conductors entering the vault shall comply with ES53 underground electrical standards.
- b. Required wall penetrations shall be cored. Minimum spacing for penetrated holes shall comply with ES54 H3-01.
- c. A designated area for wall penetration is enclosed with strips equal to ¼ of the wall width along vertical wall corners and ¼ of the wall height along top and bottom horizontal corners.
- d. Perform penetration outside the designated areas with caution, ensuring reinforcement bars remain intact and clear spacing between holes is minimum 300 mm. For example, a wall 2.4 m wide by 2.8 m high measured outside shall be penetrated in the designated area 1.2 m by 1.4 m. Penetration in areas along vertical corner strips 600 mm wide and horizontal corner strips 700 mm wide shall be performed with caution, ensuring reinforcement bars are not damaged. If the rebar location cannot be accurately determined or the rebar is located at a distance less than 25 mm from the proposed hole, the penetration shall be done with a carbide bit at a slow speed and shall stop if hitting rebar. The hole shall be sealed with non-shrink Portland grout. The grout shall be prepared, placed, and courted per manufacturer’s instructions. The new hole can be cored when the grout has set.

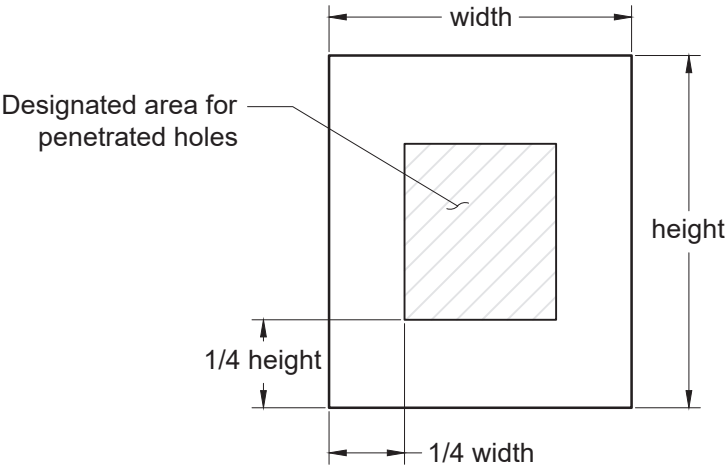


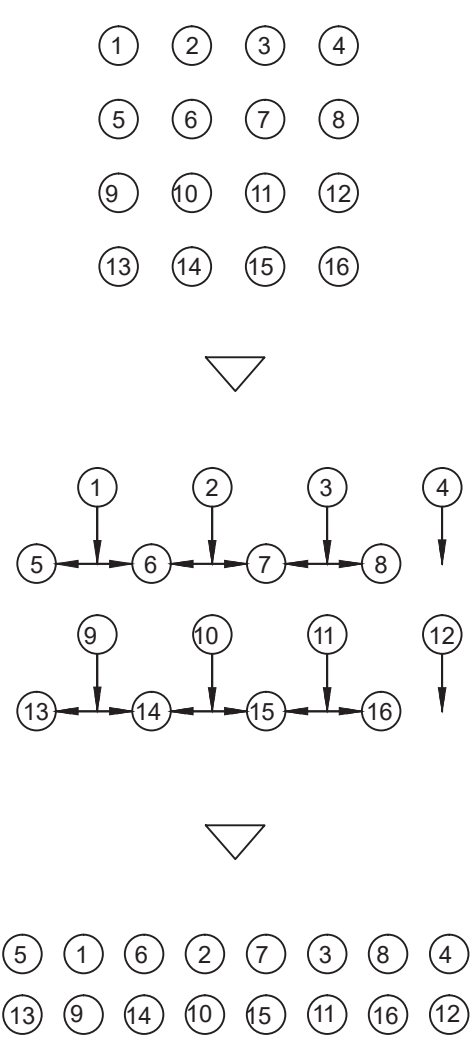
Figure 1 – Wall penetration

4. Acceptance

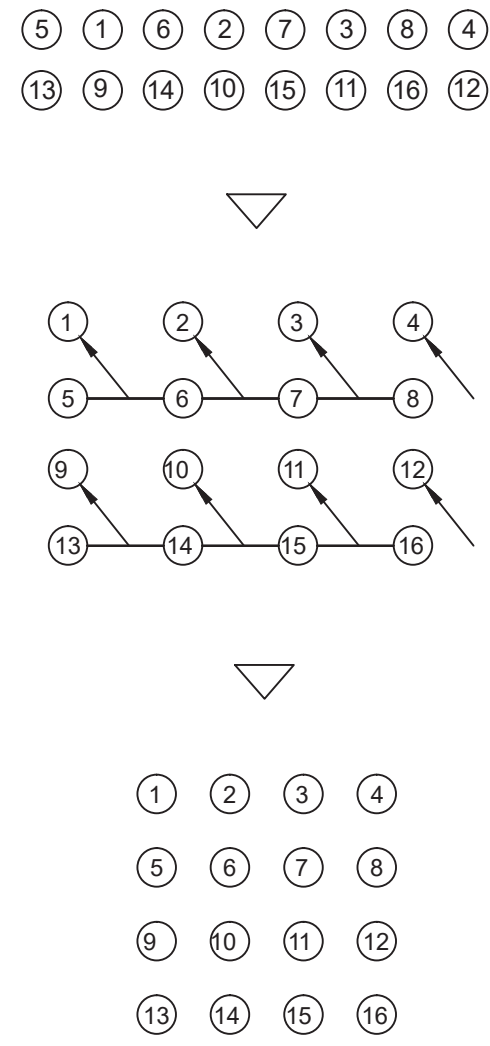
Table 1 shows the acceptance criteria and hold points for construction items.

Table 1 – Acceptance criteria and hold points

| Item             | Acceptance criteria      | Hold point                     |
|------------------|--------------------------|--------------------------------|
| Concrete         | ES54 W1-05               |                                |
| Trench grade     |                          | Prior to pouring concrete base |
| Ducts            | Separation between ducts | Prior to pouring concrete      |
| Spacers          | Type and locations       | Prior to pouring concrete      |
| Wall penetration | ES54 H3-01               | Prior to and after coring      |



**Figure 2** – Transition from 4x4 to 2x8 duct configuration



**Figure 3** – Transition from 2x8 to 4x4 duct configuration

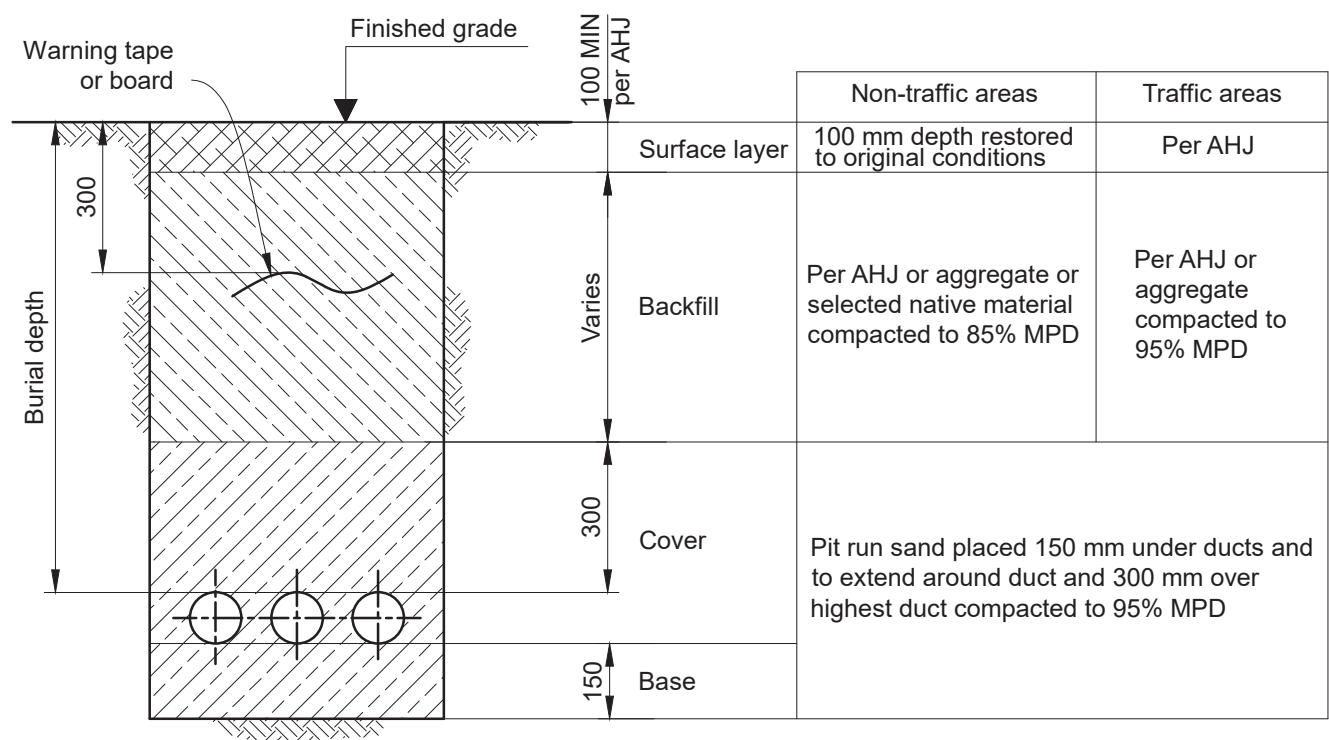


Figure 4 – Direct buried duct trenching details

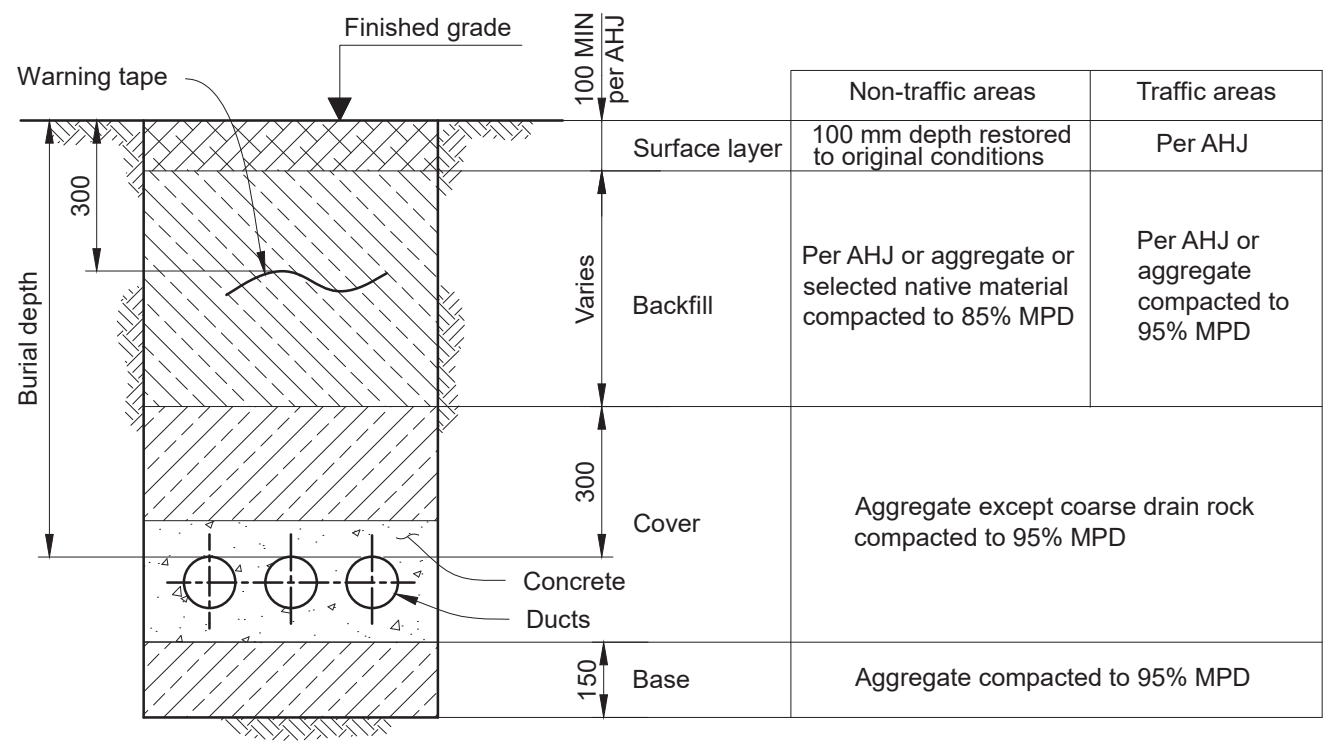


Figure 5 – Concrete encased duct trenching details

## Application

This standard provides general trenching details for duct entry at pads.

## Revision Notes

R3 – Removed notes on concrete encasement for tension pulls exceeding 5.5 kN. Added sections *Application* and *Revision Notes*. General layout changes. September 2022, JY

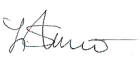
R2 – Backfill material specified in new ES54 section W. Minimum depth of top layer changed to 100 mm. Minimum trench depth deleted. Containment frame added. March 2016, MK

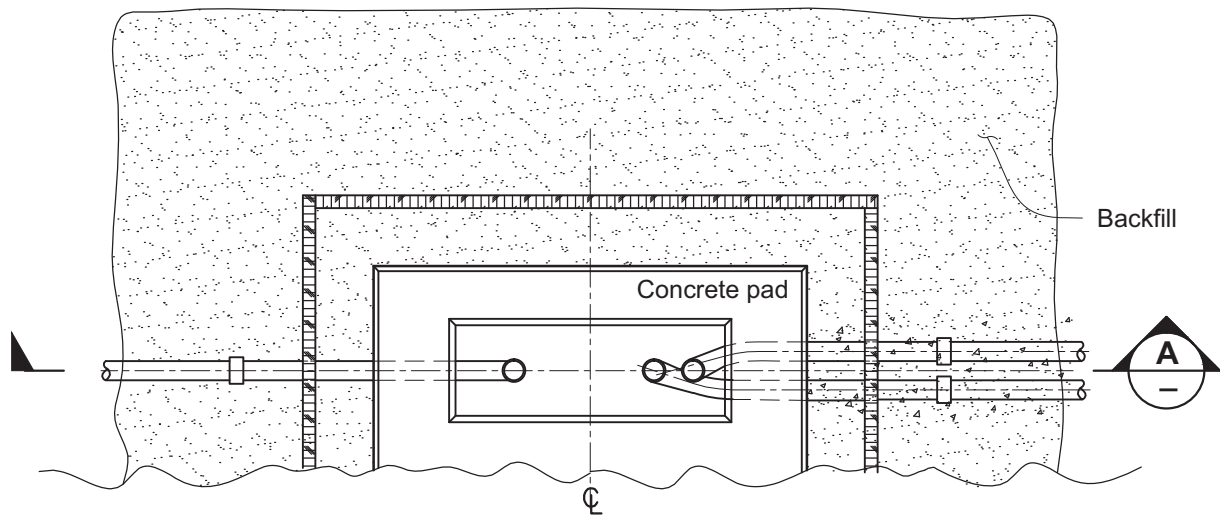
R1 – Redrawn, dimensions and notes revised. January 2001, MF

R0 – Original issue. November 1981

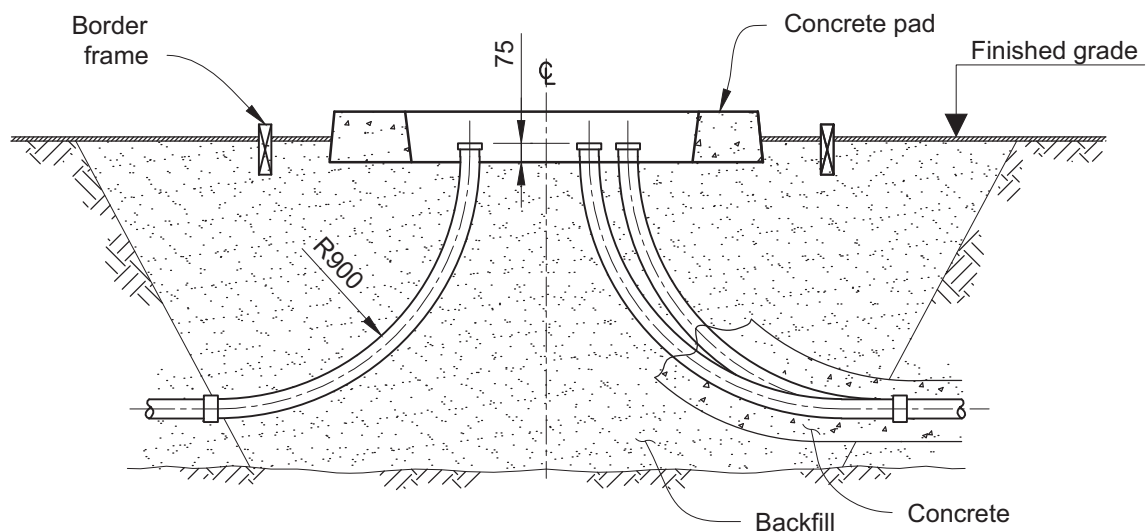
## Notes

The caps on ducts ending in transformer pads shall not be cemented because the duct might be too short to cut off the cap.

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                       |                                                 |  |                |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--|----------------|
| DESIGNED<br><br>J. YANG       | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>L. STEVANOVIC<br>1002449 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY AT PADS |  |                |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: SEP 2022<br>REPLACES: MAR 2016<br>ORIGINALLY<br>ISSUED: NOV 1981                                      |                                                                                                                                       |                                                 |  | PAGE 1<br>OF 3 |



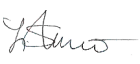
Plan

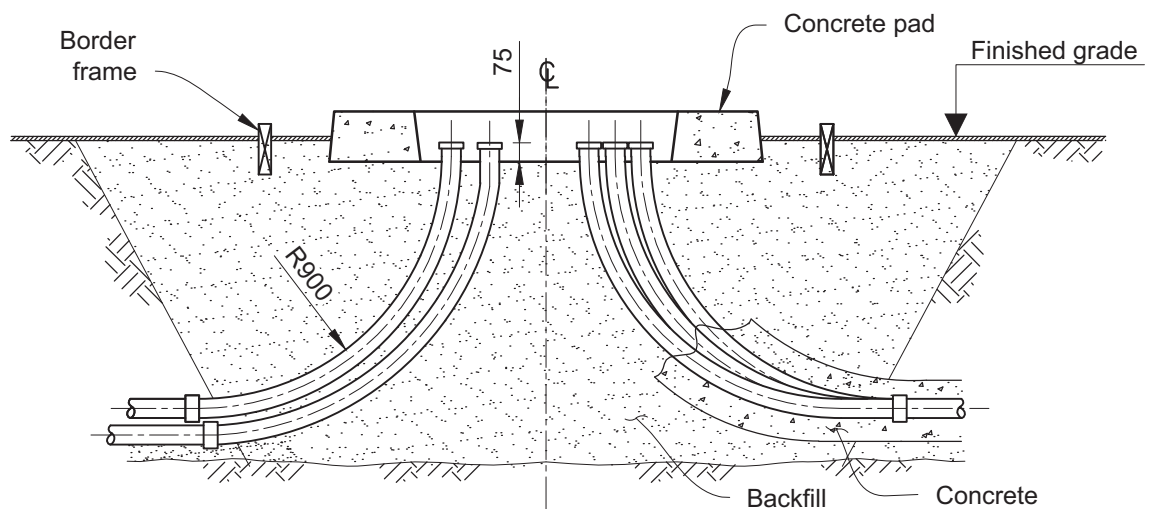
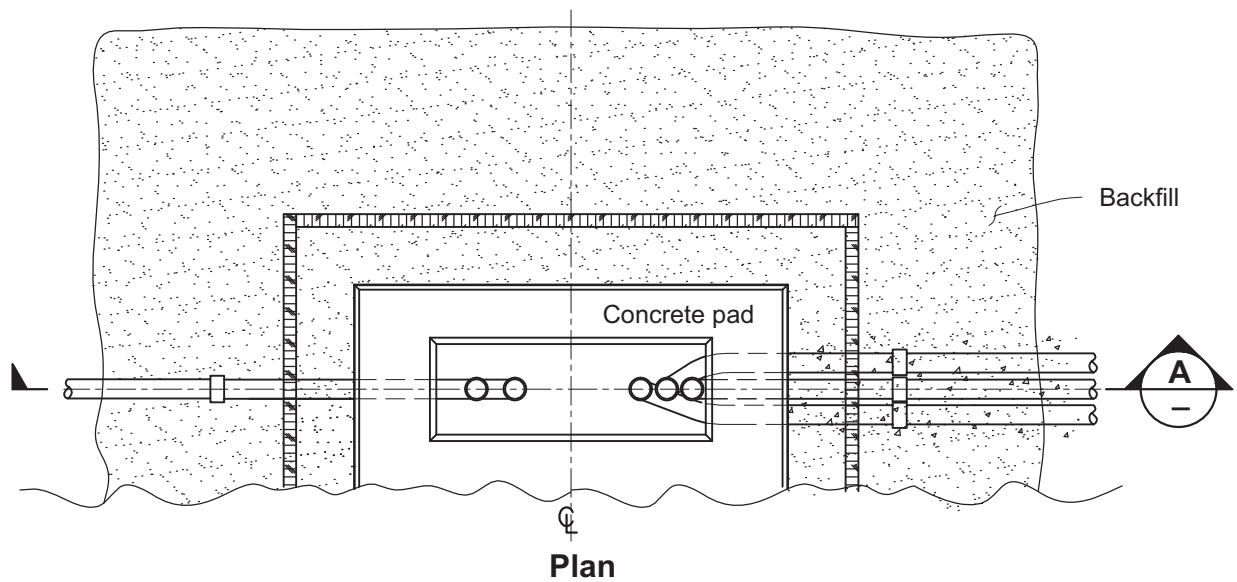


Single Duct or Two  
Non-Adjacent Ducts

Two or 2x2 Adjacent Ducts  
Horizontal Configuration

Section **A**

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 |        |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------|
| DESIGNED<br><br>J. YANG       | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br>1002449<br><br>L. STEVANOVIC<br>BRITISH COLUMBIA<br>ENGINEER<br>2022-09-01 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY AT PADS |        |
| DISTRIBUTION<br>STANDARDS<br> | ISSUED: SEP 2022<br>REPLACES: MAR 2016<br>ORIGINALLY<br>ISSUED: NOV 1981                                            | PAGE 2<br>OF 3                                                                                                | ES54 H1-03.02                                                                                                                                                                       |                                                 | R<br>3 |



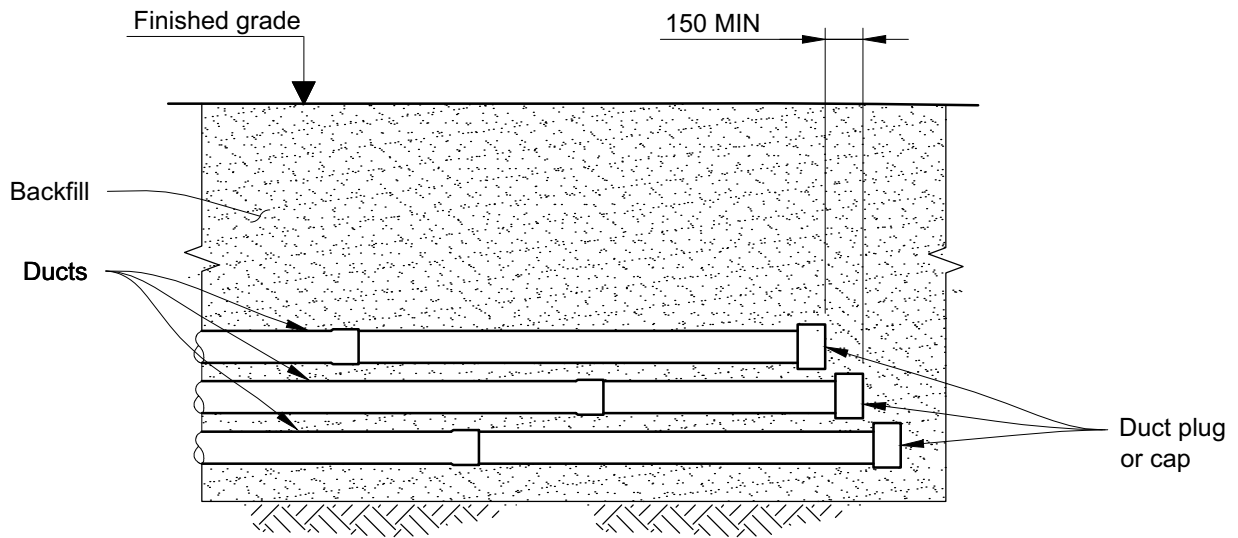
**Two or 2x2 Adjacent Ducts  
Vertical Configuration**

**Three or 2x3 Adjacent Ducts  
Horizontal Configuration**

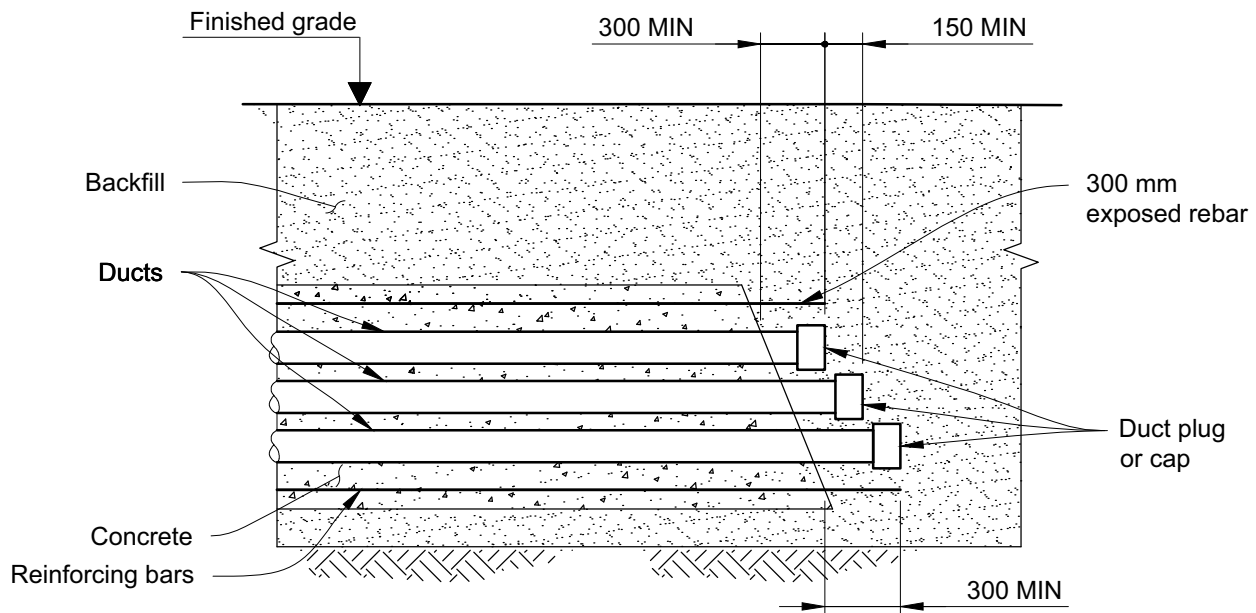
**Section**

**A**

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 |               |     |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------|-----|
| DESIGNED<br><br>J. YANG       | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br>1002449<br><br>L. STEVANOVIC<br>BRITISH COLUMBIA<br>ENGINEER<br>2022-09-01 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY AT PADS |               |     |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: SEP 2022<br>REPLACES: MAR 2016<br>ORIGINALLY<br>ISSUED: NOV 1981                                      |                                                                                                                                                                                     | PAGE 3<br>OF 3                                  | ES54 H1-03.03 | R 3 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 |               |     |



**Direct Buried End**

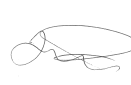


**Concrete Encased End**

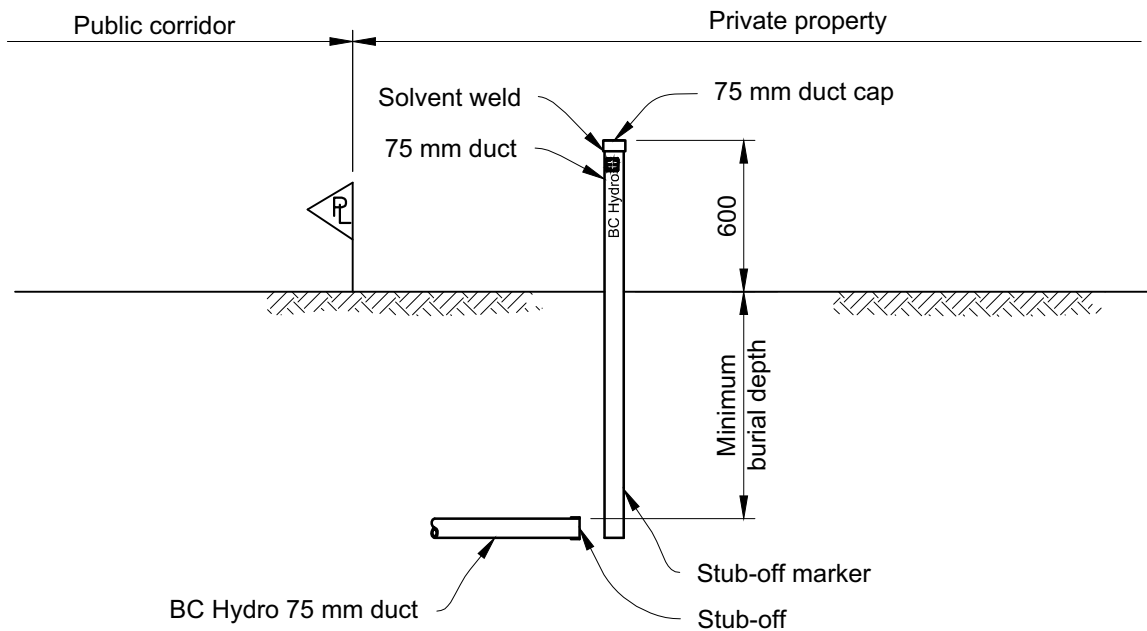
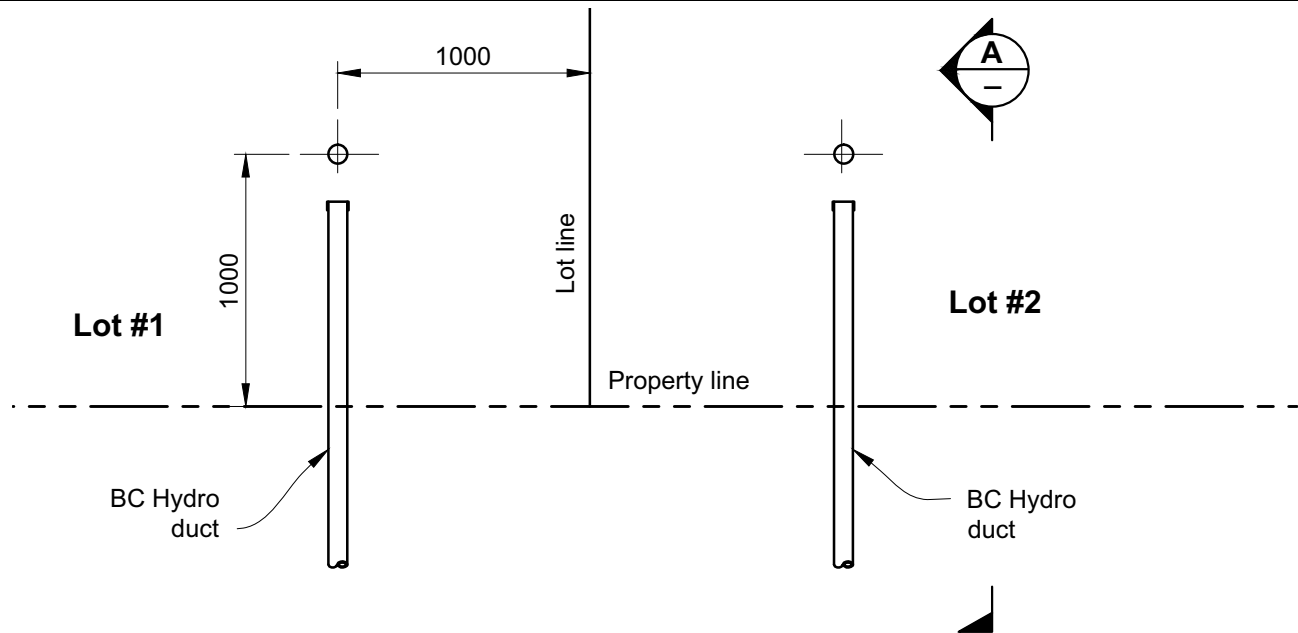
**Notes**

1. Where the ends of ducts in a run will be extended later, they shall be staggered and shall extend a minimum length equal to two (2) times the duct diameter beyond the end of the concrete envelope.
2. The duct ends shall be closed and cemented with caps. Alternatively, when stub-off time is less than six months, plugs can be used instead of caps.

REVISIONS: R.2 - REMOVED TIMBER BOX AROUND STUB OFF DUCTS. MAR '16 MK

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                    |            |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------|
| DESIGNED<br><br>M. KELVIN     | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | GENERAL TRENCHING DETAILS<br>DUCT STUB-OFF DETAILS |            |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2016<br>REPLACES:FEB 2001<br>ORIGINALLY<br>ISSUED:APR 1982                                        |                                                                                                                         | PAGE 1<br>OF 1                                     | ES54 H1-04 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                    | R<br>2     |

REVISIONS: R.2 - CHANGED DUCT STUB OFF DISTANCE TO PROPERTY LINE. MAR '16 MK

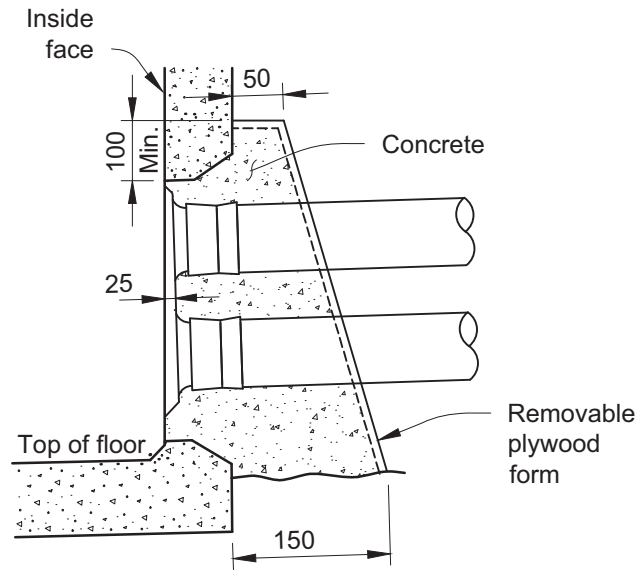


**Section A**

**Notes**

1. The caps installed on stubbed-off service ducts shall not be cemented, except for caps on main runs intended for future extension, which shall be cemented.

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                           |        |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------|
| DESIGNED<br><br>M. KELVIN     | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | GENERAL TRENCHING DETAILS<br>SERVICE DUCT STUB-OFF<br>MARKER INSTALLATION |        |
| DISTRIBUTION<br>STANDARDS<br> | ISSUED:MAR 2016<br>REPLACES:MAR 2002<br>ORIGINALLY<br>ISSUED:OCT 1987                                               | PAGE 1<br>OF 1                                                                                                |                                                                                                                         | ES54 H1-05                                                                | R<br>2 |



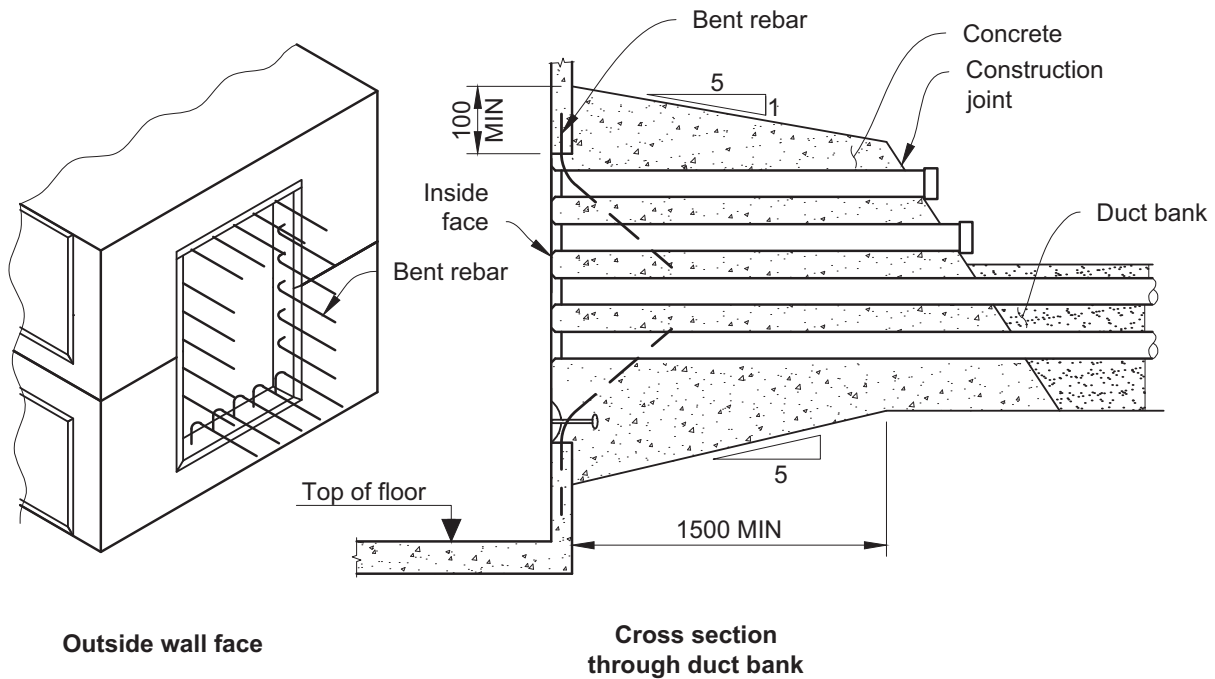
Duct Entry at Window for  
Direct Buried Duct Banks

## Notes

1. Where conduits enter vaults, boxes, or building concrete walls, the bell-end shall be installed watertight and flush with the wall's inside face.
2. Knockouts or windows shall be cored as necessary to provide openings for bell-ends and duct entry through the wall.
3. The ducts shall be installed in the bottom portion of the window, so that unused bell-ends are left at the top portion of the window. The short ducts shall be installed into unused duct bell-ends and stubbed-off for future service expansion.

REVISIONS: R3 - UPDATED NOTE 6 ON PAGE 2 AND NOTE 3 ON PAGE 4, MAR 2021 CC

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                    |                                                 |               |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------|
| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C. E. CROWSON<br>#45713<br>BRITISH COLUMBIA<br>ENGINEER<br>2021-03-03 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY DETAILS |               |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2021<br>REPLACES: NOV 2018<br>ORIGINALLY<br>ISSUED: APR 2003                                      |                                                                                                                                                                                    | PAGE 1<br>OF 5                                  | ES54 H1-06.01 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                    |                                                 | R<br>3        |



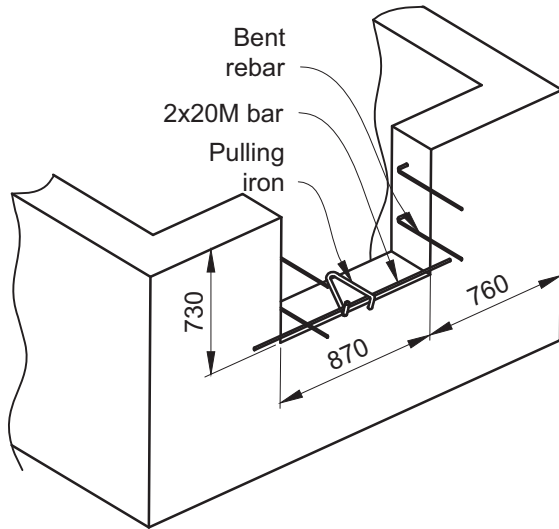
### Entry at Wall with Window

#### Notes

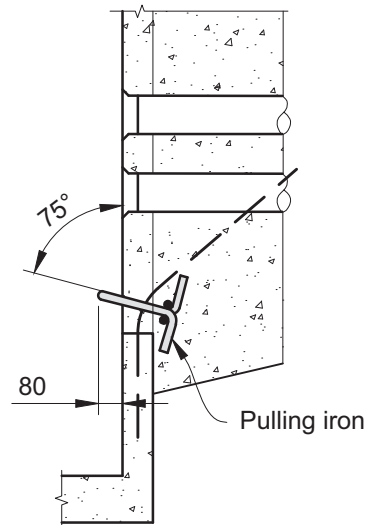
1. Where conduits enter vaults or boxes, the bell-end shall be installed watertight and flush with the wall's inside face.
2. Vaults and boxes are provided with knockouts or windows through walls for duct entry. Knockouts shall be cored as necessary to provide openings for bell-ends and duct entry through the wall.
3. Rebar provided in the wall window shall be bent to protrude into the concrete-encased duct bank and provide anchorage. The bell-ends shall be installed in a 4 x 4 configuration and fixed flush with the wall's inside face.
4. The ducts shall be installed in the bottom portion of the window, so that unused bell-ends are left at the top portion of the window. The short ducts shall be installed into unused duct bell-ends and stubbed-off for future service expansion.
5. Pulling irons shall be Dayton Superior P75 utility anchor type 8UA671 galvanized and shall be installed with setting plug P76D in accordance with the manufacturer's requirements. Alternatively, two hairpin pulling irons (BC Hydro material number 420-0916) may be used.
6. The duct bank shall be connected to the concrete wall with 15M rebar dowels placed between the ducts along the duct bank perimeter, anchored to the full depth into the concrete wall and extended a minimum of 1.5 m into the duct bank.

REVISIONS: R3 - UPDATED NOTE 6 ON PAGE 2 AND NOTE 3 ON PAGE 4, MAR 2021 CC

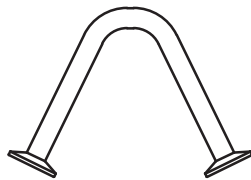
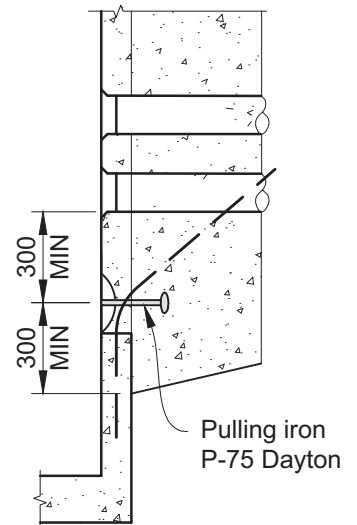
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|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------|
| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C. E. CROWSON<br># 45713<br>BRITISH COLUMBIA<br>ENGINEER<br>2021-03-03 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY DETAILS |               |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2021<br>REPLACES: NOV 2018<br>ORIGINALLY<br>ISSUED: APR 2003                                      |                                                                                                                                                                                     | PAGE 2<br>OF 5                                  | ES54 H1-06.02 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 | R<br>3        |



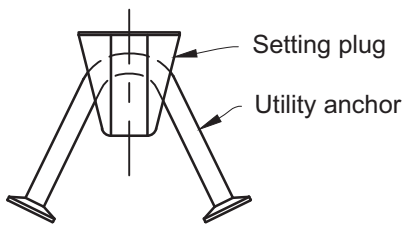
**Pulling Iron and Rebar Detail  
to Vault Duct Opening**



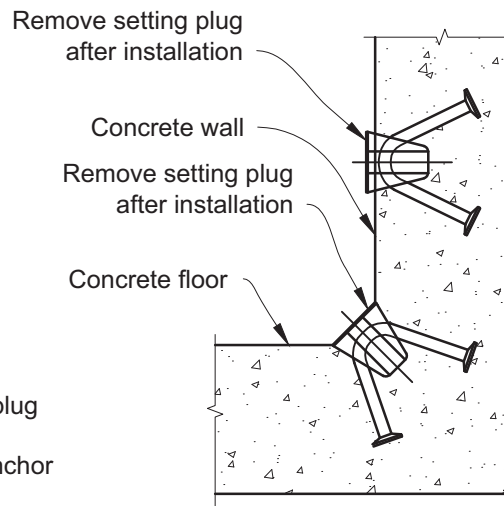
**Duct Bank to Wall Connection  
Pulling Iron Position**



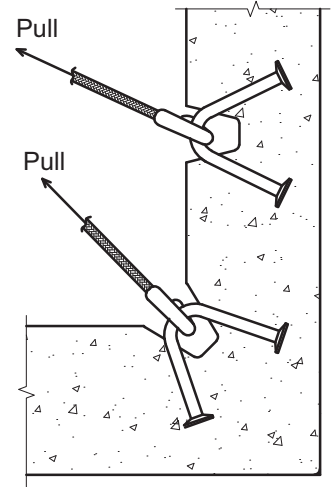
**Pulling Iron  
P-75 Dayton**



**Pulling Iron P-75  
Dayton System**



**Step 1**

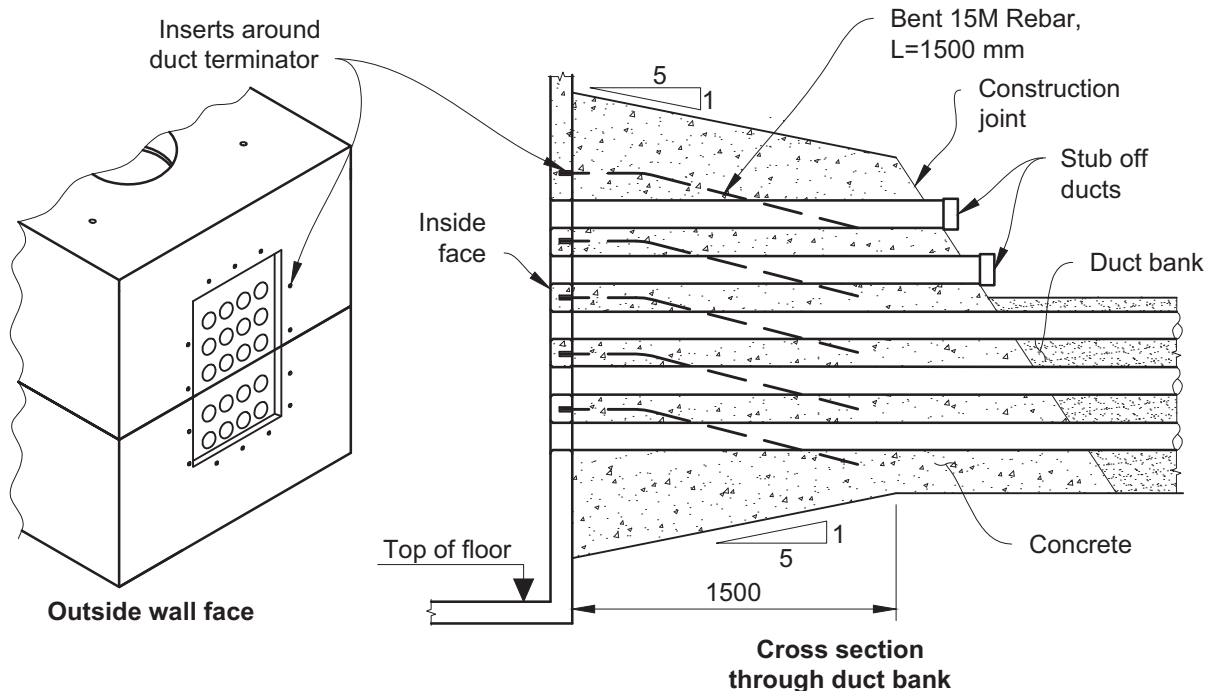


**Step 2**

**Pulling Iron P-75 Dayton  
Installation Details**

REVISIONS: R3 - UPDATED NOTE 6 ON PAGE 2 AND NOTE 3 ON PAGE 4, MAR 2021 CC

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 |               |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------|
| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C. E. CROWSON<br># 45713<br>BRITISH COLUMBIA<br>ENGINEER<br>2021-03-03 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY DETAILS |               |
| DISTRIBUTION<br>STANDARDS<br> | ISSUED: MAR 2021<br>REPLACES: NOV 2018<br>ORIGINALLY<br>ISSUED: APR 2003                                            |                                                                                                               |                                                                                                                                                                                     | PAGE 3<br>OF 5                                  | ES54 H1-06.03 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 | R<br>3        |



### Entry at Wall with Duct Terminators

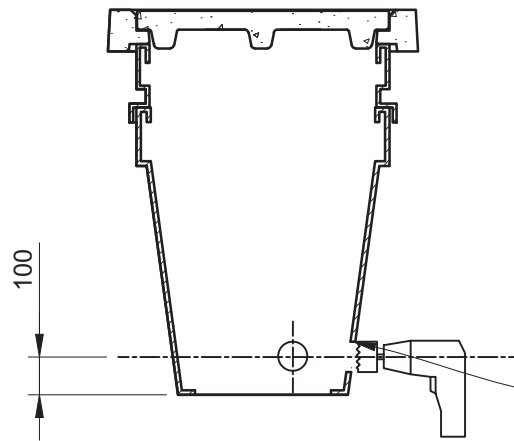
#### Notes

1. The vault is provided with PVC duct terminators or bell-ends cast in the walls in five horizontal by four vertical rows. The feeder duct bank shall be installed in four lower horizontal rows. The top row of ducts is intended for fibre optic, communication, and service cables. If the feeder duct bank has less than 16 ducts according to the design, the ducts shall be installed by starting from the bottom row and then using subsequent rows above, until all ducts are plugged.
2. Short ducts shall be installed into all unused duct terminators or bell-ends, including the top row, and stubbed-off for future service expansion.
3. The concrete duct bank to wall connection is designed with rebar dowels embedded in the duct bank and wall. The vaults are supplied with coupler inserts embedded in the concrete wall above and on the sides of the duct bank window. The contractor shall supply 1500 mm-long rebar dowels, threaded to ½" -13 N.C., 2.5" long threads, and screw them into the coupler inserts in the wall. Upon installation, the dowels shall be bent down to provide between 60 and 75 degrees to the horizontal plane.

REVISIONS: R3 - UPDATED NOTE 6 ON PAGE 2 AND NOTE 3 ON PAGE 4, MAR 2021 CC

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                    |                                                 |               |        |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------|--------|
| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C. E. CROWSON<br>#45713<br>BRITISH COLUMBIA<br>ENGINEER<br>2021-03-03 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY DETAILS |               |        |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2021<br>REPLACES: NOV 2018<br>ORIGINALLY<br>ISSUED: APR 2003                                      |                                                                                                                                                                                    | PAGE 4<br>OF 5                                  | ES54 H1-06.04 | R<br>3 |

REVISIONS: R3 - UPDATED NOTE 6 ON PAGE 2 AND NOTE 3 ON PAGE 4, MAR 2021 CC



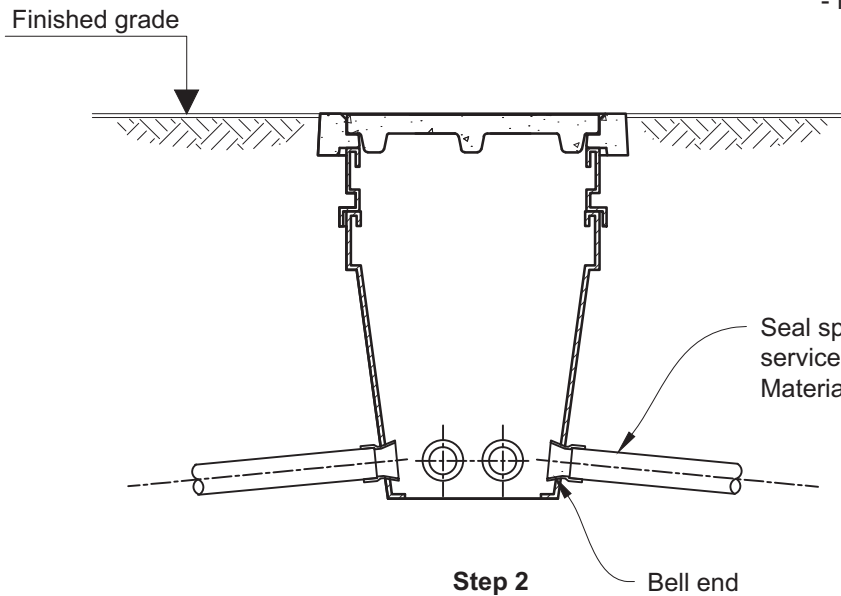
Step 1

Cut holes as required into sidewalls of service box with a hole saw at the appropriate location.

Hole diameters:

- for 3" ducts = 92 mm

- for 4" ducts = 120 mm

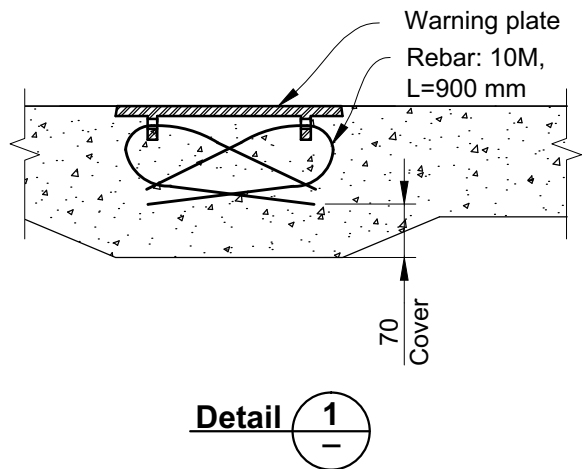
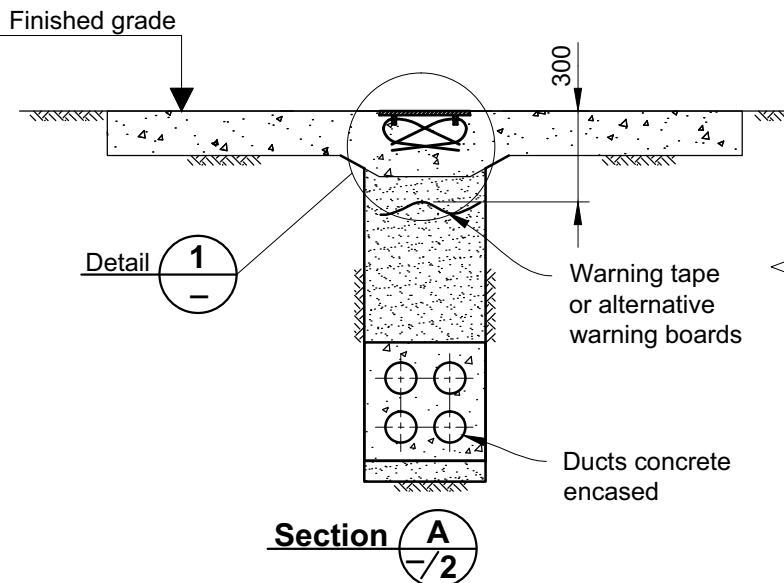
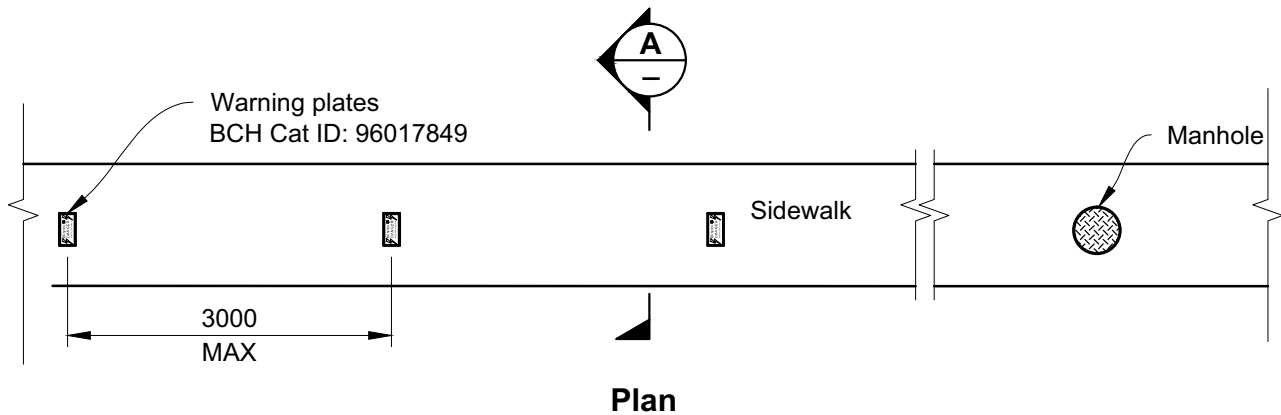
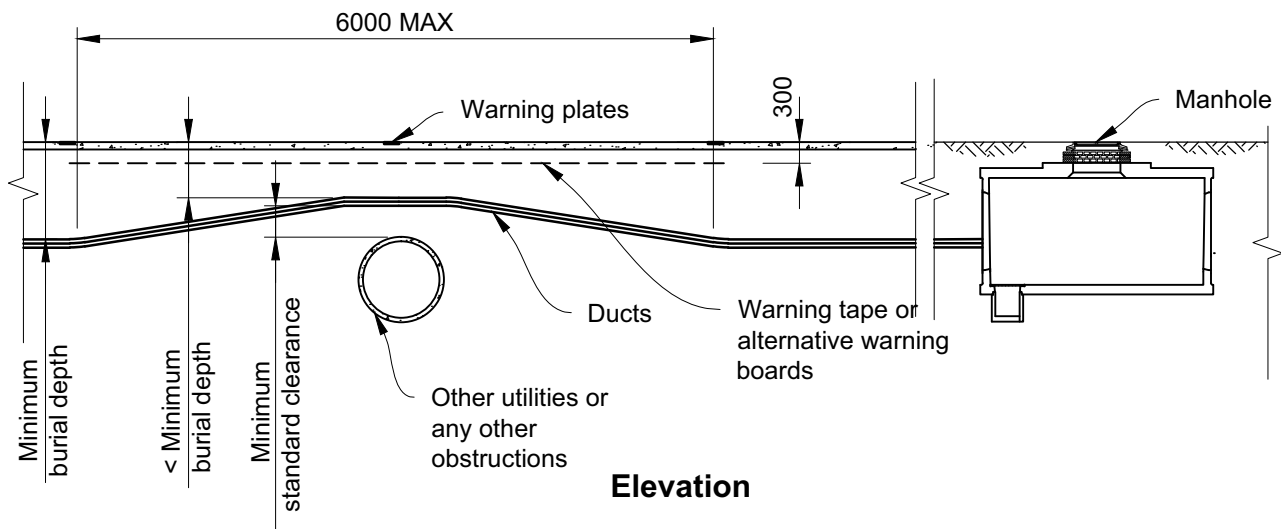


Step 2

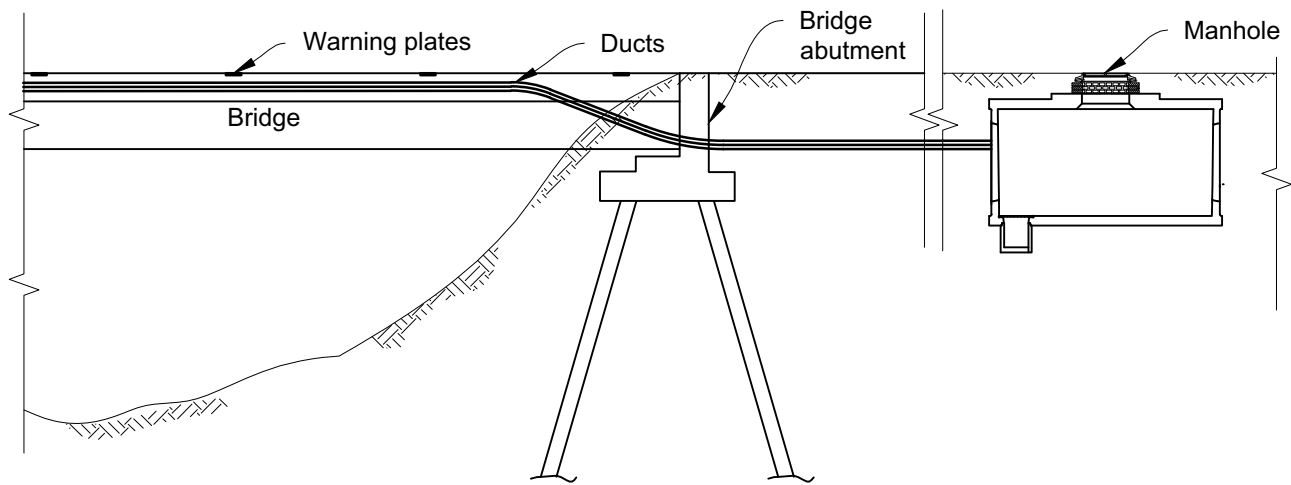
### Duct Entry for Plastic Service Boxes

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 |               |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------|
| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C. E. CROWSON<br># 45713<br>BRITISH COLUMBIA<br>ENGINEER<br>2021-03-03 | GENERAL TRENCHING DETAILS<br>DUCT ENTRY DETAILS |               |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2021<br>REPLACES: NOV 2018<br>ORIGINALLY<br>ISSUED: APR 2003                                      |                                                                                                                                                                                     | PAGE 5<br>OF 5                                  | ES54 H1-06.05 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                     |                                                 | R<br>3        |

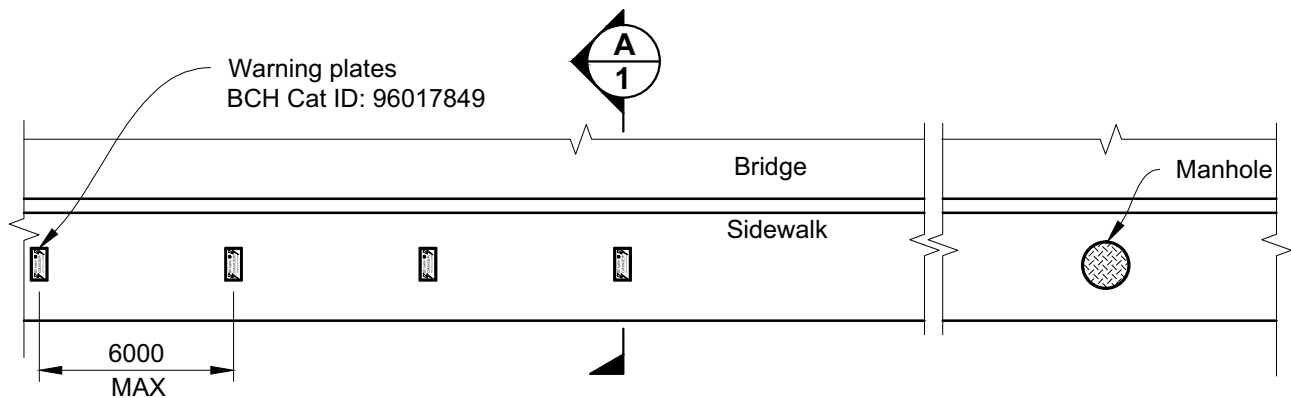
REVISIONS: R.1 - WARNING BOARD CAT ID 91002902 HAS BEEN CORRECTED TO READ 97000676. AUG '16 MK



|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                      |                   |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------|
| DESIGNED<br><br>M. KELVIN     | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | GENERAL TRENCHING DETAILS<br>INSTALLATION AT REDUCED<br>BURIAL DEPTH |                   |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: AUG 2016<br>REPLACES: N/A<br>ORIGINALLY<br>ISSUED: MAR 2016                                           |                                                                                                                         | PAGE 1<br>OF 4                                                       | ES54 H1-07.01     |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                      | <sup>R</sup><br>1 |



**Elevation**



**Plan**

**Installation in Bridge Deck**

REVISIONS: R.1 - WARNING BOARD CAT ID 91002902 HAS BEEN CORRECTED TO READ 97000676. AUG '16 MK

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                      |               |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------|
| DESIGNED<br><br>M. KELVIN     | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | GENERAL TRENCHING DETAILS<br>INSTALLATION AT REDUCED<br>BURIAL DEPTH |               |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: AUG 2016<br>REPLACES: N/A<br>ORIGINALLY<br>ISSUED: MAR 2016                                           |                                                                                                                         | PAGE 2<br>OF 4                                                       | ES54 H1-07.02 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                      | R<br>1        |

## Notes

1. The minimum burial depth may be reduced where absolutely necessary to overcome unavoidable site obstructions.
2. The design shall be approved by the BC Hydro Distribution Engineer.
3. The duct bank shall be concrete-encased along the entire length and reduced burial depth.
4. The maximum continuous length of the reduced burial depth shall not exceed 6 metres.
5. Warning tape shall be placed a minimum of 300 mm below the grade along the reduced burial depth.
6. Cast iron warning plates (BC Hydro Catalogue ID 96017849) shall be installed within a finished grade at 3000 mm distance along the duct bank alignment at the reduced burial depth.
7. When installation of cast iron warning plates is impracticable, warning tape shall be replaced with warning boards (Cat ID 97000676).

## Warning Plates

Warning plates are designed primarily to be installed within a concrete sidewalk. For installation within a roadway traffic surface, their replacement should be scheduled to follow the road maintenance and resurfacing program.

**Installation in Concrete:** The plates shall be cast in the concrete during sidewalk construction as follows:

1. Install a rebar loop through each hole at the bottom side of the plate;
2. Tie the loops to other rebar in the concrete and secure the plate in the proper position;
3. Ensure that the top surface of the plate is flush with, or below, the roadway surface;
4. Pour the concrete, and ensure minimum concrete cover below the rebar, and
5. Ensure that the concrete does not cover the plate's top surface.

**Installation in Asphalt:** The asphalt surface of the roadway is cut for the plates during pavement construction, and the plates are epoxy-cemented in the cut-outs as follows:

1. Construct the roadway surface with a minimum 75 mm asphalt pavement thickness at the warning plate's location.
2. Mark the locations of the warning plates at the roadway surface along the centre line of the duct bank. The locations shall be free of cracks, joints or deficiencies in the pavement, and away from pavement marking and line stripping.
3. Cut and grind the asphalt pavement surface at the marked locations, to a depth necessary to fully recess the warning plates in the roadway surface. Cut-outs shall be within the pavement depth. Any overcut shall be abandoned and a new location selected.
4. Test the plate fitting into the cut-outs, and extend the cut depth if necessary to allow a 3 mm clearance between the pavement cut and plate for the epoxy to bond properly.

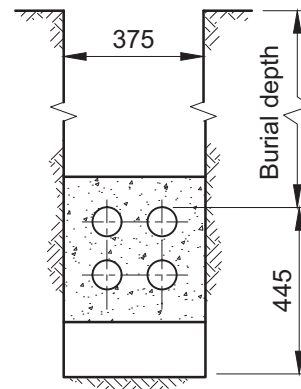
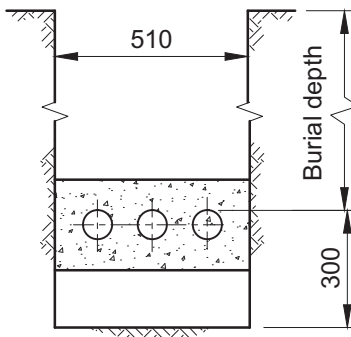
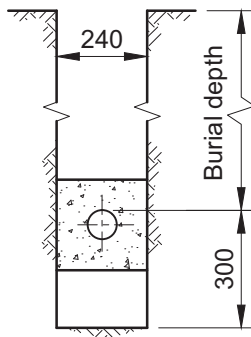
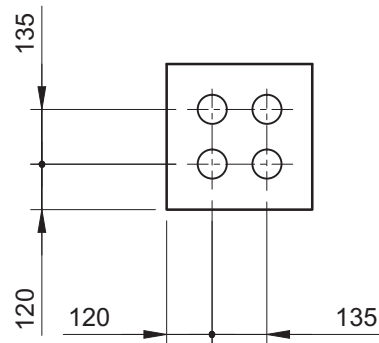
REVISIONS: R.1 - WARNING BOARD CAT ID 91002902 HAS BEEN CORRECTED TO READ 97000676. AUG '16 MK

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                      |               |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------|
| DESIGNED<br><br>M. KELVIN     | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | GENERAL TRENCHING DETAILS<br>INSTALLATION AT REDUCED<br>BURIAL DEPTH |               |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     |                                                                                                               | ISSUED: AUG 2016<br>REPLACES: N/A<br>ORIGINALLY<br>ISSUED: MAR 2016                                                     | PAGE 3<br>OF 4                                                       | ES54 H1-07.03 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                      | R<br>1        |

5. Apply epoxy grout into the cut-outs, in accordance with the manufacturer's recommendations. The cut-outs shall be completely dry and free of oil and foreign materials prior to applying epoxy. Epoxy shall comply with AASHTO M237 Type 4.
6. Place warning plates into the epoxy field cut-outs. The top surface of the plate shall be flush with, or below, the roadway surface. Additional epoxy shall be added, if needed to overflow around the plate and seal the cut area. The plate surface shall be cleaned of epoxy and protected from traffic during the epoxy curing time.

REVISIONS: R.1 - WARNING BOARD CAT ID 91002902 HAS BEEN CORRECTED TO READ 97000676. AUG '16 MK

|                                                                                                                      |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                      |                      |
|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------|
| DESIGNED<br><br>M. KELVIN         | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | GENERAL TRENCHING DETAILS<br>INSTALLATION AT REDUCED<br>BURIAL DEPTH |                      |
| <b>DISTRIBUTION STANDARDS</b><br> |                                                                                                                     |                                                                                                               | ISSUED: AUG 2016<br>REPLACES: N/A<br>ORIGINALLY<br>ISSUED: MAR 2016                                                     | PAGE 4<br>OF 4                                                       | ES54 H1-07.04<br>R 1 |



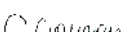
### 3" Ducts

#### Notes

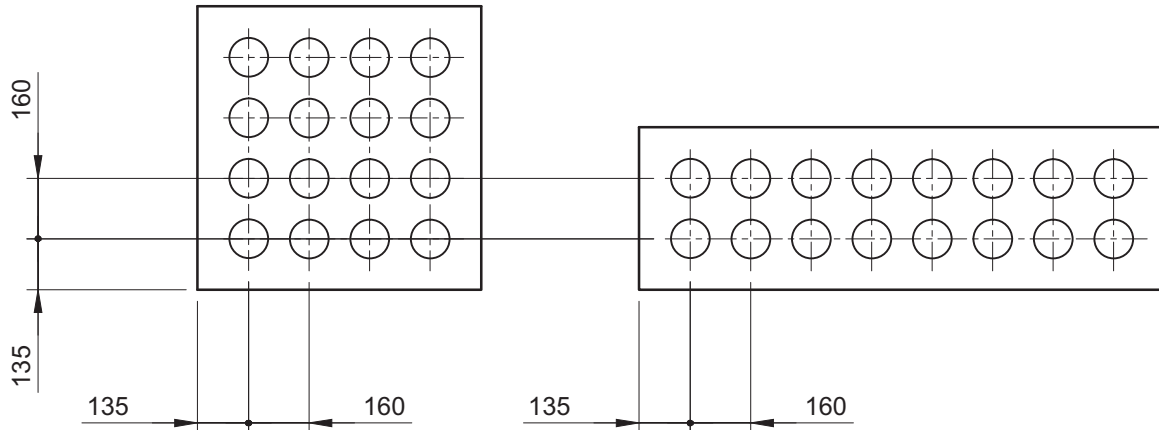
1. All cross-sections shown are for 3 inch URD or UD PVC duct.
2. Duct separation for 3 inch duct banks (direct buried and concrete encased) is 50 mm but shall not be less than 45 mm.

#### Reference Standards

ES54 H1-01 General Trenching Details  
ES54 H3-01 Duct Window in Concrete Vaults and Boxes

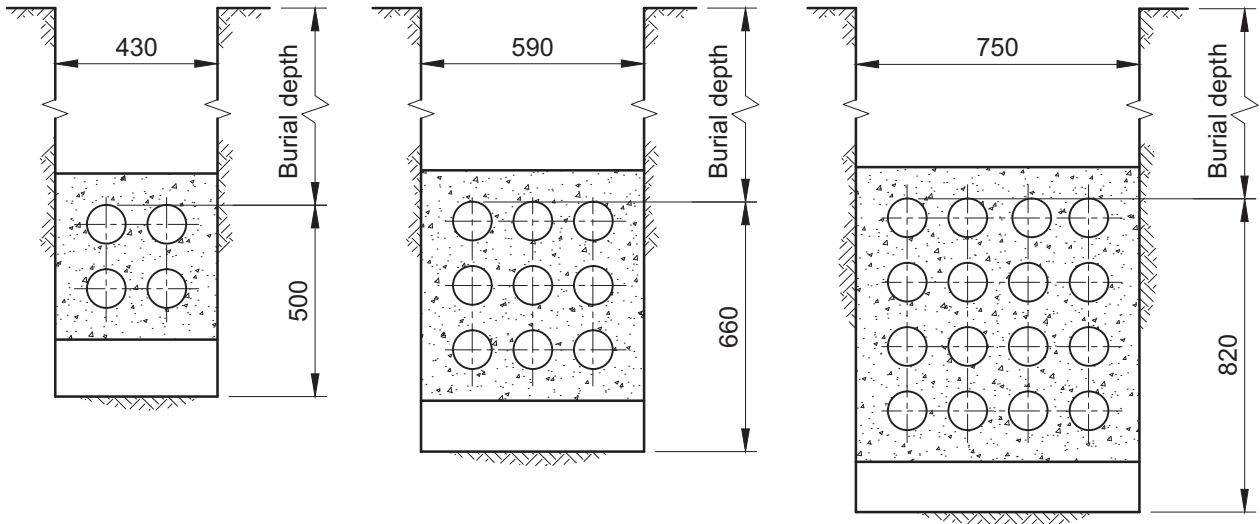
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                                          |                                    |            |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------|
| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C. E. CROWSON<br>#45713<br>PROFESSIONAL<br>OF<br>BRITISH COLUMBIA<br>ENGINEER<br>2018-10-30 | CONCRETE ENCASEMENT<br>3 INCH DUCT |            |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: OCT 2018<br>REPLACES: FEB 2017<br>ORIGINALLY<br>ISSUED: JUN 1980                                      |                                                                                                                                                                                                          | PAGE 1<br>OF 1                     | ES54 H2-01 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                                          |                                    | R<br>5     |

REVISIONS: R.3 - REVISED DETAILS AND NOTES. MAR '16 MK | R.4 - DIMENSIONS CORRECTED. FEB '17 MK | R.5 - MINIMUM DUCT SEPARATION SPECIFIED. OCT '18 CC



**Typical 4" Ducts Configuration**

**2 x 8 - 4" Ducts Transition**  
(see ES54 H1-07.03)



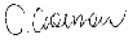
**4" Ducts**

### Notes

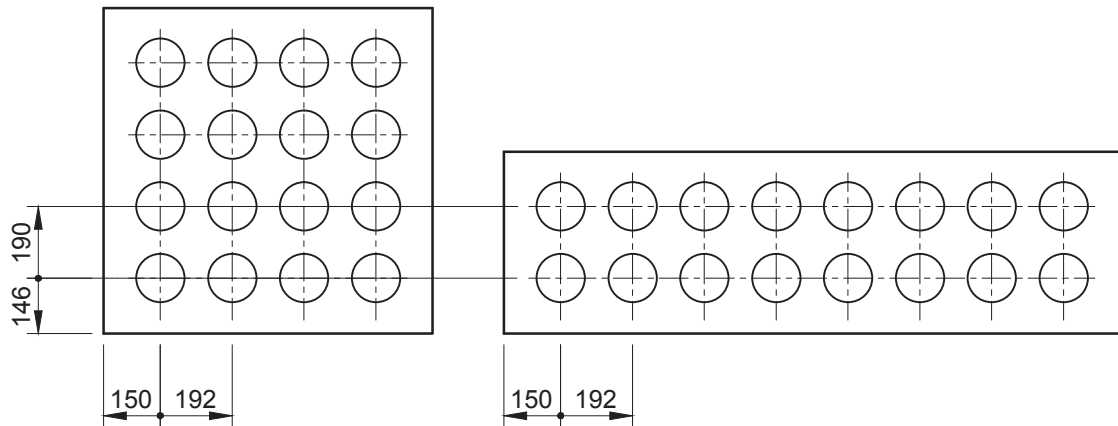
1. All cross-sections shown are for 4 inch UD or feeder PVC duct or rigid FRE conduit.
2. Minimum duct separation for 4 inch duct banks (direct buried and concrete encased) shall be 50 mm.

### Reference Standards

- ES54 H1-01                      General Trenching Details  
ES54 H3-01                      Duct Window in Concrete Vaults and Boxes

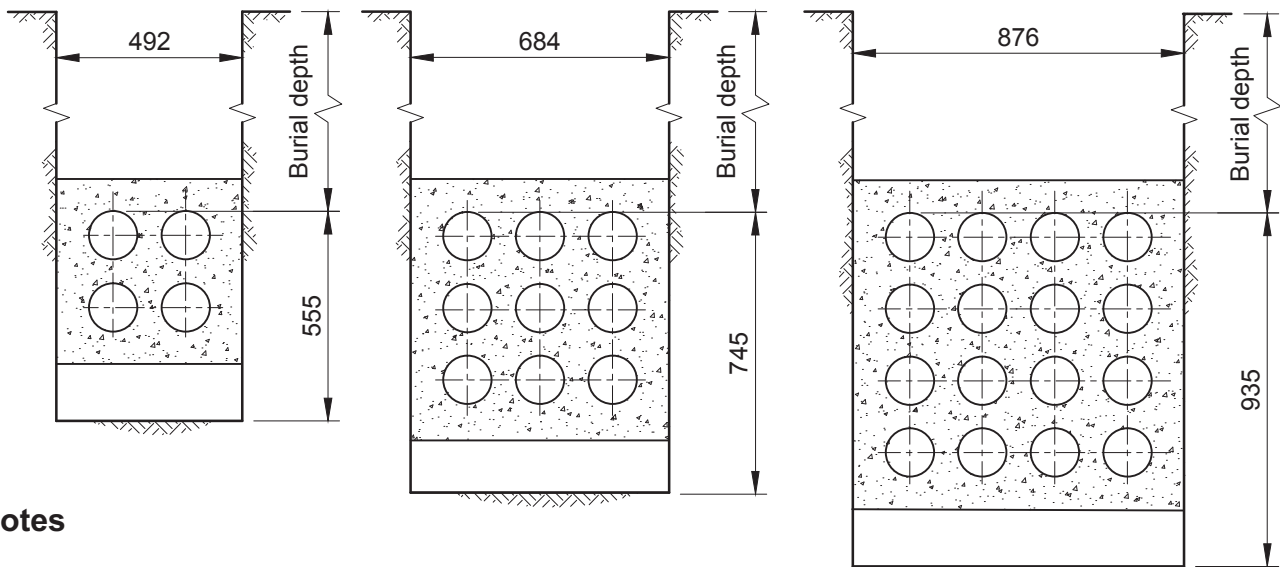
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                     |                                    |        |
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| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C.E. CROWSON<br>#45713<br>BRITISH COLUMBIA<br>ENGINEER | CONCRETE ENCASEMENT<br>4 INCH DUCT |        |
| DISTRIBUTION<br>STANDARDS<br> | ISSUED: OCT 2018<br>REPLACES: FEB 2017<br>ORIGINALLY<br>ISSUED: JUN 1980                                            | PAGE 1<br>OF 1                                                                                                |                                                                                                                                                                     | ES54 H2-02                         | R<br>5 |

REVISIONS: R.4 - DIMENSIONS CORRECTED, FEB '17 MK | R.5 - EXCAVATION DEPTH REVISED, MINIMUM DUCT SEPARATION SPECIFIED, OCT '18 CC



**Typical 5" Ducts Configuration**

**2 x 8 - 5" Ducts Transition**  
(see ES54 H1-07.03)



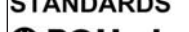
**Notes**

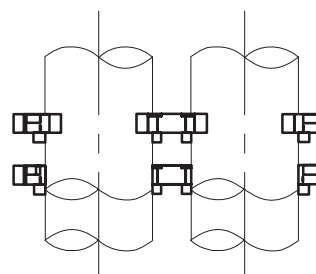
1. All cross-sections shown are for 5 inch UD or feeder PVC duct or rigid FRE conduit.
2. Concrete-encased 5 inch duct banks shall be assembled using prefabricated duct spacers, IPEX 5W20-2, BC Hydro Catalogue ID 96022508.
3. Minimum duct separation for 5 inch duct banks (direct buried, concrete encased and bridge crossing) shall be 50 mm.

**5" Ducts**

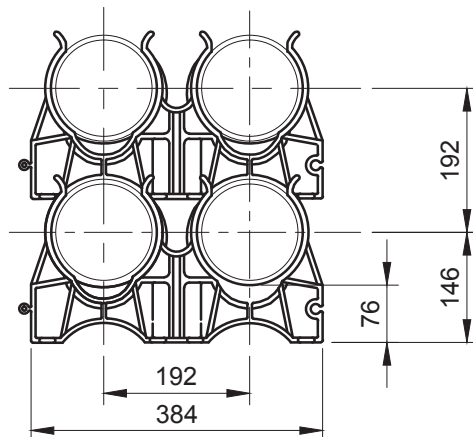
**Reference Standards**

- ES54 H1-01 General Trenching Details  
ES54 H3-01 Duct Window in Concrete Vaults and Boxes

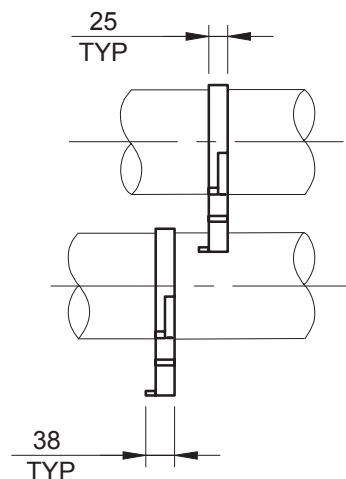
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                    |        |
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| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2018-10-30 | CONCRETE ENCASEMENT<br>5 INCH DUCT |        |
| DISTRIBUTION<br>STANDARDS<br> | ISSUED: OCT 2018<br>REPLACES:FEB 2017<br>ORIGINALLY<br>ISSUED:JUN 1980                                              | PAGE 1<br>OF 2                                                                                                |                                                                                                                         | ES54 H2-03 .01                     | R<br>5 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                    |        |



**TOP VIEW**



**FRONT VIEW**



**SIDE VIEW**

**5" Duct Spacer Catalogue ID 96022508**

**Notes**

1. The installation shall comply with the spacer manufacturer's recommendations.
2. Spacers shall not be used for direct-buried ducts.
3. Ducts shall be secured to avoid flotation during the pouring of concrete and to provide uniform concrete cover around the conduits. Any reinforcement required shall be tied to the plastic spacers.
4. Interlock spacers horizontally as necessary to achieve designed duct bank configuration.
5. Place the interlocked spacers on the trench bottom at 3.0 m maximum distance and lay the first tier of ducts on the spacers.
6. Place the next layer of spacers on top of the ducts and lay tiers of ducts continuing in the same manner until the designed duct configuration is completed. Ensure that the spacers are staggered a minimum of 150 mm on each tier.

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                   |                                    |                |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------|
| DESIGNED<br><br>C. CROWSON    | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>C.E. CROWSON<br>#45713<br>BRITISH COLUMBIA<br>ENGINEER<br>2018-10-30 | CONCRETE ENCASEMENT<br>5 INCH DUCT |                |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: OCT 2018<br>REPLACES: FEB 2017<br>ORIGINALLY<br>ISSUED: JUN 1980                                      |                                                                                                                                                                                   | PAGE 2<br>OF 2                     | ES54 H2-03 .02 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                                                                                   |                                    | R<br>5         |

## Application

This standard covers the reinforcement of concrete encased ducts. Concrete encasement prevents incidental breaking of ducts during excavation and provides a safer work environment near power lines. A concrete duct bank is considered a non-structural member when it sits on firm, well compacted, or non-disturbed ground. A concrete duct bank is considered a structural member in non-standard circumstances such as exposure to differential settlements or lateral movements and shall be designed and reinforced accordingly.

## Revision Notes

Removed diagram *Concrete Encasement Reinforcing Details 4x4 Duct Configuration* and revised notes regarding the requirement of reinforced concrete duct banks. Updated *Application* and *Revision Notes* sections. Changed standard title from *Concrete Encasement Minimum Reinforcing Details* to *Reinforcement of Concrete Encased Ducts*. April 2023, Ljubomir Stevanovic.

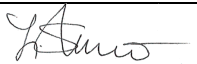
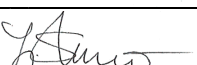
## References

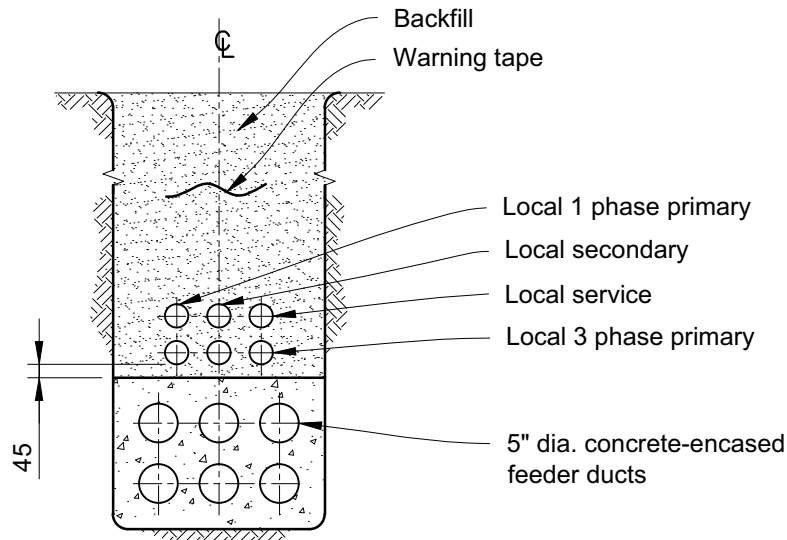
### BC Hydro Distribution Standards

|            |                                     |
|------------|-------------------------------------|
| ES54 H2-01 | Concrete Encasement 3 Inch Duct     |
| ES54 H2-02 | Concrete Encasement 4 Inch Duct     |
| ES54 H2-03 | Concrete Encasement 5 Inch Duct     |
| ES54 U3-02 | Soil Construction in Frosted Ground |

## Notes

1. A professional engineer shall design a reinforced concrete duct bank in the following locations:
  - a. When installed in soil classes 6 to 8;
  - b. At crossings over a water main, concrete culvert, or other rigid structure, except when soil around the rigid structure is undisturbed;
  - c. Where a duct bank is installed above the frost depth and the material below the duct bank base does not comply with ES54 U3-02; and
  - d. Other locations where differential settlements are expected below the duct bank.

|                                    |                                                                                     |                                                                                                                                                    |                                                                                                                   |               |
|------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------|
| Designed:<br>L. Stevanovic, P. Eng |  | Professional of Record<br>EGBC Permit 1002449<br><br>2023-04-27 | Reinforcement of<br>Concrete Encased Ducts                                                                        |               |
| Checked:<br>L. Stevanovic, P. Eng  |  |                                                                                                                                                    |                                                                                                                   |               |
| Reviewed:<br>J. Yang, P. Eng       |  |                                                                                                                                                    | DISTRIBUTION<br>STANDARDS<br> | ES54 H2-04 R5 |
| Approved:<br>H. Giesbrecht, P. Eng |  | Issued: April 2023<br>Effective: May 2023                                                                                                          |                                                                                                                   |               |



**Typical Trench Cross-Section**

### Notes

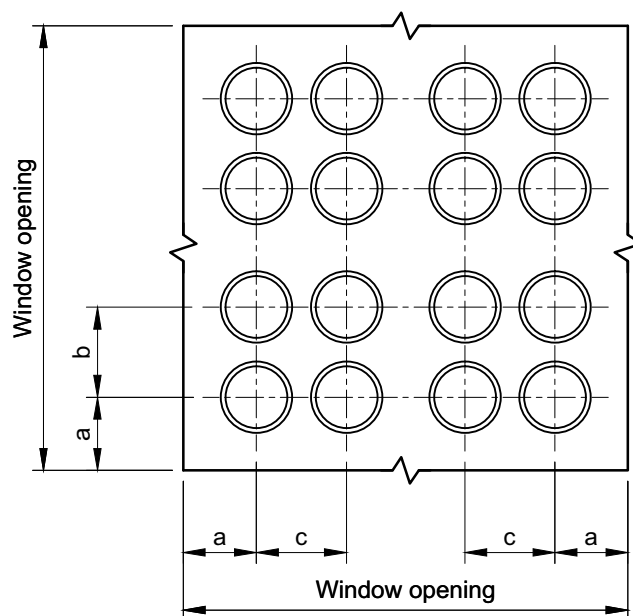
1. Typical cross-section is shown. An addition or lateral may be added to any duct bank configuration.
2. 6 mil poly sheeting shall be placed between duct banks when a concrete-encased service duct bank is constructed simultaneously with a main duct bank. The service duct bank shall be cast after the main duct bank concrete encasement is set.

### Reference Standards

|            |                                  |
|------------|----------------------------------|
| ES54 H2-03 | 125 mm Duct                      |
| ES54 H2-02 | 100 mm Duct                      |
| ES54 H2-01 | 75 mm Duct                       |
| ES54 H1-01 | URD, UD and Feeder Installations |

REVISIONS: R.3 - REVISED DETAILS AND NOTES. MAR '16 MK

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                        |            |        |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------|--------|
| DESIGNED<br><br>M. KELVIN     | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | CONCRETE ENCASEMENT<br>SERVICE DUCTS AND/OR ADDITIONS<br>TO DUCT BANKS |            |        |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2016<br>REPLACES: JUL 2002<br>ORIGINALLY<br>ISSUED: JUN 1980                                      |                                                                                                                         | PAGE 1<br>OF 1                                                         | ES54 H2-05 | R<br>3 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                                                                        |            |        |



| Dimension | Duct Size |        |        |
|-----------|-----------|--------|--------|
|           | 75 mm     | 100 mm | 125 mm |
| a (min)   | 110       | 120    | 140    |
| b         | 205       | 230    | 255    |
| c         | 145       | 170    | 195    |

## Notes

1. The overall dimensions of the duct window shall be governed by the duct bank size.
2. The vertical separation between ducts shall be gradually reduced to the values shown in the ES54 H2-01/02/03 standards for 75 mm, 100 mm and 125 mm duct, respectively, over the first 6 m from the vault, chamber or manhole.
3. Tolerances: dimensions shown are typical only. A minimum concrete cover of 70 mm and duct separation of 45 mm, both vertically and horizontally, must be maintained.

## Reference Standards

|            |             |
|------------|-------------|
| ES54 H2-03 | 125 mm Duct |
| ES54 H2-02 | 100 mm Duct |
| ES54 H2-01 | 75 mm Duct  |

|                                                    |                                  |                            |                                                                                        |                                                                                    |  |                                          |
|----------------------------------------------------|----------------------------------|----------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--|------------------------------------------|
| DESIGNED<br><br>M. KELVIN                          | RECOMMENDED<br><br>L. STEVANOVIĆ | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15                                                   | <div>DUCT WINDOW<br/>IN CONCRETE VAULTS AND BOXES</div> <div>PAGE 1<br/>OF 1</div> |  | <div>ES54 H3-01</div> <div>R<br/>4</div> |
| <div>DISTRIBUTION<br/>STANDARDS<br/>BC Hydro</div> |                                  |                            | <div>ISSUED: FEB 2017<br/>REPLACES: MAR 2016<br/>ORIGINALLY<br/>ISSUED: JUN 1980</div> |                                                                                    |  |                                          |

Application

ES54 section H applies to BC Hydro installations on public property. See ES54 section S *Services* for installations on private property.

Revision Notes

Updated *References*. Reduced horizontal separation to water, sanitary, and sewer lines from 900 mm to 300 mm in Table 1 and removed table note that stated concrete encasement shall extend a minimum of 1500 mm on either side of crossing. Replaced railway crossing requirements in note 1.2 with reference to CSA C22.3 No. 7. Removed two railway crossing figures. Substantive changes are marked by green vertical revision lines in the left margin. This revision released concurrently with Standards and Equipment Advisory 2025-044 *Revised ES54 Section H Duct Standards*.

References

BC Hydro Distribution Standards

- ES54 H1-01 General Trenching Details URD, UD, and Feeder Installations
- ES55 B2-02 Clearances for Buried Utilities

External Documents

- CSA C22.3 No. 7 Underground systems

Notes

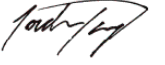
1. Minimum Separation

A minimum crossing separation is required from other utilities to provide clearance for repairs. Other utilities and subsurface structures shall have a minimum 300 mm of separation from BC Hydro ducts unless stated differently in Table 1.

Table 1 – Minimum separations to BC Hydro ducts

| Type of Pipe or Duct                                                           | Direct buried (mm) |                     | Concrete encased (mm) |                     |
|--------------------------------------------------------------------------------|--------------------|---------------------|-----------------------|---------------------|
|                                                                                | A (Fig. 3)         | B (Fig. 3)          | A (Fig. 3)            | B (Fig. 3)          |
| Telephone, cable TV, street lights                                             | 300                | 150                 | 75                    | 150                 |
| Gas mains, water, sanitary, sewer lines                                        | 300                | 300                 | 300                   | 300                 |
| Oil pipelines, jet fuel lines                                                  | 900                | 300                 | 300                   | 300                 |
| Steam pipe (maximum inner diameter 225 mm)                                     | 1500               | 1500 <sup>(1)</sup> | 1500                  | 1500 <sup>(1)</sup> |
| Table note 1. Separation for steam pipe crossing above the duct bank is 300 mm |                    |                     |                       |                     |

Horizontal clearances shall be maintained regardless of vertical clearances. Additional separation may be required when the cables are in the vicinity of other power cables or metal pipes, to maintain the specified heat ratings from these nearby services.

|                                   |                                                                                     |                                                                                     |                                       |               |
|-----------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------|---------------|
| Designed:<br>E. Eliasov, P.Eng    |  |  | Duct Separation<br>to Other Utilities |               |
| Checked:<br>J. Yang, P.Eng        |  |                                                                                     |                                       |               |
| Reviewed:<br>L. Stevanovic, P.Eng |  |                                                                                     |                                       |               |
| Approved:<br>H. Giesbrecht, P.Eng |  | Issued: 2025-08-29<br>Effective: 2025-08-29                                         | DISTRIBUTION<br>STANDARDS<br>BC Hydro | ES43 H4-01 R6 |

Horizontal clearances of concrete-encased duct banks to vaults and boxes shall be 300 mm minimum.

Vaults and boxes shall have the same minimum clearances as concrete-encased BC Hydro ducts.

### 1.1 Steam Pipes

The clearances shown are for steam pipes less than 225 mm nominal inner diameter. Consult a BC Hydro designer for larger diameter steam pipes.

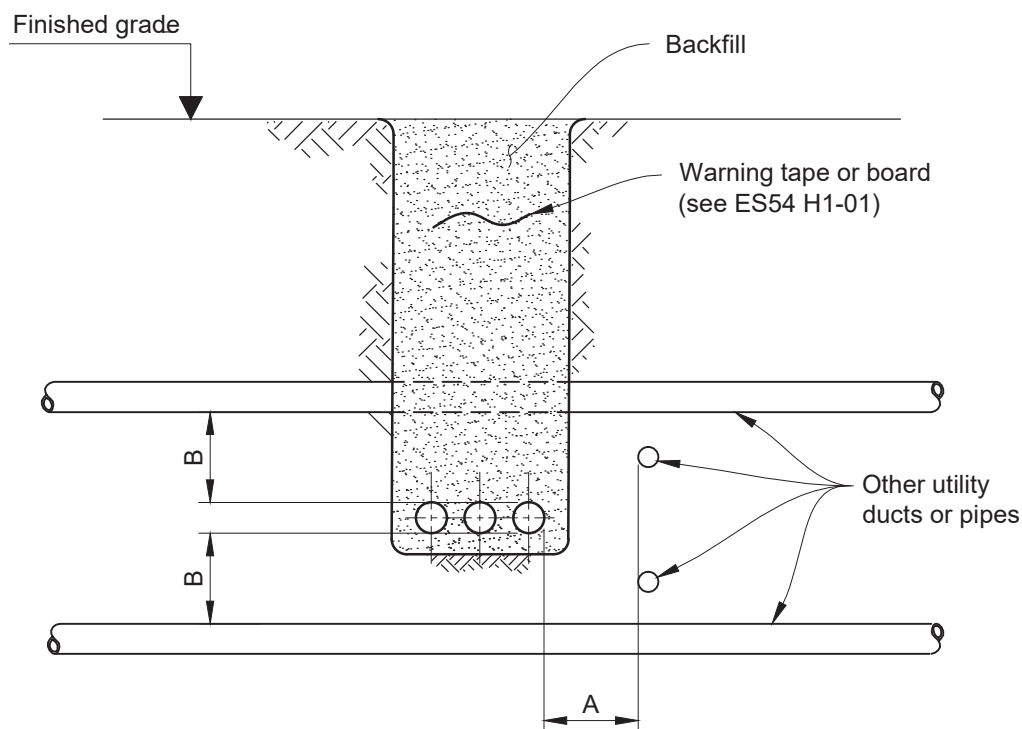
Steam pipes shall be insulated with a minimum of 75 mm thick foam glass pipe insulation, extending a minimum 1200 mm on each side of the crossing. If a steam pipe crosses below the BC Hydro duct bank, the backfill material between the steam pipe and BC Hydro duct bank shall have thermal resistivity to limit the temperature to below 20°C at the duct bank base.

### 1.2 Railway Crossings

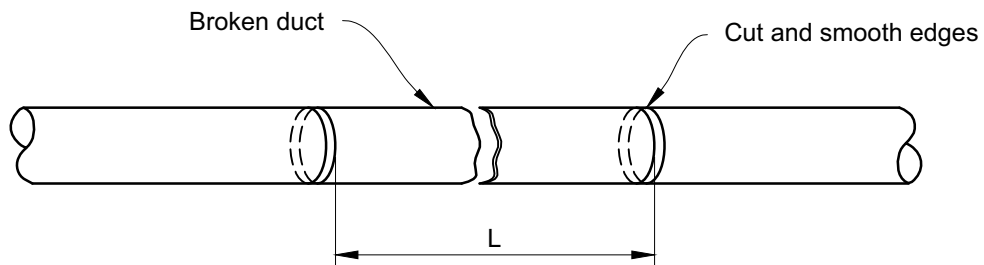
See CSA C22.3 No. 7.

### 1.3 Vertical Stacking of Utilities

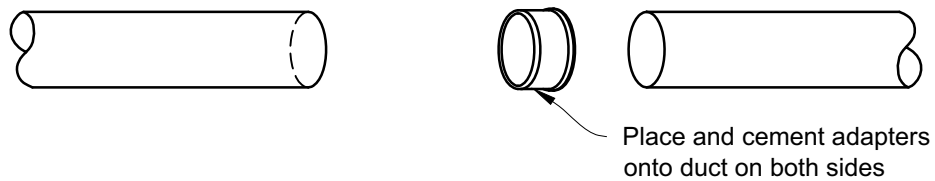
A utility duct or duct bank paralleling another underground utility, system, or structure shall not be installed in the same vertical plane. Doing so would preclude maintenance access. See CSA C22.3 No. 7, paragraph 6.2.1.1.



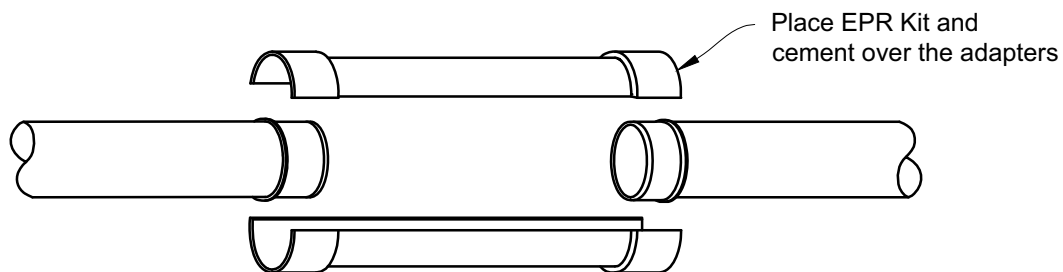
**Figure 1** – Typical trench cross section of direct-buried duct



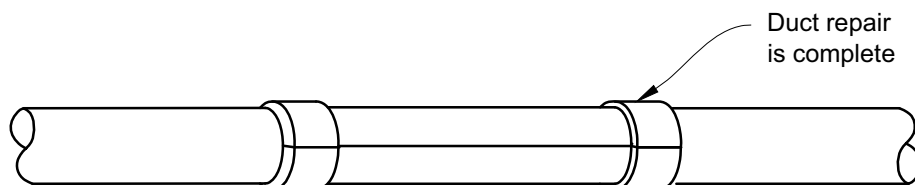
**Step 1**



**Step 2**



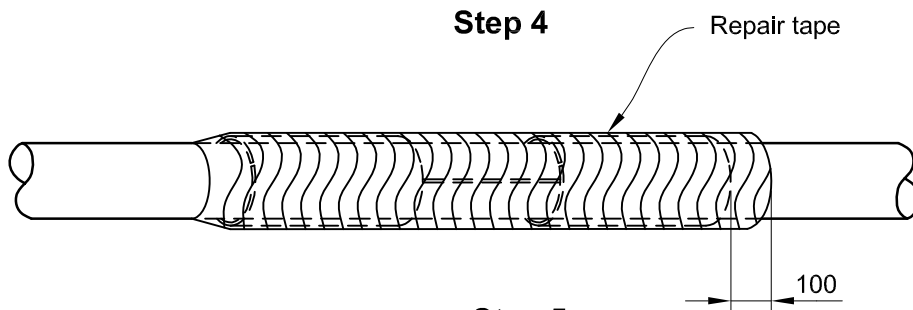
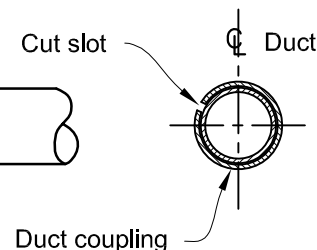
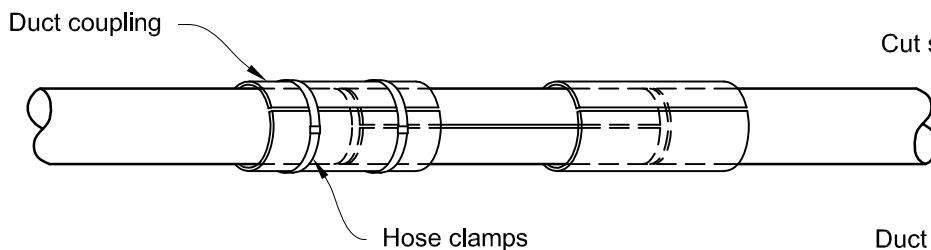
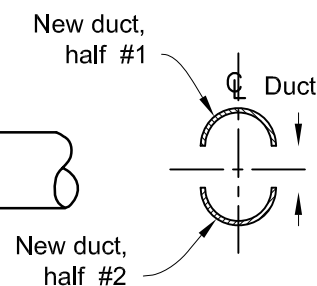
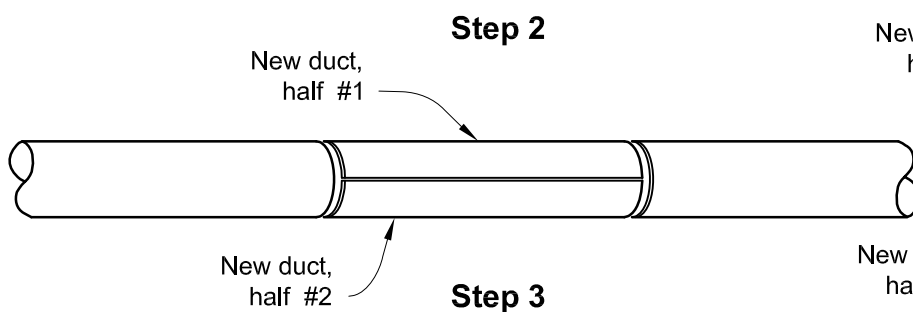
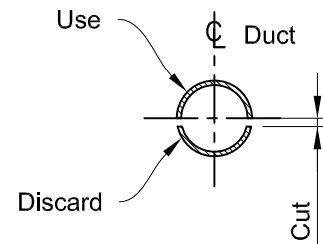
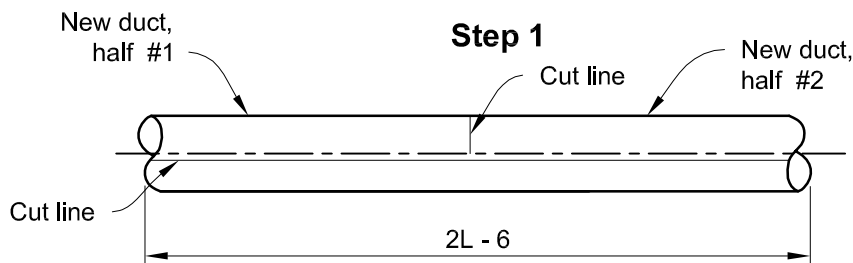
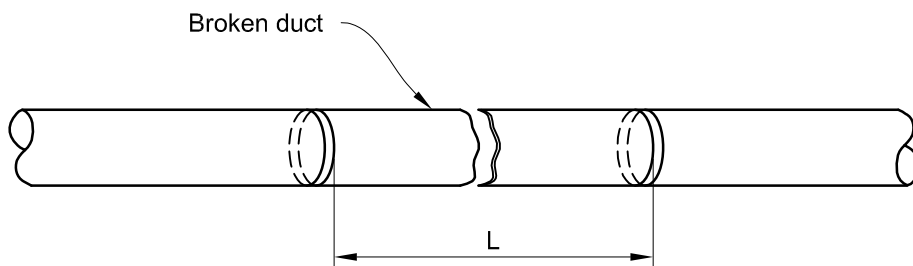
**Step 3**



**Step 4**

REVISIONS: R.2 - ADDED IPEX REPAIR KIT. MAR '16. MK

|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                          |               |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------|
| DESIGNED<br><br>M. KELVIN     | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | CONDUIT REPAIR PROCEDURE |               |
| DISTRIBUTION<br>STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2016<br>REPLACES: SEP 2002<br>ORIGINALLY<br>ISSUED: JUN 1980                                      |                                                                                                                         | PAGE 1<br>OF 3           | ES54 H5-01.01 |
|                                                                                                                  |                                                                                                                     |                                                                                                               |                                                                                                                         |                          | R<br>2        |



REVISIONS: R.2 - ADDED IPEX REPAIR KIT. MAR '16. MIK

|                                                                                                               |                                                                                                                     |                                                                                                               |                                                                                                                         |                          |               |
|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------|
| DESIGNED<br><br>M. KELVIN  | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | CONDUIT REPAIR PROCEDURE |               |
| DISTRIBUTION STANDARDS<br> |                                                                                                                     | ISSUED: MAR 2016<br>REPLACES: SEP 2002<br>ORIGINALLY<br>ISSUED: JUN 1980                                      |                                                                                                                         | PAGE 2<br>OF 3           | ES54 H5-01.02 |
|                                                                                                               |                                                                                                                     |                                                                                                               |                                                                                                                         |                          | R<br>2        |

## Notes

1. Any ducts damaged during construction shall be removed and replaced with new ducts before conductors are installed.
2. The damaged ducts shall be repaired by applying an IPEX EPR Conduit Repair Kit, or by using the alternate procedure specified below. The Contractor shall cut and remove the damaged portion of the duct, deburr all cut edges, smooth with sandpaper and install IPEX EPR Kits using standard PVC solvent cement in accordance with the manufacturer's instructions.

Alternately, if the application of the IPEX EPR Conduit Repair Kit is impracticable, the following procedure shall apply:

**Step 1:** Cut back to sound duct and remove damaged duct. Measure the distance "L" between the duct ends. Cut new duct of equivalent diameter to length (2L-60 mm). Split newly cut duct into two halves. Make sure the cut leaves one complete half as shown. Keep one complete half and discard the other half. Cut the usable complete half into two equal lengths of (L-30 mm). Deburr all cut edges and smooth with sandpaper.

**Step 2:** Install two complete halves, each of length (L-30 mm), over the existing conductors.

**Step 3:** Apply PVC cement to all engaging surfaces. Cut a slot in each of the two duct couplings. Install one duct coupling over each joint between the existing cut duct and new duct halves. Use two hose clamps on each coupling to tighten down over the duct. When PVC cement has cured, remove the hose clamps.

**Step 4:** Apply two half-lapped layers of repair tape over the entire repair section. Overlap both couplings by 100 mm with repair tape.

REVISIONS: R.2 - ADDED IPEX REPAIR KIT. MAR '16. MK

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| DESIGNED<br><br>M. KELVIN         | RECOMMENDED<br><br>L. STEVANOVIC | ACCEPTED<br><br>F. DENNERT | ENGINEER OF RECORD<br><br>2017-02-15 | CONDUIT REPAIR PROCEDURE |                |
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