Section R - Grounding

Scope

This section covers the installation of safety grounding for the BC Hydro underground distribution system, BC Hydro equipment and customer underground services, as part of the BC Hydro civil installation contracts.

Underground distribution grounding standards are based on the following references:

- CSA22.3 No.7 Underground Systems
- CEC Part I Section 36
- BC Hydro DEA No. 74/43 report
- BC Hydro ETR 012 Ground Resistance Testing of Precast Concrete Vaults
- BC Hydro Safety by Design Workshop 2012/13
- CEA 249 D 541 report
- IEEE No. 80 Ground System Design.

Design Parameters

The BC Hydro DEA No. 74/43 Report sets the following grounding design parameters:

- Short circuit withstand of 12 kA maximum fault current for 8 cycles;
- Minimum grounding conductor size shall be 4AWG Cu stranded;
- Galvanized steel ground electrodes shall be ⅝" dia. x 8 ft long for typical soil;
- Copper-clad steel ground electrodes shall be ⅝" dia. x 9 ft long for corrosive soil;
- The counterpoise shall be galvanized steel multi-stranded poly-core ¾" dia. minimum;
- The typical touch potential critical zone is 3 metres, but the potential gradient decays to a safe level 6 metres away from the enclosure;
- All pad-mounted equipment shall include two ground electrodes minimum and a counterpoise around the perimeter of the enclosure, to mitigate touch potential, and
- Step potential is not critical and there is no counterpoise around subsurface vaults.

The customer portion of an HV safety grounding installation on private property, associated with the installation of BC Hydro pad-mounted equipment, is exempt from BCEC Section 36 and shall comply with BC Hydro construction standards. Accordingly, the GPR shall not exceed the 7 kV limit and all exposed metal structures shall be interconnected and grounded to ensure an equipotential grounding installation. The customer grounding conductor jumpers terminated to a ground bus inside BC Hydro equipment shall be 600 V rated green, for visual identification of customer-owned conductors.

Grounding of Pad-Mounted Equipment in Public Corridors

Pad-mounted distribution equipment, such as switchgear, transformers and junction boxes, shall be installed as shown in ES54 R1-01.01, per the design parameters set in the DEA No. 74/42 Report. If protective metal bollards are required, they shall be bonded to the BC Hydro counterpoise to ensure the safe equipotential grounding installation. Any excess counterpoise length shall be looped in 0.5 metre coils as shown in ES54 R1-01.02.

Frequently, BC Hydro distribution equipment enclosures (or other utilities' enclosures) are installed in close proximity to other pad-mounted equipment, as shown in ES54 R1-01.03. Accordingly, two BC Hydro counterpoises shall be connected to ensure an equipotential ground surface. Similarly, other utilities' enclosures require the installation of 2/0 Cu minimum, bare stranded, gradient control conductor, and must be connected to the BC Hydro counterpoise.

Grounding of Pad-Mounted Equipment on Private Property

For all installations of BC Hydro-owned pad-mounted equipment on private property, BC Hydro requires clear maintenance access to the equipment, as well as clear maintenance access to BC Hydro counterpoise and ground rods. For this reason, the customer grounding portion of the installation, if required, must be kept separated at least 300 mm away, horizontally from the BC Hydro counterpoise. However, the customer grounding installation shall be connected to the BC Hydro pad-mounted equipment ground bus to ensure equipotential grounding.

For BC Hydro pad-mounted equipment located more than 3 metres away from a customer building or exposed metal and conductive surfaces, the customer shall complete all ducting and grounding installations according to the ES54 R1-02 standard. A customer-owned ground loop may not be required. If protective bollards are required, they shall be bonded to the BC Hydro counterpoise. However, all other exposed customer-owned metal and conductive surfaces located within 3 metres of the BC Hydro pad-mounted enclosure shall be bonded two green insulated customer grounding pigtails brought into the concrete pad window. Upon completion of the installation, the Installer's Declaration for ducting and grounding per ES54 R1-02.04 shall be submitted to the BC Hydro civil inspector.

For BC Hydro pad-mounted equipment located less than 3 metres away from a customer-owned building with a steel-reinforced concrete wall, or located inside a building alcove, or close to a conductive metal siding, the grounding installation shall comply with the ES54 F3-07 or ES54 E4-04 standards. All exposed metal structures shall be bonded to the customer ground loop and the two green insulated customer grounding pigtails shall be brought into the concrete pad window for connection to the BC Hydro equipment ground bus. BC Hydro requires the customer to carry out ground resistance and a fall-of-potential test and submit engineer-stamped calculations with reference to the BC Hydro acceptable limits for the GPR, as well as the safe step-and-touch potentials.

For those installations located inside the customer building alcove or within the footprint of the building, as shown in ES54 F3-06 or ES54 E6-01, BC Hydro requires the customer to carry out ground resistance and fall-of-potential tests, and submit engineer-stamped calculations with reference to the

BC Hydro acceptable limits for the GPR, as well as the safe step-and-touch potentials listed in the above standards.

Grounding of URD and UD Subsurface Vaults in Public Corridors

Each subsurface precast concrete vault installed in a public corridor shall have at least one BC Hydro standard ground rod, vertically driven, in close proximity to the concrete vault. This ground rod, as shown in the ES54 R2-01 standard, provides an effective local grounding connection for bonding of the equipment inside the BC Hydro concrete vault.

BC Hydro continues to develop subsurface concrete vaults with an integral concrete-encased ground electrode. These vaults can easily be identified by a visible copper-alloy ground plate, 90 mm (3½") square, located on the inside wall. An integral ground electrode performs the function of a self-grounding vault, and therefore the installation of external ground rods is not required, as seen in ES54 R3-02.01.

Grounding of URD and UD Subsurface Vaults on Private Property

Nearly all subsurface precast concrete vaults installed on private property may be grounded per ES54 R2-01 using one external ground rod with no counterpoise, if there is adequate depth of soil below the vault for an effective local earth connection. All installations of subsurface concrete vaults on private property shall be done with a permit, and require the Installer's Declaration per ES54 R1-02.04 to be submitted to the BC Hydro civil inspector.

In some installations, BC Hydro subsurface concrete vaults are placed on top of building structures which do not have adequate depth of soil for an effective local earth connection. For these installations, the customer shall provide two remote grounding connections to the building foundation wall rebar and bring two long insulated pigtails into the BC Hydro concrete vault, as shown in ES54 R2-02. Upon completion of the installation, the customer shall perform a standard fall-of-potential field survey and submit an engineer-stamped report to confirm that the remote ground electrode resistance to earth is less than 10.0 Ohm. The same requirements shall also apply for concrete vaults that have an integral ground electrode.

Grounding of Large Subsurface Vaults with External Ground Rods

Previous BC Hydro grounding standards for large cable vaults and switchgear-type vaults were based on driving two external ground electrodes through the duct windows on opposite sides of the concrete vault – see ES54 R3-01. The ends of the ground electrode are kept a minimum clearance of 100 mm (4") from the inside wall surface of the vault.

The life expectancy of these ground rods ranges from 10 to 25 years, depending on the type of rod, corrosive soil conditions, road salt, etc.

Large subsurface concrete vaults do not require a counterpoise for the control of step potential.

Grounding of Large Subsurface Vaults with Internal Ground Electrodes

BC Hydro has implemented the industry standard for a concrete-encased integral ground electrode for grounding large concrete vaults. Large subsurface vaults have an extremely large contact surface with the earth, several hundred times larger than the surface of the BC Hydro standard ground rod. Consequently, the ground resistance of a large subsurface vault could be hundreds of times lower than the ground resistance of a single ground rod. This has been confirmed by the field measurements tabled in the BC Hydro ETR 012 engineering report.

Currently, all BC Hydro large concrete vaults, such as the 1500 kVA street vault, 3-way and 4-way cable vaults and VISTA chambers, are fabricated with an integral concrete-encased ground electrode – see the ES54 R3-02 standard.

Large subsurface concrete vaults with integral grounding do not require a counterpoise.

Grounding in High Corrosion Areas

Occasionally, the BC Hydro designer may encounter a wet, peaty, clay or sea-level terrain for grounding installation. Such locations may require the installation of copper-clad ground rods (Cat. ID 420-1104) and stranded bare copper counterpoise to prevent the corrosion of galvanized steel grounding materials. To confirm the pH characteristics and the requirements for copper type grounding, the designer shall carry out soil sample testing.

The soil testing procedure and copper grounding type bill of material are shown in ES54 R4-01.

REVISIONS: R.1 - TEXT REVISIONS. FEB '17 MK

DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD	
M. KELVIN	C. PICASSI	F. DENNERT	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. KELVIN 2017-02-15	GROUNDING GENERAL NOTES
DISTRIBUTION STANDARDS BC Hydro	ISSUED:FEB 2017 REPLACES: MAR 2016 ORIGINALLY ISSUED: MAR 2016			PAGE 4 OF 4 — ES54 R0-02.04 — R 1

Application

This standard provides requirements for grounding pad-mounted equipment in public corridors.

Revision Notes

Added *Application* and *Revision Notes* sections. Updated *References*. Updated item 9 quantity and material number in *Items Required*. Substantive changes are marked by green vertical revision lines in the left margin. This revision released concurrently with Standards and Equipment Advisory Information Bulletin 2025-049 *Revised ES43 and ES54 Standards Using Theft Deterrent Ground Wire*.

References

BC Hydro Distribution Standards

ES53 Z3-01	Grounding Assemblies
ES54 section F	Transformers
ES54 R4-01	Grounding in High Corrosion Areas
ES54 U2-01	Concrete Pad Protection General Notes
ES54 U2-02	Concrete Pad Protection Bollards

Items Required

Item	Description	Material no.	Quantity	Supplied by
1	Counterpoise, ¾" diameter, galvanized steel	106-2510	As required	BC Hydro
2	Ground rods, ⅝" x 8 ft galvanized steel	420-1093	2	BC Hydro
3	Connector, counterpoise to ground rod, galvanized steel	420-1157	2 or as required	BC Hydro
4	Rope clamp, ¾" diameter, galvanized steel	420-0965	1	BC Hydro
5	Cap, heat-shrink, 1.2" x 3"	394-0605	2	BC Hydro
6	Protective bollard, precast, grounded	9700-2788	2	BC Hydro
7	Burndy GAR 6426 or equivalent	N/A	2	Contractor
8	2/0 Cu bare stranded (minimum)	N/A	As required	Contractor
9	Theft deterrent wire, ERICO	9701-1048	13 m	BC Hydro
10	Connector, ERICO wire to counterpoise or precast grounded bollard stud	420-1158	4 (2 per bollard)	BC Hydro

Designed: C. Picassi, P. Eng		Professional of Record EGBC Permit 1001348 PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. C. PICASSI # 35692 2025-08-20	Grounding Pad-Mounted Equipment in Public Corridors	
Checked: C. Picassi, P. Eng				
Reviewed: V. Batinovic, P. Eng			DISTRIBUTION STANDARDS BC Hydro	ES54 R1-01 R7
Approved: H. Giesbrecht, P. Eng	H. Giesbrecht	Issued: 2025-08-22 Effective: 2025-08-22		

Notes

1. The distance of the counterpoise from the pad shown in Figure 2 is designed for optimum protection against touch potential. Every effort should be made to conform to the standard.
2. The full length of the ground rod shall be driven into the ground. The rod shall be driven in at an angle in rocky or hardpan areas where the rod cannot be advanced to at least ⅔ of its length. For a rod driven in at least ⅔ of its length, bend the rod horizontally parallel to the counterpoise and install the connector below the bend using the parallel connector grooves (see detail 1 in Figure 2). Ensure there is a minimum 0.3 m cover over any portion of the rod. Do not cut off the ground rod under any circumstances.
3. Do not cut off the excess length of counterpoise supplied in the grounding packages. The excess length shall be taken up by making a series of coils as shown in Figures 3 and 4.
4. Ground rods shall be placed on either side of equipment access doors or the hood used by operating personnel, for an extended “zone of influence”. Some installations may require four or more ground rods and connectors to achieve this.
5. Do not install the counterpoise under a roadway or a curb. Installation under a sidewalk should be avoided. If it cannot be avoided, install the ground rods on each side of the equipment pad outside the sidewalk, as shown in Figures 3 and 4.
6. Other utility metal boxes or fixtures (e.g. TELUS service boxes, street light bases, fence posts, sprinkler pipes) located within 3 m of the equipment pad shall be grounded and bonded to the BC Hydro equipment ground, as shown in Figures 5 and 6.
7. Protective metal grounded bollards in public corridors may be located as required inside or outside the counterpoise loop, see ES54 U2-02.
8. Grounding in high corrosion areas shall be per ES54 R4-01.

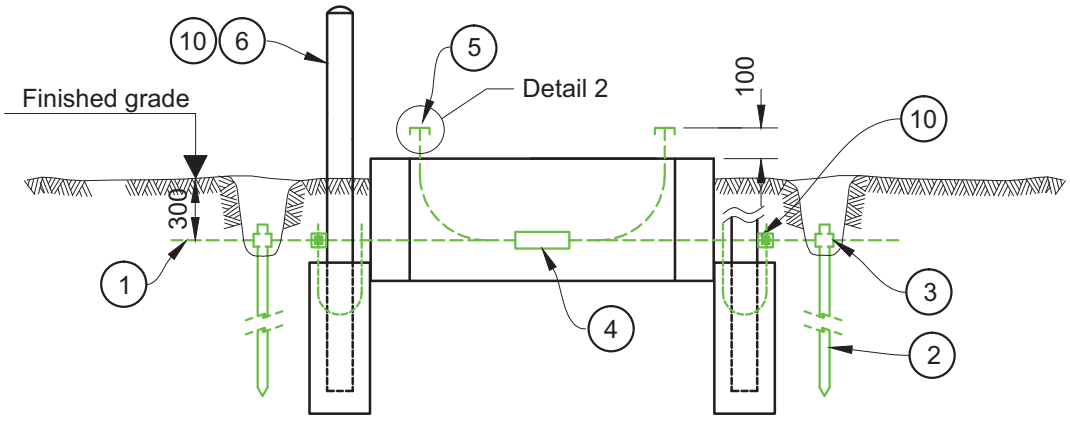
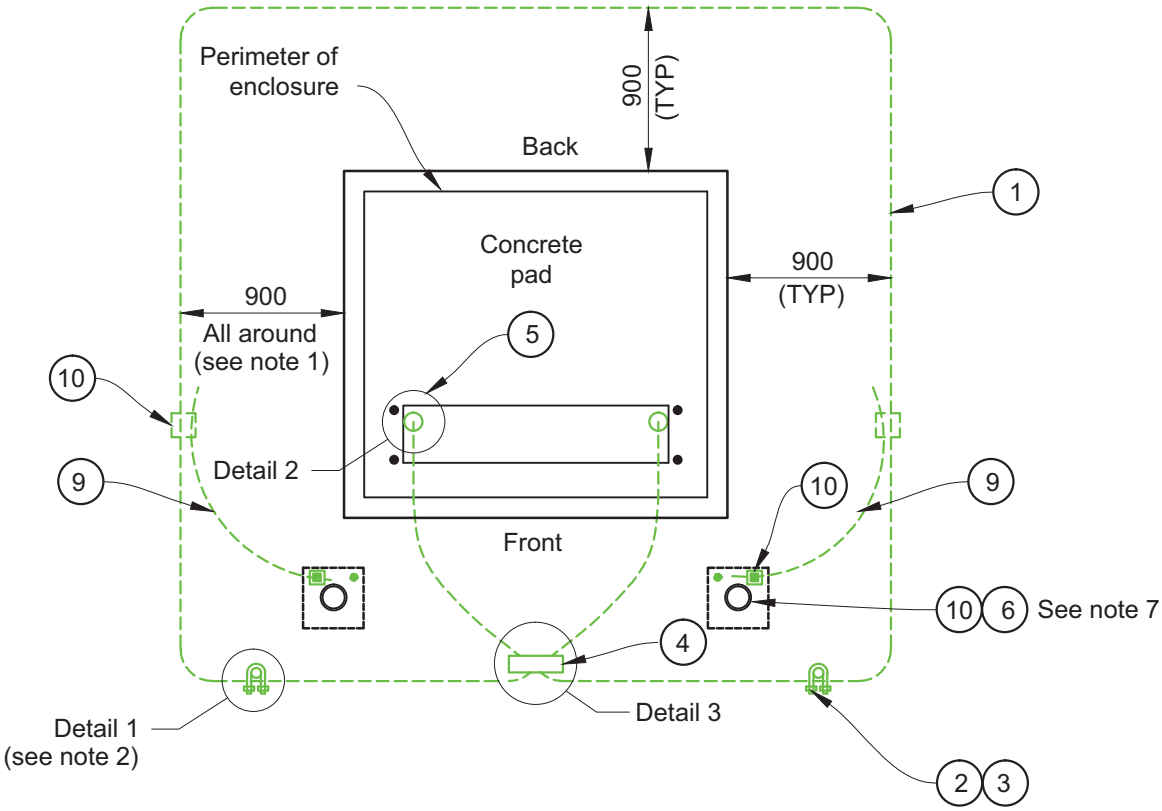
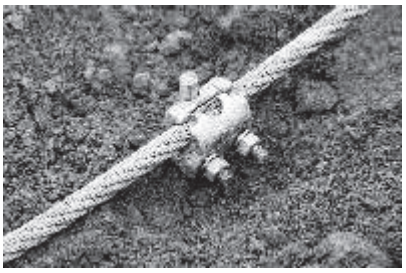


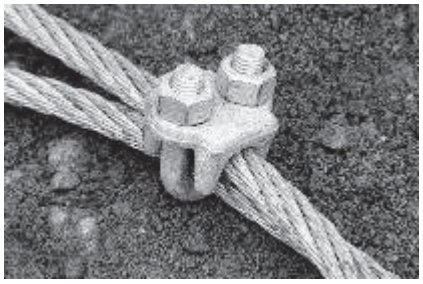
Figure 1 – Elevation view





Detail 1
Counterpoise to ground rod connection

Detail 2
Heat shrink cap



Detail 3
Mechanical restraint of counterpoise

Figure 2 – Plan view with details

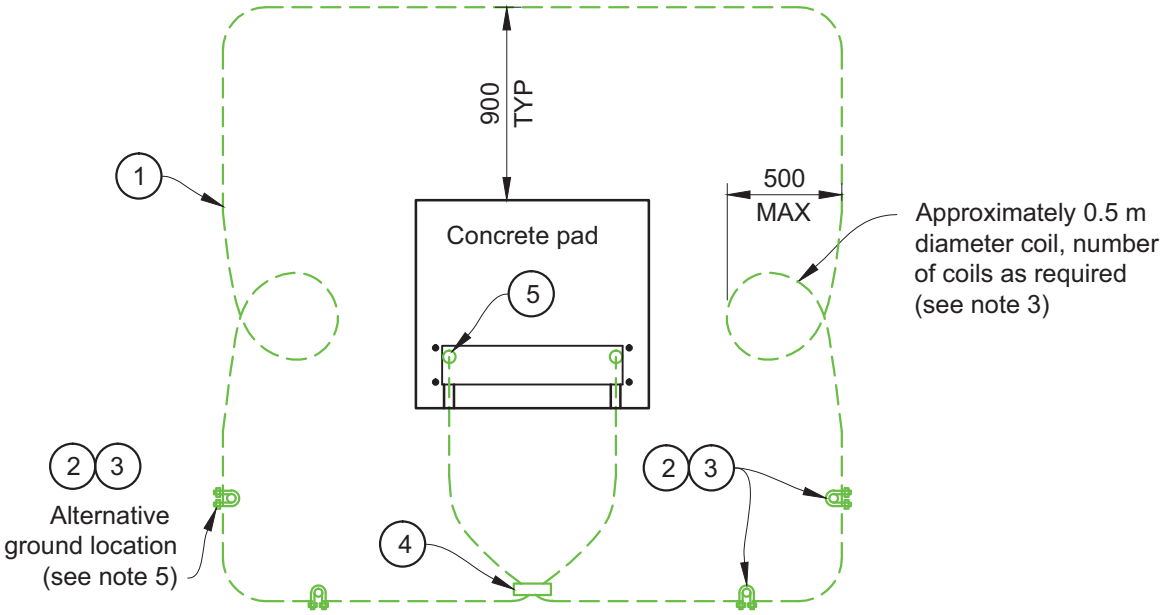


Figure 3 – Coiling excess counterpoise length in grounding kits

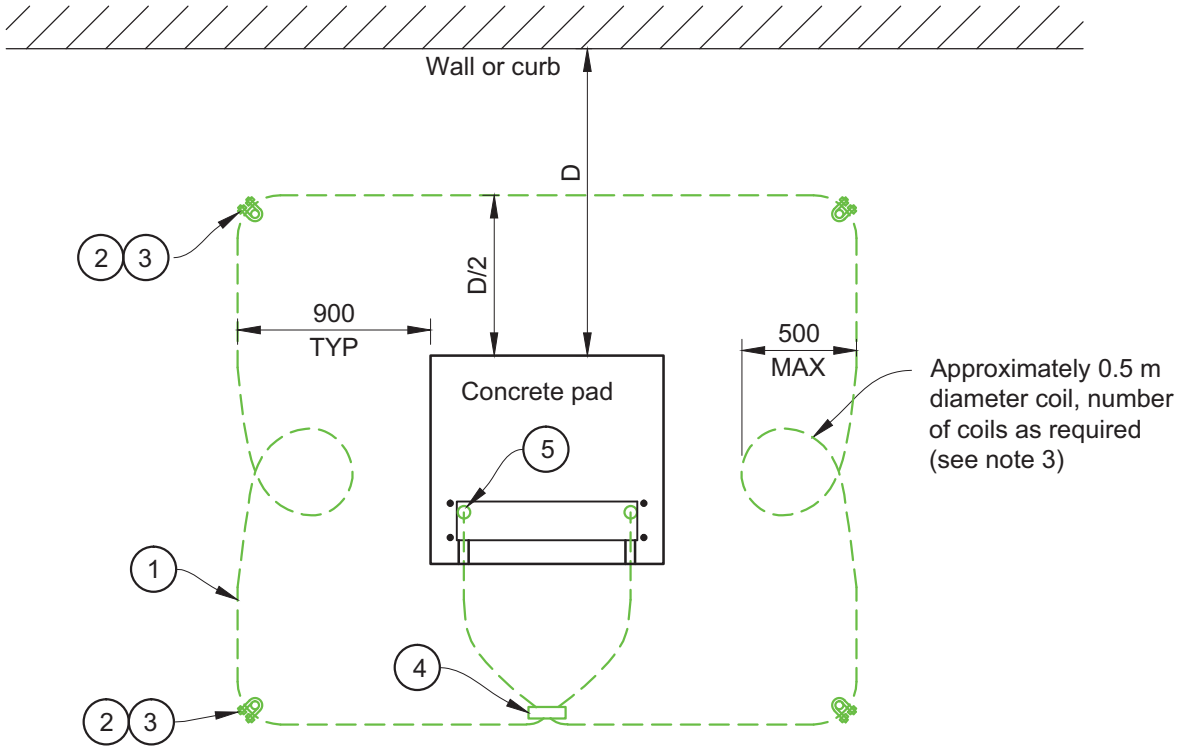


Figure 4 – Coiling excess counterpoise length for reduced back/front clearance

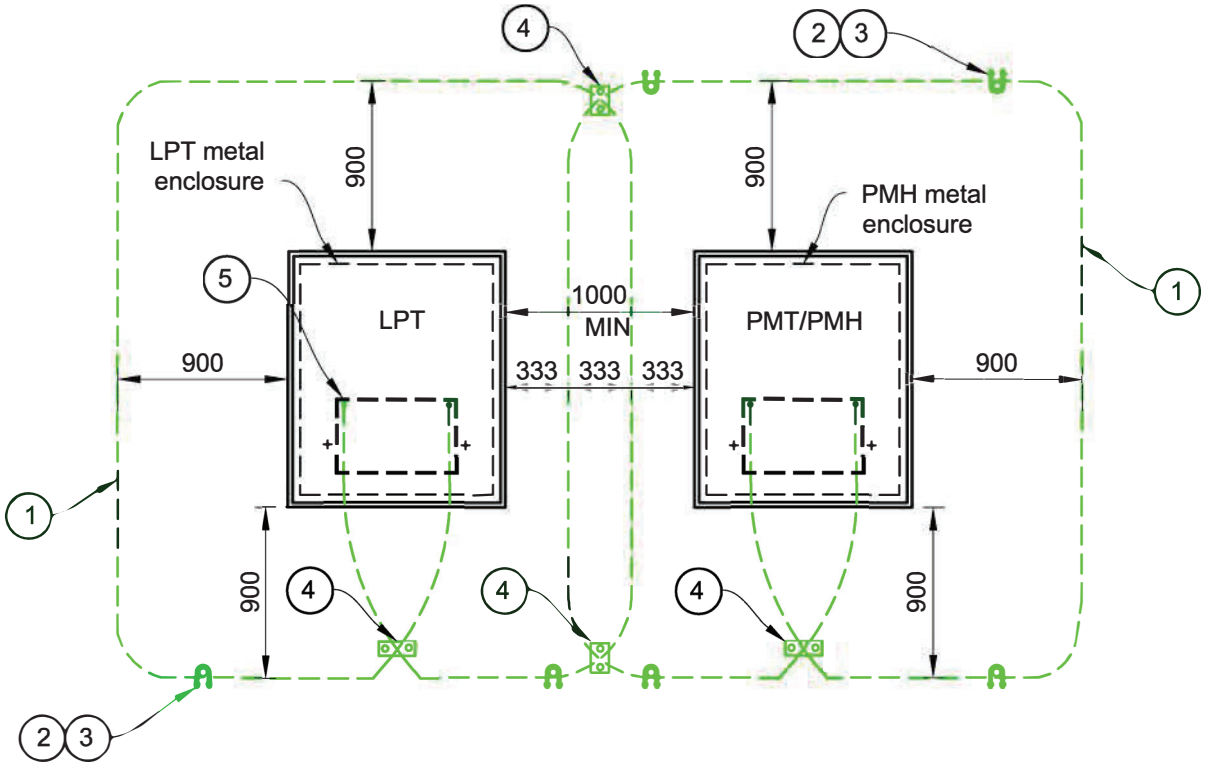


Figure 5 – Grounding adjacent transformers

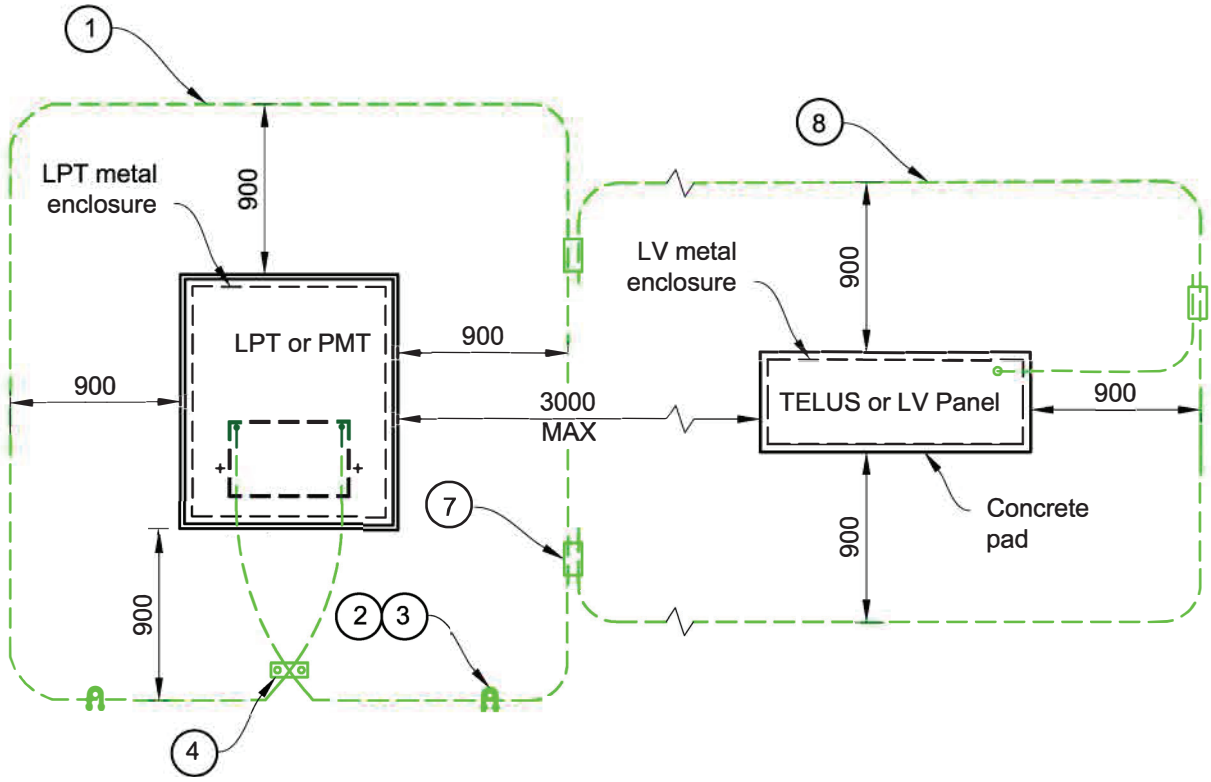


Figure 6 – Grounding adjacent low-voltage enclosure

Application

This standard provides requirements for grounding pad-mounted equipment on private property.

Revision Notes

Changed reference from note 3 to note 2 in Figure 1. Removed references to notes 1 and 5 from concrete pad in Figure 2. Substantive changes are marked by green vertical revision lines in the left margin.

References

BC Hydro Distribution Standards

ES53 Z3-01	Grounding Assemblies
ES54 section F	Transformers
ES54 R1-01	Grounding Pad-Mounted Equipment in Public Corridors
ES54 R4-01	Grounding in High Corrosion Areas
ES54 U2-01	Concrete Pad Protection General Notes
ES54 U2-02	Concrete Pad Protection Bollards

Items Required

Item	Description	Material no.	Quantity	Supplied by
1	Counterpoise, ¾" diameter, galvanized steel	106-2510	As required	BC Hydro
2	Ground rods, ⅝" x 8 ft galvanized steel	420-1093	2	BC Hydro
3	Connector, counterpoise to ground rod, galvanized steel	420-1157	2	BC Hydro
4	Rope clamp, ¾" diameter, galvanized steel	420-0965	2	BC Hydro
5	Cap, heat-shrink, 1.2" x 3"	394-0605	2	BC Hydro
6	Protective bollard, precast, grounded	9700-2788	2	BC Hydro
7	2/0 AWG Cu insulated 600 V green, stranded	N/A	As required	Contractor
8	Ground rod, ⅝" x 8 ft galvanized steel	N/A	As required	Contractor
9	Ground rod to 2/0 Cu connector for direct burial, Burndy GUV5821 or equivalent	N/A	As required	Contractor
10	Pipe grounding clamp 2/0 Cu stranded to 4" dia. pipe, Burndy GD2226 or equivalent	N/A	2	Contractor
11	Theft deterrent wire, ERICO	9701-1048	13 m	BC Hydro

Designed: C. Picassi, P. Eng		Professional of Record Engineer Permit 1001348 PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. C. PICASSI # 35692 2026-01-16	Grounding Pad-Mounted Equipment on Private Property
Checked: C. Picassi, P. Eng			
Reviewed: V. Batinovic, P. Eng			DISTRIBUTION STANDARDS BC Hydro / ES54 R1-02 R4
Approved: H. Giesbrecht, P. Eng	H. Giesbrecht	Issued: 2026-01-16 Effective: 2026-01-16	

Item	Description	Material no.	Quantity	Supplied by
12	2/0 Cu bare stranded (minimum)	N/A	As required	Contractor
13	Connector, ERICO wire to counterpoise or precast grounded bollard stud	420-1158	4 (2 per bollard)	BC Hydro

Notes

1. BC Hydro requires unobstructed access for counterpoise and BC Hydro ground rod maintenance and testing. The customer grounding portion shall not be connected to the BC Hydro ground rod or counterpoise.
2. Customer bare grounding conductors shall be kept 300 mm minimum (900 mm maximum) from the BC Hydro counterpoise. The customer shall leave 600 mm-long pigtails inside the concrete pad window for future termination to the equipment ground bus by BC Hydro.
3. The customer shall connect exposed conductive and metal structures to the customer ground loop, located within 3 m of the BC Hydro pad-mounted equipment, to eliminate dangerous touch potentials. Protective metal bollards shall be bonded to the BC Hydro counterpoise.
4. Concealed grounding and ducting installations shall be inspected by a BC Hydro civil inspector before placing backfill. The electrical contractor shall complete the attached Installer's declaration (Figure 4) and submit it to the BC Hydro civil inspector or BC Hydro representative.

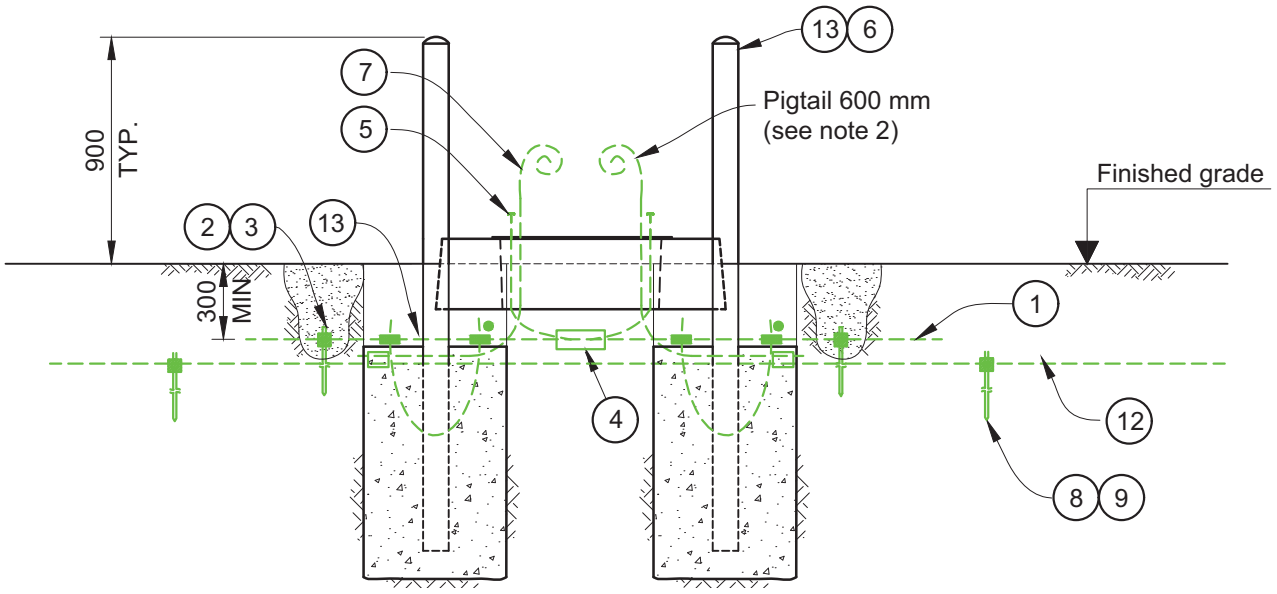


Figure 1 – Elevation view

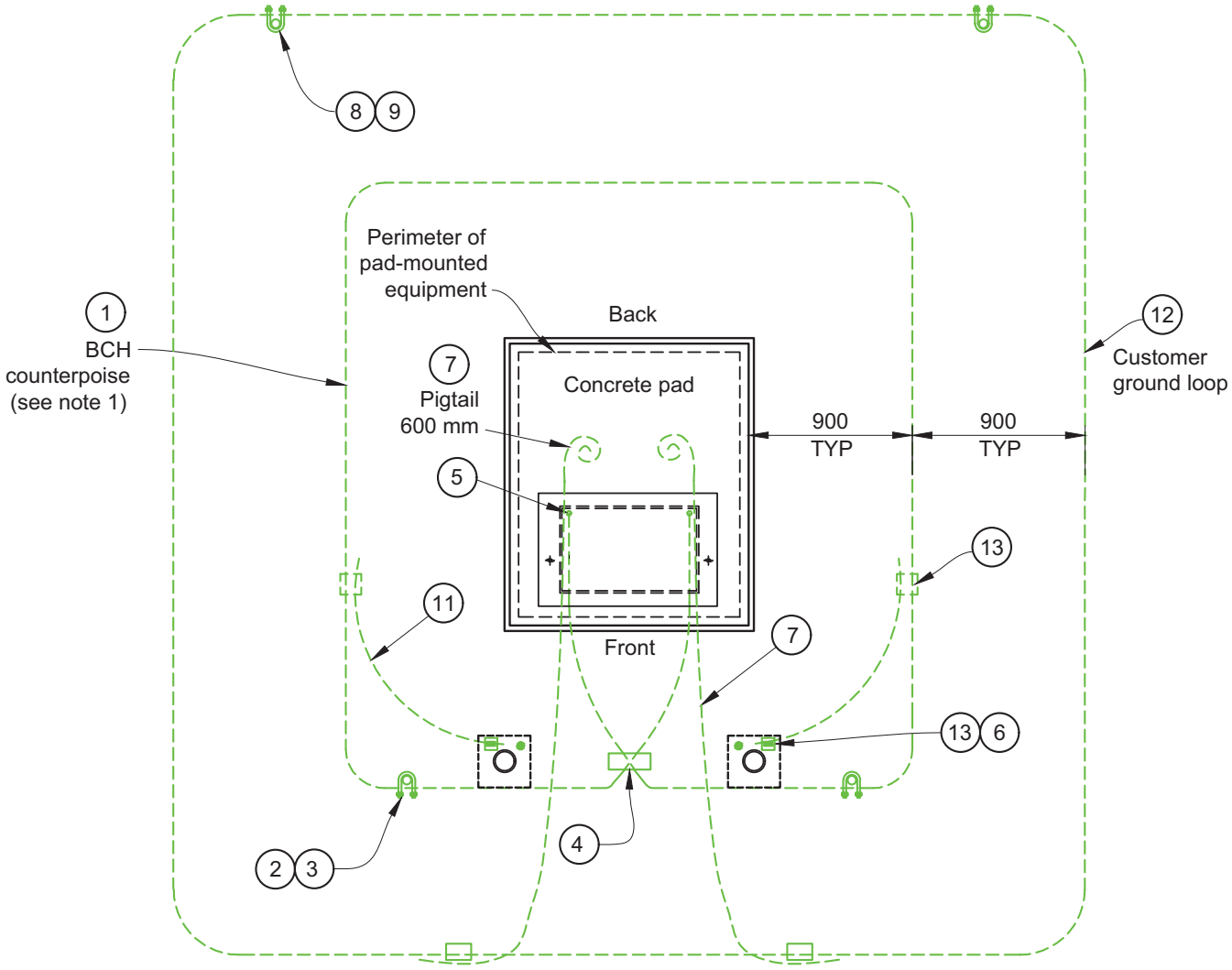


Figure 2 – Plan view

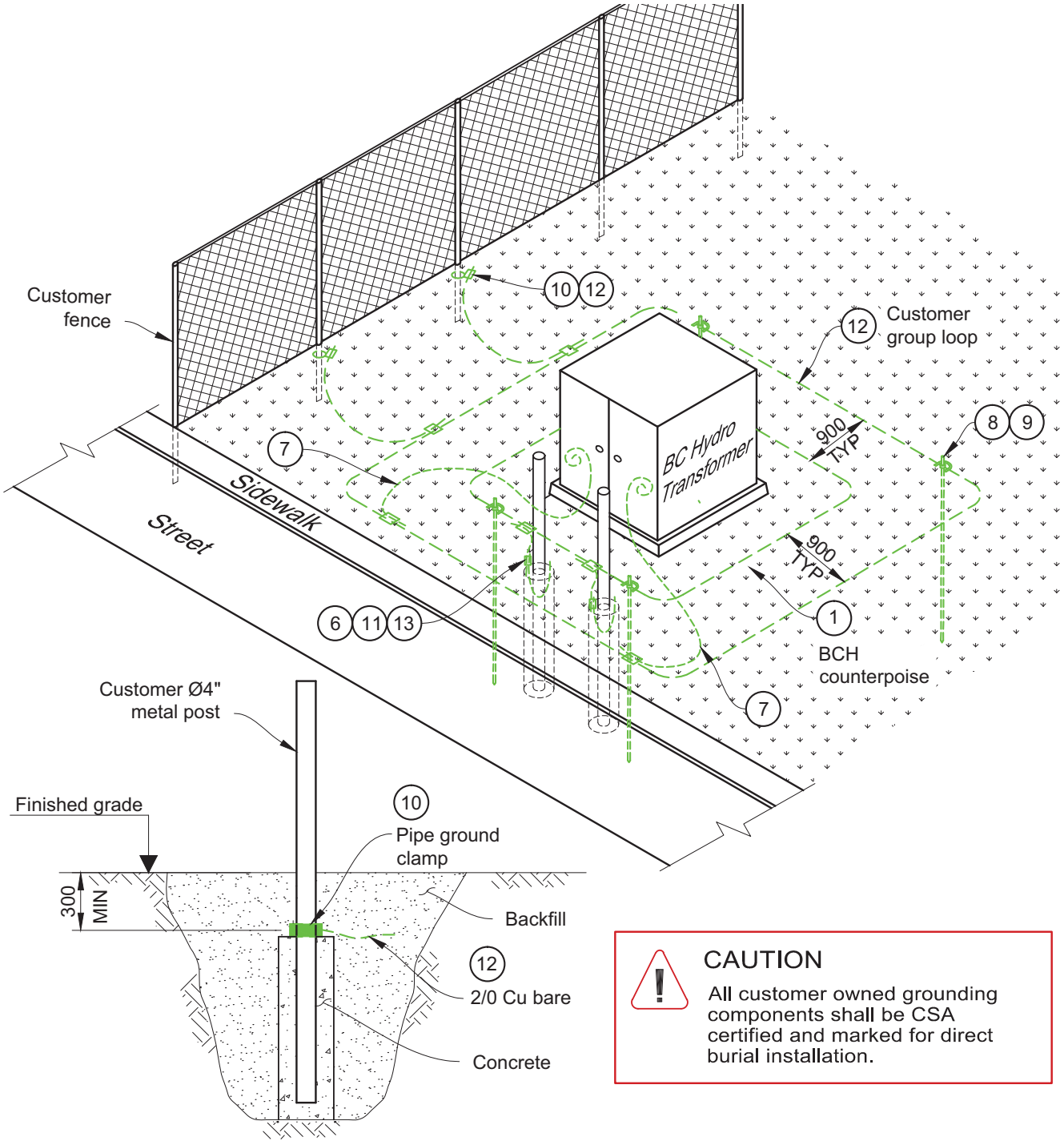


Figure 3 – Metallic fence post grounding

Please complete this page and provide to the BC Hydro designer.
All fields on this page are mandatory to avoid processing delays.

DUCT AND GROUNDING INSTALLER'S DECLARATION

BC Hydro reference no. ES54 R1-02	Electrical permit no.:	
Installer name:	Installer phone no.:	Mobile:
Service address:		
Lot no.:	City:	Postal code:
Installers registration no.:	Building permit no.:	
The Electrical Safety Regulations require that persons installing underground electrical raceway shall be registered as an electrical contractor and shall hold a valid certificate of qualification.		
Owner name:	Owner phone no:	

Site Plan

Indicate:
- North arrow
- Building foundation outline
- BC Hydro equipment location
- Grounding

1. This declaration does not constitute an authorization for connection.
2. The installation shall comply with the Canadian Electrical Code and amending bulletins issued by the Electrical Safety Branch of British Columbia.
3. Governing statutes for said installations are available at BC Hydro or the Electrical Inspection Branch.
4. Any discrepancy between the above BC Hydro reference and the actual installation must be approved in advance by a BC Hydro service representative.

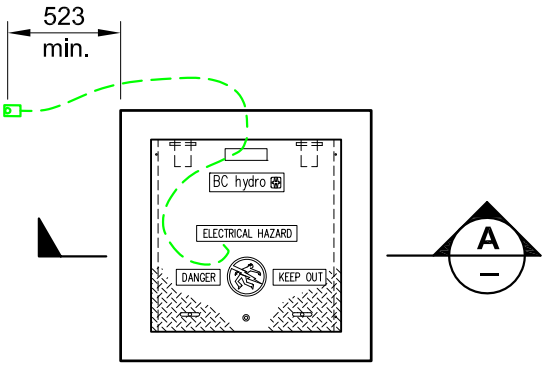
I am the installer and hereby certify that the service duct and grounding installation has been installed to comply with BC Hydro requirements.

Permit holder signature

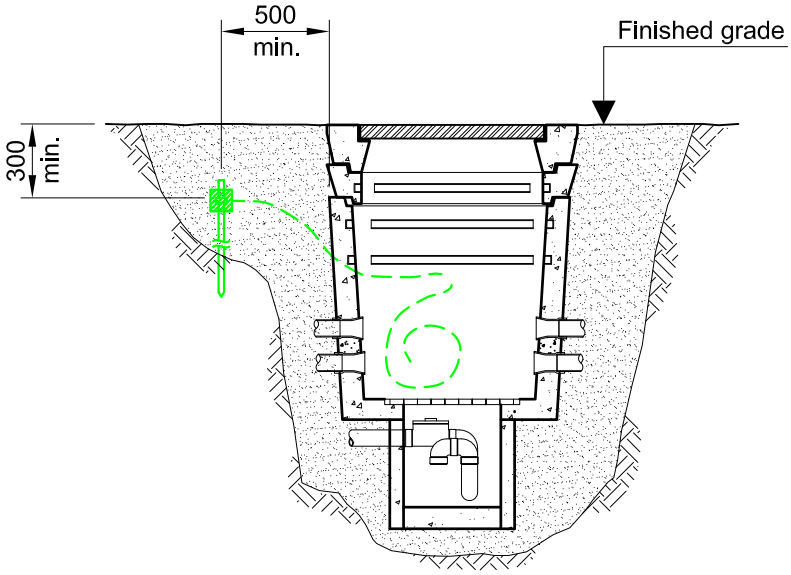
Print name

Date

Figure 4 – Duct and grounding installers declaration



Plan



Section A –

REVISIONS: R.5 - CORRECTED CATALOGUE ID NUMBER IN BILL OF MATERIAL TABLE. AUG '16 MK

DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD	GROUNDING OF URD AND UD SUBSURFACE STRUCTURES IN PUBLIC CORRIDORS	
M. KELVIN	C. PICASSI	F. DENNERT	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. KELVIN 2017-02-15		
DISTRIBUTION STANDARDS BC Hydro	ISSUED:AUG 2016 REPLACES:SEP 2002 ORIGINALLY ISSUED: JUN 1980			PAGE 1 OF 2	ES54 R2-01.01 R 5

Notes

1. For vaults and boxes without hinged lids and/or having a round shape, locate the ground rod from the corner or point on the circumference that is least likely to be used as a position from which equipment in the vault or box will be operated.
2. For grounding in high corrosion areas, see ES54 R4-01.
3. The full length of the ground rod shall be driven into the ground. In rocky or hardpan areas where the rod cannot be advanced to at least ⅔ of its length, the rod shall be driven in at an angle. For a rod driven in at least ⅔ of its length, bend the rod horizontally parallel to the counterpoise. Install the connector below the bend using the parallel connector grooves. Ensure there is a minimum 0.3 m cover over any portion of the rod.

DO NOT UNDER ANY CIRCUMSTANCES CUT OFF THE GROUND ROD.

4. If solid rock is encountered, lay the rod in a trench running parallel to the box or vault.
5. When backfill is required within 0.3 m of the rod, it shall be sand or native fill devoid of rocks 50 mm or greater in diameter.

Bill of Material

Item	Description	Catalogue ID	Quantity	Supplied By
1	Ground rod, galvanized steel, ⅝" x 8'	420-1093	1	BC Hydro
2	Connector, ground rod, galvanized steel	420-1158	1	BC Hydro
3	#2 MHD Cu. P. E. jacketed	380-0256	As required	BC Hydro

Items 2 and 3 are available as a package with 4 m of item 3 under catalogue ID 412-0022.

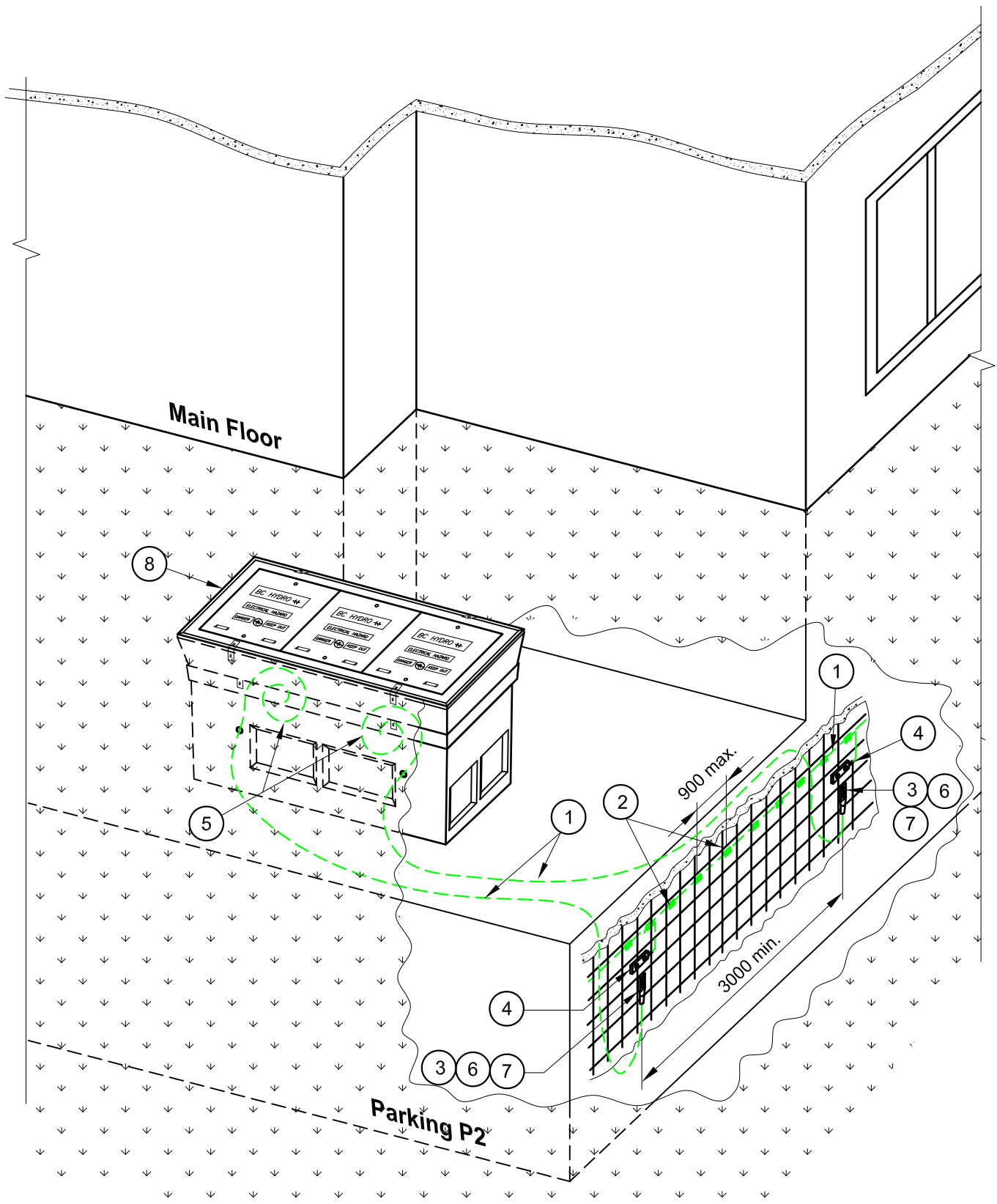
Reference Standards

ES54 R4-01 Grounding in High Corrosion Areas

ES53 R2-01 Bonding and Grounding, URD and UD Subsurface Structures, General Practices

REVISIONS: R.5 - CORRECTED CATALOGUE ID NUMBER IN BILL OF MATERIAL TABLE. AUG '16 MK

DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD	GROUNDING OF URD AND UD SUBSURFACE STRUCTURES IN PUBLIC CORRIDORS	
M. KELVIN	C. PICASSI	F. DENNERT	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. KELVIN 2017-02-15		
DISTRIBUTION STANDARDS BC Hydro	ISSUED:AUG 2016 REPLACES:SEP 2002 ORIGINALLY ISSUED: JUN 1980			PAGE 2 OF 2	ES54 R2-01.02 R 5



DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD
M. KELVIN	C. PICASSI	F. DENNERT	2017-02-15

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. KELVIN

DISTRIBUTION STANDARDS
BC Hydro

ISSUED: FEB 2017
REPLACES:MAR 2016
ORIGINALLY ISSUED: MAR 2016

GROUNDING OF URD AND UD SUBSURFACE STRUCTURES ON PRIVATE PROPERTY

PAGE 1 OF 2

ES54 R2-02.01

R 1

REVISIONS: R.1 - BOM REVISED. FEB '17 MK

Notes

1. When a BC Hydro subsurface concrete vault is placed on top of a building structure that has inadequate depth of soil for an effective earth connection, the customer shall provide two remote grounding connections to the building foundation wall rebar. These remote connections shall be made with two separate 2/0 Cu conductors terminated onto CSA certified grounding pads bonded to the concrete wall rebar.
2. For more details of rebar grounding and remote connections, refer to ES54 F3-07.
3. The customer shall provide a sealed Fall of Potential Report to verify that the remote concrete wall rebar ground electrode earth resistance is less than 10 Ohm. This requirement is applicable to both externally grounded and self-grounding type concrete vaults.
4. A subsurface concrete vault installed within the building envelope may be subject to additional requirements of the BC Building Code and local inspection authority.

Bill of Material

Item	Description	Catalogue ID	Quantity	Supplied By
1	2/0 AWG Cu bare stranded	N/A	As Required	Contractor
2	Ground connector ¾" vertical rebar to 2/0 Cu bare direct burial, Blackburn GUV5821 or equivalent	N/A	As Required	Contractor
3	Compression lug for 2/0 Cu Burndy YGHA26 or equivalent	N/A	4	Contractor
4	Ground plate direct burial Burndy YGF29-2N	N/A	2	Contractor
5	2/0 Cu insulated 600 V green, stranded	N/A	As Required	Contractor
6	Bolt S/S ½" dia x 1" long	N/A	4	Contractor
7	Washer S/S ½" dia	N/A	8	Contractor
8	BC Hydro precast 832 box	400-0990		BC Hydro

Reference Standards

ES54 Section B Pull/Splice Service and Junction Boxes

ES54 F3-07 Grounding on Private Property

REVISIONS: R.1 - BOM REVISED. FEB '17 MK

DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD
M. KELVIN	C. PICASSI	F. DENNERT	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. KELVIN 2017-02-15

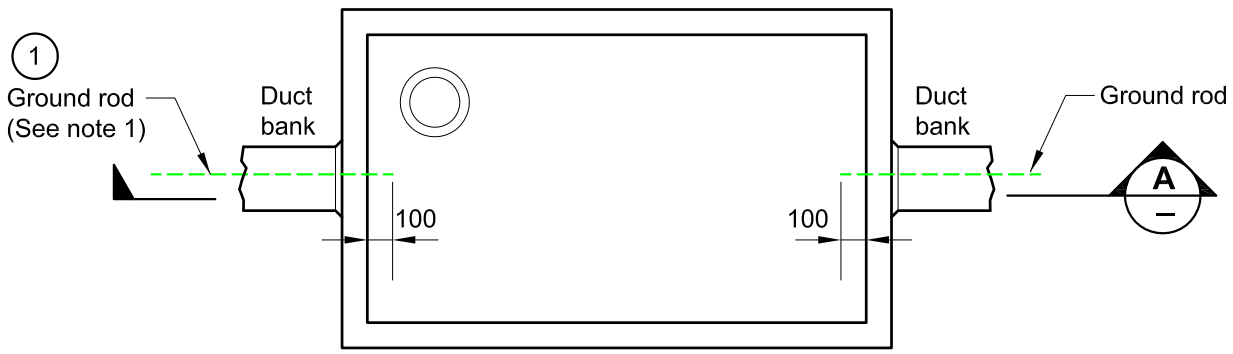
DISTRIBUTION STANDARDS BC Hydro

ISSUED: FEB 2017
REPLACES:MAR 2016
ORIGINALLY ISSUED: MAR 2016

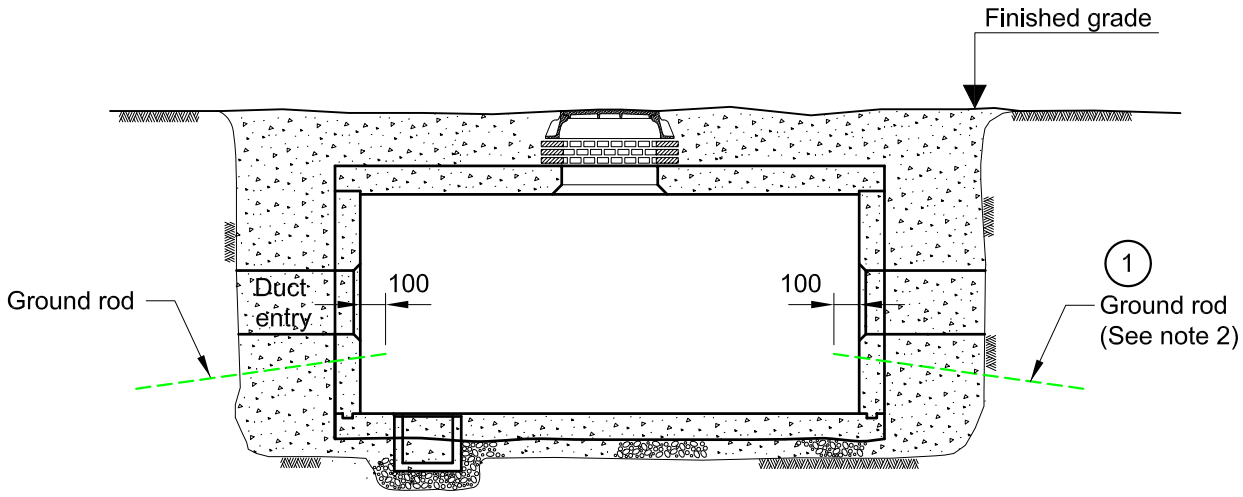
GROUNDING OF URD AND UD SUBSURFACE STRUCTURES ON PRIVATE PROPERTY

ES54 R2-02.02

R 1



Plan



Section A –

REVISIONS: R.6 - TITLE CHANGE. NOTE 1 REMOVED. MAR '16 MK

DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD
M. KELVIN	C. PICASSI	F. DENNERT	2017-02-15

DISTRIBUTION STANDARDS
BC Hydro

ISSUED:MAR 2016
REPLACES:APR 2004
ORIGINALLY
ISSUED: JUN 1980

GROUNDING OF CONCRETE VAULTS WITH EXTERNAL GROUND ELECTRODE

PAGE 1
OF 2

ES54 R3-01.01

R 6

Notes

1. Install one ground rod inside each duct bank window: 2 rods for through-type, 3 rods for T-type, and 4 rods for 4-way type manholes.
2. For precast vaults, insert the ground rod through the bottom corner of the duct bank window. Leave the end of the rod projecting 100 mm approx. inside the vault.
3. For grounding in high corrosion areas, see ES54 R4-01.
4. Do not bend the ground rod – always install it straight and in-line.
5. Backfill within 0.3 m of the rod shall be sand or native fill devoid of rocks 50 mm or greater in diameter.

Bill of Material

Item	Description	Catalogue ID	Quantity	Supplied By
1	Ground rod, ⅝" x 8', galv. steel	420-1093	2 (See Note 1)	BC Hydro

Reference Standards

ES54 R4-01	Grounding in High Corrosion Areas
ES53 R3-01	Bonding and Grounding, Manholes, General Layout

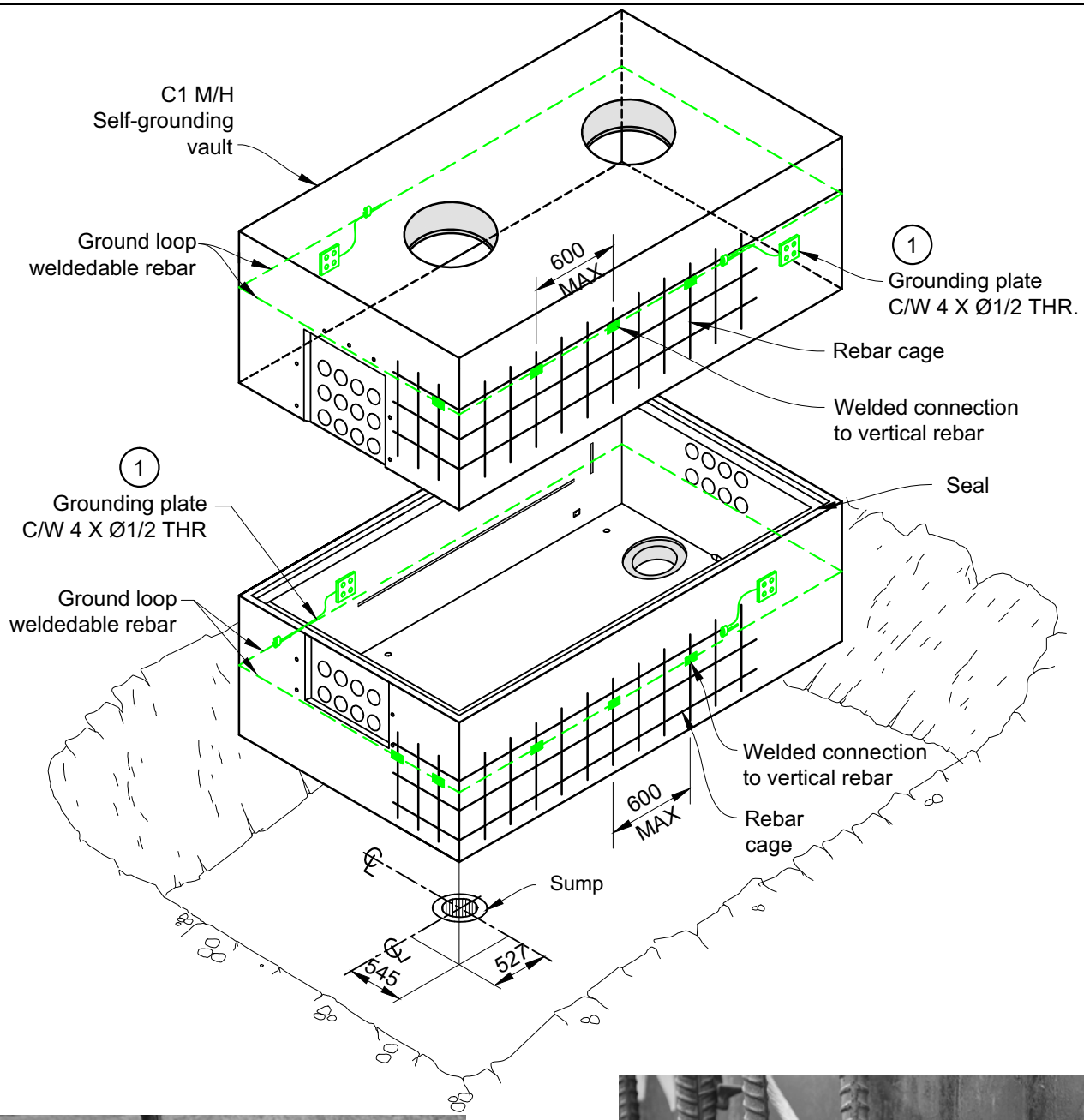
REVISIONS: R.6 - TITLE CHANGE. NOTE 1 REMOVED. MAR '16 MK

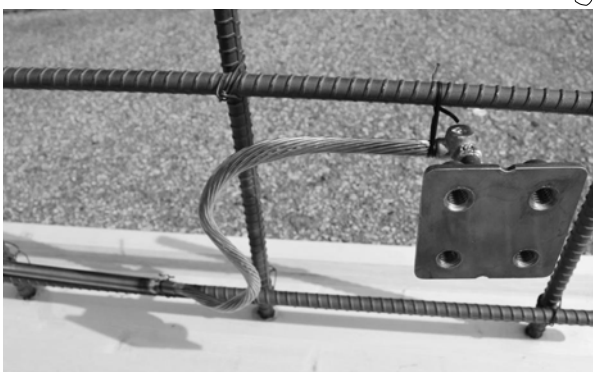
DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD
M. KELVIN	C. PICASSI	F. DENNERT	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. KELVIN 2017-02-15

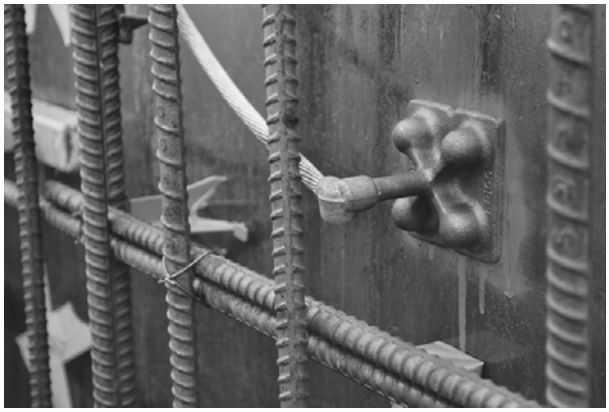
DISTRIBUTION STANDARDS
BC Hydro

ISSUED:MAR 2016
REPLACES:APR 2004
ORIGINALLY ISSUED: JUN 1980

GROUNDING OF CONCRETE VAULTS WITH EXTERNAL GROUND ELECTRODE







REVISIONS: R.1 - CAST IN PLACE ADDED. FEB '17 MK

DESIGNED	RECOMMENDED	ACCEPTED
M. KELVIN	C. PICASSI	F. DENNERT

DISTRIBUTION STANDARDS
BC Hydro

ISSUED: FEB 2017
REPLACES:MAR 2016
ORIGINALLY
ISSUED: MAR 2016

ENGINEER OF RECORD

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. KELVIN

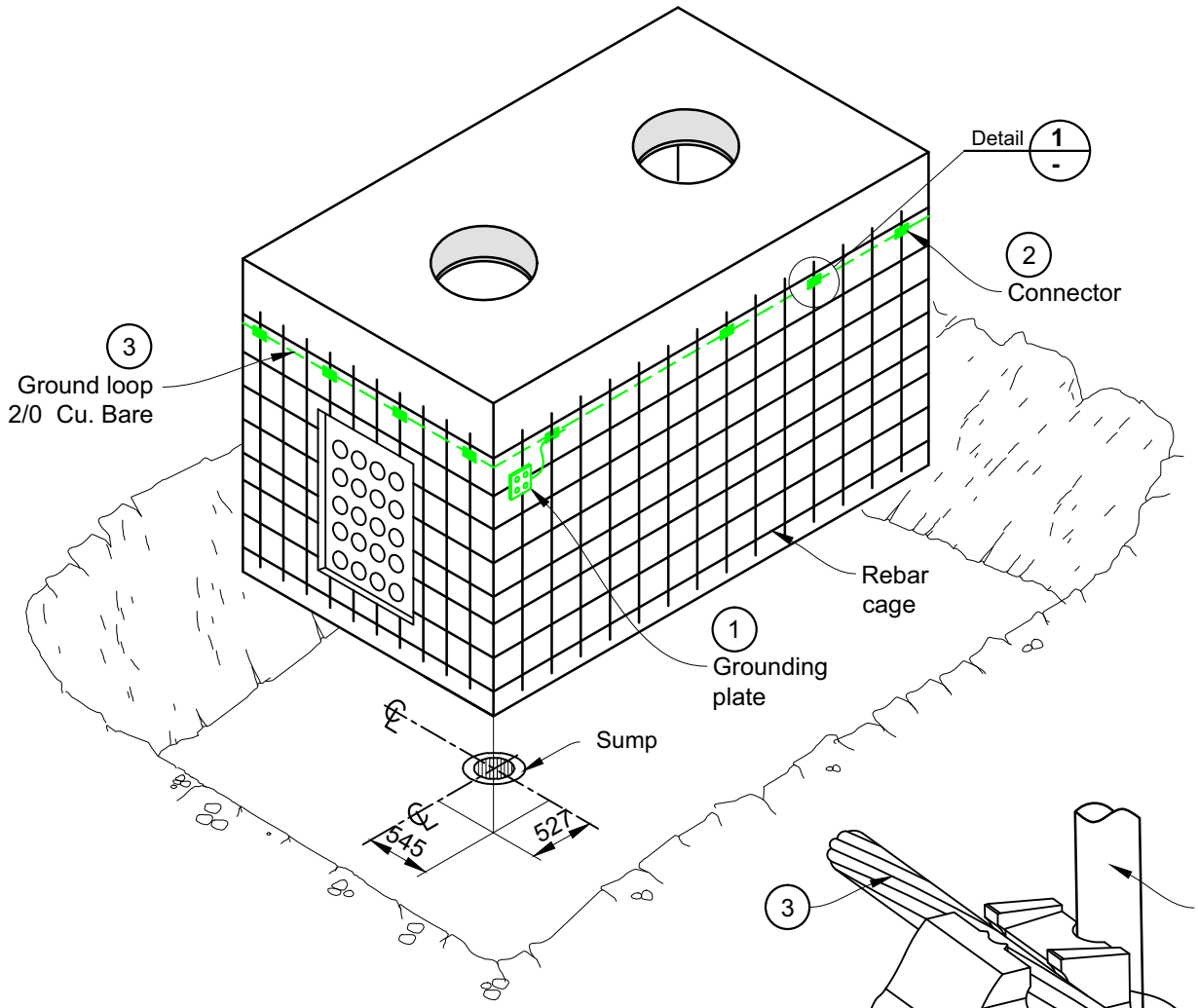
2017-02-15

GROUNDING OF CONCRETE VAULTS WITH INTERNAL GROUND ELECTRODE

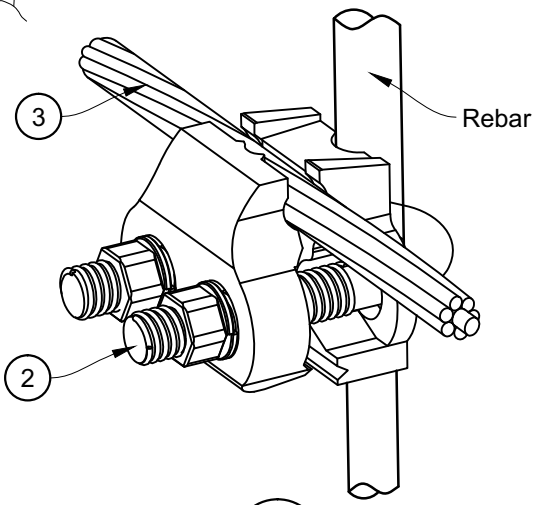
PAGE 1
OF 3

ES54 R3-02.01

R
1



Cast-in-Place Concrete Vault



Detail 1 –

REVISIONS: R.1 - CAST IN PLACE ADDED. FEB '17 MK

DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD	GROUNDING OF CONCRETE VAULTS WITH INTERNAL GROUND ELECTRODE	
M. KELVIN	C. PICASSI	F. DENNERT	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. KELVIN 2017-02-15		
DISTRIBUTION STANDARDS BC Hydro	ISSUED: FEB 2017 REPLACES:MAR 2016 ORIGINALLY ISSUED: MAR 2016			PAGE 2 OF 3	ES54 R3-02.02 R 1

Notes

1. BC Hydro has implemented the industry standard for a concrete-encased integral ground electrode for grounding large concrete vaults. Ground resistance of a large subsurface vault could be hundreds of times lower than the ground resistance of the BC Hydro standard ground rod. This has been confirmed by the field measurements tabled in the BC Hydro ETR 012 engineering report.
2. Large subsurface concrete vaults with integral grounding do not require an external counterpoise and external ground electrodes.
3. Concrete vaults with integral ground electrode have one or more visible ground pads on the inside wall surfaces of the vault.
4. This standard may be used as a reference for precast concrete vaults, as well as cast-in-place concrete vaults with an integral concrete-encased ground electrode.

Bill of Material

Item	Description	Part Number	Quantity	Supplied By
1	Ground pad assembly, 2/0 Cu bare 24" long c/w weldable bar	ERICO EWB2G9161	4	Precast Concrete Fabricator
1	Ground pad, 2/0 Cu bare c/w C-tap connector, 4 holes NEMA spacing	BURNDY YGF29-2N	2	Cast-in-place Contractor
2	Ground loop to vertical rebar connector	Welded connection	As Required	Precast Concrete Fabricator
2	Ground loop to vertical rebar connector	BLACKBURN GUV5821	As Required	Cast-in-place Contractor
3	Ground loop	Continuous weldable rebar loop	As Required	Precast Concrete Fabricator
3	Ground loop	Continuous 2/0 AWG Cu bare, stranded	As Required	Cast-in-place Contractor

Reference Document

BC Hydro ETR 012 Engineering Report

Reference Standards

ES54 R4-01 Grounding in High Corrosion Areas

ES53 R3-01 Bonding and Grounding in Manholes, General Layout

REVISIONS: R.1 - CAST IN PLACE ADDED. FEB '17 MK

DESIGNED	RECOMMENDED	ACCEPTED	ENGINEER OF RECORD
M. KELVIN	C. PICASSI	F. DENNERT	2017-02-15

DISTRIBUTION STANDARDS
BC Hydro

ISSUED: FEB 2017
REPLACES:MAR 2016
ORIGINALLY ISSUED: MAR 2016

GROUNDING OF CONCRETE VAULTS WITH INTERNAL GROUND ELECTRODE

ES54 R3-02.03

R 1

A. Parameters Defining Corrosive Soils

The corrosiveness of soils is roughly based on three parameters: pH, soil resistivity and chloride ion content. Table 1 lists the value ranges of the parameters for which a copper grounding system should be used.

Table 1 Criteria for Selecting a Copper Grounding System

Soil Parameter	Value Range	Comments
pH	< 6	Occurs in peaty, marshy areas.
soil resistivity	< 25 Ω -m	Occurs in loamy or clay soil with >20% moisture content. (This type of permanent soil condition is extremely rare.)
chloride ion	> 50 ppm	Occurs in areas at or within a few metres of sea level.

If one or more of the soil parameters fall within the value range of Table 1, and the sulphide ion is not present, a copper grounding system should be used. If the sulphide ion is present, as in soils holding swamp water or polluted brackish water, then the general purpose galvanized steel grounding system should be used.

B. Procedure for Determining Soil Parameters

If an area is suspected of having corrosive soils, or if there has been a history of corrosion problems with ground rods and anchor rods (on O/H systems), then a soil sample should be taken using the following procedure:

1. Remove the top 0.3 m of soil cover and fill a one-litre plastic freezer bag with a soil sample. Care should be taken to ensure that the soil retains any water that it may contain.
2. Copy form on page 3, complete Section A and send with the soil sample (suitably packaged for mailing) to Powertech Labs, and send a copy of the form to Distribution Standards Department.

C. Documentation and Responsibility

The designer shall be responsible for recognizing possible corrosive soil conditions. However, a copy of the soil sample form should be routed to the appropriate Field Service Engineer, who should act as the central coordinator for mapping of potential corrosive soil areas.

D. Revised Bill of Material

Pad-Mounted (see ES54 R1-01)

Item	Description	Catalogue ID	Quantity	Supplied By
1	Counterpoise, #2/0 MHD copper	380-0155	As Required	BC Hydro
2	Ground rods, copper-clad steel, ⅝" x 9'	420-1104	2	BC Hydro
3	Connector, copper bronze, counterpoise/ ground conductor to ground rod	420-1159	2	BC Hydro
4	Connector, tinned bronze, two bolt	388-0353	1	BC Hydro

URD & UD Sub-Surface Structures (see ES54 R2-01)

Item	Description	Catalogue ID	Quantity	Supplied By
1	Ground rod, copper-clad steel, ⅝" x 9'	420-1104	1	BC Hydro
2	Connector, copper bronze, counterpoise/ ground conductor to ground rod	420-1159	1	BC Hydro
3	#2 MHD Cu, P.E. jacketed	380-0256	As Required	BC Hydro

Vaults (see ES54 R3-01)

Item	Description	Catalogue ID	Quantity	Supplied By
1	Ground rods, copper-clad steel, ⅝" x 9'	420-1104	2	BC Hydro

Powertech Labs Inc.
12388 - 88th Avenue
Surrey, B.C.
V3W 7R7
OCS: Powertech, Surrey
ATTENTION: _____

Form for Submitting Soil Sample for Corrosion Analysis

Section A (To be filled in by designer)

1. Location of sample:

2. Date sample was taken:
3. General weather conditions:

4. Return Address:

Section B (To be filled in by Powertech Labs Inc.)

Soil Parameter	Value	
pH		
soil resistivity		Ω-m
chloride ion		ppm

Sulfide Ion present: (check appropriate one) YES NO

COMMENT (if any)

cc. BC Hydro
Distribution Standards Department
6911 Southpoint Drive, 13th Floor
Burnaby, B.C.
V3N 4X8
OCS: Distribution Standards Department