CONSTRUCTION OF PRIMARY UNDERGROUND ELECTRICAL SYSTEMS

HOLY CROSS ENERGY GUIDEBOOK

April 2024

Prepared For

HOLY CROSS ENERGY

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SGM Project # 2017-480.014

Foreword

Holy Cross Energy has implemented a policy which requires the Owner to provide all the excavation, backfill, compaction and cleanup needed for the installation of the underground power system extension to serve the Project. The Owner must also set all vaults and install all conduits as specified by Holy Cross Energy's design for the Project and the enclosed construction specifications. Holy Cross Energy will supply all material which will be delivered to construction site or can be picked up by the Owner at the appropriate storage yard.

Holy Cross Energy has been affected by supply chain issues since 2021, similar to other areas of construction. Some impacts have been concrete vault availability, pad mount transformer availability, and conduit supply. Understandably, the costs of these components have and continue to fluctuate as well. We have been forced to change designs or substitute comparable but different products to accomplish an acceptable final product. This document assumes our desired design and availability, but Holy Cross will entertain options if possible. All changes need to go through Engineering review and receive approval prior to construction

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PART 1 – CONSTRUCTION OF UNDERGROUND ELECTRICAL SYSTEMS

LIST OF APPENDICES

1.0 UG Section 1 – Definitions

THE FOLLOWING DEFINITIONS ARE FURNISHED FOR THE APPROPRIATE INTERPRETATION OF THIS TEXT AND ARE NOT NECESSARILY UNIVERSALLY ACCEPTED DEFINITIONS.

BACKFILL
The process of putting soil back into a trench/excavation.

BOLLARD
A short post used to protect an area or piece of equipment from being damaged.

COMPACTION
The process of compressing particles together to reduce the air space between them—creating a hard surface.

CONDUIT
Standard tubular material used for mechanical protection of electrical systems which may be exposed, buried beneath the surface of the ground or encased in a building structure as required.
NOTE: For the purpose of this publication, this term is used interchangeably with DUCT.

CONTRACTOR
Any person, company, or corporation acting under agreements for either Holy Cross Energy or the consumer.

GRADE
The ground level/elevation at a certain point.

GRC
Galvanized Rigid Conduit (NEC).

GROUNDING
The process of providing a safe way for excess electricity to travel back to the ground. It is a safe way to discharge excess energy from a system.

HDPE – High Density Polyethylene
Commonly used in bore applications.

HOLY CROSS ENERGY INSPECTOR
Person, provided by Holy Cross Energy, that will conduct site visits to ensure project is being constructed per Holy Cross Energy Specifications.

JUNCTION BOX
Plastic box used to enclose wire connections that transfer power from transformer to secondary conduits and provides added secondary lug spaces, allowing electricians to pull their wire without opening the transformer. See Appendix A-2 through A-3.

OWNER
The head person, company, or corporation receiving the product.

PROJECT
The overall construction of power facilities that will serve a specified area.

PROJECT ENGINEER
Person in charge of the project's design.

PROJECT MANAGER
Person in charge of planning, monitoring, and executing the project.

PVC
Polyvinyl Chloride (plastic pipe) (NEC)

ROAD BASE
A blend of gravel and fine materials which will form a hard surface with high levels of strength when compacted.

SHALL
Used to say that something certainly will or must happen.

SUBGRADE
The native soil/material (usually compacted) that is used to withstand the loads above it (roads, slabs, etc.).

SWITCHGEAR
Electrical equipment composed of switches, fuses, and breakers to control, protect, and isolate electrical lines/equipment.

TRANSFORMER
Electrical apparatus used to change the voltage traveling through power lines. Usually decreases the voltage levels to be more suitable for residential and commercial use.

TRENCH
A narrow, hollow excavation made to lay utilities in the ground or have access to services.

VAULT
Container made of concrete that will be set underground to store cables/wires. This container will sit on a concrete base and have a concrete lid on top.

2.0 UG Section 2 – Trench and Conduit

1. The developer or contractor will contact Holy Cross Energy before conduit and vault installation begins to schedule a pre-construction meeting with the project manager.

2. Changes in power facility construction from that shown on the project plans will not be made without advance approval from the Holy Cross Energy Inspector and/or Holy Cross energy Project Engineer.

3. Holy Cross Energy material shall not be moved from the project to which it was assigned without the advance approval of the Inspector and the completion of necessary paperwork. Holy Cross Energy material shall not be installed for any use other than the construction of power facilities.

4. All roads will be built to subgrade and all drainages will be constructed to grade before any vaults or conduits are installed.

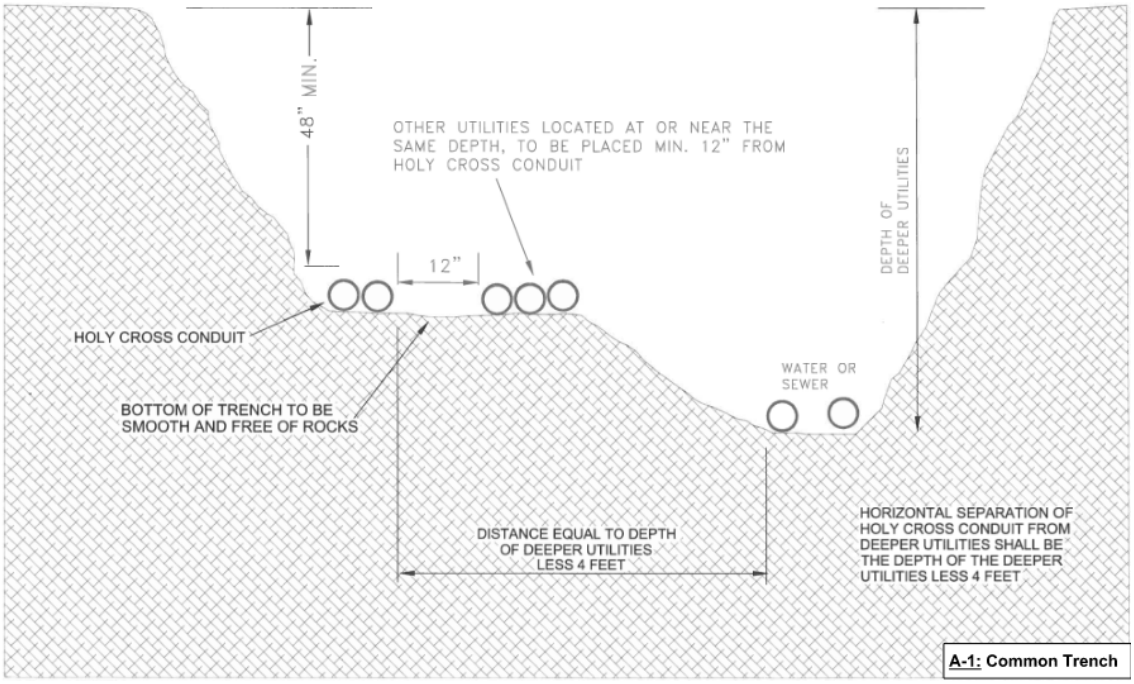
5. Contractor shall use GRC conduit (provided by Holy Cross Energy) at all bridge crossings. We have historically allowed welded steel provided by others. HCE Engineering approval required.

6. All trenches will be excavated deep enough to ensure that the top of installed power facilities will be 48” below final grade. Special care must be taken to ensure that the top of conduits will be 48” below the bottom of drainage ditches and all other low areas.
   When 48” of cover cannot be achieved, the inspector may require additional conduit protection.
   - MIN COVER is 30” ref: NEC Table305.15(A) & Note 4.
   - Recommendations: pipe is entirely encased instead of just capped; Dye concrete red to indicate electric.

Cover is 24” – 30”	= 2” concrete
Cover is 18” – 24”	= 4” concrete
Cover is 12” – 18”	= 6” concrete

7. Trench will be as straight as possible between vaults and shall have a smooth bottom free from low and high spots. Six (6) inches of well compacted ¾” road base will be placed on the entire length of the trench prior to conduit installation. Sand, crusher fines, and clean native soil are also acceptable.
   - When placed in the trench, the conduit shall be in continuous contact with the compacted road base with no hold down weight added.
   - Twelve inches of ¾” road base, as measured from the top of the conduit, will be placed on the conduit and well compacted prior to returning any native backfill to the trench. Large rocks shall not be placed directly on the road base layer.
   - **Care must be taken to avoid conduit damage during backfill and compaction; Conduits found to be unusable at the time of power cable installation will be repaired by the developer or our contractor before power can be made available.**

8. Power facilities to be placed parallel to deeper utilities will have a horizontal separation from the deeper utility greater than the depth of such utility below final grade less four (4) feet. When crossing a deeper utility is unavoidable, the crossing will be made as close to perpendicular as possible.



9. Power line conduits will be installed with a minimum separation of 12” from all other new or existing underground utility lines. Wherever possible, this separation will be horizontal. The 12” of separation shall be maintained when crossing other utilities in the trench. Whenever possible, gas line crossings should have 3’ of separation from HCE conduit.
    - The power line separation from plastic gas lines should be at least 3 ft whenever possible.
    - Power line conduits will be located deeper in the trench than the facilities of all other utilities unless the Inspector grants a waiver prior to the start of construction.
    - When two or more Holy Cross Energy conduits are being installed, the contractor shall maintain at least 1” of separation between conduits.

10. Backfill and compaction above the road base layer will be as required by the governmental entity or other party having jurisdiction.

11. Conduit bell ends are not allowed in the vaults. Holy Cross Energy will supply factory couplers/bends, 90^0, 45^0, and 22.5^0 elbows as needed for the job.

    - Non-factory bends and heated bends will not be allowed.
    - No more than 180 degrees of bend will be allowed in a conduit run of 500 feet. The conduit shall run straight between factory bends.
    - Allowed bends must be further than 5’ from a vault.
    - Factory elbows supplied must be used intact; they cannot be cut to make a lesser bend.
    - Bells will not be cut off conduit sticks to use as couplers.

- Holy Cross Energy elbows and pipe will be used only for the power facility installation.

12. The conduit will not be backfilled without the Holy Cross Energy Inspector seeing all joints unless the Inspector gives prior permission.
    - All joints shall be completely seated to the line marked on the male end of the conduit after sufficient glue is applied to both conduits being jointed, even in areas where the trench cannot be excavated completely straight.
    - Glue in the joint shall be allowed to completely dry prior to any stress being applied to the conduit on either side of the joint.
    - **Trench backfilled without the Inspector viewing each joint or giving prior permission to cover the conduit will be re-excavated to expose the conduit, or Holy Cross Energy will put a camera through each conduit in the span which was prematurely backfilled to verify the joint seating and conduit condition at the expense of the developer. If conduit is damaged and Holy Cross is unable to pull wire, a crew will be sent to camera the conduit to find the obstruction at a rate of $500 an hour.** The camera verification will be witnessed by the Holy Cross Energy Inspector.

13. Individual conduits shall enter each vault at a consistent location. There is to be no crossing of conduits in the trench.

14. Both ends of a conduit run shall be securely plugged at the time of installation with Holy Cross Energy supplied material. Conduit ending outside a vault shall be plugged and marked with a Holy Cross Energy supplied 4” X 4” post or other approved method.

15. Red caution tape will be supplied by Holy Cross Energy and shall be installed 24” above the conduit during backfill.

16. At completion of the job, the Inspector will do a final inspection. If the job does not meet Holy Cross Energy’s specifications or the approval of Inspector, service will not be provided until specifications are met.

17. Bore installations: HDPE will be minimum Sch40 with preference Sch80. Couple to PVC with a gasketed coupler or other approved HDPE to PVC connection.

*Example of an approved HDPE to PVC connection

3.0 UG Section 3 – Vaults

1. Vaults shall be installed as follows:

    1. Splice vaults shall be installed with the manhole lid grade being slightly above final grade of the surrounding area, except when the vault is in a roadway. The manhole lid grade shall match or be slightly below the grade of the finished roadway surface. Holy Cross Energy supplied grade rings may be required. Vaults placed in roads will not be located in areas normally traversed by vehicle wheels.

    2. Splice vaults located in roads or other sloped areas will be installed so that the concrete base and lid are at the slope of the surrounding area. The Inspector must approve all vaults installed at a slope.

    3. Transformer and switchgear vaults will be installed with the bottom of the lid slightly above final grade. The contractor will ensure bases for transformer and switchgear vaults are level prior to installation of vault sections.

    4. Where transformer and switchgear vaults are set into hillsides or sloped cuts, the downhill side of the vault will be graded according to “3” above. The slope behind the vault will be laid back sufficiently to prohibit soil or rocks from sloughing onto the vault. If the slope cannot be laid back far enough, a retaining wall shall be constructed behind the vault at the direction of the Inspector.

    5. All vault lids will be placed on the vaults at the time of vault installation to protect the public and wildlife, unless otherwise instructed by the Inspector. The holes through transformer and switchgear pads will be covered at the time of vault installation with concrete pieces supplied by Holy Cross Energy, unless otherwise instructed by the Inspector.

2. Holes knocked in vaults for conduit installation shall be as small as possible and shall be grouted closed on the outside of the vault and grouted smooth to the wall inside the vault prior to backfill. Any secondary conduit coming into a transformer vault shall be cut back to 4” and grouted smooth to the wall. Any holes knocked into vaults with energized cable must be performed by Holy Cross personnel.

3. Conduit shall enter vaults perpendicular to the vault wall, at least 6” from any adjacent walls and at least 4” above the vault base. There shall be a minimum separation of 1” between conduits.

4. Conduit will extend 4” into the vault (measured from the inside wall of the vault) after backfilling is complete.

5. Ground rods in vaults for underground cable installation shall be laid in the trench with the conduits. The end of the rod, which is inside the vault, shall extend approximately 6” into the vault through the conduit knockout with the rod bent at a 45-degree angle. The bent end of the rod must be far enough from the vault wall to allow crimping the grounding conductor onto the rod. The rod must be at least 2” from the conduit at its entrance into the vault.

6. After the vault has been set, conduits extended in and grouted, and the ground rod is in place, vaults shall be swept out, removing all dirt or rocks. Cleanup shall be completed to the satisfaction of the Inspector prior to cable installation being scheduled.

7. Pedestals for other utilities shall not be located closer than 10' to a vault on sides where transformers or switchgear will have access doors. Pedestals shall not be located closer than 4' to a transformer or switchgear on sides where the pad-mounted equipment will not have access doors. In other words, 10' of clearance is required in front of transformer/switchgear doors, and 4' of clearance on all other sides.

8. Vaults should not be placed within the distance of required bury depth of water or sewer lines without insulation added to prevent freezing of deeper utilities. (Not the same as the deeper utility depth minus four feet separation from conduit. See Appendix A-23: Vaults Adjacent to Water Lines.

4.0 UG Section 4 – DO's & DON'Ts

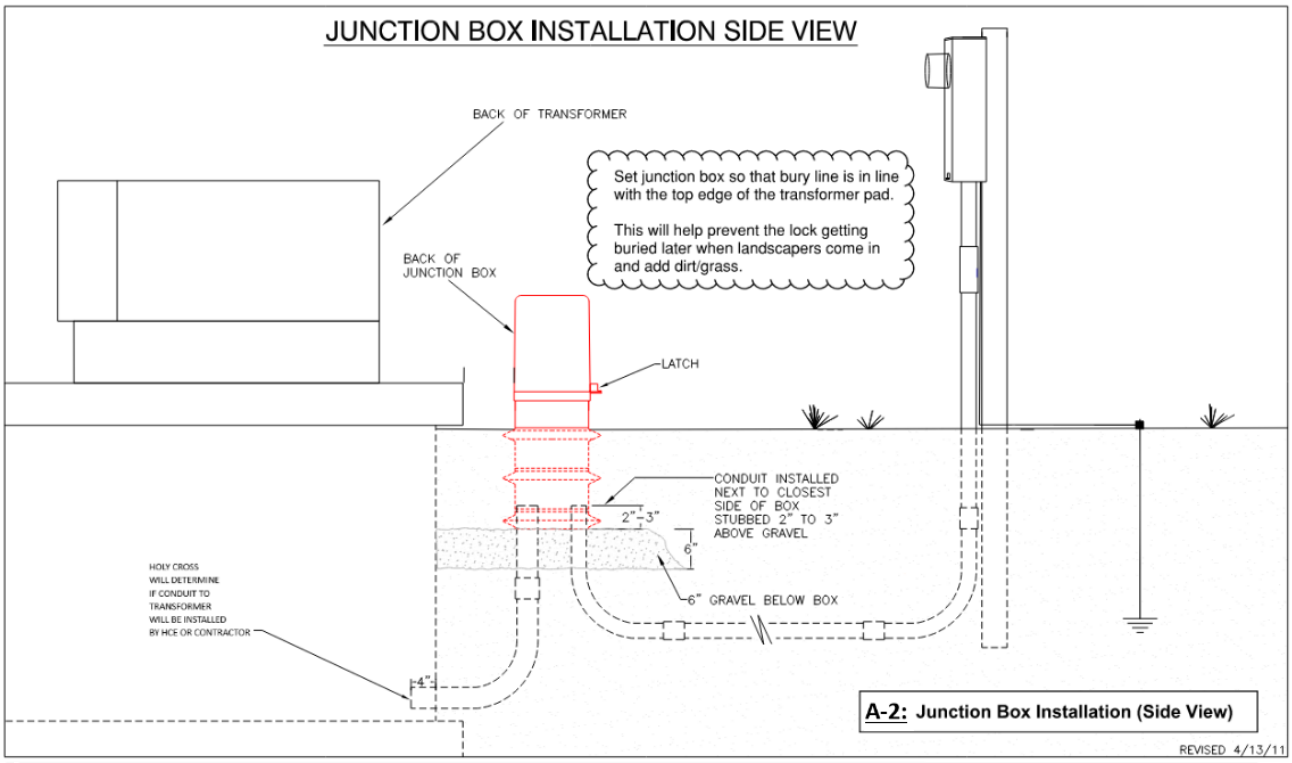
- Conduits Entering Vaults:
    - If two or more HCE conduits enter vault, they must have 1" of separation between them. See Appendix A-15: Required Separation Between Conduits
    - Conduits should extend into vault at equal lengths. See Appendix A-16: Conduit Lengths Inside of Vaults
    - Should be square and flush—especially when entering at an angle. Conduit ends cannot be cut to a tapered point. See Appendix A-17: Conduits Entering Vault at an Angle
    - Should not enter at adjacent corner windows in the same section. This leaves no space for grunt tube to pull wire. See Appendix A-18: Conduits Entering Vault Using Adjacent Corner Windows
    - Ground rod to be set next to conduit entering vault. If two conduits enter vault, ground rod must be set on one side of both conduits (not between conduits). See Appendix A-19: Ground Rod Adjacent to Conduits
    - Allowed bends must be further than 5 ft from vault. See Appendix A-20: Allowed Bends Near Vault
    - When entering vault level and straight is not possible, it is best to enter vault with conduits angling up, rather than angled toward the base. See Appendix A-21: Conduit(s) Entering Vault with A Vertical Angle
    - Bottom of conduit(s) must have at least 4" of separation from vault base. See Appendix A-22: Conduit and Vault Base Separation

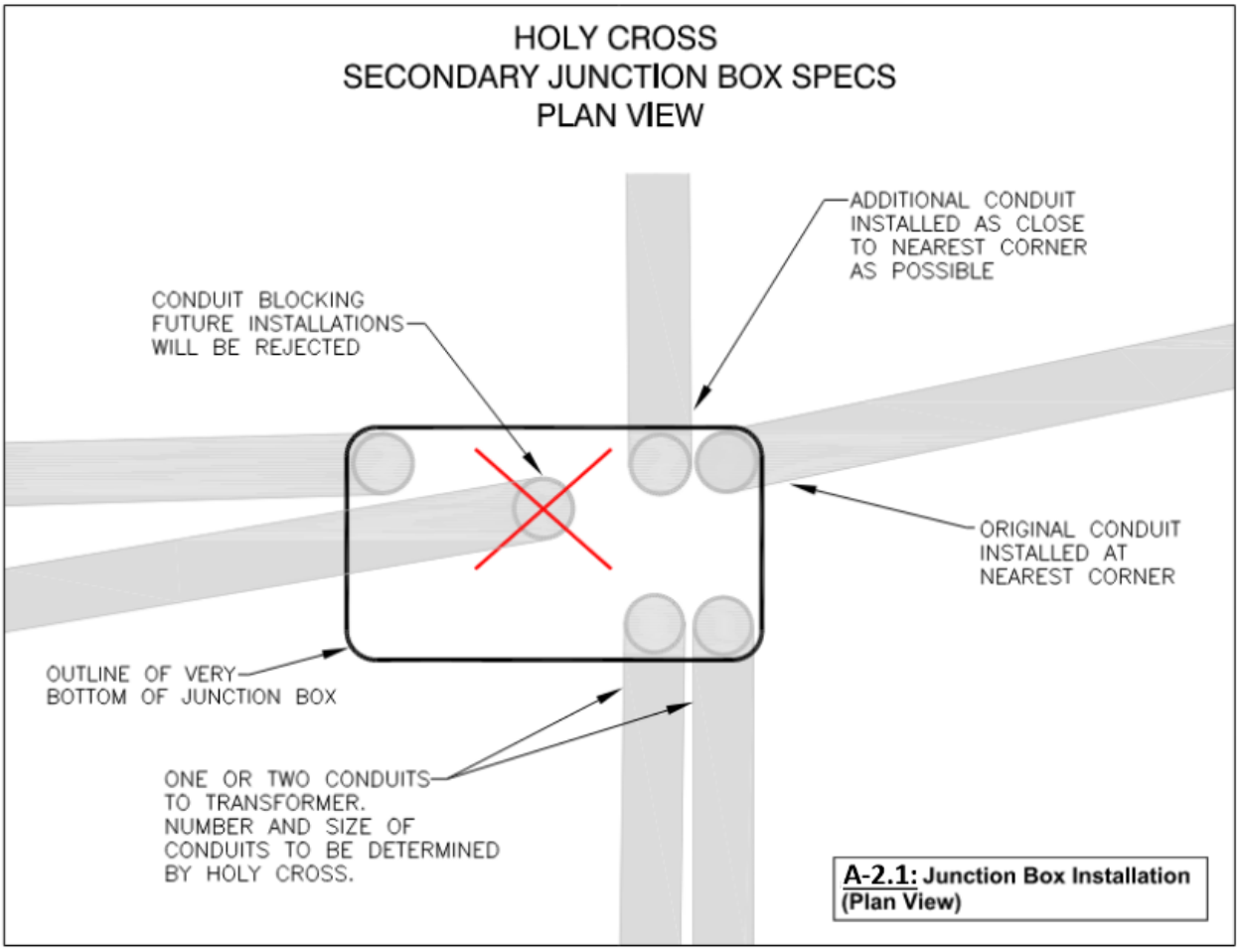
5.0 UG Section 5 – Junction Box

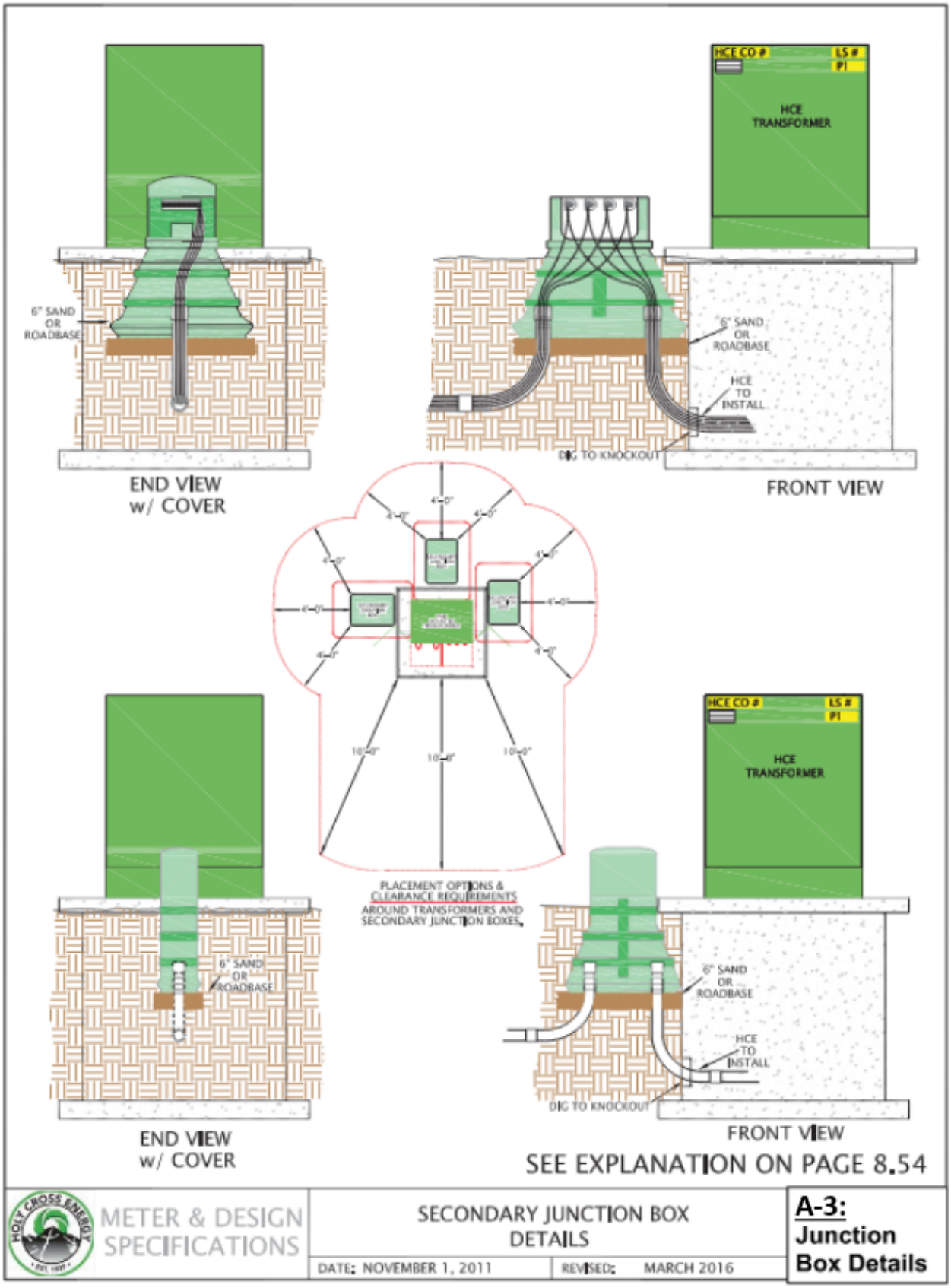
SECONDARY JUCTION BOXES (LARGE AND SMALL)

General Notes

1. A secondary junction box may be required next to 120/240V single phase and 120/208V three phase transformers per the design of the Holy Cross Engineering Department or as directed by a Holy Cross Operations representative. When required, the following conditions apply:
    - A. For new developments, the developer, owner, or electrician may be allowed to install the secondary junction box according to Holy Cross Energy specifications and directions.
    - B. Junction boxes shall be installed in the position determined by a Holy Cross Engineering or Operations representative.
    - C. Once the location has been determined for the junction box, the excavator shall excavate an area approximately 4' x 4' alongside the transformer for a Holy Cross Energy Service crew to install conduit and wire from the transformer vault to the junction box. This excavation shall be done before the Holy Cross Energy service crews arrive to assist on the installation of the junction box.
    - D. Junction boxes shall be installed on level ground and backfilled around the outside to the "ground line" mark on the outside of the junction boxes. The "ground line" mark on the outside of the junction box should be in line with the top edge of the transformer pad. This will avoid the lock from getting buried in the future when the landscapers add dirt and grass around the box. Note that the interior ground level of the box will be below the exterior, not fill shall be placed inside the junction box. Backfill shall be done after the HCE conduit is installed.
    - E. The junction location shall be over-excavated by 6" and bedded with a 6" depth of sand or road base to allow for improved access for future conduits and wires. Junction box shall be set one foot away from the transformer pad.
    - F. The party responsible for the installation of the junction box shall confirm the secondary conduit entrance location with Holy Cross. Failure to install the conduit as directed by Holy Cross may result in the need for the conduit to be moved/reinstalled.
    - G. Secondary conduit sizes for small junction boxes (approximately 24" x 13") shall be limited to no larger than 3" diameter and limited to no more than 6 consumer conduits per junction box.
    - H. Secondary conduit sizes for large junction boxes (approximately 32" x 18") shall be limited to no larger than 4" diameter and limited to no more than 5 consumer conduits per junction box.
    - I. The conduit inside the junction box shall be set 3" below the "ground line" on the outside of the junction box.
    - J. It is suggested, in some areas, that the consumer's conduit inside the junction box be neatly sealed with foam to prevent dirt from entering the conduit.
    - K. The electrician shall pull enough wire to leave 18" of excess above the top of the junction box when the lid is off.
    - L. Excess compaction at the exterior ground level can lead to damage of the junction box. The cost of replacing a junction box shall be the responsibility of the party who caused the damage.
    - M. Installation of the junction box shall be such that there is room provided for future expansion. Service pipes shall be installed neatly and exit the side of the box facing the service location.


JUNCTION BOX INSTALLATION SIDE VIEW
BACK OF TRANSFORMER
Set junction box so that bury line is in line with the top edge of the transformer pad.
This will help prevent the lock getting buried later when landscapers come in and add dirt/grass.
BACK OF JUNCTION BOX
LATCH
CONDUIT INSTALLED NEXT TO CLOSEST SIDE OF BOX STUBBED 2" TO 3" ABOVE GRAVEL
2"-3"
6"
6" GRAVEL BELOW BOX
HOLY CROSS WILL DETERMINE IF CONDUIT TO TRANSFORMER WILL BE INSTALLED BY HCE OR CONTRACTOR
4"
A-2: Junction Box Installation (Side View)
REVISED 4/13/11


HOLY CROSS
SECONDARY JUNCTION BOX SPECS
PLAN VIEW
ADDITIONAL CONDUIT INSTALLED AS CLOSE TO NEAREST CORNER AS POSSIBLE
CONDUIT BLOCKING FUTURE INSTALLATIONS WILL BE REJECTED
ORIGINAL CONDUIT INSTALLED AT NEAREST CORNER
OUTLINE OF VERY BOTTOM OF JUNCTION BOX
ONE OR TWO CONDUITS TO TRANSFORMER. NUMBER AND SIZE OF CONDUITS TO BE DETERMINED BY HOLY CROSS.
A-2.1: Junction Box Installation (Plan View)


HCE CO #
LS #
PI
HCE TRANSFORMER
6" SAND OR ROADBASE
HCE TO INSTALL
DIG TO KNOCKOUT
END VIEW w/ COVER
FRONT VIEW
PLACEMENT OPTIONS & CLEARANCE REQUIREMENTS AROUND TRANSFORMERS AND SECONDARY JUNCTION BOXES.
END VIEW w/ COVER
FRONT VIEW
SEE EXPLANATION ON PAGE 8.54
METER & DESIGN SPECIFICATIONS
SECONDARY JUNCTION BOX DETAILS
DATE: NOVEMBER 1, 2011
REVISED: MARCH 2016
A-3: Junction Box Details

6.0 UG Section 6 – Clearances and Screening

EQUIPMENT SCREENING SPECIFICATIONS

HOLY CROSS ENERGY
ENGINEERING DEPARTMENT
3799 Highway 82 – P.O.Box 2150
Glenwood Springs, Colorado 81602
(970) 945-5491

All proposed designs or proposed alterations to existing screens shall comply with the following specifications. Proposals (plans and specifications) shall be submitted to the Holy Cross Energy Engineering Department for written approval prior to construction. Compliance and approval shall be the sole determination of the Holy Cross Energy Engineering Department. Noncompliance with these specifications or failure to gain written approval, shall result in the denial of a permanent meter connection or the dismantling of nonconforming screens.

Examples of suggested equipment screens are shown on the drawings that follow.

General Specifications:

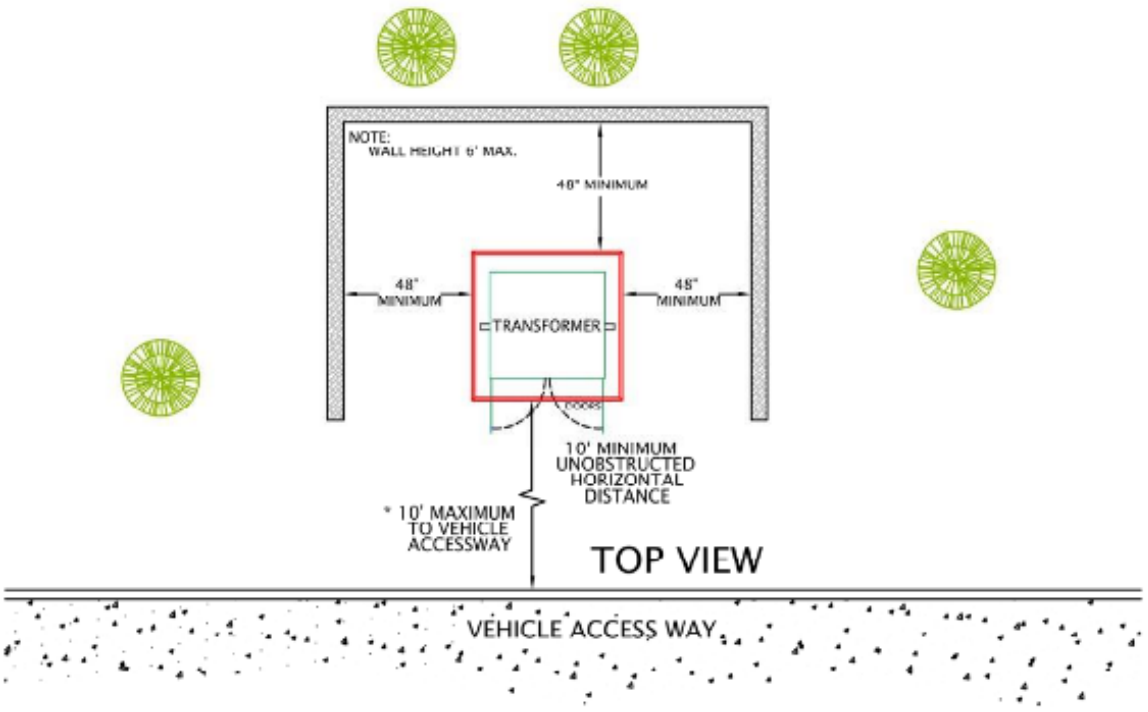
1. Holy Cross Energy shall not be liable for any damage to screens.
2. Screen construction and maintenance shall be the responsibility of parties other than Holy Cross Energy.
3. The area inside the screen shall be kept clean. There shall be no material of any kind inside the screen.
4. Holy Cross Energy equipment will be installed in accordance with Holy Cross Energy installation specifications.

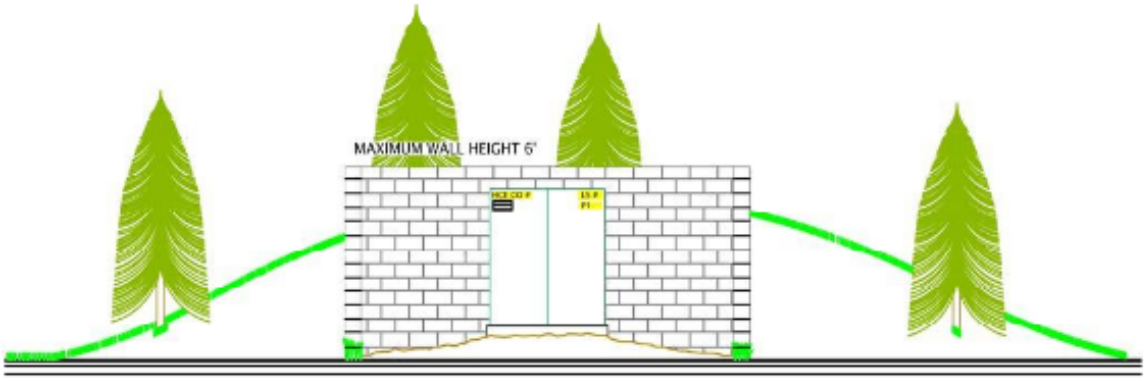
Design Specifications:

1. All equipment shall be readily accessible by Holy Cross Energy personnel.
2. All construction shall be permanent in nature and shall not interfere with operation and maintenance of Holy Cross Energy facilities.
3. There shall be a maximum of 10 feet horizontal distance from equipment to nearest vehicle access way to permit removal or replacement of equipment.
4. There shall be a minimum of 10 feet level, unobstructed, horizontal distance in front of equipment doors for maintenance and operations activities.
5. Water, snow, and ice buildup shall be prevented. Proper drainage shall be provided. The area inside the enclosure shall be gravel or concrete. Snow removal by parties other than Holy Cross Energy may be required. Equipment will not be located under rooflines where water, snow or ice buildup and drainage may occur.
6. Equipment shall not be covered in any manner above the equipment.
7. There shall be no doors or moving parts associated with the screen. *
8. Walls shall be a maximum of six feet in height.
9. There shall be no walls within ten feet of equipment sides having doors.
10. Equipment doors shall be able to open fully. *
11. Proper equipment ventilation (minimum four feet from equipment pad shall be maintained. This may require snow removal by parties other than Holy Cross Energy.
12. Shrubs and trees (in all stages of growth), ornamental decoration, landscaping or any other camouflage shall conform to all specifications.
13. Contact Holy Cross Energy for equipment and pad dimensions.

* Doors are discouraged. However, in some cases, such as locations near schools, doors may be approved for equipment screening. Door supports shall be concrete block or concrete. Doors shall be of sturdy construction and open onto an area that is kept free of snow and ice, such as parking lots, driveways, etc. Doors shall have removable hinges and be locked with a Holy Cross Energy lock. If problems develop with door operation, the doors will be dismantled.

8.46

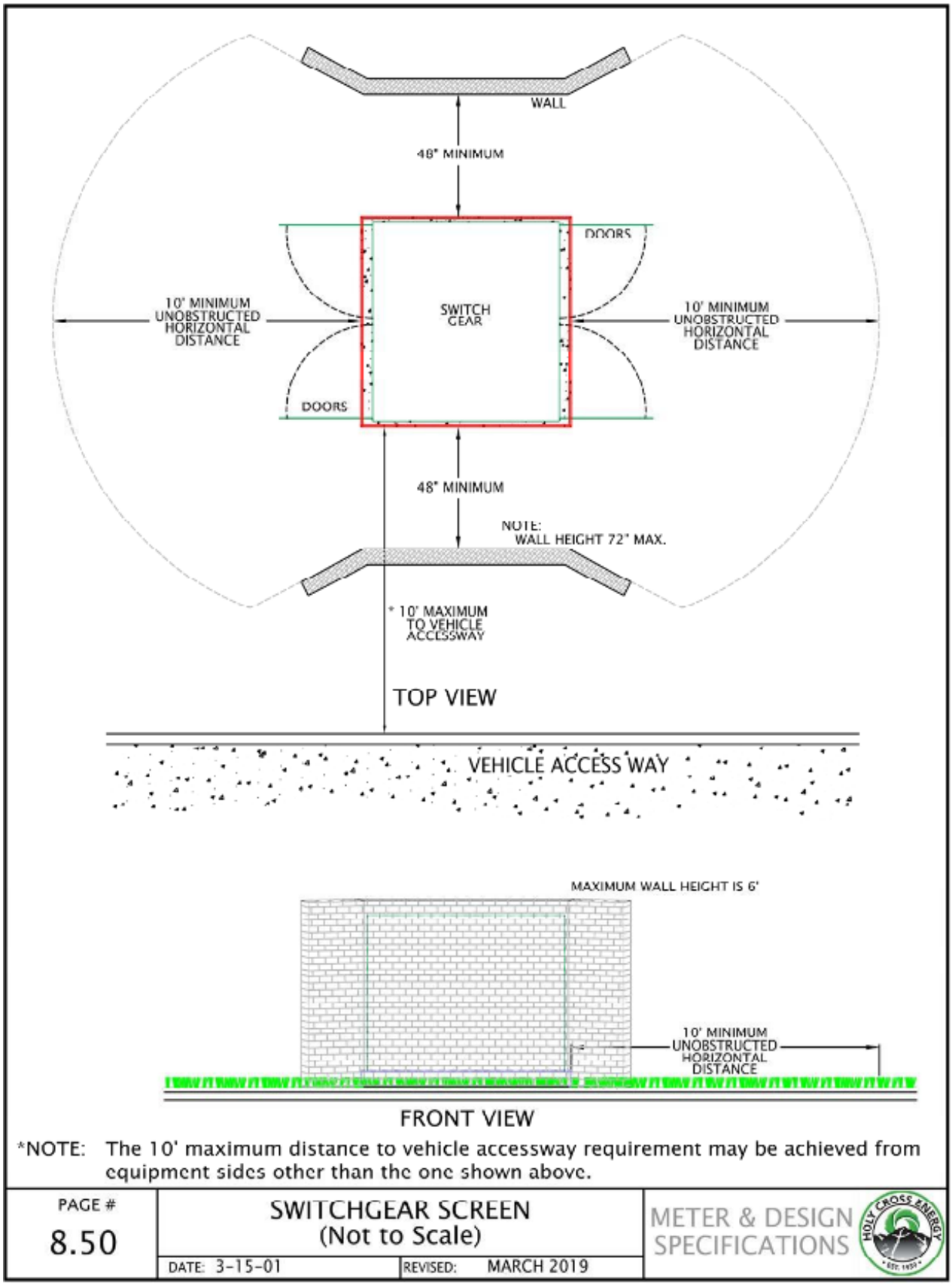




FRONT VIEW

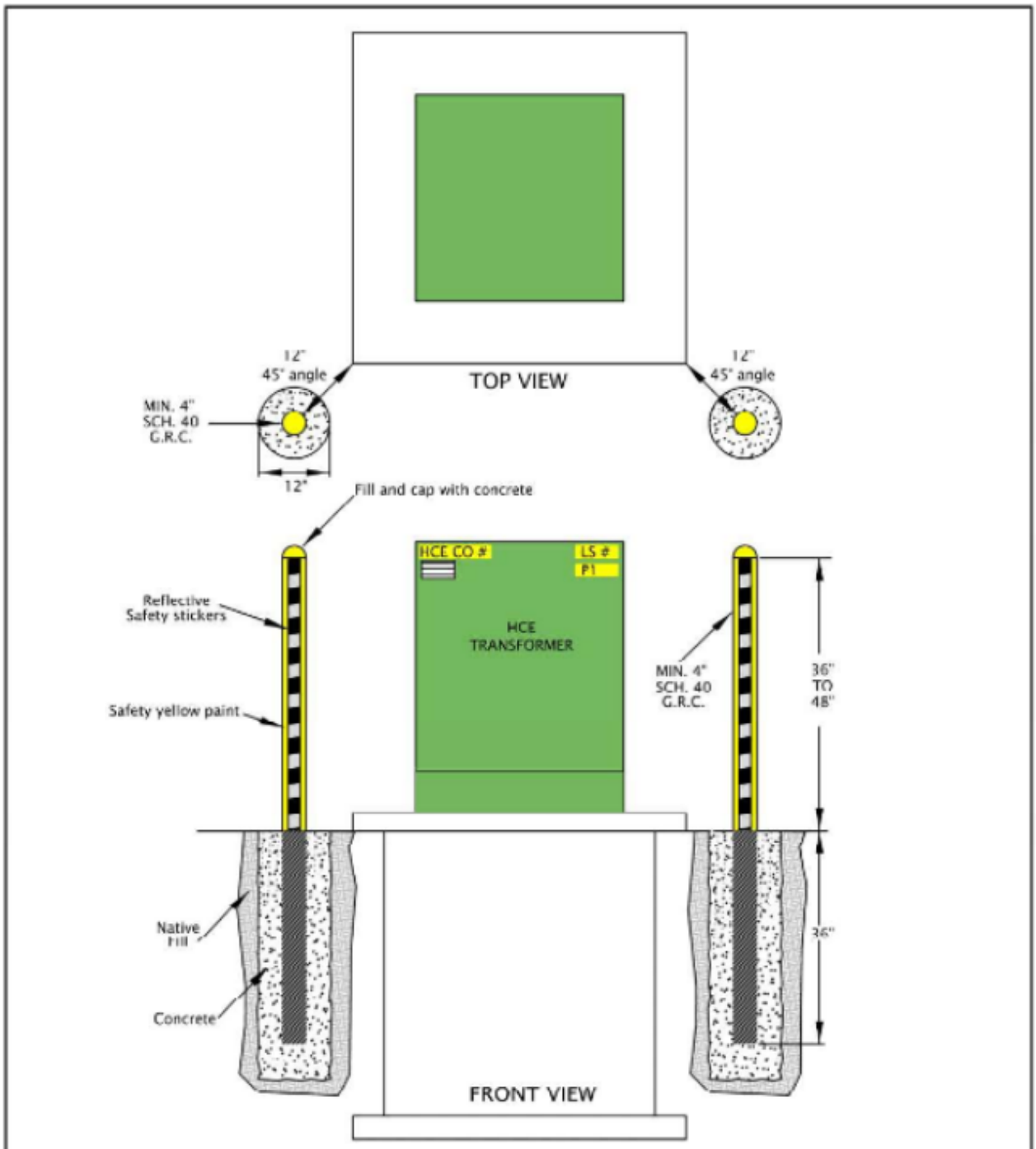
*NOTE: The 10' maximum distance to vehicle accessway requirement may be achieved from equipment sides other than the one shown above.

METER & DESIGN SPECIFICATIONS	TRANSFORMER SCREEN (Not to Scale)	PAGE # 8.47
	DATE: 3-15-01 REVISED: MARCH 2019	



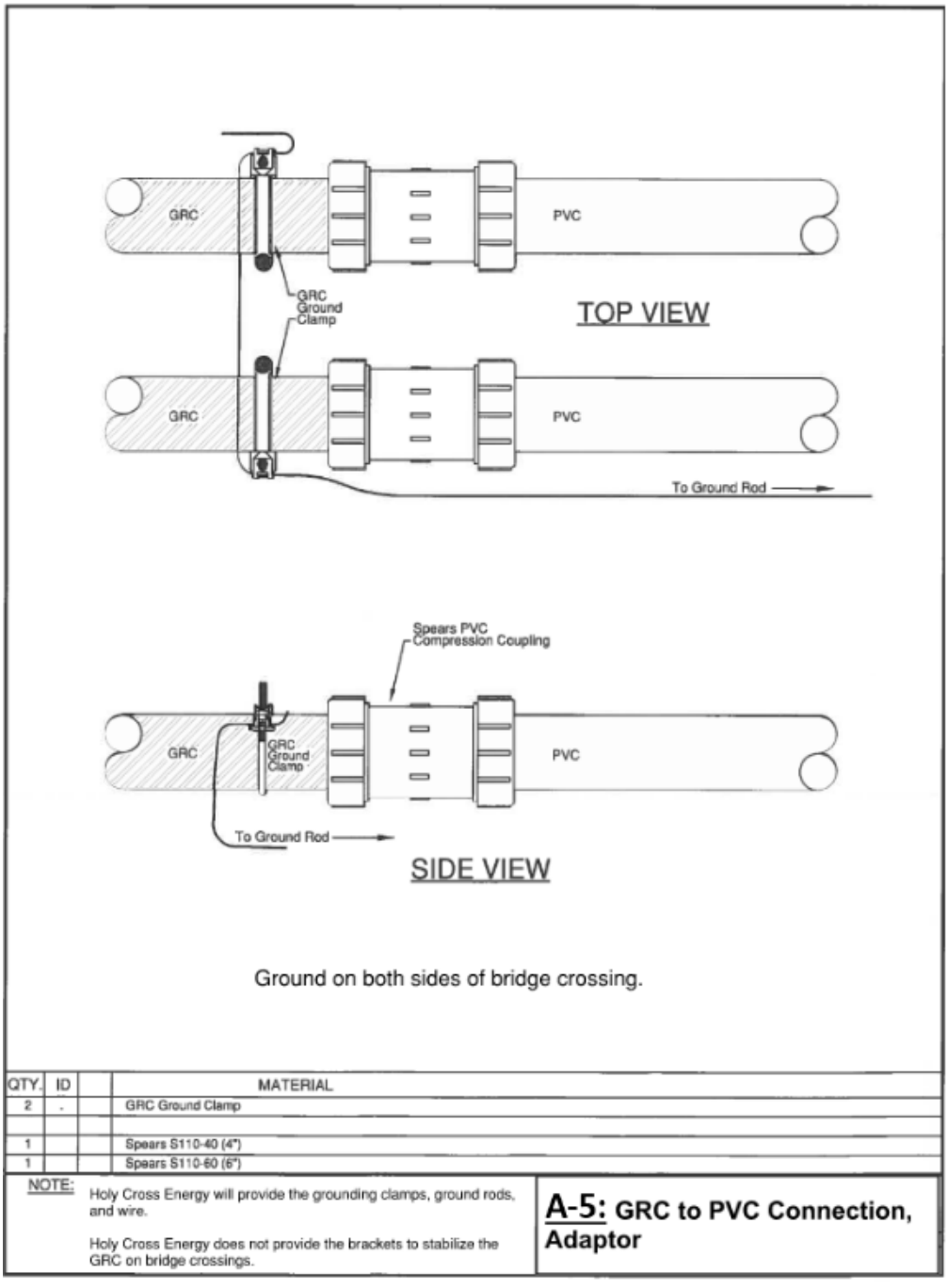
*NOTE: The 10' maximum distance to vehicle accessway requirement may be achieved from equipment sides other than the one shown above.

PAGE #	SWITCHGEAR SCREEN (Not to Scale)	METER & DESIGN SPECIFICATIONS
8.50	DATE: 3-15-01 REVISED: MARCH 2019	


TOP VIEW
12" 45° angle
12" 45° angle
MIN. 4" SCH. 40 G.R.C.
12"
Fill and cap with concrete
HCE CO #
LS #
P1
HCE TRANSFORMER
Reflective Safety stickers
Safety yellow paint
MIN. 4" SCH. 40 G.R.C.
36" TO 48"
Native Fill
Concrete
36"
FRONT VIEW
COLORADO 811
SEE EXPLANATION ON PAGE .
METER & DESIGN SPECIFICATIONS
SINGLE PHASE TRANSFORMER BOLLARDS DETAIL
DATE: JUNE, 2019
REVISED:
A-4:
Bollard Details

7.0 UG Section 7 – Bridge Crossings

Bridge crossings typically involve GRC or welded steel conduit (SCH80 (not pvc - too brittle when exposed) or greater with no way to come apart at joints) coupled to pvc outside of bridge abutment, with a special coupler incorporating a means to ground the steel pipe by bonding to a ground rod on both ends. See sheet 39 for GRC to PVC coupler.
If the conduit doesn't have 30" cover, means are required to meet our depth requirements until 30" is met. Conduit in the bridge should not extend down any lower than any other bridge structure component. Pipe should be supported every 10'.



8.0 Appendices

Vault Types

SPLICE VAULTS

- UM30R – Used in applications where 6 or less primary conductors are planned. See Appendix A-6: Splice Vault UM30R
- UM30S – Used in applications where 7 or more primary conductors are planned. See Appendix A-7: Splice Vault UM30S
- UM1-35L – Used for 500 MCM cable when more than 6 splices are anticipated (maximum 12 splices), or when a large number of conduits are needed. See Appendix A-8: Splice Vault UM1-35L

Note: The 40420 pad can be swapped out for a 40430 pad when a manhole flush with the pad is preferred.

SINGLE PHASE TRANSFORMER VAULTS

- UM1-3 – 4' Round, Used in applications where no three phase expansion is planned. See Appendix A-9: Single Phase Vault UM1-3
- UM1-3S – 4' Square, Used in applications where three phase expansion *could* happen, but would be less than 300 kVA. See Appendix A-10: Single Phase Vault UM1-3S

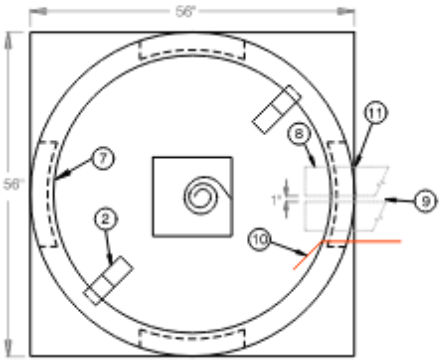
Note about square vs. round vaults. Knockouts on square vaults go all the way to the bottom, so the square vault works better for intercepting (notching) existing conduit/cable.
Exception: To retrofit a large 6 x 6 vault for a 1phase transformer, there is a UM40440 Lid with a manhole in one corner/1ph transformer hole in the opposite corner.

THREE PHASE TRANSFORMER VAULTS

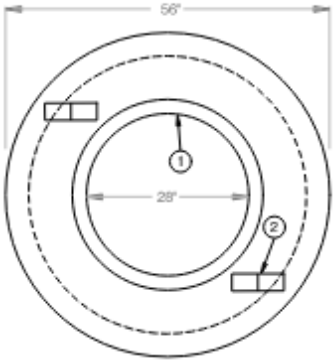
- UM1-11S – Three phase, 500 kVA or larger. See Appendix A-11: 3 Phase Vault UM1-11S
- UM1-13S – Three phase, 300 kVA or smaller. See Appendix A-12: 3 Phase Vault UM1-13S

SWITCHGEAR VAULTS

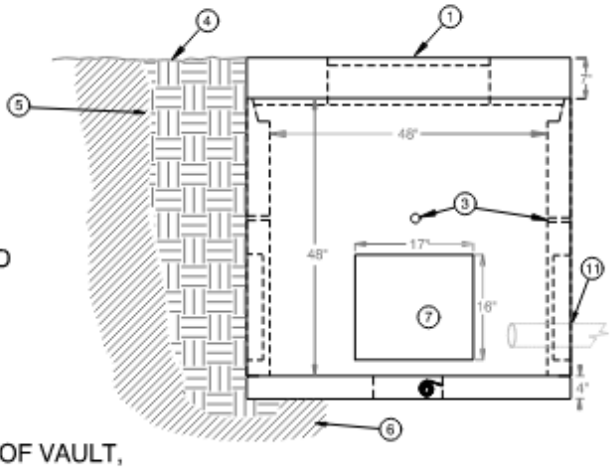
- UM1-35 – Used for all switchgear applications. Switchgear vault can be either 2 or 3 sections, but 3 sections is preferred. See Appendix A-13: Switchgear Vault UM1-35
- Optional lid for Vista model SG or where smaller hole is desirable: UM40655



VAULT CENTERED ON BASE



PAD CENTERED ON VAULT



NOTES:

1. 28" MANHOLE
2. LIFTING HANDLES
3. 1" LIFTING HOLE (TOTAL OF FOUR)
4. GROUND LEVEL WITH THE TOP OF PAD
5. BACKFILL TO BE WELL COMPACTED
6. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
7. FOUR KNOCKOUTS (17"X16")
8. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
9. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
10. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2" OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
11. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT

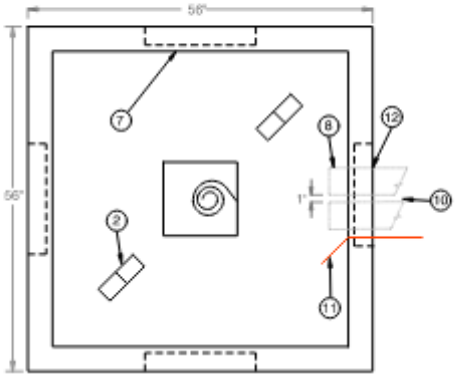
Splice Vault (Round)	
1 - 40150 Small Base	~1,100 lbs.
1 - 40750 4' x 4' Round Vault	~2,500 lbs.
1 - 40400 Pad	~1,300 lbs.

REVISED 03/26/2024 BY: GW

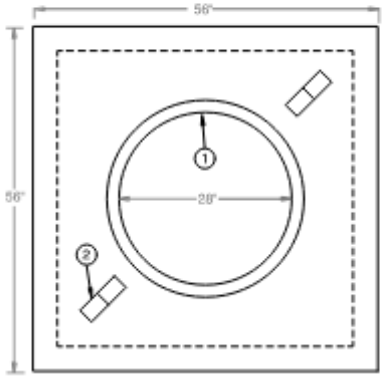
VAULT DESIGN SPECIFICATIONS

SPLICE VAULT (4' ROUND)

Date	Unit
2024	UM30R



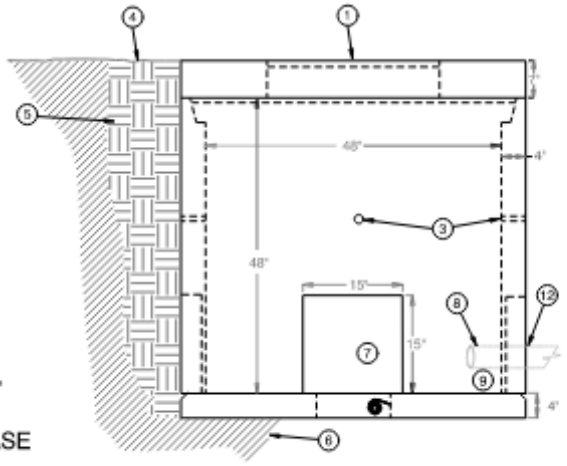
VAULT CENTERED ON BASE



PAD CENTERED ON VAULT

NOTES:

1. 28" MANHOLE
2. LIFTING HANDLES
3. 1" LIFTING HOLE (TOTAL OF FOUR)
4. GROUND LEVEL WITH TOP OF PAD
5. BACKFILL TO BE WELL COMPACTED
6. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
7. FOUR KNOCKOUTS (15"X15")
8. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
9. CONDUITS(S) SHALL BE SET 4" ABOVE VAULT BASE
10. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
11. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2" OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
12. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT



Splice Vault (Square)	
1 - 40150 Small Base	~1,100 lbs.
1 - 40700 4' x 4' Square Vault	~3,500 lbs.
1 - 40410 Pad	~1,700 lbs.

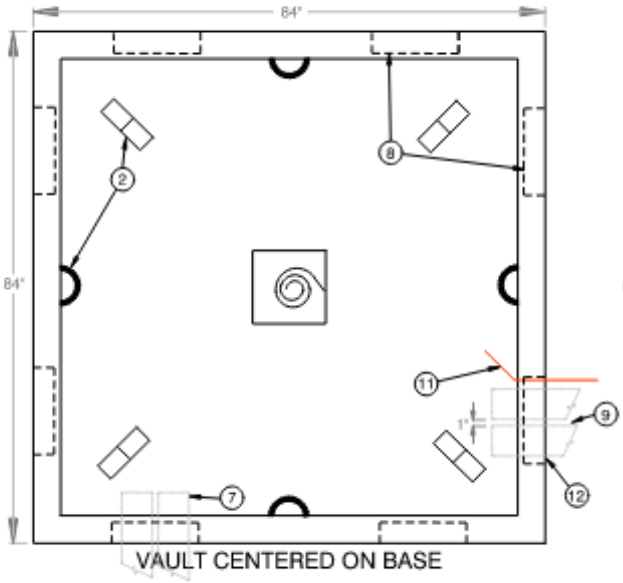
REVISED 03/26/2024 BY: GW

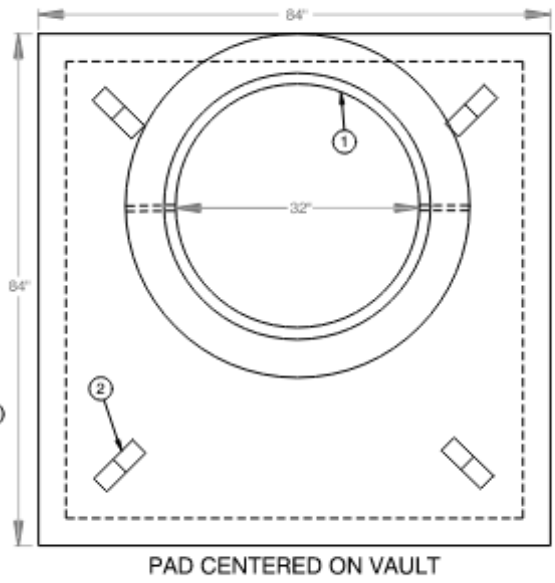
VAULT DESIGN SPECIFICATIONS

SPLICE VAULT
(4' square)

Date	Unit
2024	UM30S

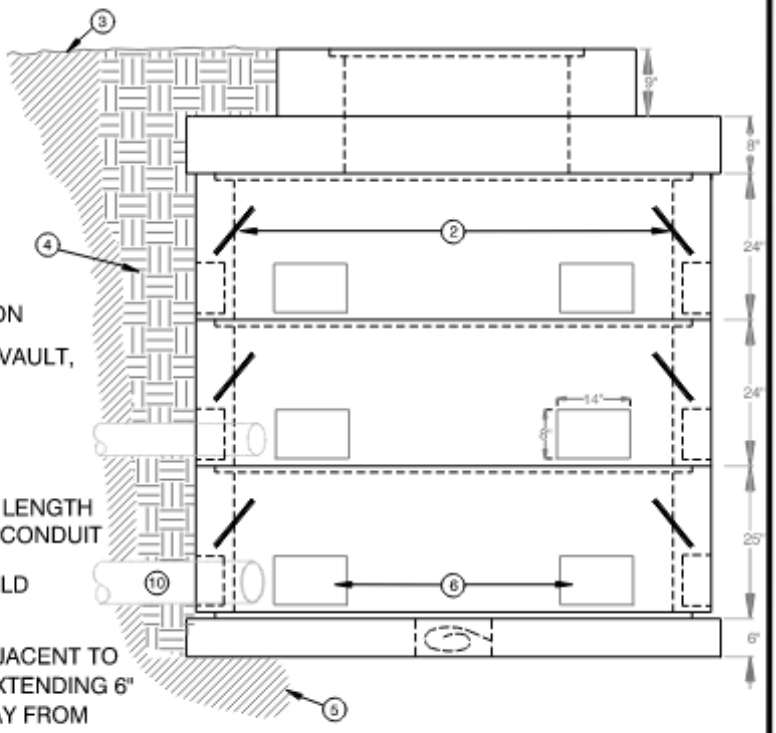
A-7





NOTES:

1. 32" MANHOLE
2. LIFTING HANDLES
3. GROUND LEVEL WITH THE TOP OF PAD
4. BACKFILL TO BE WELL COMPACTED
5. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
6. (8) KNOCKOUTS 8"X14" PER VAULT SECTION
7. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
8. CONDUITS CANNOT ENTER VAULT IN ADJACENT KNOCKOUTS
9. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
10. WHEN 6" CONDUIT IS INSTALLED, IT SHOULD ENTER THE BOTTOM VAULT SECTION
11. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2" OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
12. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT



Splice Vault		
1 - 40200	Large Base	-3,600 lbs.
3 - 40800	Vault, 6'x2'H	-3,000 lbs. Each
1 - 40420	Pad	-4,200 lbs.

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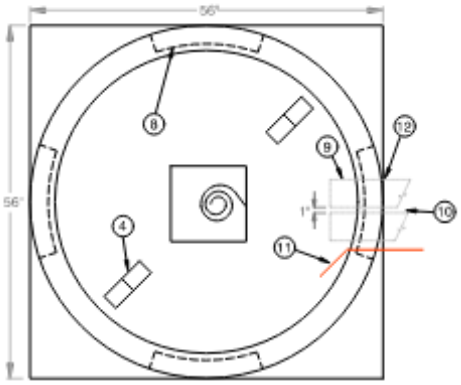
VAULT DESIGN SPECIFICATIONS

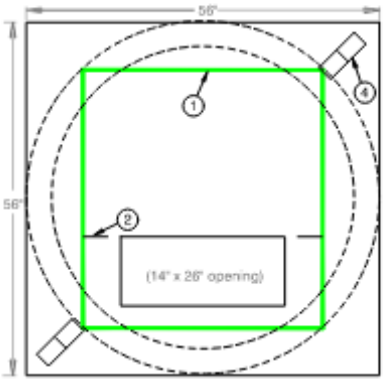
SPLICE VAULT (6' SQUARE)

Date: 2024

Unit: UM1-35L



VAULT CENTERED ON BASE

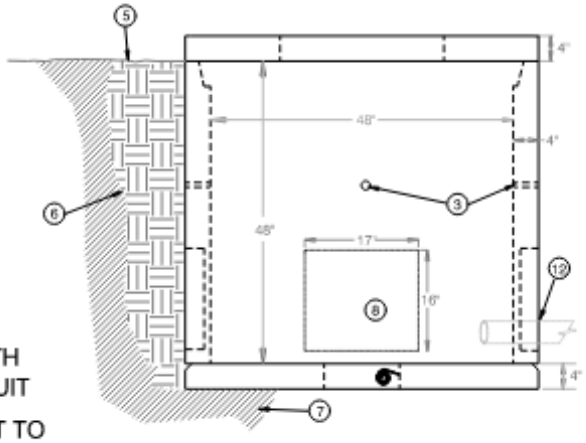


PAD CENTERED ON VAULT
TRANSFORMER ON PAD

NOTES:

1. TYPICAL TRANSFORMER OUTLINE
2. BACK EDGE OF TRANSFORMER OPENING
3. 1" LIFTING HOLE (TOTAL OF FOUR)
4. LIFTING HANDLE
5. GROUND LEVEL WITH THE BOTTOM OF PAD
6. BACKFILL TO BE WELL COMPACTED
7. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
8. FOUR KNOCKOUTS (17"X16")
9. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
10. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
11. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2" OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
12. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT

* FOR CONSUMERS INSTALLING SECONDARIES, CABLE TAILS SHALL BE 60" LONG MEASURED FROM TOP OF THE PAD



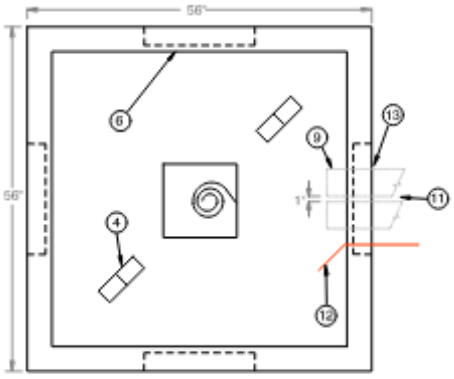
SINGLE PHASE TRANSFORMER VAULT (Round)		
1 - 40150	Small Base	~1,100 lbs.
1 - 40750	4'x4' Round Vault	~2,500 lbs.
1 - 40450	Pad, 1Phase	~1,200 lbs.

REVISED 03/26/2024 BY: GW

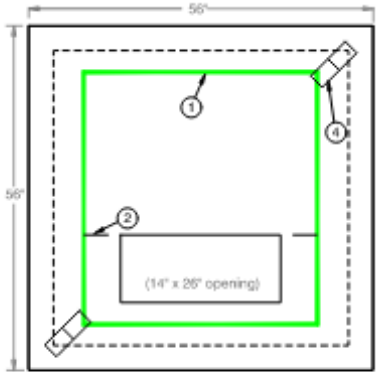
VAULT DESIGN SPECIFICATIONS

1 PHASE
TRANSFORMER VAULT

Date	Unit
2024	UM1-3



VAULT CENTERED ON BASE

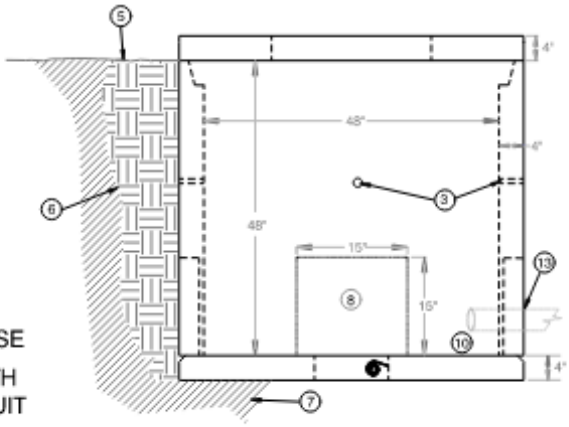


PAD CENTERED ON VAULT
TRANSFORMER ON PAD

NOTES:

1. TYPICAL TRANSFORMER OUTLINE
2. BACK EDGE OF TRANSFORMER OPENING
3. 1" LIFTING HOLE (TOTAL OF FOUR)
4. LIFTING HANDLE
5. GROUND LEVEL WITH THE BOTTOM OF PAD
6. BACKFILL TO BE WELL COMPACTED
7. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
8. FOUR KNOCKOUTS (15"X15")
9. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
10. CONDUITS(S) SHALL BE SET 4" ABOVE VAULT BASE
11. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
12. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2" OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
13. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT

* FOR CONSUMERS INSTALLING SECONDARIES, CABLE TAILS SHALL BE 60" LONG MEASURED FROM TOP OF THE PAD



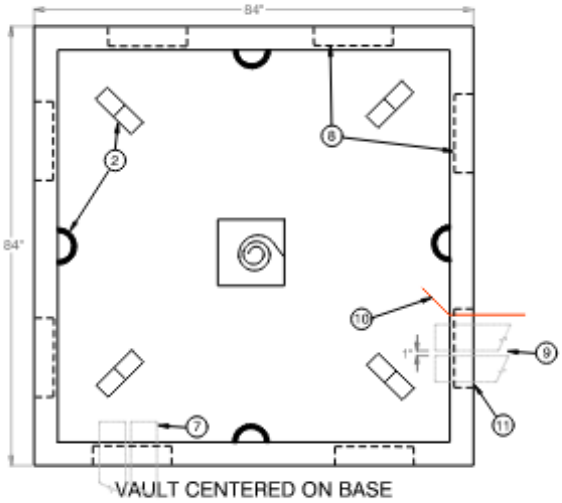
SINGLE PHASE TRANSFORMER VAULT (Square)	
1 - 40150 Small Base	~1,100 lbs.
1 - 40700 4' x 4' Square Vault	~3,500 lbs.
1 - 40450 Pad, 1Phase	~1,200 lbs.

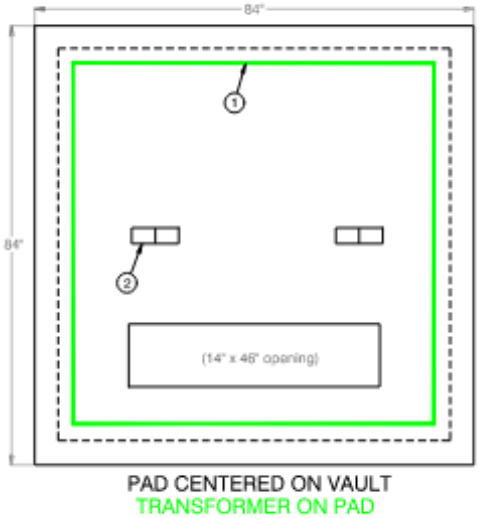
REVISED 04/01/2024 BY: GW

VAULT DESIGN SPECIFICATIONS

1 PHASE
TRANSFORMER VAULT

Date	Unit
2024	UM1-3S

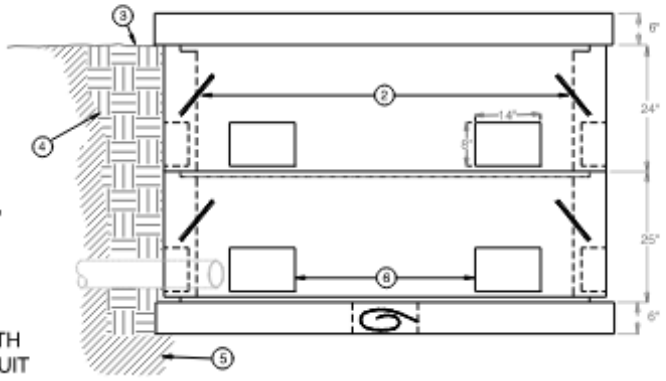




NOTES:

1. TYPICAL TRANSFORMER OUTLINE
2. LIFTING HANDLES
3. GROUND LEVEL WITH THE BOTTOM OF PAD
4. BACKFILL TO BE WELL COMPACTED
5. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
6. (8) KNOCKOUTS 8"X14" PER VAULT SECTION
7. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
8. CONDUITS CANNOT ENTER VAULT IN THE SAME ADJACENT CORNER
9. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
10. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2" OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
11. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT

* FOR CONSUMERS INSTALLING SECONDARIES, CABLE TAILS SHALL BE 60" LONG, MEASURED FROM THE TOP OF THE PAD



THREE PHASE TRANSFORMER VAULT	
500 kVA or larger	
1 - 40200 Large Base	~3,600 lbs.
2 - 40800 Vault 6'x2'H	~3,000 lbs. Each
1 - 40500 Pad, 3 Phase	~3,400 lbs.

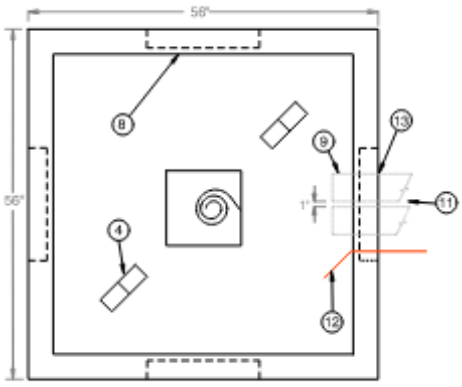
REVISED 03/25/2024 BY: GW

VAULT DESIGN SPECIFICATIONS

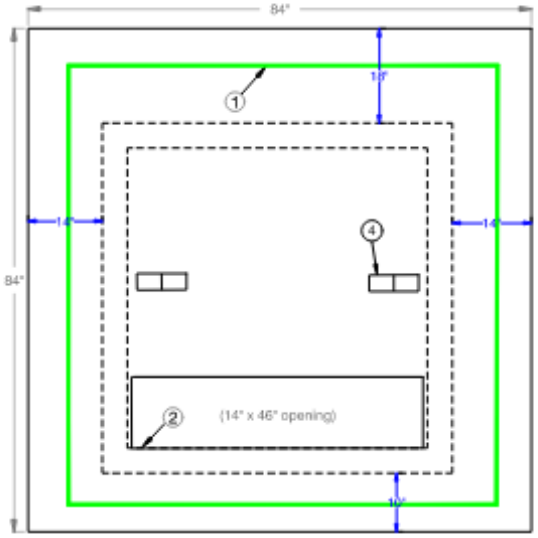
3 PHASE TRANSFORMER VAULT
(500 kVA or larger)

Date: 2024

Unit: UM1-11S



VAULT CENTERED ON BASE

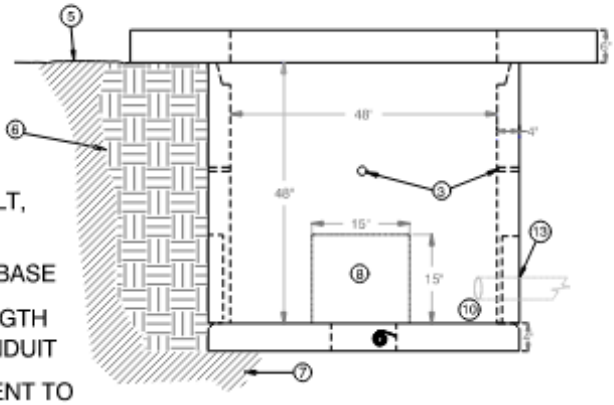


PAD PLACED ON VAULT
TRANSFORMER ON PAD

NOTES:

1. TYPICAL TRANSFORMER OUTLINE
2. BACK EDGE OF TRANSFORMER OPENING FLUSH WITH INSIDE OF VAULT WALL
3. 1" LIFTING HOLE (TOTAL OF FOUR)
4. LIFTING HANDLE
5. GROUND LEVEL WITH THE BOTTOM OF PAD
6. BACKFILL TO BE WELL COMPACTED
7. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
8. FOUR KNOCKOUTS (15"X15")
9. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
10. CONDUITS(S) SHALL BE SET 4" ABOVE VAULT BASE
11. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
12. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2" OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
13. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT

* FOR CONSUMERS INSTALLING SECONDARIES, CABLE TAILS SHALL BE 60" LONG MEASURED FROM TOP OF THE PAD



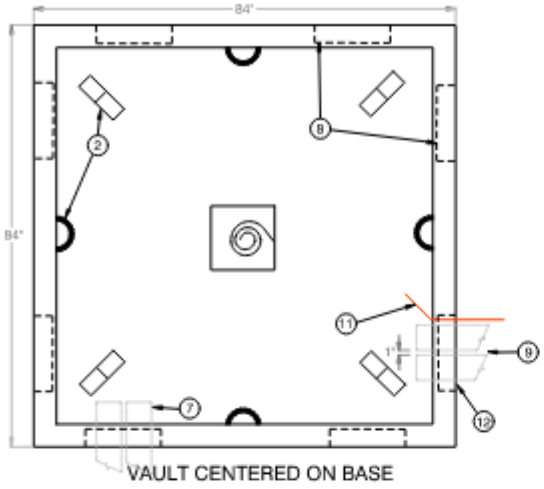
THREE PHASE TRANSFORMER VAULT	
300 kVA or smaller	
1 - 40150 Small Base	~1,100 lbs.
1 - 40700 4' x 4' Square Vault	~3,500 lbs.
1 - 40500 Pad, 3 Phase	~3,400 lbs.

REVISED 03/25/2024 BY: GW

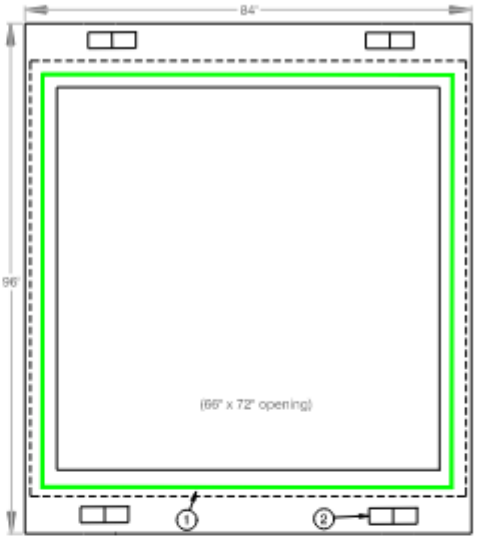
VAULT DESIGN SPECIFICATIONS

3 PHASE TRANSFORMER VAULT
(300 kVA or smaller)

Date	Unit
2024	UM1-13S



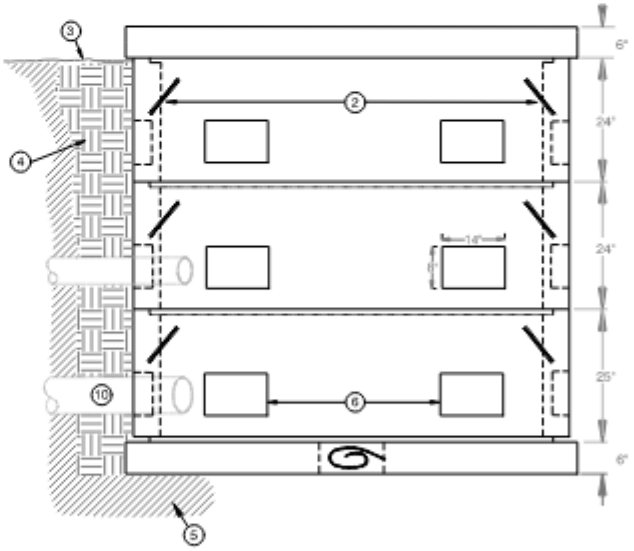
VAULT CENTERED ON BASE



PAD CENTERED ON VAULT
SWITCHGEAR ON PAD

NOTES:

1. TYPICAL SWITCHGEAR OUTLINE
2. LIFTING HANDLES
3. GROUND LEVEL WITH THE BOTTOM OF PAD
4. BACKFILL TO BE WELL COMPACTED
5. SOIL UNDER BASE TO BE UNDISTURBED OR WELL COMPACTED
6. (8) KNOCKOUTS 8"X14" PER VAULT SECTION
7. CONDUIT(S) SHALL EXTEND 4" INSIDE OF VAULT, SQUARE TO THE VAULT WALL
8. CONDUITS CANNOT ENTER VAULT IN THE SAME ADJACENT CORNER
9. MULTIPLE CONDUITS SHALL BE EQUAL IN LENGTH WITH 1" OF SEPARATION BETWEEN EACH CONDUIT
10. WHEN 6" CONDUIT IS INSTALLED, IT SHOULD ENTER THE BOTTOM VAULT SECTION
11. A GROUND ROD SHALL BE INSTALLED ADJACENT TO THE CONDUIT WITH 2' OF SEPARATION, EXTENDING 6" INSIDE OF VAULT, BENT 45 DEGREES AWAY FROM THE CONDUIT
12. ALL OPENINGS TO BE SEALED WITH NON-SHRINK GROUT



SWITCHGEAR VAULT	
1 - 40200 Large Base	~3,600 lbs.
3 - 40800 Vault 6'x2'H	~3,000 lbs. Each
1 - 40600 Pad, Switchgear	~1,700 lbs.

REVISED 03/25/2024 BY: GW

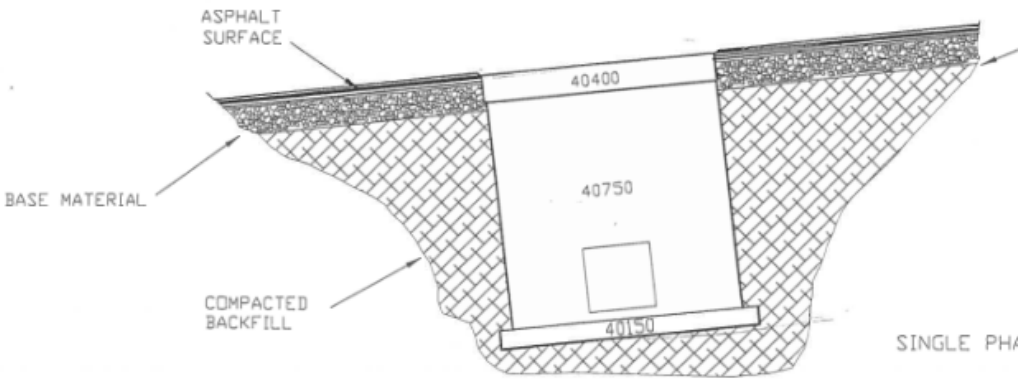
VAULT DESIGN SPECIFICATIONS

SWITCHGEAR VAULT

Date: 2024

Unit: UM1-35

ELECTRICAL VAULT SPECIFICATIONS FOR ROAD APPLICATION



UM1-30R

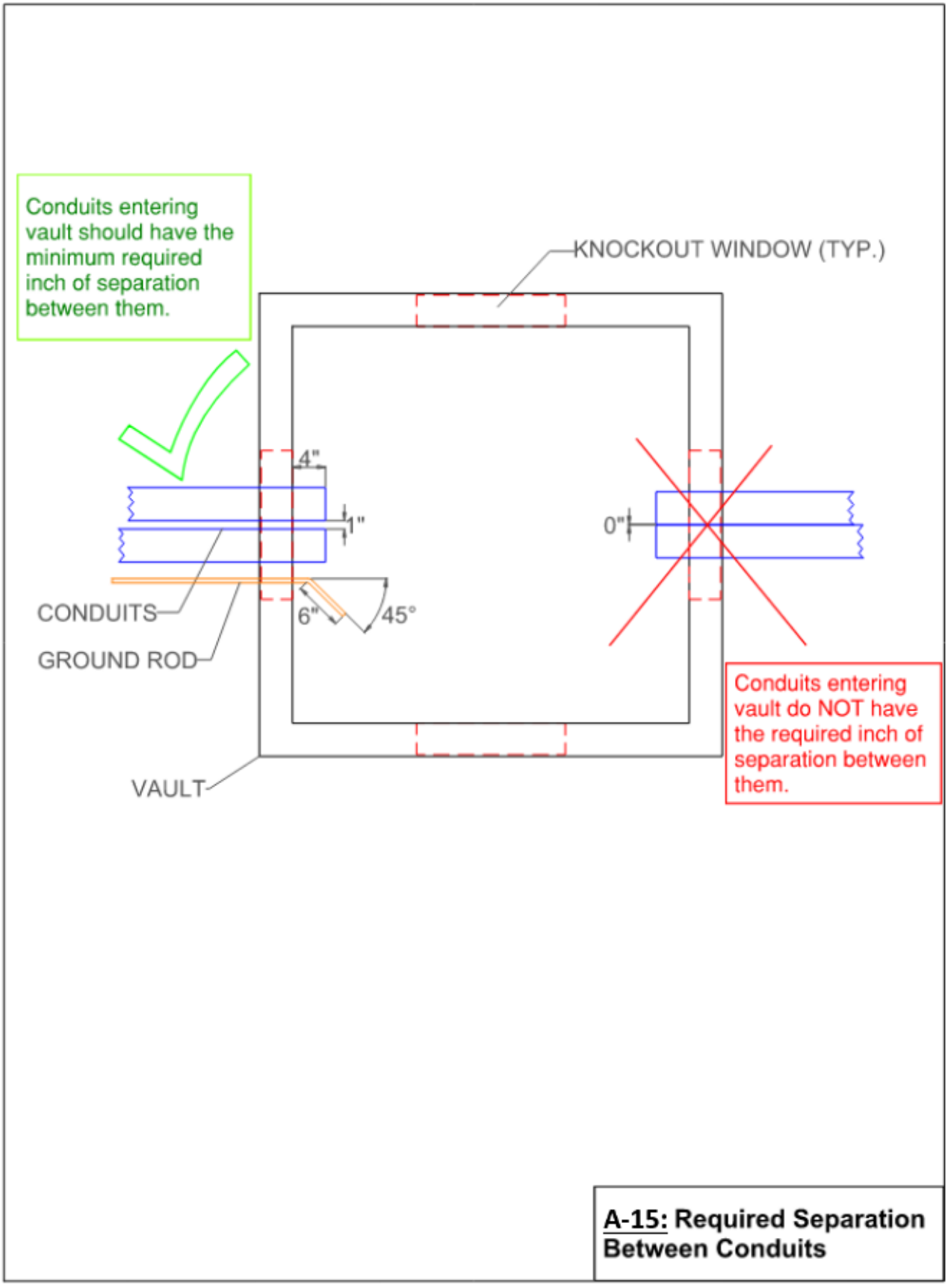
SINGLE PHASE SPLICE VAULT (ROUND)

40150-BASE-1,100 LBS
40750-ROUND-2,500 LBS.
40400-PAD-1300 LBS

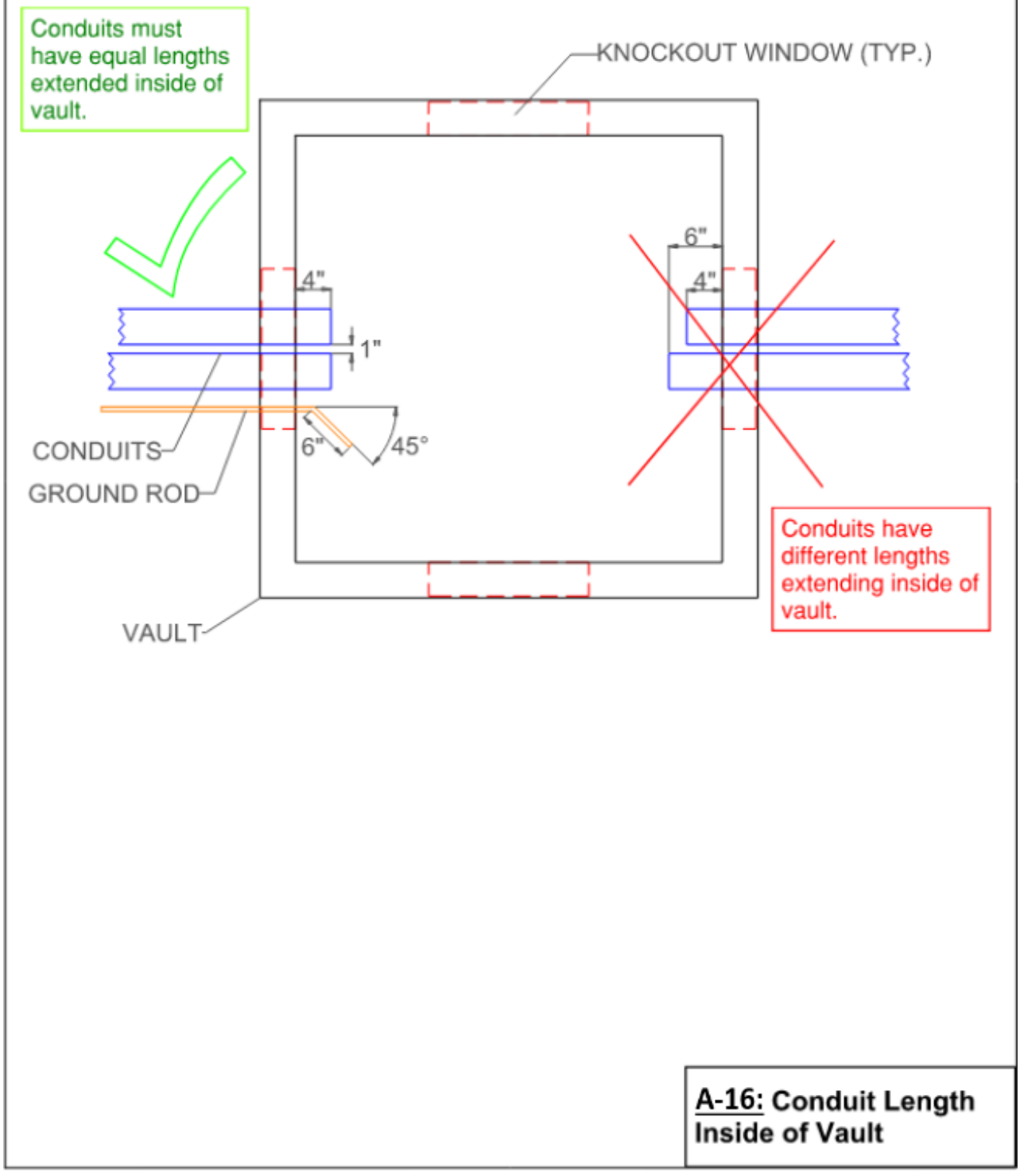
NOTE:

1. VAULTS BASES SHALL BE INSTALLED ON COMPACTED BACKFILL AT THE SLOPE OF THE GROUND SURFACE FINAL GRADE.
2. ALL HOLES PLACED IN THE VAULTS SHALL BE GROUTED INSIDE AND OUT, AND THE VAULT SHALL BE CLEAN.
3. VAULT KNOCKOUT SHOULD ONLY BE TAPPED OUT TO THE SIZE OF THE CONDUIT BEING INSTALLED.
4. VAULTS WILL NOT BE LOCATED IN ROAD AREAS WHERE VEHICLE WHEELS NORMALLY TRAVEL.

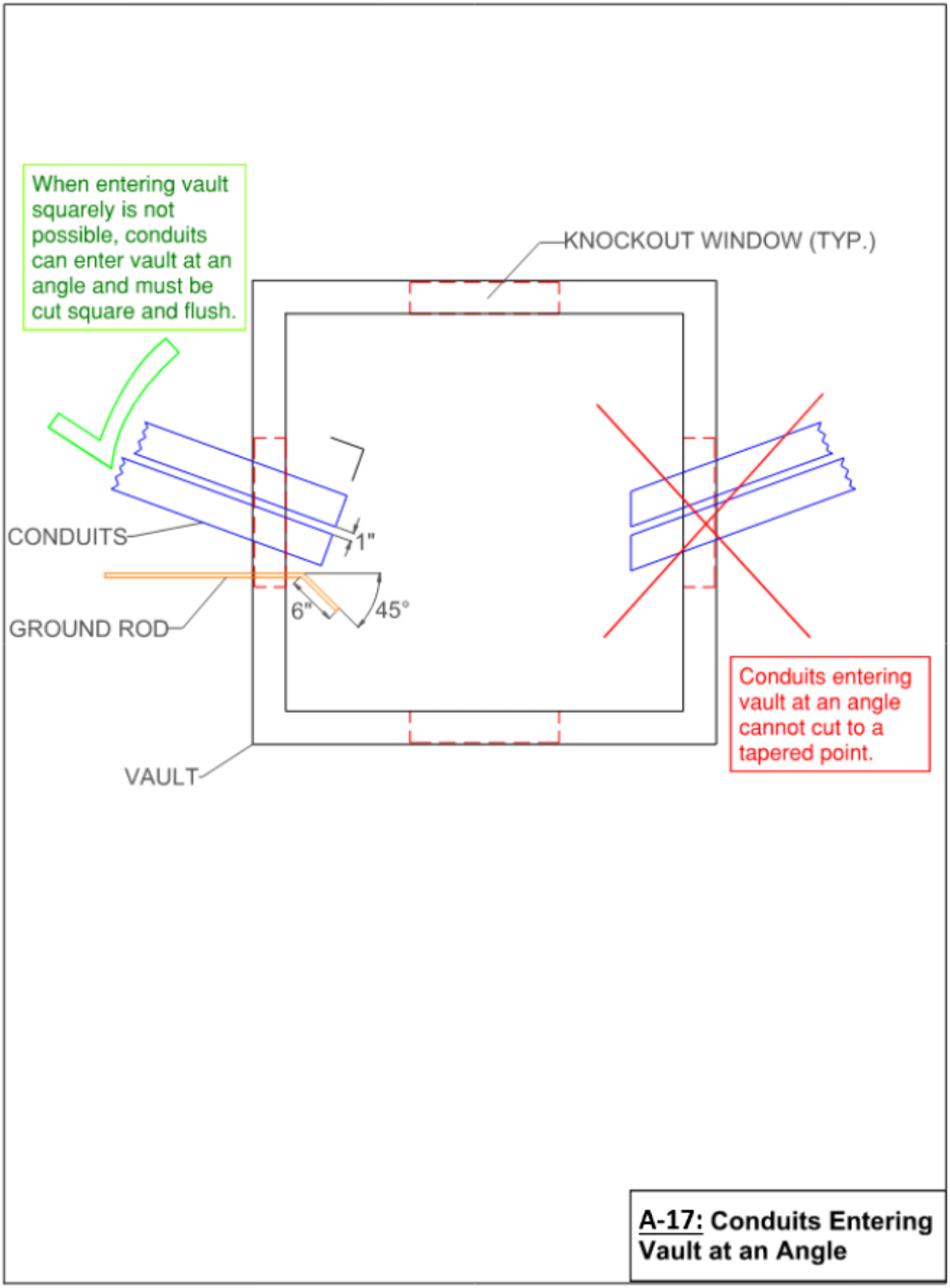
A-14: Vault in Road



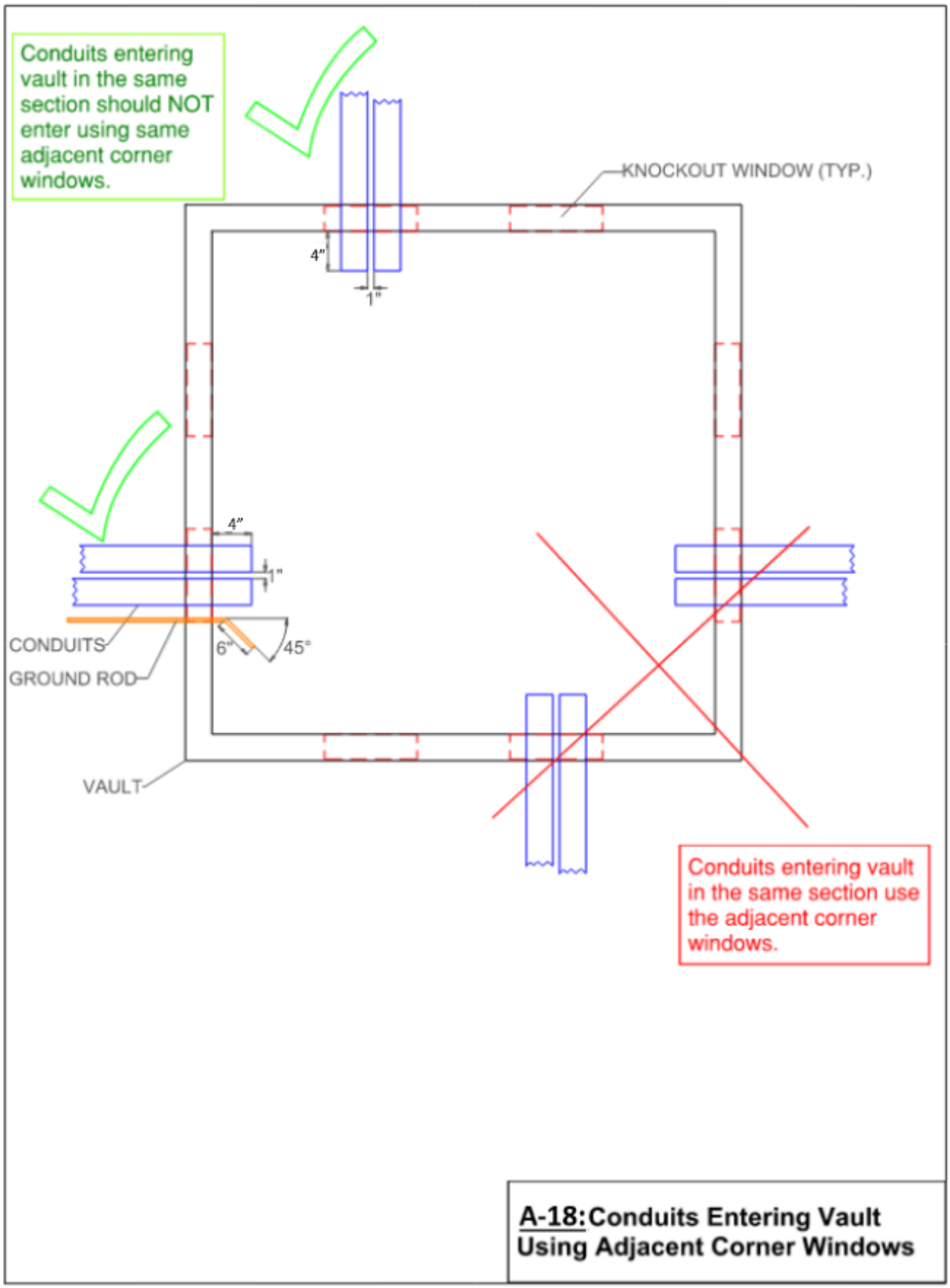
A-15: Required Separation Between Conduits

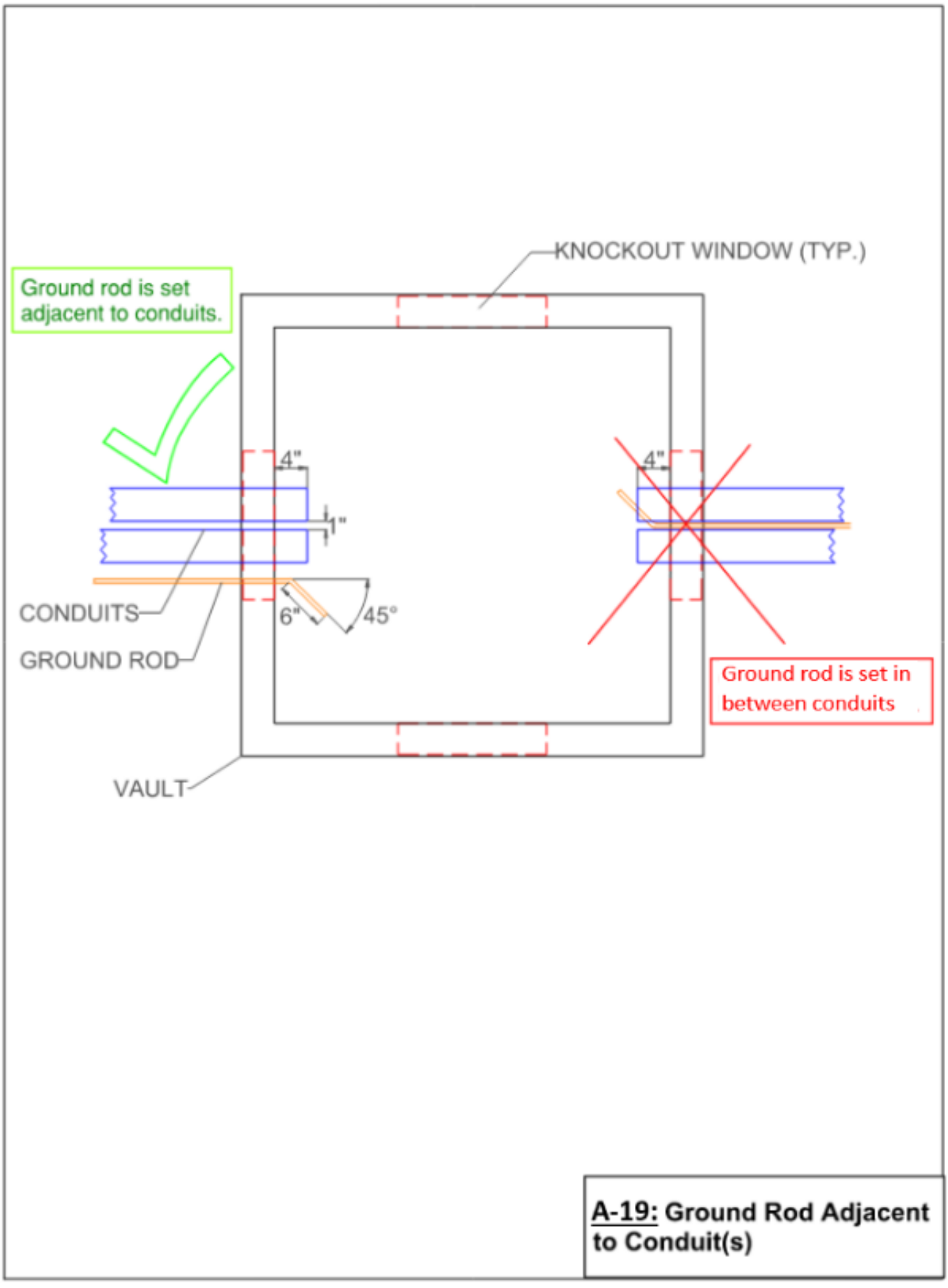


A-16: Conduit Length Inside of Vault

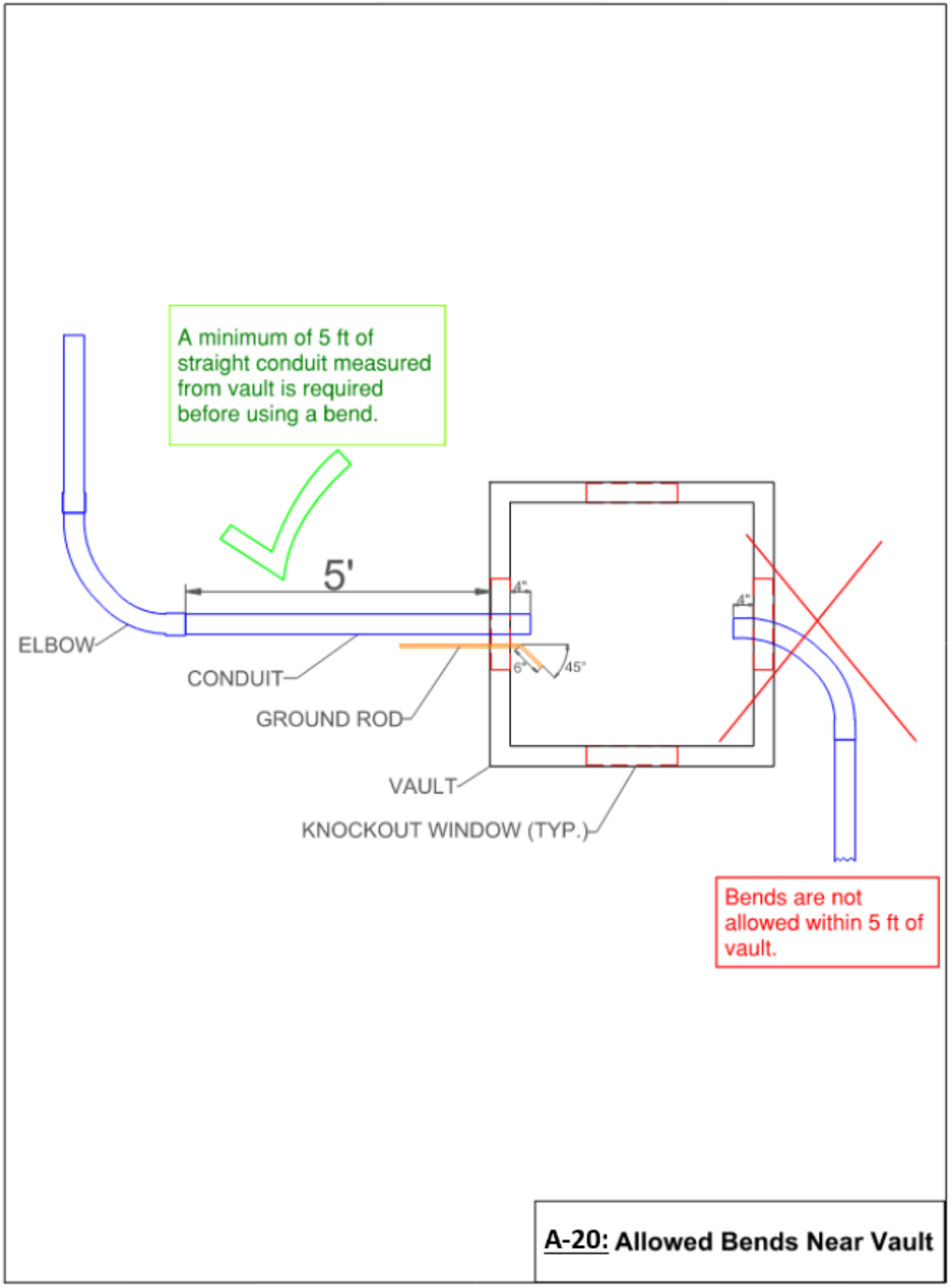


A-17: Conduits Entering Vault at an Angle

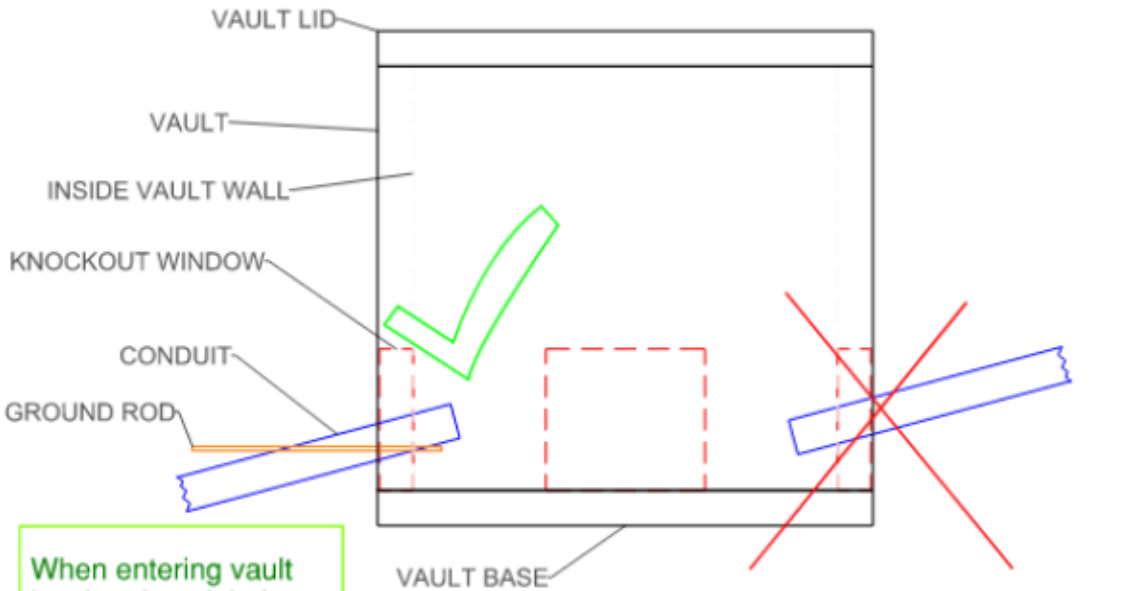

Conduits entering vault in the same section should NOT enter using same adjacent corner windows.
KNOCKOUT WINDOW (TYP.)
4"
1"
4"
1"
CONDUITS
GROUND ROD
6"
45°
VAULT
Conduits entering vault in the same section use the adjacent corner windows.
A-18: Conduits Entering Vault Using Adjacent Corner Windows



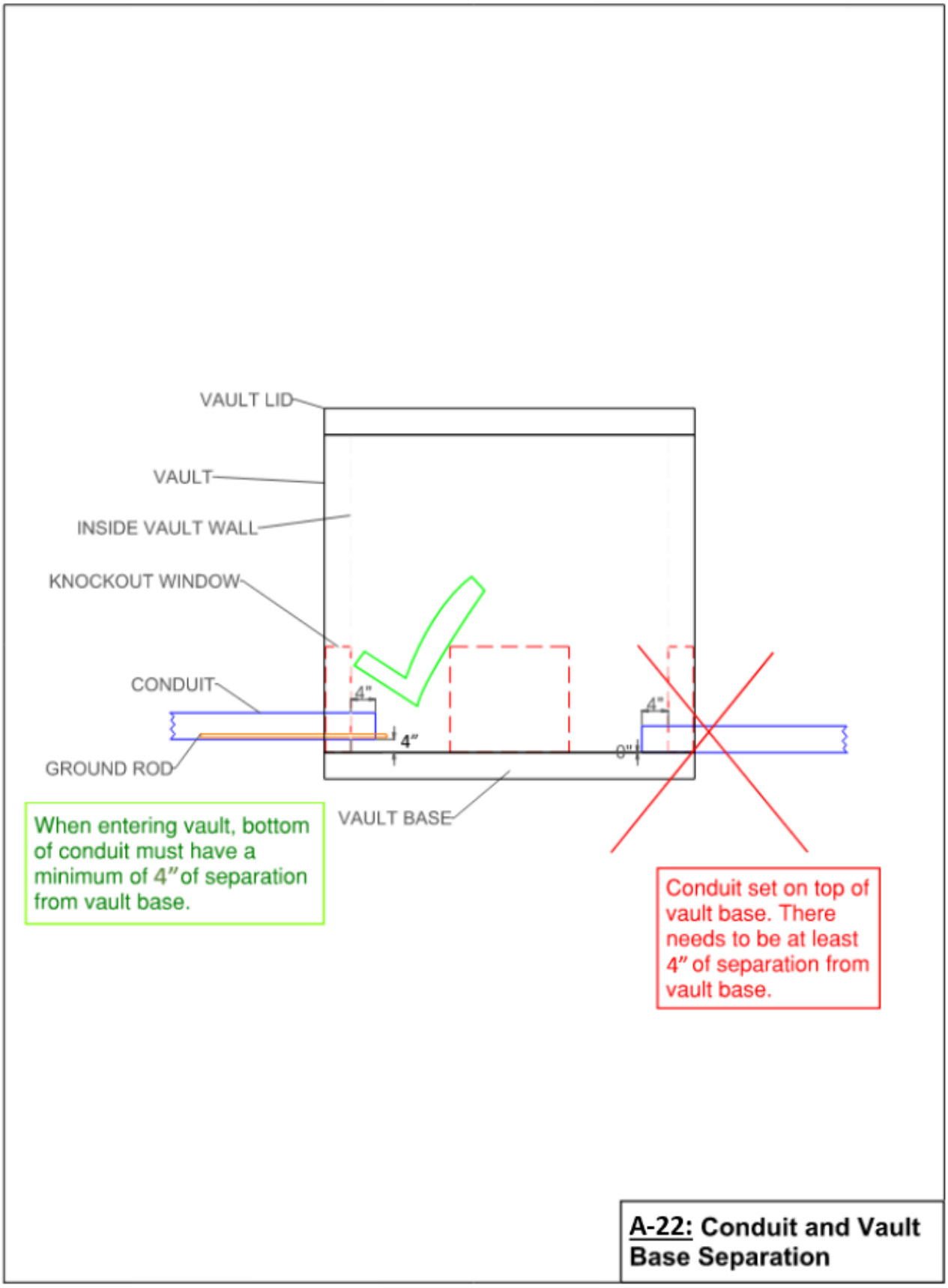
A-19: Ground Rod Adjacent to Conduit(s)



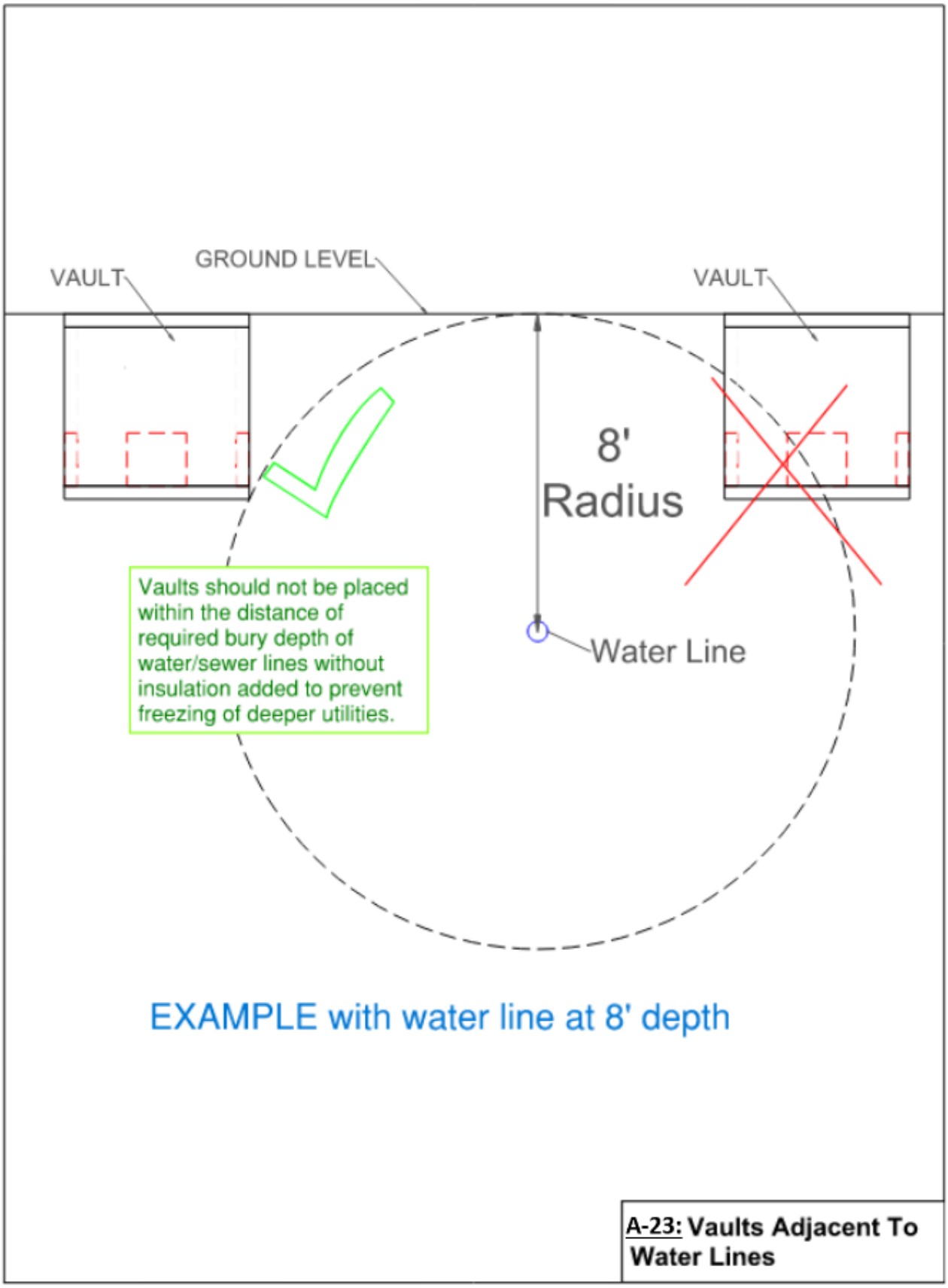
A-20: Allowed Bends Near Vault



A-21: Conduit(s) Entering Vault with A Vertical Angle



A-22: Conduit and Vault Base Separation


VAULT
GROUND LEVEL
VAULT
8'
Radius
Vaults should not be placed within the distance of required bury depth of water/sewer lines without insulation added to prevent freezing of deeper utilities.
Water Line
EXAMPLE with water line at 8' depth
A-23: Vaults Adjacent To Water Lines