

# **1610**

## **VAULT ROOM**

3/15/2010

**N** COVR Customer-Owned Vault Room Requirements

**N** New Standard  
**R** Redrawn Standard  
**C** Changed Standard  
**~** No Change

# Scope

This standard documents requirements for customer-owned vault rooms containing equipment owned, operated, and maintained by Clark Public Utilities.

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# Code Requirements

Vault rooms shall be designed and constructed so they will be considered separate buildings under IBC 705. The vault room shall meet the requirements of NEC Article 450, Part III. Raceways shall be designed and constructed so they will be considered outside the building under NEC 230.6.

Nothing in this standard shall be interpreted to conflict with the regulations of the State of Washington or other regulatory bodies that have jurisdiction.

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# Vault Room Availability

Clark Public Utilities' preferred design is to use padmounted equipment installed outdoors. Equipment installed in a vault room is only allowed if the customer demonstrates that an outdoor installation is physically impractical, an undue hardship, or required by a government authority. Aesthetics alone is not adequate justification.

Approval for use of a vault room must be obtained from the Clark Design Engineer prior to submitting a vault room design for review.

# Vault Room Location

All vault room locations must be reviewed and approved by the Clark Construction Design Engineer. Vault rooms should be located at grade level adjacent to the exterior wall or under the sidewalk that is closest to Clark's existing distribution system. All vault rooms must have direct access with a boom truck.

In all cases, the location shall be accessible by a door, removable wall, or ceiling to an outside location where Clark can reach the transformer, switchgear and related equipment for installation, maintenance and replacement. The customer shall provide a location where Clark crews will have 24-hour access to operate the equipment.

# Circuit Design Criteria

Equipment installed in a vault room shall not serve any other buildings.

The equipment inside the vault room shall have the ability to be de-energized from outside the vault room without causing a permanent outage to other customers. The intent of this is to be able to de-energize the vault room in case of a fire or other hazardous circumstance.

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# Vault Room General Requirements

## What is Allowed in the Vault Room

- Equipment, pipes, ducts, wires, and other fixtures allowed in a vault room shall be a necessary part of the Clark electrical installation. All items must be approved by the Clark Construction Design Engineer.
- No foreign fixtures may pass through a vault room or a cable room. This includes water or sewer pipes, or any other equipment that may require inspection or service by the customer.
- Vault rooms shall not be accessible to unqualified personnel.
- Vault rooms shall not be used as temporary or permanent storage spaces.
- All metering equipment and customer equipment, other than service conductors or bus, shall be located outside of the vault room.

## Clark Public Utilities Responsibilities

- Test and energize new facilities
- Terminate primary cables in any energized facilities
- Upon energizing the facilities, Clark will assume ownership of and maintain all primary cables and conduits, transformers, junction boxes, and other primary voltage equipment.

## Customer Responsibilities

- Approval for use of a vault room must be obtained from the Clark Design Engineer prior to submitting a vault room design for review.
- The customer is responsible for providing and installing all facilities.
- All materials must comply with Clark technical standards and be supplied from Clark's material list by an approved distributor.
- All Clark primary voltage facilities must be installed per Clark technical standards by a contractor on Clark's list of approved electrical contractors.

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The customer will provide, install, and maintain the following:

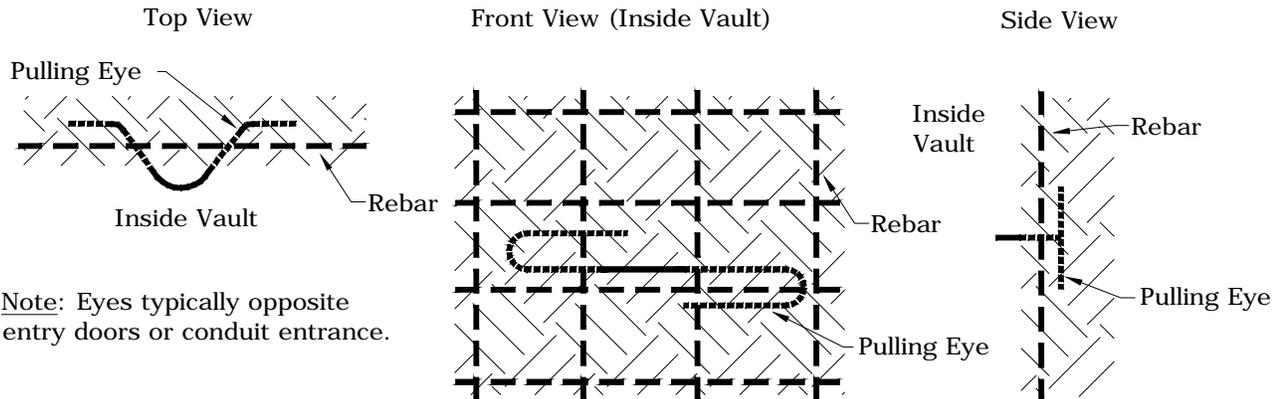
Vault Room Requirement	Customer General Responsibilities
Location, Design, Layout, and Access	<ul style="list-style-type: none"> <li>• Vault room located either inside or on the exterior of the building constructed as specified in NEC 450, Section III, Transformer Vaults.</li> <li>• Personnel and equipment access doors.</li> <li>• Restricted room access to qualified utility workers only. See WAC 295-45-035.</li> <li>• Smooth floor surface for rolling/sliding of equipment if access for installation and removal is not directly above transformer.</li> </ul>
Fire Detection/ Suppression	<p>Fire detection equipment (smoke and temperature).</p> <ul style="list-style-type: none"> <li>• Portable ABC fire extinguisher outside access door(s).</li> <li>• Any additional equipment or systems required by local fire officials.</li> <li>• Clark does not allow water fire suppression in vault rooms.</li> <li>• Adequate ventilation for cooling of equipment.</li> </ul>
Ventilation	<ul style="list-style-type: none"> <li>•</li> </ul>
Ground Bus	<ul style="list-style-type: none"> <li>• Ground bus for equipotential zone.</li> </ul>
Oil Containment	<ul style="list-style-type: none"> <li>• Oil containment sills, sumps, oilwater separators, drains, and valves</li> </ul>
Duct and Cable Racking	<ul style="list-style-type: none"> <li>• Inserts, ducts, or knockouts in the wall for entrance and termination of ducts for primary cable, and Clark Communications cables.</li> <li>• Pulling inserts/hooks for installation of cables.</li> <li>• Racking for primary and secondary service cables.</li> </ul>
Lighting and Outlets	<ul style="list-style-type: none"> <li>• Room lighting, emergency lighting, and convenience outlets.</li> </ul>
Service Conductors	<ul style="list-style-type: none"> <li>• All service cables, rigid bus, and supports up to the point of interconnection.</li> </ul>
Approval Drawings	<ul style="list-style-type: none"> <li>• Drawings for approval by Clark Public Utilities Construction Design Engineer.</li> </ul>
Seismic	<ul style="list-style-type: none"> <li>• All electrical systems, components, and elements, including supporting structures and attachments, shall be installed in accordance with the International Building Code (IBC), Section 1621.</li> </ul>
Noise and Vibration	<ul style="list-style-type: none"> <li>• The vault room shall be designed so the noise and vibration from the transformer, fans, and other equipment, is not objectionable to the tenants of the building.</li> </ul>
Signage	<ul style="list-style-type: none"> <li>• Customer to install "Warning" and "Danger" signs provided by Clark</li> <li>• Switch rooms shall be labeled w/ switch number provided by Clark</li> <li>• Transformer rooms shall be permanently marked w/ 2" phenolic numbers and letters (i.e. Transformer 1234-2500.)</li> </ul>
Keys	<ul style="list-style-type: none"> <li>• The customer will provide all copies of keys to Clark.</li> <li>• The customer will <u>not</u> keep copies of any keys to the vault room.</li> </ul>



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# Pulling Eyes



Pulling Eyes Shown Embedded in Concrete Vault Walls Behind Reinforcing Steel

Pulling eyes are required in Clark's vaults. Pulling eye number, location, and height shall be determined and approved by the Clark Construction Design Engineer. The location of pulling eyes should be chosen to facilitate moving electrical equipment, including cable, to be located in or removed from the vault.

Minimally, but without duplication, pulling eyes for rigging equipment shall be installed as follows:

- opposite the entry door (one);
- adjacent to the entry door (one);
- centered on each wall without a center door;
- opposite each conduit entrance at approximately the same height (one);
- adjacent to one side of each conduit entrance (one);
- for vaults with ceiling hatches for transformer installation and removal, pulling eyes should be installed adjacent to the hatches (two); and
- similarly, for conduits entering through the ceiling or the floor, pulling eyes should be installed adjacent and opposite the conduit entrances (two).

Locations for pulling eyes can vary depending on the vault plan and configuration (entry door, conduit entrance, hatch, and transformer locations). Clark prefers that pulling eyes on walls shall be at a height of 26 inches from the floor although for conduit entrances, the height of the pulling irons should approximately match the height of the conduits. If the vault is constructed of concrete blocks, eyes may be floor-mounted.

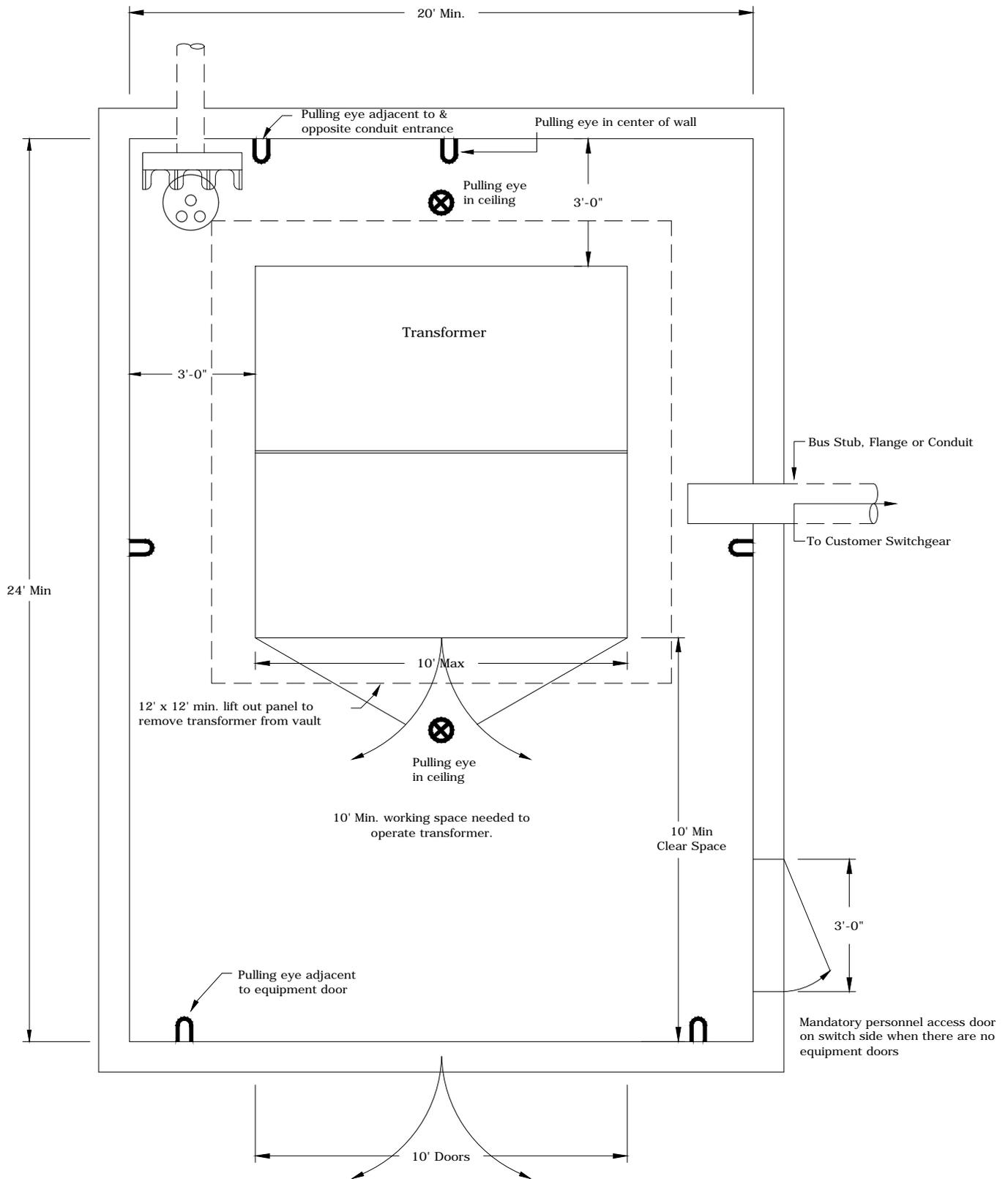
Pulling eyes shall be installed with the following requirements:

- Pulling eyes shall be made of stainless steel.
- Pulling eye installation shall be rated and labeled in the vault as 10,000 pounds pulling strength.
- Install pulling eyes behind concrete reinforcing rebar steel (Note: spacing and size of rebar to be determined by a licensed civil engineer.).

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Figure 1: Transformer vault room (top view)



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# J-Boxes

When space is not available for the normal exterior junction vault, junction bushings may be installed on a wall in a separate vault room. Use of interior junction bushings should be avoided whenever possible to reduce access times during emergency conditions.

If junction boxes are installed in a vault room, the space must be designed to accommodate the following:

- The junction bushings shall be mounted 36 inches above the floor
- The cables shall be racked on the wall and not laid on the floor. The cables shall be secured to the racking. The racking shall be supplied and installed by the customer. The racking must be approved by Clark's Standards Engineer.
- The portions of the cables close to the elbow shall be free to move and not be trapped under other cables.
- There shall be enough slack to easily move the elbows from the junction bushings to the stand-off brackets. The cable shall not come out of the floor directly below the junction bushings because this does not provide adequate slack.
- The cables may approach the racking from above, or below, or a combination.
- A 10-foot by 10-foot working space shall be provided in front of the junction bushings.

# Switches

The preferred design when switches are required to serve a new customer is to have them set outside the building and above ground (padmounted). If they cannot be located outside of the building, they must be placed in a vault room separate from the transformer. The switches required for vault rooms are the S&C "Vista" switch.

Transformers greater than 1500kVA will require a S&C "Vista" switch, whether inside or outside the building, for system protection.

## Room Dimensions and Clearances

Vault rooms for switches shall be a minimum of 24' x 15'. The minimum ceiling height shall be 12'. Vault rooms shall provide a minimum working space of 10 feet deep and 8 feet wide from the control panel side of the switch, and 3 feet on the sides. The minimum equipment entry door side shall be 10' x 10'.

The room shall be a minimum of 8 feet from the floor to the cable racks above. See Figures 3 and 4.

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**Installing and Removing the Switch**

The preferred method of installing and removing the switch is by a boom truck. The door shall be 10' x 10'. The vault room can be open on top to the outside or have a minimum 10' x 10' opening for a S&C "Vista" switch obtained by removing an access.

- The opening or hatch and switch must be in a location on the property where it is accessible by lift equipment that is owned by Clark or its normal utility contractor.
- The hatch must be equipped with Clark's standard lifting inserts or the customer shall provide any non-standard lifting devices for use with the rigging of a mobile crane.
- The entire access hatch, if one piece, or each section, must weigh 15,000 pounds or less.

Note: The customer is responsible for removal and replacement of any seals or coverings in preparation for installation or removal of equipment.

**Equipment Door**

If equipment shall be installed and removed through a wall, the minimum access door required is 10 feet wide by 10 feet high.

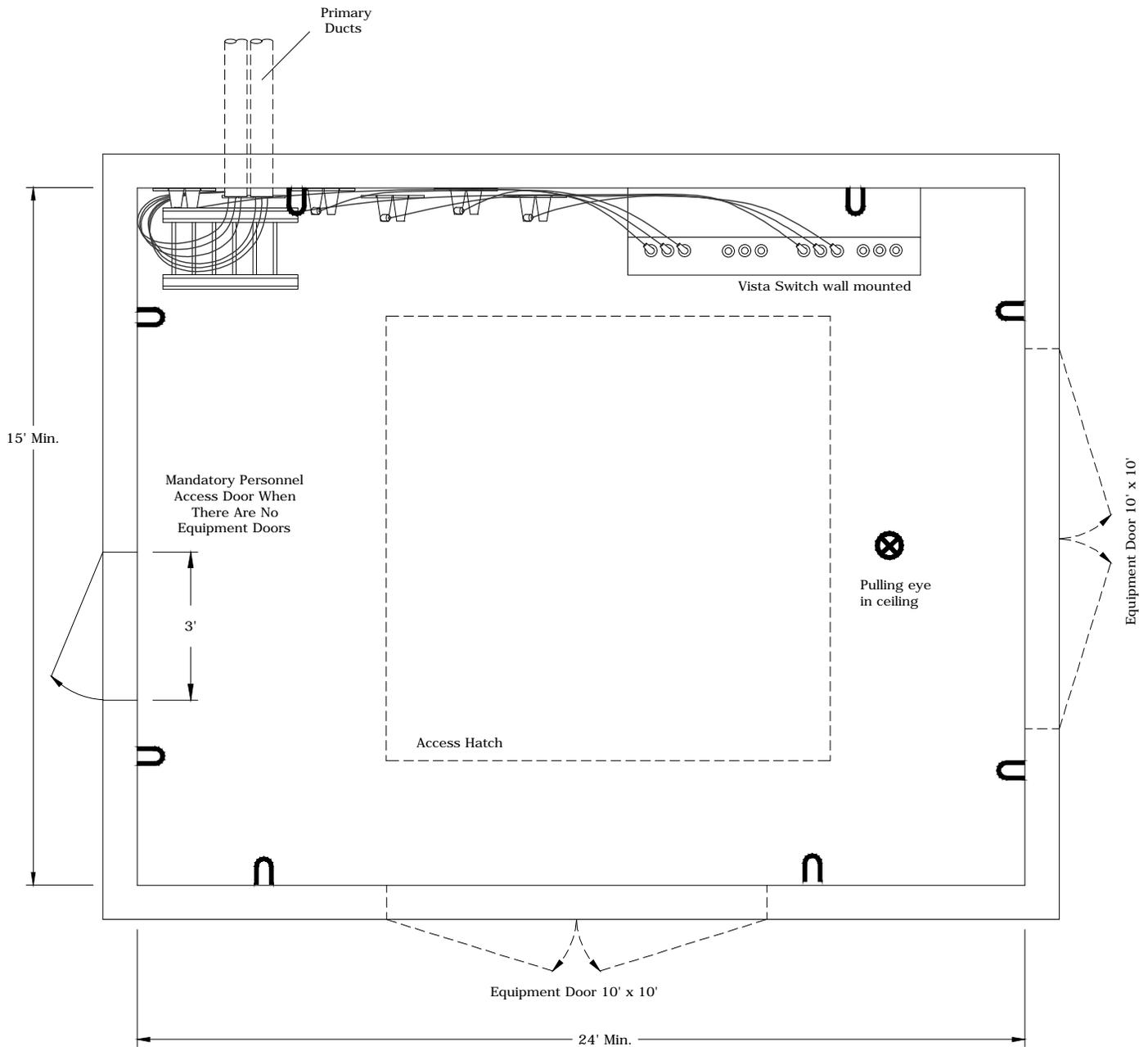
**Multiple Switches**

If multiple switches are required to serve a facility, they will be placed in separate rooms to keep an equipment failure from damaging or limiting access to the other equipment.

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Figure 3: Vista Switch Vault Room (Top View)



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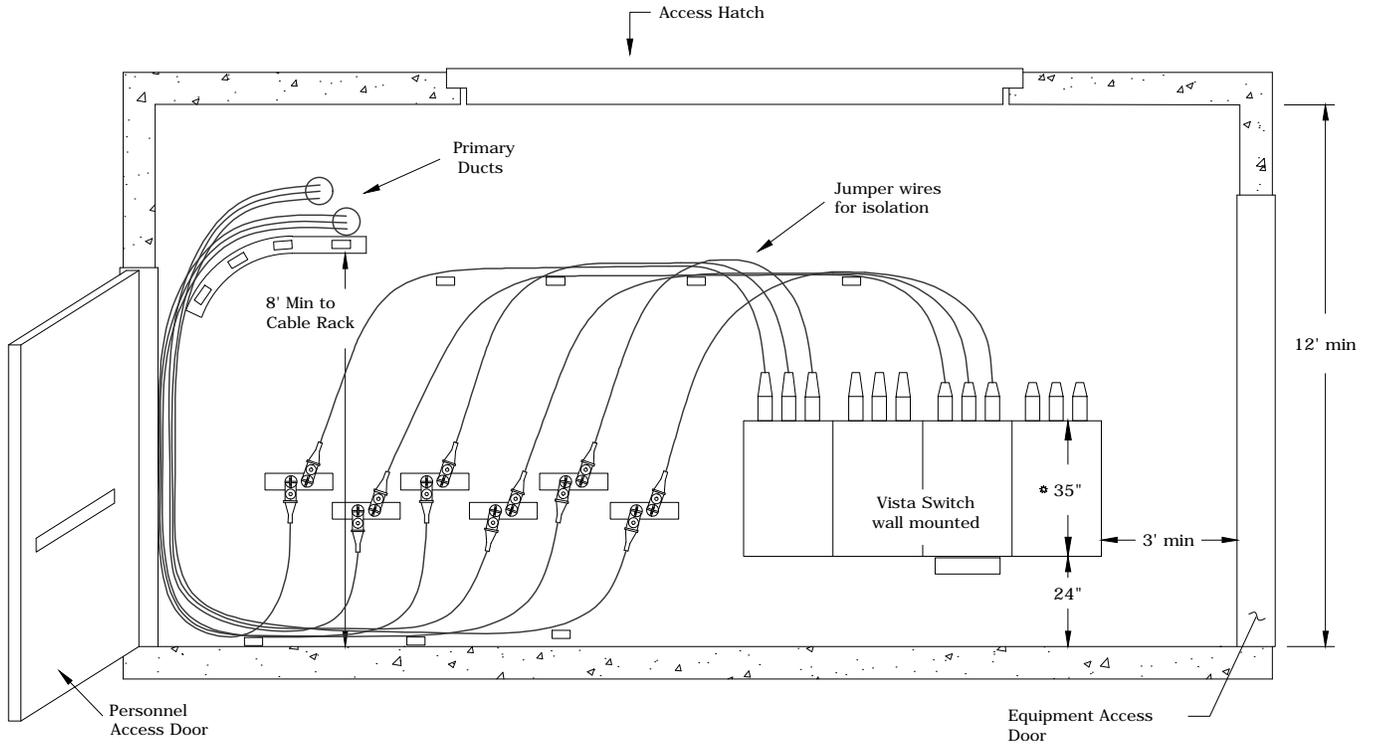
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Figure 4: Vista Switch Vault Room (Side View)



\* Tank is 35" wide. Anchor brackets are 37" apart.



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# Cable and Cable Racking

## Responsibilities

Customer's Responsibilities	Clark's Responsibilities
Furnish, install, and maintain the service cables.	Maintain the primary voltage cables.
Furnish all conduit and racking inside the building required to bring the primary and service conductors to the switchgear and/or transformer.	
Furnish and install the primary 1/0 cables.	Furnish and install the primary 1000MCM cables.
Terminate 1/0 cable	Terminate 1000MCM cable

**Cable Bending Radius**      The minimum bending radius of any primary or secondary cable shall not be less than 36 inches.

**Clearance**      Space shall be provided for entry and training of the primary and secondary cables.

**Service Conductors**      The service cables must be completely supported to keep the weight of the cables from damaging the transformer secondary bushings.

The customer supplies the service conductors to the secondary lugs of the transformer and terminates.

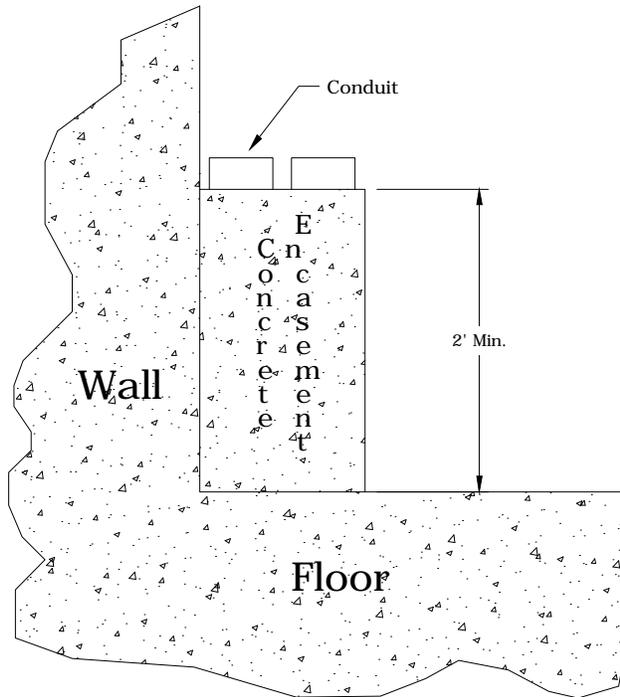
The number of available secondary transformer connections is 8 conductors per phase.

Conduits opening to the building interior shall be firestopped. To ensure oil containment, secondary conduits shall be installed a minimum of 24 inches above the vault floor. Figure 5 shows a typical detail for encasing ducts entering through the vault floor.

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Figure 5: Encasing Ducts For Oil Containment



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# Duct Systems

## Responsibilities

<u>Customer's Responsibility</u>	<u>Clark's Responsibility</u>
<ul style="list-style-type: none"> <li>• Provide a primary duct system from the vault room(s) to a location outside the facility as specified by Clark.</li> <li>• Provide raceways for Clark conductors that meet the requirements of NEC 230.6.</li> <li>• Sealing the exterior of all ducts or inserts for ducts where they penetrate through the outside of the building or vault rooms.</li> <li>• Firestop all conduits leaving the vault room except 1000MCM conduits.</li> </ul>	<ul style="list-style-type: none"> <li>• Design the duct system to be used by specifying the type, size, location, and number of conduits</li> <li>• Firestop all 1000MCM conduits leaving the vault room</li> </ul>

## Grounding

The customer is responsible for installing a ground bus along the back wall of the vault room.

- The ground bus will be a 4/0 copper conductor.
- The ground bus will be located 1 foot above the floor and must not cross any access doors.
- The ground bus shall be tied to the building's grounding electrode system and building reinforcing structure to create an equal potential zone in the vault room. This requires inspection by Clark prior to pouring concrete.  
The ground bus shall be tapped to each piece of equipment (not daisy-chained),
- so the ground wire to one piece of equipment can be cut without leaving other pieces of equipment ungrounded.

## System Protection

Clark will provide overcurrent protection for the primary side of the transformer but does not provide any protection on the secondary side of the transformer for the customer's service cables.

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# Personnel Access Door to Transformers and Switches

A direct and unobstructed rescue/escape route through a personnel access door shall be provided from every working space where an operator will stand when he/she operates a switch in or on a sealed piece of equipment (a S&C "Vista" switch or a 200-amp elbow on a piece of equipment). The personnel access door allows 24-hour access to the vault room from outside the building. The access shall meet NESC Section 113.

- Doors shall be designed for Clark's Substation lock cores or have a Vinter Changeable Hasp installed to accept a Clark padlock with a 3/8-inch shank.  
Personnel access doors can be a standard size (3' x 6'8" min).
- All standard-size access doors into the vault room shall open outward and shall
- be equipped with panic bars, pressure plates or other devices that are normally latched but open under simple pressure.  
Equipment access doors (hinged or roll-up) must be a minimum of 10 feet wide.
- Bollards may be required to protect access to the vault room.
- 

## Signage

All vault rooms shall have "Warning" signs on the outside of all access doors and "Danger" signs on the inside of all access doors in accordance with ANSI Z535. Clark will provide the signs to the customer. The customer is responsible for installing them at a height of 5' to the top of the sign from the floor.

The customer will provide and install 2" phenolic numbers and letters 3" below the "Warning" sign with the name of the equipment and the equipment number. Clark will provide the switch number label. See Figures 6 and 7.

If a roll-up door is used for equipment access, the "Warning" signs, "Danger" signs, and phenolic letters and numbers can be placed on the concrete wall on the side of the door at the same heights. Placards will be used instead of adhesive signs.

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Figure 6: Outside of Access Doors to Vault Room

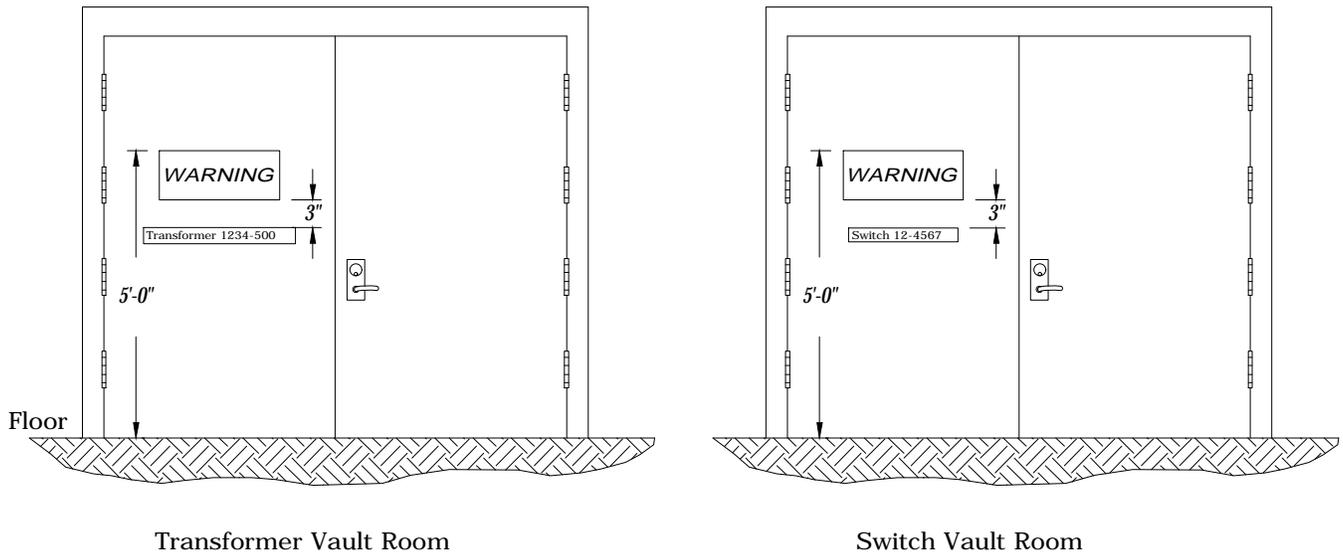
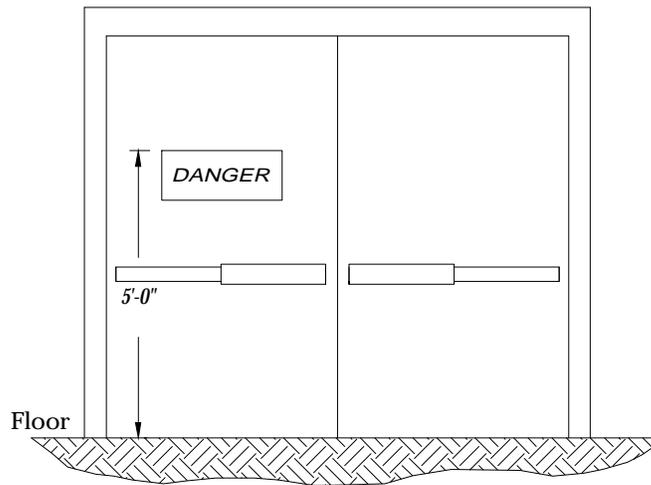


Figure 7: Inside of Access Doors to Vault Room



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# Fire Detection and Suppression

## Requirements for Customer-owned Vault Rooms

The vault room shall be built to meet the NEC 450 Section III and the IBC 705. A portable ABC-rated fire extinguisher shall be located outside each personnel access door. The customer is responsible for keeping the fire extinguisher up to date.

Fire detection equipment (smoke and temperature) shall be located where they can be tested and maintained without climbing over or on top of transformers or switches.

## Water Sprinkler Systems in Vault Rooms

Electrical fires and oil fires are not easily controlled by sprinklers. Water sprayed on burning oil can cause frothing and boilover. If the capacity of the containment system is exceeded, flaming oil can overflow and expand the scope of a fire. For these reasons, Clark does not recommend water sprinkler systems in vault rooms.

If the local fire department requires a sprinkler system in the room, a containment system shall be installed that is sized to adequately handle the water volume of the room's sprinkler system, plus the volume of oil of the transformer.

# Oil Containment

The transformer vault room shall include an oil containment system that can store 500 gallons of oil.

Floor drains are not allowed in Clark's vault rooms. Removable or breakable sills may be required at each access door.

# Ventilation

## Natural Circulation

The preferred method of ventilation is natural circulation to the outside air. The minimum net clear area required for natural ventilation is 3 square inches for each kVA of transformer capacity (see Table 3). Only the area of the opening shall be included in this calculation and not the area occupied by a screen or grating if present. All the ventilation area may be in the ceiling or along the walls, but not within 2' of the floor.

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**Forced-Air**

If natural ventilation to the outside air is not available, forced ventilation will be provided. The minimum cubic feet per minute (c.f.m.) of airflow will be 1.6 times the transformer capacity in kVA (shown in Table 3). Forced ventilation will be controlled by a thermostat set to come on at 86 degrees Fahrenheit and turn off at 140 degrees Fahrenheit. If the room temperature exceeds 140 degrees Fahrenheit, an alarm shall sound in the building management system. All ventilation openings to the inside of the building will be supplied with automatically closing fire dampers. All ventilation openings will be to the outside of the building to prevent smoke damage.

**Airflow Factor Formula**

The c.f.m. airflow factor of 1.6 times the kVA was obtained using the following formula:

$$Q = \frac{(3.16 \times WL)}{(t_i - t_o)}$$

- Where:
- Q = Rate of air transfer in c.f.m.
  - WL= Transformer full load loss in watts
  - t<sub>i</sub> = Maximum allowable temperature in vault or 140°F (40°C)
  - t<sub>o</sub> = Incoming ambient air temperature or 86°F (30°C)

**Table 3**

Minimum net clear opening required for natural ventilation or c.f.m. for forced ventilation

Transformer (kVA)	Natural Ventilation		Forced Ventilation
	(Sq Ft)	(Sq In)	(C.F.M.)
300	6.25	900	480
500	10.41	1500	800
750	15.63	2250	1200
1000	20.82	3000	1600
1500	31.23	4500	2400
2000*	41.64	6000	3200
2500*	52.05	7500	4000

\* Require S&C "Vista" switch for system protection.

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# Lighting and Outlets

These are the requirements for lighting and outlets in vault rooms:

- All four sides of the equipment shall be illuminated.
- Vault room lighting shall be provided at a rate of 3 watts per square foot of floor space.
- The light switch shall be located inside the vault room next to the personnel access doorway.
- Emergency lighting shall be provided as specified in the NEC-700, Emergency Systems.
- A 120-volt duplex convenience receptacle shall be provided on two opposite walls of the vault.
- The customer shall provide an additional convenience outlet to power a communication enclosure required by Clark Public Utilities for supervisory and data acquisition controls for switch rooms.
- All branch lighting and outlet circuits serving the vault room shall be tied to the facility's emergency generator panel.

# Approval Drawings

The customer shall be responsible for providing detailed construction drawings, for Clark Public Utilities' approval, outlining:

- The dimensions, layout, and location within the building of vault rooms, given in both plan and profile
- Load bearing capabilities of all areas subject to equipment loads
- Access doors
- Oil containment
- Ventilation
- Lighting and outlets
- Knockouts or inserts for Clark's ducts entering the vault
- Grounding system.
- Fire detection system and fire extinguisher location.
- Fire rating of vault room walls, floor, ceiling and doors/hatches
- Equipment removal plan if not by boom truck through an exterior door or through an opening or access hatch directly over the equipment.
- Customer's secondary bus system and supports
- Support system for primary cable runs

## Responsibilities

Customer Design Responsibilities	Clark's Design Responsibilities
Shall provide the vault room drawings during the preliminary design stage of the project.	Shall review and approve vault room design drawings in a timely fashion.

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