Instructions for VAC-CLAD Metal-Clad Switchgear

Indoor Housings

Westinghouse Electric Corporation

Switchgear Division, East Pittsburgh, Pa. 15112
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CAUTION

The metal-clad switchgear described in this book has been designed and tested to operate within its nameplate ratings. Operation outside of these ratings may cause the equipment to fail, resulting in bodily injury and property damage.

PURPOSE

This instruction book has been prepared to help engineers and technicians install, operate, and maintain Type VAC-CLAD Switchgear.

For information on the application of this type of switchgear, refer to the pertinent ANSI Standards and to Westinghouse Application Data 32-264. The nearest Westinghouse sales office will also supply this kind of information.

SAFETY

All safety codes, safety standards, and safety regulations must be strictly adhered to in installing, operating, or maintaining this equipment.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

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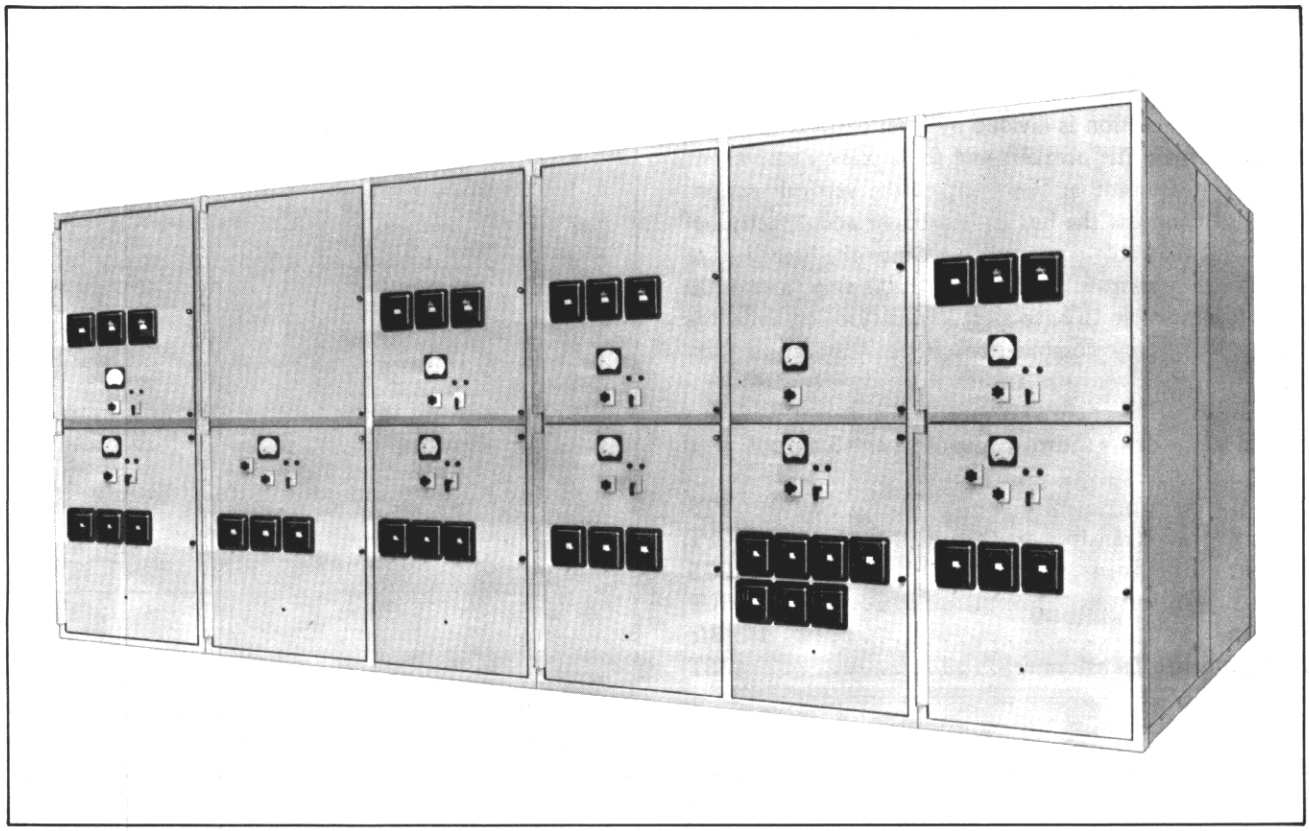


Fig. A1 *VAC-CLAD Switchgear – Indoor Front View*

INTRODUCTION

Type VAC-CLAD Medium Voltage, Metal-Clad Switchgear is designed to control various types of electrical apparatus and power circuits.

VAC-CLAD is available in ratings of 4.16 kV, 7.2 kV, and 13.8 kV with interrupting capacities of 250 MVA, 350 MVA, 500 MVA, 750 MVA, and 1000 MVA.

VAC-CLAD Switchgear is designed, manufactured and tested in accordance with ANSI, NEMA, and IEEE standards.

The switchgear vertical sections contain the breakers, the auxiliary equipment, the bus, and the cables. The vertical sections are built of steel sheet bolted to a rigid frame made of steel members. A switchgear installation consists of one or more of these vertical sections bolted together and connected electrically to make an integrated system.

BRIEF DESCRIPTION OF VAC-CLAD SWITCHGEAR

Each vertical section is divided by steel barriers into four compartments. The breakers and the auxiliary equipment are mounted inside at the front of the vertical section. Directly behind is the bus compartment and directly behind that, the cable compartment. Since the breakers are available in ratings of 1200 amp, 2000 amp, and 3000 amp, it is possible to have a great variety of components arranged in many combinations. (See Application Data 52-264.)

The components shown in Figs. 1, 2 and 3 are :

Potential Transformers	PTS
Control Power Transformers	CPT
Current Transformers	CTS
Surge Suppressors	SUP
Potheads	1/c; 3/c
Zero Sequence Transformer	ZST

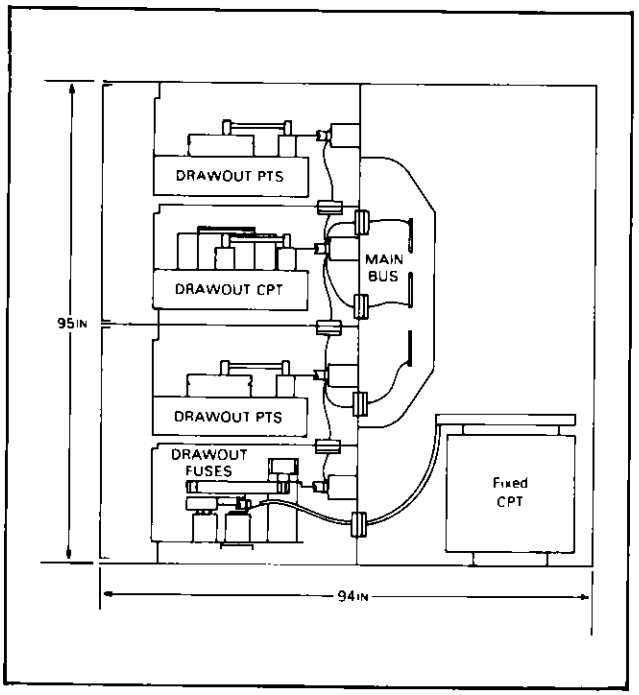


Fig. 2 *Typical Auxiliary/Auxiliary Vertical Section*

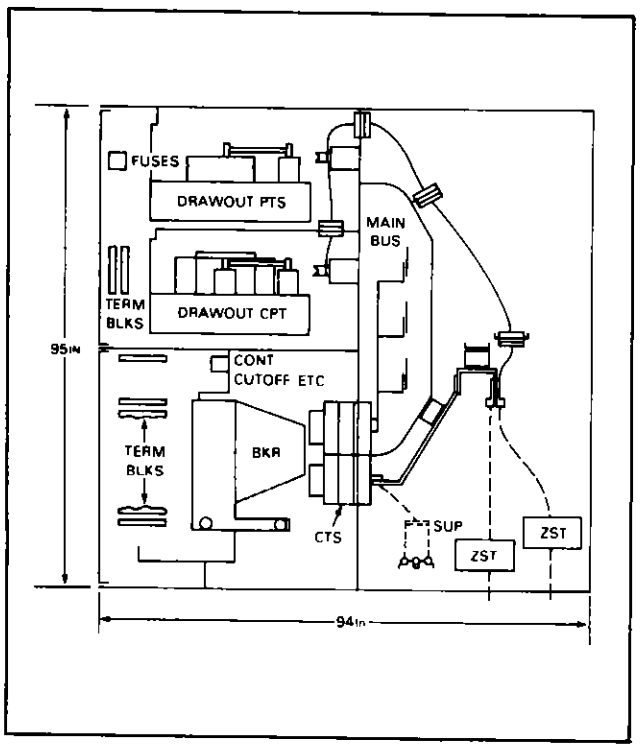


Fig. 1 *Typical Auxiliary/Breaker Vertical Section*

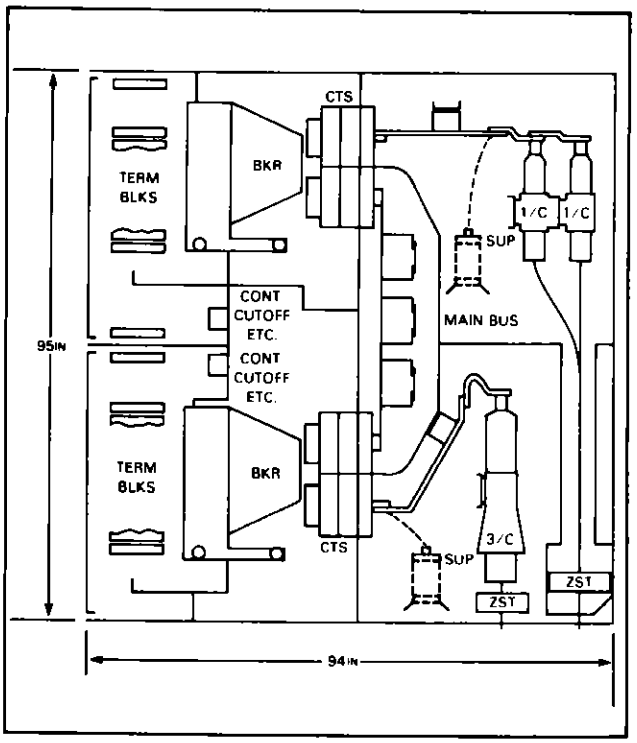


Fig. 3 *Typical Breaker/Breaker Vertical Section*

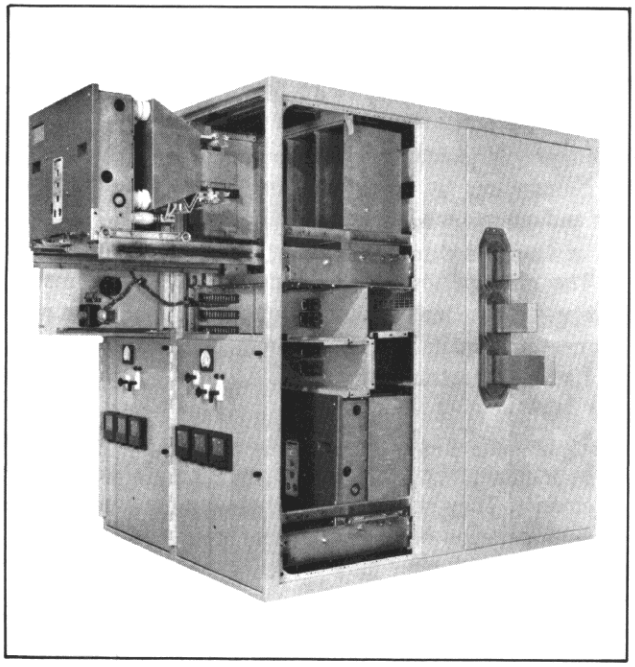


Fig. 4 *Upper Breaker in Withdrawn Position on Rails*

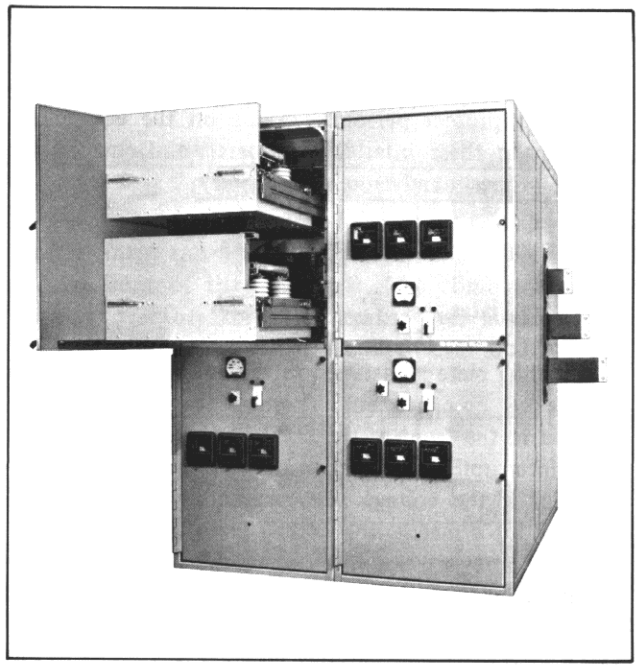


Fig. 5 *Upper Auxiliary Equipment in Withdrawn Position on Rails*

The breaker is installed by positioning it on the rails that can be pulled out from each side of the compartment. The breaker can be pulled out on these rails for maintenance. The potential transformers and the control power transformers are mounted in drawers in the auxiliary compartment. These drawers can also be pulled out to facilitate inspection and maintenance. Hinged panels on the front of the vertical sections hold meters, relays, and other control devices. Steel covers are bolted to the back of the housing to close the cable compartment.

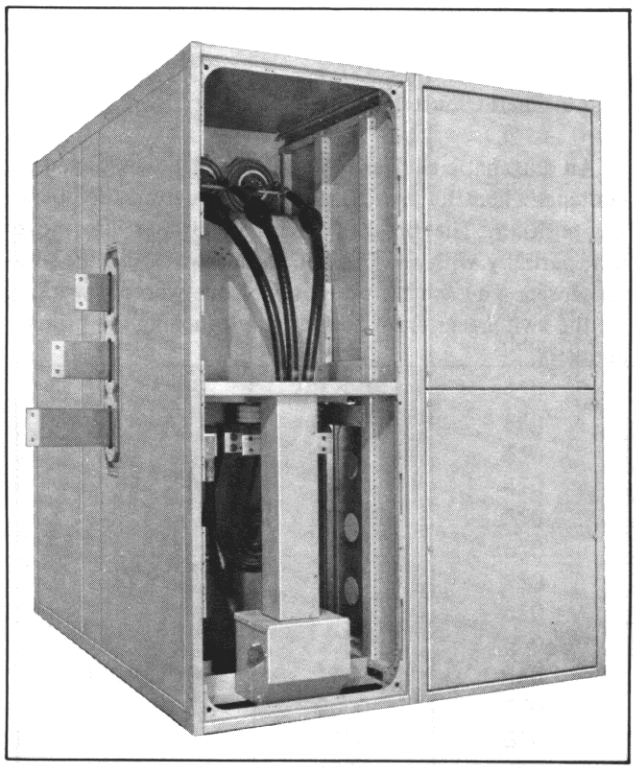


Fig. 6 *Rear View Illustration of Primary Circuit Separation*

SAFETY FEATURES

Westinghouse VAC-CLAD Switchgear is manufactured with several built-in interlocks. These interlocks are intended to protect persons working on the equipment. Never make these interlocks inoperative. Doing so can damage property and cause severe injury.

Following are two of the interlocks:

1. Coding Plates

A coding plate is fastened to the bottom front edge of the breaker compartment. There is also a coding plate fastened to the front of the breaker. If the breaker has a lower interrupting rating than the rating of the compartment, or if the voltage and continuous current characteristics don't match, the coding plate on the compartment will prevent the entrance of the breaker into the compartment.

NOTE: **Even with the coding plates it is possible to put into the compartment a breaker whose control wiring is not coordinated with that of the compartment. ALWAYS CHECK THE SHOP ORDER DRAWING TO MAKE SURE THE CONTROL WIRING OF THE BREAKER AND THE COMPARTMENT ARE BOTH THE SAME.**

2. Automatic Shutter

An automatic shutter covers the primary disconnecting contacts when the breaker is withdrawn from the operating position. The breaker interphase barrier also moves out partially with the breaker withdrawn, locks the shut-

RECOMMENDED SAFETY PRACTICES

Type VAC-CLAD Switchgear is complex electrical equipment. It has been designed to operate within the voltage and current limits shown on its nameplates.

Never apply this equipment to systems where the voltage and current are beyond these limits.

- The only persons who should be allowed to install, operate, or maintain this equipment are those who meet the qualification requirements described in the National Electric Safety Code.

- To perform work on this type of equipment, one must be trained and experienced in working with high-voltage circuits. They should be familiar with the construction and operation of this equipment and aware of the hazards involved.

- Before attempting to do any maintenance, always be sure to de-energize both the primary and secondary circuits.

- Never leave a breaker in an intermediate position in its compartment. Always use the levering-in crank to crank the breaker into the fully connected or withdrawn position.

- Before removing a bolted-on cover first make sure that all the circuits have been de-energized.

- Never try to disconnect or open the secondary cir-

SECTION 1
RECEIVING, HANDLING AND STORING VAC-CLAD INDOOR SWITCHGEAR

1.1 RECEIVING INDOOR SWITCHGEAR

The switchgear is shipped to the customer as completely assembled as possible. Depending on the number of switchgear vertical sections it may be necessary to ship the switchgear in several groups to facilitate handling.

Each group is bolted to wooden skids and covered with weatherproof material.

Each VCP, Vacuum, Circuit Breaker is shipped in a wooden crate with weatherproof material, bus runs, synchronizing panels, and accessories are shipped in separate cartons also packaged in the same manner.

Each switchgear group and all the cartons and crates are labelled with an order number and a shipping weight. On one of the groups there will be a shipping packet, securely attached, that contains the shipping lists, drawings, etc.

When the switchgear arrives at the installation site, check it to make sure all the parts described on the shipping list have been received. Do this before discarding the packing material to prevent losing parts. If the switchgear has been damaged, file a claim as soon as possible with the carrier and notify the nearest Westinghouse representative.

If the switchgear is going to be installed as soon as it has been received, unpack it and handle it according to the procedure outlined in the following paragraphs. If the switchgear is to be stored, inspect it to make sure the shipment is complete and undamaged. Repack it so it will be protected until it has been installed. (See section on storing of equipment.)

1.2 HANDLING INDOOR SWITCHGEAR

Table 1 gives the approximate weights of the various combinations of switchgear and the various ratings of breakers. The vertical section refers to the way the breaker compartment and the auxiliary compartment are arranged in the front of the switchgear. The combinations are: breaker over breaker B/B; breaker over auxiliary B/A; auxiliary over breaker A/B; auxiliary over auxiliary A/A; and sometimes the breaker B only.

Table 1
Typical Weights (Pounds)

Type of Vertical Section	Main Bus Rating Amps	Vertical Section Less Breaker
B/B	1200	2400
	2000	2500
	3000	2600
B/A	1200	2300
or	2000	2400
A/B	3000	2500
A/A	1200	2000
	2000	2100
	3000	2220
B	1200	2200
	2000	2300
	3000	2400
Type of Breaker	**Current Rating Amps**	**Breaker Element**
50VCP250	1200	450
	2000	550
	3000	650
50VCP350	1200	450
	2000	550
	3000	650
75VCP500	1200	450
	2000	550
	3000	650
150VCP500	1200	450
	2000	550
	3000	650
150VCP750	1200	450
	2000	550
	3000	650
150VCP1000	1200	450
	2000	550
	3000	650

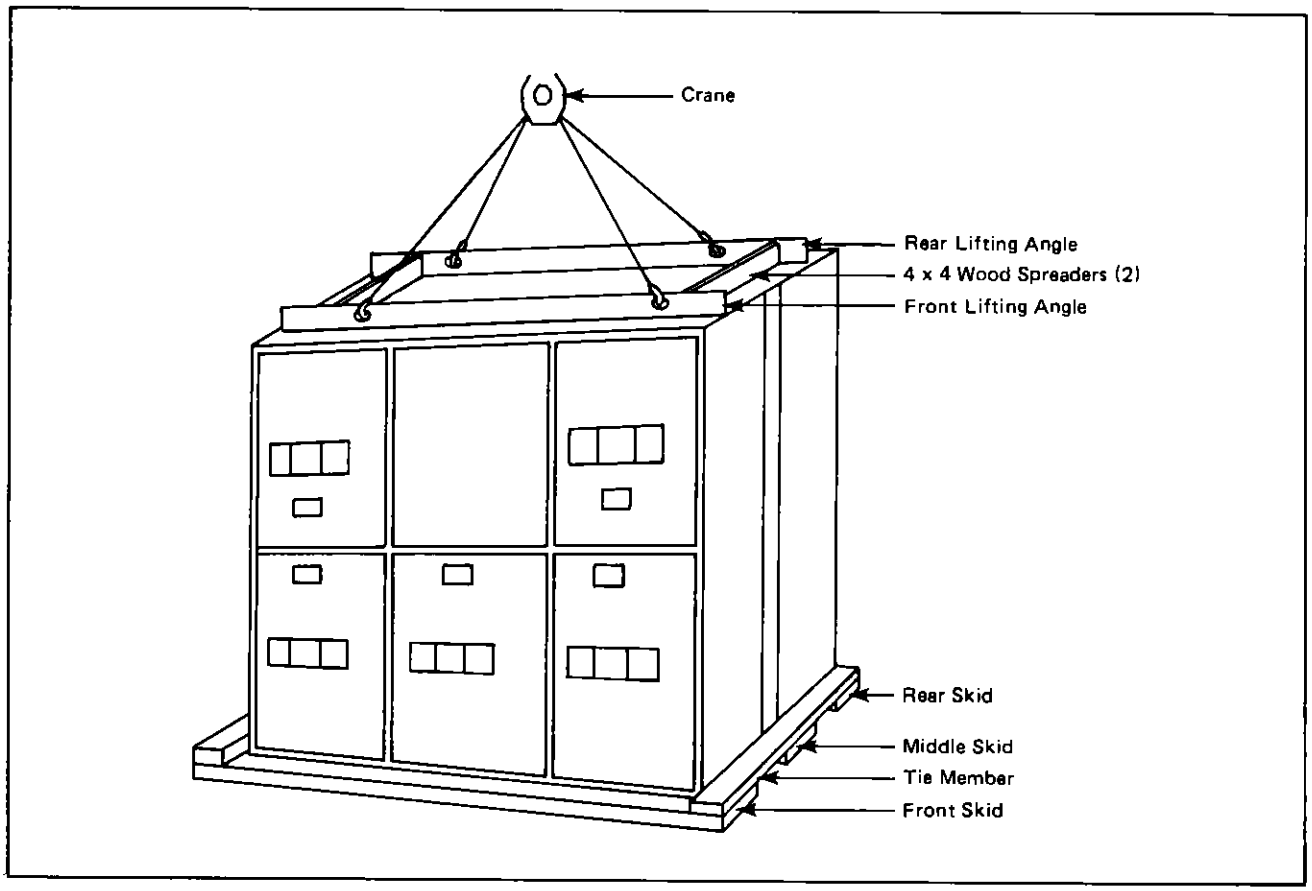


Fig. 7 *Handling of Indoor Shipping Group*

HANDLING - Cont.

Lifting members are bolted to the top of each shipping group. Put a crane hook through each of the four holes to lift and move the group. After the group has been moved into installation position remove the lifting members and discard them.

If a crane is not available, move the group into installation position on rollers. Skids run the length of the group. If the group is to be skidded sideways, the front and back skids are enough. If it is to be moved across its depth (from front to back), put in several short skids across the depth of the group and roll it into position on these.

NOTE: **Never maneuver the switchgear directly on the rollers. Always use the skids to protect the switchgear from being distorted or damaged.**

Handle all switchgear whether crated or uncrated with great care. The instrument panel on the front of the vertical sections contain delicate instruments, relays and meters that can be damaged by rough handling. If the switchgear is not put into service right away, cover it to keep clean. See section on storing of equipment.

1.3 STORING INDOOR SWITCHGEAR

Westinghouse packages switchgear to assure protection during shipment. Packaging for shipment is not necessarily suitable for storage. Moreover, part of the original packaging may be discarded when the switchgear is removed from the carrier. Switchgear bus runs, because of their open connection ends, are particularly vulnerable to moisture and dirt during storage.

If the switchgear must be stored for a while, prepare a suitable storage space. Keep it indoors in a heated building that is clean and dry. The floor should be smooth and level to prevent strain and distortion in the equipment. Be sure the space is well-drained so there is no standing water. Store the switchgear on its skids to keep it off the floor and to allow air to move under it freely.

Take steps to protect the switchgear against dampness, cement dust, corrosive atmospheres, and extreme temperature changes. To control condensation, make sure the equipment is well ventilated. Install temporary space heaters if necessary.

Storing the switchgear outdoors is not recommended, but if it cannot be avoided, make sure the equipment is stored in a shelter that provides adequate protection. The shelter should protect the equipment against rain, snow, wind, dirt, mud and moving vehicles. Install temporary heating to keep the equipment warm and dry.

Arrange the storage so the switchgear is accessible only to authorized persons. Store the equipment in such a way that it can be quickly located when it is needed for installation.

It is the responsibility of the purchaser to assure protection during storage.

Primary Considerations

Proper storage must protect switchgear from moisture, contamination, and physical damage. This protection must be accomplished with proper:

1. Supporting Foundation
2. Shelter
3. Ventilation
4. Heat

1. Supporting Foundation

To prevent distortions and stresses in the switchgear, the foundation of the storage area must be reasonably true and flat.

To minimize the effects of ground temperature, ground moisture, and permit air circulation, it may be advisable to place the switchgear on supports to elevate it above ground level. The foundation must be well-drained and free of standing water.

The weights in Table 1 can be used to plan the storage floor and to schedule the cranes needed to handle the equipment.

2. Shelter

To properly protect the switchgear during storage, the type of shelter will depend upon facilities and local conditions such as rain, snow, wind, dust, dirt, drippings, moving vehicles, local construction, and the like. Furthermore, the shelter must incorporate the ventilation, heat and supporting foundation.

The ideal shelter would be a clean, heated, ventilated, well-constructed building.

The minimum shelter (which should be avoided) would be a protective covering such as tarpaulin, plastic shroud, or paper shroud in an outdoor area. Should this be necessary, the switchgear and protective covering must be provided with ventilation. Furthermore, the switchgear must be provided with internal heat in each vertical section.

3. Ventilation

To prevent moisture condensation, ventilating air must be provided through and around the switchgear.

Switchgear vents must be open for free air circulation.

Protective covering such as tarpaulins, plastic or paper shrouds, and shipment packaging must be provided with ventilation for free air circulation from the bottom out through the top. It may be advisable to place the switchgear on supports to elevate it and increase ventilation up through the equipment.

Enclosed storage areas such as buildings, warehouses, sheds, temporary shelters, and the like must be well-ventilated. So-called indoor storage can be damaging without adequate ventilation of the storage area itself.

4. Heat

To prevent moisture condensation, heat may be required depending upon the shelter, rate of temperature change, extremes of temperature change, humidity, etc. in the locality. When in doubt, heat is recommended.

Enclosed storage areas with heat are generally satisfactory if the storage area temperature is maintained at least ten degrees above the outside temperature.

Enclosed storage areas without heat are generally satisfactory if the switchgear itself is provided with internal heat in each vertical section.

Open or outdoor storage areas without heat should be avoided but can be satisfactory if the switchgear itself is provided with internal heat in each vertical section.

NOTE: **Indoor switchgear is generally supplied without internal heaters so that temporary heaters may be required.**

STORAGE OF SPARE PARTS AND MISCELLANEOUS EQUIPMENT

All parts should be stored with the same care as the main switchgear.

In summary of:

1. Check the ventilation of the switchgear itself.

2. Check the ventilation of protective coverings. Serious damage can result from a non-ventilated tarpaulin.

3. Check the ventilation of enclosed storage areas or buildings.

4. Ventilation is a must.

5. Check for adequate heat, when in doubt provide heat.

6. Check for distortion.

7. Check for drainage and standing water.

8. Check weather protection including open doors, windows, drafts, etc.

9. Avoid outdoor storage.

10. Inspect periodically.

NOTE: **For detailed instructions on storing switchgear, refer to Westinghouse Drawing 700B214, a copy of the drawing is attached to each group of switchgear.**

SECTION 2
INSTALLING VAC-CLAD INDOOR SWITCHGEAR

2.1 OUTLINE OF INSTALLATION PROCEDURE

1. Prepare the installation foundation.

2. At the factory the switchgear system may have been divided into groups to facilitate shipping. At the installation site the groups must be rejoined to form the switchgear system.

Align the groups, side by side, on the installation foundation.

3. Bolt the groups together through the tie bolt holes.

4. Bolt the base members of the vertical section frame, front and rear, to the foundation channels.

5. Remove all shipping braces.

6. Connect the ground bus.

7. Install the primary bus removed for shipping.

8. Reconnect wiring between shipping groups. Run the control wiring for remote apparatus through the conduits in the foundation (or on top of the vertical sections).

9. Replace the metal barriers in the bus compartments.

10. Connect the main power cables.

11. Replace the rear covers on all the vertical sections.

12. Check the operation of the levering-in system in the breaker compartments.

13. Check the potential transformers and the control power transformers in the auxiliary compartments.

14. Perform loading check on both control and primary circuits to assure system is ready for operation.

2.2 DETAILS OF THE INSTALLATION PROCEDURE

1. Prepare the Foundation

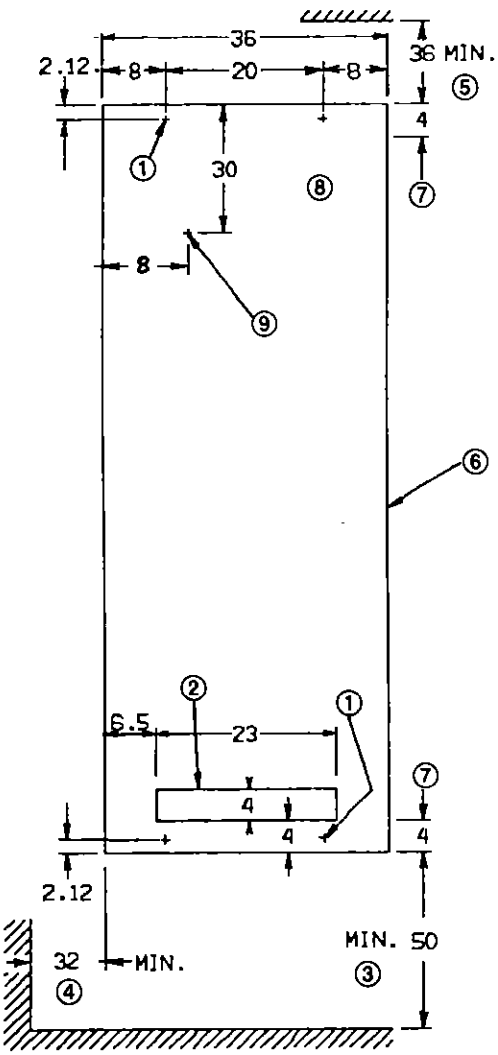
Review the instruction books and the drawings carefully. Usually the drawings are sent ahead of the shipment of switchgear so there will be ample time to plan the installation thoroughly.

a. Locate the switchgear so there is enough aisle space at the front and rear of the system. The amount of space recommended is shown in Fig. 8.

b. Leave enough space so the doors can be opened and the breakers and transformers can be pulled out for inspection and maintenance. Leave enough space at the rear so there will be room to install the cables and to perform whatever inspection and maintenance may be necessary.

The minimum clearances are shown in Fig. 8. Refer to the floor plan drawing furnished with each order.

c. Make sure the foundation is flat and level. Doing this job carefully holds installation costs down and promotes good performance by the switchgear.



1. Anchor Locations for 0.5 Inch Bolts or Welding
2. Secondary Conduit Space, 1.0 Inch Projection Max.
3. Minimum Front Clearance
4. Minimum Left Clearance
5. Recommended Min. Rear Clearance
6. Finished Foundation Surface (including Floor Steel) must be flat and level and in true plane
7. Floor Steel, if used, must not exceed this dimension under VAC-CLAD
8. Primary Conduit Area – See Shop Order Base Plan
9. Customer's Ground – Location by Shop Order Base Plan

Fig. 8 *Typical Base Plan*

d. Design the foundation so it will be strong enough to support the weight of the switchgear without sagging. Table 1 gives the weights of the various ratings of switchgear and breakers. Be sure to take into account the shock or impact weight that occurs when the breaker trips and when it closes. The impact weight is 1.5 times the weight of the breaker.

The weights in the tables are only an approximation. The actual weight will vary, depending on the type and the amount of equipment in the switchgear. Use adequate safety factors.

e. The recommended foundation consists of steel channels imbedded in a level concrete floor. For instructions on how to locate the channels in the floor, refer to the detailed floor plan drawings supplied with each order.

The channels must lie in a flat and level plane. (A slope of 0.125 inch in 3 feet in any direction is acceptable.) In no case may the non-supporting areas of the foundation be higher than the tops of the steel channels.

The anchor bolts, the channels and other materials are to be furnished by the purchaser of the switchgear. A 4-inch structural channel is recommended as the minimum size for the average indoor switchgear system.

If unit substation transformers are part of the installation, be sure the floor steel under the transformer conforms to the specifications of the transformer manufacturer.

f. Install the conduits in the foundation.

When the primary and secondary cables enter the switchgear from below, the conduits that carry them are embedded in the foundation. A floor plan drawing is furnished with each order. Use this drawing to determine the conduit layout, the spacing of the steel channels, etc. NOTE: Encircling loops of reinforcing or building steel around single phase conductors rated 600 amps or more should be avoided to prevent overheating due to induced currents.

To accommodate the cables the conduits should project one inch above the floor level after the installation has been completed. To simplify moving the switchgear into place, keep the conduit flush with the surface of the floor. After the group has been set into place on the foundation, add extension sleeves to the conduit so it can accommodate the wiring etc. If the full conduit is put in before the switchgear group has been moved into place, it will be necessary to raise the group on timbers so the pipe rollers can clear the tops of the conduits.

2. Align the shipping groups side by side on the foundation

a. Remove the crating and packaging material from the groups of switchgear that are going to be installed.

b. Let the shipping skids remain on each group until the group has been moved into its final installation position. (The skids help protect the switchgear and reduce the risk that it will be damaged or distorted during the move.)

c. If an odd number of groups is to be installed, install the middle one first. Then install the other groups, working out from the middle.

If an even number of groups is to be installed, start with either group on either side of the middle shipping break.

If a unit substation or a power center is being installed, line up the power transformer and the adjacent switchgear group first. Set them in the position called for on the drawing of the base plan. Then install the rest of the groups.

d. Handling the switchgear by crane is the preferred method.

Move the first group into position. Line up the bolt holes in the base of the vertical sections with the bolt holes in the steel channels in the foundation.

A few inches in front of the line-up draw a base line along the length of the intended location of switchgear. As the groups are maneuvered into place, keep the front of each group parallel to the base line.

e. A bolt at each end of the wooden skids holds the skids to the base of the group. Lift and remove the bolts, and discard the skids.

f. Set the group into its installation position. Use a level to make sure the group is level both across its width and along its length. Use a plumb line to make sure the group is plumb. (To level or plumb the group use shims at the points where the vertical sections will be bolted to the floors.

Move each group into position and repeat the preceding steps.

g. If no crane is available the groups may be moved on the skids and rollers.

3. Bolt the groups together through the tie bolt holes

a. Remove the back covers from the vertical sections on each side of the shipping group. Insert and tighten tie bolts in the rear upright members.

b. Open the front panels on these vertical sections. Insert and tighten tie bolts between the front upright members.

4. Bolt or weld the entire switchgear system to the channels in the foundation

Check the system again to make sure it is level and plumb.

5. Remove all the shipping blocks or braces

a. Examine all the meters, relays, etc. and remove any shipping blocks or braces. The time dials on the relays are set at zero in the factory so the relay contacts will be closed during shipping.

6. Connect the ground bus

a. The ground bus in the switchgear is assembled in sections. There is a joint in each housing. Solderless terminals are provided on the ground bus (see the floor plan in the shop order drawing). Use these terminals to connect the ground bus to the station ground. Make the connection as direct as possible. It should be large enough to carry the ground fault current of the installation. Never house it in a metal conduit.

b. The standard ground bus is a .25-inch x 2-inch copper bus bar bolted to the cross members of the frame in the bottom of each enclosure. The ground bus runs through the center of each section through the length of the entire switchgear system. Where the system is split for shipping, a splice plate (and hardware) is furnished to bridge the shipping break when the system is installed.

NOTE: **The importance of adequate grounding cannot be overstressed. For the design and installation of a grounding system refer to "Electric Power Distribution for Industrial Plants" (IEEE Std. 141); "Grounding of Industrial Power Systems (IEEE Publication 141, formerly AIEE 953); and the National Electric Code, articles 100, 200, and 250.**

For generating stations and larger substations, the ground resistance should be one ohm or less. For industrial plants and small substations, the ground resistance should be less than five ohms. (The National Electric Code states that the ground resistance should never exceed 25 ohms.)

7. Reconnect the high voltage bus where it was dismantled between groups

a. Remove the horizontal and vertical metal barriers from the cable compartment. Remove the vertical section of the bus barrier. (Also remove any other components such as potheads, surge suppressors, etc. that interfere with access to the bus compartment.)

b. Obtain the section of bus that was removed to separate the groups for shipping. Each section is labelled and shipped in the carton with the details.

c. The surfaces in the bus joints are tin or silver plated. Clean the plated surfaces of the bus section by brushing them lightly with crocus cloth only if necessary. Then wipe clean.

d. Slide the section of bus through the porcelain supports in the side of the vertical section. Slide the rubber snubber along the bus until it fits inside the opening in the bus support.

When the bus section is disconnected for shipping, the splice plates and hardware are left bolted to the end of the bus in each of the adjoining vertical sections. Sandwich the end of the disconnected section between the splice plates and fit the other end of the section between the splice plates on the end of the bus in the adjacent section. Bolt the splice plates together on each end of the bus section.

Repeat these steps for each section of bus at each shipping break.

Tighten the bolts in the splice plate to the torques shown in Table 2.

Table 2 – Bolt Tightness for Bus Connections

Bolt Material	Torque in Foot-Pounds for Bolt Size				
	.25-20	.31-18	.38-16	.50-13	.62-11
High Strength Steel	5	12	20	50	95
Silicon Bronze	5	10	15	40	55

8. Reconnect the wiring which was disconnected at the factory for shipping. The wiring is labeled as well as the connecting points.

a. Connect the wiring to the remote apparatus and to the terminal blocks mounted within the front of the vertical sections.

9. Replace the metal barriers and any other parts that may have been removed to give access to the bus compartments.

10. Connect the main power cables.

a. Before connecting a cable, determine its phase. The switchgear system is usually supplied with connections for phasing 1-2-3 left to right (viewed from the front). Check the shop order drawing to make sure because sometimes another phasing may have been specified.

b. If two systems are to be paralleled, make sure the phase rotation and the phase angle are the same. They must be the same to prevent damaging the equipment. The phase rotation must conform to the phase rotation on the shop order drawing so that the instruments, meters, and relays will operate properly.

c. When forming cables to fit inside the cable compartment, avoid bending it sharply or kinking it. Make sure it doesn't rest on sharp corners or edges that could damage the insulation.

d. Follow the instructions of the cable manufacturer to determine what minimum bending radii is permitted. Follow the instructions on insulating the joints so the insulation will taper properly through the correct gradient. The insulation will vary with the type and size of cable and with the service voltage for which it was designed.

e. Solderless connectors are usually furnished if the cable is non-leaded. The connection must be insulated according to the recommendation of the cable manufacturer.

f. If potheads or other types of terminators are furnished, follow the instructions of the manufacturer when connecting the cable to them. Use the flexible connectors to connect the aerial lugs to the conductors. This will keep strain off the insulators of the pothead or the terminator. Tape (or otherwise insulate) the entire joint (including the flexible connectors).

g. If zero sequence current transformers are used, pass the power cables through the transformer. Connect it to the terminals or to a pothead. (See Standard Drawing 700B222 or Fig. 9 on page 29.)

11. Replace the rear covers on all the vertical sections.

12. Make sure the levering-in system in the breaker compartment is working properly. Install the breakers. (See Instruction Book 32-254-1.)

13. Check the potential transformers, control power transformers and drawout fuses in the auxiliary compartments.

a. The transformers and etc. are mounted in separate drawers in the auxiliary compartments. They were adjusted in the factory and have been shipped, installed in the switchgear.

b. Remove the shipping brace mounted between the handles on each drawer.

c. Pull out the rails mounted on each side of the auxiliary compartment. Push the two drawer handles in toward each other and pull the drawer out of the compartment. (Rollers on the base of the drawers ride on the extended rails.)

d. Remove the protection paper from the main contacts and from the secondary contacts. The paper is used to protect the contacts during shipping.

e. Check to make sure the primary contacts and secondary contacts are engaged when the drawer is closed. Use the "lighting out" or "ringing" method – should engage when drawer is a min. of 1.0 in. of closed.

f. Check the fuses for continuity. Make sure there is proper contact in the fuse clips.

g. Suspended from inside the top of the compartment are three flexible, copper ground contacts. As the drawer is pulled open watch inside to make sure the copper contacts the fuses and grounds them.

h. Make sure the mechanical interlock (or the key interlock) is working properly for control power transf. or disc. fuses. When the interlock is working, it should be impossible to pull the drawer out without first opening the breaker in the secondary circuit.

14. Perform a loading check of the control circuits.

a. Before energizing the control circuits, check the control bus with an ohmmeter to make sure there are no

short circuits in the control wiring. If an ohmmeter is not available, connect a small fuse in series with the source of the control power. This will protect the control wiring against damage. (The fuse should be one-fourth the normal rating of the circuit.)

SECTION 3
ADJUSTING AND TESTING

1. After the switchgear has been installed and connected to the apparatus it is to control, give it a final check before it is put into service. (Make sure the apparatus being controlled is not connected to the system while the tests are being carried out.)

The testing equipment will depend on the size and type of installation. Use portable voltmeters. Rig up some simple device for "ringing" or "lighting out" circuits.

2. Examine all wiring circuits to make sure they have not been damaged or loosened during shipment or installation.

3. Make sure all the connections are correct before the equipment is operated. "Light out" connections between the switchgear and remote apparatus such as instrument transformers, auxiliary switches, and remote control and interlock circuits.

4. Coordinate the settings of the relays with other parts of the system in accordance with the standards or operating practice of the Purchaser. Refer to the schematic diagrams on the shop order drawings for the actual settings and connections of relays.

5. If the covers are removed from meters, relays, or other devices for installation or test, handle them carefully. Replace the covers as soon as possible to keep out dust and dirt.

6. After the switchgear has been put into operation, review the drawings supplied with the equipment. Mark them to show any revisions made during installation. Return a set of these drawings to Westinghouse so the tracings can be changed for the permanent record.

SECTION 4
OPERATION OF THE SYSTEM

1. Install the circuit breakers and check their operation.

2. Study and be sure to understand the three line diagram and the schematic diagram furnished with each switchgear system.

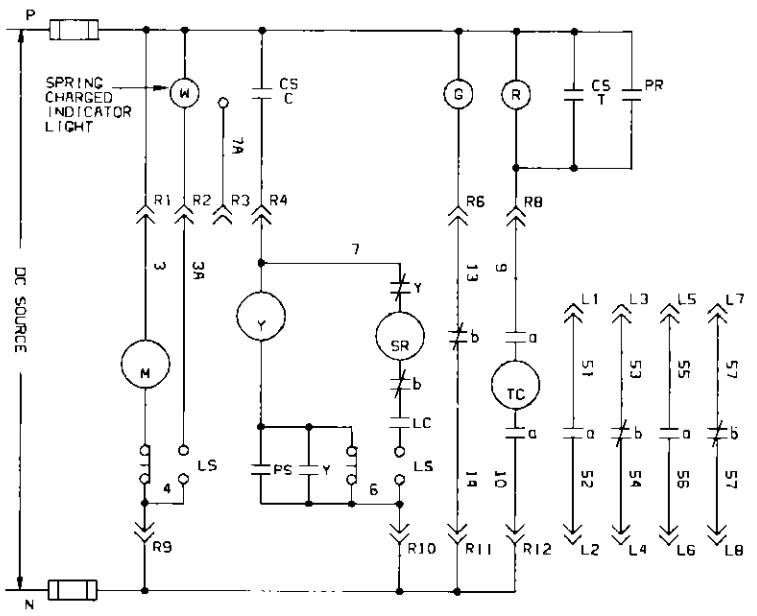
3. Electrically trained personnel will be familiar with all the indicating and recording instruments and meters required to operate the system. They will also be familiar with the use of instrument switches, rheostat control switches, and governor motor control switches.

4. NOTE: As checks are being made the breakers should be in the test position with the secondaries made up.

5. A green light on the hinged instrument panel on the front of the breaker compartment shows that the breaker is open. A red light shows the breaker is closed. In a d-c control scheme the red light supervises the trip coil and indicates the trip coil circuit has continuity.

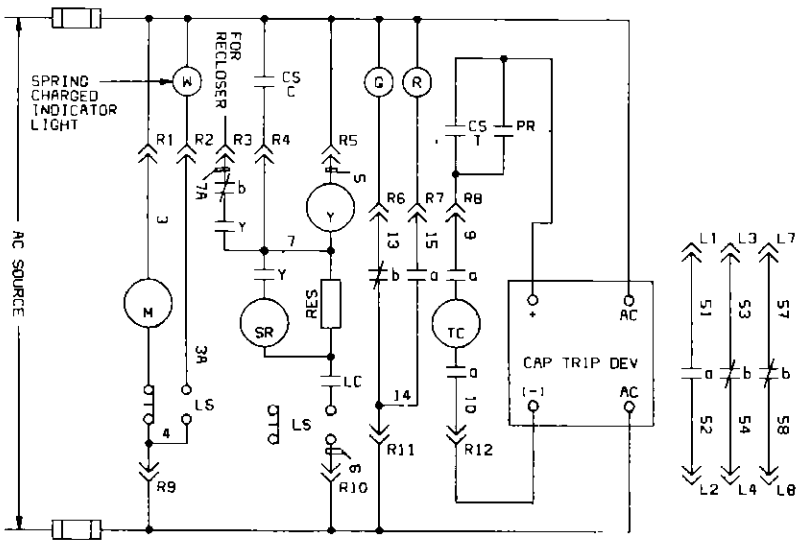
6. The details of the breaker control schemes vary from one installation to another. All the schemes are derived from basic control schemes shown in Fig. 10.

They comply with the requirements set forth by AEIC, IEEE, NEMA, and ANSI. All of the schemes are designed to coordinate electrically with the mechanical design of the breaker.



ANSI STANDARD VCP BREAKER DC CONTROL SCHEMATIC

CS C – Breaker Control Switch – Close
CS T – Breaker Control Switch – Trip
Y – Anti Pump Relay
SR – Spring Release Coil (Close Coil)
M – Spring Charging Motor
TC – Trip Coil
PR – Protective Relay
LS – Limit Switch (Motor Cut-off)
LC – Latch Check Switch
UV – Undervoltage Coil
PS – Position Switch, Mechanically Actuated to make before Secondaries Engage and Break after Secondaries Engage



ANSI STANDARD VCP BREAKER AC CONTROL SCHEMATIC

CS C – Breaker Control Switch – Close
CS T – Breaker Control Switch – Trip
Y – Anti Pump Relay
SR – Spring Release Coil (Close Coil)
M – Spring Charging Motor
TC – Trip Coil
PR – Protective Relay
LS – Limit Switch (Motor Cut-off)
LC – Latch Check Switch
UV – Undervoltage Coil

Fig. 10 *Typical Control Schemes*

SECTION 5
INSPECTION AND MAINTENANCE

5.1 SAFETY PRECAUTIONS

WHEN INSPECTING, REPAIRING, AND PERFORMING MAINTENANCE ON METAL-CLAD SWITCHGEAR, THE FACT THAT DANGEROUS VOLTAGES MAY EXIST MUST BE KEPT IN MIND; AND PRECAUTIONS MUST BE TAKEN TO INSURE THAT PERSONNEL DO NOT COME IN CONTACT WITH ENERGIZED HIGH VOLTAGE PARTS. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

Some common general precautions for high voltage work are:

1. All connections should be considered energized until the crew expecting to work on them is assured that the circuits are de-energized, and until every possible precaution has been taken to see that there is no chance of a circuit being energized while the crew is working.

2. Switches which have been opened to de-energize a circuit to permit work on equipment should be locked or blocked open and a suitable visible warning device placed on them.

3. Do not work on parts normally carrying current at high voltage until these parts have been disconnected from the system and connected to the ground bus. Provision should be made by the Purchaser for connecting adequate flexible ground leads to every part of the switching equipment.

4. A good and reliable ground connection is necessary for every switchgear installation. It should be of sufficient capacity to take care of any abnormal condition that might occur on the system and should be independent of the grounds used for any other apparatus. See GROUND BUS CONNECTIONS.

5.2 ACCESS TO SWITCHGEAR PARTS

1. High Voltage Parts

VAC-CLAD metal-clad switchgear is designed so that internal compartments provide metal isolation between the VCP circuit breaker compartment, the main bus, and the primary line terminations. Access to high voltage parts is provided by removable covers and barriers WHICH SHOULD NOT BE REMOVED UNLESS THE PARTS TO BE EXPOSED ARE DE-ENERGIZED.

2. Main Contacts and Current Transformers

Both the stationary main disconnecting contacts and the ring-type current transformers are located just behind the moulded interphase barrier and metal shutter.

Upper and/or lower contacts and transformers are easily exposed. For this reason CAUTION MUST BE EXERCISED. DO NOT EXPOSE ANY CONTACTS OR TRANSFORMERS UNLESS ALL UPPER AND LOWER HIGH VOLTAGE PARTS ARE DE-ENERGIZED. FAILURE TO DO SO COULD CAUSE PERSONAL INJURY OR PROPERTY DAMAGE.

3. Disconnecting Transformers and Fuses

Simply opening the drawer automatically disconnects and grounds the moving high-voltage parts. The cable and stationary contacts are accessible either by removing back covers or by removing the complete assembly.

CAUTION: DO NOT ATTEMPT TO REMOVE THE BACK COVERS, THE DISCONNECTING ASSEMBLIES OR SHUTTERS UNLESS THE HIGH VOLTAGE CIRCUIT TO THE COMPARTMENT IS DE-ENERGIZED AND PRECAUTIONS TO PREVENT RE-ENERGIZING HAVE BEEN TAKEN. FAILURE TO DE-ENERGIZE THE CIRCUIT AND TO TAKE PRECAUTIONS TO PREVENT RE-ENERGIZING IT COULD RESULT IN BODILY INJURY OR ELECTROCUTION. WHEN ENERGIZED, CIRCUIT CARRIES LETHAL HIGH VOLTAGES.

4. Control Equipment

With the exception of apparatus such as current transformers and rear mounted heaters, control equipment and wiring is generally accessible without exposing high voltage parts.

5.3 INSPECTION AND MAINTENANCE SCHEDULE

To assure high quality service, a definite maintenance schedule, systematically followed, is essential. Plant, operating, and local conditions vary to such an extent that the schedule must be prepared to suit the conditions. However, the following general requirements should be helpful in setting up the program.

CAUTION: BEFORE ATTEMPTING ANY INSPECTION OR MAINTENANCE BE SURE THAT ALL PRIMARY AND CONTROL CIRCUITS HAVE BEEN DE-ENERGIZED AND GROUNDED AS REQUIRED AND THAT PROPER STEPS HAVE BEEN TAKEN TO BE SURE THAT THEY WILL REMAIN DE-ENERGIZED UNTIL ALL WORK IS COMPLETED. FAILURE TO DO SO COULD RESULT IN BODILY INJURY OR ELECTROCUTION. WHEN ENERGIZED, CIRCUIT CARRIES LETHAL HIGH VOLTAGES.

1. Individual Devices

The maintenance schedule for individual devices such as circuit breakers, relays, meters, etc. should be based upon recommendations contained in the individual instruction book for the device. These operations should be coordinated with the overall program to result in the least operating inconvenience and circuit shutdown.

2. Overall Installations

The switchgear installation should be given a thorough overall maintenance check at the end of the first year in service because it provides an opportunity to evaluate conditions at an early point the life of the equipment. Where conditions are abnormal, more frequent inspection and maintenance is necessary. Where conditions warrant, a longer period of time between maintenance periods may be used. No equipment should be left in service longer than three years without being inspected. The following items require attention:

3. Buses and Connections

De-energize primary circuits and remove cover plates from the primary compartments. Before cleaning take "megger" readings between phases and to ground. Inspect for signs of overheating or weakened insulation. Remove dust from buses, connections, supports, and enclosure surfaces. A vacuum cleaner with a long nozzle will be of assistance. Wipe clean with a warm soap water solution, wipe dry.

After buses have been dusted and wiped clean, take "megger" readings again between the buses and ground and between phases. Keep a record of these readings for future reference in determining when trends occur that would indicate a lowering of the insulation resistance.

Periodic high potential tests are not required and are recommended only after repair of high voltage buses or insulation, or when the trend of megger readings indicates it to be advisable. This field test should be made before the main cables are connected and should not exceed 14.25 kV, 60 Hz, 1 minute, for 4.76 kV switchgear and 27 kV, 60 Hz, 1 minute for 8.25 kV and 15.0 kV switchgear. Transformer primary fuses should be removed during high potential tests.

4. Main Disconnecting Contacts and Supports

Remove each breaker from its compartment. De-energize primary circuits and expose primary contacts and their porcelain supports. Wipe clean with a cloth moistened in a non-flammable solvent. Inspect for abnormal wear or overheating. Discoloration of the surfaces is not harmful unless corrosion due to atmospheric conditions is severe, leaving deposits on the surface. If necessary, these can be removed by a light application of crocus cloth. Check each breaker while it is out of the housing for all items recommended in the instruction book applying to that particular type of breaker. See Instruction Book 32-254-1.

5. Other Disconnecting Contacts

Inspect all primary and secondary disconnecting contacts such as those on drawout transformers for abnormal wear, fatigue, or overheating. Replace if necessary. Otherwise treat the same as Main Disconnecting Contacts above.

6. Control Contactors

Contacts should be inspected and dressed or replaced when the surface becomes pitted. Unless repetitive duty has been experienced, little attention should be required.

7. Instruments, Relays and Other Panel Mounted Devices

Individual devices should be maintained according to the specific instructions supplied for each device. Remove all relay covers and inspect the interiors for dust or dirt. This operation can most readily be performed by relay test personnel during period relay tests.

8. Secondary Wiring

Check all wiring connections for tightness including those at the current and potential transformers and at the terminal blocks where circuits leave the switchgear. Make sure that all secondary wiring connections are properly connected to the switchgear ground bus where so indicated.

9. Mechanical Parts

Visually check and manually operate mechanical moving parts such as the shutter, TOC and MOC switch assemblies, the position interlock, hinged doors, and the draw-out features of the transformers and fuses. Examine mechanical mating parts such as the movement block, side rails and trippers.

10. Ventilation

Check all labyrinths, grillwork, and air passages for obstructions and accumulations of dirt.

11. Battery and Charging Equipment

THE CONTROL BATTERY IS SUCH AN IMPORTANT ITEM IN SWITCHGEAR OPERATION THAT IT MUST BE GIVEN SPECIAL PERIODIC ATTENTION IF IT IS TO GIVE RELIABLE SERVICE FOR A LONG PERIOD OF TIME. Periodic inspections and tests are recommended in the battery supplier's instructions. At the same time the battery is checked, inspect the battery charger and remove accumulations of dust and dirt. On all chargers having a manual transfer switch for setting the charging rate, check carefully to be sure that the selector switch is returned to the value appropriate for a floating charge at the end of the periodic inspection. SERIOUS DAMAGE TO THE CONTROL BATTERY CAN OCCUR IF THE CHARGER IS LEFT ON A HIGH CHARGING RATE FOR AN EXTENDED PERIOD OF TIME.

12. Records

The condition of each switchgear unit at the time of inspection should be listed in a permanent record to become a guide for anticipating the need for replacements or for special attention between the regular maintenance periods. Megger tests are suggested for checking the insulation. A series of these tests will indicate any tendency toward a reduction in dielectric strength of the insulation. Megger readings should be taken before and after cleaning the equipment and, where possible, under similar conditions at successive periods. Records should include the megger reading, the temperature and the humidity. The readings will vary with the extent and design of the bus structure. In contrast with a small installation, the longer switchgear assemblies will have a more extensive bus structure with a greater number of insulators and, thereby, a larger number of parallel insulation resistance paths to ground which will tend to decrease megger readings. This variation in insulation resistance between different switchgear assemblies emphasizes the value of a series of readings which can be charted to establish a normal insulation level so that progressive weakening of the insulation can be recognized.

13. Abnormal Conditions

Local conditions such as high humidity, salt-laden atmosphere, corrosive gases, heavy dust, or severe circuit operating conditions, are considered to be abnormal; and will require more frequent inspections.

It should be emphasized that a series of inspections should be made at quarterly intervals until the progressive facts of the local conditions can be analyzed to determine a schedule which will maintain the equipment in satisfactory condition.

In some locations conditions may be so bad that the frequency of maintenance will interfere with operating and production schedules. In such cases, consideration should be given to the possibility of enclosing the switchgear equipment in a relatively tight room and to supplying a sufficient quantity of clean air to maintain a positive pressure in the room. Under such conditions maintenance schedules may then be established on a more normal basis. Such an arrangement might also provide for cooling the air where the ambient temperature is relatively high, thus further improving operating conditions.

SECTION 6
LUBRICATION

VAC-CLAD switchgear is designed so that lubrication is not required under normal conditions. However, abnormal local conditions such as high humidity, salt-laden atmosphere, corrosive gases, or severe circuit operating conditions may demand the use of lubricants. In such cases a dry or powder lubricant should be used on moving or mating mechanical parts and a thin film of vaseline on disconnection contacts. The application of the lubricants should be held to a minimum to reduce the accumulation of dust and dirt.

SECTION 7
RENEWAL PARTS

When ordering renewal or spare parts, include as much information as possible. In many cases the style number of the new part can be obtained from identification on the old part. Always include a description of the part. Specify the rating, housing number, and shop order number of the metal-clad housing in which the part is to be used.

SECTION 8
A FURTHER DESCRIPTION OF VAC-CLAD SWITCHGEAR

8.1 INDOOR ENCLOSURES

VAC-CLAD switchgear consists of a number of enclosures connected electrically and mechanically into an integrated system. The number of vertical sections depends on the customer's needs. Each vertical section is divided by metal barriers into four compartments.

The front half of the housing contains the breaker compartment (or compartments) and the auxiliary compartment, arranged one on top of the other according to the customer's needs. Directly behind these compartments is the bus compartment and behind that the cable compartment. The metal barriers are grounded through the station ground system, see Fig. 11.

8.2 INSTRUMENT PANEL

On the front of each compartment is a hinged door that acts as an instrument panel. Relays, meters, and instruments are mounted on the panel. There are also controls for operating the breaker.

Auxiliary switches on the breaker and in the breaker compartment operate indicator lights on the instrument panel to show whether the breaker is open or closed. Switch handles on the instrument panel can be turned to open or close the breaker. All this can be done without opening the door (the instrument panel) to the compartment, see Fig. 12.

8.3 CONTACT MOUNTING

Mounting is made of two 3-phase glass polyester mouldings backed up by a steel barrier.

Contact Stud

May be flat, as shown, or round, dependent on amperage rating. See Fig. 14.

8.4 RING-TYPE CURRENT TRANSFORMERS

The ring-type current transformers are mounted so they slip over the primary contact stud insulating tube on the rear wall of the breaker compartment. There is space for a max. of four transformers per phase.

They are mounted so they can be reached from the front of the enclosure. This makes it possible to add or to change transformers when the switchgear is de-energized without handling high voltage connections or breaking the primary insulation. The polarity marks on the transformers show the relative instantaneous polarity in the primary and secondary windings. The schematic and the three line diagrams show how to connect the transformers to give the polarity needed to operate relays and instruments, see Figs. 13 and 14.

CAUTION: DO NOT MANUALLY RAISE OR REMOVE SHUTTER UNLESS MAIN CONTACTS ARE DE-ENERGIZED AND SAFETY PROCEDURES HAVE BEEN INITIATED TO MAKE SURE THE CIRCUITS CAN NOT BE RE-ENERGIZED. FAILURE TO EXERCISE CAUTION MAY RESULT IN BODILY INJURY AND PROPERTY DAMAGE.

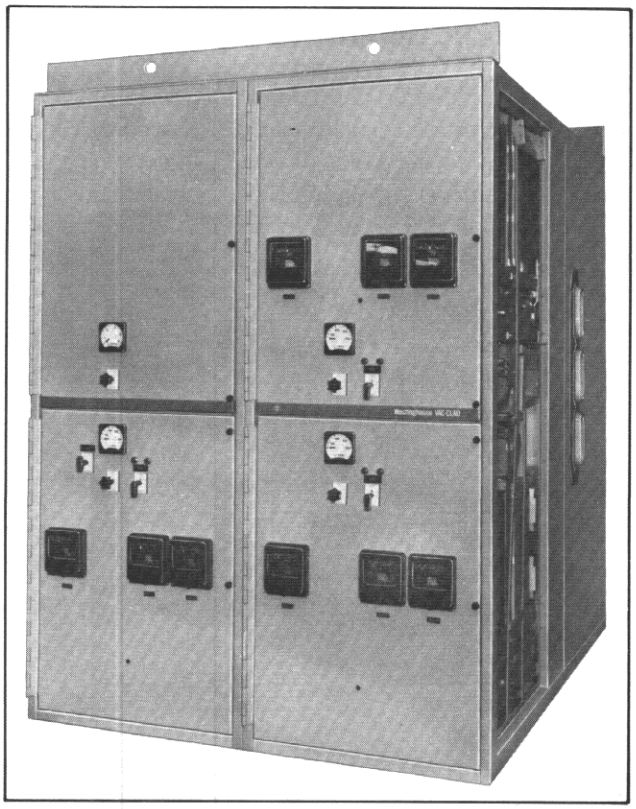


Fig. 11 *A Typical Two-Section Shipping Group (Shipping Groups may be greatly dependent on Your Capabilities)*

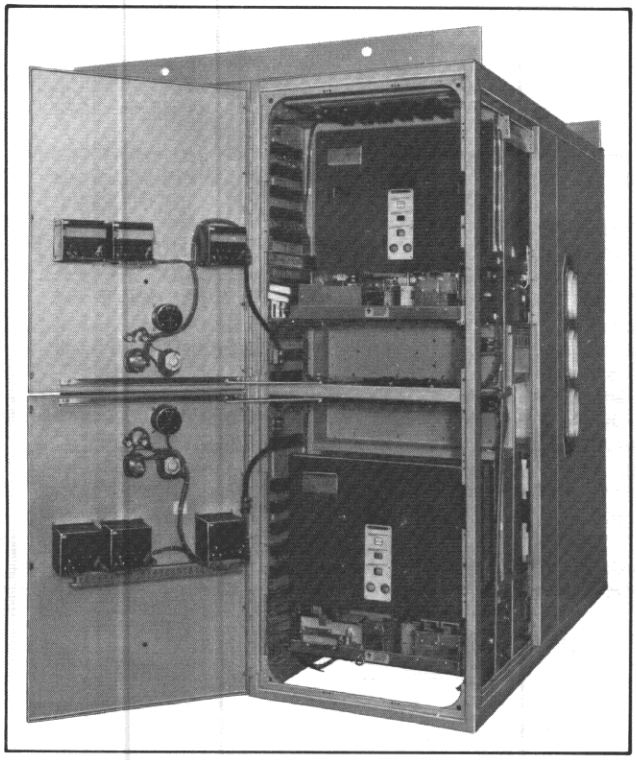


Fig. 12 *Breaker Compartment Front View with Instrument Panels Open Exposing Rear of Relays, Instruments and Wiring*

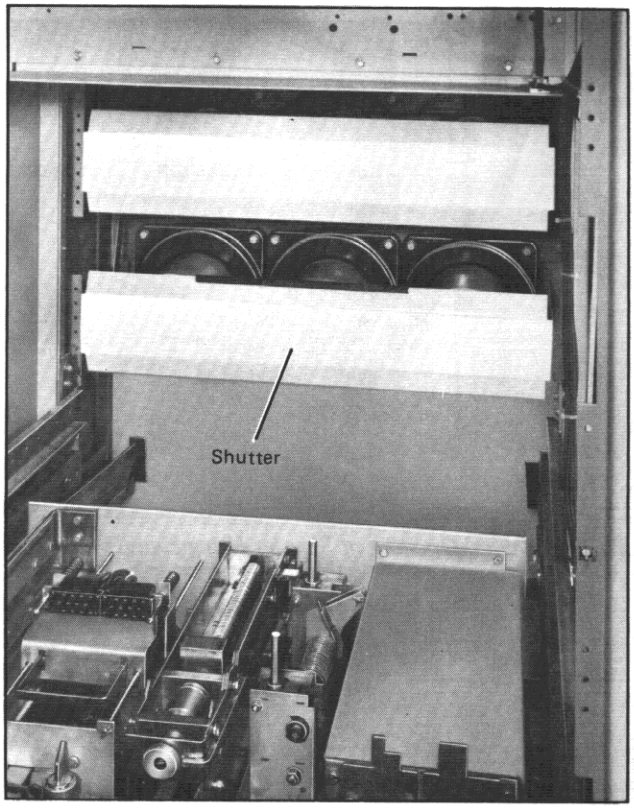


Fig. 13 *Breaker Compartment Front View with Interphase Barrier Removed and Shutters Closed*

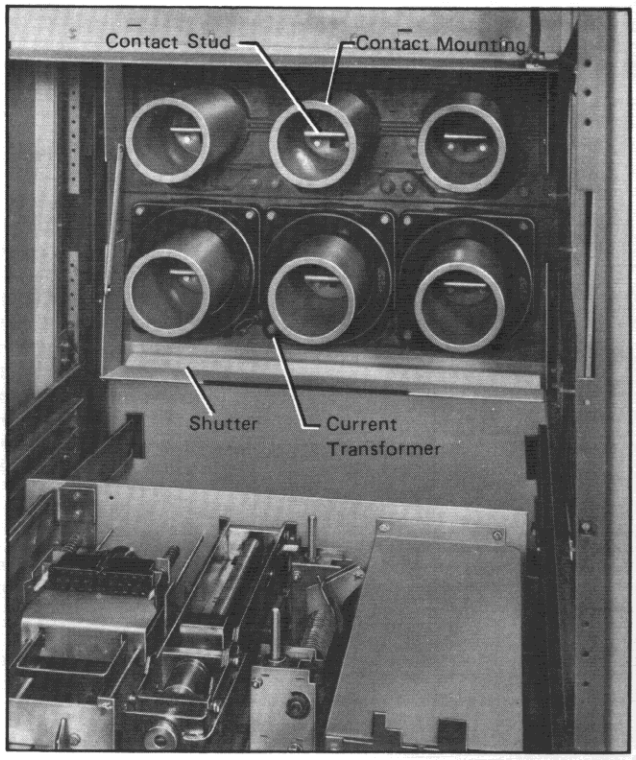


Fig. 14 *Breaker Compartment Front View with Interphase Barrier Removed and Shutters Open*

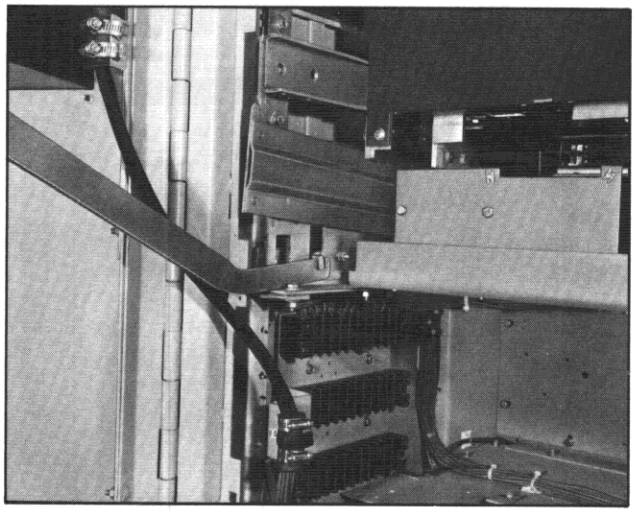
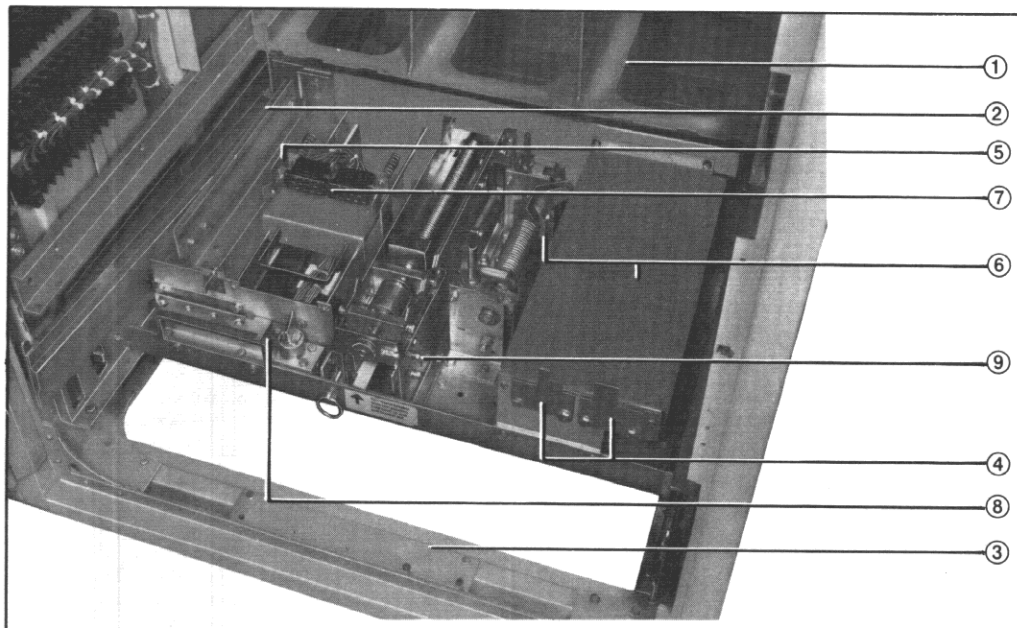


Fig. 15 *Manual Opening of Shutter Using Handle*

8.5 AUTOMATIC SHUTTER

The automatic shutter closes when the circuit breaker is withdrawn from the compartment. The shutter covers the primary contacts and keeps workmen from coming into contact with them. The shutter is raised by a roller on the breaker when the breaker is levered into the connected position. When the breaker is levered out, the shutter closes by positive action. In Fig. 14, the interphase barrier has been removed from the compartment so the shutters can be seen.

8.6 PAN ASSEMBLY



1. The Interphase Barrier

The interphase barrier is mounted in the compartment not on the breaker. This helps simplify maintenance since the barrier cannot interfere with work that may be done on the breaker. The barrier is made of flame-resistant glass polyester. When the barrier is out of the compartment, an interlock prevents levering the breaker into the connected or operating position. To remove for maintenance, remove the three parts which the barrier presses against.

CAUTION: DO NOT REMOVE BARRIER UNLESS MAIN CONTACTS ARE DE-ENERGIZED AND SAFETY PROCEDURES HAVE BEEN INITIATED TO BE SURE THE CIRCUITS CAN NOT BE RE-ENERGIZED. FAILURE TO EXERCISE CAUTION MAY RESULT IN BODILY INJURY AND PROPERTY DAMAGE.

2. The Ground Bus

The ground bus connected to the switchgear ground bus is engaged by the fingers on the underside of the breaker so the breaker is grounded the entire time it is in the compartment.

3. The Instrument Ground Pad

The instrument ground pad is connected to switchgear ground bus. It is provided as an accessible point to ground secondary wires.

4. The Code Plates

Please refer to Page 8 under Safety Features.

5. Auxiliary Switches

Spare auxiliary switch contacts on the circuit breaker are limited by the breaker control requirements.

When additional contacts are needed, optional mechanism-operated compartment switches are required.

5A. Truck-Operated Switch (TOC Switch)

The TOC switch is an assembly of one, two, or three 4-pole switches. Each switch has two-make and two-break contacts. The TOC switch is mounted on the L.H. beneath the breaker ground and cover. As the breaker is being levered into the operating position, a bracket on the front of the breaker pushes the TOC switch lever during the last inch of travel. As a result, the TOC switch can be used to electrically indicate whether or not the breaker is in the operating position.

6. Mechanism-Operated Compartment Switch (MOC Switch)

The MOC switch is an assembly of switches that is operated by a lever on the breaker mechanism. It can contain as many as three Type W or Type W-2 switches.

The MOC switch is mounted beneath cover to the right with the operating mechanism directly to the left.

The MOC switch is activated by the breaker closing. It extends a lever out the bottom of the mechanism pushing down on the plunger of the operating mechanism. This, in turn, transmits the motion to operate switch.

7. Secondary Disconnecting Contacts

The control wiring is arranged for pullout disconnecting by means of two 12-point female receptacles arranged to connect to male plugs on the breaker. The secondary disconnecting contacts are the connections for the control leads between the removable breaker and the stationary housing. See Breaker Instruction Book for further descriptions.

8. Breaker Position Interlock

The breaker position interlock is a device to prevent putting the breaker into the operating position.

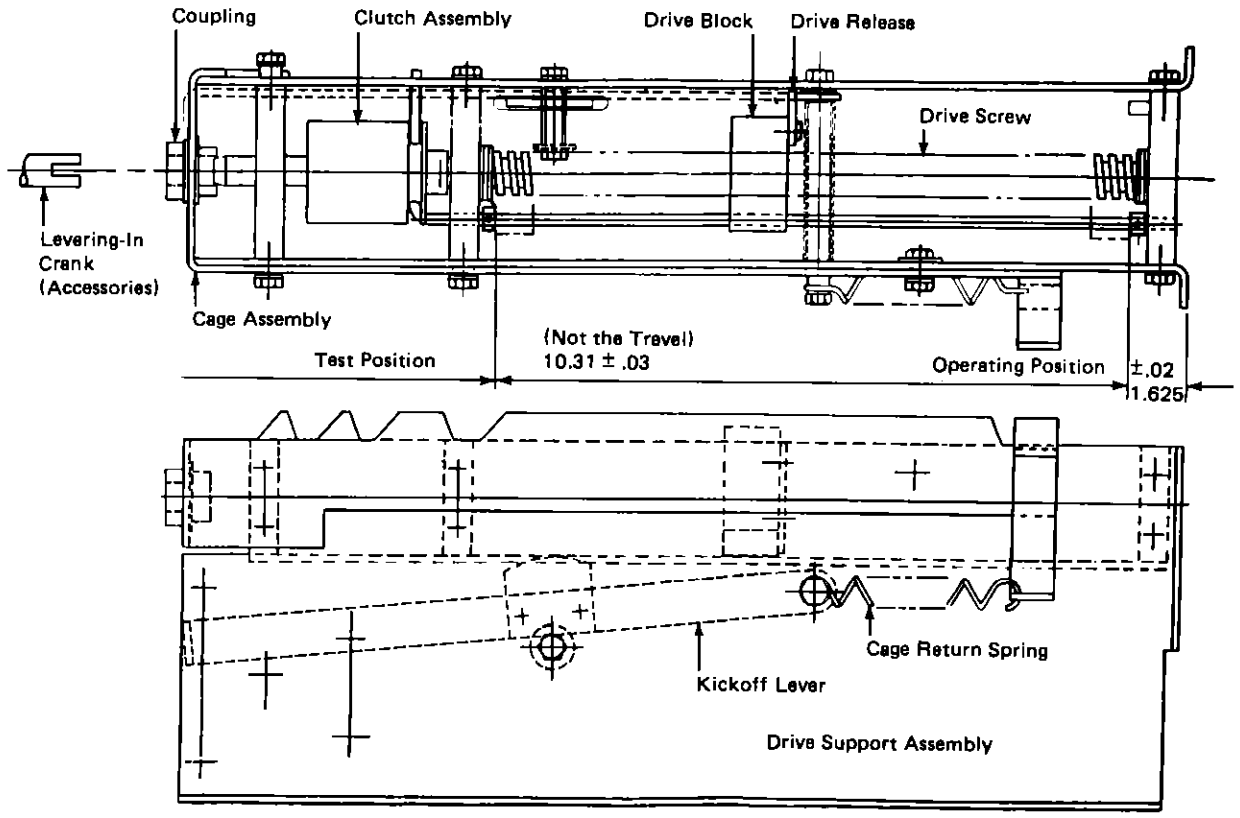
The position interlock is a mechanical, manually operated assembly. To operate, pull the ring at front of pan and extend lock bolt or slide padlock clip into place.

9. Levering Device

See Fig. 17.

Fig. 16 *Breaker Compartment Front View with Interphase Barrier Reinstalled and showing the Pan*

8.7 LEVERING DEVICE ASSEMBLY



LEVERING-IN DEVICE (DRIVE BLOCK SHOWN IN NON-STANDARD LOCATION)

Operation of:

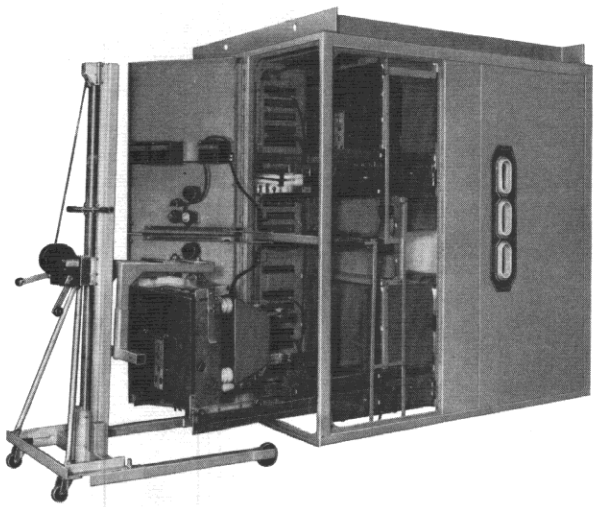
1. Advance breaker into compartment until breaker latch mates with drive block.
2. Restore breaker rails in.
3. Insert levering-in crank in coupling, press in and turn.
4. Turn crank, while still pressing in, until breaker stops moving in. Note: Drive nut hits stop and the clutch begins to slip.
5. Removeble of breaker is the reverse of 2, 3 and 4.
6. With one hand lift and hold kickoff lever, which lifts drive release, to release breaker. Roll out with other hand to clear drive block.

NOTES:

1. The top of cage assembly present the surface which keep breaker trip free when levering.
2. The cage assembly in the normal extended position can be blocked there by padlocks or position interlock such that breaker cannot be levered.

Fig. 17 *Levering Device Assembly*

8.8 LIFTING OF BREAKER



① After the unpacking of breakers and checking for shipping damage and following instructions in I.B. 32-254-1, the breakers can be moved into place.
② Attach lifting attachment provided. By means of lifting device attach and lift. If lifting device is of your choosing it must be able to support 1000 lbs. and high enough to set breakers on rails (must be maneuverable).
③ Open instrument panel fully and extend side rails fully, lock in place.
④ Maneuver breaker above and between rails.
⑤ Lower breaker onto rails. Check positioning while lowering breaker.
⑥ Once solidly on rails disconnect lifting attachment.
⑦ Push breaker into test position. Breaker will latch-in and stay secure.
⑧ Return siderails to in position. (Lift and shove in.)
⑨ Lever-in or out is by prior page.

Fig. 18 *Lifting of and Setting of Breaker in Housing*

8.9 KEY INTERLOCKS

Keylock interlocks are often supplied in conjunction with disconnecting switches, dummy element and special compartments to which access is to be denied unless the circuit breakers controlling the power to these non-switching devices have been withdrawn to the test position. The operation of key interlock schemes is generally described by a note or keying chart on the shop order assembly drawings.

CAUTION: TO FACILITATE MANUFACTURE AND INSTALLATION PROCEDURES, A KEY IS USUALLY SUPPLIED WITH EACH LOCK. BEFORE PLACING SWITCHGEAR WITH KEY INTERLOCKS IN OPERATION, THE KEY SCHEME MUST BE CAREFULLY CHECKED; AND ONLY THE PROPER KEYS LEFT IN THE LOCKS. ALL EXTRA KEYS MUST BE REMOVED AND DESTROYED OR STORED WHERE NOT AVAILABLE TO OPERATING PERSONNEL. THIS PROCEDURE IS NECESSARY SINCE IMPROPER USE OF SPARE KEYS WILL DEFEAT THE INTERLOCKING SCHEME.

8.10 MOVING PARTS

There are few moving parts in VAC-CLAD Switchgear and, in general, they do not require field installation as they are factory-installed. However, it is recommended that all moving parts be operated manually (even if normally operated automatically) to assure that no binding or damage has occurred during shipping, handling or storage.

SECTION 9
AUXILIARY COMPARTMENTS

9.1 Drawout Drawer for Potential Transformers

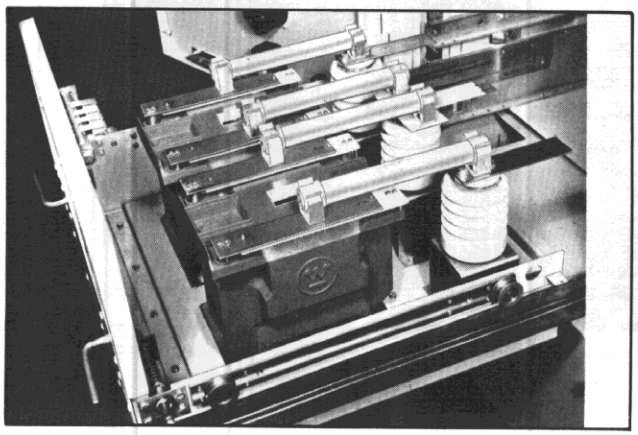


Fig. 19-1 The potential transformers are the latest design cast epoxy meeting all industry standards. Up to three potential transformers can be supplied per drawer.

9.2 Drawout Drawer for Power Transformers

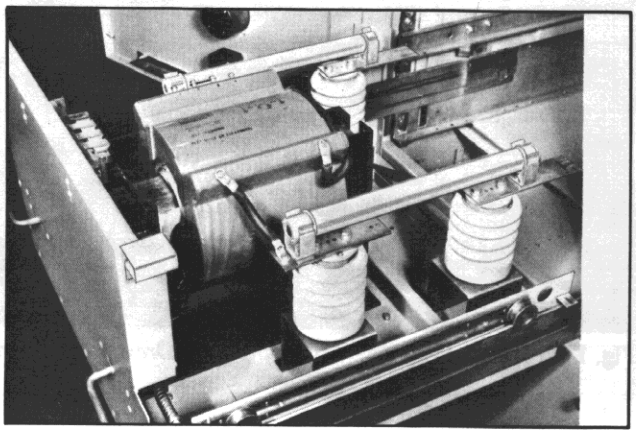


Fig. 19-2 The control power transformer drawer accommodating up to 15 kVA single phase transformers with protective primary fuses is shown in connected position installed below the potential transformer.

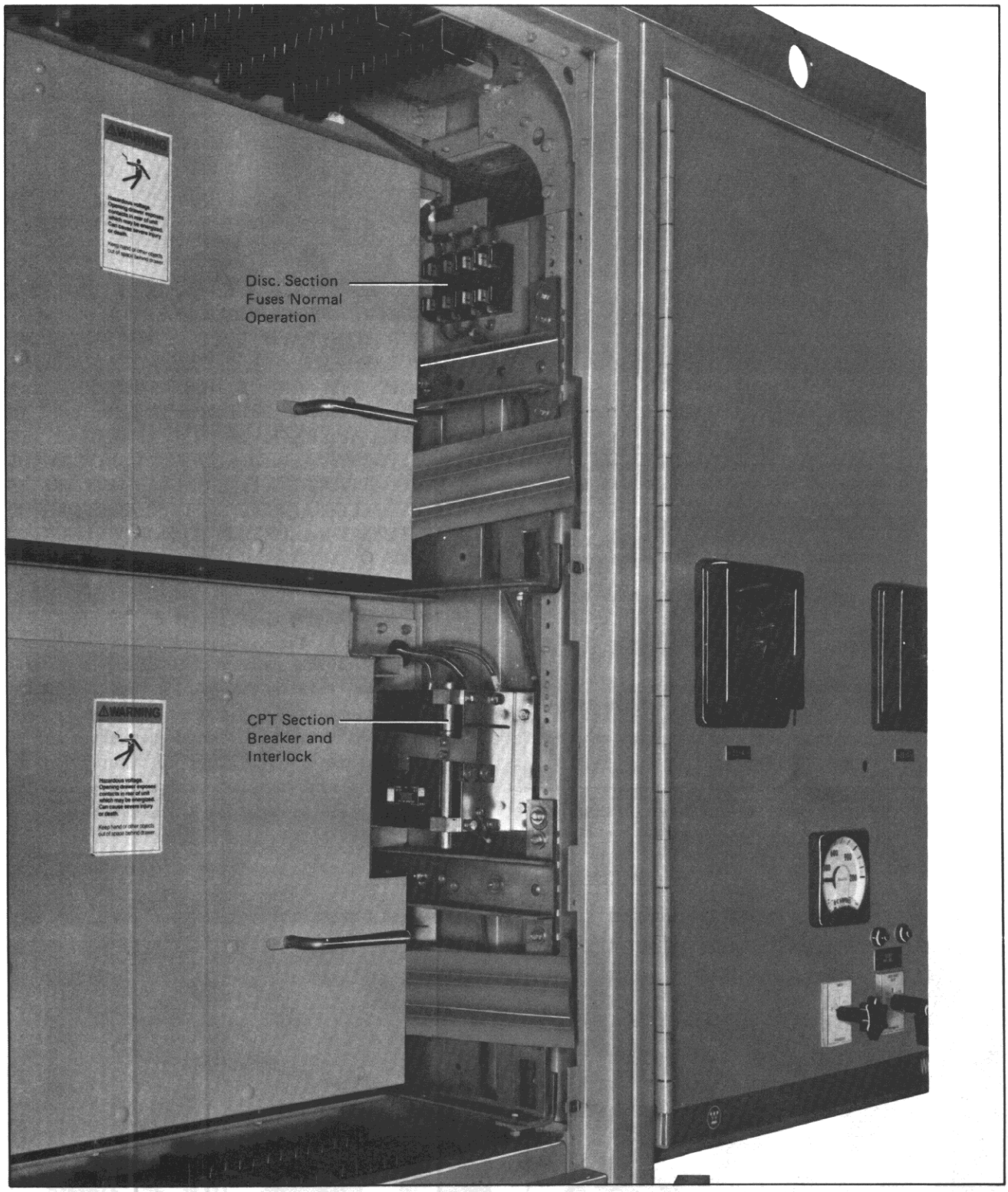


Fig. 19 *Typical Auxiliary with Equipment Drawers in Operating Position*

9.3 AUXILIARY SECTION

VAC-CLAD design permits four auxiliary drawers in one vertical section (only two shown here). A potential transformer drawer and a control transformer drawer are shown withdrawn on the rail extensions, which permits easy testing and fuse replacement with safety assured.

SECTION 10
ACCESSORIES

Each new VAC-CLAD installation is provided with a set of accessories. Depending upon customer's specifications and the nature of the installation, the accessories will include one or more of the following:

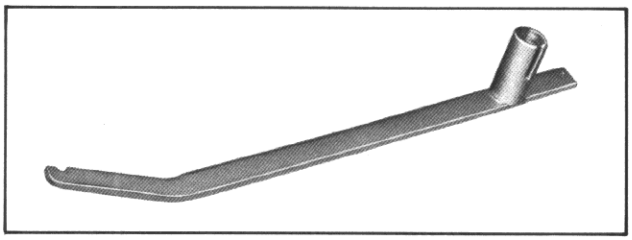


Fig. 20a. *A Maintenance Tool*

Used for:

Slow closing the breaker outside the compartment.

Manually charging the breaker closing spring.

Manually opening the shutter.

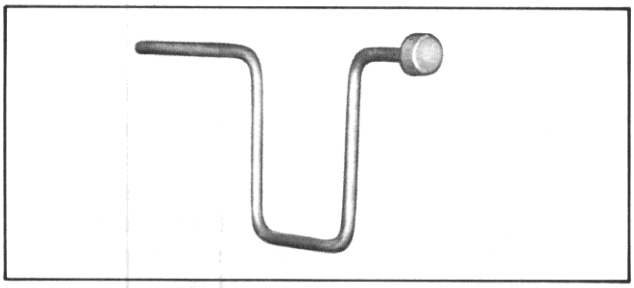


Fig. 20b. *A Levering Crank*

For moving the breaker between the test and connected positions.

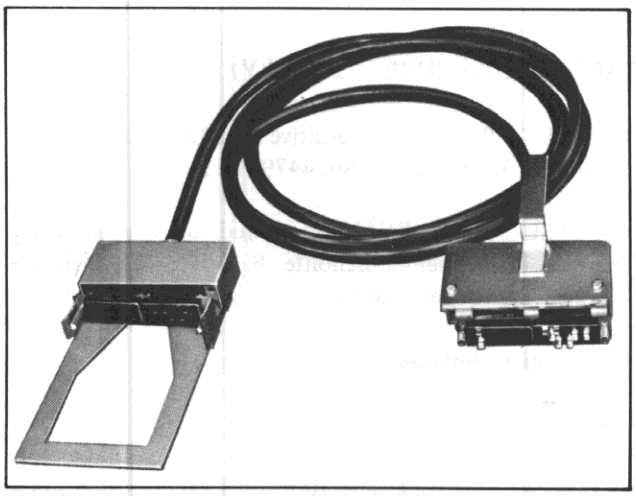


Fig. 20c. *Test Jumper*

For electrically operating the breaker while out of its compartment.

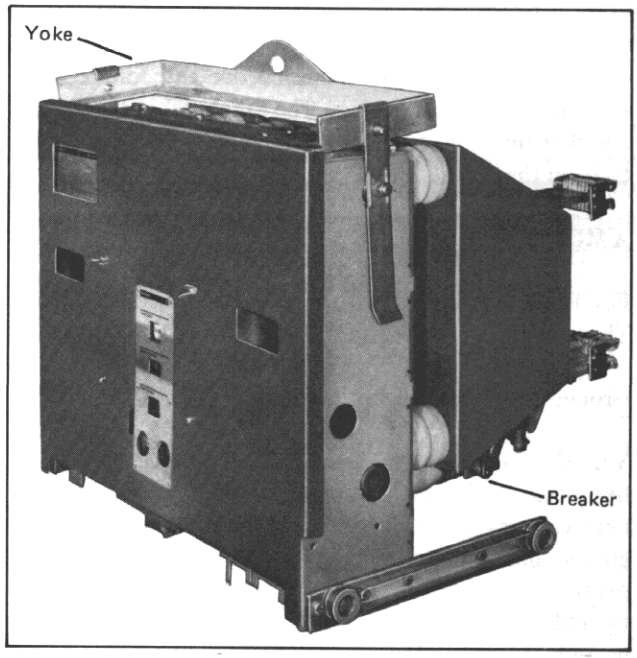


Fig. 20d. *Breaker Lifting Yoke*

Used for attachment to breaker for lifting breaker on or off breaker compartment rails.

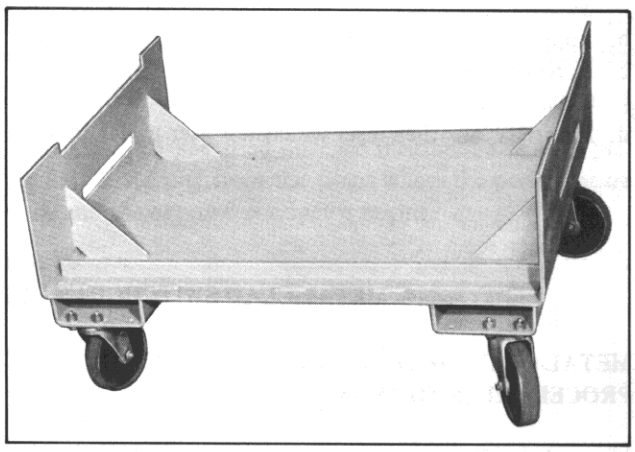


Fig. 20e. *Transport Dolly*

For moving breaker about outside its compartment.

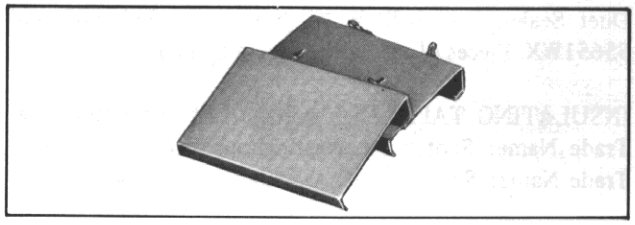


Fig. 20f. *Rail Clamps*

For clamping breaker on extended rails for maintenance.

10.1 OPTIONAL ACCESSORIES

A TEST CABINET for electrically operating the breaker when it is out of its housing. The cabinet includes control power connections, a cutoff switch, necessary control equipment, and a cable which has one end connected to terminals in the test cabinet. The other end of the cable is a socket that connects into the secondary disconnect contacts on the breaker itself.

A MOBIL LIFT

For lining breaker up with compartment extended rails. Then either lift breaker on to or off the rails.

Ground and Test Devices

VAC-CLAD switchgear assemblies are designed with all bus work completely insulated for safety. Since the current carrying parts are not readily accessible, suitable ground and test devices have been designed. These devices permit access to the stationary primary disconnecting contacts in the housing and thus allow various tests and connections to either the bus or the outgoing line. Ground and test devices provide for:

a. Grounding a circuit for safety during maintenance work.
b. Application of potential for cable testing.
c. Access to both bus and line circuits for "phasing out" tests.
d. A variety of other tests which the user might require.

Standard Grounding and Test Device

The standard grounding and test device consists of a drawout element that is inserted into the vacuum circuit breaker compartment in the same manner as the drawout vacuum circuit breaker element. The device includes six insulated bushings arranged with isolating barriers and ground bus connections. The grounding of either bus or line is accomplished by connecting suitable cables from either the bus or the line bushings to the ground connection. Cable testing or "phasing out" testing may be accomplished by connecting suitable test equipment, as required, to the bushings. The bus, line, and ground connections are separated from each other by isolating barriers with the bus and line connections. Each is accessible after opening a front hinged door.

SINCE THE STANDARD GROUNDING AND TEST DEVICE HAS NO MAKING OR INTERRUPTING ABILITY, THE CIRCUITS MUST BE DE-ENERGIZED BEFORE THE DEVICE IS INSERTED OR WITHDRAWN FROM THE HOUSING.

Complete Grounding and Test Device

The complete grounding and test device combines the facility of the standard device with an electrically operated switch for connecting the test circuit to ground or test equipment. The switch is capable of closing against fault current and is interlocked to prevent an incorrect operation. **SINCE THE SWITCH HAS NO INTERRUPTING ABILITY, FAULTS MUST BE CLEARED BY AN INTERRUPTER ON THE SOURCE SIDE OF THE EQUIPMENT.**

SECTION 11
METAL-CLAD SWITCHGEAR FIELD TAPING PROCEDURE (5 TO 15 kV)

METAL-CLAD SWITCHGEAR FIELD TAPING PROCEDURE (5 TO 15 kV)

Materials for Taping

FILLER: A putty-like material. Trade Names: Duxseal, Duct Sealer, Scotchfil, Westinghouse No. 53351BB and 55651WX. Pieces of insulating tape may be used.

INSULATING TAPE: High voltage EPR insulating tape. Trade Name: Scotch 23, Westinghouse No. 45151RX or Trade Name: Scotch 130R, Westinghouse No. 45151SE.*

FINISH TAPE: Pressure sensitive PVC tape. Trade Name: Scotch 66, Westinghouse No. 44791DC.

OR INSULATING ENAMEL: A red, air dry insulating enamel, Trade Name: Benolite B 6-670, Westinghouse No. 32230JF or equivalent.

Field Taping Methods

General

1. Elongate insulating tape 10 to 25 percent during application to insure a smooth, tight fit. On pads elongate corners only.

****NOTE:* When Westinghouse No. 45151SE is used, enamel or finish tape is not required. Reverse roll position with adhesive side inside.**

2. Should a tape roll expire, start the new role by overlapping the previous end by 1/2 turn.

Joint-No Hardware

1. Clean area of dirt and foreign matter.

2. Apply one turn of 1 inch tape so 1/2 of the tape filler is on the conductor and 1/2 is on the preinsulation. Overlap tape ends 1-1/2 inches.

3. Apply one layer of insulating tape, lapping as specified in the chart, overlapping any preinsulation by 1-1/2 inches.

4. Apply red insulating enamel to completely cover tape (or apply one layer of finish tape)*.

Joint-With Hardware

1. Clean area of dirt and foreign matter.

2. Apply filler over bare conductor and hardware to cover and smooth out the surface. Blend contour into preinsulation surfaces. Cover conductors and hardware with at least 1/8 inch of filler.

3. Apply pad(s) of insulating tape of sufficient width to overlap preinsulation by one inch or more.

4. Apply one layer of insulating tape, lapping as specified in the chart, overlapping any preinsulation or pads by 1-1/2 inches.

5. Apply red insulating enamel to completely cover tape (or apply one layer of finish tape)*.

Taping Chart

kV on Swgr.	Preinsulation or Pad Overlap Min., Inches	Insulating Tape		
		Lap of Tape	Layers	No. of Pads
Up to 5	1-1/2	1/2	1	1
7.5 & 15	1-1/2	2/3	1	2
		Finish Tape*		
All Ratings	1-1/2	1/2	1	1

Definitions

JOINT: Area to be covered with tape. Consists of bare conductor and 1-1/2 inches of any preinsulation next to the bare conductor.

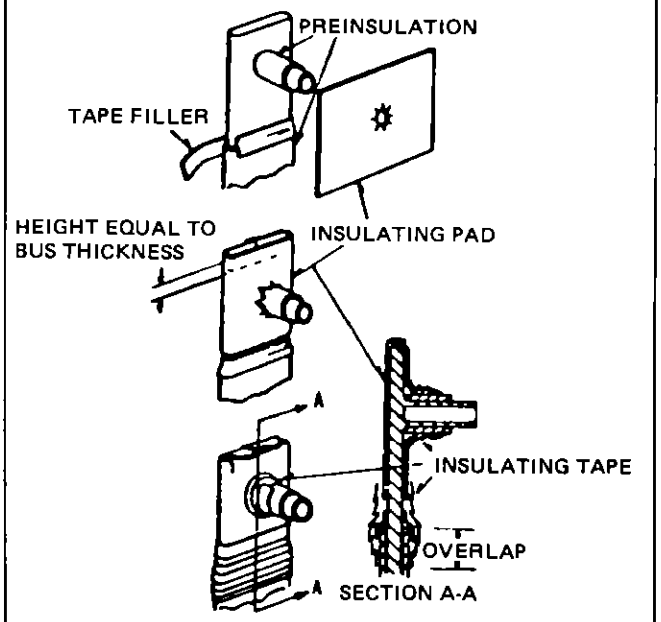
PREINSULATION: Any insulation covering or adjacent to an exposed conductor prior to taping.

PAD: Any insulating tape applied which is wider than one inch. Includes a band of tape consisting of one or more turns wrapped directly on top of each other.

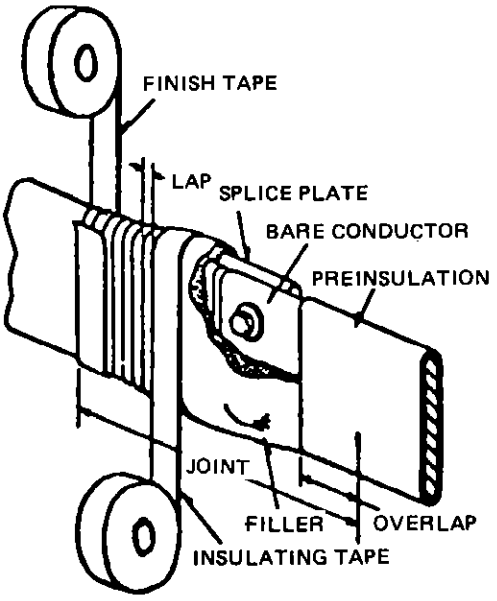
LAYER: Insulating tape, 1 inch wide, wrapped from one end of the joint to the other (or to a pad) so each succeeding turn laps the previous turn by the amount specified in the chart.

OVERLAP: A specified distance measured along the preinsulation starting from the point where the preinsulation ends and the exposed conductor begins.

Typical Tape Joint No Hardware

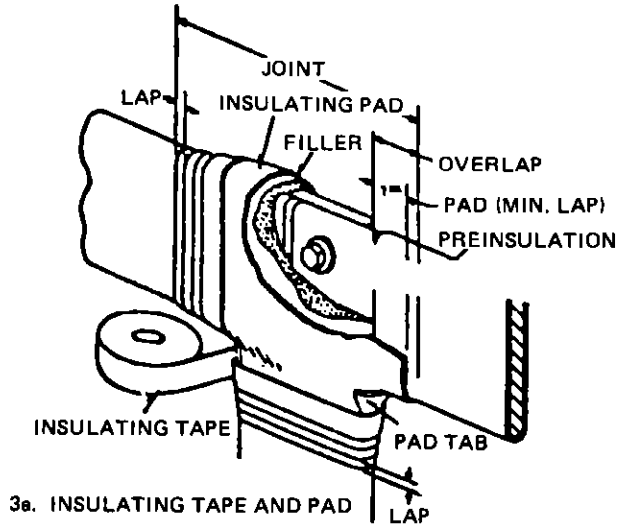


Typical Tape Joint

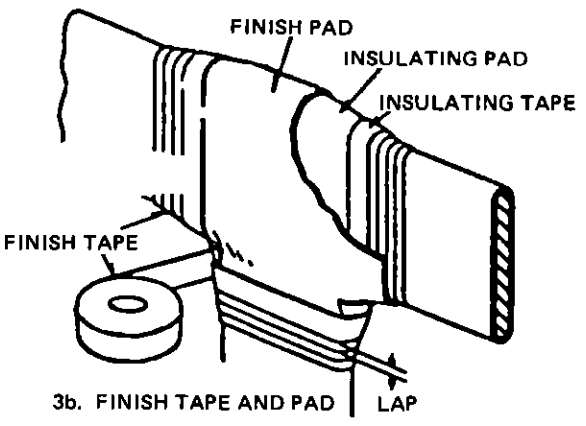


NOTE: Roll position during taping is different for each tape.

Typical Tape and Pad Joint

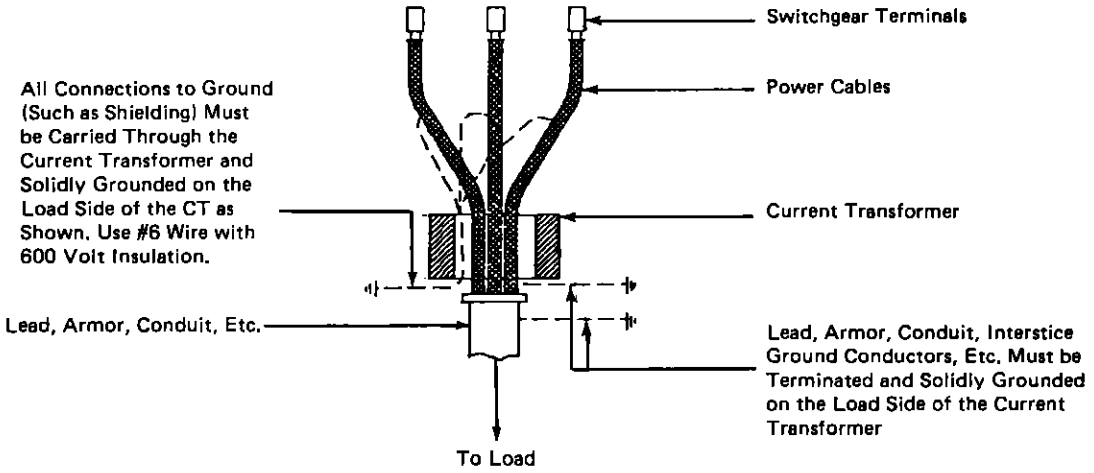


3a. INSULATING TAPE AND PAD

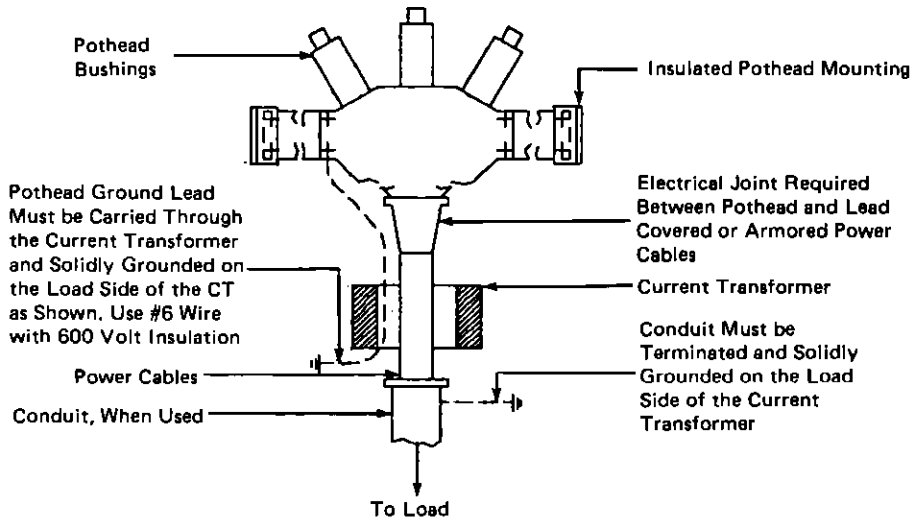


3b. FINISH TAPE AND PAD

Fig. 21 *Typical 5 to 15 kV Taping Illustrations*



Cable Connections To Switchgear Terminals



Cable Connections To Switchgear Potheads

Fig. 9 *Zero Sequence Current Terminal Connections*

I.B. 32-254

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