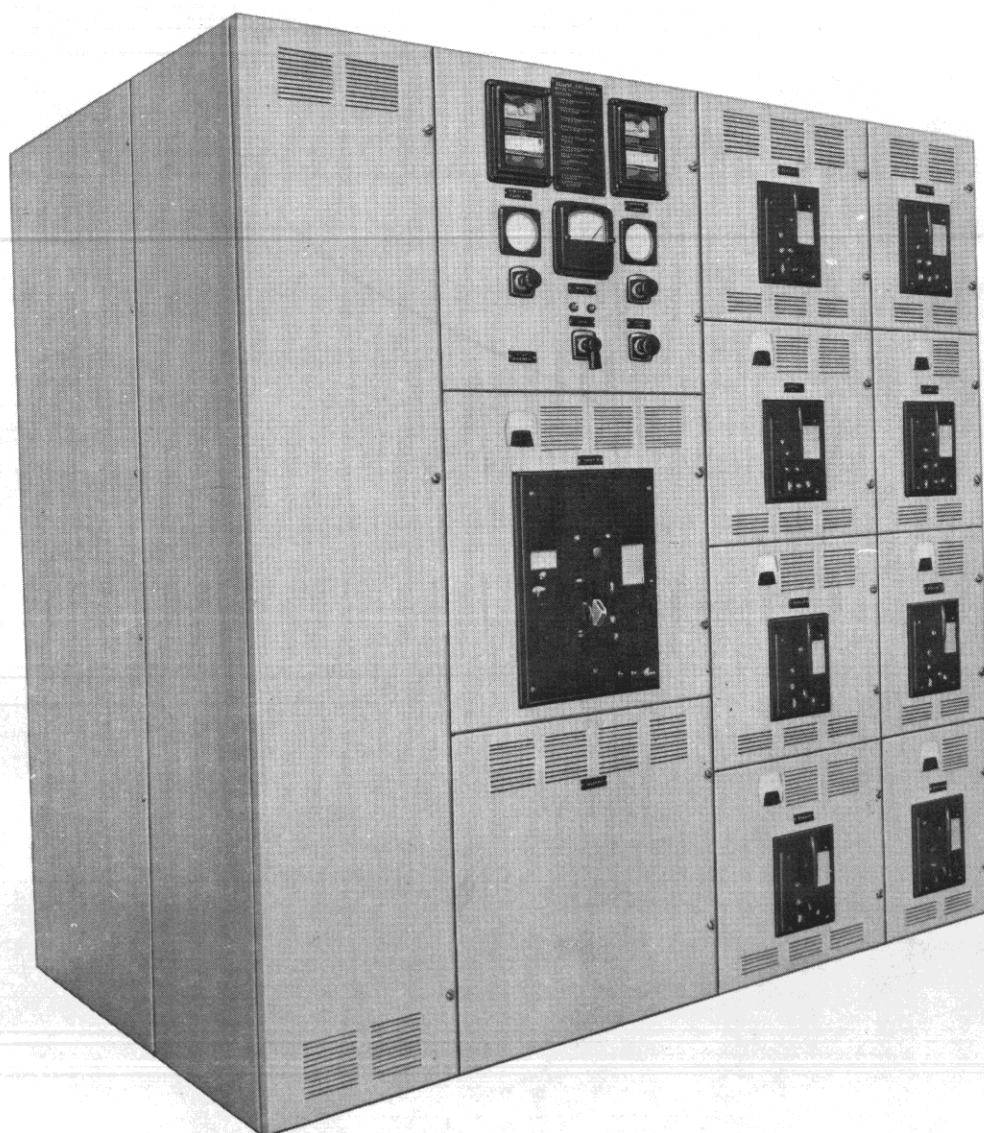


## Installation/Maintenance Instructions

### I-T-E Low-Voltage AC Metal-Enclosed Power Switchgear

---

K-Line®



## TABLE OF CONTENTS

## Page

INTRODUCTION .....	3
SCOPE OF INSTRUCTION .....	3
IMPORTANT NOTES AND WARNINGS .....	3
TRANSPORTATION .....	3
UNLOADING AND HANDLING .....	4
STORAGE .....	4
PREPARATION OF THE FLOOR .....	4
INSTALLATION .....	4
INDOOR INSTALLATION .....	5
OUTDOOR INSTALLATION .....	6
ROOF BUSHINGS .....	7
ASSEMBLING THE HOUSINGS .....	7
UNIT SUBSTATIONS .....	7
CONNECTIONS .....	7
CONNECTION TO GROUND BUS .....	8
CONNECTION TO CONTROL SOURCE .....	8
INSTALLATION OF BUS BAR CONNECTION BETWEEN GROUPS .....	8
TESTING AND INSPECTION .....	8
STANDARD CONSTRUCTION .....	9
CIRCUIT BREAKERS .....	10
PLACING SWITCHGEAR IN SERVICE .....	10
MAINTENANCE .....	11
RENEWAL PARTS .....	12

## Service Conditions

The ratings described herein are based on the usual temperature and altitude service conditions as defined in American National Standard C37.20. Unusual service conditions are considered as special applications and appropriate derating factors must be applied.

## INSTALLATION AND MAINTENANCE I-T-E K-LINE AC METAL-ENCLOSED LOW-VOLTAGE POWER SWITCHGEAR

### INTRODUCTION

These instructions should be read carefully and used as a guide during installation and initial operation.

File these instructions in a readily accessible place together with drawings and descriptive data of the switchgear. The use of these instructions will facilitate proper maintenance of the equipment and prolong its life and usefulness.

### SCOPE OF INSTRUCTIONS

These instructions are general. They cover requirements for installation as applied to I-T-E K-Line Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

Specific information on particular installations is furnished in the form of Bills of Materials and drawings as follows:

1. Bills of Materials listing electrical devices and equipment.
2. Front view showing arrangement of relays, instruments and circuit breakers.
3. Single line drawings showing power connections.
4. Floor plan indicating available space for power and control conduits.
5. Special construction details.
6. Elementary and schematic diagrams.
7. Connection diagrams.

The first sheet of the Bill of Materials indicates the application of the drawings.

### IMPORTANT NOTES AND WARNINGS

The successful and safe operation of switchgear is dependent upon proper handling installation, operation and maintenance. Neglecting certain fundamental installation and maintenance requirements may lead to personal injury, and the failure and loss of the switchgear as well as possible damage to other property.

### WARNING WARNING WARNING WARNING

THERE IS A HAZARD OF ELECTRICAL SHOCK AND/OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. POWER MUST BE OFF BEFORE WORKING INSIDE SWITCHGEAR. TURN POWER OFF AHEAD OF THE SWITCHGEAR BEFORE PERFORMING ANY MAINTENANCE OPERATIONS. CHECK INCOMING LINE TERMINALS TO ASCERTAIN POSITIVELY THAT THE EQUIPMENT IS TOTALLY DE-ENERGIZED. ALWAYS CHECK OUTGOING TERMINALS TO ENSURE NO BACK-FEED CONDITION EXISTS. SHOULD ANY OF THE EQUIPMENT NOT FUNCTION AS DESCRIBED IN THE OPERATING PROCEDURE, CONTACT THE NEAREST COMPANY REPRESENTATIVE BEFORE ENERGIZING. ONLY QUALIFIED AND AUTHORIZED PERSONNEL WHO HAVE PREVIOUS EXPERIENCE AND TRAINING IN THE OPERATION AND MAINTENANCE OF ELECTRICAL/POWER SYSTEMS SHOULD PERFORM TASKS ASSOCIATED WITH THIS TYPE OF SWITCHGEAR.

### TRANSPORTATION

Prior to shipment, the switchgear undergoes careful factory inspection. Each section is plainly marked at convenient places with its number and position. When size or other reasons make it necessary to divide the equipment for shipment, the unit number of the particular equipment is also marked on the section, along with its weight. The circuit breakers are shipped in individual cartons or crates.

Immediately upon receipt of the switchgear, examine for any damage or loss sustained during transportation. Check the contents against the packing list before discarding any packing material.

If there is any shortage, notify the nearest District Office.

The Company is not responsible for damage after delivery of shipment to the carrier. However, if the company

is notified of such claims, it will furnish forms to facilitate securing any adjustments. If damage to the shipment indicates rough handling, claim for damage should be filed at once with the carrier and the Company promptly notified.

### UNLOADING AND HANDLING

Unloading and handling at the site is usually done by placing rollers under the shipping bases. To avoid distortion to the switchgear, any force to move the structures should be applied to the bases by means of crowbar, block and tackle, crane, etc.

The following is a recommended method for unloading and handling the switchgear housings.

These methods are based on availability of an unloading dock, and access to motorized material handling equipment of sufficient capacity for the weight of the switchgear.

#### Overhead Lifting

The switchgear can be lifted from its conveyance by an overhead hoisting device. Slings of ample rating should be attached to holes of roof lifting angles. When switchgear is overhead lifted, it is required that spreaders be used with cables or slings to obtain a vertical pull on the lifting angles. The tracks of the traveling circuit breaker lifting device, when furnished, serve as lifting angles.

#### Jacking and Rolling

If no lifting device or motorized material handling equipment is available, the switchgear can be unloaded manually from the conveyance to the dock area. The bed of the conveyance should be even with or slightly higher than the dock for ease of movement. A detailed description of this method is given in the section "INDOOR INSTALLATION". Refer to this portion of the instructions before attempting to unload the switchgear manually.

### STORAGE

It is recommended that the storage building be constructed such that it is not subject to flooding and that the floor be paved and well drained. The storage temperature of the building should be warm (approximately 15°C) and dry (approximately 50% maximum humidity).

Some indoor switchgear sections may be shipped covered with plastic wrap to protect the equipment from dust, dirt and weather during shipment only. This plastic wrap must be removed after the equipment is placed in storage at the job site.

Leave each switchgear group on its shipping base for subsequent moving. Remove circuit breakers and accessories from cartons or crates.

Observe the following precautions:

1. Check for missing or damaged parts.
2. Store in clean, dry place.

3. Cover with heavy wrapping paper to keep dirt or dripping water from entering. Dirt or moisture may foul working parts or deteriorate contacts and insulation.
4. In order to provide proper ventilation all louvered or filtered openings should not be covered. Plastic film wrapping materials are not recommended as these materials tend to retain moisture due to condensation.
5. If the switchgear is to be stored for any length of time, or in any place where dampness may be present, then heaters should be used to keep the switchgear dry until it is placed in service. When outdoor switchgear equipped with heaters is stored, the power source for the heaters should be brought to the load terminals of the cutout device which controls the heater circuits.

### CAUTION CAUTION CAUTION CAUTION

THE BREAKER OR CUTOUT DEVICE MUST REMAIN OPEN WHEN A SEPARATE POWER SOURCE IS USED. MAKE SURE THAT ALL CARTONS, PACKING MATERIAL, ETC. ARE REMOVED FROM THE SWITCHGEAR BEFORE ENERGIZING THE HEATERS.

### PREPARATION OF FLOOR

Floor plan drawings are supplied for each installation. Typical floor plan drawings are not enclosed since they usually vary with each installation due to length and arrangement of housings.

The design of the floor may include channel iron sills embedded in the concrete. It is important that these sills be straight and level their full length, and correctly spaced. To insure this condition, it is recommended that ties be bolted between the sills at various intervals after which the lower flange of the sill be shimmed to proper height.

Where necessary, power and secondary (control) conduits should be installed before the installation of the housings. Available space for the conduits is given on the floor plan accompanying each order. These conduits should not extend more than one (1) inch above the station floor level. Take precautions to plug conduit openings before pouring cement.

### INSTALLATION

#### General

Before attempting any installation operations consult all drawings furnished for the particular order. These drawings are in the form of floor plans, front views, primary and secondary connection diagrams and Bills of Materials of the equipment furnished. These drawings and the following recommendations should be studied carefully previous to planning the work.

### Location

The switchgear should be located with ample clearance from walls, columns, etc. Clearances at the front should be sufficient to permit removing the circuit breakers. Clearance at the back should be sufficient to permit opening the hinged rear door and provide access to the interior of the compartments. This access will be required for making connections to the switchgear previous to putting it in operation and for periodic inspections thereafter. The minimum required clearances are shown on the drawings or may be obtained on request.

### INDOOR INSTALLATION

Indoor switchgear housings are shipped in sections. For shipping lengths up to 78 inches the sections may be mounted on heavy timber shipping bases. Longer shipping sections are mounted on steel channel shipping bases.

The switchgear should be unloaded as near to the installation site as possible. The operation may be completed by raising the switchgear with track jacks or overhead lifting device. The following is a general description of each method.

### Raising by Jacks

#### CAUTION CAUTION CAUTION CAUTION

DO NOT APPLY JACKS TO THE HOUSINGS AT ANY OTHER POINTS. USE OF FORK LIFT TRUCKS FOR JACKING MAY RESULT IN STRESS DISTORTIONS AND DAMAGE TO SWITCHGEAR.

In most locations the practical way of handling the switchgear is by jacks.

1. After switchgear housings have been moved near site, raise the units by placing jacks under the switchgear housing near the front and rear corners as shown in Fig. 1.

Some shipping sections are mounted on steel channels.

Raise evenly and just enough to position rollers. Repeat operation at other end of assembly so that rollers are equally distributed under units as shown in Fig. 2.

2. While a crew pushes the switchgear longitudinally toward its final position, one man should insert an additional roller under the forward end of the units. He should continue this operation by moving each roller that is freed from the rear to the forward end until the units are in the desired position.
3. For lateral moving, raise the units by jacks and remove the rollers. Place the rollers laterally with steel channels (not furnished) resting on the rollers as shown in Fig. 3 and 4. Move the units, using procedure described in paragraph 2, until they are

in the desired position.

4. When the units are in their final position, raise the units enough to just clear the rollers and any channels resting on the rollers.

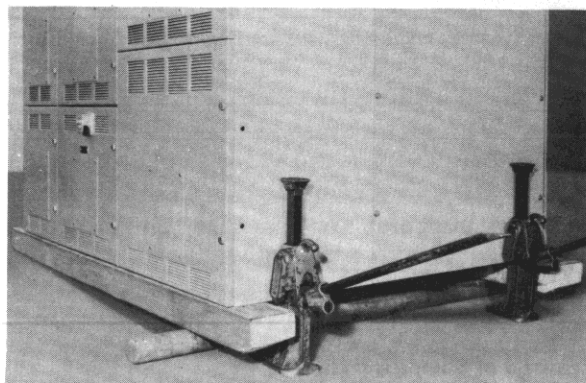


Fig. 1-Method of Raising Switchgear by Use of Jacks. Rollers in place.

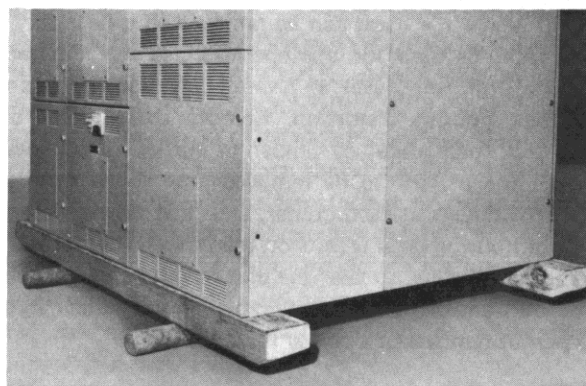


Fig. 2-Jacks Removed and Switchgear Ready for Longitudinal Moving.

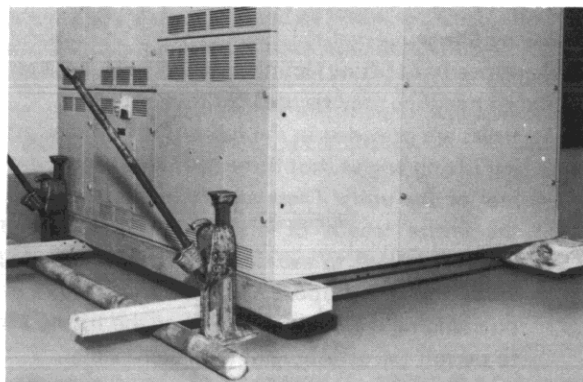


Fig. 3-Switchgear Raised, Rollers and Channels in Place Prior to Lateral Moving.

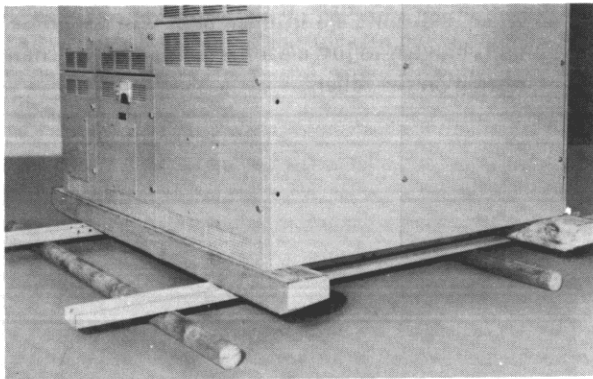


Fig. 4-Jacks Removed and Switchgear Ready for Lateral Moving.

#### Removal of Shipping Base

Open the switchgear doors and remove the bolts fastening the shipping bases to the switchgear. Make sure that all doors and panels are closed and secure before proceeding further.

Jack up the switchgear uniformly on both sides to a height where the bases can be removed. It is necessary that four jacks be used for this operation, so that the housing will be uniformly level to prevent any undue stress with resultant housing distortion. Remove the shipping bases.

Select four pieces of timber of sufficient thickness to permit toe of jack to be removed after lowering. Place a piece of timber at each corner, and then slowly lower one side of housing until it rests on the timber. Repeat this step on the other side, so that the unit now rests completely on the four lumber pieces. Use a crowbar and timber fulcrum to permit removal of a corner lumber piece.

#### CAUTION CAUTION CAUTION CAUTION

USE THE CROWBAR AT THE SAME POSITIONS USED FOR JACKING TO AVOID DISTORTIONS OR DAMAGE

#### Raising by Slings

Where overhead lifting facilities are available, an alternate method of handling may be used for moving.

1. Holes are provided in the top of the units for attaching lifting angles (not furnished) along the front and rear of the units. These angles should be continuous the entire length of the assembled units and be securely bolted to each unit using all the holes provided for this purpose. Provide a large hole in the outstanding leg, near each end of the lifting angles, to permit the attaching of steel cable slings.
2. Spreaders should be placed where necessary on the slings so that the cables rise vertically from the top of the units. This will avoid the transfer of lateral

stresses to the top of the units and prevent damage during lifting.

3. The switchgear should be raised high enough to clear projections above the floor level, moved over the installation site and lowered into place. Then slings and lifting angles should be removed.

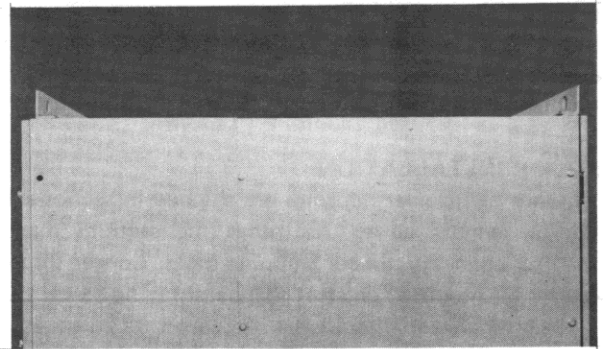


Fig. 5- Lifting Angles Bolted to Top of Switchgear. (When Specified)

#### OUTDOOR INSTALLATION

Outdoor installation is handled similarly to the indoor type. Outdoor switchgear is constructed with a steel base that serves as a shipping convenience as well as a permanent support for the internal and external housings. Jacks may be placed under the base to raise the whole structure for positioning rollers.

Where overhead lifting facilities are available, lifting holes are provided at each end of the steel bases. Cable slings attached to these lifting holes should be equipped with spreaders placed above the assembly to prevent damage to the top of the switchgear.

#### CAUTION CAUTION CAUTION CAUTION

DO NOT ATTACH SLINGS TO THE HOUSING AT ANY OTHER POINTS.

Before assembling a Walk-In structure read the drawing "Erection Procedure", listed on the front sheet of the Bill of Materials, carefully and follow procedure indicated thereon.

For proper weatherproofing procedures consult the drawings entitled "Gasket Application".

#### ROOF BUSHINGS

Roof bushings, for cable entrance, are shipped detached from the housing, and must be mounted in place when the switchgear is installed. Each bushing is furnished with a gasket that must be properly inserted between the roof and the bushing flange, using the adhesive as a binder between each of the parts. Cement the gasket to the roof using one

layer of adhesive, then spread cement on the remaining flat surface of the gasket. Now put the bushing in place and bolt to the structure. Apply a bead of sealer to the exposed edge of the gasket to provide a weathertight seal.

### ASSEMBLING THE HOUSINGS

When the floor has been properly prepared, assembly of the switchgear may be started. Sections of the housings may be moved on their bases adjacent to final positions.

If the switchgear consists of a number of sections, the center sections should be installed first, and the remaining sections added at each end. When the first section is in position, it should be checked for distortion in shipment. This may be done by dropping a plumb bob from the center of the front and rear doors. If the structures are not true, they should be straightened before proceeding. As each section is added, it should be checked for distortion, otherwise considerable pressure may be required to bring the sections into alignment.

Holes are provided in the floor for plug welding the housings to the channel sills.

When shipment is made in sections, the main bus, control wiring and inter connections are dismantled at the point where the switchgear is separated. These should now be reassembled and all bolts and screws tightened. Incoming and outgoing connections should be made for both the main power circuit and all control circuits.

### UNIT SUBSTATIONS

On unit substations one or more power transformers and a switchgear constitute a coordinated assembly. The transformers and their primary disconnect switches, when provided, are shipped separately. At the time of installation, primary disconnect switches, transformer and switchgear are to be mounted adjacent to each other.

When several unit substations are ordered at the same time, care must be exercised in pairing the primary disconnect switch, transformer and switchgear sections properly. The different transformers may be identical in rating, dimensions and arrangement, and it may seem therefore that it is not important to install any particular transformer alongside each switchgear. However, proper selection is important when the transformers have disconnect switches key interlocked with the secondary breakers, since the successful operation of the key interlock sequence depends on having locks on the switch and the breaker operated by the same key. To avoid unnecessary work, the key numbers should be checked before each piece of equipment is moved to its final location.

### CONNECTIONS

**WARNING WARNING WARNING WARNING**

BEFORE MAKING ANY PRIMARY SOURCE CONNEC-

TIONS MAKE SURE THAT THE PRIMARY CABLES ARE DEENERGIZED.

Unit substations are generally shipped in separate sections, each transformer constituting a separate section. Switchgears are shipped in sections when their dimensions or weights exceed the maximum values specified by the purchaser or by the carriers. The buses are arranged to permit splitting for shipment. Terminal blocks are inserted in the secondary and control wiring running between units at the points where shipping splits occur. The individual wires are marked to correspond with marks on the terminal block and then they are disconnected and coiled up.

After the separate units have been erected and bolted together, the bus work and the secondary and control wiring must be reconnected at the points where it was split for shipment. It is important to make sure that all bolted joints are tight.

In replacing secondary and control wiring connections, the connection diagram must be followed to insure that no connection is missed.

After completing all internal connections, make the external connections to control power sources and circuits, to secondary and potential circuits, to feeders and to power sources and to ground. AFTER COMPLETING ALL CONNECTIONS TO SECONDARY CURRENT CIRCUITS, FOLLOW THESE CIRCUITS AND REMOVE ANY TEMPORARY CONNECTIONS ACROSS CURRENT TRANSFORMER SECONDARIES. These jumpers are installed to protect against abnormally high voltages that may occur if the current transformer primaries carry currents while the secondary circuits are still not complete. After the secondary circuits are closed, the jumpers are no longer necessary and failure to remove them will interfere with the operation of meter, relays or other devices connected in these circuits.

Outgoing power connections are made to the feeder circuit breakers by means of lugs furnished with the switchgear.

Incoming power connections should be made after all other connections have been completed. If the switchgear contains any device affected by phase sequence, the connection diagram includes a note indicating the proper phase sequence to use to obtain correct operation of these devices. The phase sequence of the incoming power source should be checked before making connections.

### CONNECTION TO GROUND BUS

Ground bus bars are bolted to the frames of the housings at the factory before shipment. When housings are shipped separately, it is necessary to bolt the ground bus to the framing. Ground bus bars should be solidly and permanently connected to the station ground by means of a cable or bus of cross section not less than that of the housing ground bus.

Cable or bus should not be in conduit, and should take



the most direct path to station ground.

### CONNECTION TO CONTROL SOURCE

The control source wiring to the switchgear should be of larger cross section than the balance of the control wiring in order to reduce the voltage drop, particularly when this source is some distance from the switchgear. Provision is made in the switchgear, in the form of heavy duty terminal blocks, for the connection of these control source leads. The leads should first be checked for proper electrical sequence before the connection is made.

### Secondary and Control Connections

All secondary and control connections on the switchgear are factory wired in accordance with the connection diagrams applying to the installation. The secondary and control connections for all outgoing connections are wired to terminal blocks accessible to the conduit connections.

Control connections between housings are provided through openings in the side of the switchgear. When shipment is made in groups of several units each, the cross connections between groups are installed at the factory, one end of each of the group connectors is then disconnected and tagged. Care should be taken to insure that all these connections between groups are securely remade when the groups are placed together again.

### INSTALLATION OF BUS BAR CONNECTIONS BETWEEN GROUPS

The main bus in each group is completely assembled in the factory. It is spliced at the shipping splits located at either end of the group and is unbolted for shipment.

All contact surfaces at all bolted joints in the bus are silver plated. These contact surfaces should be cleaned and then bolted together. Conductivity of a bolted or clamped joint depends upon the pressure applied. The contact surfaces may be cleaned by wiping with cloth saturated with an approved solvent. Take care not to remove silver plating.

Use of solvents should be limited to removal of grease and contamination from primary conductors and insulation.

#### WARNING WARNING WARNING WARNING

DO NOT USE CARBON TETRACHLORIDE. USE ONLY OSHA APPROVED SOLVENTS. AVOID PROLONGED EXPOSURE TO SOLVENT VAPORS. USE SOLVENTS IN A WELL VENTILATED AREA.

After bolting the sections of the main bus at junction point of shipment groups, torque 1/2 inch diameter hardware 30 to 45 foot-pounds to insure adequate electrical connection.

### TESTING AND INSPECTION

With the housing erected, assembled, and connected,

observe the following precautions:

1. Remove all extraneous matter and see that all internal parts are free of dirt, grease, and moisture. If moisture has penetrated, dry out with air or heat.
2. Remove all blocks in relays used for protection in shipment.
3. Apply potential tests to check for any damaged insulation.

60 Hz, RMS, WITHSTAND VOLTAGES ( PRIMARY CIRCUITS) (1 MINUTE)			DC WITHSTAND *
Rated Voltage	Factory Test	Field Test	Field Test
240v,480v,600v	2200 volts	1650 volts	2300 volts

\*The column headed "DC Withstand" is given as a reference only for those using dc tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage class of switchgear. The presence of this column in no way implies any requirement for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to ANSI C37.20, either for design tests, production tests or conformance tests. When making dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one (1) minute.

#### CAUTION CAUTION CAUTION CAUTION

EXERCISE EXTREME CARE TO INSURE THAT THE EQUIPMENT IS NOT CONNECTED TO THE PRIMARY POWER SOURCE DURING TESTING.

DO NOT EXCEED THE LISTED VOLTAGES FOR THE VOLTAGE CLASS OF THE EQUIPMENT UNDER TEST. IF PHASE TO PHASE TESTS ARE MADE IN ADDITION TO PHASE TO GROUND TEST, CARE MUST BE TAKEN THAT NO SHUNT CONNECTED COILS SUCH AS POTENTIAL TRANSFORMERS ARE CONNECTED DURING THE TEST.

DO NOT TEST SOLID STATE SENSORS WITH HIGH VOLTAGE. DISCONNECT SOLID STATE SENSORS AND RELAYS PRIOR TO APPLICATION OF VOLTAGE TESTS.

4. Check continuity of all circuits. A great deal of this work can be done after the circuit breakers are installed by energizing the control source and operating the equipment with the main circuit dead. Indicating instruments check the continuity of current transformer circuits after the main circuit is energized.



5. Set all relays, regulators, and other devices for proper operation of loads. No relays are set at the factory. Remove screws from short circuiting strip on terminal blocks in current transformer circuits. Screws should be stored in tapped holes in corners of the blocks. See Safety Precautions. (Page 10)

**IMPORTANT: PROPER PHASING OF ALL MAIN CIRCUITS SHOULD BE CHECKED ACCORDING TO DIAGRAM.**

#### Final Inspection

**WARNING WARNING WARNING WARNING**

THERE IS A HAZARD OF ELECTRICAL SHOCK AND/OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. POWER MUST BE OFF BEFORE WORKING INSIDE SWITCHGEAR. TURN POWER OFF AHEAD OF THE SWITCHGEAR BEFORE PERFORMING ANY MAINTENANCE OPERATIONS. CHECK INCOMING LINE TERMINALS TO ASCERTAIN POSITIVELY THAT THE EQUIPMENT IS TOTALLY DE-ENERGIZED. ALWAYS CHECK OUTGOING TERMINALS TO ENSURE NO BACK-FEED CONDITION EXISTS.

After the switchgear together with apparatus which it is to control has been installed and all interconnections made, it should be given a final check and test before being put into service. This is necessary to insure that the equipment has been correctly installed and that all connections are completed. Extreme care must be exercised to prevent the equipment to be controlled from being connected to the system while the preliminary tests are being conducted.

If disconnecting switches are not part of the apparatus or switchgear, the line leads should be disconnected to accomplish this. The testing equipment required will depend entirely on the type of installation. Portable volt-meters both a-c and d-c with a wide range of scales will usually be required.

Some simple portable device for ringing or lighting out circuits should be included in the testing equipment.

#### STANDARD CONSTRUCTION

##### Bus Support Insulation

All bus work in the switchgear with the exception of the ground bus is supported with polyester laminated insulation. The insulation is designed to assure safe operation clearances of all bus work, phase to phase and phase to ground, when bus is subjected to the stresses of the short circuit current available.

#### Primary Disconnect Device

Each primary terminal of a drawout circuit breaker is equipped with a disconnect device consisting of a circle of fingers compressed by a garter spring or a set of inline fingers compressed with compression springs. The mounting of these fingers on the circuit breaker permits inspection of them when the circuit breaker is withdrawn. This is a high pressure, self-aligning device, whose parts are silver plated to reduce the resistance to a minimum. The springs are outside the current path.

The tubular or flat stationary element is rigidly mounted in an insulating molding located in the housing.

#### Secondary Disconnecting Devices

All electrically operated circuit breakers are provided with separable disconnecting devices of the self-aligning pressure-type. These devices are amply proportioned for carrying the required amount of current. The flexible member of the device is mounted on the breaker frame to facilitate inspection and maintenance. These devices make contact in the fully connected and test position, and no test jumper is needed.

#### Ground Bus and Contacts

The ground bus contacts are located on the rear structure of the circuit breaker and engage the ground bus extension when the breaker is in the connected, test and any intermediate position.

#### Control Wires

The main control leads are mounted in the rear of the bus compartment. All electrically operated equipment is connected to these control wires through a suitable control circuit protective device.

#### Breaker Overhead Lifting Device (Optional)

For ease of handling K-Line circuit breakers, a traveling overhead lift device may be provided. This device is supported from the front section of the switchgear assembly. The hoist can be moved the full length of the switchgear and, with the aid of a lifting yoke, the breaker can be lifted from the floor or from the completely withdrawn breaker cradle. Lifting power is provided through a removable hand-crank, worm-driven mechanism and sturdy flexible cable. Although the driving mechanism is designed for easy hand operation, the weight of the circuit breaker cannot accidentally move the mechanism. Detailed operating instructions are given in drawing 368486, which is included with the lifting device shipment.

#### CIRCUIT BREAKERS

Circuit breakers are boxed and shipped separately. Moveable parts of the breakers are not blocked for protection in shipping.

On each switchgear all circuit breakers of like rating are interchangeable unless the secondary (control) circuit requires otherwise. In these cases interlocking will be used to prevent interchangeability.

Circuit breakers and housing are each set in a fixture at the factory.

Circuit breakers have three positions in the housing. In the "DISCONNECT" position the main and control disconnecting devices on the breaker are disengaged and separated a safe distance from the stationary part of the devices located on the housings. In the "TEST" position also, the main disconnecting devices are disengaged, but certain of the control contacts are connected so that the circuit breaker may be operated.

In the third or "CONNECTED" position the main disconnecting devices are engaged. All control contacts, except those connected to the push buttons on the breaker, are connected.

Interlocks prevent moving a circuit breaker from one position to another unless the breaker is open, and prevent closing the breaker between positions.

For handling of circuit breakers, for the procedure of inserting them into the switchgear compartment and removing them, refer to the separate bulletin covering the breakers.

### PLACING SWITCHGEAR IN SERVICE

#### Safety Precautions

#### WARNING WARNING WARNING WARNING

THERE IS A HAZARD OF ELECTRICAL SHOCK AND/OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. POWER MUST BE OFF BEFORE WORKING INSIDE SWITCHGEAR. TURN POWER OFF AHEAD OF THE SWITCHGEAR BEFORE PERFORMING ANY MAINTENANCE OPERATIONS. CHECK INCOMING LINE TERMINALS TO ASCERTAIN POSITIVELY THAT THE EQUIPMENT IS TOTALLY DEENERGIZED. ALWAYS CHECK OUTGOING TERMINALS TO ENSURE NO BACK-FEED CONDITION EXISTS.

THE CIRCUIT BREAKERS SHOULD BE IN TEST POSITION WHEN PRACTICABLE. WHEN A THOROUGH INSPECTION OR WORK IS REQUIRED ON A BREAKER, IT MUST BE REMOVED FROM THE HOUSING. THE BUS SHOULD BE DEENERGIZED AND GROUNDED WHENEVER POSSIBLE WHEN WORK IS TO BE DONE ON SWITCHGEAR.

BEFORE ENERGIZATION, THE SWITCHGEAR MUST BE FREE AND CLEAN OF ALL RANDOM FOREIGN MATTER SUCH AS DIRT AND DEBRIS. IT IS RECOMMENDED THAT AN AIR HOSE BE USED TO BLOW CLEAN ALL SURFACES, BOTH INSIDE AND OUTSIDE, THAT MIGHT HAVE ACCUMULATED DIRT DURING THE INSTALLATION AND CONSTRUCTION PERIOD.

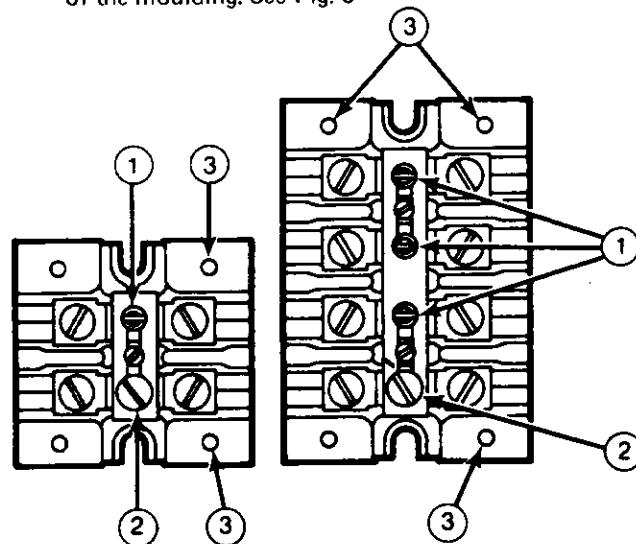
Before energizing any part of the switchgear make a complete check of mechanical operation of all devices. Remove any blocking wedges that may have been inserted in relays, circuit breakers, meters, etc. to prevent movement during shipment. Operate all circuit breakers and relays by hand and make sure that there is no binding of moving parts.

Make sure that no foreign matter, tools, etc. have fallen into or been mislaid in the rear of the switchgear.

The secondary circuits of energized current transformers **SHOULD NEVER BE OPEN CIRCUITED**. Current transformer secondaries are short circuited when shipped from the factory.

To open the short circuiting device:

1. Check current transformer secondary circuits to assure that they are complete. Do not open circuit the secondary of an energized current transformer.
2. Remove the special short circuiting screws from the short circuiting strip. Do not remove the grounding screw.
3. Store the screws in the holes provided at the corners of the moulding. See Fig. 6



- ① Special short circuiting screws in short circuiting position.
- ② Grounding screw - DO NOT REMOVE.
- ③ Holes for storing short circuiting screws.

Fig. 6 - SHORT CIRCUITING DEVICE

See Connection on Diagram for Location. (Symbol 卄)

#### Operation of Breaker Overhead Lifting Device

Proper operation of the breaker lifting device is accomplished when the following requirements are observed:

#### CAUTION CAUTION CAUTION CAUTION

1. BE SURE THE CIRCUIT BREAKER LIFTING DEVICE WHEELS ARE SEATED PROPERLY ON THE TRACK AND THE CABLE IS SECURELY FASTENED TO THE DRUM. THE CABLE AT-

TACHMENT TO THE DRUM SHOULD NOT BE DEPENDED UPON TO SUPPORT FULL CAPACITY. ALWAYS ALLOW 4-5 WRAPS OF CABLE TO REMAIN ON THE DRUM WHEN THE LOAD IS PLAYED OUT.

2. DO NOT USE THE CIRCUIT BREAKER LIFTING DEVICE FOR MORE THAN ITS 800 POUND CAPACITY.
3. GUARD AGAINST SNARLING, KINKING OR KNOTTING OF THE CABLE.
4. DO NOT LIFT LOADS OTHER THAN CIRCUIT BREAKERS.
5. DO NOT MAKE ANY ALTERATIONS TO THE LIFTING DEVICE.
6. NEVER WALK OR STAND UNDER A CIRCUIT BREAKER SUSPENDED BY THE CABLE.
7. DO NOT LEAVE A CIRCUIT BREAKER SUSPENDED ON THE CABLE.

#### Control Circuit Checkout

**CAUTION CAUTION CAUTION CAUTION**

THE BREAKER OR CUTOUT DEVICE OF THE LOCAL CONTROL POWER CIRCUIT MUST REMAIN OPEN WHEN A SEPARATE CONTROL POWER SOURCE IS USED.

The preferred method to check the control circuit is to furnish a separate source of control power of the required control voltage rating. The separate source must have a properly coordinated backup circuit breaker in the circuit and set so as to clear any fault that inadvertently might occur. Initially all circuit breakers should be in the "DISCONNECT" position and the main circuit deenergized. Stationary circuit breakers, if supplied, should be tripped open. Similarly, all control switches should be in the "TRIP" position. When ac control power is from the control power transformers in the switchgear, all fuses in the transformer circuits must be removed. On electrically operated circuit breakers, the motor disconnect switch should be in the "OFF" position.

1. Open compartment doors on all drawout type circuit breakers and move these breakers to the disconnect position.
2. Trip all stationary type breakers.
3. Check each control switch, making sure that it is in "TRIP" position.
4. Connect a separate control power source to the control power circuit load terminals in the switchgear. Energize the control circuit by closing the back-up circuit breaker from which the separate source is controlled.
5. Rack one circuit breaker into the "TEST" position. The charging of the closing springs of an electrically operated circuit breaker will indicate that the control power is connected when the on-off switch is placed in the "ON" position.
6. Rack the remaining circuit breakers into the "TEST" position, one at a time.
7. Test all electrically and manually operated breakers for closing and tripping, while they are in the "TEST" position. Utilize the optional test set available with

- the power shield device for testing solid-state tripping.
8. Deenergize control circuit. If AC control power is from transformers in the switchgear, the external source of control power must be removed. Reinstall all fuses in the transformer circuit.
9. Close all compartment doors and ascertain that all door panel screws are completely engaged.
10. Rack all drawout type breakers to the full connected position.

#### Energizing The Main Bus

After completing the control circuit checkout, the switchgear main bus may be energized.

1. Energize the incoming bus to the switchgear main circuit breaker and observe if operation of instruments and relays is correct.
2. Re-energize separate control power source if furnished.
3. Close the main circuit breaker. The switchgear main is now energized. Observe if operation of relays and instruments is correct.
4. Close the desired feeder circuit breakers.

#### MAINTENANCE

**WARNING WARNING WARNING WARNING**

THERE IS A HAZARD OF ELECTRIC SHOCK AND/OR BURN WHENEVER WORKING IN OR AROUND ELECTRICAL EQUIPMENT. POWER MUST BE OFF BEFORE WORKING INSIDE SWITCHGEAR. TURN OFF POWER AHEAD OF THE SWITCHGEAR BEFORE PERFORMING MAINTENANCE OPERATIONS. CHECK INCOMING LINE TERMINALS TO ASCERTAIN POSITIVELY THAT THE EQUIPMENT IS TOTALLY DEENERGIZED. ALWAYS CHECK OUTGOING TERMINALS TO ENSURE NO BACK-FEED CONDITION EXISTS. (WHERE SOLVENTS ARE CALLED FOR USE ONLY APPROVED SOLVENTS PER OSHA OR LOCAL REGULATIONS. A NON-FLAMMABLE SOLVENT WITH THRESHOLD LIMIT VALUE OF 300 PPM OR HIGHER IS RECOMMENDED. AVOID PROLONGED EXPOSURE TO SOLVENT VAPORS. USE SOLVENTS IN A WELL VENTILATED AREA).

#### General

All switchgear installations should be given a general inspection at frequent intervals. Perform a visual inspection, front and rear, to see that there is no evidence of loose parts, warping or undue vibration. Take steps to remedy any deficiencies of this nature that may appear. Keep the assembly dry at all times. If leaks from overhead pipes and dripping from condensation or other sources cannot be eliminated, install suitable covering to prevent the moisture from falling on the gear.

#### Semi-Annual Inspection

At least twice yearly, a through inspection of the gear should be performed. Prior to this inspection, deenergize all circuits. The following checks in particular are emphasized:

1. Inspect all bolted connections, nuts and screws for tightness. Discoloration, excessive corrosion, or

## BBC Brown Boveri, Inc.

Switchgear Products Group  
Spring House, PA 19477

Supersedes IB 7.2.7-1E  
Printed in U.S.A. 5M CMC 385

embrittled and discolored cable or support insulation may indicate an overheated connection. If found, follow the procedure described under the section "Suspect Joint Maintenance".

2. Inspect all cables for tight connections and ample support.
3. Inspect control wiring for signs of wear and damage. Replace wires wherever doubtful.
4. Examine resistors and other devices prone to overheating.
5. Open all hinged panels and remove all bolted panels.
6. Clean all insulation thoroughly.
7. Withdraw all drawout components and clean. (Refer to Circuit Breaker Instructions Bulletin before cleaning circuit breakers.)
8. Clean the stationary portion of the switchgear by wiping with a clean cloth. A compressed air hose will be useful in the relatively inaccessible areas.
9. Remove covers of all panel devices where practicable. Check wiring for secure connections. Clean contacts on relays and switches wherever necessary. Replace covers.
10. Remove air filters when used, examine for dust, and flush with water if necessary. After drying, recoat with Randolph Products Super Coat Adhesive or equivalent, and replace.
11. Inspect the gearing of the overhead lifting device when used. Keep well lubricated. For normal operation use a heavy gear lubricant. In very dirty or gritty conditions, it is advisable to use a dry lubricant, such as dry graphite.
12. Follow the recommendations of any individual device instruction data furnished for maintenance of the device.
13. Replace all panels and components.

### 18 Month - 3 Year Inspection

1. Clean stationary circuit breaker connection stabs in the enclosure with solvent. Inspect for evidence of excessive heat, arcing, or corrosion. If found, follow procedure described under the section SUSPECT JOINT MAINTENANCE.
2. Inspect secondary wiring bundles for signs of discoloration because of heat, chafing and embrittled or cracked insulation. Replace wire whenever doubtful.
3. Inspect primary insulation system for accumulated contamination. Clean insulation with dry cloth, dry air, vacuum, or if necessary, with solvent.

### 10 Year Maximum Inspection

1. All primary conductor connection bolts should be torqued to recommended values. Experience indicates that thermal cycling, materials deformation and vibration effects can reduce tightness of hardware

with consequential increase in resistance and heat developed.

An alternative to retorquing may be use of infrared heat sensor (thermographic) techniques. These procedures are specialized, however, and require planning to overcome safety and loading difficulties.

2. Tighten all secondary control wire connections while checking for loose lug crimps and broken wire strands.

### Suspect Joint Maintenance

1. Open joint and inspect connection surfaces.
2. Clean surfaces with solvent. Dress contact surfaces that show minor corrosion or pitting by lightly rubbing with polishing cloth such as 3-M SCOTCH-BRITE; taking care to minimize removal of plating.
3. If heavy corrosion, arcing or melting has occurred, replace conductor parts.
4. Contact finger springs should be replaced after any exposure to excess heating at the breaker disconnect.
5. Contact surfaces should be protected with NO-OX-ID Special A compound (a product of SANCHEM CHEMICAL CO.) applied before assembly.
6. Use proper torque in tightening bolted connections.

### TORQUE VALUES FOR LOW VOLTAGE EQUIPMENT HARDWARE

BOLT SIZE	FOOT-POUNDS (DRY THREADS)
3/8	15-35
1/2	30-45

### Care of Finish

The exterior finish used on the switchgear is of the highest grade paint. The interior frame work is also phosphatized and finished with the highest grade paint. The switchgear should be kept clean at all times. Wiping with a clean dry cloth will usually suffice. To remove oil and grease marks, use warm water and soap, wiping dry with a soft cloth.

To touch up the exterior or interior finish after final erection, use Randolph Touch-Up Finish (Randolph Products Co., P.O.Box 67, Carlstad, N.J. 07072) of the corresponding color. The color finish furnished on the exterior varies, and this information is stated on the front sheet of the Bill of Material.

### RENEWAL PARTS

The quantity of renewal parts to be stocked varies with the installation. Previous experience and the number of units in service are the best guides available. To order replacement parts, contact the nearest District Office. Give a complete description of the parts and the nameplate data of the device requiring these parts. Specify the quantity required.