ASEA BROWN BOVERI

TRAINING PROGRAM
FOR
OPERATION AND MAINTENANCE
OF
K-LINE CIRCUIT BREAKERS

A) Introduction

B) Description

C) Receiving and Storage

D) Circuit Breaker Operation

1. Escutcheon Operating Features

2. Racking Mechanism and Cradle

3. Integral Operating Mechanism

4. Circuit Breaker Electrical Control Devices

5. Overcurrent Trip Devices

6. K-Don Fuses and Open Fuse Trip Device

E) Installation of Circuit Breaker Into Compartment

F) Maintenance

A) INTRODUCTION

These instructions and procedures apply to the type K-225 thru K-2000 and K-600S thru K-2000S circuit breakers; 225, 600,800, 1600 and 2000 ampere AC continuous current rating respectively. This program also includes the K-3000, K-4000 and K-3000S, K-4000S circuit breakers; 3000 and 4000 ampere AC continuous current rating respectively.

The K-225 thru K-2000 and K-3000/4000 ampere circuit breakers can be furnished with two or three pole for DC or AC operation.

All circuit breakers can be furnished as drawout or stationary mounted and are available as manually or electrically operated and with electrical control devices, available in various AC and DC voltage combinations. The manually and electrically operated mechanisms are interchangeable on the circuit breakers having the same current rating. Many optional features are also available.

B) DESCRIPTION

K-line circuit breakers have been developed for the protection of feeder circuits and for use as main breakers where the interruption requirements are within design ratings.

The low voltage feeder circuit protection breakers are the type K-225 thru 2000 and K-600S thru K-2000S circuit breakers. The main ~~high voltage~~ circuit protection breakers are the K-3000/4000 and K-3000S/4000S circuit breakers.

The low voltage K-line circuit breakers also can be equipped with fuses. This breaker is called the K-Don. These circuit breakers are the same assemblies of the basic K-line, with the addition of integral current-limiting fuses and an open-fuse trip device to provide a coordinated protective device. The K-Don circuit breakers are supplied in drawout arrangement only and should never be used in stationary mounting. All instructions and procedures pertaining to the basic K-line circuit breaker also apply to the K-Don.

C) RECEIVING AND STORAGE

Immediately upon receipt of the circuit breakers, examine the cartons to determine if any damage or loss was sustained during transit. If injury or damage is evident, file a damage claim at once with the carrier and promptly notify the nearest Service Center. ASEA Brown Boveri is not responsible for damage of goods after delivery to the carrier. However, we will lend assistance if notified of claims.

Always unpack circuit breakers as soon as possible after receipt. If unpacking is delayed, difficulty may be experienced in making a claim for damages not evident upon receipt. Use care in unpacking in order to avoid damaging any circuit breaker parts. Check the contents of each carton against the packing list before discarding any packing materials.

If possible, a drawout circuit breaker should be stored and locked in the "Disconnected" position in its compartment, with the door closed. Both the primary and control separable contacts are disconnected in this position. If the breaker cannot be installed in its compartment, it should be kept in its original carton and the carton should be sealed to prevent infiltration of dirt. Where conditions of high humidity prevail, the use of heaters is recommended, regardless of the method of storage selected.

D) CIRCUIT BREAKER OPERATION

1. Escutcheon Operating Features

All K-line circuit breakers are provided with an extendable escutcheon face plate. This escutcheon provides a central area for the manual and electrical circuit breaker controls which interface the controls directly with the Integral Operating Mechanism. The escutcheon is mounted directly on the circuit breaker.

The escutcheon features are: Electrical Close Button Switch, Electrical Trip Button Switch, Motor Disconnect Switch. The escutcheon also includes the manual close lever and closing springs charge indicator with electrically operated circuit breakers only. The following information is found on the nameplate which is mounted on the left lower corner of the escutcheon face plate. It gives various interrupting and shortcurrent ratings and the various AC and DC control voltages assigned to the particular type of circuit breaker.

The Manual Controls are: Closing Handle; Manual Trip Button; Automatic Trip Indicator with optional facilities for alarm and lockout indication; Padlock Device; Open and Close Indicator which apply to the electrically operated circuit breakers also, and the lift shutter which gives access to the racking gear. This feature does not apply to the stationary design circuit breaker.

A self aligning dust plate, assembled around the escutcheon face plate, is used to prevent dust from entering the circuit breaker compartment. On drawout type circuit breakers, the escutcheon face will protrude through the front door of the compartment when the circuit breaker is in the TEST, DISCONNECTED positions. In these positions the dust plate still functions to exclude dust.

2. Racking Mechanism and Cradle

The racking mechanism incorporates the racking gears, drawout bar assembly and arms. They all interconnect together within the circuit breaker frame. The arms interface with the cradle to permit racking the circuit breaker in any of its three positions: DISCONNECTED, TEST or CONNECTED. All positions are attainable with compartment door closed.

The racking shutter is interlocked with the integral operating mechanism so that the circuit breaker contacts must be open before the shutter can be lifted, preventing access to the racking mechanism and insertion of the racking crank. The circuit breaker cannot be closed when the shutter is open or has not dropped completely after withdrawal of the racking crank. The circuit breaker will be in a trip free state.

When installing the circuit breaker into its compartment, the racking mechanism must be properly racked into each of its positions correctly. There are two sets of arrows and indicating lines to show the racking mechanism position. One set is utilized with the compartment door closed and one set with the door open. The indicator used when the compartment door is ~~closed~~ OPEN is mounted directly on the upper left corner of the circuit breaker frame and aligns with the racking position indicator plate mounted on the upper left side of the circuit breaker compartment. The indicator used when the compartment is ~~open~~ CLOSED is the racking mechanism label placed on the right side of the escutcheon box.

All K-line circuit breakers equipped with a racking mechanism can be locked in any of its three basic racking positions: DISCONNECTED, TEST and CONNECTED, by means of padlocking the mechanism in a trip-free state. This is accomplished by the padlock device that is associated with the shutter interlock, which is interconnected with the manual trip button.

To obtain the condition for padlocking the circuit breaker in the open position, the manual trip button is pushed inward. Then the padlock device is pulled out and momentarily held while a padlock is inserted into the vertical slot on the padlock plate located at the lower left corner, protruding approximately 1/2" through the escutcheon face plate. In this position, the mechanism is maintained trip free and the contacts cannot be closed.

All K-line low voltage feeder and ~~high voltage~~ main circuit breaker compartments have a cradle installed within them. The cradle is a very important sector of the switchgear. It interfaces the circuit breaker with the bus area and all other compartment controls. A cradle comprises main and secondary separable contacts, current transformers (if required) and all other drawout mechanisms in a complete jig-welded rigid assembly. There is no dependence upon the

switchboard frame for any critical alignment of main or separable control contacts. Any size cradle can be installed into any compartment of its own size or larger. Blank compartments not required for other functions may be converted to a circuit breaker compartment by the installation of a cradle and necessary riser bus modifications.

3. Integral Operating Mechanism

The Operating Mechanism is where all primary functions of the circuit breaker take place. It comprises the latch "bite" engagement and tripper bar engagement screws, tripper bar, primary latch, secondary latch and toggle assembly. For manually operated mechanisms; a closing cam. For electrically operated mechanisms; a ratchet and pawl assembly. Both electrically and manually operated mechanisms have slow close levers but with different designs and locations within the operating mechanism. These parts interface with all the primary controls of the escutcheon face plate and jack shaft. Push rods link the jackshaft directly to the primary contacts. The required energy needed to push the primary contacts closed is supplied by a pair of powerful stored energy springs. They are automatically discharged for safe breaker maintenance when the circuit breaker is racked to the disconnected position. It is also equipped with a hand-reset automatic trip indicator which provides for usual indication of automatic trip operation.

The manual operated mechanism closing springs are charged by pulling downwards on the closing handle approximately 100 degrees. The initial 90 degree movement fully charges the closing springs and the remaining motion releases the spring energy to drive the contacts closed. The closing springs supply sufficient energy to close and latch the breaker contacts safely under any conditions within the breaker ratings.

The electrically operated mechanism closing springs energy is momentarily stored. They are fully charged by a high torque, high speed, fractional-horsepower, speed reduction gear motor. The motor operates from DC or AC voltages. After the closing springs are fully charged the breaker contacts can now be closed by pushing the electric close push button switch. Upon tripping, the breaker contacts open, and the springs are automatically recharged, provided the motor disconnect switch is left in the "ON" position. An emergency charging handle is provided for manually charging the springs if control power is lost. A manual close lever on the escutcheon is also provided for simple manual closing of the breaker contacts, if power is lost.

4. K-Line Circuit Breaker Electrical Control Devices

The electrical control devices of the K-line circuit breakers are: the standard control device, shunt trip and auxiliary switch. The breaker can be equipped with an undervoltage device, which is an optional feature. The control device is the black insulated molding 3" X 5" X 6" approximately, located at the lower left corner of the mechanism. The device contains three electrical components, the limit switch, the lockout "anti-pump" relay (52Y), and the latch release relay (52X). In addition to this electrical function, the base of the device provides a terminal block for the circuit breaker.

The shunt trip consist of a coil, DC or AC operated, assembled within a square metal housing 2" X 2" X 3" located on the left side of the mechanism. It provides the basic electrical function of tripping open the circuit breaker contacts.

The auxiliary switches are the black molding 3" X 3" X 4" mounted on the top left and right of the circuit breaker frame that contains the "A" and "B" contacts and are furnished in 4 or 8 contact arrangements. They are mechanically interconnected with the main breaker contacts so that with the circuit breaker's contacts closed, the "A" contacts are closed, and with the circuit breaker open, the "B" contacts are closed. The left auxiliary provides a terminal block for connecting all standard electrical components in sequence of the opening and closing of the circuit breaker. The right auxiliary switch provides a terminal block for connecting all optional electrical components in sequence of circuit breaker operation.

The electrically reset undervoltage trip device is a single-phase device which automatically trips the circuit breaker when the line voltage decreases to 30-60% of rated voltage. This device may be furnished either for instantaneous trip operation or with adjustable time delay tripping of 1.5 - 15 seconds. The undervoltage device may be connected so that the automatic trip indicator will protrude from the front plate when the breaker is tripped by the undervoltage device. It is an integral unit which can be added to the circuit breaker either at the factory or in the field.

5. Overcurrent Trip Device

a) Electro-Mechanical - The K-line type OD electro-mechanical overcurrent trip device is a three-phase assembly mounted on a one-piece, impact resistant, polyester-glass molding for breaker sizes up to K-600. On larger size breakers the overcurrent trip device assembly consists of three individual units. ITE low voltage power circuit breakers equipped with this device are available in any desired combination of long-time delay, short-time delay and instantaneous tripping. The trip devices are clearly visible and within easy reach from the front of the circuit breaker. A wide

range of adjustments makes this unit ideal for protection of motors and equipment which require close protection, for AC or DC operation.

The K-3000 and K-4000 circuit breakers can be furnished with two or three poles for AC and DC operation. All electro-mechanical trip devices pickup settings have been set at the factory. However, if device needs adjustment or repair due to replacement of overloads or other parts, re-adjustment or repair should be done by an ABB Field Service Technician or Engineer.

b) Power Shield - Solid State Overcurrent Trip Device Power shield is a three-phase solid state, overcurrent trip device designed for low-voltage power system protection against damage caused by overloads and short-circuit conditions. The solid state overcurrent trip system consists of current sensors, logic assembly, magnetic latch andinter-connecting wiring. There are two current sensors mounted on the breaker lower base molding around each primary conductor. For breaker sizes up to K-600S, the sensors and primary conductor are mounted on a one piece impact resistant, polyester glass molding. On large size breakers the current sensors and primary conductors are mounted on three individual units, for AC operation only.

One sensor supplies the logic assembly with a signal current proportional to the primary current. It is referred to as the signal sensor. The other sensor, designated the power supply sensor, supplies the power required to operate the magnetic latch and solid state circuitry. The logic assembly contains the circuitry and various tap blocks used to set the overcurrent trip levels and time delays.

The magnetic latch is similar in function to a shunt trip device, but is powered by the fault current through the power supply sensors, and is actuated by the logic assembly system. After the magnetic latch releases, it is automatically reset mechanically by a clip mounted on the jackshaft.

All field settings are made by insertion of tap plugs into the front of the trip device. The ampere tap plug selects the continuous rating of the current sensor. This setting is shown in primary amperes. The long-time, short-time and instantaneous functions are then adjusted by tap plugs which are a percentage of the primary ampere tap plug. In addition, three time-delay bands, minimum, intermediate and maximum can be selected for both long-time and short-time functions.

For those applications in which it is desirable to protect the system against faults to ground, a ground function can be included in the logic assembly. For three-wire applications with ground protection, not additional sensors are required. With four-wire applications, one ground sensor is remotely mounted around the neutral

conductor and is wired to the logic assembly through a breaker secondary disconnect. The ground function is tap selected directly on amperes and is independent of the ampere tap setting.

E. INSTALLATION OF CIRCUIT BREAKER INTO COMPARTMENT

Before attempting to insert breaker into its compartment, insure breaker is open and motor disconnect switch (for electrically operated breakers only) in the "OFF" position.

Installation Procedures

1. Open compartment door and pull cradle extension tracks out until the tracks lock and latch securely. The latches prevent the cradle tracks from easily sliding back when the breaker is pushed into the compartment on to the tracks. An additional positive push will be required to release the latches when the breaker is being installed.

2. Using a lifting yoke, lower the circuit breaker so that the positioning pins (two each side of circuit breaker) rest in the cut out sections of each track.

3. Remove the lifting yoke and push the circuit breaker into the compartment until the racking cams stop against their guides on the cradle.

4. Lift shutter and hold, while inserting racking crank. When crank has been inserted, release shutter.

5. Turn racking crank counter-clockwise until it stops. Push breaker again to insure breaker has traveled far enough into cradle for proper alignment of racking cams with guide slots on cradle.

6. Turn racking crank clockwise four full revolutions. The breaker should now be in the "DISCONNECTED" position. Read breaker position from the indicator label on the right side of escutcheon panel. If breaker is set correctly in any of its positions the shutter lift will completely close when the racking crank is withdrawn.

7. If racking crank was withdrawn to verify position, lift shutter and re-insert racking crank. Turn racking crank again clockwise, seven revolutions. The breaker should now be in "TEST" position. Check position is same as above.

8. Turn racking crank thirteen and a half revolutions. The breakers should now be in "CONNECTED" POSITION. When racking crank is withdrawn, the shutter lift should drop (close) completely.

If shutter doesn't properly close, indicates breaker isn't in position and contacts should not be closed. If operator attempts to close breaker the mechanism will trip free.

After breaker has been properly racked in connected position, the compartment door should be closed and secured before operator attempts to close circuit breaker contacts.

When the breaker is in "DISCONNECTED" position, both primary and secondary contact fingers are disconnected from the cradle primary and secondary contacts.

When the breaker is in "TEST" position, only the secondary contact fingers are engaged, permitting the operator to open and close the circuit breaker electrically.

F. MAINTENANCE

The safety and successful functioning of the connected apparatus depends upon the proper operation of the circuit breaker. Therefore, it is recommended that a maintenance program be established that will provide for a periodic inspection of the circuit breaker.

K-225	After 2500 Operations
K-600, K-600S	After 1750 Operations
K-800, K-800S	After 1750 Operations
K-1600,K-1600S	After 500 Operations
K-2000,K-2000S	After 500 Operations
K-3000/4000	After 250 Operations

The above inspection periods apply for no load or load current switching. If the listed number of operations are not completed in the first year of service, the circuit breakers should be inspected regardless. The circuit breakers should also be inspected after a short circuit or severe overload interruption, regardless of time period or number of operations.

The inspection should include opening and closing the circuit breaker electrically and manually, and visual inspection for loose or damaged parts. The K-line circuit breakers are lubricated during factory assembly. However, if the grease should become contaminated or if parts are replaced, any lubrication should be done with NO-OX-ID on any mating surfaces of moving current carrying joints and all other mechanism parts, bearings, pins, etc. should be lubricated with Anderol 757 grease.

The insulation parts should be checked for damage. Dust or dirt should be removed by air or wiped clean with a clean lint free cloth. Do notuse any oil base solvents. Do not allow solvents to get on primary and secondary contact fingers at rear of breaker.