Instructions for Cutler-Hammer ATH2/ATV2 Automatic Transfer Switch (30-1000 Amperes)

WARNING

READ AND UNDERSTAND THE INSTRUCTIONS CONTAINED HEREINAFTER BEFORE ATTEMPTING TO UNPACK, ASSEMBLE, OPERATE OR MAINTAIN THIS EQUIPMENT.

HAZARDOUS VOLTAGES ARE PRESENT INSIDE TRANSFER SWITCH ENCLOSURES THAT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. FOLLOW PROPER INSTALLATION, OPERATION AND MAINTENANCE PROCEDURES TO AVOID THESE VOLTAGES.

TRANSFER SWITCH EQUIPMENT COVERED BY THIS INSTRUCTION BOOK IS DESIGNED AND TESTED TO OPERATE WITHIN ITS NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS MAY CAUSE THE EQUIPMENT TO FAIL RESULTING IN DEATH, SERIOUS BODILY INJURY AND/OR PROPERTY DAMAGE. ALL RESPONSIBLE PERSONNEL SHOULD LOCATE THE DOOR MOUNTED EQUIPMENT NAMEPLATE AND BE FAMILIAR WITH THE INFORMATION PROVIDED ON THE NAMEPLATE. A TYPICAL EQUIPMENT NAMEPLATE IS SHOWN IN FIGURE 1.

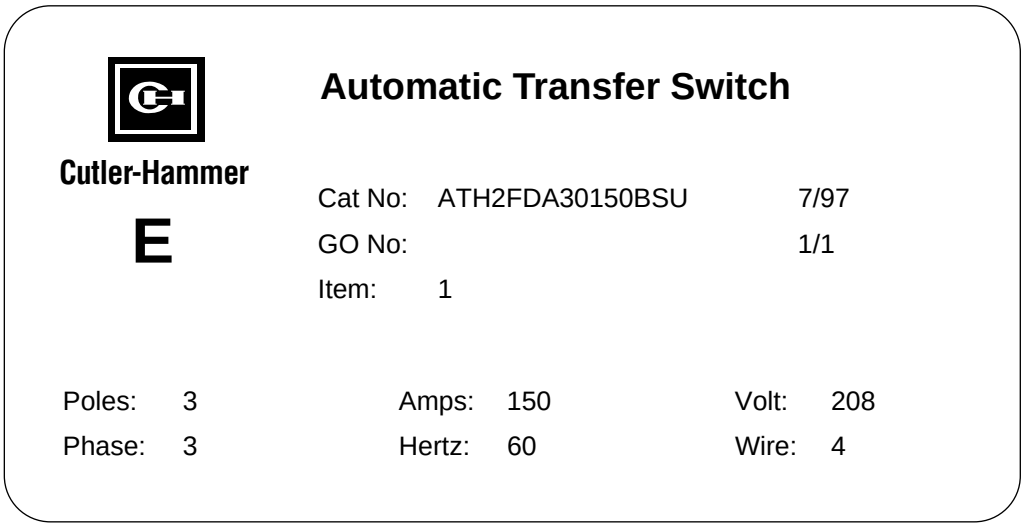

Figure 1 *Typical Automatic Transfer Switch Equipment Nameplate*

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do no purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of particular equipment, contact a Cutler-Hammer representative.

TABLE OF CONTENTS

Page

SECTION 6: TESTING AND PROBLEM SOLVING

SECTION 7: MAINTENANCE

SECTION 8: MAINTENANCE

LIST OF FIGURES

LIST OF TABLES

SECTION 1: INTRODUCTION

1.1 PRELIMINARY COMMENTS AND SAFETY PRECAUTIONS

This technical document is intended to cover most aspects associated with the installation, application, operation and maintenance of the Transfer Switch with ratings from 30 through 1000 amperes. It is provided as a guide for authorized and qualified personnel only. Please refer to the specific WARNING and CAUTION in Section 1.1.2 before proceeding. If further information is required by the purchaser regarding a particular installation, application or maintenance activity, a Cutler-Hammer representative should be contacted.

1.1.1 WARRANTY AND LIABILITY INFORMATION

No warranties, expressed or implied, including warranties of fitness for a particular purpose of merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations and descriptions contained herein. In no event will Cutler-Hammer be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information and descriptions contained herein.

1.1.2 SAFETY PRECAUTIONS

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and maintenance of this device.

⚠ WARNING

THE WARNINGS AND CAUTIONS INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS DOCUMENT ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE TO FAMILIARIZE PERSONNEL WITH THE STYLE OF PRESENTATION. THIS WILL HELP TO INSURE THAT PERSONNEL ARE ALERT TO WARNINGS, WHICH APPEAR THROUGHOUT THE DOCUMENT. IN ADDITION, CAUTIONS ARE ALL UPPER CASE AND BOLDFACE.

⚠ CAUTION

COMPLETELY READ AND UNDERSTAND THE MATERIAL PRESENTED IN THIS DOCUMENT BEFORE ATTEMPTING INSTALLATION, OPERATION OR APPLICATION OF THE EQUIPMENT. IN ADDITION, ONLY QUALIFIED PERSONS SHOULD BE PERMITTED TO PERFORM ANY WORK ASSOCIATED WITH THE EQUIPMENT. ANY WIRING INSTRUCTIONS PRESENTED IN THIS DOCUMENT MUST BE FOLLOWED PRECISELY. FAILURE TO DO SO COULD CAUSE PERMANENT EQUIPMENT DAMAGE.

1.2 GENERAL INFORMATION

Transfer switches are used to protect critical electrical loads against loss of power. The load's normal power source is backed up by a secondary (emergency) power source. A transfer switch is connected to both the normal and emergency power sources and supplies the load with power from one of these two sources. In the event that power is lost from the normal power source, the transfer switch transfers the load to the secondary (emergency) power source. Transfer can be automatic or manual, depending upon the type of transfer switch equipment being used. Once normal power is restored,

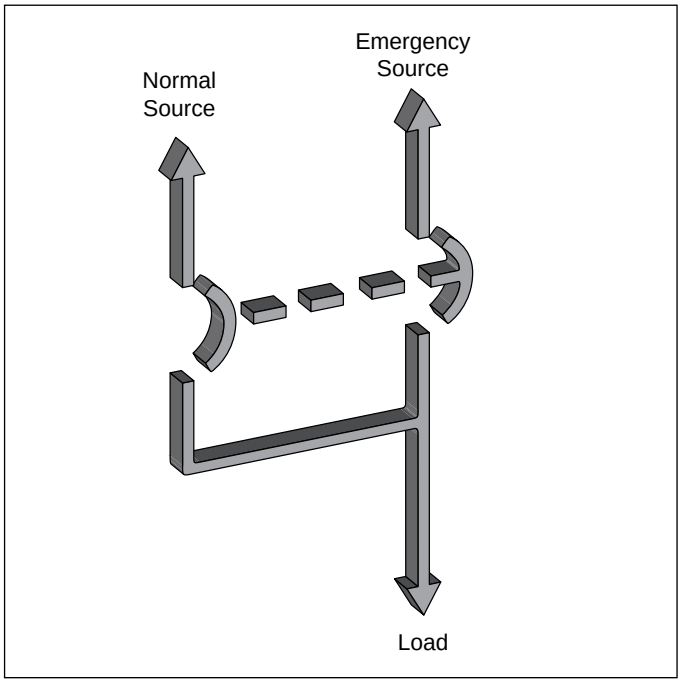

Figure 1-1 Typical Load Transfer Switch (circuit breaker type) Schematic

the load is automatically or manually transferred back to the normal power source, again depending upon the type of transfer equipment being used (Figure **1-1**).

In automatic transfer switch equipment, the switch's intelligence system initiates the transfer when normal power fails or falls below a preset voltage. If the emergency power source is a standby generator, the transfer switch initiates generator starting and transfers to the emergency power source when sufficient generator voltage is available. When normal power is restored, the transfer switch automatically transfers back and initiates engine shutdown. In the event the normal power source fails and the emergency power source does not appear, the automatic transfer switch remains connected to the normal power source until the emergency power source does appear. Conversely, if connected to the emergency power source and the emergency power source fails while the normal power source is still unavailable, the automatic transfer switch remains connected to the emergency power source.

Automatic transfer switches automatically perform the transfer function, and include three basic elements:

(1) Main contacts to connect and disconnect the load to and from the source of power.

(2) A mechanism to make the transfer of the main contacts from source to source.

(3) Intelligence/supervisory circuits to constantly monitor the condition of the power sources and thus provide the intelligence necessary for the switch and related circuit operation.

1.2.1 DESIGN CONFIGURATION

The Cutler-Hammer transfer switch is a rugged, compact design that used molded case switches to transfer essential loads from one power source to another (Figures **1-2** [225-1000A] and **4-2** [30-200A]). Molded case switches are interlocked to prevent both switching devices from being closed at the same time.

Molded case switches and the associated transfer mechanisms are mounted vertically to save space in the assembly. The compact, vertical configuration uses a positive, metallic transfer and interlocking system between the molded case switches.

The Cutler-Hammer automatic transfer switch was designed with easy installation and simplified maintenance in mind. Two main panels compromise the automatic transfer switch design:

Figure 1-2 Automatic Transfer Switch Equipment with Solid Steel Shield in Place over Power Panel

- Power Panel
- Microprocessor-based Controller

Each panel is independently mounted with interconnecting wiring terminated in connector plugs to permit individual door or panel removal without disturbing critical connections. Mounting the enclosure is simple using top and bottom mounting flanges with elongated mounting holes. These mounting holes, along with power panel positioning bolts and pre-tapped inserts insure proper power panel mounting after initial enclosure installation or when switching from top to bottom entry and vice versa. Refer to Section 4 for mounting and modification details.

1.3 TRANSFER SWITCH CATALOG NUMBER IDENTIFICATION

Transfer switch equipment catalog numbers provide a significant amount of relevant information that pertains to a particular piece of equipment. The Catalog Number Identification Table (Table **1.1**) provides the required interpretation information. An example is offered to initially simplify the process.

Example: Catalog Number *(circled numbers correspond to position headings in Table **1.1**)* –

① to ② ③ ④ ⑤ to ⑥ ⑦ ⑧ ⑨ to ⑫ ⑬ ⑭ ⑮

AT V 2 KD A 2 0300 W R U

The catalog number ATV2KDA20300WRU describes an Automatic Transfer Switch with the switching devices mounted vertically in the enclosure. The intelligence represented by the control panel is microprocessor based. The Cutler-Hammer Series C Type HKD is used as the switching device and is in the form of a 2-pole molded case switch on each source. The continuous current rating of this equipment is 300 amperes and applicable at 240VAC, 60Hz. The transfer switch equipment is enclosed in a NEMA 3R enclosure and is listed for UL/CSA applications.

Table 1.1 *Transfer Switch Catalog Number Explanation*④

Positions 1-2		Position 3		Position 4		Positions 5-6		
Basic Device		**Switching Device Orientation**		**Control Panel**		**Switching Device**		
Automatic Transfer Switch	**AT**	Horizontal	**H**①	Transfer Switch	**2**	HFD	Cutler-Hammer Series C	**FD**
		Vertical	**V**			HKD	Cutler-Hammer Series C	**KD**
						HLD	Cutler-Hammer Series C	**LD**
						HMA	Cutler-Hammer Series C	**MA**
						HNB	Cutler-Hammer Series C	**NB**

Position 7		Position 8	Positions 9-12	Position 13		Position 14		Position 15	
Switching Device Arrangement		**Number of Poles**	**Ampere Rating**	**Voltage/ Frequency**		**Enclosure**		**Listing**	
Fixed Mount Molded Case	**A**	Two **2**	30A – **0030**	208VAC/60Hz	**B**	Type 3R	**R**	UL Listed	**U**②
Both Normal and Emergency	**B**	Three **3**	70A – **0070**	240VAC/60Hz	**W**	Type 1	**S**		
Molded Case Circuit			100A – **0100**			No Enclosure	**K**		
Breakers			150A – **0150**			Type 12	**J**		
Normal Molded Case	**C**		200A – **0200**						
Circuit Breaker and			225A – **0225**						
Emergency Molded			300A – **0300**						
Case Switch			400A – **0400**						
			600A – **0600**						
			800A – **0800**						
			1000A – **1000**						

① 30-200 amperes only.

② CSA Listed without option 16 (position 7, A only)

SECTION 2: RECEIVING, HANDLING, AND STORAGE

2.1 RECEIVING

Every effort is made to ensure that the transfer switch equipment arrives at its destination undamaged and ready for installation. Packing is designed to protect internal components as well as the enclosure. Care should be exercised, however, to protect the equipment from impact at all times. Do not remove protective packaging until the equipment is ready for installation .

When transfer switch equipment reaches its destination, the customer should inspect the shipping container for any obvious signs of rough handling and/ or external damage that occurred during transportation. Record any external and internal damage for reporting to the transportation carrier and Cutler-Hammer, once a thorough inspection is complete. All claims should be as specific as possible and include Shop Order and General Order numbers.

A shipping label affixed to the shipping container includes a variety of equipment and customer information, such as General Order number and Customer Number. Make certain that this information matches other shipping paper information.

Each transfer switch enclosure is bolted through its top and bottom mounting flanges to a rigid wooden pallet. The pallet is open at two ends for movement by a forklift. Heavy duty cardboard sides surround the enclosure and are further supported with reinforced cardboard corner posts. An egg crate design cardboard protector covers the entire top of the enclosure with additional cardboard protectors over the indicating light panel and operating handle. A heavy duty cardboard lid covers the entire opening. The shipment is secured and further protected with shrink wrap. Do not discard the packing material until the equipment is ready for installation.

Once the top packaging is removed from the shipment, the enclosure door can be opened. A plastic bag of documents will be found in the enclosure, usually attached to the inside of the door. Important documents, such as test reports, wiring diagrams, appropriate instruction leaflets and a warranty registration card, are enclosed within the bag and should be filed in a safe place.

2.2 HANDLING

As previously mentioned, transfer switch equipment is packaged for forklift movement. Protect the equipment from impact at all times and do not double stack. Once the equipment is in the installation location and ready to be installed, packaging material can be removed. Once the enclosure is unbolted from the wooden pallet, it can be hand moved to its installation position. Be careful not to damage the top or bottom enclosure mounting flanges. Refer to Section 4 of this manual for specific installation instructions.

2.3 STORAGE

Although well packaged, this equipment is not suitable for storage outdoors. The equipment warranty will not be applicable if there is evidence of outdoor storage. If the equipment is to be stored indoors for any period of time, it should be stored with its protective packaging material in place. Protect the equipment at all times from excessive moisture, construction dirt, corrosive conditions, and other contaminants. It is strongly suggested that the package-protected equipment be stored in a climate-controlled environment of -20°C to 65°C with a relative humidity of 80 percent or less. Do not under any circumstance, stack other equipment on top of a transfer switch equipment enclosure, whether packaged or not.

SECTION 3: EQUIPMENT DESCRIPTION

3.1 GENERAL

The Transfer Switch consists of two basic items interconnected via connector plugs and mounted in an enclosure (Figure **1-2**).

3.2 POWER PANEL

The power panel is used for making load, power, and neutral connections. The main contacts and the transfer mechanism are all on one steel frame (Figure **3-1** and **3-2**).

3.2.1 STEEL BASE PLATE

The steel base plate design permits the power panel to be moved vertically within the enclosure to accommodate top or bottom cable entry (Figure **4-1**). Elongated holes on either side of the base plate ensure proper positioning. The bottom set of elongated holes positions the power panel higher in the enclosure, thus permitting bottom cable entry. The top set of elongated holes positions the power panel lower in the enclosure for top cable entry. Section 4 discusses equipment mounting and load lug location in detail.

3.2.2 MAIN CONTACTS

The main contacts connect and disconnect the load to and from the different power sources. High withstand molded case switches are the main contacts for the normal and emergency power sources in standard automatic transfer switches (Figures **3-3** and Section **3.6**). These continuous duty transfer switches are rated for all classes of loads, open or enclosed.

In addition, they have high dielectric strength, heavy-duty switching and withstand capabilities, and high interruption capacity. This transfer switch incorporates Cutler-Hammer-type molded case switches.

The switching devices are mechanically and electrically interlocked to prevent the two sets of main contacts from being closed simultaneously. The load side contacts of each switching device are joined with a bus bar assembly to form a common load terminal location, either top or bottom (Figures **4-2** and **4-3**).

3.2.3 TRANSFER MECHANISM (225-1000A)

The transfer mechanism transfers between power sources through a motor-driven, ratchet-type operation. A rotational motion is created on an indicator wheel by the ratchet's operation. The indicator wheel is attached to rigid shafts which convert the rotary motion into vertical linear motion. Opening and closing the switching devices is accomplished as a result of this vertical linear motion. The transfer mechanism is mounted in front of the molded case switches (Figure **3-1**).

A solid steel shield attached to the ratchet assembly permits viewing of the rotary switch position indicator while restricting access to other parts of the power panel (Figure **1-2**).

3.2.4 TRANSFER MECHANISM (30-200A)

This mechanism transfers between power sources using a motor-driven arm that connects to a lever which operates both the normal and emergency switches (Figure **3-2**).

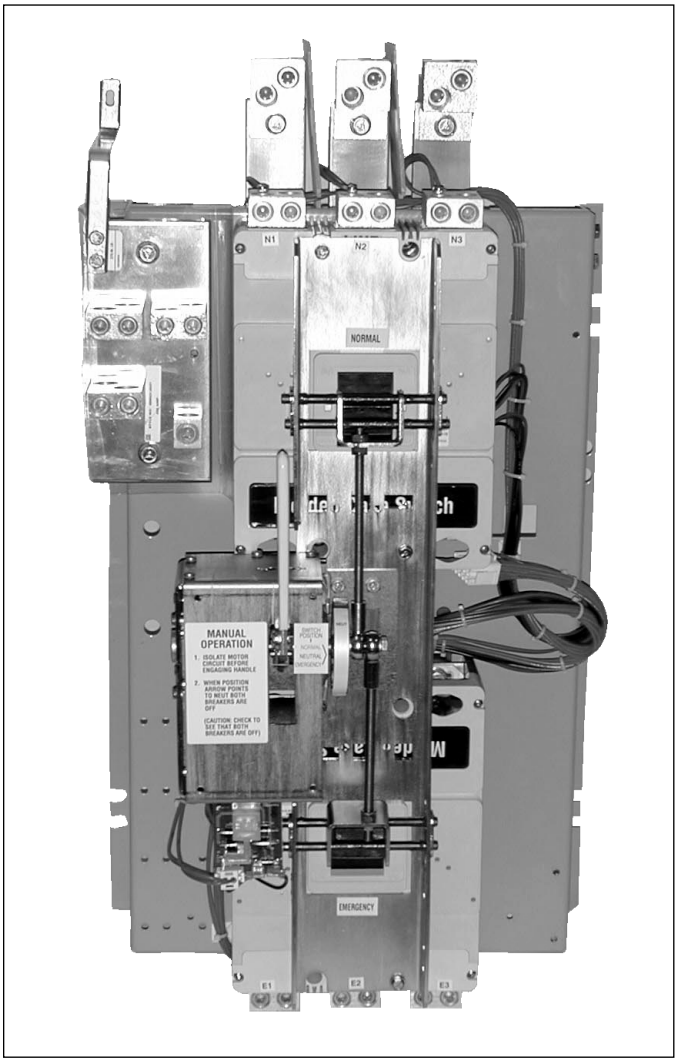

Figure 3-1 Typical Power Panel (Unmounted) for 225-1000A Models

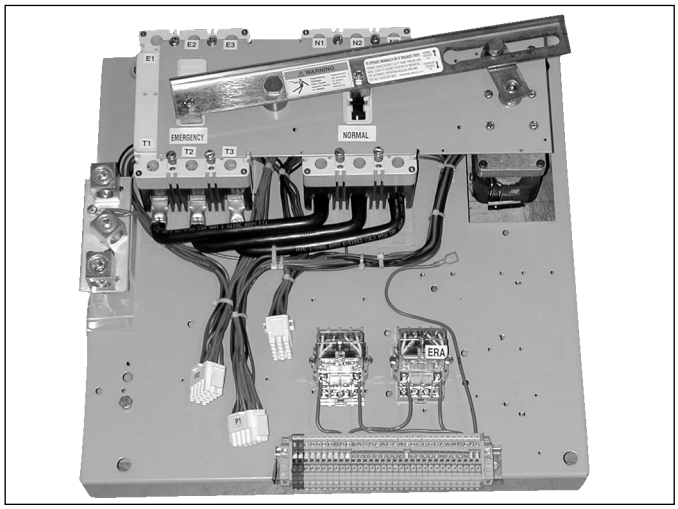

Figure 3-2 Typical Power Panel for 30-200A Models

Figure 3-3 Mounted Molded Case Switches with the Transfer Mechanism Removed for Clarity (225-1000A Models)

3.3 MICROPROCESSOR BASED LOGIC PANEL

The Transfer Switch is a microprocessor-based transfer switch logic control package. The hardware and software of the controller contain the intelligence/supervisory circuits that constantly monitor the condition of the power sources. It provides the intelligence necessary for the operation of the transfer switch (Figure **3-4**).

The ATS controller has an operating temperature of -20 to 75° C.

The Controller circuit board is protected by an insulating conformal coating.

The specifications under normal operating conditions are as follows:

- Tolerance for voltage sensing function: ±2% of setting
- Tolerance for frequency sensing function: ±0.2 Hz of setting
- Accuracy of time delay range: ±2% of setting

3.4 AVAILABLE FEATURES

A variety of switch features are available to meet a wide variety of application requirements. Individual features or feature combinations permit a switch to be tailored to individual needs. Features are numbered with an associated description. More detailed selections that must be made within a specific feature are lettered.

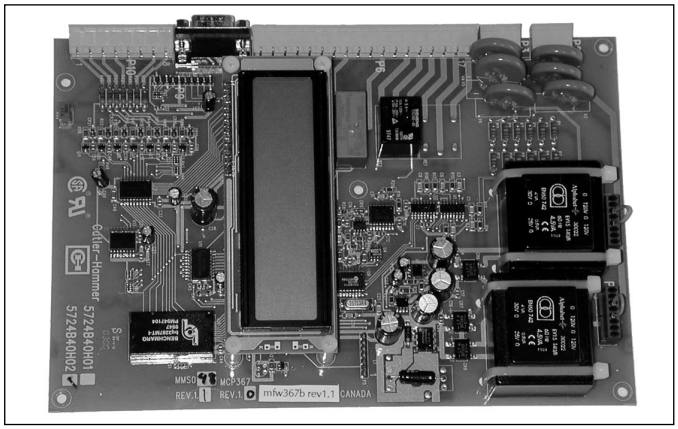

Figure 3-4 Microprocessor-based Logic Control Panel

Standard Feature 1: Time Delay Normal to Emergency (TDNE)

This feature delays the transfer from the normal power source to the emergency power source in order to override momentary normal power source outages and/or fluctuations. Timing begins when the emergency power source becomes available. It does not affect initiation of the engine start circuit. Should the normal power source fail, the engine start contact will immediately close, and if connected to the engine generator, will initiate an engine start-up. The timer is user adjustable from 0 to 1800 seconds. **This feature can be programmed using the membrane switch. See section 7.3 for further details on settings.**

Standard Feature 2: Time Delay Engine Start (TDES)

This feature is used only where the emergency power source is an engine generator. It delays initiation of the engine start circuit in order to override momentary normal power source outages and/or fluctuations. It does not affect the transfer switch's ability to transfer from the normal power source to the emergency power source. The timer is user adjustable from 0 to 120 seconds. **This feature can be programmed using the membrane switch. See section 7.3 for further details on settings.**

Standard Feature 3: Time Delay Emergency to Normal (TDEN)

This feature delays the transfer from the emergency power source to the normal power source in order to allow for stabilization of the normal power source before the transfer is initiated. Timing begins when the normal power source becomes available. If the emergency power source fails during, the time delay is overridden and an immediate transfer to the normal power source will occur. The timer is user adjustable from 0 to 1800 seconds. **This feature can be programmed using the membrane switch. See section 7.3 for further details on settings.**

Standard Feature 4: Time Delay for Engine Cool-Off (TDEC)

This feature enables the generator to run under a no-load condition after transfer to the normal power source has been made. Timing begins immediately after the transfer has been made. The timer is user adjustable from 0 to 1800 seconds. **This feature can be programmed using the membrane switch. See section 7.3 for further details on settings.**

Standard Feature 5B/5J: All Phase Undervoltage/Underfrequency Sensing

The controller monitors the voltage of each phase of the emergency/standby power source. Frequency is also monitored. User adjustable dropout and pickup settings are provided.

Standard Feature 7: Time Delay Emergency Failure (TDEF)

This feature delays the unnecessary retransfer to the normal source during any test of the emergency source due to dips in voltage and/or frequency upon initial loading or changing loads during an emergency source test. Timing begins when the emergency source voltage and/or frequency fall outside of the programmed setpoints. If the voltage and/or frequency return to their designated ranges before the TDEF times out, the test will continue unmolested. If the controller times out, the transfer switch will transfer to the normal source if the normal source is available. The timer is user adjustable from 0 to 6 seconds. **This feature can be programmed using the membrane switch. See section 7.3 for further details on settings.**

Standard Feature 12C: Normal Connected (Green)

Indicates that the transfer switch is connected to the normal source.

Standard Feature 12D: Emergency Connected (Red)

Indicates that the transfer switch is connected to the emergency source.

Standard Feature 12G: Normal Available (Amber)

Indicates that the normal source is available and the voltage and frequency are within the programmed parameters.

Standard Feature 12H: Normal Available (Amber)

Indicates that the emergency source is available and the voltage and frequency are within the programmed parameters.

Standard Feature 14C: Normal Power Source Auxiliary Relay Contacts

This feature provides four NO and four NC contacts. The relay is energized only when the normal power source is available. This feature is labeled NRA.

Standard Feature 14D: Emergency Power Source Auxiliary Relay Contacts

This feature provides four NO and four NC contacts. The relay is energized only when the emergency power

source is available. This feature is labeled ERA.

Standard Feature 26: Normal Source Undervoltage Sensing

All phase undervoltage sensing is standard. The controller monitors each phase of the normal power supply, and is factory set at 80% dropout and 90% pick-up. These values are programmable using the membrane switch and may be adjusted from 50% to 97% of nominal.

Standard Feature 26D: Go To Emergency

This feature provides two terminal blocks for connection of a customer provided normally opened (NO) contact. When the NO contact is closed, the transfer switch initiates an engine start and will transfer the load to the emergency power source. Reopening of the NO contact will initiate a retransfer back to the normal power source.

Standard Feature 32A: Time Delay Neutral

This feature provides a time delay in the neutral (both OFF) position when the load is transferred in either direction to prevent excessive in rush currents due to out-of-phase switching of large motor loads. This timer utilizes a normally open auxiliary contact from each molded case switch. Adjustment is from 0 to 120 seconds. This value can be changed using the membrane switch located on the enclosure door.

Optional Feature 5C/5K: All Phase Overvoltage/Overfrequency Sensing

The controller monitors the voltage of each phase of the emergency/standby power source. Frequency is also monitored. User adjustable dropout and pickup settings are provided.

Optional Feature 16: Integral Overcurrent Protection

Use of this feature can , in many cases, eliminate the need for separate upstream, overcurrent/short circuit protection and provide significant material, labor, and space savings over other system layouts. In addition to overcurrent protection, for safety purposes, selection of this optional accessory also includes a lock-out function that prevents further automatic transfer operation until the appropriate source is manually reset. **(Note: Supplied with feature 37A).**

Optional Feature 16B: Provides overcurrent protection on both power source supplies.

Optional Feature 16N: Provides overcurrent protection on the normal power source only.

Optional Feature 23J: Load/No Load Plant Exerciser

This feature allows for automatic testing of the generator at least once a week. Both load and no load testing can be selected. If the generator fails while in a load test and the TDEF is set to 0 seconds, the transfer switch will return to the normal power source automatically. The plant exerciser may be programmed using the membrane switch located on the enclosure door. This exerciser can be programmed to run on any day of the week and at any hour of the day.

Optional Feature 26C: Normal Source Overvoltage Sensing

The controller monitors each phase of the normal power supply. User adjustable dropout and pickup settings are provided.

Optional Feature 26E: Normal Source Underfrequency Sensing

The controller constantly monitors the frequency of the Normal Source. User adjustable dropout and pickup settings are provided.

Optional Feature 26C: Normal Source Overvoltage Sensing

The controller monitors each phase of the normal power supply. User adjustable dropout and pickup settings are provided.

Optional Feature 26E: Normal Source Underfrequency Sensing

The controller constantly monitors the frequency of the Normal Source. User adjustable dropout and pickup settings are provided.

Optional Feature 26F: Normal Source Overfrequency Sensing

The controller constantly monitors the frequency of the Normal Source. User adjustable dropout and pickup settings are provided.

Optional Feature 37A: Service Equipment Rating

Provides transfer switch as suitable for service equipment rating. A key operated selector switch permits external power-operated service disconnection with external pilot light for disconnect indication. **(Requires feature 16).**

Optional Feature 41A: Space Heater

This feature provides a thermostatically controlled 100W

space heater to combat accumulation of moisture in the enclosure.

3.5 ENCLOSURE

The rugged steel switch enclosure is supplied with three door hinges, regardless of enclosure size, this ensures proper support of the door and door mounted devices (Figures **3-5** and **4-1**). The hinges have removable hinge pins to facilitate door removal. Certain procedures, such as switch mounting, are simplified with the door removed. The doors are supplied as standard with a key-lockable handle.

The door is used to mount a variety of lights, switches and push-buttons, depending upon the options required for a particular switch. All switch doors are supplied with a metal accessory panel. All lights and switches are mounted in the metal door-mounted panel.

The rear of the enclosure is supplied with teardrop shaped holes in the top and bottom mounting flanges to facilitate mounting. It is also supplied with two positioning bolts and various pre-tapped inserts to insure proper positioning of the power panel anytime the power panel must be repositioned to accommodate a different cable entry position. Cable entry holes are the responsibility of the customer.

Transfer switch enclosures and all internal steel mounting plates, such as the power panel mounting plate, go through a pretreatment cleaning system prior to painting to ensure a durable finish.

The standard switch enclosure is NEMA Type 1.

3.6 STANDARDS

Cutler-Hammer transfer switch equipment enclosed in a NEMA Type 1, 3R, or 12 enclosure is UL and CSA listed. In addition, Cutler-Hammer automatic transfer switches are listed in File E38116 by Underwriters Laboratories, Inc. under Standard UL 1008. This standard covers requirements for automatic transfer switches intended for use in ordinary locations to provide lighting and power as follows:

a. In emergency systems, in accordance with articles 517 and 700 in the National Electrical Code, ANSI/NFPA 70 and the National Fire Protection Association No. 76A and/or

b. In standby systems, in accordance with article 702 of the National Electrical Code and/or

c. In legally required standby systems in accordance with article 701 of the National Electrical Code.

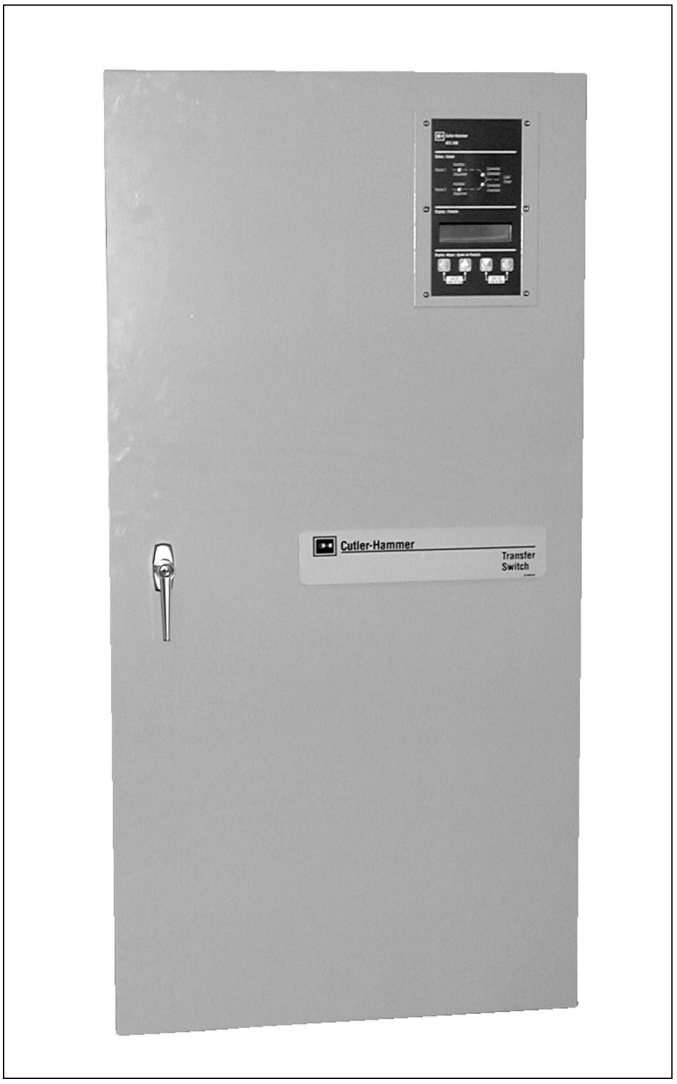

Figure 3-5 Typical Type 3R Enclosure (Door)

Cutler-Hammer automatic transfer switches are available to meet NFPA110 for emergency and standby power systems, and NFPA99 for health care facilities when ordered with the appropriate options.

Cutler-Hammer automatic transfer switches use specially designed molded case switches as the main power switching contacts.

SECTION 4: INSTALLATION AND WIRING

4.1 GENERAL

Transfer switches are factory wired and tested. Installation requires solidly mounting the enclosed unit and connecting power cables and auxiliary pilot circuits. Physical mounting procedures and power cable connections are covered in this section. All other required wiring or electrical connection references are covered in a separate Customer Wiring Booklet packed with the transfer switch. Locate the wiring booklet, review it, and keep it readily available for reference purposes during installation and testing. Once a transfer switch is properly installed and wired, it should be mechanically and electrically checked for proper installation and operation. The procedures for these initial mechanical and electrical checks are outlined in Section 6 of this instruction manual.

NOTICE

To facilitate the procedures described in this section, the solid steel shield over the power panel should be removed. The shield is attached to the ratchet assembly with four screws. Remove the four screws and shield until the procedures are completed.

WARNING

BE CERTAIN THAT THE SOLID STEEL POWER PANEL SHIELD IS PROPERLY INSTALLED BEFORE TRANSFER SWITCH EQUIPMENT IS PUT INTO SERVICE.THE SHIELD PROVIDES PROTECTION FROM DANGEROUS VOLTAGES AT THE LINE AND LOAD TERMINALS WHEN THE EQUIPMENT IS IN OPERATION. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR DEATH.

4.2 MOUNTING LOCATION

Choose a location that offers a flat, rigid mounting surface capable of supporting the weight of the enclosed transfer switch equipment (Figures 4.1). Avoid locations that are moist, hot, or dusty, however, there are enclosure designs available for special environments. If there are any doubts as to location suitability, discuss them with your Cutler-Hammer representative.

Check to make certain that there are no pipes, wires, or other mounting hazards in the immediate mounting area that could create a problem.

Carefully remove all packing material from the transfer switch at the mounting location. Even though an equipment inspection was made when the equipment was received, make another careful inspection of the enclosure and the enclosed transfer switch as packing material is removed and the enclosure readied for mounting. Be especially alert for distorted metal, loose wires or damaged components.

4.3 MOUNTING PROCEDURE

CAUTION

SINCE THE ENCLOSED TRANSFER SWITCH MUST BE LIFTED INTO PLACE FOR MOUNTING, BE CERTAIN THAT ADEQUATE RESOURCES ARE AVAILABLE FOR LIFTING TO AVOID PERSONNEL INJURIES OR EQUIPMENT DAMAGE.

Refer to Figures 4.1 for enclosure and power panel mounting dimension references. All vertical design transfer switch equipment enclosures and power panels are of the same design. Only the overall physical dimensions change. Note in Figure 4.1 that the enclosure is provided with four elongated mounting holes, two in the top mounting flange and two in the bottom. Also notice that the power panel has two sets of mounting holes. One set positions the panel for top entry of cables and one set for bottom entry. This will be covered in more detail in Section 4.4

Transfer switch equipment is assembled and supplied as standard for top entry, although equally adaptable to bottom entry. Cable entry holes are not part of the enclosure when shipped from the factory and must be provided in the field, either before or after mounting the enclosure.

CAUTION

EXTREME CARE SHOULD BE TAKEN TO PROTECT THE TRANSFER SWITCH FROM DRILL CHIPS, FILINGS AND OTHER CONTAMINANTS WHEN MAKING THE CABLE ENTRY HOLES AND MOUNTING THE ENCLOSURE TO PREVENT COMPONENT DAMAGE OR A FUTURE MALFUNCTION.

Power Panel Type	A	B	C	Weights
FD 30-200A	36" (.91m)	21" (0.53m)	10" (.5m)	195 lbs (88kg)
KD 300A	56" (1.35m)	21" (0.53m)	19.63" (0.50m)	380 lbs (172kg)
LD 400A	53" (1.35m)	26" (0.66m)	20.63" (0.52m)	430 lbs (195kg)
LD 400A (optional)	64" (1.63m)	26" (0.66m)	20.63" (0.52m)	430 lbs (195kg)
LD 600A	64" (1.63m)	26" (0.66m)	20.63" (0.52m)	430 lbs (195kg)
NB 800A	78" (1.99m)	26"(0.66m)	20.63" (0.52m)	610 lbs. (275kg)
NB 1000A	78" (1.99m)	26"(0.66m)	20.63" (0.52m)	610 lbs. (275kg)

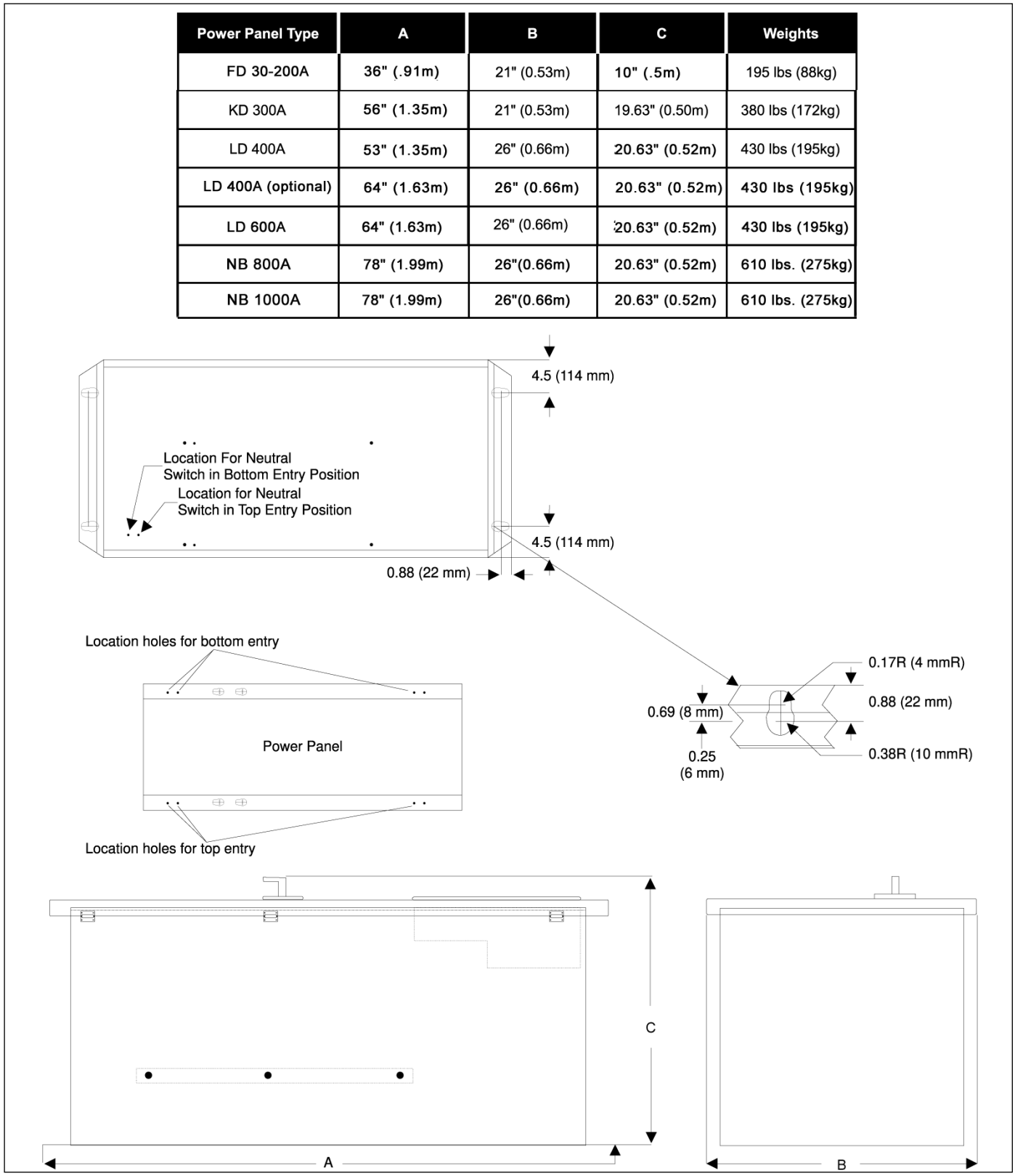

Figure 4-1 DImensions of Enclosed Automatic Transfer Switch and Approximate Weights

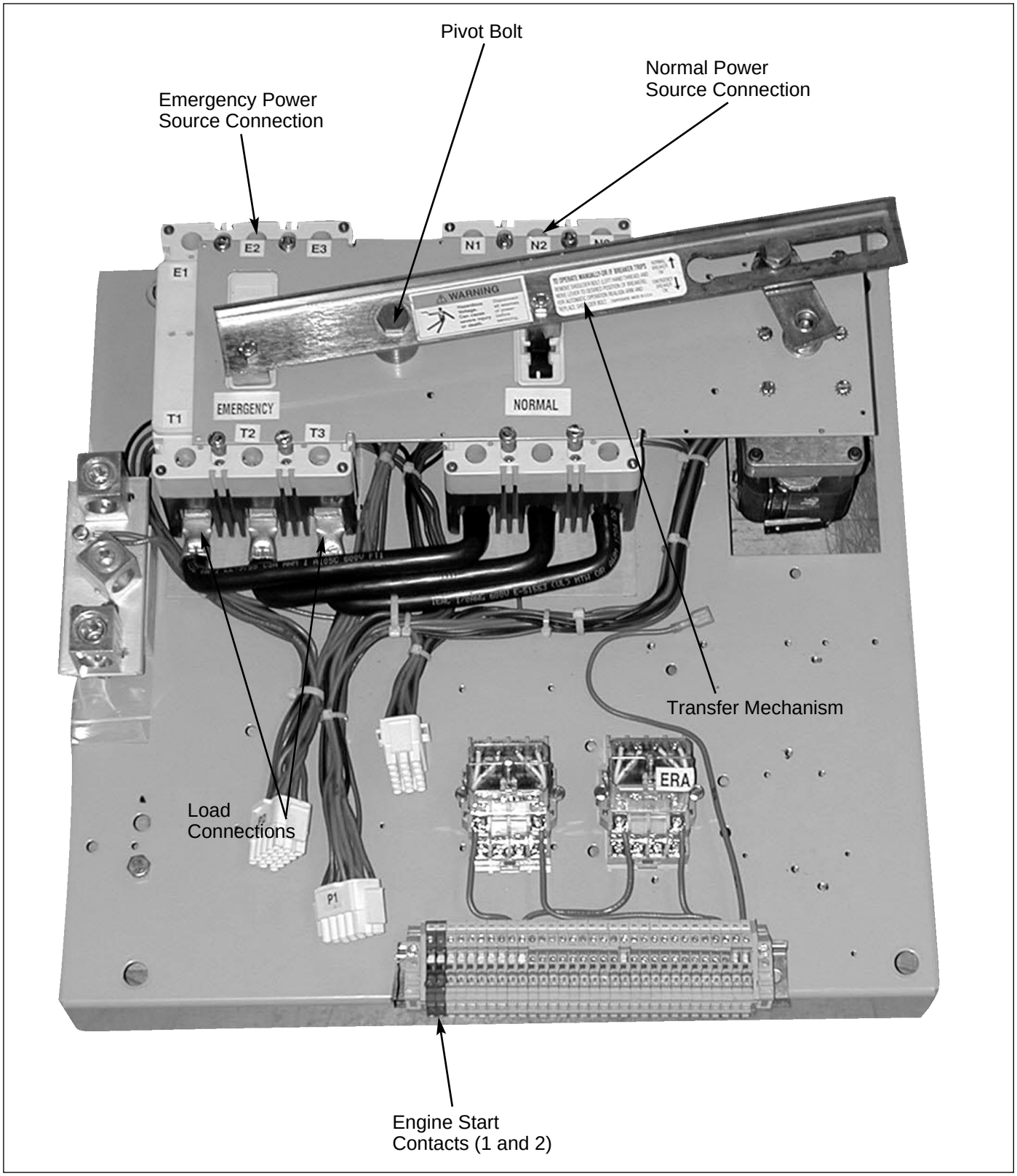

Figure 4-2 Automatic Transfer Switch Power Panel (100A Model)

With the enclosed transfer switch equipment unpacked and ready for mounting, proceed with these steps:

Step 1: The transfer switch enclosure door is hinge mounted with removable hinge pins. To simplify the mounting procedure and avoid damaging the door-mounted logic panel, carefully remove the door and put it in a safe place until mounting is complete.

Step 2: Install required mounting bolt anchors and the two upper mounting bolts in the mounting surface.

Step 3: Gently lift the enclosure and guide the elongated holes in the upper mounting flange over the upper mounting bolts, but do not completely tighten the bolts.

Step 4: While still supporting the enclosure, install the two lower mounting bolts in the lower mounting flange, but do not completely tighten. Use shims, if required, to prevent deformation of the enclosure when the mounting surface is distorted.

Step 5: Tighten all four mounting bolts after any required shimming is completed.

Step 6: Double check to ensure that all packing and shipping material has been removed.

4.4 LOAD LUG LOCATION

This section applies only to the 300A-1000A switches. The load lugs for the 30-200A switch are fixed.

Transfer switch equipment is supplied as standard from the factory with load terminal lugs at the top. If the load lugs are to be repositioned to the bottom, do it at this time before wiring the unit or making power cable connections.

⚠ WARNING

IF THE LOAD LUG LOCATION IS BEING CHANGED ON ALREADY INSTALLED TRANSFER SWITCH EQUIPMENT, MAKE SURE THAT THE NORMAL, EMERGENCY AND OTHER POWER SOURCES CONNECTED TO THE EQUIPMENT ARE DE-ENERGIZED. HAZARDOUS VOLTAGES ARE PRESENT INSIDE TRANSFER SWITCH EQUIPMENT AND CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

With the solid steel shield removed, proceed with the following steps for bottom feed load termination.

Step 1: Disconnect the power panel from the rest of the transfer switch by unplugging the connector plugs (P1, P2, and P3) (Figures **1-2**).

Step 2: Remove the bolt that bonds the neutral strap to the rear of the enclosure, if it is in place.

Step 3: Remove the four bolts that secure the power panel in the enclosure. Depending upon the size of the panel, it may be advisable to have assistance with the removal. Once the power panel is free, carefully move it to a solid work surface (Figure **3-1**).

NOTICE

At this point, take the time to refer to Figure 4-1 and become familiar with the inside rear of the enclosure and the power panel mounting provisions available for both top and bottom entry. It will facilitate reinstallation of the power panel.

Step 4: Remove the operating mechanism from the front of the power panel by removing the six bolts holding the mechanism in position. The molded case switches or optional circuit breakers do not have to be removed (Figure **3-3**).

NOTICE

The rear-mounted load lugs, dip-insulated bus bars, standoff insulators, glass polyester phase barriers, and metal mounting bracket are designed to be removed as one load lug assembly (Figure 4-3).

Step 5: The load lug assembly, just mentioned, is removed by first removing the six or eight bolts securing the pieces of insulated bus to the back of the power panel. The number of mounting bolts depends upon whether 2- or 3-pole devices are installed. Mounting bolts are accessed through holes in the load end of the molded case switches or optional circuit breakers.

Step 6: Next, remove the four bolts holding the mounting bracket to the upper rear portion of the power panel. The load lug assembly can now be removed as one unit. Note that there are

grooves in the back of the power panel and in the mounting bracket that keep the polyester phase barriers in their proper positions.

Step 7: Turn the load lug assembly 180° with the lugs at the bottom and remount the assembly by reversing the procedures described in Steps 5 and 6. The mounting bracket will now be bolted to the bottom of the power panel. Make certain that all glass polyester phase barriers are in place and positioned properly in the grooves provided. When making any bolted connection to the bus, comply with the torque requirements as outlined in Table **4.1**.

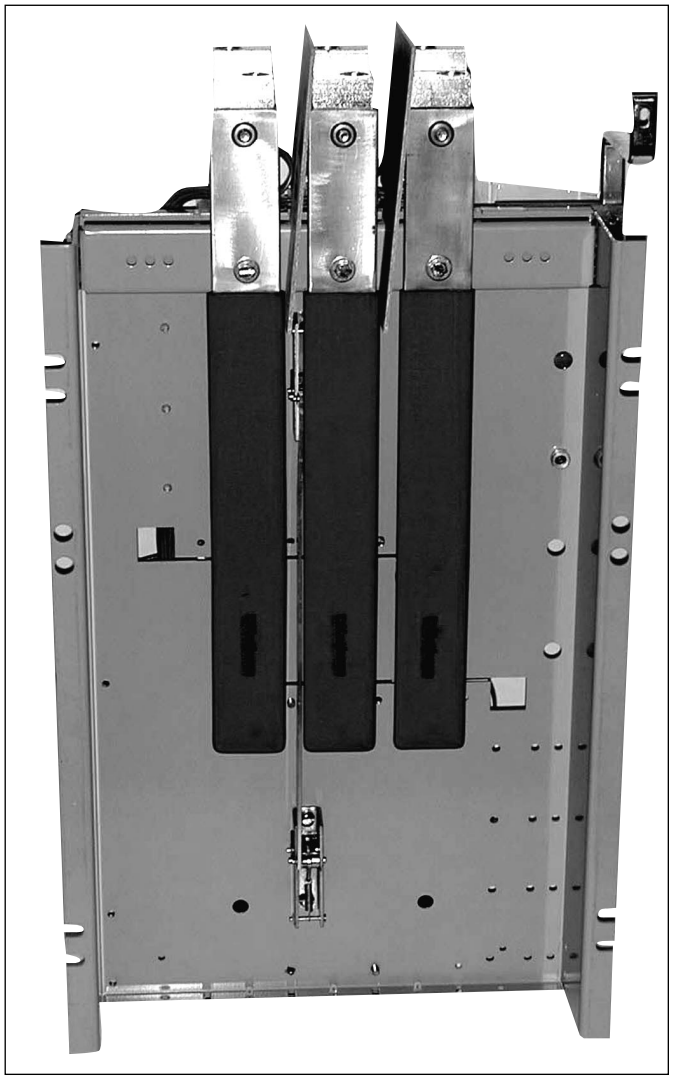

Figure 4-3 Mounted Load Lug Assembly (225-1000A Models)

Table 4.1 Bolted Bus Connection Torque Requirements

Power Panel Switching Device	Torque ft-lb (Nm)
Type FD	10 (14)
Type KD	20 (27)
Type LD	25 (34)
Type NB	25 (34)

Step 8: Remount the operating mechanism to the front of the power panel with the six bolts removed previously in Step 4.

Step 9: Position the power panel in the enclosure such that the two upper elongated holes, one on either side of the power panel, fit over the two positioning bolts located in the rear of the enclosure. This will line up the four correct mounting holes in the power panel with the pre-tapped inserts in the rear of the enclosure.

Step 10: With the power panel held securely against the back of the enclosure, replace and tighten the four mounting bolts removed previously in Step 3.

Step 11: Attach the neutral strap to the back of the enclosure through the upper bonding hole, which may or may not have been previously removed in Step 2.

Step 12: Reconnect the connector plugs and the transfer switch equipment is now configured for bottom entry.

4.5 POWER CABLE CONNECTIONS

WARNING

POWER CONDUCTORS MAY HAVE VOLTAGE PRESENT THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. DE-ENERGIZE ALL POWER OR CONTROL CIRCUIT CONDUCTORS TO BE CONNECTED TO THE TRANSFER SWITCH EQUIPMENT BEFORE BEGINNING TO WORK WITH THE CONDUCTORS AND/OR TERMINATING THEM TO THE EQUIPMENT.

CAUTION

USE OF CABLE LUGS NOT DESIGNED FOR THE TRANSFER SWITCH MAY CAUSE HEATING PROBLEMS. BREAKER LUGS ONLY MOUNT TO THE BREAKER,WHILE TRANSFER SWITCH LUGS MOUNT TO BOTH THE BREAKER AND THE BUS BAR BEHIND THE BREAKER. FOR INSTALLATION INSTRUCTIONS, REFER TO THE INSTRUCTION LEAFLET SUPPLIED FOR THE SPECIFIC LUGS.

CAUTION

TO HELP PREVENT COMPONENT DAMAGE OR FUTURE MALFUNCTIONS, USE EXTREME CARE TO KEEP CONTAMINANTS OUT OF THE TRANSFER SWITCH EQUIPMENT WHEN MAKING POWER CABLE CONNECTIONS.

CAUTION

RUN POWER CABLE THROUGH THE GUTTER SPACE PROVIDED TO THE RIGHT OF POWER PANEL. DO NOT ROUTE THE POWER CABLES BEHIND OR TO THE LEFT OF THE POWER PANEL. RUNNING THE CABLES BEHIND OR TO THE LEFT OF THE POWER PANEL COULD INTERFERE WITH THE PROPER OPERATION OF THE TRANSFER SWITCH.

Test all power cables prior to connection to the unit to ensure that conductors or cable insulation have not been damaged while being pulled into position.

Power cables are to be connected to solderless screw type lugs located on the transfer switch switching devices. Refer to the separate Customer Wiring Booklet supplied with the transfer switch equipment for power termination Verify that the lugs supplied will accommodate the power cables being used. Also verify that the cables comply with local electrical codes. Standard transfer switch equipment, as supplied from the factory, will accommodate the wire sizes shown in Table **4.2**.

Carefully strip insulation from the power cables to avoid nicking or ringing of the conductor strands. Prepare the stripped conductor termination end by cleaning it with a wire brush. If aluminum conductors are used, apply an appropriate joint compound to the clean conductor surface area.

Table 4.2 Transfer Switch Equipment Wire Sizes

Transfer Switch Ampere Rating	Wire Size Ranges	Number of Cables per Phase
30-100	#14-3/0	1
150-200	#6-300MCM	1
300	#3-350MCM	1
400	#3-350MCM	2
400 (optional)	#1-500MCM	2
600	#1-500MCM	2
800	3/0-400MCM	3
1000	4/0-500MCM	4

CAUTION

IMPROPER POWER CABLE CONNECTIONS CAN CAUSE EXCESSIVE HEAT AND SUBSEQUENT EQUIPMENT FAILURE.

Tighten cable lugs to the torque identified on the label affixed to the unit immediately adjacent to the lugs.

4.6 WIRING

WARNING

POWER CONDUCTORS AND CONTROL WIRING MAY HAVE VOLTAGE PRESENT THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. DE-ENERGIZE ALL POWER OR CONTROL CIRCUIT CONDUCTORS BEFORE BEGINNING TO PERFORM ANY WIRING ACTIVITY TO OR WITHIN THE TRANSFER SWITCH EQUIPMENT.

Power sources, load conductors and control wiring should be connected to locations as indicated in the Customer Wiring Booklet supplied with the transfer switch equipment.

CAUTION

CHECK THE TRANSFER SWITCH EQUIPMENT NAMEPLATE FOR RATED VOLTAGE. IT SHOULD BE THE SAME AS THE NORMAL AND EMERGENCY LINE VOLTAGES. OPERATING THE EQUIPMENT ON IMPROPER VOLTAGE CAN CAUSE EQUIPMENT DAMAGE.

Once the transfer switch equipment has been installed and wired, perform initial mechanical and electrical procedures as outlined in Section 6 to verify that the equipment is installed and operating properly.

NOTICE

Remember to reattach the solid steel power panel shield to the ratchet assembly after completing any of the procedures described in this section.

4.7 ENGINE START CONNECTION

The engine control contact connections are located on the logic panel of the ATS. Connect the engine start wires to the colored terminal blocks marked 1 and 2. A contact closes between these terminal blocks when an engine start signal is provided by the ATS logic. The wiring diagram provides additional engine start connection information.

NOTICE

Prior to making the engine start connection to the switch, set the engine generator controls selector switch in the OFF position to prevent an unwanted engine start.

4.8 ADDITIONAL IMPORTANT INSTALLATION INSTRUCTIONS

⚠ CAUTION

IT IS IMPORTANT, AS APPLICABLE, TO BE AWARE OF AND FOLLOW THE ADDITIONAL INSTRUCTIONS PRESENTED HERE WHEN INSTALLING THE EQUIPMENT. FAILURE TO DO SO COULD RESULT IN EQUIPMENT DAMAGE AND/OR IMPROPER OPERATION.

Importance of Proper Bonding and Grounding of the Neutral

Your Cutler-Hammer Transfer Switch uses the neutral as a reference for deriving control power to operate the transfer switch. Failure to connect the Transfer Switch Neutral in the power system properly can result in equipment damage, or damage and improper operation of the transfer switch.

Proper grounding and bonding of the neutral is covered in Article 250 of NFPA 70. Generally this will involve the following if the Transfer Switch is applied as Service Equipment:

1. The Neutral MUST be grounded to a system ground, which may be an 8 foot long ground rod driven in the ground near the transfer switch. Other grounding means may be acceptable/necessary.

2. The neutral must be bonded (using the supplied bonding jumper) to the Transfer Switch enclosure.

A Green grounding stud is supplied at the bottom of the enclosure. The stud can be used to bond the enclosure to a system ground or other grounding means.

Feature 32 TDN (Time Delay Neutral)

In facilities where the typical load consists of fans, well pumps, fluorescent lighting and feeding equipment, it is EXTREMELY important that Option 32 (Time Delay Neutral) is properly applied.

Motors disconnected from a source, become generators of electricity. If a new source of power is immediately connected, and this new source is "out-of-phase" with the voltage being generated by the motors, then inrush currents will be MUCH higher than normal starting currents for those motors.

It is important that the TDN timer (which is optional on the Cutler-Hammer Transfer Switch) be set to allow adequate time for regenerative voltages to decay. This allows the EMF created when motors are disconnected from their source to decay BEFORE connecting another source. This helps prevent several potential problems from occurring: (1) Excessive inrush currents caused by an out-of-phase connection. (2) Excessive starting loads on the generator, which causes the system voltage to "sag". (3) High switching transients, and imbalanced currents on the system.

Failure to use this timer feature can result in damage to equipment, or unnecessary tripping of circuit protective devices.

SECTION 5: OPERATION

5.1 GENERAL

A transfer switch provides main contacts to connect and disconnect the load to and from the normal and emergency power sources (Paragraph 3.2.2). Each transfer mechanism provides the mechanical motion required to open and close the mechanically interlocked main contacts (Paragraph 3.2.3).

Note that the transfer mechanisms for the two types of ATS described in this booklet (30-200A and 225-1000A) are different for both the manual and automatic modes.

NOTICE

If a transfer switch with any type of electrical operating capabilities is to be operated utilizing the manual operating handle, it is strongly recommended that the transfer motor circuit first be isolated. This is accomplished by unplugging the (P3) plug marked motor disconnect (Figure 1-2). Any attempt to operate the manual handle without first isolating the motor circuit may cause an automatic transfer.

5.2 MANUAL OPERATION (225-1000A)

The manual operating handle can be used to create the rotational motion required to open and close the main contacts through a rigid mechanical interlocking system (Figure **5-1**). An indicator wheel attached to the operating handle and mechanical interlocking system rotates with each movement of the handle to open and/or close the main contacts (Figures **5-2**). Three distinct switch positions are provided and indicated visually on the indicator wheel (Figure **5-3**). The three distinct switch positions or contact conditions are:

- **Normal -** The contacts associated with the normal power source are closed and the emergency power source contacts are open.
- **Neutral -** The contacts associated with both the normal power source and emergency power source are open. This position allows for load circuit maintenance.
- **Emergency -** The contacts associated with the normal power source are open and the emergency power source contacts are closed.

Figure 5-1 Transfer Switch Manual Operating Handle in Use (225-1000A Models)

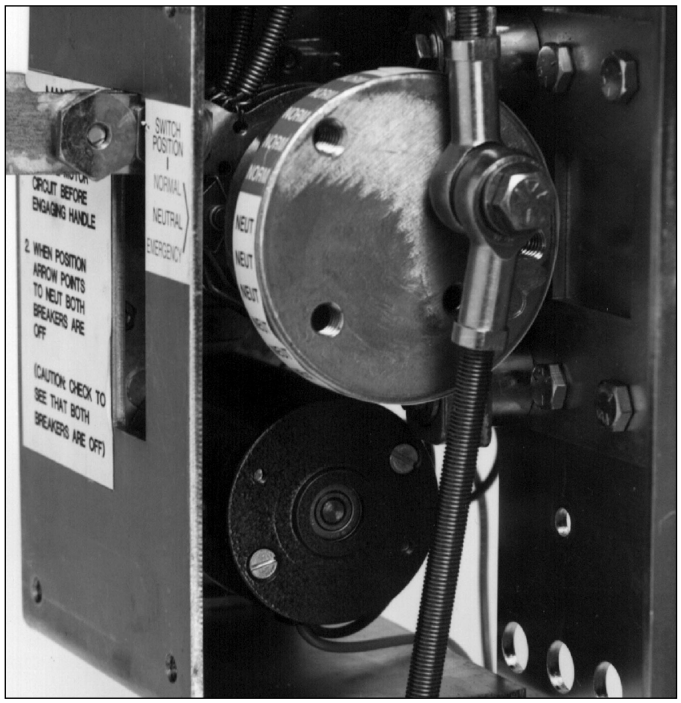

Figure 5-2 Indicator Wheel Mounted in the Switch with Motor Under the Wheel (225-1000A Models)

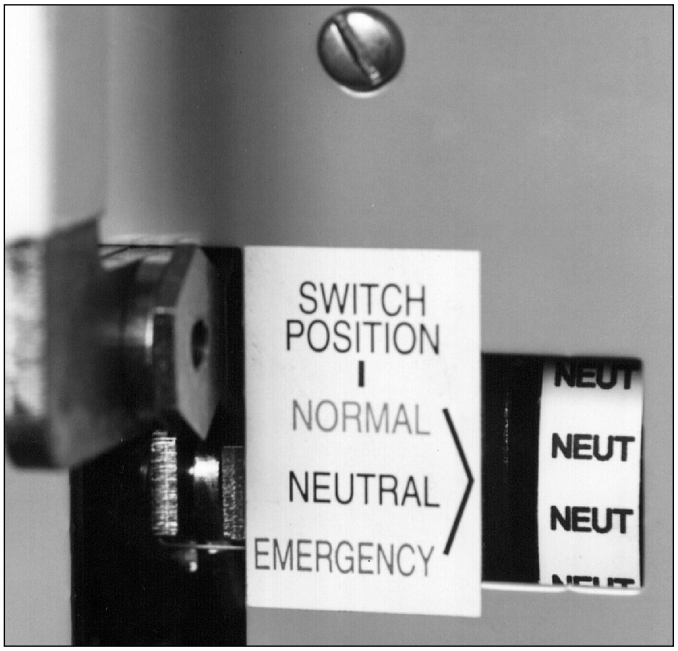

Figure 5-3 Indicator Wheel in Neutral Position (225-1000A Models)

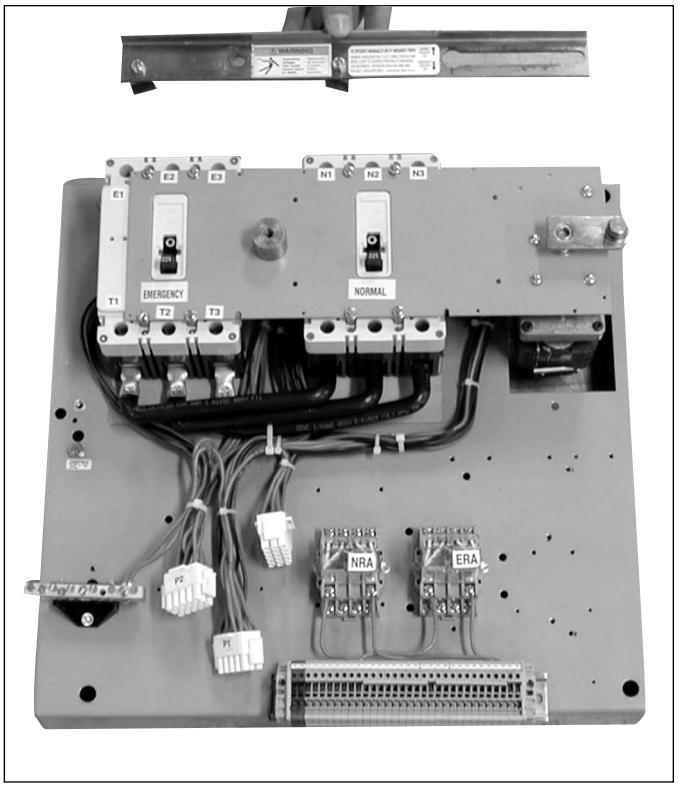

Figure 5-4 Transfer Mechanism with Lever Removed (30-200A Model)

To manually operate the transfer switch, the operating handle is ratcheted until the desired switch position is indicated on the indicator wheel. The operating handle, no matter what design or type of switch operation, is always electrically "dead" and the indicator wheel free-wheels should a particular switch have a motor and be capable of electrical operation. This feature ensures no operator problems should the switch automatically operate while the manual handle is being used.

5.3 MANUAL OPERATION (30-200A)

To operate the switch manually, remove the pivot bolt (located between the two switches (Figure **4-2**) using a 5/8-inch wrench or socket. Lift the lever off the two switches (Figure **5-4**), which can then be operated manually (Figure **5-5**). The switches are mechanically interlocked so that only one can be in the ON position at any one time, but both can be in the OFF position at the same time.

5.4 AUTOMATIC TRANSFER

The operating sequence of an automatic transfer switch is dictated by the switch's standard features and selected options. Operation of an automatic transfer switch during normal source failure and normal source restoration will be described here with only standard options included on the switch. Additional options, as described in Section 3, can change sequences and timing, depending upon the options selected. Become familiar with additional options selected and their effect on the normal operation of an automatic transfer switch.

5.4.1 NORMAL POWER SOURCE FAILURE

Standard normal source failure is defined as a reduction or loss of voltage. If this occurs, the sequence of operation is as follows:

- Failure of the normal source is detected by the microprocessor intelligence.
- When the microprocessor detects a failure, the normal relay drops out, opening certain contacts while closing others. One of the contacts starts the engine-driven generator.
- When the emergency source voltage reaches its operation rating, an emergency relay closes, starting the transfer operation. This operating sequence opens the normal switch and closes the emergency switch.
- The load is now transferred to emergency source.

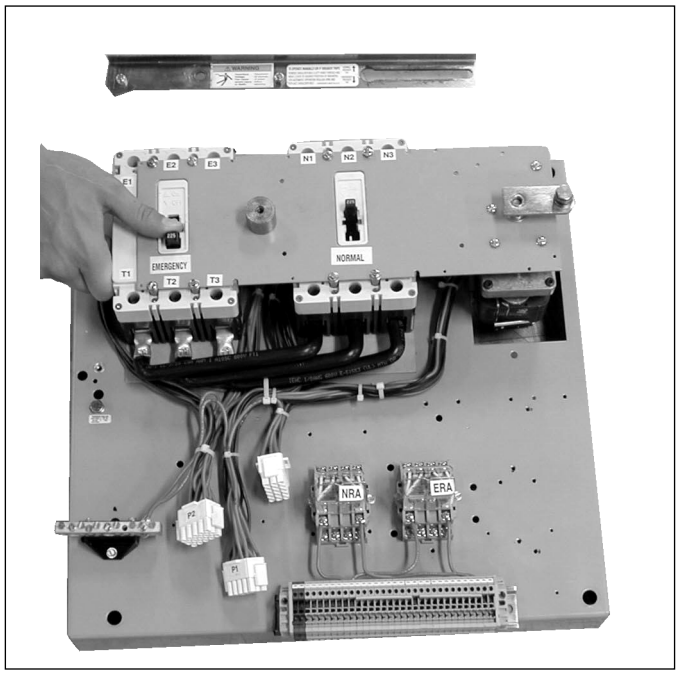

Figure 5-5 Switch Being Manually Operated (30-200A Model)

5.4.2 NORMAL POWER SOURCE RESTORATION

- A return to the normal power source begins when the voltage in all phases of a three-phase sensing unit or phase-to-phase in a single sensing unit is restored to a preset value.
- At the preset voltage, the microprocessor will cause the normal relay to pickup.
- The normal relay closes certain contacts while opening others. This starts the return to the normal power source and normal transfer switch operation.
- During this sequence, the emergency power source switch is opened and the normal power source switch is closed.
- Simultaneously, the engine cool-down relay initiates the shut down of the engine driven generator.
- Transfer of the load back to the normal power source is now complete.

SECTION 6: TESTING AND PROBLEM SOLVING

6.1 TESTING

After the transfer switch equipment is initially installed or during planned outages, the installation should be tested to ensure that all equipment operates properly. This attention to detail will help to avoid unexpected malfunctions. Mechanical and/or electrical tests should be performed as described in this section.

The frequency of subsequent testing should be based on recommendations of the generator set manufacturer. Use the test buttons to check the electrical operation of the switch.

WARNING

HIGH VOLTAGES ASSOCIATED WITH OPERATIONAL TRANSFER SWITCH EQUIPMENT PRESENT A SHOCK HAZARD THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION TO AVOID TOUCHING ELECTRICAL CONNECTIONS WHENEVER INSPECTING OR TESTING THE EQUIPMENT.

IN ADDITION, IMPROPER OPERATION OF THE GENERATOR SET PRESENTS A HAZARD THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. OBSERVE ALL SAFETY PRECAUTIONS IN YOUR GENERATOR SET OPERATIONS AND INSTALLATION MANUALS.

6.1.1 MECHANICAL AND/OR ELECTRICAL TESTING

NOTICE

Since Option 4 (Time Delay Engine Cool-Off) as described in Section 3 is standard, an engine start signal will be present for a period of time when the switch is first energized. The period of time is equal to the timer setting. To avoid starting the engine during this time period, turn the generator controls to the OFF position.

Energize the transfer switch equipment as described in Paragraphs 6.1.2 through 6.1.6. Insure that all safety precautions are taken and that all WARNINGS and CAUTIONS are observed.

6.1.2 NO VOLTAGE STEPS

With no voltage available on either power source, proceed as follows:

Step 1: Check to make sure that both the normal and emergency power switching devices are in the OPEN position. The switching devices can be put into the OPEN position by use of the manual operator and stopping in the NEUTRAL position.

Step 2 The generator engine start controls should be in the OFF position to prevent an undesired start.

Step 3 All timing circuits are factory set per I.B. ATS-AT201. They can be changed upon energization by following the instructions in I.B. ATS-AT201.

Step 4 Check all transfer switch loads to ensure that they are ready to be energized.

6.1.3 CONNECTING POWER SOURCES

Step 1: Close the normal power source upstream protection device.

a) The normal power switching device should close.

Step 2: Connect the engine start battery cable.

Step 3: With the emergency generator in the OFF position close the emergency power source upstream protective device, assuming such a device used.

NOTICE

At this point and prior to making any attempt to energize the transfer switch equipment, the engine-driven generator should be operated. If necessary, the voltage regulator on the generator should be adjusted according to the manufacturer's recommendations. The automatic transfer switch equipment will respond only to the rated voltage and frequency indicated. on the switch rating nameplate.

Step 4: Reclose any generator engine-start controls opened as a result of actions taken in Step 4, Paragraph 6.1.2

Step 5: Where required, use an accurate voltmeter to check phase-to-phase and phase-to-neutral voltages present at the transfer switch normal, emergency, and/or load terminals.

6.1.4 OPERATIONAL CHECKS

Step 1: Check to ensure that the normal switching device is in the CLOSED position. This should have been done in Step 1a Paragraph 6.1.3.

Step 2: Initiate an automatic transfer operation from the normal to emergency power source

Step 3: Initiate an automatic transfer operation back to the normal power source

a) After the Time Delay Emergency to Normal timer (TDEN) and Time Delay Neutral Timer (TDN) have timed out, the transfer switch will transfer back to the normal power source (emergency switching device opens and normal switching device closes).

b) The Time Delay for Engine Cool-Off (TDEC) option will allow the engine to run unloaded for a preset time after transfer to normal power source is completed.

6.1.5 ALTERNATE TESTS

1. Alternate operational tests may be possible depending upon the options provided with any given transfer switch. Refer to the schematic diagram provided with the transfer switch equipment along with the specification nameplate to determine the exact options provided.

2. If the transfer switch is operated manually with the normal power source connected and available, it will cycle back to normal power source, since it is the preferred source. The transfer switch is designed for safe manual transfer if an automatic transfer is initiated during the manual transfer.

6.2 PROBLEM SOLVING

WARNING

HAZARDOUS VOLTAGES IN AND AROUND TRANSFER SWITCH EQUIPMENT DURING THE PROBLEM SOLVING PROCESS CAN CAUSE PERSONAL INJURY AND/OR DEATH. AVOID CONTACT WITH ANY VOLTAGE SOURCE WHILE PROBLEM SOLVING.

WARNING

ONLY PROPERLY TRAINED PERSONNEL FAMILIAR WITH THE TRANSFER SWITCH EQUIPMENT AND ITS ASSOCIATED EQUIPMENT SHOULD BE PERMITTED TO PERFORM THE PROBLEM SOLVING FUNCTION. IF AN INDIVIDUAL DOES NOT FEEL QUALIFIED TO PERFORM THE PROBLEM SOLVING FUNCTION,THE INDIVIDUAL SHOULD NOT ATTEMPT TO ANY OF THESE PROCEDURES.

A basic problem-solving effort is the first step to take prior to calling for assistance. Frequently, the effort will successfully address most problems encountered. The problem solving procedure is presented in the following paragraphs as observed problem symptoms and one or more possible solution steps. Remember, only qualified individuals familiar with the transfer switch equipment and the system in which it is applied should attempt these problem solving procedures.

If a problem persists after having completed the problem-solving procedure, contact a Cutler-Hammer representative for further assistance. When calling for assistance, the following is the minimum information required to properly address the need:

1. General Order Number
2. Style Number of transfer switch
3. Catalog Number of transfer switch
4. Actual location of transfer switch (type of facility, address etc.)
5. Company name Name and position of individual representing company
6. Basic description of situation as it exists
7. Any results of problem solving steps taken and/or readings taken

6.2.1 TRANSFER SWITCH APPEARS INOPERATIVE (Display is blank)

Step 1: Verify that all plugs and sockets are properly interconnected

Step 2: Verify correct system voltage at the line side of the NORMAL switching device. See figure 1 for typical location.

Yes: See Step 3.
No: Troubleshoot upstream of ATS and repair circuit. Possible problems may be an open breaker or disconnect with, fuse or utility is not supplying power to site.

Step 3: Verify correct system voltage at plug J2 on the controller.

Yes: Replace controller
No: Troubleshoot wire harness from J2 on the controller to the line side of the NORMAL switching device.

Step 4: Is Generator running?
Yes: See Step 5.
No: See Step 7.

Step 5: Verify that there is proper system voltage and frequency available at the line side of the EMERGENCY switching device.

Yes: See Step 6.
No: Troubleshoot generator

Step 6: Verify correct system voltage and frequency at plug J3 on the controller.

Yes: Change controller
No: Troubleshoot wire harness from J3 on the controller to the line side of the EMERGENCY switching device.

Step 7: Verify good battery voltage.

Yes: Troubleshoot wiring between TB1-1 and J6-3 and TB1-2 and J6-2.
No: Replace battery.

6.2.2 TRANSFER SWITCH CONTINUES TO CYCLE AND TRANSFER SWITCH WILL NOT STOP IN POSITION

For Normal Position

Step 1: Disconnect Plug J1 on the Motor Break Board located next to the motor mechanism.

Step 2: Using the manual handle, ratchet the Transfer Switch into the Normal position. With an ohmmeter, verify continuity between pins P1-7 and P1-8.

Yes: See step 3.
No: Check for broken wire to Auxiliary switch. If no broken wires are found, replace auxiliary switch.

Step 3: Verify continuity between plug J10-1 and J10-6.

Yes: Replace controller.
No: Troubleshoot wire harness between J10-1 and J10-6 and repair.

Step 4: Repeat steps 1-3 after ratcheting to Emergency position. Use P2-7 an dP2-8 in Step 2.

6.2.3 TRANSFER SWITCH WILL NOT AUTOMATICALLY TRANSFER TO NORMAL

Step 1: See steps 1 through 3 of 6.2.1

Step 2: Verify that Option 26D is not in use.
Yes: See step 3.
No: Disable option 26D

Step 3: Verify correct system voltage and frequency at plug J2 on the controller.
Yes: Replace Motor

No: Without separating any plugs, verify 120 VAC at J6-6

Yes: Troubleshoot wire harness from J6 to J71
No: Verify continuity between TB1-21 and the neutral assembly and repair if required.

No: Verify correct voltage and frequency available at line side of NORMAL switching device. Troubleshoot wire harness from J2 on the controller to the line side of the NORMAL switching device if required.

6.2.4 TRANSFER SWITCH WILL NOT AUTOMATICALLY TRANSFER TO EMERGENCY

Step 1: Is Generator running?
Yes: See Step 2.
No: See Step 4.

Step 2: Verify that there is proper system voltage and frequency available at the line side of the EMERGENCY switching device.
Yes: See Step 3.
No: Troubleshoot generator.

Step 3: Verify correct system voltage and frequency at plug J3 on the controller.

Yes: Verify 120 Volts AC at plug J1-1 to J1-2

Yes: Replace Motor
No: Without separating any plugs, verify 120 VAC at J6-6

Yes: Troubleshoot wire harness from J6 to J1
No: Verify continuity between TB1-21 and the neutral assembly and repair if required.

No: Troubleshoot wire harness from J3 on the controller to the line side of the EMERGENCY switching device.

Step 4: Verify good battery voltage
Yes: Check continuity between TB1-1 and TB1-2.

Yes: Check generator start circuit
No: Troubleshoot wiring between TB1-1 and J6-3 and TB1-2 and J6-2. If wiring is ok change controller.

No: Replace battery.

SECTION 7: ADJUSTMENTS

7.1 GENERAL

Certain devices, such as the sensing relays and timers, need to be set and/or calibrated prior to placing the transfer switch equipment into service. The devices furnished with the equipment will be the same or similar to those described in this section. Adjustments should be made as instructed for the devices supplied. Refer to Instruction Book I.G. ATS-AT201.

7.2 PLANT EXERCISER TIMER

The plant exerciser is a 7-day timer used to exercise the engine driven generator.

7.2.1 TIMER PROGRAMMING

The timer incorporates a 7-day time base, permitting each day of the week to be uniquely programmed. The timer displays in 24 hour format.

7.3 MICROPROCESSOR-BASED LOGIC

There are four main groups of functions included in the Transfer Switch controller.

7.3.1 VOLTAGE SENSING FUNCTIONS

Volt sensing functions are factory programmed

- 1-phase or 3-phase sensing
- Undervoltage sensing

The pickup and dropout points for normal undervoltage and emergency undervoltage can be programmed using the controller.

Undervoltage Sensing Function

- Available pickup settings (% of normal): 100, 95, 90, and 85
- Available dropout settings (% from pickup setting): 5, 10, 15, and 20.

7.3.2 FREQUENCY SENSING FUNCTIONS

The controller is factory programmed to sense underfrequency of the emergency power source only.

The normal frequency of the power sources and the pickup points can be programmed using the controller.

The normal frequency settings are 50 or 60 Hz. Available dropout settings for the under frequency function are:

- at 60 Hz nominal = 90-97% of the nominal system frequency
- at 50 Hz nominal = 90-97% of the nominal system frequency

Under frequency pickup settings are the dropout settings +1 Hz to 99% of the nominal system frequency.

7.3.3 TIME DELAY FUNCTIONS

The controller is factory programmed to include different time delay functions. Each function has different timing ranges that can be adjusted by using the membrane switches on the controller.

TDNE, TDEN, and TDEC

- Programmable
- 0 to 1800 seconds
- TDES
- 0 to 120 seconds

TDEF

- 0-6 seconds

Both the pickup and dropout values of the sensing function and the timing ranges of the time delay functions may be easily changed by following the instructions provided in the later sections.

Controllers shipped from the factory are programmed to the standard pickup and dropout values as follows:

Function	Pickup	Dropout
Undervoltage	90%	80%
Underfrequency (60 Hz)	58 Hz	56 Hz
Underfrequency (50 Hz)	48 Hz	46 Hz

7.3.4 ON-BOARD INDICATORS

Four LED indicators are installed on the controller's membrane for the following functions:

Normal Available	LED ON indicates the voltage and frequency levels of the Normal Source are within the programmed values.
Normal Connected	LED ON indicates that the load is connected to the Normal Source.
Emergency Available	LED ON indicates the voltage and frequency levels of the Emergency Source are within the programmed values.
Emergency Connected	LED ON indicates that the load is connected to the Emergency Source.

Table 7.8 This Table Serves as a Quick Reference for Finding the Actual Voltage Level that Relates to the Percentage of the Normal System Voltage

	120	208	220	240	
65%	78	135	143	156	
70%	84	146	154	168	
75%	90	156	165	180	
80%	96	166	176	192	**Std. UV Dropout**
85%	102	177	187	204	
90%	108	187	198	216	**Std. UV Pickup**
95%	114	198	209	228	
100%	120	208	220	240	

SECTION 8: MAINTENANCE

8.1 INTRODUCTION

HIGH VOLTAGES ARE PRESENT IN AND AROUND TRANSFER SWITCH EQUIPMENT. BEFORE INSPECTING OR MAINTAINING THIS EQUIPMENT, DISCONNECT LINE POWER FROM LOCKING OUT, IF POSSIBLE, THE NEXT HIGHEST DISCONNECT DEVICE. FAILURE TO FOLLOW THIS PROCEDURE COULD CAUSE PERSONAL INJURY AND/OR DEATH.

In general, transfer switch equipment is designed to be relatively maintenance free under normal usage. However, because of the variability of application conditions and the importance placed on dependable operation by this type of equipment, inspection and maintenance checks should be made on a regularly scheduled basis. Since equipment maintenance will consist mainly of keeping the equipment clean, the frequency of maintenance will depend to a large extent on the cleanliness of the surrounding. If a significant amount of dust of foreign matter is present, a more frequent maintenance schedule should be followed.
It is suggested that visual inspections of the equipment be made on a regular basis, not just during scheduled periods. Always be alert for an accumulation of dirt in and around the structure; loose parts and/or hardware; cracks and/or discoloration to insulation; and damaged or discolored components.

8.2 PROCEDURES

A suggested maintenance procedure to follow is outlined in Table **8.1**.

Table 8.1 Periodic Maintenance Procedures

Step	Action
a. Make transfer switch equipment safe for inspection and/or maintenance.	Disconnect line power from equipment being serviced by opening next highest disconnect device. Make certain that any accessory control power is switched off by disconnecting all control plugs.
b. Inspect structure area for safety hazards or potential maintenance problems.	Inspect area, especially where molded case switching devices are installed, for any safety hazards, including personnel safety and fire hazards. Exposure to certain chemical vapors can cause deterioration of electrical connections. Inspect for accumulated dirt, loose hardware or physical damage. Examine primary insulation for evidence of cracking or overheating. Overheating will show as discoloration, melting, or blistering of conductor insulation, or as pitting or melting of conductor surfaces due to arcing. Inspect secondary control connections for damage, and control wiring for insulation integrity.
c. Inspect molded case switching devices for dust, dirt, soot, grease, moisture or corrosion.	Remove dust, dirt, soot, grease, moisture and corrosion contamination from the surface of the switching device using a dry soft lint-free cloth, dry soft bristle brush and vacuum cleaner. Do not blow debris into circuit breaker or nearby breaker structure. If contamination is found, look for the source and fix the problem.
d. Check for material integrity, uneven wear, discoloration or loose hardware.	Severe material cracking will require replacement and loose hardware will need to be tightened.
e. Check terminals and connectors for looseness or signs of overheating.	Overheating will show as discoloration, melting, or blistering of conductor insulation. Connections that do not have signs of looseness or overheating should not be disturbed.
f. Exercise the molded case switching devices if they are not often exercised while in operation. This will permit wiping action by the contacts.	If a switching device is used for frequent switching during normal operation, this step can be disregarded.
g. Return transfer switch equipment to service.	Make certain all barriers are in place and doors closed. Re-apply secondary and primary power.

This instruction booklet is published solely for information purposes and should not be considered all inclusive. If further information is required, you should consult Cutler-Hammer.

Sale of product shown in this literature is subject to terms and conditions outlined in appropriate Cutler-Hammer selling policies or other contractual agreement between the parties. This literature is not intended to and does not enlarge or add to any such contract. The sole source governing the rights and remedies of any purchaser of this equipment is the contract between the purchaser and Cutler-Hammer.

NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN. In no event will Cutler-Hammer be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and description contained herein.

Cutler-Hammer
Pittsburgh, Pennsylvania U.S.A.

Effective 9/00 (ISI)
Style 5724B48H01
Printed in U.S.A.