



Instructions for Cutler-Hammer Solid State Logic Control Panel

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ATION AND MAINTENANCE PROCEDURES TO AVOID THESE VOLTAGES.

TRANSFER SWITCH EQUIPMENT IS DESIGNED AND TESTED TO OPERATE WITHIN ITS NAME-PLATE 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 BEFORE WORKING WITH TRANSFER SWITCH EQUIPMENT, INCLUDING THE SOLID STATE LOGIC.

All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of the equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding a particular installation, operation or maintenance of particular equipment, contact a Cutler-Hammer representative.

1.0 INTRODUCTION

The logic panel provides the intelligence and supervisory circuits which constantly monitor the condition of both normal and emergency power sources, thus providing the required intelligence for transfer operations. These instructions cover the solid state logic panel only which is usually installed in a transfer switch enclosure. Instructions associated with the transfer switch equipment are contained in a separate document.

2.0 GENERAL

The solid state logic circuits automatically initiate an immediate transfer of power when power fails or voltage levels drop below a preset value. Transfer back to the normal power source is automatic upon return of the normal power source. Monitoring of the power source is always performed on the line side of the source to which the switch is connected.

The solid state logic panel is normally mounted to the enclosure door (Figure 1). An extender cable is available if it is desirable to mount the logic panel in a location other than on the enclosure door.



WARNING

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

HAZARDOUS VOLTAGES ARE PRESENT INSIDE TRANSFER SWITCH ENCLOSURES IN WHICH THE SOLID STATE LOGIC IS INSTALLED. THESE VOLTAGES CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. FOLLOW PROPER INSTALLATION, OPER-



Figure 1 Typical Solid State Logic Panel (Door Mounted)

All solid state logic panels are the same size regardless of the switch type or number of options. The panel is drilled and tapped for the maximum number of options.

Solid state logic panels have two power transformers (normal power source and emergency power source) and one logic transformer package (monitoring both power sources).

A solid state logic package is mounted on the logic panel and consists of a number of plug-in printed circuit cards. A plug-in relay is used for outputting from the logic package.

Along with standard operational functions, certain other options are also performed by printed circuit cards. A number of plug-in cards have adjustment knobs that can be screwdriver or finger adjusted.

Voltage cards and frequency cards are interchangeable, as are timing cards. A timing card, however, cannot be used in a voltage/frequency slot or vice versa, since

they are interlocked to prevent improper insertion. Each card is held in place by two captive screws with unused card slots covered by blank covers.

Each logic package is divided into a Normal power source section and an Emergency power source section. Each source section is further sub-divided into sections for Voltage/ Frequency and Timing. A standard catalog numbered switch without options has two driver cards which are required for operation, one in the Normal and one in the Emergency timing slots. If timing options are selected, the drivers are omitted since either a driver or a timer is required on both the Normal and Emergency power sources for operation.

A light emitting diode (LED) is supplied on each sensing or time delay card. The light is lit on the sensing card (voltage or frequency) when the monitored voltage or frequency is within the preset limits. The light is lit on the time delay cards after the preset time has elapsed. In other words, when the card has "picked-up" the light is on.

3.0 OPTIONS

Logic options, which are not part of the transfer switch, are available to meet a variety of logic scheme requirements. Options are numbered with an associated description. More detailed selections that must be made within a specific option are lettered. For available options associated with the transfer switch, refer to the specific document dedicated to the transfer switch.

NOTICE

Options are Underwriters Laboratories, Inc. listed, except as noted, when supplied on UL Listed switches. If an option is selected that is Not UL Listed, the switch Will Not Have A UL Label.

NOTICE

Not all options are available for all transfer switch configurations. If in doubt, check Price List 29-920 for the availability of options for a specific transfer switch design. The option numbers used here correspond to the numbers used in the price list.

1. Time Delay Normal to Emergency (TDNE)

This option delays the transfer to emergency in order to override momentary power outages and/or fluctuations. Timing begins when the Emergency source appears. 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 an engine generator, will initiate engine startup. The timer is user-adjustable over 5 ranges covering 1 second to 64 minutes. An instruction leaflet is provided with each card.

2. Time Delay on Engine Starting (TDES)

This option is used only where the Emergency source is an engine generator. It delays initiation of the engine start circuit in order to override momentary power outages and/or fluctuations. It does not affect the switch's ability to transfer from Normal to Emergency source.

- B. Adjustable .5 to 15 seconds
- C. Adjustable 4 to 120 seconds

3. Time Delay Emergency to Normal (TDEN)

This option delays the transfer to normal to permit stabilization of the normal power source before re-transfer is made. Timing begins when the normal source appears. If the Emergency source fails during timing, transfer to the Normal source is immediate overriding the time delay. The timer is user-adjustable over 5 ranges covering 1 second to 64 minutes. An instruction leaflet is provided with each card.

4. Time Delay for Engine Cool-Off (TDEC)

This option permits the generator to run under a no-load condition after transfer to Normal has been made. Timing begins when transfer is made. The timer is user-adjustable over 5 ranges covering 1 second to 64 minutes. An instruction leaflet is provided with each card.

5. Frequency/Voltage Sensing for Emergency Source

A sensing card used for the Emergency source constantly monitors that source. It prevents transfer from Normal to Emergency until the engine generator has reached acceptable operating frequency and/or voltage. When the switch is in the Emergency position and the Emergency source is outside the sensing card setting, the switch will initiate transfer to the Normal position if the Normal source is present.

- B. 1 Phase Under Voltage/Under Frequency
- C. 1 Phase Over Voltage/Over Frequency
- D. 1 Phase Under Voltage
- E. 1 Phase Over Voltage
- F. 3 Phase Under Voltage
- G. 3 Phase Over Voltage
- H. Phase Reversal
- J. 3 Phase Under Voltage/Under Frequency
- K. 3 Phase Over Voltage/Over Frequency

6. Two and Four Position Selector Switches

- D. Two Position Switch – A two position switch can be supplied with an automatic transfer switch. It simulates a loss of normal power. Engine starting will be initiated and a transfer to the Emergency source will occur. The two position switch is omitted if the four position switch is selected.
- H. Four Position Switch – This switch permits four modes of switch operation: “TEST”, “AUTO”, “OFF”, and “ENGINE START”. The “OFF” position de-energizes the control relays, opens the engine start circuit, and opens the motor circuit for maintenance or manual operation. The switch will not operate nor will the engine start on power failure. A white light is also furnished that lights only when the switch is in the “OFF” position. The “TEST” position simulates power failure. Engine starting is initiated and the switch will transfer when emergency voltage appears. The “AUTO” position returns the transfer switch to Normal operation. The “ENGINE START” position retains the transfer switch at normal and initiates the engine start circuit. The switch will not transfer unless the normal source fails.

8. Bypass Pushbutton

The pushbutton provides a bypass on the TDNE (Option 1) or TDEN (Option 3) relay permitting the switch to be transferred to Normal or Emergency source without a time delay. The option is normally used in testing when it is not desirable to wait for the timers to finish their timing sequence. The pushbuttons are mounted in the enclosure cover.

- C. Bypass TDEN (PBEN)
- D. Bypass TDNE (PBNE)

9B. Selector Switch Maintenance

The two position switch disconnects power to the transfer motor. Marked “OFF/ AUTO”. Subsequent manual operation of the transfer switch isolates the transfer switch load circuit from either source. The switch is mounted in the enclosure cover.

10. Preferred Source Selector Switch

- B. Utility to Utility/Generator – For use when Normal and Emergency Source are both commercial power, or when the Normal Source is commercial power and the Emergency Source is engine generator. Option permits selection of either source as the preferred source to which the switch will always transfer, if that source is available, marked Source1/ Source 2. It is mounted in the enclosure cover.
- D. Generator to Generator – For use when Normal and Emergency Source are engine generators. Two

engine start contacts are provided marked Source 1/Source 2. It is mounted on the enclosure cover.

12. Pilot Lights

Pilot lights can be furnished to indicate (1) switch position; (2) source condition; and, (3) tripped condition. They are mounted in the enclosure cover.

Switch Position: A 1A breaker auxiliary contact is utilized

- C. Normal Supply (green)
- D. Emergency Supply (red)

Source Condition: It indicates whether or not a source voltage is present.

- G. Normal Supply (white)
- H. Emergency Supply (white)

Tripped Condition: It is available only with thermal-magnetic breakers, Option 16 or 37.

- L. Normal Supply (amber)
- M. Emergency Supply (amber)

23. Plant Exerciser

A digital 7 day timer provides for automatic test operation of the plant for pre-selected intervals at least once a week, and is mounted on intelligence circuit.

- C. Without interrupting normal supply
- D. By simulation of power failure
- G. With a selector switch for choosing 23C or 23D
- I. Same as D except with fail-safe return to Normal should Emergency fail during exercise period
- J. Same as G except with fail-safe return to Normal should Emergency fail during exercise period

26. Type of Protection (Normal Source)

Undervoltage protection is standard. A voltage sensing card monitors each phase of the Normal power supply, and is normally set at 70% dropout and 90% pickup. Other sensing options are available.

- C. Overvoltage Sensing Relay-adjustable, nominally set at 110% pickup and 115% dropout .
- D. Area protection connections with override circuit. Provides two terminal blocks for connection of one or more NO (open when there is no voltage) area protection contacts. These terminal blocks are wired in the same manner as the test switch. When the NO area protection contact opens, the switch will initiate engine start and will transfer to Emergency. If the NO area protection contact remains open and

the Emergency source fails when the switch is in the Emergency position, an override circuit will retransfer the switch to the Normal source, if it is available.

- E. Underfrequency, adjustable 45-60 Hz (drops out 2 Hz lower than setting) - A frequency sensing relay is connected to 1 phase only of the Normal source and constantly monitors that phase.
- F. Overfrequency, adjustable 50-65 Hz (drops out 2 Hz above setting) - A frequency sensing relay is connected to 1 phase only of the Normal source and constantly monitors that phase.
- H. Phase Reversal Sensing

29. Alternate Modes of Operation

Automatic operation is standard. It provides for automatic transfer and re-transfer from source-to-source as dictated by the reset values of the transfer switch intelligence circuits.

- E. Pushbutton return to Normal - Automatic operation
Normal to Emergency - Pushbutton operation
Emergency to Normal
- G. Automatic/Manual operation - Two position selector switch (marked Auto/Manual) permits selection of automatic or manual operation - Not UL Listed
- J. Automatic/Manual pushbutton return to Normal - Two position selector switch (marked Auto/Manual) permits selection of automatic or manual pushbutton return to Normal - Includes Option 29E which is functional only when selector switch is in the manual position.

30A. Cranking Limiter

Adjustable 4-120 seconds - Interrupts motor start circuit if voltage does not appear within pre-selected time.

32A. Delayed Transition Timer (Time Delay Neutral)

It 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. It utilizes a 1A Breaker auxiliary contact. Adjustment is from .5 to 60 seconds.

35A. Pretransfer Signal Device

Provides tow form "C" contacts for interface with other equipment (typically elevator controls). Contacts close at user set time prior to transfer in either direction.

4.0 ADJUSTMENTS


Certain devices, such as sensing relays and timers, need to be set and/or calibrated prior to placing the transfer switch equipment into service. The devices fur-

nished with Solid State Logic equipment will be the same or similar to those described in this section. Adjustments should be made as instructed for the devices supplied.

4.1 PLANT EXERCISER TIMER

Option 23, which is described in Paragraph 3.0 entitled "Options," utilizes a Plant Exerciser. The Plant Exerciser is a seven day timer switch used to exercise the engine driven generator. The specific time switch is the "FM/1 digi 20" manufactured by Grasslin Controls Corporation.

The "FM/1 digi 20" incorporates a 7-day time base, permitting each day of the week to be uniquely programmed (Figure 2). For convenience, Block Programming is also provided. This allows up to seven days to be grouped together, if the ON and OFF times are the same.

The circular keypads are positioned to provide a sequential path for programming. Starting with **Prog.** to select a program, clockwise to  to select On or OFF, then **h** for hour, **m** for minute, and finally **Day** to select day or days of the week.

NOTICE

A flashing display indicates either incomplete data entry or the battery is low. Check to see if days and ON or OFF times are entered and check the power supply to the time control.

The load is shown in the display as either ON or Off.

In the case of a power failure, the built-in nickel-cadmium battery maintains the time of day, program storage and LCD display. During a power outage the relays are de-energized.

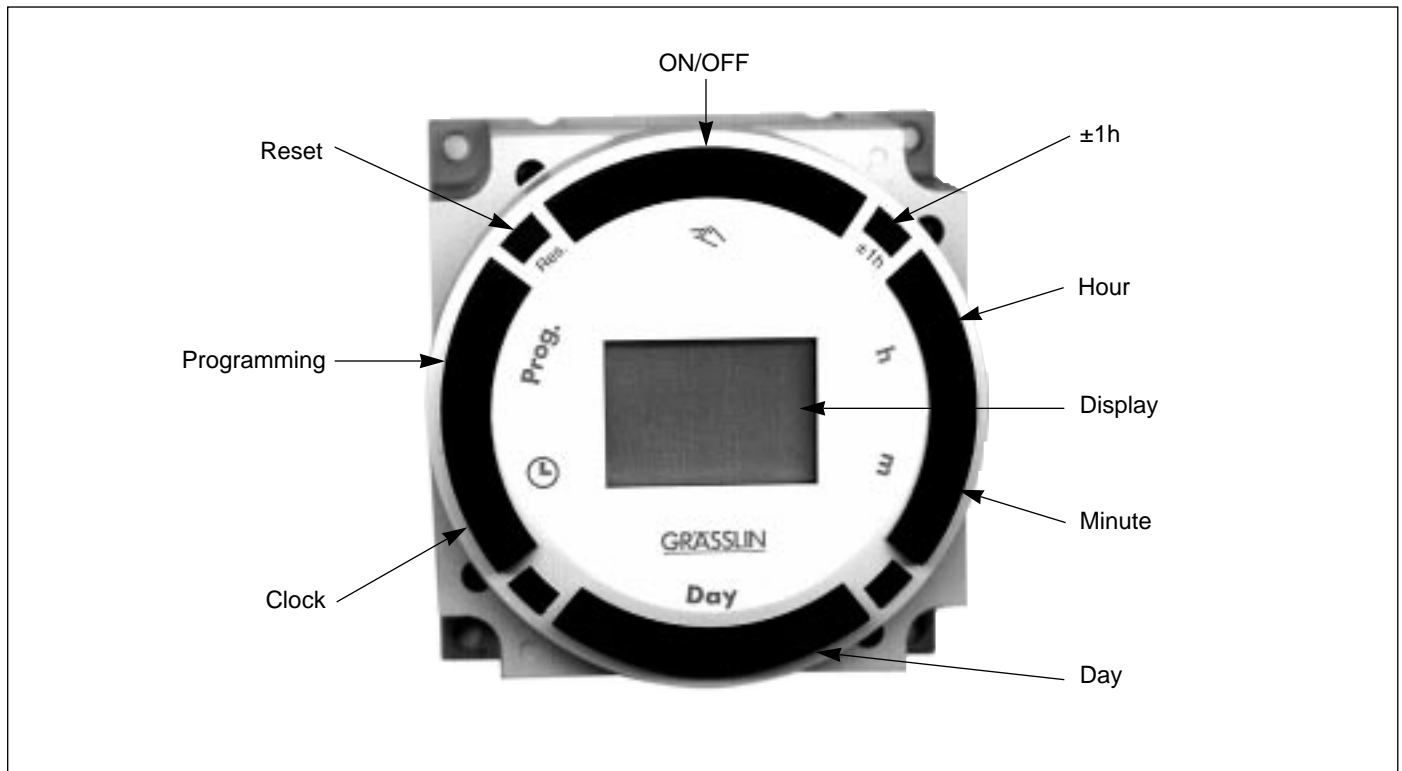


Figure 2 Plant Exerciser Timer

NOTICE

After power-up, press the “Reset” button before setting the time or programming. This will clear the memory of all data from testing and handling.

4.1.1 TIME SETTING STEPS

Step 1: Select military (24:00 hr.) or AM/PM (12:00 hr.) time mode by depressing and holding **h** key while pressing **±1h** key to toggle between military and AM/PM. (AM appears in display when in AM/PM mode.)

Step 2: Press and hold down **⌚** key.

Step 3: If setting the time when daylight savings time is in effect, press **±1h** key once (+1H will appear in display).

Step 4: Set hour with **h** key. If AM or PM does not appear in display, the unit is in military time. See note above to change display.

Step 5: Set minutes with **m** key.

Step 6: Press **Day** key repeatedly to the day of the week. (1 is Monday, 7 is Sunday)

Step 7: Release **⌚** key, colon will begin flashing. If the days are flashing, the day of the week was not entered (see step 6).

4.1.2 ENTERING PROGRAMS

Step 1: Press **Prog.** key

1	2	3	4	5	6	7
AM---:--						

 will appear in display. (Pressing **Prog.** key again, display will show the number of free programs; **Fr 20**). Press again to RETURN to 1st program.

Step 2: Press **⏏** key, **●** ON symbol will appear. Pressing the key again will toggle to OFF **○**.

Step 2a: Select ON or OFF for the program with the **⏏** key.

Step 3: Press **h+** to select hour for switching time.

Step 4: Press **m+** to select minute for switching time.

Step 5: If the program is to occur every day of the week, (24 hour time control) ignore **Day** key

and press **Prog.** key to advance to next program.

Step 6: If 7 day time control is desired, press **Day** key. 1 2 3 4 5 6 (Mon thru Sat) block of days appears in display. Pressing **Day** key again, 1 2 3 4 5 (Mon thru Fri) appears in display. Pressing **Day** key again, 6 7 (Sat & Sun) appears in display. Pressing **Day** key again, 1 (Mon) appears in display. Repeated presses will cycle through all days of the week, and back to 1 thru 7 (Mon thru Sun).

Step 6a: Select day or block of days desired with the **Day** key.

Step 7: Press **Prog.** key and repeat steps 2 thru 6a to enter additional programs of ON and OFF times. (Note that more than one OFF time program may be entered, enabling automatic control of manual overrides.)

Step 8: Press **⌚** key to enter run mode.

NOTICE

The output relays will switch ON (or OFF) only at the programmed times. After programming is completed, if a channel should be ON, it must be manually turned ON with the **⏏** key. For example, programming is completed at 2PM and CH1 was programmed to be ON at 8AM and OFF at 5PM. After pressing the **⌚** key, CH1 will be OFF; press **⏏** to turn it on.


4.1.3 CHANGING OR CHECKING PROGRAMS






Step 1: To review a program at any time, press **Prog.** key. Programs will be displayed in the sequence they were entered with repeated presses of **Prog.** key.

Step 2: To change a program, select the program to be changed with the **Prog.** key, and enter the new time of day, and/or days of week just as in the programming steps shown above. The old program is overwritten with the new selections. Press **Prog.** to store the new program.

Step 3: To delete an individual program, select the program as in step 1 and press **h** and **m** keys until “—:—” appears in display. Press either **Prog.** or **⌚** key until “—:—” flashes. The program is deleted after a few seconds.

4.1.4 MANUAL OVERRIDE

While in the **Run** mode, (⏸ symbol is displayed), pressing the  key will reverse the load status (switch load OFF if it is ON, or switch ON if it is OFF). A hand symbol appears in display to indicate the override is active. At the next scheduled switching time, automatic time control will resume, eliminating the override.

- Pressing the  key a second time  appears in the display indicating the load is switched **permanently ON**.
- Pressing the  key a third time,  appears in the display indicating the load is switched **permanently OFF**.
- Pressing the  key a fourth time returns to automatic, (⏸ symbol appears in the display).

4.2 SENSING CARDS

A variety of sensing cards are utilized in Cutler-Hammer transfer switch equipment to perform timing, voltage and frequency functions. The associated options described in Paragraph 3.0 are performed by these sensing cards supplied in various combinations.



Figure 3 Portable Test Kit

Cards are keyed to prevent insertion into an incorrect slot in the card cage. Older sensing card versions can be replaced directly by the sensing cards presently supplied and described in this section.

The series of cards now supplied with Cutler-Hammer transfer switch equipment does not require a variable source of control power to make adjustments to the cards. If, however, it is desirable to verify that the cards are functioning properly, a compact, field test kit (Style Number 1278C67G01) is available for this purpose (Figure 3). Refer to a Cutler-Hammer representative for availability.

NOTICE

Older versions of the sensing cards do require the use of the test kit for calibration.

4.2.1 TIMER CARD (S/N 7820C96G01)

The Timer Card is a multi-range timer for use with Cutler-Hammer transfer switch equipment (Figure 4). It can be programmed for any one of five timing ranges by simply moving a jumper to the appropriate position. The actual time desired is then set with a front accessible potentiometer. The Timer Card is applied for the following options:

- Option 1 - Time Delay Normal to Emergency
- Option 3 - Time Delay Emergency to Normal
- Option 4 - Time Delay Engine Cool-off

NOTICE

If the Timer Card must be removed from a transfer switch that is in service, it is a good idea to disable the logic first by separating the logic disconnect plug. This will avoid the possibility of an undesired transfer.



CAUTION

DISCONNECTING THE LOGIC WILL CAUSE THE ENGINE GENERATOR TO START UNLESS IT HAS BEEN DISABLED.

The card is supplied with a single jumper which must be placed on the appropriate Range Select Terminals (Table 1).



Figure 4 Multi-range Timer Card

Table 1 Timer Card Range Selections

Range Select	Timing Range ①
1	1 - 60 sec.
4	4 - 240 sec. (.07 - 4 min.)
8	8 - 480 sec. (.13 - 8 min.)
32	.5 - 32 min.
64	1 - 64 min.

① Typical timing ranges are shown. Actual available range may be slightly greater.

Table 2 Voltage Card Standard Settings

Function	Pickup	Dropout
Undervoltage	90%	80%
Overvoltage	110%	115%

4.2.2 VOLTAGE SENSING CARD (S/N 7820C97G01)

The voltage sensing card is a versatile sensing card for use with Cutler-Hammer transfer switch equipment. The card can be programmed to perform either undervoltage or overvoltage sensing on single or three phase applications.



CAUTION

THE CARD CAN BE PROGRAMMED FOR EITHER UNDERVOLTAGE OR OVERVOLTAGE, BUT NOT BOTH. ATTEMPTING TO PROGRAM THE CARD FOR BOTH VOLTAGE SENSING FUNCTIONS WILL CAUSE THE CARD TO MALFUNCTION, AND POSSIBLY DAMAGE THE CARD'S ELECTRONICS.

Cards shipped from the factory are programmed to the user's original specifications or to the factory's standard pickup and dropout values (Table 2).

Programming of the card is accomplished by positioning jumpers on the appropriate positions labeled J1 through J7 on the board itself. This allows for easy modification of the card at the user's discretion. The instructional steps outlined in Table 3 allow the pickup and dropout for either undervoltage or overvoltage to be easily changed (reprogrammed) in the field.

NOTICE

Before reprogramming, it is recommended that all jumpers be removed from positions J1 through J7. The card, as supplied from the factory, has enough jumpers for all function and value possibilities.

4.2.3 COMBINATION VOLTAGE/FREQUENCY SENSING CARD (S/N 7820C99G01)

The combination voltage/frequency sensing card is a versatile dual function sensing card for use with Cutler-Hammer transfer switch equipment (Figure 5). The card can be programmed to perform a voltage sensing function, either undervoltage or overvoltage, and a frequency sensing function, either underfrequency or overfrequency.



CAUTION

THE CARD CAN BE PROGRAMMED FOR EITHER UNDERVOLTAGE OR OVERVOLTAGE, NOT BOTH,

AND UNDERFREQUENCY OR OVERFREQUENCY, NOT BOTH. ATTEMPTING TO PROGRAM THE CARD FOR TWO VOLTAGE OR TWO FREQUENCY FUNCTIONS WILL CAUSE THE CARD TO MALFUNCTION, AND POSSIBLY DAMAGE THE CARD'S ELECTRONICS.

Cards shipped from the factory are programmed to the user's original specifications or to the factory's standard pickup and dropout values (Table 6).

Programming of the card is accomplished by positioning jumpers on the appropriate positions labeled J1 through J12 on the board itself. This allows for easy modification of the card at the user's discretion. The instructional steps outlined in Table 3 for voltage and Table 7 for frequency allow the pickup and dropout values to be easily changed (reprogrammed) in the field.

NOTICE

Before reprogramming, it is recommended that all jumpers be removed from positions J1 through J12. The card, as supplied from the factory, has enough jumpers for all function and value possibilities.

4.3 TIMING RELAYS

Agastat Time Delay Relays used on Options 2A, 2B, 30A and 32A are adjustable by rotating the dial or via screwdriver adjustment pots (Figure 6).

NOTICE

Timer models SSFR90X must be set in the ON delay mode for proper operation.

Table 3 Undervoltage and Overvoltage Programming Steps

Undervoltage		Overvoltage	
Step	Action	Step	Action
1	Place jumper on J6	1	Place jumper on J7
2	Insure no jumper is on J7	2	Insure no jumper is on J6
3	Choose desired pickup and dropout values from Table 4	3	Choose desired pickup and dropout values from Table 5
4	Place jumpers on pins indicated in Table 4	4	Place jumpers on pins indicated in Table 5
CAUTION			
<p>IF THE CARD IS TO BE USED FOR THREE PHASE SENSING, YOU MUST INSURE THAT THE SENSING POSITION (NORMAL OR EMERGENCY) IS FED BY A THREE PHASE TRANSFORMER PACKAGE. ON THREE PHASE UNITS SOLD BY CUTLER-HAMMER, THE STANDARD IS THREE PHASE SENSING ON NORMAL, AND SINGLE PHASE SENSING IS ON EMERGENCY.</p> <p>THREE PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY INSTALLED OPTION. IF IN DOUBT, CONTACT THE FACTORY FOR ASSISTANCE.</p>			
5	For Three Phase Sensing, place jumper on J1	5	For Three Phase Sensing, place jumper on J1

Table 4 Undervoltage Pickup and Dropout

Pickup (%)	Dropout (%)	Jumpers
95	90	J2
	85	J2, J4
	80	J2, J5
	75	J2, J4, J5
90	85	J3
	80	J3, J4
	75	J3, J5
	70	J3, J4, J5
85	80	J2, J3
	75	J2, J3, J4
	70	J2, J3, J5
	65	J2, J3, J4, J5

Table 5 Overvoltage Pickup and Dropout

Pickup (%)	Dropout (%)	Jumpers
105	110	none
	115	J4
	120	J5
	125	J4, J5
110	115	J2
	120	J2, J4
	125	J2, J5
	130	J2, J4, J5
115	120	J3
	125	J3, J4
	130	J3, J5
	135	J3, J4, J5
120	125	J2, J3
	130	J2, J3, J4
	135	J2, J3, J5
	140	J2, J3, J4, J5



Figure 5 Combination Voltage/Frequency Sensing Card

Table 6 Combination Card Standard Settings

Function	Pickup	Dropout
Undervoltage	90%	80%
Overvoltage	110%	115%
Underfrequency (60Hz)	58Hz	56Hz
Overfrequency (60Hz)	62Hz	64Hz
Underfrequency (50Hz)	48Hz	46Hz
Overfrequency (50Hz)	52Hz	54Hz

Table 7 Underfrequency and Overfrequency Programming Steps

Underfrequency		Overfrequency	
Step	Action	Step	Action
1	Place jumper on J8	1	Place jumper on J9
2	Insure no jumper is on J9	2	Insure no jumper is on J8
3	Choose desired pickup and dropout values from Table 8	3	Choose desired pickup and dropout values from Table 8

Table 8 Underfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	Jumpers
46	44	none
47	45	J11
48	46	J12
49	47	J11, J12
56	54	J10
57	55	J10, J11
58	56	J10, J12
59	57	J10, J11, J12

Table 9 Overfrequency Pickup and Dropout

Pickup (Hz)	Dropout (Hz)	Jumpers
51	53	none
52	54	J11
53	55	J12
54	56	J11, J12
61	63	J10
62	64	J10, J11
63	65	J10, J12
64	65	J10, J11, J12



Figure 6 Panel Mounted Timing Relay

4.4 TESTING

After transfer switch equipment is initially installed or during planned outages, the installation should be tested to insure that all equipment operates properly. This attention to detail will help to avoid unexpected malfunctions.

The frequency of subsequent testing should be based on recommendations of the generator set manufacturer. Use the test pushbutton to check the electrical operation of the switch. IF A TEST SWITCH IS PROVIDED, ALWAYS RETURN THE SWITCH TO THE AUTO POSITION AFTER THE TEST IS COMPLETE.



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.

For mechanical operations, refer to the instruction book covering the automatic transfer switch equipment. Refer to the rest of this section for electrical testing.

4.4.1 ELECTRICAL TESTING

NOTICE

If Option 4 (Time Delay Engine Cool-off) as described in the applicable logic instruction book (Paragraph 3-4) is furnished, 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 the following paragraphs, 4.4.2 through 4.4.6. Insure

that all safety precautions are taken and that all WARNINGS and CAUTIONS are observed.

4.4.2 NO VOLTAGE STEPS

WITH NO VOLTAGE AVAILABLE ON EITHER POWER SOURCE, PROCEED AS FOLLOWS:

- Step 1:** Check to make sure that both the Normal (NB) and Emergency (EB) 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:** Check to make sure the Test Selector Switch (TSS), if provided, is in the AUTO position.
- Step 3:** If the Four Position Selector Switch (FPSS), Option 6H, is used, the switch should be in the OFF position.
- Step 4:** If the Four Position Selector Switch (FPSS), Option 6H, is not used, the generator engine start controls should be in the OFF position to prevent an undesired start.
- Step 5:** Pre-set all timing circuits in keeping with timing relay instructions.
- Step 6:** Pre-check all transfer switch loads to insure that they are ready to be energized.

4.4.3 CONNECTING POWER SOURCES

- Step 1:** Close the Normal power source upstream protection device.
 - a) If the Four Position Selector Switch (FPSS), Option 6H, is not used, the Normal power source switching device (NB) should close.
 - b) If the Four Position Selector Switch (FPSS), Option 6H, is used and is in the OFF position, the Normal power source switching device (NB) will not automatically close. Place the FPSS switch in the AUTO position.
- 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 is 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 of the previous paragraph (4.4.2).

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.

4.4.4 OPERATIONAL CHECKS (WITHOUT FOUR POSITION SELECTOR SWITCH) (FPSS)

Step 1: Check to insure that the Normal power source switching device (NB) is in the CLOSED position. This should have been done in Step 1a of the previous paragraph (4.4.3).

Step 2: Initiate an automatic transfer operation from the normal to emergency power source by moving the Test Selector Switch (TSS) from the AUTO to the TEST position, or by pushing and holding the Test Pushbutton.

- a) The engine should start and run, building up to normal voltage and frequency within a few seconds, depending upon the machine's characteristics. If a Time Delay on Engine Starting (TDES) option, Option 2, is provided, it must time out before the engine starts.
- b) The transfer switch will transfer to the Emergency power source (NB opens and EB closes) after the Time Delay Normal to Emergency (TDNE), Option 1, times out, if the option is provided.

Step 3: Initiate an automatic transfer operation back to the Normal power source by moving the Test Selector Switch (TSS) from the TEST to the AUTO position, or releasing the pushbutton.

- a) The transfer switch will transfer back to the Normal power source (EB opens and NB closes).
- b) The transfer to Normal power source will be delayed by the Time Delay Emergency to Normal (TDEN) option, Option 3, if provided.
- c) The Time Delay for Engine Cool-off (TDEC) option, Option 4, when provided, will allow the engine to run unloaded for a pre-set time after transfer to normal power source is completed.

4.4.5 OPERATIONAL CHECKS (WITH FOUR POSITION SELECTOR SWITCH) (FPSS)

The operational checks with the Four Position Selector Switch are similar to the Two Position Selector Switch just described in paragraph 4.4.4 except two additional positions are provided, OFF and ENGINE START positions.

Step 1: With the switch in the OFF position, all control relays are de-energized and the engine start circuit is open. The transfer switch will not transfer nor will the engine start. A white light lights to indicate that the selector switch (FPSS) is in the OFF position and the normal power source is available.

Step 2: With the switch in the ENGINE START position, the transfer switch remains in the normal power source position. This means that NB is closed, EB is open and the engine start circuit is closed, thus starting the engine. The transfer switch will not change power sources unless the Normal power source fails.

Step 3: Return the test switch (FPSS) to the AUTO position. The engine will immediately stop running.

4.4.6 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, it will cycle back to Normal power source, since it is the preferred power source. A ratchet is designed into the mechanism of 225 ampere and larger switches so it can be held

stationary during automatic operation, thus preventing operator injury.

4.5 PROBLEM SOLVING (VERTICAL MECHANISM TYPE TRANSFER SWITCHES)



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 PERFORM 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. All of the steps presented may not apply to all transfer switches, depending upon the logic. 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. Shop Order Number (SO#) or General Order Number (GO#) of transfer switch, plus related Item Number
2. Catalog and/or Style Number of transfer switch

3. Actual location of transfer switch (type of facility, address, etc.)
4. Company name
5. 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

4.5.1 TRANSFER SWITCH APPEARS INOPERATIVE

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

Step 2: Verify that the correct system voltage appears at NORMAL switch. Measure the voltage at the breaker lugs.

Step 3: Verify that the voltage selection plug is in the proper position to match the system voltage.

Step 4: Look for any obviously burned components. Determine the cause and rectify, if possible. Replace defective components after the cause is determined.

Step 5: Manually ratchet the operating handle to the NORMAL position. Verify whether or not the system voltage now appears on the load terminals.

If YES: Proceed to check logic for problems in respective logic instruction book.

If NO: Check all power connections and the switching mechanism.

4.5.2 MOTOR KEEPS TURNING AND TRANSFER SWITCH WILL NOT STOP IN POSITION

Step 1: Check the appropriate limit switch (NLS or ELS). NLS should open with NORMAL closed and ELS should open with EMERGENCY closed

4.5.3 TRANSFER SWITCH WILL NOT AUTOMATICALLY TRANSFER TO NORMAL

Step 1: Is Option 29 installed? If so, there would be a pushbutton labeled "Manual Transfer to Normal."

If YES: STOP! Transfer Switch must be MANUALLY transferred to NORMAL by depressing the NORMAL Pushbutton.

If NO: Proceed to step 2.

Step 2: Are the correct line voltage and frequency available at terminals N1, N2, N3 and neutral (if used)? Record reading.

If YES: Proceed to Step 3.

If NO: Check Source.

Step 3: Is the voltage selector plug in the correct position?

If YES: Proceed to step 4.

If NO: Position plug correctly.

Step 4: Is the TEST pushbutton (PB) depressed or the TEST SWITCH in the TEST position?

If YES: Release PB or move switch to "AUTO".

If NO: Proceed to Step 5.

Step 5: Check the voltage on Card Cage terminals 1 and 2 using an AC voltmeter. The voltage should measure 24 VAC +/- 10 volts. Record reading.

If YES: Proceed to Step 6

If NO: Measure voltage on Transformer NT1X1 and X2. Voltage should measure 120 VAC +/- 10 volts. Record reading.

If NO: Check NT1.

If YES: Measure voltage from Transformer NT1 X1 to Terminal Block 59. Voltage should be 120 VAC.

If YES: Check NT2.

If NO: Check jumpers and options installed between terminals 60 and 59.

Step 6: Are yellow wires attached to terminals 4 through 7 on the Card Cage?

If YES: Proceed to Step 7.

If NO: Proceed to Step 9.

Step 7: Check voltage on Card Cage terminals 4 and 5 using an AC voltmeter. Voltage should measure 12 VAC +/- .5 volt. Record reading.

If YES: Proceed to Step 8.

If NO: Check NT3.

Step 8: Check the voltage on Card Cage terminals 6 and 7 using an AC voltmeter. The voltage should measure 12 VAC +/- .5 volt. Record reading.

If YES: Proceed to Step 10.

If NO: Check NT4.

Step 9: Check any sensing cards installed on the NORMAL Power Source (slot 1 on a 6 position cage, or slots 1, 2 and 3 on a 9 position cage). Are ALL LED's on NORMAL Sensing cards lit?

If YES: Proceed to Step 10.

If NO: Verify Cards are properly programmed. Replace card if necessary.

Step 10: Is the LED on TDEN or Driver Card lit?

If YES: Proceed to Step 11.

If NO: Test TDEN and TDNE cards with a test kit or use substitution method.

Step 11: Check the voltage from NT1 X4 to Terminal 22 on the Card Cage. Is it 120 VAC?

If YES: Proceed to Step 12.

If NO: Check NLS limit Switch in Normal Switch.

Step 12: Check the voltage from Terminal 21 to NT1 X4. Is it 120 VAC?

If YES: Check motor and bridge rectifier board.

If NO: Check NR Relay.

Step 13: Contact Cutler-Hammer.

4.5.4 TRANSFER SWITCH WILL NOT AUTOMATICALLY TRANSFER TO EMERGENCY

Step 1: If the alternate source is a generator, is it running?

If YES: Proceed to Step 2.

*If NO: Check generator.
Check Engine start contact.*

Step 2: Are the correct line voltage and frequency available at terminals E1, E2, E3 and neutral (if used)? Record reading.

If YES: Proceed to Step 3.

If NO: Make sure Generator Breaker is closed. Verify there is output voltage from Generator.

Step 3: Is the voltage selector plug in the correct position?

If YES: Proceed to Step 4.

If NO: Position plug correctly.

Step 4: Is the NORMAL Power Source Available?

If YES: Is a Test (either manual or exercise) being run?

If YES: Proceed to Step 5.

If NO: STOP! Transfer switch SHOULD NOT transfer to EMERGENCY.

If NO: Proceed to Step 5.

Step 5: Check the voltage on Card Cage terminals 8 and 9 using an AC voltmeter. The voltage should measure 24 VAC +/- 1 volt. Record reading.

If YES: Proceed to Step 6

If NO: Measure voltage on Transformer ET1X1 and X2. Voltage should measure 120 VAC +/- 10 volts. Record reading.

If NO: Check ET1.

If YES: Measure voltage from Transformer ET1 X1 to terminal Block 61. Voltage should be 120 VAC.

If YES: Check ET2.

If NO: Check jumpers and options installed between Terminals 62 and 61.

Step 6: Are there yellow wires attached to terminals 11 through 14 on the Card Cage?

If YES: Proceed to Step 7.

If NO: Proceed to Step 9.

Step 7: Check the voltage on Card Cage terminals 11 and 12 using an AC voltmeter. The voltage should measure 12 VAC +/- .5 volt. Record reading.

If YES: Proceed to Step 8.

If NO: Check ET3.

Step 8: Check the voltage on Card Cage terminals 13 and 14 using an AC voltmeter. The voltage should measure 12 VAC +/- .5 volt. Record reading.

If YES: Proceed to Step 9.

If NO: Check ET4.

Step 9: Are any sensing cards installed on the EMERGENCY Power Source? (Slots 5, 6 on a 6 position cage, or slots 7, 8 or 9 on a 9 position cage.)

If YES: Are ALL LED's on EMERGENCY Sensing cards lit?

If YES: Proceed to Step 10.

If NO: Verify Cards are properly programmed. Replace card if necessary.

If NO: Proceed to Step 10.

Step 10: Is the LED on TDNE or Driver Card lit?

If YES: Proceed to Step 11.

If NO: Is LED on TDEN (Time Delay Emergency to Normal) or Driver lit?

If YES: STOP! ATS should not be in Emergency.

If NO: Test TDNE and TDEN cards with test kit or use substitution method.

Step 11: Check the voltage from ET1 X4 to Terminal 30 on the Card Cage. Is it 120 VAC?

If YES: Proceed to Step 12.

If NO: Test ER Relay.

Step 12: Check the voltage from ET1 X4 to Terminal 23 on the Card Cage. Is it 120 VAC?

If YES: Proceed to Step 13.

If NO: Check jumper between terminal blocks 30 and 23.

Step 13: Check the voltage from Terminal 21 to Terminal XT1 X4. Is it 120 VAC?

If YES: Proceed to Step 14.

If NO: Test NR Relay or Motor or bridge rectifier board.

Step 14: Contact Cutler-Hammer for additional assistance.

4.6 PROBLEM SOLVING (SPB TYPE TRANSFER SWITCH)



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 PERFORM 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. Most problem solving procedures are outlined in the instruction manual unique to the type of logic being used. In addition, several problem solving procedures are presented here which are specific to the type of switches or circuit breakers used in this equipment.

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. Shop Order Number (SO#) or General Order Number (GO#) of transfer switch, plus related Item Number
2. Catalog and/or Style Number of transfer switch
3. Actual location of transfer switch (type of facility, address, etc.)
4. Company name
5. 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

4.6.1 TRANSFER SWITCH APPEARS INOPERATIVE

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

Step 2: Verify that the correct system voltage appears at NORMAL switch. Measure the voltage at the breaker lugs.

Step 3: Verify that the voltage selection plug is in the proper position to match the system voltage.

Step 4: Look for any obviously burned components. Determine the cause and rectify, if possible. Replace defective components after the cause is determined.

Step 5: Press the push-to-close button on the normal switching device. Verify whether or not the system voltage now appears on the load terminals.

If YES: Proceed to check logic for problems in respective logic instruction book.

If NO: Check all power connections and the switching mechanism.

4.6.2 TRANSFER SWITCH WILL NOT AUTOMATICALLY TRANSFER TO NORMAL

Step 1: Check for proper line voltage on N1, N2, N3.

Step 2: Is the normal switching device charged?

If YES: Continue with other procedures.

If NO: Go through section 6.2.4 first before continuing.

Step 3: Is the emergency switch OPEN?

If YES: Proceed to Step 5.

If NO: Proceed to Step 4.

Step 4: Measure voltage between terminals A9 and A8 on the emergency switching device (shunt trip). Does the voltage measure 120 VAC \pm 10 volts? Record reading.

If YES: Check shunt trip in emergency switch.

If NO: Check wiring to A9 and A8.

Step 5: Measure voltage between terminals A1 and A2 on the normal switching device (spring release coil). Does the voltage measure 120 VAC \pm 10 volts? Record reading.

If YES: Check spring release coil in normal switching device.

If NO: Check wiring to A1 and A2.

4.6.3 TRANSFER SWITCH WILL NOT AUTOMATICALLY TRANSFER TO EMERGENCY

Step 1: Check for proper line voltage on E1, E2, E3.

Step 2: Is the emergency switching device charged?

If YES: Continue with other procedures.

If NO: Go through Section 6.2.4 first before continuing.

Step 3: Is the normal switching device OPEN?

If YES: Proceed to Step 5.

If NO: Proceed to Step 4.

Step 4: Measure voltage between terminals A9 and A8 on the normal switching device (shunt trip). Does the voltage measure 120 VAC \pm 10 volts?

If YES: Check shunt trip in normal switch

If NO: Check wiring to A9 and A8.

Step 5: Measure voltage between terminals A1 and A2 on the emergency switching device (spring release coil). Does the voltage measure 120 VAC \pm 10 volts? Record reading.

If YES: Check spring release coil in emergency switch.

If NO: Check wiring to A1 and A2.

4.6.4 TRANSFER SWITCH WILL NOT AUTOMATICALLY RECHARGE SWITCHES

Step 1: Measure the voltage between the terminals A6 and A2 on the switching device that does not automatically recharge. Does the voltage read 120 VAC \pm 10 volts? Record reading.

If YES: Check electrical operator inside the switching device. Refer to SPB Maintenance Manual.

If NO: Verify wiring to A6 and A2.

Step 2: If problem persists contact Cutler-Hammer.

Cutler-Hammer

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Pittsburgh, PA 15220

Effective 6/98 (ISI)
Style 8165A04H02
Printed in U.S.A.

