1. WARNING

SAFETY PRECAUTIONS

a. Do not touch uninsulated parts of the output connector or the battery terminals as there is a possibility of electrical shock.

b. In operation batteries produce hydrogen gas which can explode if ignited. Never smoke, use an open flame, or create arcs or sparks in the vicinity of the battery. Ventilate well when the battery is in an enclosed space or when it is being charged.

c. Lead-acid batteries contain sulfuric acid which causes burns. Do not get in eyes, on skin or clothing. In case of contact flush immediately with clean water. Obtain medical attention when eyes are affected.

d. Connect or disconnect the battery plug only when the charger output is off to prevent arcing and burning.

e. Only qualified personnel should attempt to service this equipment.

f. De-energize all AC and DC power connections before servicing this unit. If injury does occur apply standard treatment for electrical shock and, if necessary, consult with a physician.

2. RECEIVING

When first received, the charger should be unpacked and carefully examined for any possible damage in transit. If practical, it should be operated normally to ensure that all features are functioning properly. Any transit damage should be reported as a claim to the carrier.

3. LOCATION

The charging location should be a clean, cool, well ventilated area. Leave a minimum of four inches of space between the charger and any wall or other equipment, to provide accessibility to all parts and to allow the free flow of air for convection cooling. Air enters through the bottom of the cabinet and exhausts through the back and top.

4. INSTALLATION

A.C. Supply

This charger must be electrically grounded to avoid shock hazard. A terminal inside the cabinet is provided for this (refer to wiring diagram).

Be sure that the A.C. supply and the number of cells and capacity of the battery to be used with this charger correspond with the values shown on the charger nameplate. A.C. connections are to be made directly to the connecting lugs at the fuse block. (Refer to wiring diagram.) The user, for compliance with local codes and convenience in servicing, should have a suitable disconnect switch, with fuses of the dual element type or circuit breaker of the motor starting type, from the A.C. supply to the charger.

Wire size for the A.C. input can be determined from the nominal A.C. input current shown in section 27.03 or on the charger nameplate.
Chargers are labeled, indicating the A.C. voltage for which they are connected at time of shipment. For each voltage range there are also several voltage taps, these being:

<table>
<thead>
<tr>
<th>Nominal A.C. Line Voltage</th>
<th>Transformer Taps</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE 1</td>
<td>208,240</td>
</tr>
<tr>
<td>240 V.A.C. nom.</td>
<td></td>
</tr>
<tr>
<td>RANGE 2</td>
<td>416,448,480</td>
</tr>
<tr>
<td>480 V.A.C. nom.</td>
<td></td>
</tr>
</tbody>
</table>

Determine the actual voltage of the system during the time the chargers are in use and reconnect, if necessary, to the taps nearest that value. See wiring diagrams and transformer connection tables.

When reconnecting for voltages within the same range, only the taps on the transformer connection block need to be changed. When reconnecting from one range to another, the coil connections of the line starter, the A.C. input primary fuses and the transformer taps will need to be changed. (Refer to wiring diagram.) If charger is equipped with options, check options manual for any additional changes required.

D.C. Connections

The D.C. charging cable is provided with the commonly used battery plug or receptacle. Connect the B+ cable to the positive charger terminal and the B- cable to the negative charger terminal. An improper connection will blow the D.C. fuse and possibly cause other damage.

The D.C. fuse is a special "fast" type to protect the rectifier diodes. It is suggested that spares be kept, as no other type should be used.

5. APPLICATION

The model NPC-3c charger line is designed to recharge a normally discharged lead-acid type battery, of the number of cells and ampere-hour capacity as shown on the charger nameplate, within an 8-hour period. For example, an NPC 18-3-680 will recharge any 18 cell lead-acid type battery in an 8-hour time period, that has been discharged 680 amp-hours.

The chargers may also be used to recharge batteries of a larger or smaller amp-hour capacity, but having the same number of cells, with a corresponding change being made in the time required for recharge.

The charger comes properly adjusted in every respect for a battery of the number of cells and ampere-hour capacity specified on the nameplate.

Information given herein refers specifically to the standard 240/480 V.A.C., 60 Hz models. For questions on special applications consult your nearest Exide representative.

6. OPERATION

To operate the charger:

a. Be sure the time-switch is at the "OFF" position.

b. Connect battery to the charging plug.

c. For daily charging turn time-switch knob clockwise to the "daily" position. The pilot lamp will light indicating presence of A.C. The line contactor will close, the charge will start and the charging rate will be indicated on the ammeter. If ammeter does not indicate current, check for:
   — Blown D.C. fuse.
   — Loose or open connections.
   — Defective ammeter or ammeter leads.
Charge will continue until battery is fully charged and then stop automatically with the time-switch in the "OFF" position. (If power source should fail, the line contactor will open, but will reclose and charge will resume automatically when power is restored).

d. If it is ever necessary to interrupt the charge before the timer has stopped, turn the time-switch to "OFF" position BEFORE disconnecting the battery.

e. Once per week, turn time-switch knob to the "weekend" position, to give a long "equalizing" charge, which will help prevent heavy sulphation of the negative plates and reduced battery capacity.

7. OPERATING CHARACTERISTICS

When the charge is first started the battery will usually draw a relatively high current, close to the capacity of the charger. Within a few minutes the charger will adapt itself to the state of discharge of the battery, and will either, stay at the start rate current, if the battery is considerably discharged, or a reduced value if the battery is only slightly discharged. The entire control of the charging rate is by means of the solid-state control unit.
The model NPC-3o uses a constant current, constant voltage, constant current charging method. This unique method is designed to provide the user with a consistently fully charged battery without danger of overcharging and subsequent damage. In operation the charger operates at a fixed "high" initial rate of 16.3 amps per 100 A.H. rated capacity (constant current). As the voltage rises to 2.37 volts per cell it is then held constant (constant voltage) until the charge rate tapers down to approximately 4.5A/100 A.H. This finish rate is held constant (constant current) until the charger shuts off.

The model NPC-3o also employs electronic charge termination. This function is "built into" the control circuitry and provides a means of protecting the battery from overcharge (or undercharge).

Control Unit — This is properly adjusted at the factory for a battery of the same size as the charger rating, and normally requires no attention. Adjustments are quite critical and should be attempted only by a qualified electrician or Exide representative.

The adjustment potentiometers are as follows:

High Current Adjustment \( (R_n) \). This adjustment provides for "start" rate current. It is adjusted in the factory for 16.3 amps per 100 A.H. capacity with a "discharged" (below 2.00 V.P.C.) battery. In addition it provides an upper limit to the output current during the first portion of the charge. (Current Limit)

Voltage Control \( (R_m) \). This control is factory set to determine the point at which the charger will begin to enter its low charge rate (finish rate). It is normally adjusted to provide this function when the battery voltage reaches 2.37 volts per cell (average).

Finish Rate Current. This has no adjustment as it is a function of the start rate setting. If the proper start rate is selected the proper finish rate will be obtained.

This finish rate can range between 4A/100 A.H. to 5A/100 A.H. capacity due to component tolerances but will normally be approximately 4.5A/100 A.H.

8. MAINTENANCE

This charger requires a minimum of maintenance. There are no rotating parts except the time-switch.

It should, of course, be kept clean and all connections tight. Twice yearly or as often as the cleanliness of the area may dictate, the interior should be thoroughly blown out with DRY air.

In the event of any irregular operation, examine, and tighten if necessary, all internal and external connections and check circuits for continuity (see wiring diagram). If the difficulty cannot be remedied, consult the nearest office of Exide Industrial Battery Division.

9. SAFETY TEST

The insulation systems employed in the power transformer protect the user from the likelihood of high voltage primary A.C. being present in the secondary circuit. The evaluation of the condition of insulation should be of great concern to those who operate and maintain electrical equipment. New equipment may be well designed; it may have received careful and proper treatment in manufacture and passed adequate and recognized acceptance tests, and been placed in service in good condition. Over a period of time, however, due to varying climatic, operating and maintenance conditions, insulation deteriorates and becomes weaker. It is, therefore, of vital concern to successful and safe operation that non-destructive tests be made on the insulation to indicate if appreciable deterioration has, or is about to occur.

The use of a 500-volt insulation resistance tester is recommended for these tests and should be used at regular intervals. The frequency of test should be based on actual service conditions with more frequent test with more severe conditions. Records should be maintained which show the service life, temperature, and insulation resistance. By plotting the aging characteristics of the individual insulation system the trend condition of the system can be established. Any rapid change in trend could indicate incipient troubles from insulation deterioration.

To conduct these tests remove the secondary power wires X1, X2, X3 from their termination points at the rear of the mag amps. Also remove all wires from the control module. Apply the insulation resistance tester from these three windings to their corresponding primary coil points H1, H2, and H3. Also check from primary to ground and secondary to ground. Typical values of 100 megohms can be expected on new equipment.
10. ROUTINE CHECKING

Caution: If necessary to test this charger, do not use a megger of any potential higher than its rated voltage as such may damage the silicon diodes or other parts.

a. There is no need of a detailed check of these chargers if they are functioning properly, this being indicated by:
   — Proper current and voltage are obtained with proper "transition" between modes (constant current-voltage-current).
   — Proper functioning of time-switch to terminate the charge.
   — Proper overall results as shown by battery receiving complete charge without appreciable overcharge.

b. When checking or adjusting these chargers at any time:
   — A voltmeter, ammeter and ohmmeter are necessary. Make sure all meters are accurate.
   — For convenience, draw a graph of the V-I curve showing total voltage and current of the size being checked. It will save a lot of figuring.
   — Before changing the control unit potentiometer, mark its original position for reference.

c. Sometimes it is desirable to make a routine check of a charger or group of them, in which case this procedure is suggested:
   — Check A.C. line voltage to insure that it is within 10% of the value for which the transformer taps are set. Change taps if necessary.
   — Examine for possible hot or loose connections, particularly at fuse and control unit.
   — Operate for 10 to 15 minutes to warm up.
   — Connect a fully-charged battery, allow current to stabilize, then measure both "start" and "finish" current and determine that the "voltage" control is operating properly and the electronic charge termination function starts the timer motor.

11. TROUBLESHOOTING PROCEDURE

When a charger is not operating properly, the cause must be determined by checking the various components until the fault is located. At times, the fault may be quite obvious, but when not, the following sequence of procedure is suggested. See later paragraphs covering each item.

a. For any condition:
   — Check A.C. voltage to insure that it is within 10% of the value for which the transformer taps are set.
   — Examine charger for any evident loose or improper connections, particularly at the control unit.
   — Check accuracy of ammeter.

b. No Output — Check:
   — Battery connector.
   — Battery connection at charger terminals.
   — All fuses (D.C. battery fuse first).
   — Power Line Contactor.
   — Control Unit.
   — Follow circuit through transformer, mag-amps and diodes.

c. Heavy Overload (D.C.) — Check:
   — Polarity of battery connection.
   — Control Unit.
   — Diodes.
   — Mag-Amps.

d. A.C. Overload only — Check:
   — Transformer.
   — One or more diodes being open, thus unbalancing the system and overloading one portion.
   — Mag-Amps.

e. High or Low Output — Check:
   — Control Unit.
   — Diodes.
   — Mag-Amps.

f. Oscillation — Check:
   — Control Unit.

g. Charge Fails to Stop — Check:
   — Electronic Charge Termination.
   — Time-Switch.
12. COMPONENTS—
TESTING OF

a. Line-Contactor

With the time-switch dial in the “ON” position the line-contactor should close and A.C. voltage should be available at the load side with no measurable drop. Check connections of contactor coils and also the heater elements (if used) to insure that they agree with the voltage range in use. If contactor does not close, press re-set button, and check contacts of time-switch by measuring voltage at coil terminals. If proper voltage is at the coils and contactor does not close, check each coil separately with ohmmeter for continuity.

b. Fuses

Make sure all fuses are the proper size and type — See Parts List. Check fuses preferably by removing them and testing with an ohmmeter or lamp circuit, etc. Make sure that contact surfaces of fuse and clip or mounting are clean and tight. In an energized circuit, there should be no significant voltage drop across them. Always keep a stock of spare fuses. Do not substitute other fuse styles or sizes as the fuses employed in these chargers are dual element, time delay, motor start rated fuses which are sized to fit the characteristics of the transformer type load.

c. Transformers

In checking the transformers, look for visual indications of overheating and measuring the voltage of all primary and secondary windings (assuming they can be energized without blowing fuses, etc.). All primary windings should have full normal A.C. voltage across them. Make sure the taps of all phases are similarly connected and that all 3 secondaries indicate equal voltage. Make this check on open circuit and under load if practical. If any of the above voltages show an appreciable difference, replacement is necessary.

d. Diodes

These should preferably be checked by disconnecting one side of them and measuring their forward and reverse resistance in either of two ways. In using an ohmmeter, use the RX1 scale for the forward resistance and this should show around 5 to 10 ohms. The reverse resistance should be up in the thousands of ohms (probably 50,000 or more) measured, of course, with a higher scale of the meter. The diodes may also be checked by connecting them in series with a 6- or 12-volt lamp across a D.C. source of the same voltage. The lamp must be one which requires at least one-quarter ampere. The lamp should light with nearly full brilliance with current flowing in the forward direction and not at all in reverse. If it lights in both directions, the diode is shorted — if in neither direction, the diode is “open.”

Diodes 1, 2, and 3 are reverse polarity. Thus they have an anode stud rather than the standard cathode stud. A reverse polarity diode cannot be interchanged with a standard polarity diode. The polarity is marked by an arrow on the side of the diode.

e. Magnetic Amplifiers

If trouble is suspected in the magnetic amplifiers (and the charger can be operated) measure the voltage across the main or gate windings of each one. These voltages should be essentially the same. If they are not, de-energize the charger and disconnect the leads from the mag-amps to the control unit. Then:

Check for grounds between all windings of the mag-amp and case. If any ground is found, separate the windings successively until the point of grounding is located and remedy if possible. If it cannot be corrected, all mag-amps should be replaced as they must be matched.

If there are no grounds, measure the resistance of all windings, being sure, of course, to open the necessary connections to isolate the windings when making these measurements. The resistance of all comparable windings should be within about 2%. For example, all main or gate windings should be within the range of each other. (These gate windings may be difficult to check because of their very low resistance.) The “control” and “bias” windings are all of equal resistance except on 3-phase rectifiers where one coil may be wound on top of the other. This results in the outer coil having a resistance perhaps 10% greater than the inner one, but all the inner ones should be comparable with each other and all the outer ones comparable with each other. If any wide differences in resistance are found, all mag-amps will require replacement.

If there are neither grounds nor appreciable differences in the resistance of the windings, check for possible mis-connection of the windings, i.e., windings connected in reverse. If the above checks indicate no fault, the mag-amps are not the source of trouble.
f. Time-Switch

Check whether the timer is running under the conditions that it should be. Check whether proper A.C. voltage is present at the actual motor terminals. Also turn the timer pointer to a position corresponding to a few minutes before shut-off and wait to learn if it completes the termination properly. If it does not function correctly in every respect it should be replaced.

g. Control Unit

Review the data given in Section 7. If adjustment has no effect, a check of the following voltages and currents will determine if improper operation is being caused by a defective control unit.

**Terminals #1 & #8** — With the charger turned off and the battery connected, you will typically read 1.35 V.D.C. across these terminals. If not check all the connections between battery and these terminals.

**Terminals #9 & #10** — With the charger output at maximum you should see approximately 35 MV. D.C. At any output other than maximum the MV. should be proportionately lower. (i.e., at half rated output you should see approximately 17.5 MV. D.C.)

**Terminals #2, #3, #4, & #8** — Terminal #8 should be considered “neutral” or “common.” Between terminal #8 and terminal #2 or #3 or #4 you should measure approximately 13.5 volts A.C.

**Terminal #6** — This is the Mag.-Amp. bias winding. At maximum output there should be approximately 50 MA D.C. flowing through wire #23. This can be checked by inserting a D.C. milliammeter (0 to 100 MA) in series between wire #23 and terminal #6 (terminal #6 being negative).

**Terminal #7** — This is the Mag.-Amp. control winding. At maximum output, in the same manner as for terminal #6 above, there should be approximately 165 MA D.C. flowing through wire #22. This again can be checked in the same manner as outlined above.

**Note:** The readings for terminals #6 & #7 will change in opposite direction as the charger output decreases. The bias current will rise and the control current will fall; the bias current will reach a maximum of 145 MA and the control current can read as low as zero.
To Check Operation of the Electronic Charge Termination Feature—

1. Connect a A.C. voltmeter across terminals #11 & #12 of the control unit.
2. With the charger running at high rate (voltage below 2.37 V.P.C.) 13 V.A.C. should be present showing the relay has not closed.
3. After the charger gets to finish rate (above 2.37 V.P.C.) there should be zero volts indicating relay has closed. Timer motor should now be running.
4. REFER TO CONTROL UNIT ADJUSTMENT — Install a D.C. variable voltage source as per the procedure outlined.
5. With the D.C. source adjusted for under 2.36 V.D.C. there should be an open circuit indicated on the continuity tester between #11 and #12.
6. With the D.C. source adjusted for over 2.40 V.D.C. there should be continuity between terminals #11 & #12.

To Adjust the Output Characteristic of the Control Unit—

1. Isolate the charger from both A.C. line and battery.
2. Remove wire #24B from top connection on F1.
3. Using a suitable source of regulated variable D.C. voltage connect the negative lead to wire #24B and the positive lead to top connection on the shunt (wire #25 or #25A).
4. Restore A.C. line to the charger.
5. Connect a discharged battery (avg. cell voltage of 2.00 volts/cell) to the charger.
6. Set the regulated variable D.C. voltage supply to 2.00 volts/cell avg. The charger should be in the high rate mode (16.3 amps/100 AH capacity). If output is too high or too low adjust R17 for correct setting (starting rate).
7. With the start rate properly adjusted set the regulated variable D.C. voltage supply to 2.37 volts/cell avg. It is at this point that the charger should switch into low rate. Adjust R21, for a mid-range current around 8 amps/100 AH capacity.
8. Set the regulated variable D.C. voltage supply to 2.40 volts/cell avg. and confirm that the finish rate current is approximately 4.5 amps/100 AH capacity. There is no finish rate adjustment as this function is a constant of the module and is a function of the start rate setting. If the proper start rate is selected the proper finish rate will be obtained.

Note: Before attempting any of the above adjustments, the I-E-I characteristic should be thoroughly understood. In addition, battery condition, A.C. input, PVT taps, etc., will affect the output. A check of these items should be made before attempting any adjustment of the control unit characteristic. Make any adjustments slowly allowing the control unit time to respond.

To Change Input Voltage Range:
1. Change coil connection.
2. Change Transformer connections.
3. Change primary fuses.

<table>
<thead>
<tr>
<th>Transformer Connections</th>
<th>FOR 240/480 VOLT DUAL RANGE UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>208</td>
</tr>
<tr>
<td>H1 to 14</td>
<td>11 to 14</td>
</tr>
<tr>
<td>11 to 15</td>
<td>13 to 17</td>
</tr>
<tr>
<td>H2 to 24, 24</td>
<td>21 to 24</td>
</tr>
<tr>
<td>21 to 25</td>
<td>23 to 27</td>
</tr>
<tr>
<td>H3 to 34, 34</td>
<td>31 to 34</td>
</tr>
<tr>
<td>31 to 35</td>
<td>33 to 37</td>
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<tr>
<td>15 to 24</td>
<td>17 to 24</td>
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<tr>
<td>25 to 34</td>
<td>27 to 34</td>
</tr>
<tr>
<td>35 to 34</td>
<td>37 to H1</td>
</tr>
</tbody>
</table>