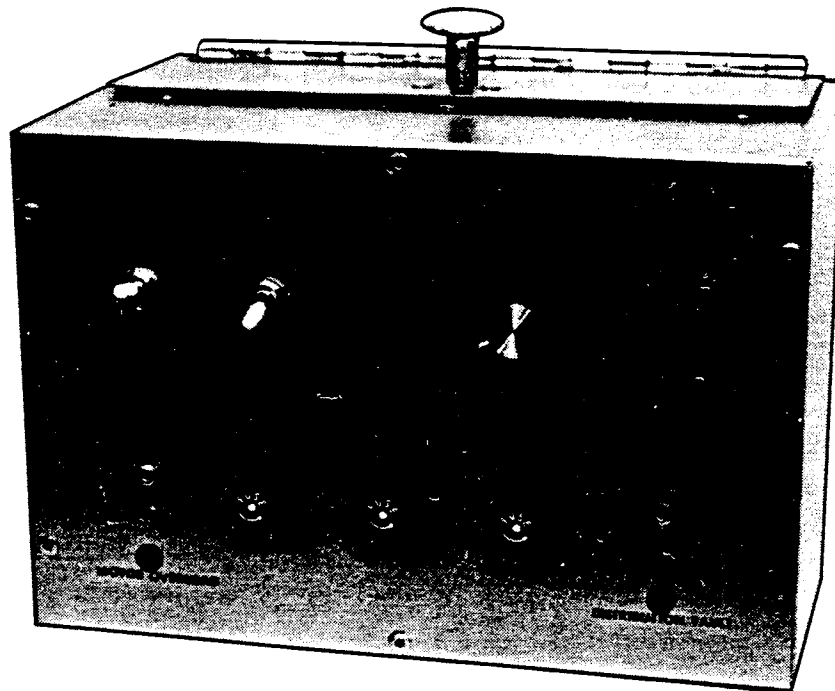





TOL-90 CTV SOLID STATE OVERLOAD TESTER INSTRUCTION MANUAL



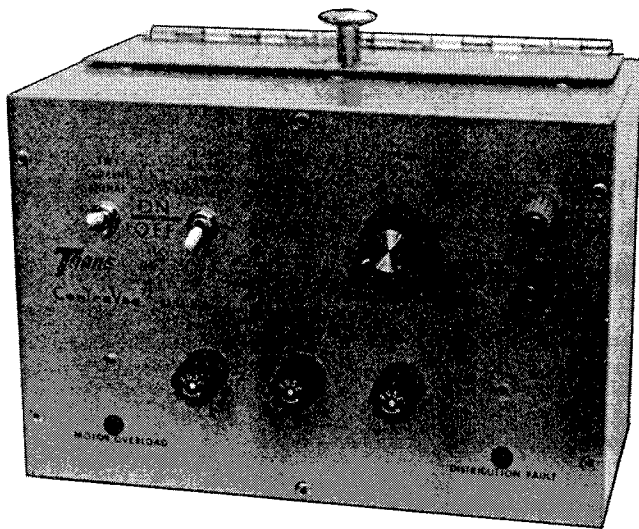
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		OPER.- MAIN.

Since the Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

FEBRUARY 1983



CENTRAVAC SOLID STATE OVERLOAD TESTER FOR USE WITH LIQUID CHILLERS- CENTRIFUGAL ELECTRIC DRIVE CENTRAVAC

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GENERAL INFORMATION

This manual provides instructions for testing the Trane CenTraVac Solid State Overload (SSOL) Module using the TOL-90 tester. Included is a description of the tester, a list of additional recommended test equipment, a copy of a test log and proper testing procedures. It may be necessary to refer to Trane Service Bulletin CTV-SB-22 or appropriate sections of CenTraVac Service Guides for additional information concerning calibration of the SSOL.

TESTER DESCRIPTION

The TOL-90 Solid State Overload (SSOL) tester has the following features:

1. Simulates any level of motor current from zero to ten times the Rated Load Amps (RLA).
2. Simulates the operation of the 1M (K27) starter contactor auxiliary.
3. Gives visual indication of a MOTOR OVERLOAD trip due to excessive locked rotor current or motor running current.
4. Gives visual indication of a DISTRIBUTION FAULT trip.

The TOL-90 front panel includes the following items: (See Figure 1)

1. CURRENT SIGNAL switch (SW1) which turns the current simulation signal to the SSOL on and off.
2. 1M CONTACTOR AUXILIARY switch (SW2) which simulates the operation of the 1M contactor.
3. A pair of output terminals (B1-B2) to which a digital voltmeter is attached to monitor the simulated current level to the SSOL.
4. Two indicator lights. One to indicate when the SSOL is giving a DISTRIBUTION FAULT signal and one to indicate when the SSOL is giving a MOTOR OVERLOAD signal.
5. Three fuses (F1,F2,F3) to protect the tester and SSOL from damage due to incorrect hookup of the tester or a defective SSOL.

DOL-90 SSOL TESTER OPERATION

The SSOL tester simulates motor current by placing a variable DC test voltage across the B1-B2 terminals of the SSOL instead of the current calibrator.

NOTE: A digital voltmeter is required to read this test voltage.

The magnitude of this CURRENT SIGNAL is such that 1.0 VDC = 100% RLA. The current is directly proportional to motor current draw (see Table 1). The source of this voltage is the +15 VDC power supply in the SSOL. The ON-OFF switch (SW1) is used for switching off the current signal.

The MOTOR OVERLOAD and DISTRIBUTION FAULT trip indicators are powered by the same SSOL outputs that trip the fault circuit breakers. An overload is indicated by a steady, glowing MOTOR OVERLOAD light. A DISTRIBUTION FAULT is indicated by a flashing DISTRIBUTION FAULT light. The flashing is due to a pulsed output from the SSOL.

RECOMMENDED ADDITIONAL TEST EQUIPMENT

1. Digital voltmeter - required.
2. Clamp-on ammeter
3. Timer or clock with second hand.

Refer to Trane Service Bulletin CTV-SB-22A for specific operation and calibration information regarding the SSOL.

OPERATING INSTRUCTIONS

Prior to testing the SSOL, fill in the "General Information" section on the Test Log, page 5. The information in this section corresponds to the information in the lower portion of the Test Log.

CAUTION: When performing the following tests, do not short output terminals F1/E1, F2/E2, E3/F3, or E4/F4 together. Damage to the SSOL could result.

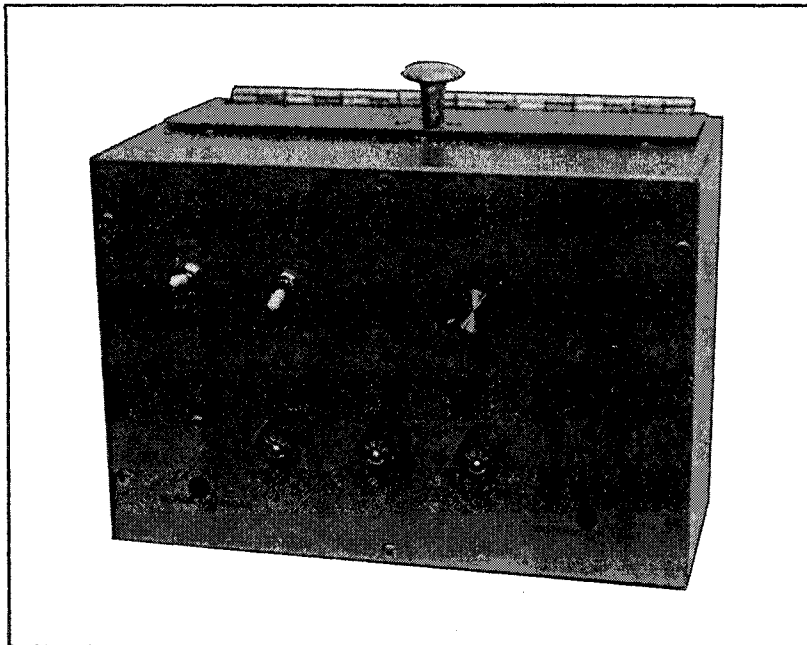


FIGURE 1 - Solid State Overload Tester, TOL-90

Preliminary Measurements

NOTE: Steps 1, 2 and 3 following, must be made with the chiller operating. The readings and calculation determined in Step 3 must be recorded on the Test Log shown on page 5.

WARNING: WHEN TESTING ENERGIZED CIRCUITS, EXTREME CARE MUST BE EXERCISED TO PREVENT COMING IN CONTACT WITH ENERGIZED COMPONENTS WITH THE HANDS. FAILURE TO EXERCISE CAUTION MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH DUE TO ACCIDENTAL ELECTRIC SHOCK.

1. Measure and record motor running current using a clamp-on ammeter.
2. As motor running current is measured (step 1), measure and record the DC voltage across the current calibrator resistor at Terminals B1 and B2 on the SSOL using a digital voltmeter.
3. Divide the Step 1 measurement by the Step 2 measurement to obtain a multiplier expressed by AMPS/VDC. This multiplier should equal the motor RLA if the current transformers and current calibrators are properly selected. This multiplier is used to obtain actual current values corresponding to the DC voltage readings obtained in the Functional Tests. The calculation is:

$$(DC \text{ VOLTAGE FROM TEST LOG}) \times (\text{MULTIPLIER}) = \text{ACTUAL MOTOR CURRENT}$$

NOTE: Before proceeding with Step 4, the chiller must be turned off. However, control power must remain energized in Steps 4 through 6.

4. Measure and record the voltage between Terminals XX1 and X2 on the SSOL. The voltage here is normally 115 VAC.
5. Measure and record the voltage between the +15 VDC terminal (on the swingout board) and Terminal B2. This voltage should be between +14.25 VDC and +15.75 VDC. If the voltage is out of tolerance, the SSOL will probably fail the Functional Tests and require replacement.

NOTE: If the SSOL is not equipped with a swing-out board, the +15 VDC output can be measured between the cathode (designated by a silver stripe) of Diode D19 located on the main printed circuit board and Terminal B2. This voltage should be between +14.25 VDC and +15.75 VDC.

6. Measure and record the voltage between the -15 VDC terminal on the swing-out board and terminal B-2. If the voltage is out of tolerance, the SSOL will probably fail the Functional Tests and require replacement.

NOTE: If the SSOL is not equipped with a swing-out board, the -15 VDC output can be measured between the anode (end opposite of silver stripe) of Diode D18, located on the main printed circuit board, and Terminal B2. This voltage should be between -14.25 VDC and -15.75 VDC.

WARNING: WIRING AT TERMINALS S1 AND D1 ON THE SOLID STATE OVERLOAD (SSOL) MUST BE DISCONNECTED TO PREVENT ACCIDENTAL COMPRESSOR START-UP DURING THE TEST SEQUENCE. FAILURE TO DISCONNECT THIS WIRING MAY RESULT IN PERSONAL INJURY OR EQUIPMENT DAMAGE.

7. Disconnect wiring from Terminals S1 and D1 on the SSOL.

WARNING: TRIP ALL SAFETY TRIP INDICATORS ON THE CONTROL PANEL AND STARTER TO PREVENT ACCIDENTAL COMPRESSOR START-UP DURING THE TEST SEQUENCE. FAILURE TO TRIP THE SAFETY TRIP INDICATORS MAY RESULT IN PERSONAL INJURY OR EQUIPMENT DAMAGE.

8. Trip the safety trip indicators on the control panel and starter to prevent compressor start-up during testing procedures.
9. Remove the Current Calibrator resistor from Terminals B1 and B2 on the SSOL.
10. Connects the leads from the TOL-90 tester to the matching terminals on the SSOL and the swing-out board (refer to Figure 2). It may be necessary to loosen the terminal screws on the SSOL.

NOTE: If the SSOL is not equipped with a swing-out distribution fault board, leave leads E3/F3 and E4/F4 **unconnected** and connect lead +15 to the cathode (designated by a silver stripe) of diode D19 on the main printed circuit board.

11. Connect the positive (+) lead of a digital voltmeter to the test point on TOL-90 labeled B1. Connect the negative (-) lead to the test point labeled B2. Set the voltmeter on the 20 VDC scale.
12. Energize the SSOL by applying 115 VAC at Terminals XX1 and X2.

The following functional tests can now be completed.

TABLE 1 - CenTraVac Running Current Vs. SSOL Proportional Current Signal

FUNCTION	NOMINAL CURRENT LEVEL (% OF RLA)	VOLTAGE ACROSS CURRENT CALIBRATOR (B1-B2)
Maximum Locked Rotor Trip Setting	1070%	10.70 VDC
Typical Locked Rotor Amps (LRA)	250%	2.50 VDC
Motor Overload Trip Level	107%	1.07 VDC*
Motor Rated Load Amps (RLA)	100%	1.00 VDC
Motor Starter Transition Level	85%	0.85 VDC*
Distribution Fault Trip Level	20%	0.20 VDC*
Motor De-energized	0%	0.00 VDC

*Actual measured test voltage may vary slightly from the values indicated. Refer to the corresponding test instructions for details.

FUNCTIONAL TESTS

A. Acceleration Time Limit (60 HZ)

1. Set frequency switch on SSOL to 60 HZ.
2. Set Digital Volt Meter (DVM) on 20 VDC scale.
3. Turn SW2 to OFF.
4. Turn SW1 to ON.
5. Turn the CURRENT SIGNAL ADJUST knob until DVM reads approximately 2.0 VDC.
6. Set maximum acceleration time switch on SSOL to desired setting.
7. Turn SW2 ON. The MOTOR OVERLOAD LED should light after the time set in Step 6 has elapsed.
8. Record the actual time observed (See Test Log, part II).

B. Acceleration Time Limit (50 HZ)

1. Set frequency adjustment switch on SSOL to 50 HZ.
2. Repeat Steps 2 through 8 from Test A.
3. Return the frequency adjustment switch to normal position.

C. Locked Rotor Trip Level

1. Set maximum acceleration time limit switch on SSOL to maximum setting all switches on. This allows 63 seconds to perform this test prior to MOTOR OVERLOAD indication due to acceleration time limit.

2. Turn SW2 Off.

3. Set DVM on 20 DVC scale.

4. Turn SW1 ON.

5. Adjust CURRENT SIGNAL until the DVM reads approximately 1.5 VDC or greater.

6. Turn SW2 ON. (Acceleration time limit is now in effect).

7. Increase CURRENT SIGNAL until the MOTOR OVERLOAD LED lights. This indicates that the locked rotor trip level has been exceeded. If the acceleration time limit is exceeded in this step, reset by switching SW2 OFF, then ON.

8. Record the trip level DC voltage obtained in Step 7. Multiplying this value by 100 will give the percentage of RLA. For example, a reading of 6.50 VDC corresponds to 650 percent of RLA. This should be equivalent to the setting of the LRA set potentiometer on the SSOL. Figure 3 represents the LRA set potentiometer. The calibrating screw should be turned fully counter-clockwise then rotated clockwise to the desired setting.

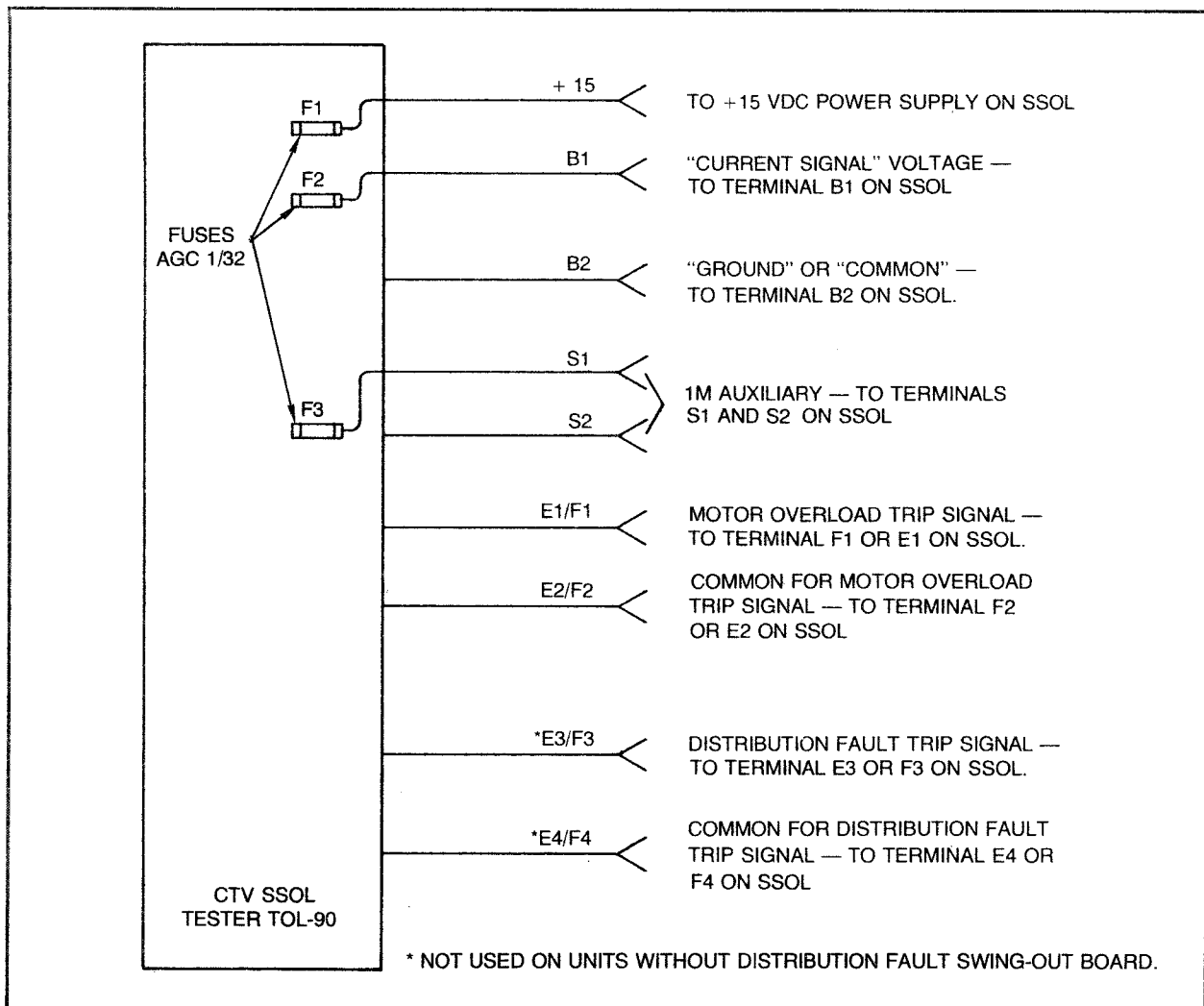


FIGURE 2 - TOL-90 Solid State Overload Tester Connection Diagram

D. Transition Level

1. Turn SW2 OFF.
2. Turn SW1 ON.
3. Adjust the CURRENT SIGNAL until the DVM reads approximately 1.20 VDC.
4. Turn SW2 ON.
5. Slowly reduce the CURRENT SIGNAL. Listen and watch for the transition relay on the SSOL to pull-in and notice the DVM reading.
6. Record the reading on the test log. The SSOL should be set to transition at 85 percent of RLA. Due to the nature of the CURRENT SIGNAL during actual operation and the SSOL circuit design, the corresponding test voltage will be approximately .80 VDC, \pm .07 VDC.

E. Motor Overload Trip Level

1. Turn SW2 OFF.
2. Turn SW1 ON.
3. Adjust the CURRENT SIGNAL until the DVM reads approximately 0.60 VDC.
4. Turn SW2 ON. The transition relay on the SSOL should pull-in after approximately one second.
5. Increase the CURRENT SIGNAL. Note the DVM reading when the MOTOR OVERLOAD indicator lights.
6. Record the DVM reading noted in Step 5. The SSOL should be set to trip at 107% of RLA. Due to the nature of the CURRENT SIGNAL during actual operation and the SSOL circuit design, the corresponding test voltage will be approximately 1.13 VDC \pm .05 VDC.

F. Motor Overload Trip Level with 10% Jumper Removed

1. Remove the 10% jumper from Terminals J1 and J2 on the SSOL.
2. Repeat Steps 1 through 5 from Test E.
3. Record the value obtained in Step 5, Test E. This value should be approximately 10 percent less than the value obtained in Test E (1.02 VDC \pm 0.05 VDC).
4. Reconnect the jumper to Terminals J1 and J2 on the SSOL.

G. Distribution Fault Trip Level

1. Turn SW2 OFF.
2. Turn SW1 ON.
3. Adjust CURRENT SIGNAL to approximately 0.50 VDC.
4. Turn SW2 ON. The transition relay on the SSOL should pull-in after approximately one-second.
5. Adjust the CURRENT SIGNAL slowly downward. Note the DVM reading when the DISTRIBUTION FAULT indicator lights.
6. Record the DVM reading noted in Step 5. The SSOL used in model CVAC chillers shipped after June 1982 and all CVHE chillers should trip at approximately 15 percent of RLA. CVAC chillers shipped before June 1982 and all CVHA chillers should trip at approximately 20 percent of RLA. Due to the nature of the CURRENT SIGNAL during actual operation and the SSOL circuit design, the corresponding test voltages must be 0.13 VDC \pm 0.05 VDC and 0.18 \pm 0.05 VDC, respectively.

H. Load Proportional DC Voltage Signal

1. Turn SW1 ON.
2. Adjust the CURRENT SIGNAL until the DVM reads as closely as possible to 1.00 VDC.
3. Remove the (+) voltmeter lead from the test point B1 and measure the voltage at Terminal V1 on the SSOL. This voltage should read -8.25 VDC \pm 0.20 VDC.

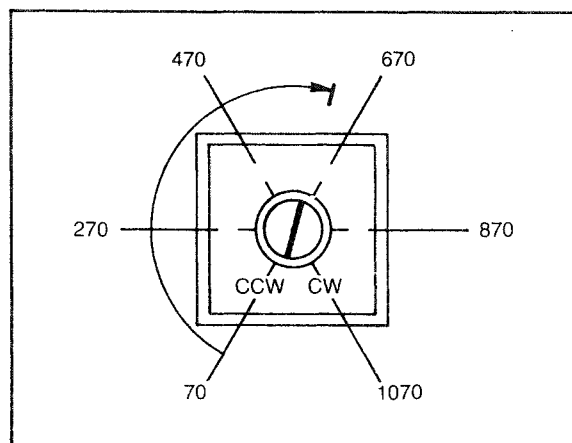


FIGURE 3 — LRA Set Potentiometer

4. Recheck the CURRENT SIGNAL voltage at test point B1 to verify that it is still as close as possible to 1.00 VDC. If not, readjust CURRENT SIGNAL and repeat Step 3.
5. Record the final DVM reading obtained in Step 3.

DRY RUNNING A STARTER USING THE TOL-90 TESTER

WARNING: BEFORE CONDUCTING THE FOLLOWING TESTS DISCONNECT ALL ELECTRICAL POWER. FAILURE TO DO SO MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH DUE TO ACCIDENTAL ELECTRIC SHOCK.

After disconnecting the compressor motor leads for dry-running the starter, TOL-90 can be used to simulate different current conditions in the motor. The CURRENT SIGNAL can be adjusted to verify starter transition and operation of the motor overload and distribution fault circuit breakers.

1. After power to the starter has been disconnected, disconnect the motor leads at the motor or at the starter depending upon ease of access. Isolate the leads to prevent contact since they may be energized during the dry-run.
2. DO NOT DISCONNECT any control wiring from the SSOL. If any wiring was disconnected for prior tests, reconnect it before proceeding.
3. Remove the current calibrator resistor from Terminals B1 and B2 on the SSOL.
4. Connect leads +15, B1 and B2 of TOL-90 to the SSOL. E1, E2, E3 and E4 may be connected if indication of motor overload and distribution fault is desired.
5. Connect a DVM to the B1 (+) and B2 (-) test points on TOL-90.

Test Procedure

1. Close the disconnect or circuit breaker to apply power to the starter and SSOL.
2. Turn SW1 ON.
3. Adjust CURRENT SIGNAL to approximately 1.50 VDC or to a value corresponding to the calculated LRA (see Figure 1).
4. Provide a start signal to the starter.
5. Reduce the CURRENT SIGNAL to approximately 0.60 VDC and verify that transition occurs.

6. Increase the CURRENT SIGNAL to approximately 1.25 VDC and verify that the motor overload circuit breaker trips.
7. Repeat Steps 1 through 5.
8. Turn SW1 OFF and verify that the distribution fault circuit breaker trips.
9. De-energize the starter and SSOL.
10. Remove TOL-90 and reconnect the current calibrator resistor to Terminals B1 and B2 on the SSOL.

Test Completion Checklist

1. Set frequency adjustment switch on SSOL to desired setting (50/60 HZ).
2. Set maximum acceleration time switch on SSOL to desired setting.
3. Reconnect the current calibrator resistor to Terminals B1 and B2 on the SSOL.
4. Reconnect the wires to Terminals S1 and D1 on the SSOL.
5. Reconnect the 10% jumper to Terminals J1 and J2 on the SSOL, if required.

TOL-90 CHECKOUT PROCEDURE

WARNING: WHEN MEASUREMENTS AND ADJUSTMENTS MUST BE MADE WITH ELECTRIC POWER ON, EXTREME CARE MUST BE TAKEN TO AVOID CONTACT WITH EXPOSED ENERGIZED PARTS. CONTACT WITH ENERGIZED PARTS MAY RESULT IN ELECTRIC SHOCK CAUSING SERIOUS PERSONAL INJURY OR DEATH.

1. Using an ohmmeter on the 200 K scale:
 - a. Connect the (+) ohmmeter lead to the B2 lead and connect the (-) ohmmeter lead to the +15 lead.
 - With SW1 ON, infinite ohms should be measured.
 - With SW1 OFF, infinite ohms should be measured.
 - b. Connect the (+) ohmmeter lead to the +15 lead and connect the (-) ohmmeter lead to the B2 lead.
 - With SW1 OFF, infinite ohms should be measured.
 - With SW1 ON, 20 K to 100 K should be measured. If infinite ohms is measured, check Fuse F1.

2. Using an ohmmeter set on the 20 K scale, connect the (+) ohmmeter lead to the B1 lead and connect the (-) ohmmeter lead to the B2 lead.

- a. Turn the CURRENT SIGNAL ADJUST knob fully clockwise. Approximately 10 K ohms should be measured.
- b. Turn the CURRENT SIGNAL ADJUST knob fully counter-clockwise. Approximately 0.01 K to 0.06 K ohms should be measured.
- c. The resistance measured should vary smoothly between 0.01 K and 10 K when the knob is turned from fully counter-clockwise to fully clockwise.
- d. If infinite resistance is measured, check Fuse F2.

3. Using an ohmmeter set on the 20 K scale:

- a. Connect the (+) ohmmeter lead to the S1 lead and connect the (-) ohmmeter lead to the S2 lead.
- b. With SW2 OFF, infinite ohms should be measured.
- c. With SW2 ON, 0.01 K to 0.06 K ohms should be measured. If infinite ohms are measured, check Fuse F3.

4. This test requires a DC voltage source of at least 6 VDC, but not more than 60 VDC. The greater voltage will produce more easily detectable results. Using the +15 Terminal as the (+) supply terminal and the -15 terminal as the (-) supply terminal, a 30 VDC supply will result.

- a. Connect lead E1/F1 to the (-) terminal and connect lead E2/F2 to the (+) terminal. There should be no indicator lights on.
- b. Connect lead E1/F1 to the (+) terminal and connect lead E2/F2 to the (-) terminal. The MOTOR OVERLOAD LED should be on.
- c. Connect lead F3 to the (-) terminal and connect lead F4 to the (+) terminal. There should be no indicators on.
- d. Connect lead F3 to the (+) terminal and connect lead F4 to the (-) terminal. The DISTRIBUTION FAULT indicator LED should be on.

CENTRAVAC SOLID STATE OVERLOAD TEST FORM

GENERAL INFORMATION:

CenTraVac:

Model # _____

Serial # _____

Sales Order # _____

Starter:

Type _____

Vendor _____

Model # _____

Serial # _____

Solid State Overload:

Number from Nameplate _____

Current Calibrator # _____

Current Calibrator Setting _____ Ohms

Locked Rotor Trip Setting _____ %

Acceleration Time Limit Setting _____ sec.

Motor Nameplate Data

RLA _____ Amps

LRA _____ Amps

(LRA/RLA) _____

Voltage _____

Current Transformer Ratio _____

Actual Line Voltage _____ Volts

Frequency _____ Hz

TEST DATA:

I. Preliminary Measurements:

- A. Motor Running Current _____ Amps
 B. Corresponding DC Voltage Across Current Calibrator _____ VDC
 C. Multiplier (A/B) _____ Amps/VDC
 D. Voltage from XX1 to X2 _____ VAC
 E. Voltage from +15 to GND _____ VDC
 F. Voltage from -15 to GND _____ VDC

II. Functional Tests:

- A. Acceleration Time Limit (60 Hz) _____ sec.
 B. Acceleration Time Limit (50 Hz) _____ sec.
 C. Locked Rotor Trip Level _____ VDC
 D. Transition Level _____ VDC
 E. Motor Overload Trip Level _____ VDC
 F. Motor Overload Trip Level with 10% Jumper Removed _____ VDC
 G. Distribution Fault Trip Level _____ VDC
 H. Voltage from V1 to V2 @ 1.000 VDC from B1 to B2 _____ VDC