STANDARD OVERHAUL PRACTICES MANUAL

ELECTRICAL AND ELECTRONIC COMPONENT STANDARD TESTING INSTRUCTIONS

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To: All holders of ELECTRICAL AND ELECTRONIC COMPONENT STANDARD TESTING INSTRUCTIONS 20-11-09.

Attached is the current revision to this STANDARD OVERHAUL PRACTICES MANUAL

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INTRODUCTION

1. General

A. The instructions in this manual tell how to do standard shop procedures during maintenance functions from simple checks and replacement to complete shop-type repair.

B. This manual is divided into separate sections:

(1) Title Page

(2) Transmittal Letter

(3) Highlights

(4) Effective Pages

(5) Contents

(6) Revision Record

(7) Record of Temporary Revisions

(8) Introduction

(9) Procedures

C. Refer to SOPM 20-00-00 for a definition of standard industry practices, vendor names and addresses, and an explanation of the True Position Dimensioning symbols used.

D. The data is general. It is not about all situations or specific installations. Use it as a guide to help you write minimum standards.

E. If the component overhaul instructions are different from the data in this subject, use the component overhaul instructions.

ELECTRICAL AND ELECTRONIC COMPONENT STANDARD TESTING INSTRUCTIONS

1. INTRODUCTION

A. The procedures in this subject are for electrical or electronic module assemblies which do not have overhaul instructions in a component-specific manual. These units could contain items such as switches, lamps, relays, capacitors, diodes, resistors, zener diodes. This includes components mounted separately, or in a small unit whose function can be easily known from its schematic diagram.

B. If the unit has a component-specific overhaul manual or component maintenance manual and the instructions in it are different, use the instructions in the component-specific manual.

2. EQUIPMENT

A. Use standard industry test equipment, such as multimeters, power supplies, etc.

B. Make sure the total error of all instruments used in the measurement is no more than 25 percent of the value of the measurement.

3. DEFINITIONS

A. Component - Any circuit element other than a wire segment, splice, lug, shield, connector, or other item related to wiring. Examples of components are capacitors, diodes, relays, resistors, SCRs, switches, transformers, and transistors.

B. Conditional node - A group of pins that are electrically common because of the condition (position) of a relay or switch.

C. Continuity - A resistance of 3 ohms or less.

D. Open Circuit - A resistance of 900 kilohms or higher.

E. Node - A group of connector pins that are electrically common because of electrical wiring or components inside the unit.

4. GENERAL

A. In general, do these tests, as applicable:

(1) Continuity and open-circuit tests on all units.

(2) An electrical test for each component of the unit, if the unit includes electrical components such as switches, resistors, diodes.

(3) A functional test for components that cannot be isolated individually.

B. Be sure to give all components protection from too much voltage or current.

C. The continuity and open circuit tests are to make sure that the wires and the components are correctly installed, and that insulated conductors are electrically isolated from each other and from the chassis.

D. The component test is to make sure that the item is correctly installed, and to be sure the electrical characteristics of the item are within specified limits. This test is for components that are individually connected in the circuit with access through pins from the assembly connectors.

E. The functional test is for components that are connected together in the circuit where one item cannot be examined by itself. For example, a diode connected across a relay coil cannot be given a resistance test because of the parallel resistance of the coil. Or a resistor in series with a zener diode without access to the junction between them cannot be given a resistance test. These units must be given a functional test as a combination of the individual components.

5. CONTINUITY AND OPEN CIRCUIT TESTS

A. Measure the continuity of all connector pins in each node and each conditional node.

B. Make sure the resistance of the wiring, and switch and relay contacts, is no more than 3 ohms.

C. Use a test current of 0.5 amp or less.

D. Measure the continuity through each switch and relay contact in each position.

E. Make sure there is an open circuit between

(1) Open contacts of switches and relays

(2) Insulated conductors

(3) Conductors and the chassis

6. COMPONENT TESTS

A. Lamp assemblies

(1) Make each lamp come on with a voltage applied to the pins of the lamp assembly through the pins of the output connector. Use the voltage as specified by the specification for the lamp assembly (±10 percent). Make sure the lamp comes on.

(2) Do this test to all lamp circuits inside the lamp assembly, and the switch contacts and diodes. For diodes, use the test of Paragraph 6.B. below, or apply a reverse voltage to the lamp assembly contacts and make sure the lamp does not come on.

B. Diodes

(1) Make sure the diode is not connected across other components which could interfere with the resistance value of the diode.

(2) Measure the forward and reverse resistances with a resistance comparator, resistance bridge, or a digital ohmmeter. Make sure the forward resistance is less than 300 ohms, and the reverse resistance is more than 900 kilohms.

(3) Apply 28 vdc through a 1000 ohm resistor to the diode in the test. Measure the voltage across the diode when the diode is forward biased, and then when it is reverse biased. Make sure the forward bias voltage across the diode is 1 volt or less. Make sure the reverse bias voltage across the diode is a minimum of 95 percent of the applied voltage.

(4) Use test equipment with these accuracies:

Measurement instruments: ±5% or better, 0.1-30 volts

Input impedance: 100 kilohms or more

DC Test Voltages: ±10%

Resistances: ±5%

C. Resistors

(1) Make sure the resistor is not connected across other components which could interfere with the resistance value of the resistor.

(2) Use one of these methods:

(a) Use a digital ohmmeter, wheatstone bridge, or resistance comparator.

(b) Apply a specified current through the resistor, and then measure the voltage this generates across the resistor. Use a constant current power supply and measure with a digital voltmeter. Be sure to consider the accuracy of the current supply and of the digital voltmeter, and the loading effect of the meter when you make you make the selection of the test equipment.

(c) Connect a resistor of known value in series with the resistor to be measured. Apply a voltage of known value across the series combination. Measure the voltage across the known resistor and calculate the value of the unknown resistance with this formula:

$R = (E_u R_{std})/(E-E_u)$ where

R is the unknown resistance

R_{std} is the known resistor

E is the applied voltage

E_u is the voltage across the unknown resistor

(3) Use test equipment with these accuracies:

(a) Make sure the total error of all instruments used in the measurement is no more than 25 percent of the value of the measurement.

(b) Make sure the input impedance of the voltmeter is sufficiently high that the accuracy of the voltage measurement is within the specified limits.

D. Capacitors

(1) Make sure the capacitor is not connected across other components which could interfere with the impedance value of the capacitor.

(2) Use one of these methods:

(a) Measure the capacitance with a capacitance bridge, comparator, or other capacitance measuring device.

(b) Connect a resistor of known value in series with the capacitor. Apply an alternating current of known voltage and frequency across the series combination. Measure the voltage across the capacitor and calculate the capacitance with this formula:

$$C = \frac{[(V_a/V_c)^2-1]^{1/2}}{6.28\ f\ R}$$ where

C is the unknown capacitance

f is the frequency of the applied voltage

R is the resistance of the added series resistor

V_a is the applied AC voltage

V_c is the voltage across the capacitor

(3) Make sure the total error of all instruments used in the measurement is no more than 25 percent of the value of the measurement.

E. Transformers

(1) Make sure the transformer is not connected across other components which could interfere with the impedance value of the transformer.

(2) Apply an AC voltage to the primary of the transformer, but make sure it is not sufficiently high to damage the transformer. Connect a load, such as a resistor of applicable value, across the secondary. Measure the voltage across the primary and across the secondary. Calculate the voltage ratio. Make sure this ratio is within the limits given by the specification or equivalent document.

F. Zener diodes

(1) Make sure the diode is not connected across other components which could interfere with the impedance value of the diode.

(2) Use one of these methods:

(a) Connect a resistor in series with the diode to keep the current within safe limits. Measure the voltage across the diode with a voltmeter. Make sure the voltage is within the specified limits. Be sure to use a resistance and voltage to make the diode operate at a minimum of 50 percent of rated power.

(b) Apply a specified current from a current source through the diode. Measure the voltage across the diode with a voltmeter. Make sure the voltage is within the specified limits. For the current, use the value specified as the test current in the specification, or use a current that lets the diode operate at a minimum of 50 percent of rated power.

(3) Make sure the total error of all instruments used in the measurement is no more than 25 percent of the value of the measurement.

7. FUNCTIONAL TESTS

A. Do functional tests on all circuit components that cannot be given a test individually.

B. If you do not know what the circuit does, review the schematic diagram and the specifications of the individual components.

C. When you know what the circuit does, make analyses of the circuit to find out applicable input and expected output signals. Then do the tests and see if the actual output signals are within expected limits. The limits can be calculated from a worst case analysis of the accuracy of the components in the unit.

D. For a test load, use a load which is a maximum of 80 percent of the rated load as given by the specification. If you know the end-use load, use this as the test load. If you use a different type of load as a replacement, be sure that the replacement you use is the same type and size as the specified end-use load. For example, if an incandescent lamp is specified as an inductive load, do not use noninductive resistors as an alternative.