Designation: B497 – 00 (Reapproved 2012)

Standard Guide for Measuring Voltage Drop on Closed Arcing Contacts[1]

This standard is issued under the fixed designation B497; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide describes recommended procedures to accurately measure voltage drop across current carrying contacts and the parameters to be documented in order to effectively record the results. Such contacts normally carry current greater than 1 amp. The applicability of these procedures to contacts carrying smaller currents should be evaluated prior to application to such devices. Contacts carrying small current may also be evaluated using Test Method B539 to measure contact resistance.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to become familiar with all hazards including those identified in the appropriate Material Safety Data Sheet (MSDS) for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements, see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B539 Test Methods for Measuring Resistance of Electrical Connections (Static Contacts)

B542 Terminology Relating to Electrical Contacts and Their Use

3. Terminology

3.1 Terms shall be defined in accordance with Terminology B542.

4. Instrument Selection

4.1 Generally, a low-impedance instrument will give greater accuracy. Since, these instruments are subject to serious damage by over-voltage, such as may occur when contacts are accidentally opened, due care should be taken in a proper instrument range selection. Many of the high-impedance meters, such as some electronic voltmeters, are not damaged by overvoltage and when used with the precautions pointed out in this recommended practice can be quite accurate. Instruments may also be protected by using the voltage-limiting circuit at the instrument input. Two types of meters are generally used and can be classified as self-contained voltmeters, or voltmeters that require an external power source.

5. Significance and Use

5.1 This guide covers the factors to be controlled, precautions and documentation necessary to measure and report the voltage drop across closed current-carrying contacts. The voltage drop is an indication of the efficiency of the contact interfaces in carrying a specified current. This efficiency can be adversely effected by any insulating areas within the contact interface. Circuits which involve substantial current and low independence can be influenced by this contact property.

6. Instrumentation Precautions

6.1 If a self-contained instrument is used, the following precautions should be observed:

6.1.1 The voltmeter leads should be connected as shown in Fig. 1 as close to the test contacts as possible.

6.1.2 The leads should be as short as possible, or calibrated with the meter, and shielded to reduce the effect of stray pick-up voltages.

6.1.3 The voltmeter input impedance should be 1000 Ω or less. This will load the circuit sufficiently to reduce the effects of stray-voltage pickup in the instrument leads. The input impedance of high-impedance meter can be reduced by placing a 1000-Ω resistor, *B*, across its input terminals as shown in Fig. 1.

6.1.4 Before measurements are made, the voltmeter leads should be shorted together at point *C*. With the voltmeter leads shorted in this position, the test current should be caused to flow in the circuit. If the voltmeter deflects, it may be caused by induction from the load circuit to the internal components of the meter. This may be minimized by orienting the meter, or relocating the meter (that is, moving it away from the circuit) until minimum meter deflection is observed. If necessary, place conductive shielding between the meter and the circuit.

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[1] This guide is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.11 on Electrical Contact Test Methods.

Current edition approved May 1, 2012. Published May 2012. Originally approved in 1969. Last previous edition approved in 2006 as B497 – 00 (2006). DOI: 10.1520/B0497-00R12.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

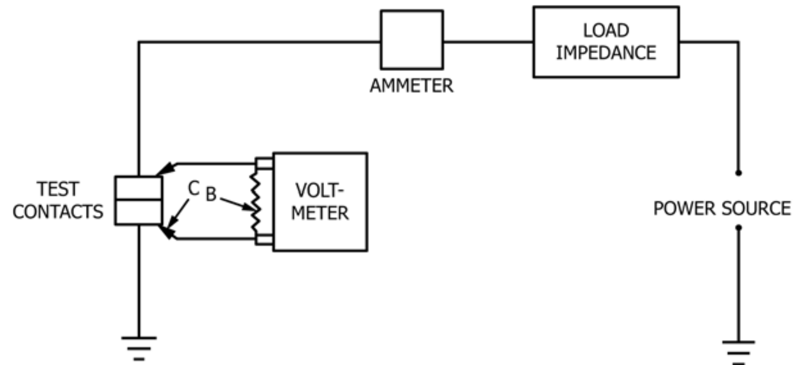

FIG. 1 Voltmeter Connections

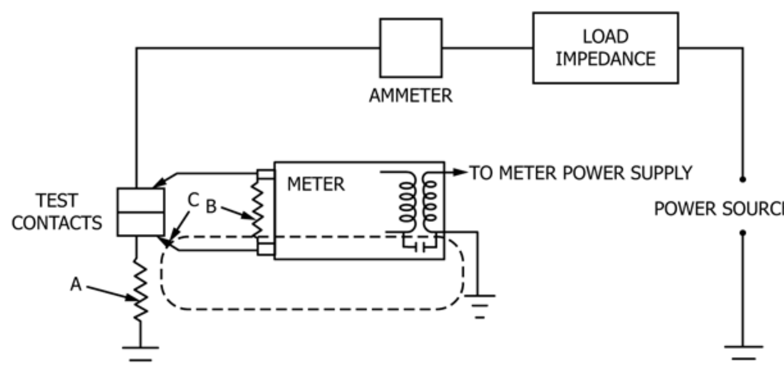

FIG. 2 Ground Loop Impedance

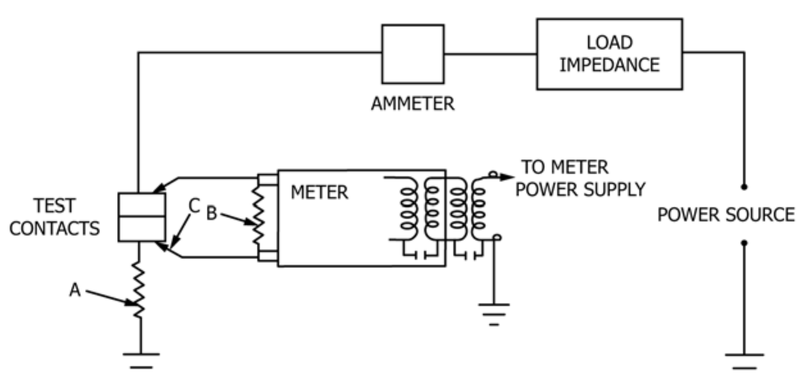

FIG. 3 Elimination of Ground Loop

6.2 If a electronic voltmeter requiring an external power supply is used, the additional precautions listed below should be observed:

6.2.1 To determine if the ground-loop impedance, illustrated by resistance *A* in Fig. 2 is detrimental to the meter short the instrument leads to each other at point *C*. If the meter gives a deflection with the leads so connected when contact current flows, the following steps must be taken to remove the disturbance:

6.2.1.1 Eliminate the ground loop formed by the connections of the electronic voltmeter to the power line. This loop is shown by the broken line in Fig. 2. It can be completed through interwinding capacitance of the instrument power transformer. This capacitance effect can be reduced by placing an additional isolation transformer between the measuring instrument and the source of instrument power (Fig. 3).

6.2.1.2 An optional technique that can be used to eliminate the effect of the ground loop, is to use a differential voltmeter. A differential voltmeter is an analog device that continuously measures the difference between two potential levels with respect to ground as a reference point.

7. Factors Affecting Voltage Drop

7.1 Quite often, contact-voltage drop will change with time. On such an occasion, it is best to wait until the voltage has stabilized to record the value.

7.2 Contact-voltage drop variations can be expected when the contact material-softening voltage is reached.

7.3 Contact resistance and, therefore, contact-voltage drop may be affected by the current flowing through the contacts at the time the measurement is made. For this reason, test currents should be specified.

7.4 For d-c measurements, thermocouple potentials produced by dissimilar metallic junctions, such as meter lead to contact junction, may influence some meters. One method to partially compensate for this is to take readings, reverse the polarity of the contact-current source, and take additional readings. By taking the average value of readings made in both polarities, the thermal effect is eliminated.

7.5 Consideration should be given to the resistance of circuit components between the voltmeter leads, since they act as a baseline resistance to which the contact resistance is additive.

8. Reporting Results

8.1 Reports of voltage drops should include:

8.1.1 *Test current*—The current must be stable at the time the voltage drop is read.

8.1.2 *Power source*—ac or dc. For ac the frequency and power factor should be recorded.

8.1.3 Timing of voltage measurement(s)—For example:

8.1.3.1 When stable.

8.1.3.2 At a fixed time after current initiation.

8.1.3.3 Averaged over a range of time.

8.1.4 *Contact characteristics:*

8.1.4.1 Material.

8.1.4.2 Size.

8.1.4.3 Shape.

8.1.5 *Contact force.*

8.1.6 *Meter type*—Manufacturer and model.

9. Keywords

9.1 closed arcing contacts; voltage drop