Electrical Testing of Electrodes and Shafts

Shafts, Rotating Ring-Disk, Rotating Cylinder, and Rotating Disk Electrodes

This document describes the procedure for testing the electrical connections of shafts, rotating ring-disk electrode tips, rotating cylinder electrodes, and rotating disk electrode tips. These simple tests can help isolate electrical problems with electrode instrumentation. Electrical problems can arise as a result of accidental damage (e.g. dropping the tip or shaft from a significant height, such as rolling off the lab bench) or in some cases, can arise from heavy chemical contamination and/or corrosion. This document describes how to make some electrical measurements of shafts and electrodes. These tests can be performed with a simple multimeter by measuring the resistance across two probes.

1. Overview

The document herein uses three colors (red, blue, and green) to differentiate electrically isolated sections of rotating ring-disk electrodes (RRDEs), rotating cylinder electrodes (RCEs), and rotating disk electrodes (RDEs). The three colors are also used to differentiate the electrically isolated sections of their respective shafts. Red corresponds to the section of the shaft that connects to the rotator, blue corresponds to the section of the electrode/shaft that connects to and controls the disk or cylinder, and green corresponds to the section of the electrode/shaft that connects to and controls the ring. Additionally, letters **A-F** are used to describe distinct sections of a shaft or electrode (see Table 1).

Letter	Color	Description
A	**Red**	Rotator connection section of shaft (electrically isolated)
B	**Blue**	Disk/Cylinder electrical connection section of shaft
C	**Green**	Ring electrical connection section of shaft
D	**Blue**	Disk electrical connection section of a RDE/RRDE tip
E	**Blue**	RDE and/or RRDE electrode tip disk/RCE cylinder
F	**Green**	Ring electrical connection section of an RRDE tip
G	**Green**	RRDE electrode tip ring

Table 1: Description of Colors and Letters Used to Describe Electrically Isolated Sections

If any of the test measurements are not as described in this document, contact Pine Research to discuss the test results. In some cases, the tip and/or shaft may be irreversibly damaged and must be replaced. In other cases, our production team may be able to attempt a repair. In the latter case, Pine Research will issue an RMA for service.

2. Rotating Ring-Disk Electrodes (RRDE)

2.1 Electrical Test for AFE6M/AFE6MB Shaft

RRDE shafts are divided into three electrically isolated sections (see Figure 1). Section **A** of the shaft connects to the rotator while sections **B** and **C** connect to the disk and ring, respectively. The resistance between these sections should be infinity. To test the shaft, use a multimeter to measure the resistance between the connections, as follows.

a) the resistance between **A** and **B** should be infinity
b) the resistance between **B** and **C** should be infinity
c) the resistance between **A** and **C** should be infinity

2741 Campus Walk Avenue | Building 100 | Durham, NC 27705 | USA
Phone: +1 919.782.8320 | E-mail: pinewire@research.com | http://www.pineresearch.com

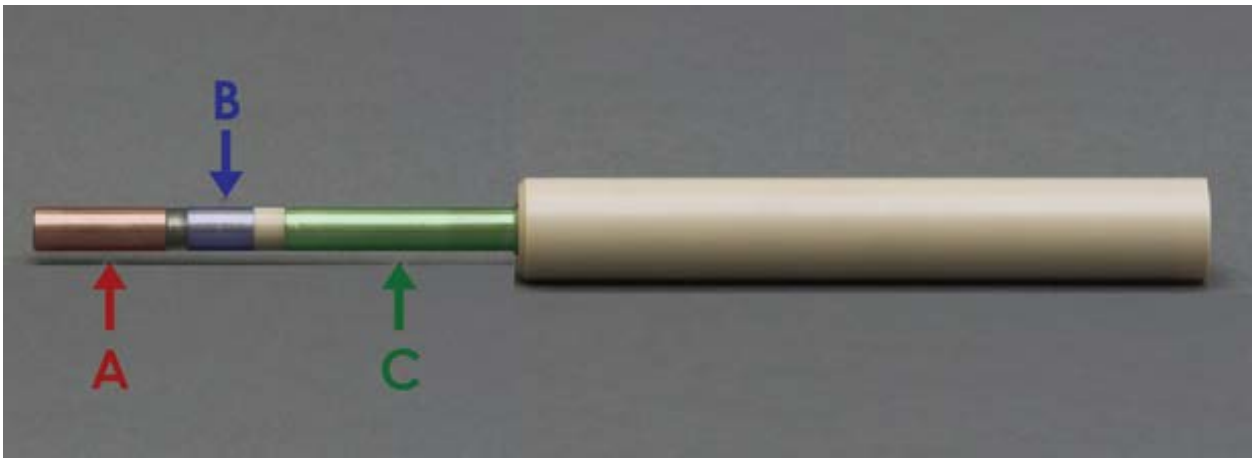

Figure 1: RRDE Shaft with Electrically Isolated Sections Labeled

2.2 Electrical Test for Rotating Ring-Disk Electrode Tips (E6 and E7 Series)

WARNING:

Be extremely careful when making contact with the electrode surfaces so as not to damage them by scratching the electrodes with the multimeter probes.

The RRDE tip is detachable from the shaft. As such, there are electrical sections within the tip that enable the ring and disk electrode surfaces to electrically contact the shaft, yet remain isolated from each other. The disk electrode **E** is in electrical contact with the threaded pin **D** (see Figure 2). The ring electrode **G** is in electrical contact with the threaded end of the tip **F** (see Figure 2). Use a multimeter to measure the resistance between these connections, as follows.

a) the resistance between **D** and **E** should be less than 10 Ω
b) the resistance between **F** and **G** should be less than 10 Ω
c) the resistance between **D** and **F** should be infinity
d) the resistance between **E** and **G** should be infinity

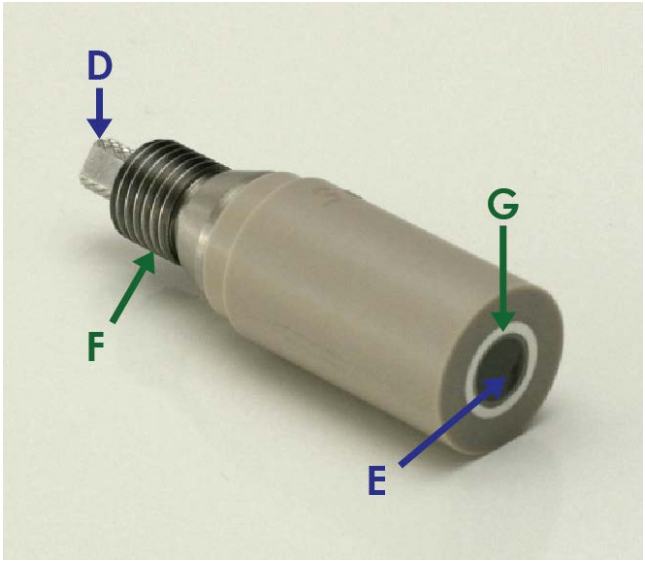

Figure 2: RRDE Tip with Connections Labeled

3. Rotating Disk Electrodes (RDE)

3.1 Electrical Test for AFE3M Shaft

The AFE3M shaft has two electrically isolated sections, **A** and **B** (see Figure 3). Section **A** of the shaft connects to the rotator while section **B** connects to the disk. The resistance between these sections should be infinity. To test the shaft, use a multimeter to measure the resistance between the connections, as follows:

a) The resistance between **A** and **B** should be infinity

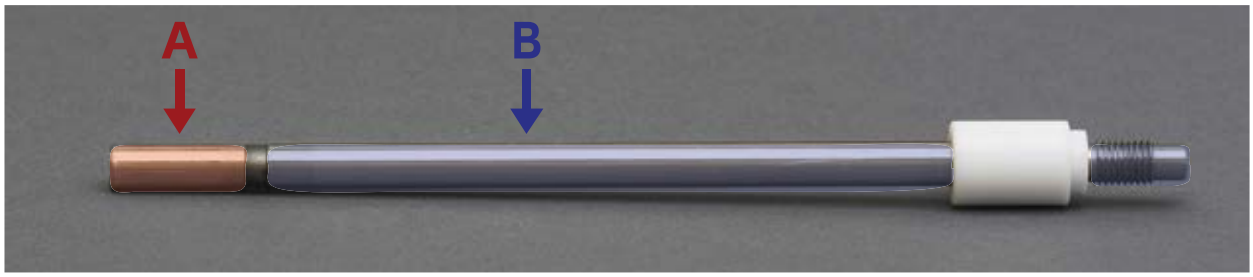

Figure 3: RDE Shaft with Isolated Electrical Connections Labeled

3.2 Electrical Test for RDE Tips (E3, E5, E5TQ, and E6TQ Series)

There are two sizes of RDE tips available for purchase from Pine Research Instrumentation: $12\ mm\ OD$ (E3 series) and $15\ mm\ OD$ (E5, E5TQ, and E6TQ series). For the $12\ mm\ OD$ tip, the disk electrode **E** is electrically coupled to the female threading **D** (see Figure 4a and Figure 4b). For the $15\ mm\ OD$ tip, the disk electrode **E** is electrically coupled to threaded pin **D** (see Figure 4c). The resistance between **D** and **E** of RDE tips should be fairly small. Use a multimeter to measure the resistance between these connections, as follows.

a) The resistance between **D** and **E** on the $12\ mm\ OD$ shaft should be less than $10\ \Omega$
b) The resistance between **D** and **E** on the $15\ mm\ OD$ shaft should be less than $10\ \Omega$

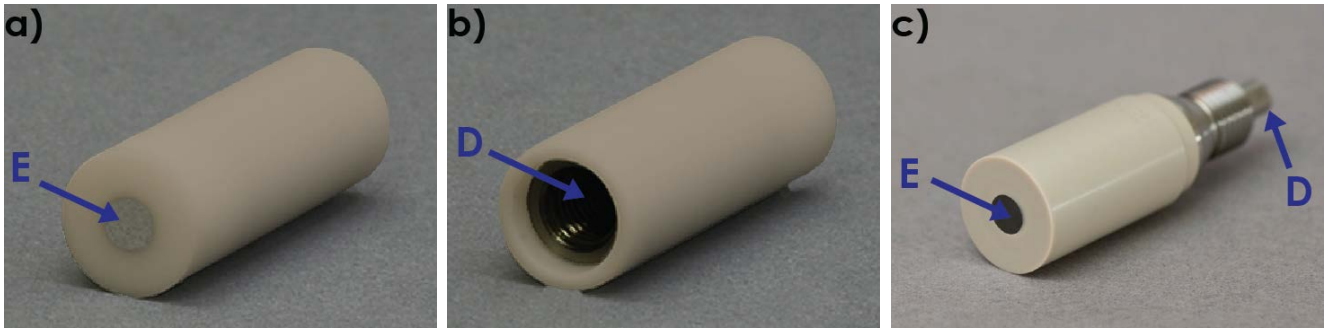

Figure 4: a) Front and b) Back of a $12\ mm\ OD$ RDE tip and c) a $15\ mm\ OD$ RDE Tip Showing Electrical Isolation

INFO:

Permanently mounted electrode disks, such as found in E5 and E6 electrodes, may be in electrical contact with both D and F. In other words, section D is shorted to section F on the electrode tip. This may not be the case for tips purchased before 2015, where section D and F were electrically isolated.

4. Rotating Cylinder Electrodes (RCE)

Pine Research Instrumentation manufactures two different shafts to be used in conjunction with $15\,mm\,OD$ and $12\,mm\,OD$ cylinder inserts (Pine Part #: AFE9MBA and AFE3M, respectively). The latter shaft, AFE3M, was discussed in section **Error! Reference source not found.**.

4.1 Electrical Test for AFE9MBA Shaft

The AFE9MBA shaft has two electrically isolated sections, **A** and **B** (see Figure 5). Section **A** of the shaft connects to the rotator while section **B** connects to the cylinder. The resistance between these sections should be infinity. To test the shaft, use a multimeter to measure the resistance between the connections, as follows:

a) The resistance between **A** and **B** should be infinity

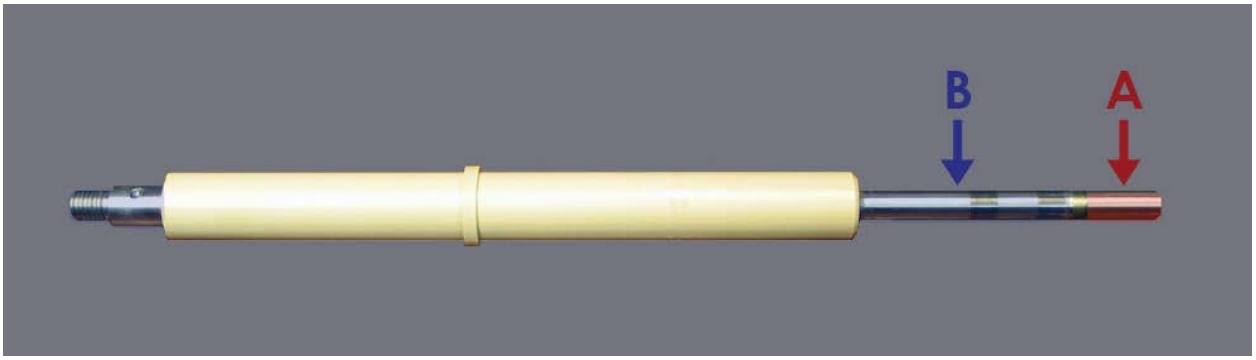

Figure 5: RCE Shaft with Electrically Isolated Sections Labeled

4.2 Electrical Test for $15\,mm$ RCE Tips (E9 Series)

The $15\,mm\,OD$ cylinder **E** slides directly onto the lower threaded of the shaft, coupled to section **B** (see Figure 6). Thus, the resistance between shaft section **B** and cylinder **E** should be minimal while the resistance between shaft section **A** and cylinder **E** should be infinity for the $15\,mm\,OD$ RCE. Use a multimeter to measure the resistance between these sections as follows:

a) The resistance between **A** and **E** should be infinity
b) The resistance between **B** and **E** should be less than $10\,\Omega$

Figure 6: Electrical Isolations Labeled with Cylinder Inserted on Shaft AFE9MBA

4.3 Electrical Test for $12\ mm$ RCE Tips (ACQC Series)

The $12\ mm\ OD$ RCE tip is detachable from the AFE3M shaft. For the cylinder to make electrical connection to the AFE3M shaft, the threading **D** is electrically connected to cylinder **E** on the RCE tip. Use a multimeter to measure the resistance between these sections as follows:

a) The resistance between **D** and **E** should be less than $10\ \Omega$

Figure 7: RCE Shaft with Electrically Isolated Sections Labeled

5. Contact Us

If you have any questions or would like to inquire about the availability of the electrodes or shafts described in this document, please contact us via the means provided below:

5.1 Email

Reach us by emailing the entire sales department: pinewire@pineresearch.com.

5.2 Website

There is a contact us form on our website.

There may also be additional resources (such as YouTube videos) for some of the products mentioned here: http://www.pineresearch.com