Techtips

*Techtips is a collection of useful ideas, techniques, and procedures designed to further EDM knowledge.*

# "Liar, Liar!!"

The following story is true. The names have been omitted to protect the guilty.

Some time ago, I was called in to a major aerospace plant with an unusual complaint: "The resin is too good. It lasts too long." Now, this is highly unusual in that most wire EDM users complain of short resin life!

Upon arrival on scene, I learned additional details. The machine alarm indicated that the dielectric conductivity was lower than the set point and continually falling. The customer had resorted to adding pinches of salt to the water to bring the conductivity back up to the set point. They hadn't changed their resin bottle in over a year. And ... everything in the work tank was rusting like crazy.

I took out my portable calibrated conductivity meter and sampled the water in the clean tank of the customer's machine. Normal conductivity would be in the range of 20 µS. My meter went wildly off the scale beyond 999 µS.

The machine conductivity display was lying, but why?

After listening to and witnessing this amazing tale, my first question was "When did you last clean the conductivity probe?" The answer "What is a conductivity probe?" quickly led to the source of the problem.

The machine measures the conductivity of the water by applying a known DC voltage to a pair of contacts separated by a known distance and immersed in the dielectric fluid. These contacts are mounted in a structure that is generally known as the conductivity probe. ***(See figures 1 & 2 for images of two different styles of conductivity probes)*** The amount of electric current that flows between the contacts through the water is measured and converted to a value, which is then compared to the control set point. The result of this comparison determines whether to engage the deionizing system to maintain the set point conductivity level. An important part of regular machine maintenance is to clean the probe so that it will not give faulty readings.

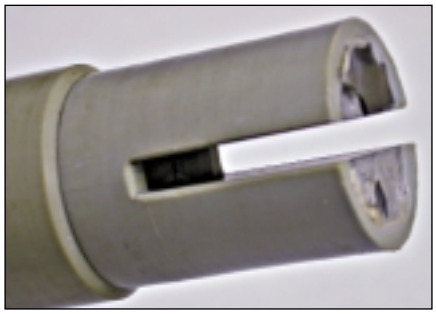

*figure 1*

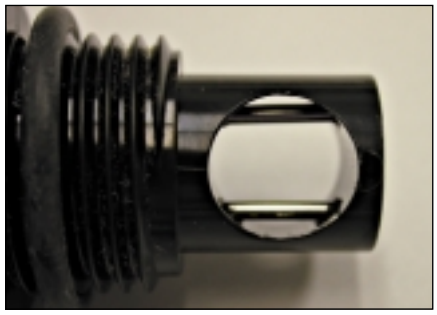

*figure 2*

Even though the conductivity probe usually resides in the clean tank (or sometimes in a fitting tee'd into a hose leading to the clean tank), in will become coated with contamination after a period of time. This contamination can take the form of eroded material not caught by the filter, chemical deposits, algae, or any combination. This coating of contamination can adversely affect the machine readings in either of two ways:

- The contamination can coat the contacts with an insulating film which inhibits the sensing current flow through the water. This will fool the machine into thinking the water is of lower conductivity than it really is, and not engage the deionizer when it should. This results in water conductivity that is higher than the set point, even though the machine display indicates the water conductivity is at or lower than the set point. This is exactly what happened to our hapless aerospace customer. Operating a wire machine with water conductivity significantly higher than the manufacturer's recommended set point can result in reduced cutting speed, unpredictable slot widths, and the combination of workpiece, tooling and machine tool corrosion. This corrosion can be particularly destructive to carbide workpieces, even on machines with anti-electrolysis power supplies.
- Conversely, the contamination can coat the structure surrounding the contacts with a conductive film, which will allow the flow of sensing current to bypass the water. This will fool the machine into thinking the water is of higher conductivity than the set point and engage the deionizer excessively. This results in water conductivity that is lower than the set point, even though the machine display indicates the water conductivity is at or above the set point. Operating a wire machine with water conductivity significantly lower than the manufacturer's recommended set point can result in reduced cutting speed and unpredictable slot widths, along with dramatically shortened resin life.

**One answer to this problem is to regularly clean the conductivity probe, at least monthly:**

- First you need to locate it. If you have difficulty finding it, check the machine manual, and if you still can't locate it, call the service department of machine tool manufacturer for help.
- Turn off the machine. You will probably have to disconnect the wires from the probe. Be sure to mark them for subsequent re-connection.
- You may even have to drain the tank.
- Remove the probe, coat the contacts and surrounding surfaces with Naval Jelly. Naval Jelly is a caustic gel that effectively removes deposits on objects that have been immersed in water, such as conductivity probes.

Even though Naval Jelly is a household product readily available at hardware stores, personal protective equipment such as rubber gloves, goggles, etc. must be used to prevent chemical burns.
- Allow the Naval Jelly to work for five to ten minutes.
- Scrub and *thoroughly rinse* the probe assembly.
- Re-install and re-connect.

In addition to a regularly scheduled conductivity probe maintenance program, you should seriously consider independently monitoring the water conductivity on a weekly basis. This can be readily accomplished with a high quality hand held conductivity meter, such as the one shown in ***figure #3***. Although there are a number of inexpensive units on the market, many of them are quite inaccurate at measuring the low levels of conductivity normally associated with wire EDM. When purchasing a conductivity meter, be sure to also purchase a bottle of calibrating fluid as shown in ***figure #4***. The conductivity meter should be calibrated each time it is used.

The use of an independent conductivity monitoring device sometimes brings up another important issue. That is, there are a number of different measurement units used to express the conductivity of water:
- Conductivity: Units of measure are µMhos or µSiemens. Typical acceptable numbers for a wire EDM are 20µS.
- Resistivity: Units of measure are Ohms. Typical acceptable numbers for a wire EDM are 50,000Ω.
- Total Dissolved solids (TDS): Units of measure are PPM. This unit of measure is used primarily in the water treatment industry. Typical acceptable numbers for a wire EDM are 15PPM.

Unfortunately, some machine manufacturers display an arbitrarily chosen unit for their machine display such as MA (milliamps) or just a number that has no direct connection to the industry standard units of conductivity measurement.

***The following checklist may be helpful in diagnosing conductivity problems:***

*figure 3*


*figure 4*

**Conductivity too high and rising:**
- **Dirty conductivity probe**.
- **Resin is exhausted.** I highly recommend installing an inexpensive red/green indicator conductivity monitoring device at the outlet of the resin system to quickly alert the operator to this condition before the machine shuts down. (Some resin systems use an amber light that provides an indicator which is somewhat counter-intuitive: on=good, off=bad)
- **Resin filter is clogged.** Some machines employ a filter just ahead of the resin system. If this filter is clogged, it will obstruct the flow of water through the resin.
- **In-line resin safety screen is clogged.** Some systems employ a safety screen assembly downstream from the resin system to protect the machine from resin infiltration in the event of resin system malfunction. If this screen is clogged, it will obstruct the flow of water through the resin system.
- **The deionizer pump is defective.** Some machines utilize a dedicated pump to pass water through the resin system intermittently on demand from the machine control. Most machines utilizing this system have a pressure gage or a flow indicator which can be observed to see if the pump is functioning.
- **The deinonizer valves are sticking.** Some machines use solenoid valves to direct the output of the filter pump through the resin system. If one of the valves is sticking, the water will not flow through the resin system.
- **The dielectric filter needs to be changed.** For machines that use deionizer valves, sometimes piloted valves are utilized. A pilot valve uses a small air or electric signal from the machine control to activate a small water valve, which then uses system water pressure to open or close the main valve. If the system water pressure is low due to a clogged filter, the valve may not open or close reliably.

**Conductivity too low and falling:**
- **Dirty conductivity probe.**
- **The deinonizer valves are sticking or leaking.** Some machines use solenoid valves to direct the output of the filter pump through the resin system. If one of the valves is sticking or leaking, the water will continue to flow through the resin system even when the control is not calling for deionizing.
- **The dielectric filter needs to be changed.** For machines that use deionizer valves, sometimes piloted valves are utilized. A pilot valve uses a small air or electric signal from the machine control to activate a small water valve, which then uses system water pressure to open or close the main valve. If the system water pressure is low due to a clogged filter, the valve may not open or close reliably.

Because the integrity of the workpiece and the process used to generate it is the end result of each and every spark generated by the machine power supply, it is essential that the water dielectric (through which each spark passes) in a wire EDM be faithfully maintained within the machine tool manufacturer's specifications. And that is the truth, the whole truth, and nothing but the truth.

*Any suggestions for future topics are welcome. Tell us what you would like to read about.*
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**EDM**