Reality Calibration

By Robert Lutz, AASHTO re:source Manager
Posted: May 2016

I have a confession to make. Although I've been an outspoken critic of "Reality TV," there is one show that I sometimes watch with my wife. It's called "Married at First Sight" and in each season six people agree to participate in an *extreme* experiment: Each pledges to legally marry a complete stranger. No dating, no talking, no getting-to-know-you period. It's not just that they have never met; they don't know a thing about their future spouse, haven't even seen a glimpse of them, until the actual marriage ceremony. (I'm not sure how this actually resembles reality, although my wife sometimes thinks that I'm an alien.) You can probably guess how these marriages work out: they usually don't. The couples struggle because they don't know how each other will respond to certain situations. How many of us would agree to that type of arrangement?

This might be a bit of a stretch but hang in there with me…the "relationship" you have with your measurement equipment in your laboratory often resembles "Married at First Sight." You purchase a new piece of equipment, you calibrate it, and then you throw it into the same rotation with all the other equipment – calibrate every 12 months. You have assumed that this piece of equipment will behave like the others, *but in reality you don't know much about it*. You need a "getting-to-know-you" period. You don't really want to find out 12 months later that the equipment didn't behave as you had expected.

Good laboratory practice dictates that you should calibrate new equipment more frequently in the beginning of its life, and not put it into the regular 12-month rotation until you establish some confidence in its operation. You may wonder: What's good laboratory practice after that? After the dating period?

To help to better understand the importance of selecting appropriate calibration intervals, let's first discuss why we calibrate measuring instruments.

- To check the accuracy of a measuring instrument;
- To improve the accuracy of a measuring instrument;
- To have confidence in a measuring instrument's results;
- To test a new instrument;
- To test an instrument after it has been repaired or modified;
- To check the operation of an instrument which has had exposure to shock, vibration, or adverse conditions;
- To check if the results of an instrument have drifted over time;
- And to ensure the best result prior to and after a critical measurement.

Sometimes we don't calibrate, or don't calibrate often enough., and some people even calibrate too often! Ironically, the consequences are the same for each scenario:

- Equipment downtime;
- Production downtime;
- Inaccurate results;
- Need for rework;
- Loss of money;
- And safety concerns.

With so much on the line, why do we not give more thought to calibration intervals? Why should we? Consider this:

> *One of the earliest records of precise measurement comes from the Egyptians, who studied geometry to assist them in the construction of the pyramids. It is believed that in about 3000 B.C., the Egyptian unit of length came into being. The Royal Egyptian Cubit was decreed to be equal to the length of the king's forearm from the bent elbow to the tip of the extended middle finger plus the width of the palm of the hand of the pharaoh or king ruling at that time. The Royal Cubit Master was carved out of a block of granite to last for all times.*

Workers building tombs, temples, and pyramids were supplied with cubits made of wood or granite. The royal architect or foreman of the construction site was responsible for maintaining and transferring the unit of length to the instruments used by workers, who were required to bring back their cubit sticks at each full moon to be compared to the Royal Cubit Master. Failure to do so was punishable by death. Yes, death. Though the punishment prescribed was severe, the Egyptians inadvertently had anticipated the spirit of the present day system of legal metrology, standards, traceability and calibration recall. With this standardization and uniformity of length, the Egyptians achieved surprising accuracy. Thousands of workers were engaged in building the Great Pyramid of Giza, which was constructed to stand roughly 756 feet. Through the use of cubit sticks, they were within 4-1/2 inches—an accuracy of 0.05%. [1]

There's nothing magical about 12-month calibration intervals. It seems natural, though, like birthdays and anniversaries. There are many factors to consider, factors like:

- What type of instrument is it?
- What interval does the manufacturer recommend?
- What is the extent and severity of use and what are the environmental conditions?
- Does it have a tendency to wear or drift?
- What is the measurement uncertainty required?
- What is the risk of an instrument exceeding the maximum permissible error?
- What is the cost of correction and recall measures when the instrument is found to be "out of calibration?"
- What does previous calibration data tell you?
- Are intermediate checks performed?
- Have the personnel been trained appropriately?

Give this some thought because there is definitely a risk/reward scenario when setting your intervals. The longer the interval, the greater the chance that you are using data from "out-of-calibration" equipment. What is the ideal interval, you ask? Not too short, not too long, just right, plain and simple. The ideal interval is just before the measurement process begins to change. That could be 1 month, 6 months, 12 months, 24 months, or even longer. How do you figure that out? I encourage you to view a presentation I gave last year on this subject. I'd welcome your comments and questions. Now back to my reality TV…

References

1. Stuart Kleven, Israel Vasquez and David Atkins, "Calibration for Nondestructive Testing."