One Small Cal Lab's Experience with an International Inter-Laboratory Comparison

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Abstract: GJS Mass Measurement is accredited to ISO 17025 by the SCC and CLAS. As a proficiency testing opportunity, CLAS involved us in an international inter-laboratory comparison. There was some reluctance since the comparison was to be reported in absolute mass, however, our scope states conventional mass. Customs and shipping problems increased our work, as we had to calibrate the weights twice, once as they were received and once after the weights were cleaned. Although the ILC report is still a draft, we are satisfied with our results and feel that we have achieved our objectives.

GJS Mass Measurement is a small calibration laboratory that has operated in Ottawa, Canada since 1990. Started as a retirement project, the original owners George Mihailov and Melodie Levitt grew the business based solely by word-of-mouth. It became apparent to Melodie that to be a successful calibration laboratory, it was vital to achieve accreditation. She started the process by writing GJS' first Quality Manual in 1992 and making an application for accreditation in 1994. It took a while, since GJS was the first mass laboratory to apply and there was no process in place for the evaluation. GJS was first accredited to ISO/IEC Guide 25 in December 1998. This has been recently updated to the ISO/IEC 17025 standard. In Canada, accreditation for calibration laboratories is provided by the Standards Council of Canada (SCC) in association with their partner the Calibration Laboratory Assessment Services (CLAS) of the National Research Council of Canada (NRC).

A mass measurement inter-comparison between secondary laboratories from Canada, Mexico and the United States with El Centro Nacional de Metrología (CENAM) in Mexico as the pilot laboratory within the framework of North American Calibration Cooperation (NACC) was undertaken in 2000.

CLAS arranged for GJS to participate in this international inter-laboratory comparison (ILC). The results would be used to meet the proficiency testing requirements of our accreditation. Both CLAS and GJS were reluctant since the CENAM comparison was to be reported in absolute mass. GJS works in and our scope of accreditation is reported in conventional mass. Finally CLAS decided we could handle the conversion from conventional to absolute mass. GJS was the only Canadian laboratory invited to participate in this international comparison with three laboratories from each Mexico and the US. Our goals in agreeing to participate in this inter-comparison were to meet the proficiency-testing requirement of ISO/IEC 17025 (Guide 25 at the time), to provide impartial evidence of our competence and of course to reflect a positive image of the Canadian assessment system.

Although the CENAM representative was in touch with us directly to provide the protocols for the inter-comparison, we did not have to deal with CENAM for anything else. The weights, the results and any difficulties were directed through CLAS. This made the process very easy for us. Since the inter-comparison was arranged by CLAS we were not responsible for shipping and receiving the weights to and from Mexico. We are lucky enough to be located in the same city as NRC we were able to pick and deliver the standards by hand, relieving us of the stress of packing and shipping them.

I was invited to NRC to pick up the weights when they arrived from Mexico so I was present for the unpacking of the weights. The case designed to hold the three mass standards was not closed properly, one of the latches was offset. The case had been packed in Styrofoam peanuts and some of the packing material had gotten inside the case next to the weights. It was also clear that the package had been opened at the border by customs and there were fingerprints on the weights. The combination of these events and their affect on our results concerned CLAS.

After some discussions with CENAM it was decided that GJS would calibrate the weights as they arrived then return them to NRC. Then NRC's Institute for National Measurement Standards (INMS) would clean the standards using a method agreed upon with CENAM. After the mass standards were cleaned GJS calibrated them a second time. INMS also took the opportunity to calibrate the weights both before and after cleaning. CLAS assured us that if something were to go very wrong with the NACC inter-comparison because of the troubles at the border, they would be able to compare our results to those found by INMS. The INMS results were not reported to CENAM since they were not a part of the inter-comparison but they gave CLAS a back up for the evaluation of GJS.

Later we were informed that similar difficulties were encountered on the return trip to Mexico and that CENAM also had to clean the standards and calibrate them twice before and after cleaning.

The inter-comparison consisted of three weights: 1 kg, 100 g and 100 mg. The volume of each standard was provided as determined by CENAM. We were told to use the CIPM 1981/91 formula to determine the air density used in calculating the buoyancy correction. We were given forms to record our results as well as to record the environmental conditions, the equipment used and the traceability. The uncertainties evaluation was to be done in accordance with the ISO Guide to the Expression of Uncertainty in Measurement, 1995. The directions were clear and easy to follow. Our only remaining concern was the conversion from conventional mass to absolute mass.

Conventional mass is widely used in every day trade to facilitate the measurement of mass. It reflects the mass of an object under assumed (conventionally chosen) conditions. Those conditions are: an ambient air temperature of 20°C, air density of 1.2 kg/m^3 and that the density of the object is 8.0 kg/m^3.

We had to decide how we wanted to approach the conversion. Should we convert our standards to absolute mass values and proceed through the whole calibration as absolute mass or should we proceed as usual and convert the final result to absolute mass at the end? Since our primary 1 kg

standards are calibrated by INMS and the certificate provided reports both absolute and conventional mass, the technologists decided it would be best to proceed in absolute mass. However, this might not have been the easiest approach for the 100 mg weight, since we had to recalibrate all our working standards from the primary 1 kg's absolute value down to the 100 mg level. This was more time consuming then necessary and introduced too much potential for error. We experienced an error that would have affected a final value we had proposed to submit for the 100 mg standard. Fortunately, it was caught in a final review and corrected before our results were submitted to CENAM.

In retrospect it would have be simpler to have done all the work in conventional mass and converted only the final results to absolute mass. A good approximation, as provided by Chapman [1], of the conversion from conventional to absolute mass is:

$$C \cong C_c + (M + C_c)\rho_o(\frac{1}{\rho} - \frac{1}{\rho_c})$$

C = Correction in absolute mass
C_c = Correction in conventional mass
M = Nominal mass
ρ_o = Conventionally chosen air density (1.2 kg/m^3)
ρ = Density of the mass standard
ρ_c = Conventionally chosen density of standard (8000 kg/m^3)

The report was easy to complete. The overall experience was very pleasant. We achieved our goals of participating in the ILC. Our results were good within the context of the ILC as well as in comparison to the results of INMS. This ensured we met the requirement of proficiency testing of our accreditation. We are able to use this information to provide impartial evidence to our clients that demonstrate our competence in this field. We feel that we have also reflected a positive image of CLAS and its accreditation process.

International inter-laboratory comparisons help to generate confidence that measurements are transferable as mass standards travel across the continent. As well the ILC provides a comparison of the accreditation of the secondary laboratories from the participating countries.

Reference:
1. G.D. Chapman, Buoyancy and the Weighing Equation, NRC Mass Course 2001, slide 26