Director’s Comments

Small Wins...Can Lead to BIG Changes!

We see nearly every day how senior Air Force (AF) leadership is re-looking, re-booting, re-inventing, re-designing major aspects of our AF. From how many squadrons we need (386, by the way), to how we acquire weapons systems faster, to the uniforms many of us wear—change everywhere you look. While major AF changes may roll out and affect the calibration community in time, I’d like to highlight a few smaller changes a little closer to home.

Two PMELs initiated self-help projects since the last newsletter was published. I’d like to give a shout-out to these units and, in doing so, encourage others to look around their work spaces and see if similar sorts of activities could improve the work environment at other PMELs.

The Wright-Patterson PMEL did some self-help in improving the appearance of their shipping/receiving entrance. Simple act of painting the steps and dock shows a high degree of pride and professionalism these individuals take in their work. First impressions are lasting so a little extra effort to

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Disclosure & Editorial Policy

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Editorial Policy Statement: The AFMETCAL Quarterly Newsletter is the AFMETCAL Director’s forum to share insights into policy and emerging trends, personnel news, technical and other information of interest to the Air Force metrology community at large. Newsletter articles cover many topics: technical issues; clarifications of policies/procedures; process improvements; and items of general interest about Air Force metrology community members.

Submissions: We encourage readers to submit articles for the following categories: From the Bench (technical), About People (field personnel news), News & Notes (general information). Submissions should be in Microsoft Word, Times New Roman 12 font, accompanied whenever possible by digital photos in JPEG format. Native photo file sizes less than 2MB per image are preferred. Photos must be accompanied with caption information which fully identifies all individuals depicted, including rank, title or office, and event. Note that all text and photo submissions are subject to editing for content, cropping and/or size. All submissions that are technical in nature are reviewed by the AFMETCAL Engineering Branch (AFLCMC/WNME) for accuracy and appropriateness. Publication of any submission, regardless of subject matter, will be approved by the AFMETCAL Division and submission does not guarantee publication. All submissions are reviewed for compliance with Privacy Act, FDO, STINFO, OPSEC and other information security requirements as applicable.

How to Make a Submission: The AFMETCAL Newsletter editor transmits quarterly calls for inputs through the PMEL MAJCOM Functional Managers and other significant metrology program POCs to the respective PMEL managers and/or program functional offices. Normal submissions are in response to these data calls. Authors should submit their article inputs via e-mail through their respective chain of command to the AFMETCAL Newsletter editor. Authors may submit inputs out of cycle, but should use the same channels for those submissions. Deadline for submissions is the 15th of the month prior to the scheduled quarterly newsletter publication (publication months are March, July and November). Do not submit copyrighted material.

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make this entrance more appealing can only have the desired effect of foretelling the high quality of work and professionalism guests will find inside. Congratulations and thanks to those who put forth some extra effort to make this “small win” a reality.

The team at Minot undertook a more extensive remodeling project. Large portions of the lab including the breakroom, airlock, QA office, etc. were stripped down to block wall and rebuilt. Was difficult to settle on just a couple of representative pictures to share but here are a few. Sadly (or not so much), out went the old carpet and the ever-classic look of dark wood-panel wainscot and burlap upper wall coverings so popular in the 1970s. Replaced with lighter and brighter, but far less iconic, tile, drywall, and fresh paint.

I like this picture as it shows a number of the team working together to get the renovation done. As they say, “Many hands make light work”.

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Director’s Comments (cont.)

Wow! How much brighter the lab is after the renovation. Many thanks to the team that came up with the suggestion and applied their considerable personal skills (and a fair amount of sweat, I’ll wafer) to improving the work environment. Much more pleasant to go to work when you have bright, newly renovated work spaces to apply your trade in.

Again, delighted to see both PMELs taking pride in their facilities. Devising and executing small wins add up over time and sometimes lead up to really BIG ideas to improve our base, command, and AF. Core AF principles of “Service Before Self” and “Excellence in All We Do” are clearly on display in these projects. What small wins would you like to propose? Love to hear your ideas.

Until next time, thanks for all you do to support AF operations. Am proud to serve with you all!

P.S. Before I close, I couldn’t resist adding one more pic…

Sorry Mark. I’m sure you heard a “beep, beep, beep”… but am pretty certain that isn’t a metal detector…and you didn’t discover Blackbeard’s treasure inside that wall!

What? No, I don’t think it’s a UXO either…so no hazardous duty pay or second career as an EOD technician.

Cheers,

NEIL B. ERNO
Director, Air Force Metrology & Calibration, AFLCMC/WNM
Chief’s Corner

In early September, I had the chance to attend the Air Force’s Inspector General Training Course (IGTC) at Kirtland AFB…and yup, that’s when I took that nerdy selfie you may have seen on Facebook by the Thunder Scientific sign outside the gate. I like to think I have a fairly good grasp of the AF Inspection System (AFIS), but just like most programs in the Air Force, IG focus areas and inspection processes continue to evolve. One particular focus area was discussed during the IGTC, and it’s the same topic that has garnered quite a bit of interest from HAF all the way down to the base level…and that is “readiness”.

You may think you understand what readiness means, but how do you inspect it under AFIS for effectiveness? Operational Readiness Inspections and/or Exercises (ORIs/OREs) are options, but to what degree do these inspections go beyond assessing universal AEF training requirements and compliance (i.e.; deployment lines, palletizing equipment, ability to survive/operate, etc…)? In other words, does an ORI always tell us if a warfighting capability can do what it was designed to do? To answer some of these questions, readiness will be one of the main topics of discussion at the next Air Force IG Advisory Board (this board is part of the AFIS Governance structure that meets twice per year and votes on changes to inspection policy and processes).

So whether a new Major Graded Area (MGA) is added by the board or the “Executing the Mission” MGA is expanded under AFIS, this conversation got me thinking. As the Team Chief and Career Field Manager, how do I make sure the AFMETCAL Evaluation Team is strategically aligned with SAF/IG, the AF Inspection Agency, and the MAJCOM IGs if those same offices are still in the process of defining readiness within the AFIS framework? SAF/IG Inspection Directorate’s mission statement is pretty clear, “…to establish Air Force policy to assess readiness, discipline and efficiency with a vision to help shape senior leader decisions affecting readiness of our Air Force to strengthen our nation’s defense.” AFMETCAL inspections already assess effectiveness which includes an evaluation of the PMEL’s efficiency, discipline, and technician proficiency. But does the Eval Team effectively assess the readiness of a PMEL and our calibration network? The short answer to this is…we’re getting there. A PMEL’s readiness is linked to its ability to meet all home station requirements (to include priorities/unscheduled mx, scheduled mx, and emerging calibration requirements) and includes the lab’s ability to deploy capable forces and serviceable equipment to meet defined rotational and contingency calibration requirements. About a year ago, I took the liberty of leaning forward a bit on readiness and directed the Evaluation Team to inspect the RASCALs and a few other critical capabilities across our network that may present risk to our warfighting commanders. At both Mountain Home and Seymour Johnson, we simulated a deployed environment and ran several items inside the RASCAL to test our unique contingency capability. The Airmen at these locations did a phenomenal job working outside their comfort zone and helped to identify several LIMFACs and improvement opportunities. In addition to RASCAL, we added a Test Cell focus area, and more recently, we have asked some PMELs to perform measurements during Evaluations on items the lab has never calibrated before. These targeted areas (we’ll call them PMEL Special Interest Items) allow us to better assess the readiness of our PMELs and provide a better

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Chief’s Corner (continued)

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picture of the overall readiness of our calibration network.

The best way for my team to assess readiness during the Measurement Capability Assessment (MCA) is to present the PMEL with a challenge or several challenges which the lab may encounter on a day-to-day basis. My team’s main focus is not human error-related NCs (unless you have a systemic mx discipline issue)… that’s your PMEL QP’s job. The AFMETCAL Evaluation Team assesses the PMEL’s capability and proficiency to ensure safe, accurate, reliable, and traceable TMDE is being sent back to customers. And this assessment needs to be as untainted and unbiased as possible.

Moving forward, you’re still going to see some of the same items we’ve selected in the past and we will still assess the Quality Program (ability to self-detect) and the Management System (ability to solve detected/known problems and shortfalls). But the Evaluation Team may elect to observe a few non-traditional items and processes…all with the intent of assessing and improving our readiness. To give you a recent example, we asked two PMELs to run a load cell using the automated Tovey Force press; in both instances, the lab had not yet used the force press fully automated. However, both PMELs were able to work through the proficiency gap, and we were able to witness first-hand, the decision making that went into gaining capability and improved efficiency. Other examples of what you may see during future Assessments include selecting lab standards with accepted commercial certs (repaired items and new items), running Acceptance Testing processes, calibrating blind artifacts (which we will hand-carry to the PMEL), performing Proficiency Testing items (which we advance-ship to the PMEL), running Test Cell calibrations (full or partial), packaging/mock-deploying the TFCU (if you have a UTC), exercising/moving the RASCAL, and further down the road, certifying the RASCAL as a stand-alone capability.

Since you all know I can go on forever (nothing compared to MSgt Cyr by the way), I’ll provide a more detailed update on development, education, and training in the next Newsletter article. For now, please know that we are working diligently on making changes to the Schoolhouse and our first priority is the PMEL Management Course. We will be targeting current TSgts and some MSgts; right now, we are still on track for the first class to go through in Apr/May 2019. As always, please let me know what I can do for you all in the field and if you have any questions on the above, feel free to shoot me an email or give me a call. I’m off to Robins next and Ramstein in December…I may or may not have a blind artifact Chief Babbitt.

GREGORY D. JOHNSON, CMSgt, USAF
Chief, Laboratory Certification Branch
PMEL Career Field Manager
News and Notes

Evaluators’ Perspective

The END is NEAR: Metrologists of the world predict the end will come on May 20, 2019

This past August, the National Conference of Standards Laboratories International (NCSLI) convened as it has nearly every year since 1962. This year’s location was in Portland, Oregon, culminating in four days of workshops, followed by four days of speeches and technology panels from the world’s leading metrologists.

The first day, however, set the tone for the conference, with many attendees walking out of the keynote address as excited as they were perplexed. Even though many had known about the coming change for years, the question that was mostly answered in the address was, ‘What does this change actually mean for the technician performing calibrations?’ Mr. Barry Wood, from the National Research Council Canada (NRC), perfectly framed one of the biggest upcoming moments in metrology history, which, if all goes well, will occur on May 20, 2019 with very few people ever being aware.

Mr. Barry Wood, NRC Keynote speaker NCSLI conference

So what is the big reveal? The international system of base units is set to remove the last physical artifact from the chain of measurements, namely the kilogram mass standard. This means there will no longer be the need for a physical chunk of metal, kept under a glass jar, buried several floors under France’s Bureau of Weights and Measures in a triple-locked vault. Instead, mass will finally be compared to a fundamental constant like the rest of the base units.

Like me, you might be thinking that a new definition of mass would be compared to something related to mass, like a fixed number of atoms. Nope. Those 4-D chess playing scientists wouldn’t pick something so mundane and obvious! Instead, it is being defined in terms of Planck’s constant. So, if you aren’t a checker playing commoner like me and didn’t have to look it up, you already know that Planck’s constant is the quantum-mechanical number showing how a particle’s energy is related to its frequency, and through Einstein’s relativistic mass to energy equation (E=mc²) is also related to its mass.

What does that all mean? Well, not much (as in, 10⁻³⁴). Essentially, the only real change is that many uncertainties will become reduced to 0, while others may experience a slight increase. The only real impact will be to the Standards laboratories as their workload shifts away from physical comparisons over to calculations, freeing them up to focus more heavily on research and development. As for us, we will still calibrate the same as we always have. We’ll just do it with less uncertainty!

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News and Notes (continued)

Evaluators’ Perspective (continued)

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To watch the shaky cell phone video of the keynote address, use Chrome or Edge Browser and go to: NCSLI Conference Keynote address- AFMETCAL https://www.milsuite.mil/video/watch/video/21412

For another take on this change, visit these articles on the web:


MSgt Jason Greer, AFMETCAL Evaluator, jason.greer.1@us.af.mil

More NCSLI Conference and possible AFMETCAL changes

One of the other topics at the forefront of everyone’s mind was the ISO 17025 latest release and what impacts the changes in it would have on the commercial calibration laboratories. AFMETCAL was also keenly interested in understanding what impact this might have on the AF PMEL’s.

There is no requirement for AFMETCAL to adhere to ISO 17025, as it is not an ISO accredited body. However, AFMETCAL endeavors to stay abreast of major changes and to incorporate as many aspects of the ISO 17025 as is feasible. This helps our Airmen when they leave the military and continue their metrology careers in the commercial sector. Thankfully, the new changes were mostly cosmetic and do not differ significantly from the 2005 edition which strongly focused on risk analysis.

As a side note, AFMETCAL’s due diligence with keeping pace with (and sometimes exceeding) the commercial sector laboratories, has brought the excellent quality of AF PMEL technicians to the awareness of our sister services. A chance meeting with the Army’s version of AFMETCAL led to a discussion in which they are very excited to begin training Army metrologists at the Keesler schoolhouse. Add to this the fact that the Navy and Marines have also inquired about putting their pipeline students through our course and very quickly you may one day see a truly Purple PMEL in which all the services are trained to the same valuable skill level as the Air Force!

MSgt Jason Greer, AFMETCAL Evaluator
Review Tracker Program

Review Tracker is a Microsoft Access program, written to aid in the implementation of paragraph 9.2.1.2 of TO 00-20-14. The database manages the following: Review Entry (for both Annual Reviews and Targeted Reviews), Measurement Area Disciplines (MADs), Managed Targets, and Evaluator Proficiency Evaluations (EPEs). It also has 17 reports ranging from review summaries to detailed schedules.

Review Entry
The Review Entry screen is a duplication of the data saved in PAMS, which must also be entered into the Review Tracker. The following are the fields required to be entered: Review Number, Review Date, Review Type (Annual/Targeted), Review Result (Pass/Fail), Label Number, Process Owner, Part Number, Nomenclature, and if the result is fail, Non-Conformity (NC) Statement. The Process performed on an individual does not need to be a technician, but could also be anyone in an administrative position, such as a PMEL scheduler.

Measurement Area Disciplines (MADs)
Paragraph 9.2.1.2.1 of TO 00-20-14, requires management to define and document their laboratory’s MADs. A review must be completed a minimum of once every 12 months. The Review Tracker allows the user to add and manage MADs with the following statuses: Review Due, Unavailable, Bypassed, No Issues, Concerns Noted, Deficient, Down, and Deleted. A note can be entered for each MAD to better clarify or justify statuses (such as TO 00-20-14, paragraph 9.2.1.2.1.2, justification for MAD bypass). MADs can then be assigned against Process Reviews (either Annual or Targeted) and a risk assigned to the MAD.

News and Notes (continued)
News and Notes (continued)

Review Tracker Program (continued)

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Target Management
TO 00-20-14, paragraph 9.2.1.2.2.2, states that it is up to management’s discretion to target any portion of any process. Review tracker allows management to target equipment, personnel, or processes. It tracks a target from creation, through all reviews performed against it, and finally when it is closed. The system provides reports to keep management and quality personnel informed of the status of each open target.

![Target Maintenance](image)

Annual Reviews/Evaluator Proficiency Evaluation (EPE)
TO 00-20-14 states that two PRs are to be accomplished every 12 months for Annual Reviews (paragraph 9.2.1.2.2.1) and EPEs (paragraph 9.2.1.2.3). The Review Tracker manages the PRs and the results performed against any Annual Review and allows EPE Review to be entered against any Annual or Targeted review. The system will generate reports notifying quality personnel when there has not been a review in the past 6-months or two in the last year.

![EPE Entry](image)

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Reports
There are 17 different types of reports provided by Review Tracker. It has three different schedules (Annual Review/EPE Schedule and MAD Schedule), which allows the user to print out what has transpired in the prior years or a current report that includes when the next review is due.

The Review Tracker also has reports for printing Active Targets, Archived Targets and Targets by Date. It provides two reports (MAD vs. Review Number and Technician Reviews) which allows finding reviews much easier. There are three reports (EPE vs. PN, MAD vs. PN, and Technician vs. PN) which presents the Part
News and Notes (continued)

Review Tracker Program (continued)

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Number performed for each review, allowing management to determine if the same type of item is being selected repeatedly. MAD Listing is a report of all the MADs with their statuses and notes. The final report combines the review due from the schedules and the current/active targets to ‘Make a Review Summary’ for the quality personnel, thus making management of the program easier. All reports are interactive while displayed, allowing the user to click an entry that will take them to that individual review. Additionally, all reports can be printed or saved in a PDF format.

Bill Belcher, Duluth PMEL

Lab Balance Calibration Procedure to Be Fielded with New Repeatability Test

Technical Order (TO) 33K6-4-3356-1, once a rescinded general Scale TO, will be reinstated in the upcoming month as a PMEL-only Calibration Procedure for Lab Balances. This procedure will be very similar to what labs have seen in the past, but incorporates a few changes designed to mimic the way a lab balance is used. The main difference is a new Repeatability test similar to the one found in recent Equipment Support Plans (ESPs). The new Repeatability test for Lab Balances is needed so that the methods of calibration and use (calibrating weights) are aligned.

AFMETCAL-fielded items will have their WUC reassigned directly to TO 33K6-4-3356-1. Unfortunately, PMEL-purchased standards cannot simply be reassigned to 33K6-4-3356-1, because they are not known at this time. In order to ensure all PMELs are using this procedure on their lab standards, general TOs 33K6-4-3607-1 and 33K6-4-3554-1 will be updated with an explicit requirement to calibrate lab balances using the latest version 33K6-4-3356-1.

In addition, TO 33K6-4-763-1 will be updated next year to require that only lab balances calibrated using 33K6-4-3356-1 shall be used for standards. In order to ensure this does not become a problem next year, it is imperative that PMELs take inventory of their mass standards now. A PMEL survey will be sent out shortly where each lab shall enter each of their standard balances not currently assigned to one of the mentioned general procedures, along with a justification (addressing range and accuracy) for why the balance is required for mass calibrations.

Sara Garverick /Mechanical Engineer /AFMETCAL
News and Notes (continued)

From The Quality Manager’s Desk

Anyone who has ever conducted a process review knows that the nonconformity code usually does not tell the whole story. While some technicians satisfactorily meet all requirements with a N00, there are also technicians that barely skate by with technicalities. Sometimes, there are even technicians that blow you away with their proficiency level but commit a major nonconformity. Due to this, Little Rock PMEL’s management team recently got together and decided that our current QP documentation could be significantly improved by capturing the technician’s proficiency level as observed during process reviews. Throughout the development of our new and improved documentation procedure, we decided that both the questions “Why was this reviewed?” and “What was the outcome of the review?” must be answered in PAMS.

We answer “Why was this reviewed?” by using standardized statements that justify all reviews conducted. For example, if a MAD Review is performed due to personnel losses, we would write “Evaluated Torque Measurement Area (MA); ensured capability is maintained. Technician that was previously observed by QP PCS’d causing increased uncertainty within MA.” Not only does this allow outside parties the opportunity to easily see the logic behind all review decisions, but also holds the MS accountable for only conducting value-added reviews that address increased uncertainty. If none of the standardized justifications apply, we ask ourselves whether we should conduct the review at all. The following are the Quality Program Review statements we’ve incorporated with our Management System:

**EPEs**

- Performed an EPE on QAE/QPM; assessed the technical ability and effectiveness of QA personnel and ensured the ability to self-identify whether or not nonconformance across the PMEL existed.

**PRs**

- Evaluated measurement area; review selection maximized the evaluation of MA I.A.W. Quality Manual and ensured area reviewed at least every 12 months. *(If not reviewed in the previous 12 months, state reason why i.e. “Not reviewed in past 12 months due to STD being out for repair since XXX”)*

- Evaluated measurement area; ensured MA capability is maintained. *Short one-two sentence explanation (i.e. Recent technician departure has led to increased uncertainty within MA. Local QP has not conducted a review of technicians currently filling the void.)*

- Evaluated measurement area; verified effectiveness of corrective action from Review # XXXXXX. *Quote the previous RCA corrective action.*

**ARs**

- Evaluated technician; review evaluated training and metrology skills appropriate to the technician’s position I.A.W. the QM. All items listed in T.O. 00-20-14 paragraph 9.2.1.1.2 were observed.

**QRs**

- Item randomly selected for QR by MIS. Reviewed end-of-line quality I.A.W. T.O. 00-20-14 paragraph 9.2.1.1.2. *(If all were not verified, state what was not reviewed i.e. “Safety compliance not verified....reason”)*

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Validating and Quantifying the Green

PAMS already requires NC and RC codes for each review, but we decided that “What was the outcome of the review?” is not fully answered without incorporating statements of the technician’s proficiency. Without that crucial element, all N00 reviews are seen as equals, and reviews with NCs would only convey where proficiency is lacking. You might be saying to yourself, “Yeah sure, but that is completely subjective, and I don’t have the time to write a story about proficiency for every review!”. We came to that same roadblock, but then thought of tying our statements back to the Proficiency Code Key in AFI 36-2201. If those statements are how the Air Force gauges task and subject knowledge, then it just makes sense to use the same standard for evaluating our technicians. This gives us a quantitative scale for a qualitative bias and allows us to convey proficiency levels without wasting time writing a novel. This also calibrates multiple QA evaluators to the same scale, thereby mitigating qualitative differences. Let’s pretend the technician from the earlier example completed the review with no NCs but struggled throughout the entire calibration. The statement “Technician performed all/most parts of the task but required significant help throughout the calibration procedure.” would be added after the justification for performing the review. Instead of just being satisfied with a N00 MAD review, the MS is fully aware of the risk for that MA and technician, and can respond accordingly. Below is our technician proficiency scale:

4 - Technician performed the complete task quickly/accurately, and demonstrated the ability to predict, isolate, and resolve problems about the task.

3 - Technician performed all parts of the task, required a possible spot check of completed work, and demonstrated the ability to identify why/when each step is needed.

2 - Technician performed all parts of the task, yet required some help on hardest parts of the calibration procedure.

1 - Technician performed all/most parts of the task but required significant help throughout the calibration procedure.

Thorough documentation is always going to be critical to a compliant and effective QP. Telling the MS why and how reviews were conducted paints the entire picture and allows decision-making to meet the requirement of being sound and logical. Our alpha-numeric codes serve a great purpose, but are they telling your MS everything they really need to know?

Now that we have gotten deeper into technician proficiency, Little Rock PMEL’s management is developing how to effectively document equipment proficiency. To be continued in a future newsletter…

TSgt Brandon Oehlke
Little Rock PMEL Quality Section Chief
News and Notes (continued)

Gage Block Packing

Several PMELs have received improperly packed gage blocks sets for calibration resulting in the entire set being condemned. Replacement gage block sets can be as expensive as $10,000. Budgets are tight and the logistics to replace gage block sets take a lot of time away from more important customer support. The following packing and shipping instructions will ensure gage block sets arrive at the intended destination without being damaged.

1) Clean all gage blocks.
2) Coat each gage block with a petroleum based Corrosion Preventative Compound such as P-2A (NSN 8030-00-244-1297).
3) Place each gage block in their respective slot in the box so they fit correctly without movement. For some gage blocks (5 to 20 inches), it may be necessary to place cardboard in the slots to ensure the gage block does not move.
4) Place a, cut-to-fit, vapor barrier Paper (MIL-B-121, Grade A, Type II, Class 2) on top of the gage blocks. The gloss side of the paper should be against the gage blocks. Cut as necessary to ensure the box lid closes and latches correctly.
5) Close the box and gently shake to ensure the gage blocks are secure. If necessary, add additional packing material such as bubble wrap on top of the vapor barrier to eliminate gage block movement.
6) Wrap two strips of 1 inch masking tape around the gage block box. One strip on each side of the box.
7) Wrap fiberglass reinforced tape around each strip of masking tape. The masking tape will permit the removal of the fiberglass reinforced tape upon delivery without damaging the gage block box.
8) Pack the gage block set into a heavy duty cardboard, fiberglass or plastic shipping container. The shipping container should be large enough to pack at least 3 inches of packing material around the gage block set.
9) Shipping documentation should identify the contents as “Precision Measurement Equipment, Handle with Care”.

Mike Rittenhouse
Mechanical Engineering Branch
AFMETCAL/WNMM
Gravity Corrections in Force Measurement Area

We have received several questions from PMELs concerning gravity corrections and when to apply them. First we will discuss why these corrections are applied, then we will take a closer look at how these corrections are derived once it has been determined that they are needed.

When are the Gravity Correction Factor (GCF) and Inverse Gravity Correction Factor (IGCF) Applied?

Correction factors are only considered when the standard being used is not of the same measurement parameter as the TI. These correction factors are applied when there is significant error caused by the difference between standard gravity and local gravity. We also consider the accuracy of the item being calibrated when determining if these correction factors need to be applied. Examples of these calculations are found in the appendices of applicable Calibration TOs (CTOs).

Understanding the Fundamentals of GCF and IGCF:

The first step is to recall Newton’s 2nd Law which states Force = Mass * Acceleration or F=ma. The second step is understanding the relationship between pound-force (lbf) and pound-mass (lbm). One pound-force is defined as the force required to accelerate an object with a mass of 1 pound-mass at a rate of 32.174 ft/s^2. This is seen in the relationship below:

\[ 1 \text{ lbf} = 32.174 \frac{\text{lbm} \cdot \text{ft}}{\text{s}^2} \]

Application:

1) Calibrations using a load cell (lbf) as the standard:
   a. Using a standard load cell (lbf) to calibrate a force TI (lbf): No correction is needed since both the standard and the TI are lbf items.
   b. Using a standard load cell (lbf) to calibrate a mass TI (lbm): A correction factor may be necessary. If 10,000 lbf is applied to an aircraft scale, we must calculate the lbm.
      i. Convert lbf to lbm*ft/s^2 using the relationship above:

\[ 10,000 \text{ lbf} \cdot \frac{32.174 \text{ lbm} \cdot \text{ft}}{\text{s}^2} = 321,740 \frac{\text{lbm} \cdot \text{ft}}{\text{s}^2} \]

ii. Use Newton’s 2nd law to find mass. This is where local gravity is used as the acceleration. Assume local gravity = 32.145 ft/s^2 for this example:

\[ F = ma \text{ or } m = \frac{F}{a} = \frac{321,740 \frac{\text{lbm} \cdot \text{ft}}{\text{s}^2}}{32.145 \frac{\text{ft}}{\text{s}^2}} = 10,009 \text{ lbm} \]

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iii. Discussion: We call this correction an Inverse Gravity Correction Factor (IGCF) and it can be simplified to IGCF = Standard Gravity / Local Gravity.

2) Calibrations using mass weights as the standard:
   a. Using mass weights (lbm) to calibrate a mass TI (lbm): No correction is needed since both the standard and the TI are lbm items.
   b. Using mass weights to calibrate a force TI (lbf):
      i. If the mass weights are adjusted to local gravity then no correction factor is needed. Mass weights adjusted to local gravity are typically only found in deadweight machines.
      ii. If the mass weights are not adjusted to local gravity then a correction factor may be necessary. If 10 lbm is applied to a force gauge, we must calculate lbf:
         1. Use Newton’s 2nd Law to calculate the force applied in lbm*ft/s^2. Assume local gravity = 32.145 ft/s^2 for this example:
            \[ F = ma = 10 \text{ lbm} \times 32.145 \frac{\text{ft}}{s^2} = 321.45 \frac{\text{lbm*ft}}{s^2} \]
         2. Convert this value from lbm*ft/s^2 to lbf using the relationship above:
            \[ \frac{321.45 \frac{\text{lbm*ft}}{s^2}}{32.174} \times \frac{1 \text{ lbf}}{\frac{\text{lbm*ft}}{s^2}} = 9.991 \text{ lbf} \]
         3. Discussion: We call this a Gravity Correction Factor (GCF) and it can be simplified to GCF = Local Gravity / Standard Gravity.

Conclusion:

Because these correction factors are simplified into ratios, it does not matter if the gravity values are in Imperial Units (ft/s^2) or Metric Units (m/s^2). Examples of TIs that read out in pounds force (lbf) are load cells and force gauges. Examples of TIs that read out in pounds mass (lbm) are crane scales, aircraft scales, and truck scales.

Shane Popson/Kevin John, AFMETCAL/WNME (Mechanical Engineering)
K9155D23 Secondary Vibration Calibration System Maintenance Tips

By now, most N112 labs have been using the new K9155D23 vibration calibration system as fielding was wrapped up in 2017. Feedback on the system has been positive for the most part, and enough time has passed that most have completed at least one calibration on the system.

It has been brought to my attention though, that in addition to performing the calibration, there are some maintenance checks that would be beneficial to also perform periodically. Recently, a few PMELs have needed to have the anti-rotation bands on the vibration shaker replaced because they had either completely broken or dry rotted. These anti-rotation bands are important as they minimize reference insert rotation when shaking (unnecessary rotation could affect calibration, especially in the horizontal position). This is normal wear and tear on the system and they will need to be replaced periodically. As the system is under warranty for five years, the Modal Shop has been sending out replacements if necessary.

There is a Shaker Maintenance video uploaded on the Modal Shop’s website that demonstrates how to perform these checks (http://www.modalshop.com/ID=778), which include alignment of the shaker, as well as visual inspection of the anti-rotation bands. There is also a Shaker Insert Installation video there that could also be useful. There have been a few instances in the field where they’ve noticed distortion in the SUT signal. This distortion is likely due to mounting adhesives such as wax or glue that may be present on the outside of the armature surface and may be removed by cleaning the armature, shown in the Insert Installation video. Note that at 3:45 in the Insert Installation video, the narrator states that continuity should be found between the DC shell and insert screws during an electrical test. This is an error as continuity should NOT be found. A link to the video has also been uploaded to the AF Metrology & Calibration Technical Support SharePoint under Engineering POCs > K-Areas > K3 > Vibration.

Lastly, I want to reiterate the importance of safe mounting practices on the K9155D23 since the armature insert is made of Beryllium, safe in solid form, but harmful to humans in dust form. You might see minor surface scratches develop on the insert over time, but I got clarification on what a “scratch” is and its impact from The Modal Shop when we began fielding the system. The insert is nickel plated coated, so generally anything that could be considered a "scratch" is 100% fine, but a "gouge" is bad.
K9155D23 Secondary Vibration Cal System Maintenance Tips (cont.)

TI surfaces shall be clean and smooth, so if the sensor you are mounting has significant material protruding out from the base of the sensor (enough to feel by hand), you should not mount it on the insert. Inspect all TI and adapter plate mounting surfaces for raised burrs, scratches and other surface defects prior to mounting and deburr, if necessary. An indicator of damage is when the reference insert causes the daily verification to fail. Also, in cases where adhesive has to be used to mount, do not scrape, file or grind the armature to remove adhesive. Removal of adhesive should be accomplished using an appropriate solvent, such as Acetone, and a paper towel. Consult the adhesive manufacturer’s recommendations for debonding instructions.

Thanks again to all for patience during this transition. Feel free to ask if you have any additional questions.

Larry D. Cotton
AFMETCAL Mechanical Engineering Branch
News and Notes (continued)

**Torque Arrows Are A Thing Of The Past…(Sort of)**

Torque Arrows have been causing Technicians and Quality personnel issues for some time due to adhesive arrows falling off (despite the old maintenance technical order [MTO] requirement to etch it), incorrect/outdated arrows not being removed, etc. Trend Analysis data has been riddled with L10a’s/A07’s related to torque arrows, and the seemingly standard issue H01 Root Causes that tag along with them. The arrow nonconformity (NC) is a data point that doesn’t tell us much about the section’s capability to run Torque while adhering to safety, accuracy, reliability, traceability (SART).

The governing torque MTO 32B14-3-1-101 changed in June 2018 from “Note the direction of the permanently etched arrow(s) on the barrel shaft of the torque wrench. This is the calibrated direction(s)” to “Note the direction of the calibrated TMDE certification label for calibrated direction of torque.” Bottom Line: The authority for the calibrated direction of Torque TMDE use has officially been changed from the direction of the etched arrow and has been replaced by the direction written in the special block of cert labels. This does not mean you have to eradicate arrows on the torque wrenches if they are in the correct direction; they can be left on the torque wrenches. This means you are no longer required to place arrows on new torque wrenches.

This change will soon be in each Torque wrench K-procedure we use, but wait! **There will be some exceptions to this rule.** Test instruments (TIs) with box, open-ended, or removable heads must have a directional arrow indicating the direction of use due to the nature of the tool/components. We’re trying to make this transition as smooth as possible and cover all aspects, so if we missed something or you have any inputs, please contact us or submit an AFTO 22.

The most important part about this change is properly communicating it. First, I encourage all PMELs to talk with their customers so that they are up to date with the new changes. Second, I have notified the schoolhouse about the change so that the curriculum can be adjusted accordingly. Finally, we recommend that you take a look at your laboratory’s torque training and ensure it adequately covers the concept of the arrow and why some TIs will need arrows and some won’t. You should see the change in the calibration procedure TO 33K6-4-2193-1 in mid-November.

Moving forward… If your entire lab isn’t aware of this change, go tell them! Go now! QA programs should be briefing this ASAP and I would expect that a change to Torque training plans is in order.

Special thanks to CMSgt Craig “Woody” Niemann (ret) and the Davis-Monthan PMEL for taking the lead on this long overdue change!

Corey Hyatt
Mechanical Engineer
News and Notes (continued)

Nellis AFB PMEL Happenings

We have spent the last few months enduring a well fought fight for renovation for the PMEL. This $1.5 million project will give us about 1,140 sq ft added to our shipping and receiving areas, new admin offices, new bathrooms, a new 100 sq ft calibration room, and a host of other facility improvements, all concluding around November 2018. This renovation was planned by the many PMEL individuals stationed here before us, but we are here to see it through, and reap the benefits this renovation will give us. This is just one step towards making the Nellis PMEL the premier calibration lab in ACC!

New Scheduling Area

New Customer Waiting Area

New Secondary Airlock

New Female Restroom

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News and Notes (continued)

Nellis AFB PMEL Happenings (continued)

(Continued from page 21)

Revamped Calibration Area (Old Torque Room and Airlock)

New Male Restroom

Front of the Lab

SMSgt Kevin Herrera,
Nellis PMEL Flight Chief
ALWAYS READY....CERTIFIED!
News and Notes (continued)

Davis-Monthan Adopts Duluth’s External Display for the Fluke 1620

Following Duluth’s lead (AFMETCAL Nov 2015 Newsletter, Vol 36 Issue 1), DM was able to secure innovation funds to stand up six external displays throughout the entire calibration area. For our lab’s workload, we anticipate this project will save approximately 142 – 169 maintenance hours annually. Special Thanks to Mr. William Pierce from Duluth for helping our QAE, SSgt Jordan Maharrey, get this project off the ground and running for DM.

From The Bench

Third Order Intermodulation/Intercept Calibration

Signal Generator SSB Requirements

The purpose of this article is to address the issue of using two generators with adequate Single Side Band (SSB) or phase noise specifications to perform Third Order Intermodulation/Intercept (TOI) calibration of spectrum analyzers. Currently, minimum use specifications of the generators are specified at the same offset as the TOI of the spectrum analyzer being calibrated. It is not always practical to use two generators meeting these minimum use specifications. Also, it is not always necessary to ensure the signal generator’s stated or explicit SSB phase noise specifications meet minimum use specifications.

Theoretically, generators having poor quality phase noise cannot make an out of tolerance (OOT) spectrum analyzer’s TOI appear in tolerance. However, they can make an in tolerance spectrum analyzer appear out of tolerance. Therefore, if a spectrum analyzer’s TOI is in tolerance, it is unnecessary to verify the phase noise specifications of the generators or to ensure their stated specifications meet minimum use specifications. We can surmise the generator’s SSB phase noise was adequate if the spectrum analyzer’s TOI is in tolerance. On the other hand, if an out of tolerance condition is found during the TOI calibration of the spectrum analyzer, we cannot conclude the spectrum analyzer is out of tolerance. We must first make sure the signal generators meet the minimum use specification. If not, we must verify the phase noise of the generators used at the appropriate carrier frequency and offsets, before concluding the Spectrum Analyzer is out of tolerance.

For example, the E8257D Opt550 (non-UNX\UNR Option) is only calibrated at 20 kHz offset from the carrier. An 8562EC spectrum analyzer calibrates TOI at 50 kHz from the carrier frequency. Therefore, in accordance with phase noise theory and the white paper on phase noise, the E8257D Opt550, as specified, isn’t good.

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From The Bench (continued)

Third Order Intermodulation/Intercept Calibration Signal Generator SSB Requirements (continued)

(Continued from page 23)

enough to verify TOI, because its SSB isn’t calibrated or specified at 50 kHz offset. However, in practice if we use two E8257Ds to calibrate TOI and the readings are in tolerance, then we can surmise that the spectrum analyzer is in tolerance and the generators did have low enough phase noise to correctly perform the calibration. However, if the TOI of the spectrum analyzer indicated out of tolerance, we cannot conclude that the TOI of the spectrum analyzer is bad, but rather we must verify the phase noise of the 8257D generators at the 50 kHz offset. If the phase noise of the generators are verified to meet the minimum use specifications listed in Table 2, then we can conclude the spectrum analyzer is out of tolerance.

In order to make the contents of this document more authoritative versus just being contained within a white paper, these calibration paradigms for TOI will be placed in the following locations: NextGen Equipment Requirements Excel TOI worksheet, NextGen spectrum analyzer TOI manual methodology, the NextGen MMR TOI manual methodology, and the generators in the Equipment Requirements Table footed accordingly in the most used 33K series spectrum analyzer TOs.

Marc McCaslin, AFMETCAL/WNE
Jeff Boulton, AFMETCAL/WNE
John Olson, Offutt QA
Matt Brown, Ellsworth Technician

AFMETCAL Personnel News

Evaluation Team Welcomes MSgt David Valdez

The Evaluation Team welcomes MSgt David Valdez. He arrived in August with his wife Susanne and sons Kai and Keanu. He calls San Diego home and brings a high degree of technical ability to the team, including eight years of quality management experience. During his 19 year Air Force career, MSgt Valdez has been stationed at Luke AFB, Mountain Home AFB and twice at Ramstein AB. The Evaluation Team is happy to have MSgt Valdez on board and looks forward to his positive contributions. We wish David and his family the best as they settle into the Heath community.

MSgt Freddie Marinas/WNM
About People (continued)

Some of the articles to look for in the next edition:

- Comments from the AFMETCAL Director
- Words of Wisdom from the Chief of the Laboratory Certification Branch
- News & Notes from AFMETCAL, the AFPSL and PMELs in the field
- Interesting articles From the Benches of PMELs throughout the world
- And much, much more!