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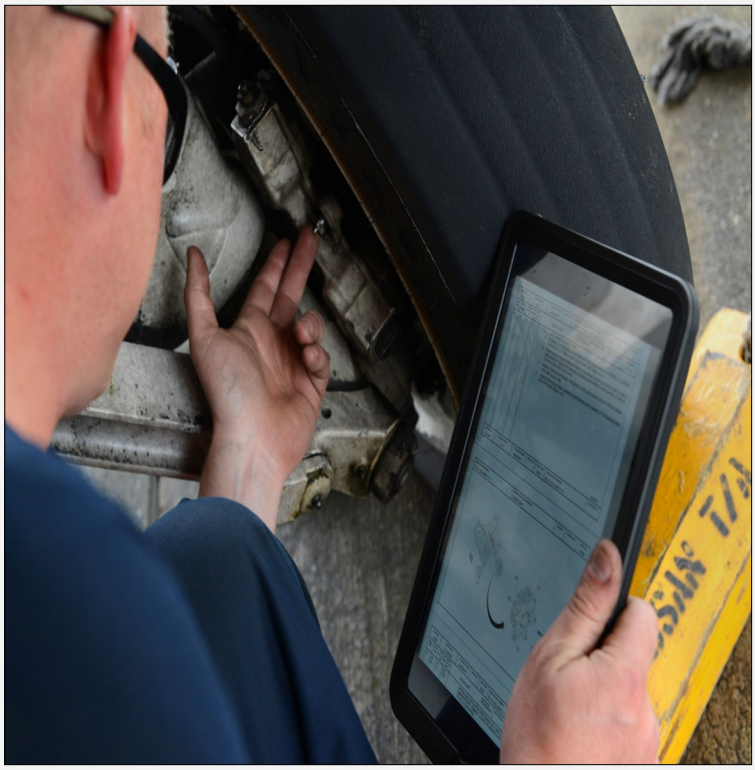

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Authors of this Newsletter

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Dr. Bill Johnson, a frequent contributor to this newsletter, is the FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. His comments are based on nearly 50 years of combined experience as a pilot, mechanic, airline engineering and MRO consultant, a professor, and an FAA scientific executive.

Factoring In: The Human Equation

Crystal Maguire

A key purpose all trade organizations have in common is to advocate on behalf of their constituencies. "Interest groups" are only as successful as their member involvement and their ability to conform to a person-centered design. ATEC is no exception; it relies heavily on industry engagement to reach goals and objectives set forth in furtherance of our common goal: promoting aviation maintenance technician education.

Workforce development is a hot topic; there is no shortage of forecasts and outlooks that support the well-known notion that aviation mechanics are in high demand and will continue to be for the foreseeable future. While the number of bodies available to support aerospace is important, it is even more important that entry-level mechanics have the requisite knowledge and skill needed to narrow the skills gap so prevalent in new hires. Industry need not ask what can be done to become part of the solution; aviation professionals need only read on.

"One of the most important elements of the trade association's 'person-centered' design—and the solution to so many of our workforce development challenges—is engagement. "

Photo by Wayne Community College.

One of the most important elements of the trade association's "person-centered" design—and the solution to so many of our workforce development challenges—is engagement. Continuous involvement and a member feedback loop are key to ensuring the trade association stays on track and in alignment with what the community actually needs from an advocate. There are several ways to provide that feedback and influence the association's priorities and trajectory.

ATEC's annual Washington Fly-in—taking place Sept. 10-13—facilitates in-the-weeds dialogue with regulators, industry peers and congressional representatives on issues that impact aviation maintenance education. Conversations held at this two-day event help set our regulatory agenda and legislative priorities for years to come. Lend your voice to the conversation. See the agenda and register to attend at https://www.atec-amt.org/fly-in.html.

Photo by National Aviation Academy.

A new industry-led initiative, Choose Aerospace, also depends heavily on the humans in our community. The campaign is a partnership of aerospace stakeholders joined together to address one of the biggest threats to continued industry growth: the availability of a diverse, qualified technical workforce. The initiative aims to unite companies, associations, labor unions, and educational institutions; to spur interest in aerospace careers; and to identify and implement solutions to the aerospace workforce shortage. The initiative will only commence with adequate industry support. Learn more at www.chooseaerospace.org.

Finally, a trade association is only as strong as its membership. ATEC's has grown two-fold over the last five years and continues to see growth both in the number of schools and companies involved, as well as the caliber of those professionals donating their time to build a strong community voice. If you're not a member, join. If you are a member, serve on a committee. Publish your thoughts and ideas in our semi-annual Journal, come to the annual conference, download and share the annual Pipeline Report, join us at an outreach meeting.

Become part of the solution. Factor in. All aviation-loving humans are welcome.

"All aviation-loving humans are welcome."

About ATEC: *ATEC is a partnership of aviation maintenance training schools and employers. The council is dedicated to promoting and supporting technician education through its communications, advocacy programs and networking events.*

Safety Culture Promotion in an Example Mx Organization

Kylie N. Key

The author acknowledges and thanks team members from Cherokee CRC, LLC (Dr. David Schroeder, Justin Durham, Dr. Inchul Choi, and Blake Nesmith) for their assistance with this article.

Previously (see Key, 2019, March Newsletter) I described safety culture promotion. This quarter, I want to provide an example of what this might look like if it were to be implemented. Let's consider the fictitious organization *XYZ Mx, Inc.* The mission of *XYZ Mx, Inc.* is to provide safe and cost-effective Mx to their customers. They are a small company that provides Mx to aircraft owner-customers and agricultural operations. Business is expanding, as they recently took on more diverse customers and aircraft types to ensure growing size and operational efficiency. As part of their new and evolving voluntary Safety Management System (SMS), they devoted a small budget to Safety Promotion.

Step 1: Assess Safety Culture in *XYZ Mx, Inc.*

First, *XYZ Mx, Inc.* assessed their current safety culture using a survey. The survey collected anonymous employee reports about their personal beliefs and attitudes toward safety in their organization. The survey addressed safety culture across three broad categories: 1) organizational job resources and job demands, 2) individual employee outcomes: well-being and satisfaction, and 3) organizational outcomes such as risky behaviors, accidents and incidents, and productivity. Employees were asked to indicate their agreement with each statement or how frequently different events occur. Employees could also leave anonymous comments.

Step 2: Analyze *XYZ Mx, Inc.'s* Safety Culture Survey Data

After collecting data with the survey, *XYZ Mx, Inc.'s* safety coordinators removed information that could potentially identify the employee then proceeded to score the data. The safety coordinators calculated the percentage of positive (versus negative) responses, and grouped the comments together into meaningful trends. Next, the safety coordinators presented the data to management for interpretation (see Figure 1).

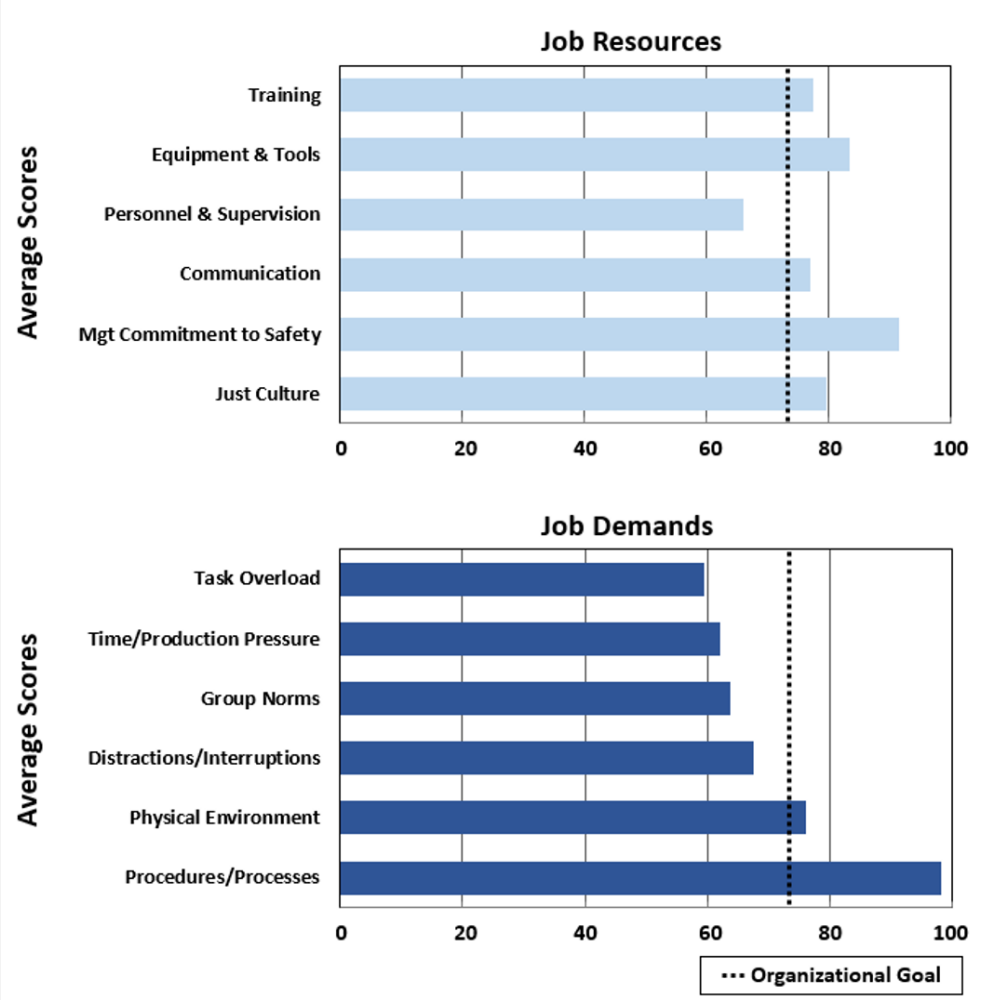

Figure 1. XYZ Mx, Inc's survey data of Job Resources and Job Demands.

To interpret the results, management compared the current survey scores to *XYZ Mx, Inc.'s* goal, shown as the dotted line in the figure. As Figure 1 shows, Job Resources scores were mostly positive but there was room for improvement in Personnel and Supervision. Job Demands had lower average scores. Based on these data, management decided to focus on reducing safety culture risks related to Job Demands, particularly in the areas where scores were below the organization's goal, including:

- **Task Overload**
- **Group Norms of Noncompliance**
- **Distractions/Interruptions**
- **Time/Production Pressure**

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Next, the survey results were shared with employees. The managers and safety coordinators worked together to present the information at a safety stand down/all hands meeting. The positive results were emphasized and celebrated, but management also shared the areas for improvement (i.e., Job Demands). The managers made sure to ask for ideas for improvement and later used that feedback to generate action items. This was done so that employees knew their voices were heard and that management was actively seeking ways to improve the organization.

Step 3: Promote Safety Culture in *XYZ Mx, Inc.*

As is the case for many Mx organizations, the survey revealed that *XYZ Mx, Inc.* was struggling with high Job Demands. Remember, they had limited resources to devote to Safety Promotion. Obviously, it's not feasible to simply minimize Job Demands across the board. They needed a way to target their limited budget to the areas most in need of improvement. Employees' survey comments hinted at some of the areas needing improvement. But to discuss root causes and specific action items, the organization hosted a series of small focus groups including safety coordinators, management, supervisors, and some front-line employees.

The focus group discussions revealed that *XYZ Mx, Inc.'s* rapid growth created a cascading effect on employees. The company took on more business to increase profit, but didn't have enough personnel to support the new work. The existing personnel were overtasked and could not keep up with production demands if they followed all safety procedures. This in turn led to risky behaviors like not wearing personal protective equipment and not following written procedures, as a way to save time. This kind of behavior may work in the short-term, but in the long run safety outcomes will eventually be impacted. The focus group recommended hiring additional employees as soon as possible to reduce task overload, as well as implementing refresher training on the importance of procedure following to reduce risky behaviors.

Another problem identified by *XYZ Mx, Inc.* involved lack of leadership and communication. Many employees commented that while managers say they care most about safety, they actually care more about productivity. The focus groups recommended that management spend more time on the hangar floor talking about safety (rather than productivity) to employees. This would help employees know that management's top value is safety, thus reducing risk-taking behaviors like cutting corners. But speaking about safety was not enough. Managers decided to also reinforce safe behaviors through incentives such as monetary rewards and social recognition (McSween, 2003).

Step 4: Reassess Safety Culture in *XYZ Mx, Inc.*

The final step for *XYZ Mx, Inc.* was to reassess their safety culture using the same survey from Step 1. This was done one year after the improvement efforts, as culture change is slow and may lag up to two years after the intervention (Neal & Griffin, 2006). Reassessing allowed them to gauge whether their efforts were successful and what other areas may need improvement. By using the same survey from Step 1, they were also able to compare their results across time. The reassessment showed that improvement had occurred, so the company hosted a picnic to celebrate. If budget allows in the future, they may offer monetary rewards instead.

XYZ Mx, Inc. understands that continued promotion of safety culture is important and they intend to continue with their Safety Promotion program. No matter how positive the safety culture survey is, if it's not maintained over the long-term, it can cause employee backlash (Taylor & Patankar, 2001) and safety culture can even decrease over time.

Summary

While this is a short and uncomplicated example, it is quite representative of the ideal format for ensuring continuing safety and operational efficiency. It is best to evolve your safety culture in incremental steps. Ideally, tackle manageable challenges first. Prove that the methods are feasible and can evolve to address the major challenges. As the old adage says, "there is only one way to eat an elephant: a bite at a time."

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Multi-Disciplinary Approach to identifying Safety Challenges

Bill Johnson

Have you heard the one about the Dutch pilot, British air traffic controller, Austrian aircraft designer, Welsh procedures writer, and American regulator all in one room? Well, it is neither a joke nor a funny story. It is a working group of the European Union Aviation Safety Agency (EASA). The team above is part of the EASA Human Factors (HF) Collaborative Analysis Group (CAG). Their work is exemplary of the continuing effort of industry and government collaboration to improve safety management.

The EASA HFCAG is one of many sources of information to define the European Plan for Aviation Safety (EPAS). The EASA website for the EPAS emphasizes that a key goal of the Safety Management plan is to manage risk. That includes identifying and prioritizing hazards and establishing mitigation plans. Committees like the HFCAG help offer content-specific advice and recommendations. The HFCAG, with about forty active delegates, is comprised of industry, academic, and government human factors specialists. The group includes designers, engineers, pilots, scientists, maintenance organizations, labor organizations, and others. Most delegates are from European Union (EU) countries but that is not a requirement. FAA usually has two representatives, usually personnel from the Chief Scientific/ Technical Advisory program. The HFCAG is a highly experienced cross-disciplinary technical group.

For the current EPAS planning period the Human Factors CAG prioritized four areas on which to provide specific assessment and guidance (Table 1).

Table 1. Target Areas for Assessment and Guidance

1. **Design and Use of Procedures**
2. **Organizational and Individual Resilience**
3. **Senior Management Competence and Commitment**
4. **Training Effectiveness and Competence**

Each of these target areas had a small group dedicated to assessing the risks and recommending potential mitigation solutions. The mitigations were designed for classification into one or more approaches including rulemaking, safety promotion, or research.

The remainder of this article describes the recommendation from Target Area 1, the Design and Use of Procedures. Now, we return to the first sentence of this article that seemed to be the starting line of a joke. The multi-disciplinary team included a pilot, air traffic controller, procedure writer, flight deck designer, and a maintenance regulator. Bill Johnson knows this story well because he was the regulatory participant and quasi-lead of the group. From the very start of deliberations, it became clear that the challenges related to design and use of procedures had no country, cultural, or occupational dependence. We all had the same issues.

"….it became clear that the challenges related to design and use of procedures had no country, cultural, or occupational dependence. We all had the same issues."

At the outset, the group was overly ambitious. Twelve challenges were identified and we embarked on solution paths. Our first written draft and briefing, to the entire HFCAG, made it clear that we did not sufficiently delimit. After a few deliberations via international telephone conferences, we accomplished the goal of arranging conference calls around 7x24 schedules and multiple time zones. More importantly, we narrowed and prioritized the recommendations to four categories as shown in Table 2.

Table 2. Safety Challenges Related to Design and Use of Procedures

1. **Unclear, Incomplete, etc. Procedures/ Instructions**
2. **Inadequate Safety Culture and Root Cause Analysis Regarding Procedures**
3. **Situations where there is no specific procedures for the situation**
4. **Not Applying Proven Technology to Deliver Procedures**

For each of the safety challenges the group wrote a characterization of the challenge to include: descriptions, example manifestations of the challenge, research approaches, and practical examples and references that have addressed the challenges. For each challenge we offered action-oriented solution paths that EASA could follow. As mentioned, we tried to classify all recommendations into one or more categories including rule-making, safety promotion, or research. In all cases, the

(Continued from page 6)

recommendations were a combination of Safety Promotion and/or Research. The committee did not recommend new or changed regulations.

Recommendations

Recommendations for Challenge 1: Review and Recommend Methods of Design and Management of Procedures

The committee recommended that EASA commission a working group to develop generic, multi-domain guidance on the process of design, validation, implementation, and maintenance of effective procedures for publication as safety promotion material. Although cavalier, someone commented "If Ikea can create useable assembly instructions for furniture assembly then our industry should be able to improve procedural guidance."

Recommendation for Challenge 2: Address Safety Culture and Root Cause Analysis related to Design and Use of Procedures

The committee recommended that EASA place the topic of "design and use of procedures" high on the priority list for continuing applied research. It is a leading threat to safety, thus it should be an applied research priority. Workers know that using procedures is a regulation. They know what procedures to use and they are capable of executing the procedures. Yet, failure to use procedures is the #1 contributing factor to negative events. Lack of procedural knowledge and skill is not the issue. R&D should examine the organizational and cultural issues that impact procedural compliance. Results should be practical and actionable. The reports should focus on understanding and addressing organizational culture regarding on-going procedural non-compliance. FAA embarked on this kind of work with the followprocedures.com training, during 2017-19. There are many remaining opportunities for improvement.

EASA should create root cause analysis (RCA) support that is specifically focused on procedural non-compliance. The research deliverables should help users to ask more and better questions related to procedural non-compliance. The RCA research results should make it easier for industry safety practitioners to effectively identify causes of procedural non-compliance and rapidly implement solutions.

Recommendation for Challenge 3: Design and Deliver Training for Resilient Behavior when Procedures Do Not Match Situations

There cannot be a specific procedure for every action in a complex system. The committee recommended that government and industry focus on increasing human and systemic resilience. This means that training regarding human performance variabilities in complex operational conditions must go beyond procedural compliance.

The committee recommended that EASA facilitate the production of training material to effectively inform audiences that procedure following does not automatically equate to safety. Safety emerges from systematic interactions (people, artefacts, training, etc.) and consequently increased focus should be aimed at adaptation skills and defensive operating techniques, ultimately fostering individual and team resilience.

Recommendation for Challenge 4: Design Guidelines and Use of Electronic Checklists (ECL) for Maintenance Tasks

ECLs for maintenance personnel lack structured human factors design approach and often contradict well established design philosophies of the flight deck, e.g. the use of color.

The committee recommended that EASA investigate how properly designed ECL for maintenance personnel could help to provide the same benefits as ECL for flight crews, and consequently, reduce human error of maintenance personnel. The committee recommended that EASA create human factors design considerations for ECL for maintenance personnel that are consistent with established design guidelines for ECL for flight crews.

"If Ikea can create useable assembly instructions for furniture assembly then our industry should be able to improve procedural guidance."

(Continued from page 7)

Conclusions

The small multi-disciplinary team felt that the list of recommendations was short yet comprehensive. In summary, write excellent procedures, foster an industry culture to use the procedures, seek to understand why a procedure was not used, deliver the procedure using an appropriate methods and technology, and train the human to cope when a procedure is not available or relevant.

The recommendations described herein are but one small example of the advice that industry/government panels can offer to all National Aviation Authorities. US Industry/FAA examples include committees like the Commercial Aviation Safety Team (CAST) and the General Aviation Joint Steering Committee (GAJSC). Internal committees like the FAA AVS Human Factors Coordinating Committee (AVS HFCC) is comprised of Human Factors personnel in Flight Standards and Aircraft Certification.

Advisory groups are extremely valuable to help governments manage safety. Multidisciplinary groups offer a broad perspective that can provide the best thinking of government, industry, and academia. Such groups can provide understandable and actionable advice. It is an ideal cooperative situation. Readers should look for opportunities to offer their experience and advice through such advisory participation.

Meet the Newsletter Staff

Can you believe we are in the 7th year for the FAA's Aviation Mx HUMAN FACTORS Quarterly newsletter? This newsletter is the brainchild implemented by Dr. Bill Johnson. Bill is a frequent author and contributor to this newsletter and he continues to offer innovative ideas for improvement and distribution.

Through the years the team has evolved, but without further ado, let's meet the *Civil Aerospace Medical Institute's FAA Aviation Mx HUMAN FACTORS newsletter staff.*

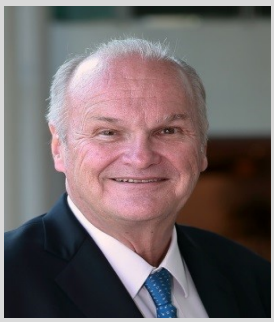
June 2019 Newsletter Staff (L\R): Dr. Bill Johnson, Kylie Key, Carrie Roberts, Blake Nesmith, Justin Durham and Janine King.

Meet the Newsletter Staff

(Continued from page 8)

Kylie Key is an FAA Engineering Research Psychologist for the Flight Deck Human Factors Research Laboratory at the FAA's Civil Aerospace Medical Institute (CAMI). She is a lead researcher for multiple aviation maintenance human factors projects. She is a recent newsletter author and has stepped into the content editor position for the Mx HF Newsletter.

Dr. Bill Johnson is the FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. His knowledge and experience are based on nearly 50 years of combined experience as a pilot, mechanic, airline engineering and MRO consultant, a professor, and an FAA scientific executive. His creation of the newsletter aids in sharing safety research and information and training. The publication is kept alive with his article contributions and industry connections to ensure author submissions. He works closely with the editorial team to ensure relevant content for every newsletter publication since 2013.



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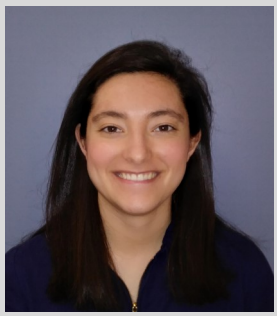

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Author Appreciation

We would like to extend our gratitude to the readers and authors for their continued support of this newsletter. We enjoy your reviews and look forward to future article submissions, keep up the good work! Our contributors are not primarily responsible for writing articles for this newsletter, however, the vast majority are experts in their fields when it comes to issues related to aviation maintenance. Most importantly, we value their input and reviews that bring interest and value to readers of this quarterly forum.

Upcoming Events

- **7th annual Networking Dinner and Silent Auction**
  Washington, D.C. (July 10, 2019)
- **Duluth Air and Aviation Expo**
  Duluth, MN (July 20-21, 2019)
- **EAA AirVenture Oshkosh 2019**
  Oshkosh, WI (July 22-28, 2019)
- **63rd HFES Conference**
  Seattle, WA (October 28-November 1, 2019)
- **Business & General Aviation Conference**
  Los Angeles, CA (October 2, 2019)
- **15th Maintenance Cost Conference (MCC)**
  Athens, Greece (September 18-19, 2019)
- **SUN 'n FUN Aerospace Expo**
  Lakeland, FL (March 31-April 5, 2020)

Our Request and Promise to You

Want to share an article, experience, or provide suggestions for the FAA Aviation Mx HF Newsletter?

Every submission will receive prompt feedback from our great editors! With your approval, we will go beyond grammar and spellcheck, followed by an author sign-off prior to the publish date. Newsletters are published every 3 months (quarterly), starting at the end of March. If you submit something to us by the middle of the quarter, we can typically make the deadline.

If you would like to discuss your idea prior to the writing phase, please e-mail Dr. Bill Johnson at bill-dr.johnson@faa.gov for guidance or recommendations. Send your submissions to Janine King at janine.ctr.king@faa.gov. If you have any interesting maintenance safety images, please include them in your submission with an image caption. We appreciate your input!

Here's what readers are saying about the FAA Aviation MX HF Newsletter…

Thanks again for all you do helping us out here in the field.

…you have done a fantastic job once again.

Dang, that is an awesome newsletter. All the info is spot-on in regards to what we talked about.

Your quarterly newsletters have an impact and are important to not only the air carriers but also the really large Part 145 repair stations.

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