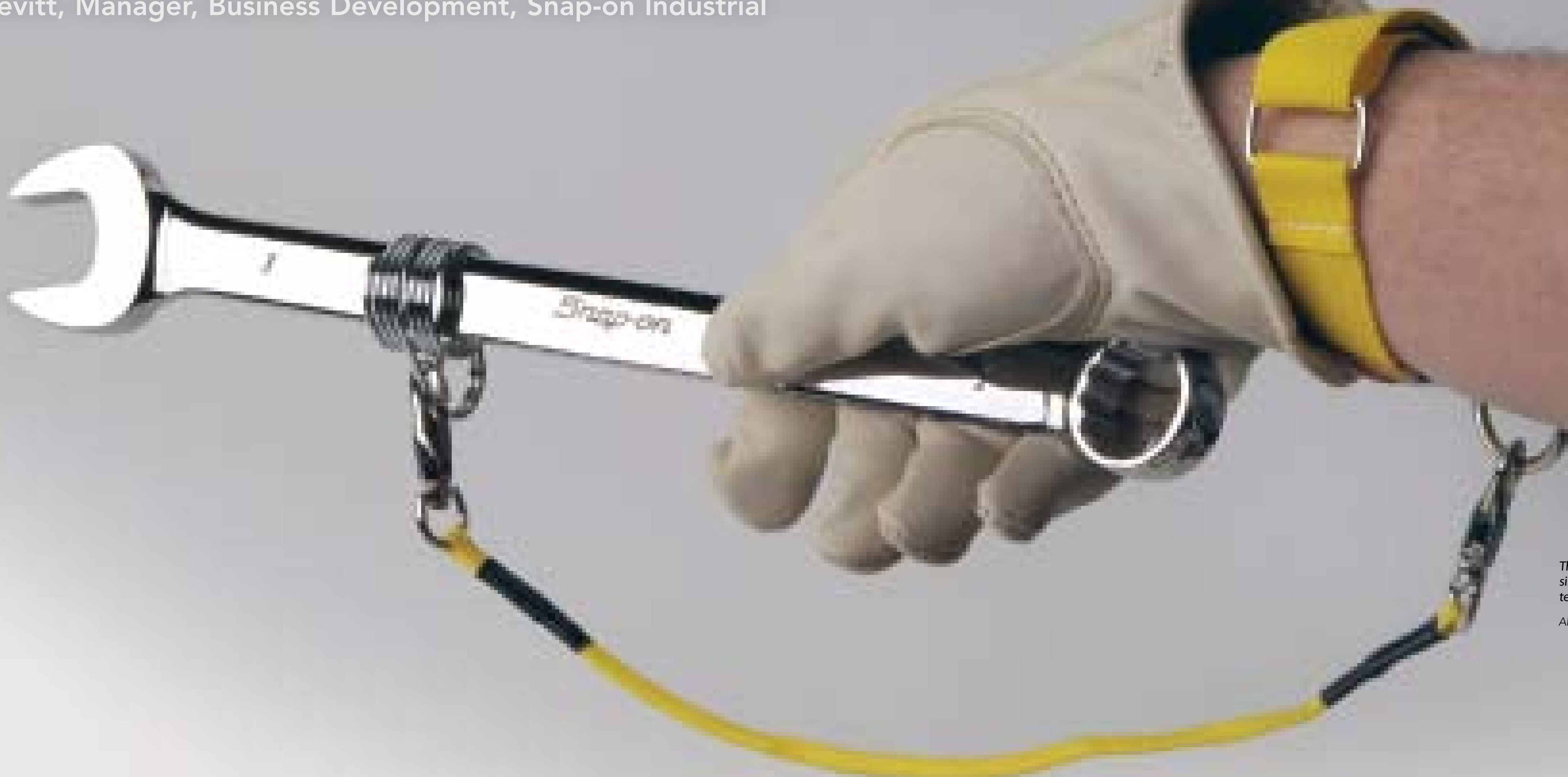
Flank Drive & Tool Control

by Pat McDevitt, Manager, Business Development, Snap-on Industrial



There are numerous methods of tool control from the simple to the highly technical. Shown here is a low tech method of controlling tools at height.

All photos courtesy of Snap-on

Aviation technicians can attest that the last thing you want happening when working on a fastener is to have the tool slip. The result can be detrimental not only to the work, but painful for your hands.

Using the right tool can make a substantial difference in getting a job done safely and on time. The Flank Drive system of tools from Snap-on have earned a reputation for success in the aerospace industry by increasing applied torque while preventing the corners of fasteners from rounding off, and are a great time saver for technicians.

But technicians can't finish a job if they don't readily have access to their tools. That's where tool control and management comes in. A lost or missing tool can be disastrous in the aerospace industry. A socket mistakenly left behind on an aircraft, hangar or ramp becomes a FOD (foreign object damage) hazard and poses a safety risk. A properly devised tool management program will help keep track of your tools, minimize FOD concerns — all the while making your MRO a more efficient operation.

Using the Right Tools – Flank Drive

Every aircraft contains thousands of fasteners. The unique design requirements of miniaturization for saving space and weight, coupled with the extremes in temperatures, vibration and other stress result in significant problems in the removal of fasteners during servicing.

The problem occurs when technicians try to remove these fasteners with standard wrenches and sockets. Often, there's not enough torque or contact available to break the fasteners free, which causes them to round off and the tool to slip. This causes a safety issue to the technician in the form of skinned hands and knuckles; if the technician is working on an elevated platform and the tool slips while he's pulling it toward him, he could fall back and be in danger of falling off the platform.

But what kinds of fasteners can be difficult to remove?

- *Skin panel fasteners – usually with internal wrenching recesses which are often filled with paint or dirt can present challenging service problems.*
- *Airframe structural fasteners – generally made of high strength materials and located in confined areas can present a variety of service problems. The fasteners are usually external wrenching with 12-point or spline wrenching shape.*
- *Propulsion system fasteners — those used in jet engines are not only high-strength and located in confined areas, but are subjected to high heat and a corrosive environment. This can lead to removal torque levels that can be more than three times the installation or tightening torque guidelines.*

Trying to remove these three types of high-strength 12-point fasteners with standard, conventional tools can cause wrenches and sockets to break, but more often the fastener becomes rounded, making fastener removal all the more challenging.

But why is the tool slipping in the first place? The answer lies in the design of the fastener, wrench and socket. In most industries, the relationship between the stud and fastener is that the fastener is about 1.5 times the size of the stud. However, in aerospace, the stud is the one that's larger than the fastener — which is typically 12-point as opposed to six-point. Having a smaller fastener means more torque needs to be applied to it.

A conventional double hex socket places the stress and torque at the corners of the socket and the fastener. When you apply torque to the fastener, the first part that touches it is the corner of the wrench or socket — this is called the point stress concentration. All the stress of the tool is placed solely at its tip, which is also the thinnest part of the wrench or socket. Fasteners in aviation often need a tremendous amount of torque to bust them loose, but conventional tools are placing all the stress at its thinnest point — the tip of either the six- or 12-point wrench or socket, and the tip of the fastener. The torque required to loosen the nut is not attainable before the corners are distorted severely enough to result in complete rounding of the fastener corners.

To address this issue, flank drive wrenches and sockets were developed to provide the proper amount of torque to successfully remove the fastener, while not rounding off the corners. The procedures are outlined in Aerospace Standard 954. The main concept within AS954 is the requirement that the wrenching tool contact the 12-point fastener away from the fastener corner, effectively reducing the tendency to round fastener corners. AS954 covers high strength thin wall commercial sockets, universal sockets, box wrenches and torque adaptors which possess the strength, clearances, and internal wrenching design so configured that, when mated with 12-point fasteners, they shall transmit torque to the fastener without bearing on the outer five percent of the fastener's wrenching points.

Flank drive tools conform to AS954 by moving the contact points between the wrench or socket and the fastener away from the fastener's tip and back to the thicker, flat surface — or flanks — of the fastener. The line of action of the force between the wrench and fastener is now essentially perpendicular to the fastener flats. As the torque and force increase, the fastener corner remains untouched. Because stress is distributed along the flank, torque limits can be increased 15-20 percent over what ordinary wrenches and sockets can provide. By placing the contact off the fastener tip, a significantly higher torque can be achieved without damaging the fastener corner, and this is often enough to achieve fastener removal. Additionally, flank drive allows tools to increase torque loads without increasing wall thickness, making them ideal for use in the tight, confined spaces of many aerospace applications.

The flank drive design makes tools safer because wrenches and sockets are less likely to slip off the fastener. It also saves technicians time by eliminating the need to drill out rounded fasteners; and the less drilling performed on an aircraft the better.

The box wrenches and socket wrenches covered in AS954 range from 3/16 to 1 5/16 inch. Thin walls on the tools, coupled with deep wrench openings and large blot clearance requirements provide fit and function on aerospace fastener applications.

The need for tool control

In addition to using right tools for the job, it's important that MROs have full control over their tools and equipment to eliminate foreign object damage (FOD) concerns. Certainly, a lost or missing tool left behind in a hangar, flightline or on an aircraft can lead to costly repairs and impact safety. Perhaps nothing illustrates the need for proper tool control better than an incident that occurred in November 2011.

A JetLite Airlines Boeing 737 was on a domestic flight in India carrying more than 130 passengers when it suddenly lost an engine. The aircraft made an emergency landing in a city about 400 miles from its intended destination of Mumbai. While many things can lead to an engine being shut down in flight, officials were surprised to learn the culprit in this incident: a tool mistakenly left behind.

The investigation revealed that while performing maintenance on the engine, an engineer and technician left a tool behind in the engine cavity. The technician tightened fasteners after servicing the engine, but failed to notice a small gap that was created when the covering didn't sit properly on the engine. That gap was caused by an expander tool overlooked in the engine. The friction during flight created a hole in the covering, which began leaking oil and led to the engine shutdown.

Airline officials reviewing the incident blamed the maintenance personnel for not following recommended procedures in accordance with standard procedures, and the engineer was suspended pending further review by the Indian Directorate General of Civil Aviation.

Fortunately the aircraft landed safely and everyone walked away unharmed, but the incident clearly illustrates the danger lost or forgotten tools can pose to the aviation industry. FOD can be caused by an expander tool, socket or even a small fastener — all of which could lead to devastating consequences.

The key to eliminating this threat is through sound tool control management, and that starts by developing a tool control program. Implementing a program and using new technologies to help manage tools and equipment will reduce FOD concerns, improve efficiencies and make an MRO's operations safer and more effective.

Implementing a Tool Control Program

A tool control program is an ideal way for organizations to account for tools and equipment. The goal of any program needs to involve a detailed process of tool inspection and accountability, both before and after a job is completed, but more importantly, the process needs to be followed. Any credible tool control system should meet five criteria: organization, visibility, security, trackability and accountability. These factors, when added together, give MROs the means to fully control their tooling systems.

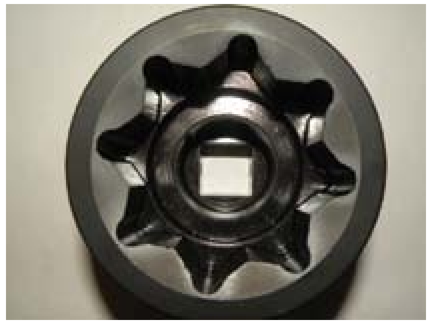
Questions MROs should ask themselves in designing a tool control program include:

- *What is the goal of a tool control program for your organization?*
- *How extensive will the program be?*
- *What materials will be monitored?*
- *Who can perform a general inspection of the area?*
- *What forms, if any, should be required?*
- *Will all the tools in the flight department be monitored?*
- *Will the company-owned tools be in the program and the technicians' personal tools be left out?*

Answering these questions will help MROs craft a tool control program that best fits their needs, while mitigating FOD concerns. Tool and equipment suppliers can assist in evaluating your tool control needs and developing a program that best meets your goals and expectations. The more reputable suppliers have proven tool control options available, such as keyless entry, clear-view tool boxes, custom foam cutouts, and a new concept called digital imaging technology, that when working together, provide a tool control program that's safe and effective.

How digital imaging technology works

Snap-on Industrial has developed digital imaging technology, a system component of a tool box that aids in tool control. The system uses vision digital imaging to scan each drawer as it opens, comparing real-time images with the original image of the full



Above, a flank drive socket in action. The proper use of a flank drive in removing fasteners is key. Snap-on flank drive wrenches and sockets were developed to provide the proper amount of torque to remove the fastener, while not rounding off the corners.

drawer. To get started, a technician scans their employee badge, unlocking the box to gain entry. Each badge is coded so that only one specific person can then access the box, and all tool withdrawals and returns are recorded to that user. A 7" monitor affixed to the top of the box visually shows the technician each drawer, and what tool has been taken. As the box is accessed to remove or return tools, the system scans each tool in the drawer to determine its status. An audio system also announces tool issue and return. If tool status is questionable, the system can display the disputed tool transaction on the LCD screen or it can be identified in the audit image at the administrator's PC. User log data and time-date information is available for every transaction. After the technician logs out, the software can forward drawer images and log files to the PC where they are stored for later access.

Digital imaging technology offers several advantages to the aerospace industry. For starters, it reduces FOD concerns. If a technician checks out 15 tools and later returns 14 tools, the audio system announces not only that a tool is missing, but which one, and the technician now knows to go back and find that tool. In the JetLite incident, if the engineer or technician had been using a tool box outfitted with digital imaging technology, it would have alerted them that the expander tool hadn't been returned. This real-time information cuts down on potential FOD issues.

The information that digital imaging can bring to organizations, such as the military and commercial MROs, can be very useful. Being able to quickly determine that all the tools are back and that nothing's been left behind, who used which tool, and when they used it, can be a helpful asset in a tool control program. There are a number of reasons why this information is important. First, if you're working under an analog system and something's lost, you don't know who lost it. Secondly, you don't know where it was taken to be used, so it's going to be difficult to find it. Finally, there's no history of what tools were used to do which jobs or what tools are in the tool box that aren't being used at all. Digital imaging gives MROs, administrators and technicians a more detailed view of overall tool use and brings greater accountability to a tool control program.

Summary

Technology is the driving force behind new advances on tools, equipment and tool control measures. The ability to safety and efficiently remove a fastener on one hand, while allowing MROs to fully track those tools are just two example of the industry recognizing a problem and responding to a need. The tooling needs of tomorrow are here today.

Pat McDevitt is manager, Business Development, at Kenosha, Wis.-based Snap-on Industrial. He can be reached at 262-656-6049 or Patrick.d.mcdevitt@snapon.com AM