

CALLBACK

From NASA's Aviation Safety Reporting System



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The "Dirty Dozen" in ASRS Maintenance Reporting

In 1993, following several publicized maintenance-related aviation incidents and accidents, Transport Canada developed programs which would serve to reduce maintenance error. In close collaboration with the aviation industry, Transport Canada subsequently identified 12 human factors – called the “dirty dozen” – that may lead to maintenance errors. Since then, maintenance technicians at many major air carriers have routinely received training to recognize “dirty dozen” factors and prevent their occurrence. This month we take a look at how the “dirty dozen” human factors play a role in maintenance incidents reported to the ASRS. The “dirty dozen” factors are:

- Lack of Communication
- Lack of Resources
- Complacency
- Pressure
- Lack of Knowledge
- Lack of Assertiveness
- Distraction
- Stress
- Lack of Teamwork
- Lack of Awareness
- Fatigue
- Norms

Lack of Awareness and Teamwork

The tail jack screw assembly of a commercial jet, part of the horizontal stabilizer system, is very important to safe flight. In an incident reported to ASRS, several “dirty dozen” factors contributed to misplacement of a jack screw lockout tool:

Lack of Awareness: Losing track of tools

Lack of Teamwork: Lack of mutual support

Lack of Communication: Failure to discuss job completion

■ Finalization of all paperwork and work was complete. Close to shift's end, I was called to the supervisor's office. A tool (horizontal stabilizer lockout) I checked out had not been turned in. I asked my partner [who] worked on the project with me if he'd seen the tool. He asked me if I had looked on the shelf behind the jack screw for the tool. I had not. I quickly went to the line to search for the tool, but the aircraft was already gone. We reported the situation to a supervisor who called where the aircraft was headed and left specific instructions. Upon arrival the tool was found.

1) My partner and I failed to do a tool list check-off. I turned in some tools and he turned in some. 2) The tool room discovered that the tool had not been turned in at shift's end and saw that the others were in. 3) We both had different duties and did not come together at the end to discuss finalization. 4) Upon cleaning the work area...I had no idea that the tool was placed on the shelf behind the jackscrew.

The hero in this incident was the alert tool room mechanic who noticed that a tool had not been returned prior to shift end, and quickly notified a supervisor. Fortunately, the

lockout tool was not installed. If the lockout tool had been engaged with the horizontal jack screw, and the flight crew did not do an adequate preflight check of the stabilizer trim, the outcome could have been serious.

The Perils of Pressure

Aviation maintenance personnel are often assigned tasks on multiple aircraft during a single shift, and are under continual pressure to return aircraft to flight status. Several incidents reported to ASRS highlight the need for technicians to slow down and take the time to do the job right, the first time.



A lead technician succumbed to a “dirty dozen” maintenance error factor while servicing a BE1900:

Pressure: Multi-tasking and high workload

■ I did not properly secure the altimeter into place. This happened because I was working 3 different things at the time, while answering questions that my junior employees had, pulling me off the current task to instruct them on how to do things...I changed [the] First Officer's altimeter on aircraft air carrier 'X.' It was not secured properly, and the altimeter fell out of the instrument panel on takeoff roll. The pilots pushed it back into place, no damage occurred to the altimeter, and outstation maintenance re-secured it into place.

A B767-300 technician experienced a maintenance discrepancy that is frequently reported to the ASRS. The responsible “dirty dozen” factor:

Pressure: Rushing to complete the task

■ Aircraft came in with a pilot write-up, which was also a repeat of nose shimmy on takeoff and wheel retraction. Before the previous flight leg the right nose tire was changed...It came down to replacing the left nose tire in order to more evenly match-up tire wear and tread. The tire was changed in accordance with the Aircraft Maintenance Manual (AMM). The flight was nearing departure time and obviously rushed, I inadvertently forgot to reinstall the nose tire assembly washer. In [my] years as a certified Airframe and Powerplant mechanic, I've never made such a serious mistake and in the future will slow down so as not to repeat this mistake again.

In the past two years, ASRS has received at least 16 reports of B767-300 nose gear washers not being installed. These aircraft have two types of axle washers. One type is internally threaded and the other is externally threaded. The externally threaded washers are the ones that are usually forgotten during nose tire installation.

ASRS Alerts Issued in July 2008	
Subject of Alert	No. of Alerts
Aircraft or aircraft equipment	5
Airport facility or procedure	4
ATC procedure or equipment	1
Maintenance procedures	1
Total	11

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July 2008 Report Intake	
Air Carrier/Air Taxi Pilots	3226
General Aviation Pilots	941
Controllers	83
Cabin/Mechanics/Military/Other	400
TOTAL	4650

Lack of Resources

Maintenance technicians trying to accomplish a strut replacement on a B737-800 failed to follow standard aircraft jacking configuration. The contributing “dirty dozen” factor:

Lack of Resources: Use of improper equipment

■ [We made] a field trip for aircraft strut replacement. We arrived and started inspecting what we had for equipment, tools, and parts. When [we] determined that we were missing a cup for one of the wing jacks, we ordered that and some miscellaneous parts from [airport] ZZZ1. We installed the right wing jack and the tail jack in place for stability to remove the #4 brake and #3 tire and brake. We were unable to accomplish this without an axle jack. Instead of waiting for the cup to come from ZZZ1, we jacked the right axle with the axle jack enough to remove the bad brakes and tire. When the cup came from ZZZ1, we installed it on the left wing jack and placed it in position under the wing. Upon setting that jack in place, we went to check the other jacks to prepare them for jacking and we found that the tail jack had slipped off of the jack pad and punched a hole through the fuselage just forward and outboard of the jack pad.

Complacency

Complacency is a state of self-satisfaction that is often coupled with unawareness of impending trouble. A maintenance technician learned that it is risky to assume that someone else has given you the right part.

Complacency: Failure to verify effectivity

■ Aircraft ‘X’ came in with #2 engine, system #1 ignition on MEL. After pushback the #2 engine would not start. We called for the Control Center to order us 2 exciter units, which I installed. The operational check failed. At this point it was the end of our shift. In order to avoid paperwork issues with the next shift, I signed off the log page as replaced units test fails and opened a new log page. Today I found out in (computer system) that the next shift had to replace both exciter units again due to (incorrect) effectivity, which fixed the problem. Next shift found the problem and it was corrected before flight. I should have verified the effectivity, not assume the (controller) ordering the parts would do so.

Stress, Fatigue, and Distraction

A triple whammy of human factors led to failure of a B737-300’s engine reversers to stow on landing rollout:

Stress: Rushing to finish jobs

Fatigue: Not getting enough sleep

Distraction: Interrupted work assignments

■ I was assigned 2 aircraft... Working the B737 window heat problem #2 right window, I pulled circuit breakers and 2 boxes, window heat controller [WHC] and the engine accessory unit [EAU] in the electronics bay to gain access to the back side of the WHC bench plugs to do resistance checks, reference maintenance manuals and wiring diagrams. Once I found the problem, I gathered the parts and crimpers I needed. At this time I was told by my lead to drop what I

was doing and start working write-ups on a B747. I was told that a widebody had priority over a narrow body. Because I was in the middle of a job on the B737 I finished repairing the broken feed wire to the #2 window, replaced WHC and EAU, and pushed in all breakers. Checked and tested window heat in which the #2 window heat was operating OK. I started working on the B747 until the end of shift. I received a call from the shift supervisor telling me that the B737 landing at another airport had the reversers deployed but would not stow on rollout. Pilots shut the engines down and were towed to the gate. Maintenance noticed that the EAU was missing. A new EAU was installed and the original EAU was found lying inside [the] E&E compartment on top of the drip curtain above the E&E door opening.

Preventive measures: Do not rush to finish job no matter what stress is put on you. Not getting enough sleep (fatigue). Pressure from management and leads, poor lighting inside the E&E, and working outside in the early morning.

Lack of Knowledge

A B757-200 technician interpreted the stamped numbers on the APU (Auxiliary Power Unit) and engine fire bottle squibs as expiration dates. The main “dirty dozen” factor that contributed:

Lack of Knowledge: Lack of training for the task

■ ...Aircraft was in phase check...I was tasked with checking the APU #1 and #2 engine fire bottle squibs for expiration on their 10-year life cycle. I was not given OJT [On the Job Training] before performing the task. I interpreted parts of the stamped numbers on the shoulder of the squibs to be dates. This aircraft went to heavy check, and it was found that these squibs were near expired or expired...After receiving OJT in reference to the...occurrence, I realized the expiration dates were etched and not stamped on the shoulder of the squibs. I suggested, and my company will modify, their phase task cards to require a date and serial number block be added to the task cards.



Lack of Communication

A common “dirty dozen” factor played a role in an incident involving a B757-200 emergency slide pack installation:

Lack of Communication: Failure to verify tasks

■ Myself and another technician were given the task to replace the left wing overwing emergency slide pack. We accomplished the task and signed the proper documents and logbook. When the aircraft went into a heavy maintenance check, it was discovered that the slide deployment lanyard was not connected to the attach point, rendering the slide pack useless. Myself and the other technician are new to the station and only worked together a few times. I believe there was miscommunication between ourselves in carrying out the Maintenance Manual steps in the installation of the slide. Also working in a dark environment (nighttime) we didn’t detect the error. Double-checking the work performed is also required in aircraft maintenance.