

## **ERGONOMIC DOOR FIXTURE AND REDUCED VIBRATION TOOLING PREVENT WORKER INJURIES AT NAVAL AIR STATION NORTH ISLAND**

Naval Air Station North Island (NASNI) Door Three Shop sheet metal mechanics repair the number three doors on FA-18 aircraft. Door number three is a compartment cover that shields FA-18 tactical aircraft components from debris and the air stream during flight. During repair operations, corrosion is removed, cracks are repaired and electromagnetic interference strips are replaced.

Until NASNI recently implemented ergonomic improvements, repairing an

FA-18 door number three was a strenuous work task. One of the tasks required sheet metal mechanics to use powered hand tools, such as die grinders, rivet shavers, and cutting wheels, to remove and then replace the more than 1,000 rivets that are needed to keep the doors' outer covering together. Use of powered hand tools put workers at risk for overexposure to hand and arm vibration.

Overexposure to hand and arm vibration can lead to progressive damage to nerves, blood vessels, and other tissue of the hands, wrists, and arms. This condition is called Hand-Arm Vibration Syndrome (HAVS) and involves numbness, tingling and loss of dexterity.



**Use of vibrating powered hand tools and maintaining awkward postures can put workers at increased risk for injuries and disabilities**

In addition to using vibrating tools to remove and replace rivets, Door Three Shop mechanics had to work in awkward positions, which added stress to their hands, wrists, backs, and shoulders. To reach all areas of the aircraft door, mechanics also needed to bend over, squat, and kneel. These postures placed pressure on the mechanics' backs, shoulders, and lower extremities.

The combination of holding awkward postures for prolonged periods and vibration exposure increased the risk of hand, wrist, neck, back,

shoulder, leg, and foot injuries and disabilities, collectively known as *work-related musculoskeletal disorders* (WMSDs). WMSDs usually involve weakness and discomfort in the affected muscles and supporting

tendons and ligaments. Hand and arm weakness and discomfort is especially severe when a worker continues the activities that brought on the WMSD. The discomfort often improves after receiving medical treatment for the WMSD and discontinuing activities that weakened the affected muscles and supporting tissues.



**Sheet metal mechanics used to bend over for long periods of time increasing risk of WMSDs**

Ergonomic improvements were required in the Door Three Shop to position the aircraft doors to make

them easily accessible and to reduce vibration exposure from powered hand tools used to remove and replace rivets. Ergonomics is the science of fitting the job to the worker, instead of requiring the worker to adapt to existing work

conditions. The goal of an ergonomics program is to reduce the frequency and severity of WMSDs. WMSD prevention involves either redefining work assignments or redesigning workstations and tasks using procedures, equipment, and



**Door fixtures lock aircraft doors in place for stability; fixtures also rotate and are height adjustable, allowing worker comfort during repairs**

tools that minimize the risk of work-related injuries and WMSDs. Work tasks, equipment, and tools that are ergonomically designed avoid cumulative trauma by eliminating stressors such as excessive repetitive

motions, vibration exposures, sustained or awkward positions, heavy, awkward, or frequent lifting, and contact stressors.

Mr. Angelito Defensor, a former sheet metal mechanic in NASNI's Door Three Shop, designed a fixture that holds door number three in place



and allows partial rotation during repair operations.

Mr. Defensor's design was part of a Hazard Abatement (HA) project submitted by NASNI'S HA planning board for approval and funding for a Chief of Naval Operations (CNO) Ergonomic Hazard Abatement Project. Once the project was funded, an outside firm of mechanical engineers expanded on the original design of the door holder.

**Aircraft door is held by fixture allowing sheet metal mechanic to work in neutral posture while using low vibration powered hand tool.**

The Naval Facilities Engineering Command, which oversees the Navy's

HA Program, reviewed the final door fixture design as part of their ergonomic services to NASNI. They approved the modified door fixture design, which includes an adjustment that accommodates to each mechanic's height. A sturdy locking pin holds the door number three firmly in place while the support structure allows the mechanic to rotate the door for maximum access. Previously, two workers had to lift and turn an aircraft door over manually to complete work on the door's underside. The new door holder allows one worker to rotate the door unaided.

During the door fixture design process, NASNI's Industrial Hygiene Department was focused on the powered hand tools used by sheet metal mechanics in the Door Three Shop. Inadequate design, substandard maintenance, and deterioration of powered hand tools can amplify vibration difficulties. Even a new powered hand tool can overexpose a user to excessive vibration if it is not fitted with vibration dampening or shielding features. Replacing the existing hand tools with *reduced-vibration* powered hand tools provided the ergonomic solution to tool vibration in the Door Three Shop. The mechanics can use the *reduced-vibration* hand tools for up to eight hours a day without risking overexposure to excessive vibration.

NASNI's industrial hygienists, sheet metal mechanics, mechanical engineers, and NAVFAC ergonomists worked together to implement ergonomic improvements that protect the health and safety of sheet metal mechanics in the NASNI Door Three Shop. The risks of WMSDs and HAVs have been greatly reduced. The Return on Investment (ROI) due to these improvements in NASNI's work methods and work environment is impressive as well.

In the past, NASNI sheet metal mechanics needed 14 to 15 days to complete repairs to each number three FA-18 aircraft door. The combination of the low-vibration tooling and the adjustable door fixture saves three to five days of labor per door. Now, a mechanic can complete the process in 11-12 days. The improvements described in this NAVOSH Success Story paid for themselves within seven months.

<b>INITIAL RETURN ON INVESTMENT FINDINGS FA-18 DOOR #3 FIXTURE AND VIBRATION REDUCED TOOLING</b>	
Pre Intervention Annual Cost (15 days/door x 8 hr/day x \$30/hr x 20 door/year)	\$72,000
Post Intervention Annual Cost (11 days)	\$52,800
Annual Cost Difference (savings) \$72,000 - 52,800	\$19,200
Expected Service Life	Ten years
Total Improvement cost over ten years per worker (tools, fixture, maintenance)	\$10,700.
<b>Return on Investment (Ten Years)</b>	
Cost Savings (Ten years)	\$181,300.
Break Even point	203 Days

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