THE CASE FOR TOOL TETHERING

AN ERGODYNE WHITE PAPER

INTRODUCTION

It's a grade school truth that a penny dropped from a skyscraper will crack the sidewalk below.

But simple physics calculations show that a 1-pound wrench dropped 10 feet from a ladder, will hit the ground in less than a second, traveling at approximately 17 miles per hour. A 5-pound drill, dropped 30 feet from a scaffold, will hit in just over a second, traveling at 30 miles per hour.

Actual damage to the tools and the objects below would depend on the orientation of the tool, and the object struck. But either case is sufficient to cause serious injury and damage to tools and surroundings.

SAFETY CONCERNS

Anyone working from heights—people like roofers; utility workers, arborists; antenna and windmill installers; and others—has a responsibility to prevent their tools from becoming falling objects which could strike a co-worker or pedestrian below. Falling from ladders, scaffolds, or bucket trucks, these objects could result in fatal injuries, even if the victim is wearing a hard hat.

OSHA regulations are specific regarding falling objects from elevated work surfaces and floor openings. Whereas the guardrails on scaffolds and platforms are designed to protect elevated workers from falling, the 4-inch high toe boards are required to protect the workers below from falling tools and objects.

Loose tools are also potentially a hazard when accessing elevated work surfaces, or when descending into recessed ones, such as utility vaults. Safe work practices require 3 points of contact at all times when climbing a ladder. This is impossible to do when one hand is hanging onto a hammer or drill. Even loose tools in a tool belt or an unsealed bucket are subject to falling.

PHYSICAL LOSS AND DAMAGE

Tethering tools not only prevents injuries, but also reduces the risk of damage to property or process equipment as well. The most obvious loss is to the tools themselves. Dropping from elevation is likely to cause damage or destruction of the tool, depending upon the surface below. Even simple hand tools can be significantly damaged when hitting concrete from elevation.

If tools are dropped into mud, snow, or heavy brush, tool loss is likely. Tool loss can also be expected when working over water, as on bridges, docks or boats. This type of loss also applies to other common but important workplace items such as flashlights, cell phones, radios, test equipment, and cameras.

Property damage on a rough construction site might be limited to windows or vehicles parked below. But in certain assembly or maintenance situations, damage to process equipment below can be extensive. In many aerospace, nuclear, and process industries workers are not allowed to carry anything in open pockets. In these situations, items as simple as a ball point pen falling into equipment can require expensive shutdowns and repair work. Larger tools or items can result in even more severe "foreign object damage."

NOT A NEW IDEA

Tethering is not a new idea. Mountain climbers carry all of their gear on slings so that they can reach the right item at a moment's notice—without taking their eyes off of the rock. Fly fishermen standing waist deep in rivers have no place to set anything down. So they traditionally use small retractors attached to their vests to hold tweezers, scissors, pliers, and other tools. Untethered, any precision tools would quickly be lost in moving water.

We have all seen forms of tethers used in everyday life: to prevent people from losing sunglasses, keys, cameras, trucker wallets, or children's mittens. In recent years, enthusiastic users of the popular Nintendo Wii gaming system have experienced a recurring problem of throwing their game controllers through expensive television sets. The solution? Wrist tethers.

AN EFFECTIVE TETHERING SYSTEM

Effective tool tethering must be thought of as a system with three components: the anchor point, the tether, and the tool attachment.

The most obvious anchor point is the worker using the tool. Purpose-designed rings on harnesses or work belts are natural attachment points. Belt loops on pants are not good choices because they can be easily torn off.

But in many situations, anchoring to something other than the worker is the better choice. Fixed anchor points in aerial buckets, or railings at elevated work locations, provide a secure location to anchor tools that won't tug at the worker if something falls. This is especially important when working with larger, heavier tools, or when a number of tools are needed to complete a project.

The tether itself should be quick and convenient to attach and easy to release when necessary. The tether should be long enough to allow unrestricted movement at the point of use, but not so long as to create tangles or trip hazards. And the tether should be rated for the weight of the tool secured.

Static tethers, such as ropes or cables will secure a tool. Dynamic tethers, such as those with a shock absorption or retraction device can also reduce the stored length of the tether without reducing its effective working length.

Any tether should be retired after a significant fall incident—even if damage is not evident—to reduce the risk of subsequent breakage. If it has arrested a fall, it has done its job.

Tool attachment is a key component of a tethering system. The tool attachment must be secure and must not interfere with the tool operation. Many tools have natural attachment points for a tether, such as a hole, loop, D-ring, etc. Some tools have narrow waists where a tether can be cinched or a secure clamp may be installed.

In other cases the attachment point must be designed by the user. This may involve drilling a hole, or installing an eyebolt, ring, or cable loop. Lighter weight items may be secured using heavy cable ties or even industrial adhesives.

Improvised attachment points must not compromise the integrity or safety features of the tool, such as electrical insulation, guards, etc. Make sure that cordless tools are tethered to the tool body, and not to a removable battery pack.

On corded tools, attachment to the tool means that the tether absorbs the shock of a fall, not the electrical cord.

When use at elevation is expected, selecting tools based on their ability to be tethered is a prudent move.

ORGANIZATIONAL BENEFITS

Tethering tools can offer specific organization benefits. Consistent with "5S" principles used in lean manufacturing (sort, straighten, shine, standardize, sustain) tethering can be used to quickly identify if all the tools required for a task are in place and in the order required.

Keeping the tethers associated with specific tools in the truck, or in designated "parking spots" allows for secure storage and quick visual inventory—like keys on a ring or storage board.

And, like the pens at bank counters, tethered tools are less likely to "walk away" at busy work sites.

PRODUCTIVITY BENEFITS

In November 2008, a NASA astronaut working on the International Space Station infamously let a tool pouch drift out of reach during a space walk. This was an extreme example of having a long way to go back for replacements.

While anyone can drop a tool, the likelihood increases during inclement weather, such as wind snow, rain, or cold; when wearing heavy protective gloves; or when working with greasy contaminants.

The cost of the tool might be minor compared to the lost productivity climbing down from the elevated work location, then back up again to resume work. This is especially true with tower, utility, and antenna work, but could apply to any location that is difficult to access.

Productivity losses might also include the time required to obtain a replacement, if the tool is damaged.

Even if a tool is not dropped or lost, there can be direct productivity gains from knowing exactly where a tool is without the worker taking his eyes off of the work, from not repetitively reaching down to the floor, from having a place to securely keep the tools when there is no place to put them down, and from bringing the tools to the workers with a secure and reliable tether.

REFERENCES

1. **Various Physics Texts**
   Potential Energy = (mass)•(acceleration due to gravity)•(height)
   Distance = ½ (acceleration)•(time)2
   Velocity = (acceleration)•(time)
   Force = (mass)•(acceleration)

2. **Nintendo Wii damage**
   http://www.wiidamage.com/about/
   http://opinion.latimes.com/opinionla/2008/12/nintendo-wiis-e.html

3. **5S Concepts**
   The Toyota Way Fieldbook Jeffrey K. Liker and David Meier McGraw-Hill 2006

4. **NASA Tool Bag Loss**
   http://www.cnn.com/2008/TECH/space/11/18/endeavour.spacewalk/index.html
   Wed November 19, 2008 Astronaut loses tool bag during spacewalk / By Kate Tobin / CNN
   (CNN) – "…First, a grease gun inside her tool bag leaked, coating everything inside with a film of lubricant. While she was trying to clean it up in the absence of gravity, the whole bag floated away…"

SAMPLE OSHA REGULATIONS

5. Walking-Working Surfaces
   1910.23(a)(3)(ii)
   1910.23(a)(8)(i)
   1910.23(c)(3)

6. "Falling object protection."
   1926.451(h)(1)
   In addition to wearing hardhats each employee on a scaffold shall be provided with additional protection from falling hand tools, debris, and other small objects through the installation of toeboards, screens, or guardrail systems, or through the erection of debris nets, catch platforms, or canopy structures that contain or deflect the falling objects. When the falling objects are too large, heavy or massive to be contained or deflected by any of the above-listed measures, the employer shall place such potential falling objects away from the edge of the surface from which they could fall and shall secure those materials as necessary to prevent their falling.

7. 1926.451(h)(2)
   Where there is a danger of tools, materials, or equipment falling from a scaffold and striking employees below, the following provisions apply:
   1926.451(h)(2)(i)

8. The area below the scaffold to which objects can fall shall be barricaded, and employees shall not be permitted to enter the hazard area; or
   ..1926.451(h)(2)(ii)
   1926.451(h)(2)(ii)

9. A toeboard shall be erected along the edge of platforms more than 10 feet (3.1 m) above lower levels for a distance sufficient to protect employees below, except on float (ship) scaffolds where an edging of 3/4 x 1 1/2 inch (2 x 4 cm) wood or equivalent may be used in lieu of toeboards;
   1926.451(h)(2)(iii)

10. Where tools, materials, or equipment are piled to a height higher than the top edge of the toeboard, paneling or screening extending from the toeboard or platform to the top of the guardrail shall be erected for a distance sufficient to protect employees below; or
    1926.451(h)(2)(iv)

11. A guardrail system shall be installed with openings small enough to prevent passage of potential falling objects; or
    1926.451(h)(2)(v)
12. A canopy structure, debris net, or catch platform strong enough to withstand the impact forces of the potential falling objects shall be erected over the employees below.
    1926.451(h)(3)
13. Canopies, when used for falling object protection, shall comply with the following criteria:
    1926.451(h)(3)(i)
14. Canopies shall be installed between the falling object hazard and the employees.
    ..1926.451(h)(3)(ii
    1926.451(h)(3)(ii)
15. When canopies are used on suspension scaffolds for falling object protection, the scaffold shall be equipped with additional independent support lines equal in number to the number of points supported, and equivalent in strength to the strength of the suspension ropes.
    1926.451(h)(3)(iii)
16. Independent support lines and suspension ropes shall not be attached to the same points of anchorage.
    1926.451(h)(4)
17. Where used, toeboards shall be:
    1926.451(h)(4)(i)
18. Capable of withstanding, without failure, a force of at least 50 pounds (222 n) applied in any downward or horizontal direction at any point along the toeboard (toeboards built in accordance with Appendix A to this subpart will be deemed to meet this requirement); and
    1926.451(h)(4)(ii)
19. At least three and one-half inches (9 cm) high from the top edge of the toeboard to the level of the walking/working surface. Toeboards shall be securely fastened in place at the outermost edge of the platform and have not more than 1/4 inch (0.7 cm) clearance above the walking/working surface. Toeboards shall be solid or with openings not over one inch (2.5 cm) in the greatest dimension.
    [44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as amended at 58 FR 35182 and 35310, June 30, 1993; 61 FR 46025, Aug. 30 1996; 61 FR 59831, Nov. 25, 1996]