Office of Environment, Health, Safety and Security
Operating Experience Level 3

OE-3: 2018-03 **April 2018**

Engineered Sling Protection

PURPOSE

This Operating Experience Level 3 (OE-3) document is being issued to raise awareness about the damage that can occur to slings during rigging operations. Any sling can be cut or damaged due to forces between the sling, connection points, and/or load that occur at edges, corners, protrusions, and rough surfaces. Appropriate, evaluated, and engineered sling protection is the industry-wide expectation to prevent sling damage or failure during rigging activities. When selected and used correctly, engineered sling protection, such as rigging softeners, acts as a buffer to protect slings from edges of loads. Training on the use of industry-engineered rigging softeners is necessary to ensure that rigging is safely performed, and to prevent severe injury, death, and/or property damage during rigging operations.

BACKGROUND

The primary purpose of rigging is to safely move and control a load, keeping it secure and stable during transport. Several Department of Energy (DOE) incidents in 2016 and 2017 highlight the need to evaluate procedures used during rigging, and to disseminate information on the importance of selecting appropriate slings and sling protection materials based upon their application and type of exposure. For example, while some materials are suitable for abrasion resistance, they offer virtually no protection against the effects of cutting.

The following DOE occurrence reports are provided as examples supporting the need for better evaluation of hoisting materials to be employed in DOE operations:

On July 15, 2017, at the Stanford Linear Accelerator Center, a bridge crane girder dropped 15 feet during a lift by a mobile crane. Slings slipped off softeners during the lift because dynamic forces applied during the lift increased the horizontal force on the slings, which overcame the force of friction on the softener. The slings failed when they contacted the edge of the load. (See photos below.) There were no injuries. The girder and the concrete floor were damaged when the load dropped. (ORPS Report SC--SSO-SU-SLAC-2017-0003)

Photos showing sling failure that caused girder to drop

On December 2, 2016, at the Separations Process Research Unit (SPRU) while preparing to relocate a 7,200-pound B-12 waste container filled with lead sheet material, a 2-inch nylon rigging strap failed, causing the waste container to drop one foot to the floor. There were no injuries, and all personnel were at a safe distance when the strap failed. The waste container was rigged with two 2-inch nylon slings, each adequately rated for 12,800 pounds. A protective sling softener material

was inserted between the sling and the waste container's bolted lid flange. As the lift was initiated, a slight shift of the sling resulted in the softener material and the sling being cut by a sharp surface on the flange connection. The selected softener material did not adequately prevent the sling from contacting a sharp edge on the waste container. (ORPS Report EM---WGI-G2H2-2016-0004)

On July 30, 2016, at Los Alamos National Laboratory (LANL), a hoisting and rigging (HR) crew was performing a programmatic equipment move of a railroad boxcar when two flat nylon rigging straps were cut by a piece of angle iron on the bottom of the object, dropping the load 20 inches. A softener had not been placed between the angle iron and the rigging sling because the angle iron was not seen during the setup, and the lifting procedure did not require the lift to be paused or modified if the bottom of the object being lifted could not be seen in case something was present that would require a softener. The load struck a piece of timber used for cribbing on the ground, which then flipped up and struck a worker in the chest, forearm, and chin. The LANL Security and Operations Management Emergency Response responded, called 911, assessed the area, accounted for all the workers, and administered patient care to the worker who had been struck. The Los Alamos Fire Department responded and transferred the worker to the Los Alamos Medical Center, where he was treated and released with restrictions. (ORPS Report NA--LASO-LANL-FIRNGHELAB-2016-0004)

ANALYSIS

It is important that qualified riggers be trained to consider the possibility of dynamic forces once the load is lifted and is being moved. These forces can create instability, which can cause sliding, and training should include methods to prevent any load sliding.

Qualified riggers need to properly select and apply sling protection to prevent loads from sliding and cutting a sling. Improper selection or application of engineered sling protection can fail to prevent sliding, resulting in failure, as indicated in the SPRU incident above.

Low sling angles apply a larger force due to the load angle factor within the sling itself. A low sling angle also applies a large horizontal force that must be addressed. The preferred sling angle for a choked or basket hitch is greater than 75° from the horizontal (15° from the vertical) to prevent sliding. The minimum allowed is 60° from the horizontal, unless there are positive stops to prevent sliding; otherwise a spreader bar should be used to distribute the load of the lift across more than one point, increasing stability and decreasing the loads applied during hoisting.

"Cut-proof" sling protection does not exist. Riggers should always operate within the specified sling and protection device limits. Extra-high-performance slings are available that can develop 25,000 pounds-per-inch work load limits. Web slings can develop 12,800 pounds-per-inch work load limits.

It doesn't take a sharp corner to cause a synthetic web sling to fail. It is very important that only load-rated, cut-resistant corner protectors be used.

RECOMMENDATIONS

Full evaluation of the loads and their interaction with the lifting surfaces should be performed to ensure that there are no sharp edges that could damage the lifting equipment. Sling protection must be evaluated and used to prevent damage to the lifting equipment and eliminate potential for a dropped load.

Additional sling protection considerations include the following:

- Slings in contact with edges, corners, protrusions, or abrasive surfaces should be protected with materials of sufficient strength, thickness, and construction to prevent damage.
- An edge need not be razor-sharp to damage slings.

- There is no such thing as cut-proof protection.
- Protection should not be makeshift. Gloves, cardboard, shop rags, fire hose, etc., are not engineered sling protection and are unacceptable.
- Use protection that has been designed, tested and labeled by a manufacturer.
- Unplanned movement, such as sliding of the sling and/or protection against the load, must be avoided.
- Abrasion protection provides little, if any, protection against cutting.
- Damaged slings, rigging hardware, and/or sling protection should not be used for any application.

CONCLUSION

Regardless of the method chosen, the goal is to ensure that the sling maintains its ability to securely and safely lift the load, while avoiding contact with damaging or abrasive surfaces under tension. A qualified rigger must carefully consider the appropriate means to accomplish this goal by selecting sling protection appropriate for any potential exposure to hazards that may cause damage to the lifting equipment. Failure to select proper sling protection could result in property damage, severe injury, or death.

REFERENCES

ORPS Report SC--SSO-SU-SLAC-2017-0003. Girder Dropped During Lift by Mobile Crane

ORPS Report EM---WGI-G2H2-2016-0004. Failure of Rigging Sling

ORPS Report NA--LASO-LANL-FIRNGHELAB-2016-0004. Near Miss: Rigging Slings Break during Hoisting Activity at TA-49

June 17, 2015, DOE Hoisting and Rigging Technical Advisory Committee Meeting minutes. https://energy.gov/sites/prod/files/2016/02/f30/2015-HRTAC-Meeting-Minutes.pdf

Mackey, Henderson. 2009. Synthetic Sling Failure - Evaluations and Recommendations, RPP-RPT-42583 http://www.osti.gov/scitech/servlets/purl/966779/

ADDITIONAL SOURCES OF INFORMATION

DOE Standard. Hoisting and Rigging. DOE-STD-1090-2011. September 2011

10 CFR 851. Worker Safety and Health Program.

Questions regarding this OE-3 document can be directed to James Lovejoy at (208) 526-4519 or e-mail lovejojb@id.doe.gov.

This OE-3 document requires no follow-up report or written response.

Josh Silverman
Director
Office of Environmental Protection and
ES&H Reporting
Office of Environment, Health, Safety and Security