Department of Justice and Attorney-General
Workplace Health and Safety Queensland

Ergonomic assessment of load restraint devices in the transport industry

Summary of the project findings

Background

The purpose of the ergonomic assessment of load restraint devices in the transport industry project was to assess the potential musculoskeletal disorder (MSD) and impact risks associated with the use of load restraint devices. The transport industry raised concerns that there could be MSD issues associated with a move towards alternate devices and away from dogs and cheater bars.

Workplace Health and Safety Queensland (WHSQ) commissioned this project as there was little research available about these issues. InterSafe[1] was engaged by WHSQ to conduct the ergonomic assessment of load restraint devices.

Project overview

As part of this project, InterSafe conducted:

- a literature review of incidents involving load restraint devices
- an ergonomic assessment of six load restraint devices (including dogs and cheater bars and their alternatives) using a range of methods to assess the MSD and impact risks associated with using the devices
- industry consultation via surveys and focus groups.

Assessment methods

Several methods were used to assess the devices in relation to the risk of MSD and impact injuries. Load restraint devices that met the following criteria were assessed:

- device is commonly available and commonly used
- device is manufactured by reputable companies / quality of the device is reputable
- device can be used on an 8 mm chain
- device is capable of achieving 750 kg of pre-tension
- device is an in-line tensioner
- device is new.

While turnbuckles and webbing straps are used in the industry they were not included in this project as industry advised:

- webbing is not a suitable replacement for chains in all applications
- turn buckles were considered unacceptable as a replacement for general applications and tensioning full length chain.

Physical tests

Physical tests were performed to determine the amount of force required to achieve approximately 750 kg of tension and the amount of force required to release the tension.

[1] InterSafe is a private consultancy group that specialises in safety and ergonomics design, implementation and evaluation.

Ergonomic assessments

Ergonomic assessments of the use of each load restraint device were performed using the University of Michigan 3D Static Strength Prediction Program (3DSSPP). This computer software allows for the assessment of the strength requirements of a task and provides an estimate of the risk of musculoskeletal damage to the worker. The software analyses both the forces exerted and the postures adopted by the worker.

The forces identified during the physical tests and photographs taken of body postures adopted when attaching, tensioning and releasing the devices were used as part of the ergonomic assessment.

Human impact assessments

Some of the devices assessed feature handles which have the potential to be accelerated to high speed during a release of tension.

To assess the impact risk, devices were set up in the same manner used to assess forces associated with operating the device. The device was remotely released using a nylon strap, and high speed footage was recorded to estimate the speed of the handle and understand the potential for a worker to be struck.

Industry consultation

Surveys

Two surveys were created and distributed to obtain industry feedback about the load restraint devices being assessed. One survey was for users of load restraint devices and the second was for employers of the users. The surveys were distributed by email to 525 participants. There were 54 responses to the employers survey and 50 responses to the users survey.

Focus group findings

Invitations to attend focus groups were circulated to the same email distribution list as mentioned above.

One focus group was for users/employers and the other was for suppliers/manufacturers of devices. There were nine attendees at the users/employers focus group and seven attendees at the suppliers/manufacturers group.

Findings

The key assessment findings were:

- Dogs and cheater bars present a fatality risk.
- The alternate in-line chain tensioning devices are preferred over dogs and cheater bars as they don’t present a fatality risk. However, both dogs/cheater bars and the alternate devices have MSD, and for some devices, impact risks.

- All alternate devices assessed require work above shoulder height which is an awkward posture.
- Releasing fixed lever dogs requires high force which is beyond the capacity of most workers. This may in part, explain the use of extension bars to release fixed lever dogs.
- Cheater bars have the potential to be accelerated to high speed during release, potentially impacting workers. The tip of the handle of the fixer lever dog was measured travelling at 55 km/h during release from 750 kgF (kilogram-force) of pretension.

The following issues were identified through industry consultation:

- Most employers (63%) stated they do not permit their drivers to use extension handles with dogs. However most users (70%) stated they used extension handles with dogs at least some of the time. There appears to be a difference between what employers expect and what users actually do.
- The industry is relatively evenly split in their acceptance, or not, of a move away from lever dogs.
- Some users/employers are not aware of alternate load restraint devices.
- Issues identified by the user group associated with a move away from lever dogs included uncertainty about whether alternatives may produce more injuries over time and the cost of converting to alternate devices.

Report recommendations

The research concluded that the range of in-line tensioners currently available to the transport industry present a MSD risk, and for some of the devices, an impact risk.

It is acknowledged that moving to alternatives devices will require time and collaboration between all industry users, suppliers/manufacturers and WHSQ.

The following recommendations were made:

1. Development and use of versatile and cost effective truck-mounted, below tray load restraint devices so that work can be done with the hands between waist and shoulder height when standing on the ground. These devices should have release mechanisms that do not permit the sudden and uncontrolled release of the load as well as tension indicators.

2. Develop in-line tensioners with the following design features:
    a. weight of device is less than 5 kg
    b. has a pull down force to tension
    c. maximum force to tension is 25 to 30 kg
    d. incremental shortening length less than approximately 5mm
    e. operator's hands to be as close to waist height as possible during release posture
    f. release force within the capability of 99% of users for the postures required
    g. has a pretension indicator
    h. below tray installation option
    i. minimal shortening length of device to achieve tension
    j. cannot significantly over tension lashing (with extension bar or handle)
    k. robust
    l. affordable
    m. versatile / adaptable
    n. easy to use
    o. maintenance is easy and cost effective

p. controlled release of lashing tension
q. can be re-tensioned without reattaching device.

3. Investigate the levels of force required to release a load restraint device when the chain lashing tension has increased due to load shift. This may identify further design criteria for load restraint devices.

4. Investigate the level of significance of load restraint incidents in the overall context of damage to people in the transport industry.

5. Discourage the use of lever dogs from a fatality prevention perspective.

Further information

For more information visit www.worksafe.qld.gov.au or call the WHS Infoline on 1300 369 915.