

# Workplace Health and Safety Bulletin



## Worker Injured When Lifting Clamp Fails

In January 2000, the operator of an overhead crane was seriously injured when he was struck by a falling steel plate at a metal fabrication and pressure vessel manufacturing facility. Two workers were in the process of cutting and beveling a steel plate measuring 5.31 m long x 2.90m wide x 12.5 mm thick. The steel plate was resting horizontally across a cutting table and had to be lifted and flipped over in order to bevel the opposite edge.

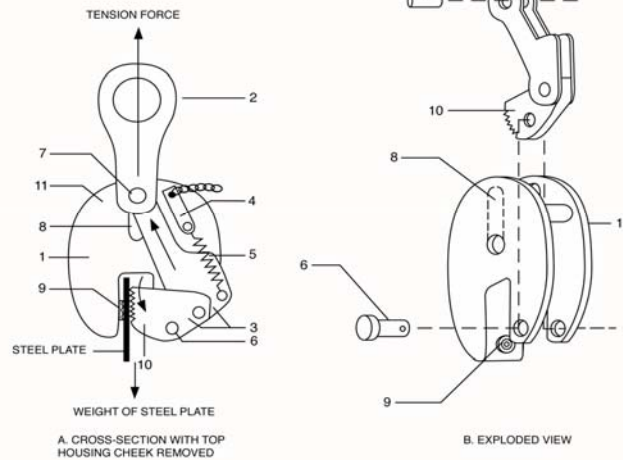
A single plate lifting clamp rated at 4.5 tonnes and connected to a 5 tonne overhead crane was used in the lifting and flipping operation. As shown in the drawing below, a plate lifting clamp is a device having a fixed serrated pad and a movable cam with teeth. The cam bites into the plate and forces it against the pad, holding the material in place as the clamp bears the weight of the load.

With the lifting clamp secured to one edge of the 1510 kg steel plate, the plate was being lifted from its horizontal resting position to the vertical when it slipped out of the clamp jaws and fell to the floor. The overhead crane operator was struck by the falling steel plate, suffering serious injuries.

## PLATE LIFTING CLAMP

### Legend

1. Body
2. Lifting shackle
3. Cam assembly
4. Locking handle
5. Spring for locking mechanism
6. Cam assembly pin
7. Lifting shackle pin
8. Lifting shackle guiding slot
9. Serrated pad
10. Cam with teeth
11. Housing cheek



## Results of the incident investigation

The follow-up investigation by Alberta Human Resources and Employment concluded that:

- With the plate positioned in the throat of the clamp, the spring-loaded locking mechanism held onto the plate as it was raised from the horizontal to the vertical. The lift failed when the plate became vertical.
- The clamp's lifting shackle guiding slots were badly worn with indentations, grooves and compressions along their upper and lower surfaces. This created excessive play at the lifting shackle guiding slots, allowing the sliding lifting shackle pin to jam within the slots and caused the pivoted cam to bind. The cam was unable to snug the plate against the serrated pad and the clamp lost its grip on the steel plate.

- Overloading and shock loading of the clamp from previous lifts, as well as vibration from the crane's braking system, may have been responsible for the excessive surface damage and abnormal wear of the lifting shackle guiding slots. This surface damage had developed over an extended period of time.
- Neither the clamp's sliding lifting shackle pin nor the guiding slots were adequately lubricated to minimize surface wear. The surface smoothness and condition of the pin and guiding slots are critical to proper function of the plate clamp.
- Workers at the manufacturing facility were required to follow the manufacturer's recommendations when visually inspecting and checking the plate clamp prior to each use. In the absence of routine preventive maintenance involving complete disassembly of the clamp, visual inspection cannot detect excessive wear at the lifting shackle guiding slots or other deficiencies inside the clamp body. The clamp must be disassembled to perform a thorough and meaningful inspection.
- The maintenance and inspection instructions provided by the lifting clamp manufacturer were vague and non-specific with respect to lifting and shackle guiding slots.
- The injured worker was positioned within the danger or fall zone of the load when it fell.

## Recommended practices: inspection and maintenance

In addition to following the manufacturer's inspection and maintenance recommendations, users of plate clamps should implement the following safety practices recommended by Alberta Human Resources and Employment:

- At regular intervals based on the conditions of use and the manufacturer's recommendations, the clamp should be disassembled and inspected by qualified personnel for wear, damage, and excessive play. Inspect the body, lifting shackle, lifting shackle guiding slots, pins, locking mechanism and spring, cam assembly, cam teeth and serrated pad.

- Inspect all clamp body surfaces for cracks. Check the lifting shackle and all pin holes for wear and elongation, all pins for wear and bending due to overloading, and the locking spring for bending and over-stretch.
- Examine the cam teeth and serrated pad. To function properly, the teeth and pad must be sharp and free of foreign material. The cam assembly must be replaced as recommended by the manufacturer based on the condition of the teeth and the pad.
- Check that the cam assembly and the spring lock mechanism function properly individually, then verify smooth operation of the entire clamp.
- Inspect the throat opening. At zero grip, the cam should be in full contact with the serrated pad. Measure the width of the throat opening at its base — where the pad is located — and at the top. If the measurement at the base exceeds that at the top, remove the clamp from service as the body has spread. The clamp can no longer be relied upon to support its rated load.
- Lubricate the lifting shackle guiding slots, guiding pin, and other moving parts with dry powdered graphite or other effective lubricant.
- Visually inspect the plate clamp at the start of each workday for obvious signs of damage or malfunction. Tag any damaged or malfunctioning clamp as needing repair and remove it from service.
- Do not alter or modify the plate clamp in any way.
- Consider having the clamp pull-tested annually, or at intervals recommended by the manufacturer, by an appropriate agency to verify its holding capacity.

## Recommended practices: using the lifting clamp

In addition to following the manufacturer's recommendations for use of their lifting clamp when lifting or flipping steel plate, the worker performing the task should follow these safety practices recommended by Alberta Human Resource and Employment:

- Check the weight and surface hardness of the material being lifted and select an appropriately rated lifting clamp. Do not use a large capacity clamp to lift light loads as the camming mechanism may not be able to secure the material. Make sure that the weight of the material being lifted exceeds the clamps minimum rated working load.
- Make sure that during lifts with a single clamp, the rated capacity of the lifting clamp is always equal to or greater than the weight of the workpiece.
- Do not lift a workpiece made of material that is either too hard or too soft for the lifting clamp. The workpiece may not be held securely enough, may become damaged during lifting, or both.
- Visually inspect the lifting clamp for obvious signs of damage or malfunction before using it. Test the locking mechanism to ensure that the spring is strong enough to hold the cam against the serrated pad. Tag any damaged or malfunctioning clamp as needing repair and remove it from service.
- The effectiveness of the plate clamp depends on the cam and serrated pad snugging up tightly on both sides of the material. *Never* lift more than one plate at a time.
- Use two or more plate clamps to balance a long load and prevent it from swinging. When using more than two plate clamps, use an equalizing bean or spreader bar to prevent overloading the clamps. If using two plate clamps with a sling, ensure that the sling angle is 60 degrees or more. Sling angles less than 60 degrees place excessive loading on the clamps.


- Ensure that the load being lifted is balanced during the lift by marking its centre using a tape measure rather than judging by eye. Place the clamp on a line through the load's centre of gravity with the gripping cam and serrated pad fully in contact with the plate edge. Engage the clamp locking mechanism to its "Lock Closed" position prior to lifting the load. Never lift any load with the clamp in the "Lock Open" position.
- Overhead crane operators must position themselves and all nearby co-workers outside of the fall zone of the load. The load should be kept as close to the floor as possible and just clear of working surfaces. This minimizes the distance that the material can fall and may limit any resulting damage. Tag lines must be used where appropriate.
- When setting the load down, the crane hook and clamp must remain vertically in-line above the lifting point. Maintain tension in the crane line until the load is fully at rest. The load should be properly blocked so that the plate can be easily removed.
- If plates are stacked horizontally on top of one another, remove each plate from the top down until the needed plate is reached. Do not lift a plate from the bottom of the stack.
- When lifting a plate already standing vertically, attach the lifting clamp to the top edge rather than to one of the sides of the plate.

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### Workplace Health and Safety



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