Safety Advice 11-2012 (Jul)(NZ)

Winch separation from pole-hole borer mast

The attached Safety Bulletin 012 is supplied courtesy of MainPower New Zealand Limited.

Any further information will be advised by the EEA as this becomes available.

Attachment: MainPower Safety Bulletin 012

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SAFETY BULLETIN

Incident – Highway Hole Borer Operator Hit on the Head by Falling Hydraulic Winch Motor

Wolffs Road, West Eyreton, North Canterbury

1. Detail Incident

At 10:30 A.M. on Thursday 19 July 2012, an employee was injured while operating a truck mounted second-hand hydraulic Highway hole boring machine. During operation, the 25 kg (55 lb) hydraulic winch motor detached from the winch mounted on the 7 m (23 ft) mast of the machine and fell approximately 3.5 m (11.5 ft) before impacting the employee's head, cracking his safety helmet (hard hat) from the top to the brim, and falling to the ground. The winch has not been utilised by MainPower and had been deactivated by a previous owner.

The employee is an experienced operator of this type of machinery, and prior to the incident that morning had used the same hydraulic Highway hole boring machine to bore two other pole holes in the same area.

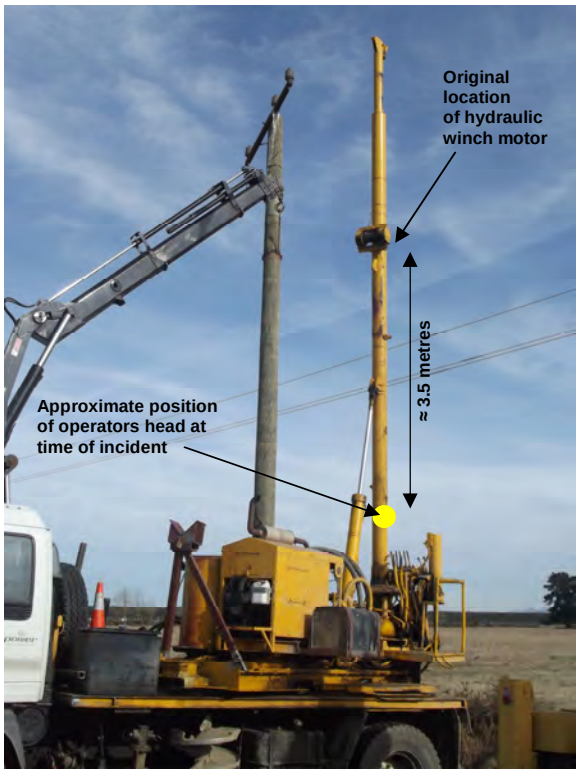

Figure 1 – Highway hole boring machine

Figure 2 – Hydraulic winch motor and employee's safety helmet

2. Detail Outcome of Incident

The employee was taken to the company doctor for assessment and diagnosed with concussion and a neck sprain, and declared unfit for work for two days. The employee returned to work on the Monday morning following the incident.

Fortunately, the injuries sustained by the employee were relatively minor due to the employee's safety helmet (hard hat) absorbing considerable energy in the impact, which appears to have been a glancing impact. Clearly, the wearing of an appropriately rated safety helmet has protected the employee from serious harm. This incident highlights the benefit and importance of wearing an appropriately rated safety helmet where there is a risk of head injury from moving or falling objects, or where a person's head may strike against a fixed object.

Highway Hole Boring Machine – Component Failure Investigation

An independent mechanical engineering consultant was engaged to investigate the failure of the component on the vehicle mounted Highway hole boring machine. The following extracts are from the investigation report:

Figure 3 – Braden winch

Figure 4 – Winch connection face

Figure 5 – Hydraulic winch motor

Component Assessment

The winch and winch motor were assessed closely.

The mast winch was identified as a Braden winch. The Maintenance and Parts manuals available at MainPower identify the original winch as a Braden winch. The position of the winch on the machine is not identified in the manuals.

The winch may have been positioned on the mast by the manufacturer. It may have been hydraulically or mechanically powered. However, there is gas-cut marks on the mount plates, indicating that the hydraulic motor unit that detached from the winch is most likely a modification and the gas-cutting was carried out to incorporate a different sized motor.

The winch has not been utilised by MainPower, as it was deactivated by a previous owner and the winch was not powerful enough to lift utility poles in any case. Therefore use of the winch by MainPower operators was unnecessary.

The hydraulic motor is mounted to the winch by 4 bolts. The following aspects of this connection are worth noting:

1. *The motor coupling must be disassembled to attach these bolts to the winch coupling*
2. *There is no positive retention design in the connection, if the bolts work loose, the motor is unrestrained*
3. *There is no evidence of measures to prevent these bolts loosening, e.g. loctite in the threads, lock-wire in the bolt heads or locking tab washers*
4. *There is no obvious failure of the connection components by cracking, shear or other material failure modes*

Conclusions

The most likely cause of failure is connection failure due to vibration-induced loosening of the four motor mount bolts. Supporting this conclusion are the following facts:

1. *There is considerable vibration in the mast during operation*
2. *This vibration will be further amplified by the motor "hanging off" the winch*
3. *There is no evidence of bolt loosening prevention measures*
4. *There is no evidence of material failure, bar some galling of the last threads in the winch connection face, which likely occurred as the bolts loosened.*

No other cause of failure is evident.

Machine specific recommendations

To eliminate future failures of this nature on this machine, we recommend the hydraulic winch motor not be re-installed and other winch components on the mast be removed.

Generic recommendations

The failure mode in question, components disengaging due to bolted connections loosening, is typically avoided by adopting the following measures:

1. *Design of components with positive restraint features, such that if a connection fails the component is restrained by a secondary component or feature. For example, a connection acting in the horizontal plane requires bolt heads to be on the top of the connection so that if the nut loosens and falls off, the bolt will still provide shear resistance.*
2. *Installation of bolts subject to vibration with loosening prevention measures, e.g. loctite, lock-wire, spring washers or tab washers where appropriate.*
3. *A maintenance procedure that regularly checks and corrects loose connections.*

In this instance, measures 1 and 2 were not implemented, possibly due to design modifications carried out by a local contractor, and measure 3 was not carried out due to the components being rendered inoperable and therefore not obviously in need of maintenance. This failure highlights a deficiency in the common preventative measures, specifically a component that is not being utilised may not be maintained and consequently may fail.

We recommend this deficiency be highlighted in safety checks on other machinery. It is easy in hindsight to identify these components, less so before a failure. Generally, the "Keep It Simple" principle can be applied, if a component is not being utilised it is simpler, and therefore safer, to remove that component.

It is also worth noting the importance of independent, overlapping safety systems. In this case the use of Personal Protective Equipment provided a safety system not related to the deficiency highlighted above.

3. Provide instruction of action required by staff to ensure a similar incident does not occur

(a) To eliminate future failures of this nature on the hydraulic Highway hole boring machine, the hydraulic winch motor has not been re-installed and other winch components on the mast have been removed.

(b) Vehicle / machinery / plant operators:

  (i) be aware that a vehicle / machinery / plant component that is not being utilised may not be maintained and consequently may fail;

  (ii) during pre-operation safety checks, look for obvious signs of any loose components that could be hazardous during operation and where identified, ensure such components are made safe prior to use.

(c) Garage maintenance staff to assess vehicle / machinery / plant items during WOF / COF / or maintenance checks for signs of any loose components that could be hazardous during operation, and make safe. Consider removal of components that are not being utilised.

4. General Comment

Employees are reminded that an appropriately rated safety helmet (hard hat) must always be worn where there is a risk of head injury from moving or falling objects, or where your head may strike against a fixed object. This incident is clear evidence of the importance of wearing a safety helmet.