CMEIG Engineering Position Paper

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ROPS/FOPS/TOPS STRUCTURES

Background

This document was formulated to avoid the likelihood of de-certification of the operator protective structure on your construction or earthmoving equipment. These structures are designed to protect operators from hazards that may be encountered during normal use. The information in this document may be similarly applied to agricultural, demolition and forestry equipment, though some terminology may change.

Rollover Protective Structures (ROPS) provide the operator with protection from a 360-degree rollover. Falling Object Protective Structures (FOPS) provide the operator with protection from falling objects, such as rocks. Tip over Protective Structures (TOPS) provide the operator with protection in the event of machine tip-over.

Protection is provided by the structure and its mountings absorbing energy from the incident, and may allow for a certain amount of deformation.

Seatbelts must be provided and should be worn by all operators of self-propelled mobile mechanical plant, and are an integral component of the protective structure.

Certification of the machine ROPS, FOPS, or TOPS is provided to customers after extensive design and testing has been completed. This certification process is designed to ensure maximum operator protection. The process requires manufacturers to meet various standards and regulations for the following subjects:

- structure strength/deflection
- operator size
- a safety zone (DLV) around the operator
- access systems
- zones of reach and comfort
- operator retention
- seat suspension
- seat index point

- sound
- vibration
- visibility
- ventilation

When unauthorised changes are made that may modify any of the above, **the certification of the structure may be voided**.

Any modifications to these structures such as welding, cutting or addition of attachments, can change the metallurgy or structural strength. Such changes can reduce the effectiveness of the structures and must be avoided.

Depending upon the specific design, some modifications or repairs may be permitted upon authorisation from the manufacturer. The original designer must assess these or a suitably qualified mechanical or structural engineer experienced in this class of work.

Examples of changes that may adversely affect the cab certification are:

- Drilled holes in the ROPS, FOPS, TOPS, seat mounting or seat
- Welding on the ROPS, FOPS, TOPS, seat mounting or seat
- Mounting heavy objects using existing cab bosses
- Use of untested (per the standards) cab mounts
- Use of attachments that exceed the machine certification weight
- Use of a seat or seat belt other than listed as standard or optional for the machine
- Installing monitoring screens etc, that invades the operator safe zone or interfere with visibility
- Any dents or deformation of the ROPS, FOPS, or TOPS structure
- Excessive rust of the ROPS, FOPS, or TOPS structure
- Heat discoloration and/or grinding on the ROPS, FOPS, or TOPS structure

Note: Failure to receive advanced approval from the manufacturer for any or all of these items may result in voided cab certification.

General Inspection
Visually inspect the structure at least every 1000 service hours or as recommended in the Operation and/or Maintenance Guide. Repair or replace if any of the following are found:

- **Loose or missing bolts**

Replace any bolts with those specified by the manufacturer and tighten to the recommended torque specifications.

- **Worn or damaged rubber-mounting pads**

If the mounting pad cannot be visually inspected for wear, replacement is necessary if the ROPS rattles (makes noise) when the machine is operated on a rough surface. Ensure that mounts are only replaced with those specified by the manufacturer.

- **Corrosion**

Contact the manufacturer for details on repairability limits.

- **Generally minor damage**

Non-structural damage e.g. damage to removable panels, doors, windows and attachments, may be repaired.

- **Machine Rollover, Tip-over, or struck by falling object**

If a machine has experienced a rollover, tip-over, or has been struck, the certification may be voided and an inspection by the manufacturer or a suitably qualified engineer is recommended. If there is any visible permanent damage or if the structures mounting brackets, legs or roof structure members are deformed the structure must be inspected by the manufacturer or a suitably qualified engineer or replaced. Replacement of all mounting bolts for ROPS and TOPS structures is necessary.

- **Cracks in welds or parent metal of the structure**

Some cracks in the welds may be repairable. Parent metal cracks that originate from welds may also be repairable.
Parent metal cracks not originating from the welds should not be repaired.
Contact your manufacturer for details on repairability limits.

- **Bent, deformed or broken ROPS legs or mounting brackets**

Repairs should not be made and replacement of the ROPS and/or mounting brackets is necessary. If damage to any structural component is detected, it may be repaired by replacing the damaged components in a manner and with parts supplied and approved by the manufacturer. If this cannot be done, the structure should be replaced. Under no circumstances should a damaged structure be straightened.
The manufacturer or a suitably qualified engineer should certify any structural repairs carried out.

- **Machine Fire**

Structures that have experienced a fire can be used again if a visual inspection of the structural members does not show evidence of permanent deformation from the heat of the fire.

Attachment Installation Guidelines

Because many countries require manufacturers to certify these structures, the unauthorised alteration or modification of these structures voids the certification. As a result, government inspectors can and do shut down a machine for such unauthorized use.

For example, a customer welded fire extinguisher mounting brackets on ROPS legs in the wrong place. He replaced the ROPS at his expense because the welds were in a critical area and these ROPS could not be certified.

Similarly, there have been a number of instances where customers have welded bosses, and drilled holes in protective structures for the mounting of vandalism guards. These have resulted in the need for replacement of the protective structure at the owner's expense.

The following guide may help avoid reoccurrences of this situation:

- Clamps are the preferred method to fasten attachments to the structure.
- The attachments should not be capable of transmitting reactive forces to the structure in case of rollover. Air conditioners, mirrors, lights, etc. meet this requirement. Hydraulic cylinders, water tanks or other mechanical devices do not.
- Do not drill, cut, or apply heat to a structure for either repair or modification without authorisation from the manufacturer.

Where a protective device has been damaged or modified to the extent that the effectiveness of the structure and/or the mounting system has been impaired, which could include rust, then the owner /controller of the machine has an obligation to repair it before it is put back into service.

Seatbelts and anchorages must be maintained and kept in an effective condition at all times.
A seatbelt warning sign should be prominently displayed in every protective structure cabin.
Operator manuals should also explain the increased level of protection provided by wearing these restraint devices in the event of a roll over or other such incident.

It needs to be remembered that these structures are fitted to provide protection to the operator, and should not be modified in any way that may reduce this level of protection.

Engineering Position Paper No. 6 – 9 October 2008
Construction & Mining Equipment Industry Group Inc
For more information about CMEIG, call (02) 9712 1497 or email: inquiry@cmeig.com.au
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