

SAFETY ALERT



EXPLOSIVE CONDITIONS:

PRE-HEATING ON CONFINED SPACE PRIOR TO WELDING

INCIDENT

A number of incidents involving cutting or pre-heating prior to welding on a confined space (eg. structural box sections) have resulted in violent explosions.

A recent incident occurred when a contract tradesman was installing an inspection plate/ repair window plate in a large excavator boom.

An explosion occurred, ejecting the inspection plate from the boom. No one was injured. However an explosion of this nature has the potential to cause serious bodily injuries or death.

CIRCUMSTANCES

A contract tradesman had completed internal crack repairs in a (300-litre) box section of an excavator boom. He had installed and tack welded in place the inspection plate / repair window plate for final welding.

The welding procedures required that the inspection plate be pre-heated within a range of 50° - 100° Celsius.

A high volume propane heater (75mm diameter Bulgin type) was used to pre-heat the area to be welded. Almost immediately after turning off the heater an explosion occurred in the box section. The force of the explosion ripped the (45mm thick - 40kg) inspection plate from the four 25mm long tack welds and propelled the plate into a handrail and across a walkway, narrowly missing the tradesman.



Photo: Box section showing inspection window

INVESTIGATION

The mine, contractor and Department of Mineral Resources investigated by simulating the incident on a manufactured box section of the same size as the excavator boom.

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When a propane torch is used to pre-heat a welding job on an enclosed, but not totally sealed space, and where the flame is played on the work, partial combustion products are projected inside the enclosed space. These partial combustion products contain measurable percentages of hydrogen and carbon monoxide. There is little propane accumulated in the space.

When the torch is first applied the mixture quickly becomes inert (too little oxygen and too little fuel), then shortly afterwards becomes rich (too little oxygen but substantial fuel).

As heating continues the gas mixture inside varies over a range, but continues to be rich.

The danger occurs immediately after the torch is removed. As the section cools air is drawn into the space and the mixture passes through the explosive range for a short time. If a small flame or red-hot metal supplies an ignition source from around the edge of the workpiece it can easily initiate an explosion.

Both hydrogen and carbon monoxide have very wide explosive ranges in air (4% to 74% for hydrogen, and 12.5% to 74% for carbon monoxide). It is easy to form explosive mixtures with these gases. Hydrogen produces a very violent explosion with an extremely high rate of pressure rise.

RECOMMENDATIONS

Conduct a risk assessment to determine controls to be implemented to prevent explosions of gas in relation to welding repair work where accumulation of explosive mixtures of gas may occur.

Controls may include:

- Continuously purging the space with an inert gas.
- Cleaning the area and surrounds.
- Considering mechanical restraints across items such as inspection plates
- Establishing a safety zone around the work
- Ensuring only the person carrying out the repair work is within this zone
- Establish safe work procedures for the person within his zone

R Regan
ASSISTANT DIRECTOR SAFETY OPERATIONS