AIGA 2007 MEETING

PACKAGED GASES

SAFETY

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PATTAYA, THAILAND
Learning from Gas Cylinder Incidents

Andrew Webb

Air Products
Some Points to Remember

- The gas industry has a very good track record of being proactive to ensure a good safety performance is maintained.
- When there is an incident, the gas industry is responsive to ensure that any issues are identified, resolved and communicated to the gases industry.
Incidents Involve........

- **Equipment**
  - Design and/or Material
  - Operation

- **Activities within our Facilities**
  - Cylinder Filling
    - Pre Fill
    - Fill
    - Venting and Maintenance

- **Third Parties**
Equipment
Activities within our Facilities – Pre Fill

- **Pre Fill Inspections**
  - Key part of the Cylinder Operation

- **Our Cylinder Operators are on “the front line”**.
  - They are the first to see problems

- Some examples of what our cylinder fillers see…
Customer “Modifications”
Customer “Modifications”
Customer’s “Improvement”
Disguised Cylinders

Damaged acetylene cylinder “repaired” with plaster
Disguised Cylinders
Disguised Cylinders

Originally 13.4 litre CO2 cylinder, base cut, barrel shortened and base welded to barrel to look like a 10 litre cylinder
Cylinder Pre-Fill Checks

- Ensure all who are involved with cylinder pre-fill checks are trained and understand the importance of their job
- Look to AIGA, CGA and EIGA for guidance and training
- Refer to International Standards such as:
  - ISO 24431: Inspection at time of Filling
Cylinder Filling

- Entirely within our control
  - In house
  - Contracted out

- Whoever does the filling, they are responsible for ensuring that the package is “Safe to Fill”. This includes:
  - Pressure
  - Compatibility of materials
  - Quantity of gas to be filled
Corrosion in Cylinders
Corrosion in Cylinders

Corrosion in cylinders has been addressed by documents looking at:

- Corrosion in gas cylinders
- Use of residual pressure valves
- Avoidance of corrosion in CO and CO/CO₂ mixtures
Overfilling of Cylinders with Liquefied Gases
Overfilling of Cylinders with Liquefied Gases

- Pressures may be low, but consequences can be very serious
- How to avoid........
  - Look at published documents, e.g. CGA P-1, ISO 11162, NFPA 58, DIS/ISO 24431
  - Audit suppliers
  - Ensure clear instructions to fillers
  - Random check weigh
Change of Service Procedures
Change of Service Procedures

- When changing service look at the ISO standard: 11621 Procedures for change of gas service

- Considers
  - Material
  - Cleanliness
  - Pressure
  - Etc, etc.
Filling of Cylinders
Material Compatibility

- Need to ensure that the correct cylinder and valve materials are used
- There is much guidance available........
  - See ISO 11114 series of documents
Flammable Oxidant Mixtures
Flammable Oxidant Mixtures
Flammable Oxidant Mixtures
Uncontrolled Venting of Gases
Uncontrolled Venting of Gases

- Consequences can be catastrophic
- Venting of gases may include:
  - Toxic
  - Flammable
  - Oxidant
  - Inert
- Must understand what is being vented and take appropriate steps
Devalving Cylinders

Introduction
An accident occurred during routine maintenance work on a 23-litre capacity aluminium alloy medical oxygen cylinder. The hand wheel of the valve of this cylinder was broken. The cylinder was stored inside a horizontal devalving machine. During the devalving process, a rupture occurred destroying the top part of the cylinder. The cylinder valve and neck were projected a considerable distance in opposite directions. The operator (at a result of severe burns) had been covered by the combustion products from the upper part of the cylinder. Most of the shoulder of the cylinder was consumed, with approximately 2 kg of the aluminium alloy having been lost.

It is assumed that the cylinder was still filled with high-pressure oxygen when the devalving process took place with the resultant fire having started at the internal neck threads of the cylinder.

This document does not address the safe release of product and purging process of gas cylinders (see EIGA TN 05096).

Recommendations
Although the exact causes of the accident are still under investigation, we would like to draw your attention to the following points:

1) Before devalving any cylinder (steel or aluminium alloy), it is essential to strictly obey the procedures for checking if gas pressure is still present in the cylinder. This may be performed by either introducing an inert gas or using a rubber bulb (except for flammable gases). A detailed written procedure is given in the International Standards for the Periodic Inspection of Gas Cylinders, see bibliography. For valves with a residual pressure function and valves incorporating an integrated pressure regulator, specific procedures are required.

2) Any cylinder with a broken or inoperable valve must be put aside and a specialist will take the necessary action.

For all cylinders (steel or aluminium alloy), with broken or inoperable valves (see EIGA TN 05096). Dealing with combustible with broken or inoperable valves, this recommendation is to put them aside and depressurize them only if the operator is protected from injury including severe fire. Special care needs to be taken for aluminium alloy cylinders in order service.

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Cylinders Beyond our Control

- When the cylinder leaves our facility they are beyond our direct control
  - Incidents with customers impact our reputation
- There is a need to communicate to our customers information about the products
  - Labels
  - Safety Data Sheets
  - Simplified information
  - Verbal communication
Cylinders Beyond our Control
Transport in Closed Vehicles
Cylinders Beyond our Control
Transfilling by Customers
Cylinders Beyond our Control
Transfiling by Customers
Learning from Gas Cylinder Incidents
Key Messages

- Equipment
  ✓ Always purchase to a specification that both the customer and supplier understand and agree on
  ✓ Ensure equipment meets a “recognized” standard
  ✓ Buy the appropriate equipment for the duty
Learning from Gas Cylinder Incidents
Key Messages

Cylinder Filling

- Ensure pre fill inspection is carried out
- Ensure when residual gases are vented that this is to a safe location
- Ensure the right cylinder and valve materials are selected
- Ensure that the cylinder is filled with the correct quantity of gas
- Ensure change of service is carried out in accordance with recognized industry practices
Learning from Gas Cylinder Incidents

Key Messages

Customers

✓ Ensure that customers are aware of the products and the potential hazards of the product

✓ The purpose is to educate and not scare
Learning from Gas Cylinder Incidents

Thank you