Safety Note #9
by C. Bonham-2/84

Fermilab

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SAFETY SECTION

February 23, 1984

TO: Addressee

FROM: C. E. Bonham

SUBJECT: Inexperienced People Working with Gas Cylinders and Regulators May Need Your Watchful Eye

The enclosed Unusual Occurrence Report emanates from another DOE organization. It may seem ridiculous and strange, it is. As a matter of fact, we had the same sort of thing occur at Fermilab about 4 years ago. In our case, the supervisor asked a new employee to put a hydrogen cylinder on line. Simple enough right? Wrong, the employee didn't know how to remove the gas cylinder cap so he stuck a long handled screw driver in the cap holes and pried. This action accidentally opened the valve. Since it was hydrogen, it self ingnited and burned while in the cylinder rack. (He never did get the cap off). Occasionally, a gas cylinder is going to be encountered that has been left in the weather and the cap has rusted in place; what then? Matheson makes a special wrench, Model TW-5, $8.50, that is suitable for removing difficult caps. You might want to keep one of these on hand, although the handle appears to be too short to be effective. An alternative choice would be to use a chain wrench on the cap while securing the bottle in a large vice. If time and conditions permit, the best thing would be that of returning the gas cylinder to the vendor appropriately marked (i.e. "stuck cap"). Penetrating oils should never be used lest someone attempt this on a oxygen cylinder. This would result in an explosion.

There is another problem that an inexperienced employee could encounter with gas cylinders - mistaking the cylinder relief valve for the cylinder dust cap. Currently Matheson has been placing valve outlet plugs in their high purity gases and those with CGA 240, 580 and 510 cylinder valve outlets including rare gases, NH_3, and anines. The purpose of the cap is to keep dust and dirt out of the discharge port. This dust cap is a hex-nut(see Figure 1). Unfortunately, the pressure relief device (a rupture disk) is also a hex nut assembly on all but the Matheson cylinders. Note that relief device penetrates below the cylinder valve on the left side of the Matheson cylinder valve.

Here, Matheson redesigned this relief device assembly nut (i.e. made it round) so that it would not be confused with the dust cap. Figure 2 shows the typical NAL or brand "X" cylinder valve as are on most of our nitrogen and helium cylinders. Note that there is no dust cap, but that the relief device is under the hex nut. It would be a grave misfortune should someone confuse a safety device for a dust cap - say either thru inexperience, lack of attention, or because of of poor lighting condition etc. Should it be hydrogen gas, it would either ignite spontaneously thru static spark produced by the discharge or could explode - or perhaps both. At the least, this would cause all of one's sphincter muscles to involuntarily contract. In case your curious about these relief devices, they are usually a small rupture disks set for around 1.6 times the bottle pressure. Those cylinders containing flammable gases have Woods metal, a low melting point material 165°F or 212°F depending on the gas, filling the vent orifice leading to the rupture disk. These rupture disks provide protection in case of fire or overheating. They have no relief valve consideration with general relief or your equipment attached to the cylinder. However, it is advisable to take into consideration the presence of these built in reliefs in risk assessment involving the storage of flammable gases within occupied buildings.

The next problem I wish to bring up are scaling deversifications on regulator gauges (usually Matheson's) that can get even the most experienced technician in trouble. This is a classic example of poor "human factors' engineering and I'm working with Matheson to see if we can't correct the problem at least locally. Figure 3 depicts lb/in^2 in black on the outer scale and the metric unit KG/cm^2 on the red inner scale. Figure 4 shows kilopascals (Standards International - S.I.) units which aren't metric but similar) on the black outer scale and psi (now abbreviated) on the red inner scale. Note that the change from metric to S.I. introduces a scaling factor of 100. Finally, Figure 5 shows yet another way to skin a cat. Here the dual scales are both black with English on the inner and S.I. on the outer scale. The interesting thing about these regulator scales was that the three regulators photographed were all next to one another.

Please see that this information is appropriately circulated within your group especially to your new or transferred employees.

Thank you.

cc: M. Palmer
[redacted]
C. Rode
D. Finley
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Attachments: 1. Figure sheet 1-5
2. UOR Report 83-60

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UUIN # 83-60

UNUSUAL OCCURRENCE INFORMATION NOTICE

In consonance with the objectives (Section 6.b.(6)) and responsibilities (Sections 7.a.(2) and 7.a.(3)) under DOE Order 5484.2, the Office of Environmental Protection, Safety and Emergency Preparedness presents the following information.

SUBJECT: Hydrogen Fire

TIME: 1632 DATE: 07/14/83 APPARENT CAUSE: Personnel

DESCRIPTION:

When removing the safety bonnet from a cylinder of hydrogen, a wrench was used to provide additional torque. The wrench was inserted through the openings of the bonnet. As the wrench (and bonnet) was turned, the valve was opened releasing the hydrogen, which was ignited by an adjacent furnace. The flame caused facial burns to the employee and slight damage to the laboratory wall.

Final Evaluation:

1. Only the correct tools should be properly used to remove the cylinder bonnets.

2. The use of brass caps (screwed into the valve outlet) should be reinstated.

3. A safety guide (standard) dealing with the presence of flammable gas systems should be prepared and issued.

4. Conducting and documenting safety reviews/inspections should be practiced.

5. A training program should be conducted for safety representatives as well as the experimenters and technicians. Additionally, hazard awareness information should be posted and circulated.

The preceding was developed from information submitted from DOE facilities or from other public and private sources of interest to DOE operations. If further detail is desired, contact C. Warren Devereux, Office of Quality Assurance and Standards, EP-35, U.S. Department of Energy, Washington, D.C. 20545.

Fig. 1 - Matheson Gas Cylinder. Note dust cap on right (Hex-nut) and specially designed assembly nut. Since this is a flammable gas cylinder, woods metal fills the two visable ports.

Typical NAL N_2 He Cylinder. Rupture Disk under Hex-nut.

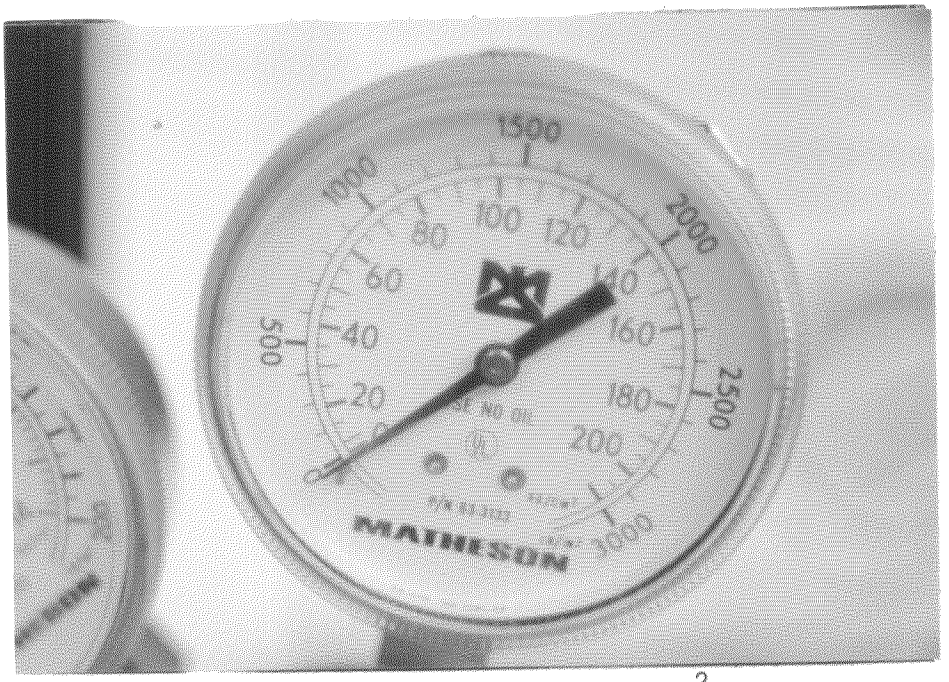

Fig. 3 Matheson Regulator Gauge - LB/in^2 vrs KG/cm^2

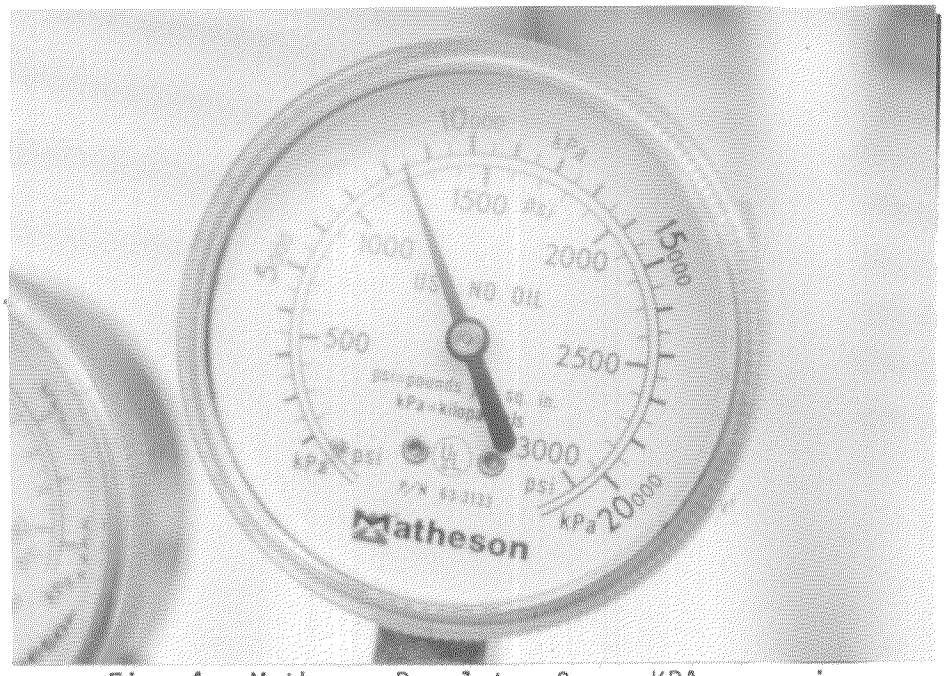

Fig. 4 - Matheson Regulator Gauge KPA vrs psi

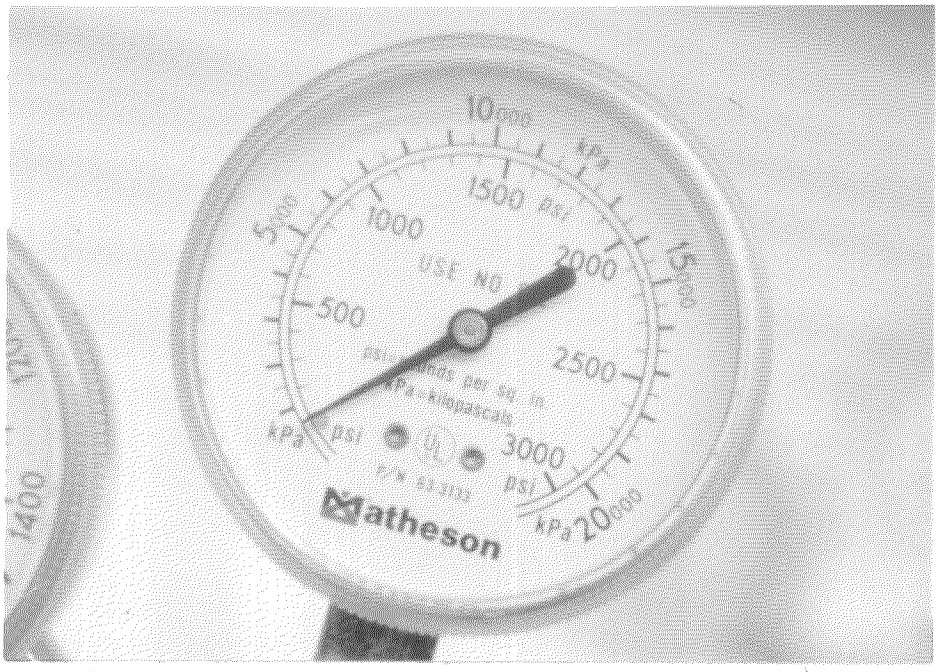

Fig. 5 - Matheson Regulator Gauge KAP vrs psi