ENVIRONMENT, SAFETY AND HEALTH

SAFETY & HEALTH HAZARDS ALERT

Assistant Secretary for Environment, Safety & Health • U.S. Department of Energy • Washington, D.C. 20585

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UPDATE June 28, 2000 - PRELIMINARY ACCIDENT INVESTIGATION FINDINGS FROM THE PLUTONIUM-238 MULTIPLE INTAKE EVENT AT THE LOS ALAMOS NATIONAL LABORATORY

DOE has recently completed a Type A Investigation of a plutonium-238 multiple intake accident that occurred at the Los Alamos National Laboratory (LANL) in March 2000. This alert is intended to apprise you of a possible need to take action to ensure the safety and health of glovebox workers. Additional lessons learned from this accident will be available in the accident investigation report to be issued shortly.

A radiological release of Pu-238 occurred near a glovebox in the Plutonium Processing and Handling Facility (TA-55). Seven workers have confirmed intakes of Pu-238. The source of the release was a compression fitting in a contaminated vacuum line serving the glovebox. Post-accident inspection revealed that this fitting was made up only finger-tight. Further, this fitting was normally under a vacuum so a leak would not be apparent. Contributing to the accident was a ball valve that was unable to hold pressure. Post-accident inspection of the ball valve revealed that the Teflon® seats were severely degraded.

Use of mechanical fittings such as compression fittings should be minimized in hazardous systems. In fact, the American Glovebox Society guideline for gloveboxes recommends continuous piping runs for glovebox auxiliary systems. When compression fittings are used, care should be taken to follow manufacturer's guidelines for installation. Special attention should be paid to use of ferrules that are compatible with the fittings and to the use of compatible tubing, ferrule, and fitting materials. Post-installation inspection or testing should be performed to confirm joint integrity, including leak checks and pressure tests. Manufacturers of compression fittings such as Swagelok™ offer gap inspection gages that provide a go/no go indication of whether the fitting has been properly assembled.

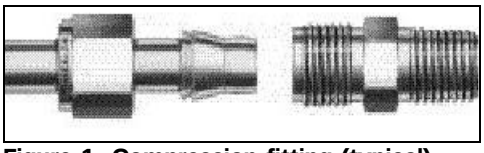

Figure 1: Compression fitting (typical)

Teflon® is known to experience significant degradation in high radiation environments.[1] The degradation in ball valve seats may manifest itself in shrinkage (as much as 25%) and pitting. Further, Teflon® valve seats in glovebox vacuum lines may experience erosion and, in the case of a Pu-238 glovebox, heat damage from product that has found its way into the vacuum system. Finally, Teflon® tape used to connect threaded connections may also experience degradation.

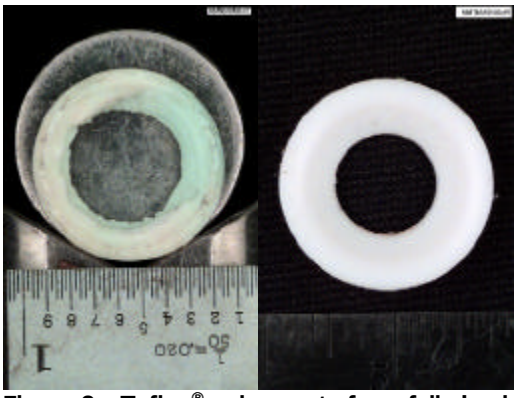

Figure 2: Teflon® valve seats from failed valve (left) and new valve (right)

[1] Radiation degradation includes detrimental changes in hardness, elongation, tensile strength, impact resistance, and discoloration. Most thermoplastics (with the exception of Teflon® polytetrafluoroethylene (PTFE) and a few others) are suitable for use up to 10^6 rads. Thermosetting polymers, such as epoxies and phenolics, and aromatic thermoplastics such as polystyrene, polyketones, and polyimides, exhibit resistance to levels up to 10^9 rads in air. Numerous industry reference materials as well as DOE Standards provide guidance on selection of appropriate sealing compounds used in radiological service. Teflon® degradation during radiological service has been a well-documented phenomenon since the 1950's.

Action

Facility Managers and DOE Field Element Managers should consider the issues in this alert and take appropriate actions:

Where compression fittings are installed in hazardous duty applications such as glovebox auxiliary systems, facilities should:

- Ensure compression fittings are assembled in accordance with manufacturer's recommendations and guidelines.
- Ensure post-installation, post-maintenance testing is performed to verify joint integrity and is performed in accordance with manufacturer's recommendations and guidelines.
- Ensure the number of mechanical joints in hazardous systems is minimized.

Where Teflon® valve seats or sealing compounds are used in process piping or associated hardware and the material is subject to high radiation fields, facilities should:

- Implement periodic inspection and replacement program to ensure component replacement prior to failure. In the accident discussed above, the ball valve felt "loose" when operated, due to degraded seats.
- Ensure design criteria carefully evaluate selection of components containing Teflon® in radiological services.
- Give consideration to radiation resistant sealing materials or seals composed of metal-to-metal surfaces.

Guidance and requirements for design, installation, and testing applicable to piping systems can be found in DOE Orders 4330.4B, *Maintenance Management Program*, and 414.1A, *Quality Assurance*, and their related guides.

UPDATE: JUNE 28, 2000

Los Alamos National Laboratory's TA-55 facility is in the process of checking every mechanical fitting in the facility. Facility managers estimate they have about 50,000 fittings. As of June 26, 2000, they have checked 16,505 Swagelok™ fittings and found 49% needed tightening. Twenty-one fittings had external contamination indicating past leaks, and a few were only finger-tight. When loose fittings were tightened, some leaked when re-pressurized, but the cause is not yet known. Another concern found during the fitting check campaign is that some installed NORGREN brand pressure regulators are "relieving" design units with built-in vent paths to the room atmosphere. In certain service line valve configurations, dialing these units to zero pressure could vent their attached system lines to the atmosphere outside the gloveboxes.

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