GAUGES? WE DON'T NEED NO STINKING GAUGES!

IIAR6, the *Standard for Inspection, Testing, and Maintenance of Closed-Circuit Ammonia Refrigeration Systems,* as part of its checklists for annual inspections in Appendix B, includes a check that "sufficient pressure/temperature gauges and/or transducers are present and functioning adequately."

Now, there is much debate as to how many gauges are "sufficient." If you make it a practice of having your operators install gauges while troubleshooting and remove them after use, then it is a good idea to document this in your mechanical integrity program to avoid having regulators or auditors ask questions if they see very few gauges installed in the system.

Regardless of how many gauges are installed in your system in an ongoing basis, it is important to make sure that they "functioning adequately.

The following pictures show some examples where this is downright untrue.

The picture above *(top left)* shows a gauge with ice buildup on it, indicating that the bourdon tube has ruptured and is allowing liquid ammonia to enter the gauge body.

In the two pictures above *(top right and right page)*, the needles are missing, suggesting that they broke off due to a hydraulic shock or vapor propelled liquid slug overpressure event. Depending upon the age of the gauge, the pin holding them in place may have corroded to the point of failure.

The gauge *(lower right page)* was an interesting one. A number of years ago, I was conducting a mechanical integrity audit at a facility. As part of that audit, I usually look at the compressor gauges and compare them to the control panel readings as a quick calibration check. In this case, the gauge was on the suction side of the compressor and should have been reading about 30 psig. Instead, it read 90 psig. When I had the operator remove it, it stayed at 90 psig.

Do your operators look at the gauges that are installed in your system, or do they rely on the electronic controls? If they aren't using them, consider removing them, as long as periodic calibrations of the electronic controls are documented.

In the newly published 2021 edition of IIAR2, the Standard for Safe Design of Closed-Circuit Ammonia Refrigeration System, Section 8.5.8 states, "Compressors shall be fitted with pressure and temperature indicating devices, including but not limited to gauges or readouts on a control display screen…" Therefore, IIAR2 does allow for electronic pressure and temperature indicating devices in lieu of gauges, allowing for the removal of unused gauges.

IIAR2 goes on to state in Section 16.4 that "Pressure gauges used for visually determining system pressures shall comply with this section. In Section 16.4.1, it states that, "pressure gauges shall be designed or selected in accordance with one or more of the following:

1. Comply with the ultimate strength requirements in Section 5.13.2; (Section 5.13.2 states that the gauge must be listed, or be designed to ASME B31.5 or the Boiler & Pressure Vessel Code.)

2. Have a documented successful performance history for devices in comparable service conditions;
3. Use a performance-based pressure-containment design substantiated by either proof tests as described in ASME B&PVC, Section VIII, Division 1, Section UG-101, or an experimental stress analysis; and
4. Be listed individually or as part of an assembly or a system."

In order to document these requirements, you will have to request this information from the manufacturer of your gauges.

Finally, Section 16.4.2 of IIAR2 states, "Where a pressure gauge is installed on the high side of the refrigeration system, the gauges shall be capable of measuring and displaying not less than 120% of the system design pressure. This means that a high side with a 300-psig design pressure must have gauge capable of displaying no less than 360-psig, while a high side with a 250 psig design pressure must have gauges on it that are capable of displaying no less than 300 psig. In Yuma, AZ, where the 1% Dry Bulb Temperature is 108.9°F, the design pressure must be no less than the saturation pressure corresponding to 30°F above the 1% DB temperature, assuming an evaporatively cooled system. Therefore, the minimum design pressure for this system would be 359.5 psig corresponding to a saturation temperature of 138.9°F, which would require gauges that read at least 432 psig. The takeaway is if you are using pressure gauges on the high side of your system, be mindful of the system design pressure.

If you have photos of an Epic Fail please pass them on to nh3isB2L@gmail.com.

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