DISCUSSION

The authors conclude that "aluminum pressure regulators can be safely used in oxygen service equally well as brass regulators" for compressed gas service. They support this with data for rapid pressurization tests and contingent upon stipulations on the regulator design and cleanliness that must be met. Our peer reviewers have taken some exception to this statement.

Rapid pressurization is indeed an important risk factor in regulators. Further, aluminum test data in the literature are often favorable in those specific procedures where exposure to high temperatures is the ignition stress (as in autoignition temperature tests and rapid pressurization tests).

However, many other data suggest aluminum does not perform equally to brass when exposed to other ignition-stress mechanisms that can also be present in practical applications, as well as after ignition has occurred:

- aluminum has been mechanically impact ignited, but brass has not
- aluminum particles and targets have exhibited sensitivity to particle-impact ignition
- aluminum has been frequently used as a promoter for its particular ability to spread fire to other materials (due to its very high combustion temperatures)
- aluminum has exhibited much higher rates of combustion and has burned at much lower pressures than brass
- aluminum releases roughly 10 times the heat of brass on a mass basis
- aluminum exhibits intense reactions not only with oxygen but with some metal oxides (iron oxides)
- recent reports indicate even a few percent addition of aluminum to copper greatly increases its flammability

These data argue that a similarly well designed brass regulator offers advantages when exposed to a number of ignition stimuli, and indeed, in any subsequent fire.

In many regulator applications, it is very difficult to ensure that the authors' stipulation on cleanliness is met throughout a regulator's life. Hence, while aluminum may give satisfactory service in a number of carefully selected applications, our peer reviewers are concerned that the authors' conclusion might be extrapolated more broadly than is justified in cases of severe regulator applications.

Do the authors share our reviewers' concern, or do they feel such an extrapolation is valid?

Dr. Robert Lowrie
BOC Group, Technical Center

AUTHOR'S CLOSURE

Brass is, of course, a more compatible-oxygen material than aluminum. However, we recall that many accidents have been reported to occur with brass regulators when subjected to rapid pressurization.

We have observed such important destructions in our tests and we have found out that, in these cases, brass bodies had thin walls; when the walls were thicker, damages were much less important.

The manufacturer of brass bodies with thin walls is explained by consideration of weight and of costs in order that such equipment can compete with aluminum regulators.

Our conclusions are consequently the following

- in agreement with the Peer Reviewers, a well designed brass regulator with thick walls will lead, if ignited, to less damages than an equally designed aluminum regulator,
- taking into account the development of brass regulators with thin walls, it is essential to have and to follow severe designing and testing conditions.

Gerard Vagnard
L'Air Liquide