TECHNICAL TALK
October 2004

Subject:
Two-stage Regulation

TWO-STAGE SYSTEMS GIVE MORE UNIFORM REGULATION, BETTER RELIEF PROTECTION, & REDUCED TROUBLE CALLS

The LIQUIFIED PETROLEUM GAS CODE, NFPA 58 requires that "A two-stage regulator system, an integral two-stage regulator, or a 2 psi regulator system shall be required on all fixed piping systems that serve 1/2 psig (3,4 kPag) appliance systems [normally operated at 11 inches water column capacity (2,7kPag) pressure]." Two-Stage systems are required on new piping installations or if a single stage piping system is changed, then it must be upgraded to a two-stage system. Single stage regulators can now only be installed on small portable appliances and on outdoor cooking appliances with input ratings of 100,000 btu/hr or less.

A two-stage regulator system provides a higher level of performance than a single stage regulator system. Single stage regulators in domestic and on nearly all commercial/industrial installations do have their limitations.

THE TWO-STAGE ADVANTAGE

With a two-stage system, a first stage regulator supplies a nearly constant inlet pressure (approximately 10 psig) to a second stage regulator. This means the second stage unit does not have to compensate for widely varying inlet pressures, conceivably as high as 200 psig in the summer and as low as 10 psig in the winter, but can provide nearly constant pressure, typically within +/- 1/4 inch w.c., to the appliance under varying load conditions. A single stage regulator's outlet pressure will deviate more from 11 inches w.c.because of the widely varying tank inlet pressure. A more common pressure fluctuation due to inlet pressure change would +/- 1 inch w.c.

If the piping distance between the tank and the house is less than 30 feet, an integral regulator is probably sufficient for most loads without having to use a large pipe or tubing size. However, if the distance between the tank and house is greater than 30 feet, a smaller pipe or tubing can be used between the first and second stage regulators due to the higher intermediate pressure, and thus the potential to save on piping costs.

BETTER OVERPRESSURE PROTECTION IN AN EMERGENCY

The internal relief valve on a single or second stage regulator can provide adequate over pressure protection for a regulator that may not lockup because of a worn disc or debris stuck on to the valve disc. However, only a large capacity relief valve in a second stage regulator can limit downstream pressure to 2-psig to the appliance if there is a mechanical failure in the regulator. Such performance is accomplished because the first stage is presumed to be operational and still providing 10 psi to the second stage regulator. Thus the second stage relief valve doesn't have to be sized for the full 250-psi tank pressure.

For large Commercial/Industrial systems, most of the regulators used for first and second stage service do not have internal relief valves and if they do, they typically only provide minimal relief protection. Therefore, for large commercial and industrial applications, external relief valves or other means of overpressure protection will have to be installed between the first and second stage regulators and also downstream of the second stage regulator to provide the 2 psig overpressure protection required by NFPA 58.

REGULATOR FREEZE UPS MINIMIZED

A two-stage regulator system provides gives better resistance to internal regulator freeze-ups (ice build-up just before the orifice) from water in the gas because:

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- A larger orifice can be used in the second stage regulator;
- Pressure reduction occurs at both the first and second stage regulators, creating less cooling and more heat transfer into each regulator;
- Most second stage regulators are mounted on the side of the wall with the inlet piping coming up out of the ground. This orientation allows any condensed moisture to drain away from the orifice, the coolest part of the regulator during pressure reduction.

With minimal pressure drop at the second stage orifice and moisture draining away from the larger second stage orifice, it becomes more difficult for water to freeze in the second stage regulator.

FEWER TROUBLE CALLS

You can expect fewer customer trouble calls due to regulator freeze-ups, pilot outages, and erratic appliance performance with a two-stage system.

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