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ENGINEERS NEWSLETTER

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What Every Designer Should Know About …

ASHRAE Guideline 3–1996

From the editor …
Last year marked the tenth anniversary of the signing of the Montreal Protocol. Many people consider this landmark agreement to be the first global environmental protection effort. More specifically, the Montreal Protocol placed controls on the production of ozone-depleting substances and led to the phaseout of chlorofluorocarbon (CFC) refrigerants.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) appointed a task group to study the issue and to devise appropriate policy and program recommendations. ASHRAE Guideline 3, first published in 1990, is one aspect of the comprehensive action program developed by ASHRAE to reduce emissions of CFC refrigerants.

The 1996 revision expands the guideline's scope to reflect the more rigorous refrigerant emission policies now in place. As the Foreword observes, ever-lower emissions of all halogenated refrigerants "may have a positive effect with respect to … environmental concerns such as global warming" and offer potential cost savings. This Engineers Newsletter highlights some of the most significant changes implemented in ASHRAE Guideline 3–1996.

ASHRAE Guideline 3, "Reducing Emission of Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems," was originally drafted in 1990 in response to the Montreal Protocol. (That 1987 treaty called for global conservation of chlorinated fluorocarbon HCFC and CFC refrigerants.) The guideline recommends methods of refrigerant conservation for all phases in the life of a refrigeration or air-conditioning system.

"ASHRAE Guideline 3–1996 contains many changes that promote improved refrigerant conservation…helping everyone involved minimize unintentional releases of halogenated refrigerants."

When used in conjunction with other relevant standards, codes and practices, ASHRAE Guideline 3 helps everyone involved—designers, manufacturers, installers, operators, service technicians and owners—minimize the unintentional release of halogenated refrigerants.

In 1996 ASHRAE approved a revision of Guideline 3. The recently published guideline still addresses basic equipment/system design, manufacture, installation, operation, maintenance and decommissioning. **But its scope now extends to cover all CFC, HCFC and HFC halogenated fluorocarbon refrigerants.**

ASHRAE Guideline 3–1996 contains many other changes that promote improved refrigerant conservation. Some of these changes carry significant ramifications for system designers and specifiers; this article highlights several of them. Section numbers are included for easy cross-reference.

4.1.3.1
Pipe Fittings

ASHRAE considers flare fittings to be an important source of preventable refrigerant loss. Guideline 3–1996 observes that *"SAE 45-degree flare fittings and short radius elbows are not extremely reliable,"* and goes on to state that *"Their use is discouraged."*

Viable alternatives for system designers include braised joints, gasketed joints and double-flare mechanical connections, as well as improved designs that eliminate joints altogether.

4.4.1.1, 4.4.1.2
Purge Systems

Purges are an important refrigerant conservation tool for low-pressure chiller systems and ASHRAE Guideline 3–1996 reinforces their worth. Section 4.4.1.1 now recommends that designers specify purges that *"emit less than one part of refrigerant per part of air as rated in accordance with the methods prescribed in ARI Standard 580."*

Most purges built before 1990 emitted five to eight pounds of refrigerant per pound of air. Contrast that with the improved efficiencies of today's purge designs: many emit less than 0.01 pound of refrigerant per pound of air … some as little as 0.002 pound! For a typical 500-ton chiller, this efficiency improvement means an annual refrigerant loss of less than one ounce versus more than 100 pounds for a chiller built 15 years ago.

Section 4.4.1.2 addresses another facet of specifying a purge: its ability to run independently of the chiller. On chillers built before 1990, the purge was typically disabled whenever the unit was idle. If the chiller was full of air and the purge inoperative, the chiller couldn't start. Often the only way the operator could restart the unit was to directly vent air and refrigerant to the atmosphere … a practice that's now illegal.

Since 1990, all manufacturers of low-pressure chillers offer purges capable of operating when the chiller is idle or in standby. ASHRAE Guideline 3–1996 encourages designers to specify purges with *"the capability of operating while the chiller is idle."* Use of such purges can virtually eliminate refrigerant emissions caused by "air-bound" chillers.

Purge System

Rupture Discs

In relief valve applications, install a nonshattering rupture disc (left) upstream of the valve. A disc that fragments when it ruptures (below) is acceptable if no relief valve is present.

4.1.6.2 Relief Systems

ASHRAE clarifies its recommendations for relief-valve applications in the 1996 edition of Guideline 3. For example, Section 4.1.6.2 now specifically cautions designers that *"the rupture disc should be a nonshattering type"* when it is installed in series with a relief valve. Designers typically specify metallic, nonfragmenting rupture discs to comply with this section.

Using a rupture disc in series with a relief valve offers two benefits:

- It reduces accidental refrigerant loss due to poor valve sealing.
- It permits installation of a pressure gauge between the disc and valve. The gauge provides instant indication if the disc bursts and enables fast response to the overpressure condition that caused it.

Since Section 4.1.6.2 recommends that a rupture disc be installed upstream of every relief valve, does it also imply that a relief valve be installed downstream of every rupture disc? The answer is "No, not necessarily." Unlike a relief valve by itself, a rupture disc is already a hermetic relief system.

4.4.3 Refrigerant Monitor

The requirement for refrigerant-specific monitors in equipment rooms was instituted after the initial publication of ASHRAE Guideline 3 in 1990. (ANSI/ ASHRAE Standard 15, "Safety Code for Mechanical Refrigeration," defines that requirement.) ASHRAE reemphasizes the importance of refrigerant monitors in Guideline 3–1996. Section 4.4.3 states *"The use of a monitor capable of low refrigerant detection (down to 1 ppm) can also provide an early warning of refrigerant leaks."* By specifying a monitor that measures concentrations as low as 1 ppm, designers can provide building operators with a powerful tool for detecting and remedying refrigerant leaks before a significant refrigerant loss occurs.

8.1.4.6 Containment Verification

Other changes in ASHRAE Guideline 3–1996 include new recommendations for owners and servicers. Section 8.1.4.6 describes the steps necessary to confirm the integrity of equipment that contains a refrigerant charge. It recommends semiannual leak inspections for any system that holds more than 200 pounds

of refrigerant. It also suggests that these examinations consist of two parts:

- A **visual check** of potential leakage sites; for example, telltale oil leaks at compressor shaft seals. And …
- A **containment check** of the equipment's refrigerant charge. This could involve recording the purge exhaust rate while the chiller is under vacuum, or logging either the concentration readings of the equipment room refrigerant monitor or measurements of the system refrigerant charge.

8.1.4.1.1 Centrifugal And Large-Positive Displacement Systems Log

Equipment operators play an important role in refrigerant conservation. While a refrigerant monitor can detect a leak before a significant amount of refrigerant is lost, logging and reviewing system performance for trends associated with refrigerant leakage provides an even earlier indication.

When first published in 1990, ASHRAE Guideline 3 recommended that operators log system liquid temperatures and refrigerant temperatures, pressures and levels at least daily. To these parameters, the 1996 version of Section 8.1.4.1.1 adds the following (if provided):

- PPM refrigerant monitor level.
- Low-pressure purge exhaust time or discharge count.

Why expand system logs to include this information? If the refrigerant monitor can accurately detect concentrations of 1 ppm, tracking its readings can provide early notice of refrigerant leaks in low- and high-pressure refrigeration systems. For low-pressure systems, tracking the duration and frequency of purge operation is still the best forewarning of a refrigerant leak.

Refrigerant Monitor

Conclusion

ASHRAE Guideline 3–1996 reflects nearly 10 years of industry expertise and review. It's the most comprehensive guide for refrigerant-conserving design considerations and practices that provide potential cost savings as well as environmental benefits.

Designers play a key role in promoting maintainable, low-emission refrigeration and air-conditioning systems. If you haven't already done so, familiarize yourself with Guideline 3's recommendations and look for practical, cost-effective solutions to satisfy them.

For example, specify features such as self-logging purges and refrigerant monitors with sensitivities of 1 ppm. Also consider the refrigerant management potential inherent in microprocessor-based controls. With the automation of a building management system, the recommended monitoring points identified in Guideline 3–1996 can be observed, logged and trended over time … and used to trigger preventive maintenance messages, a boon for operators and service technicians.

For the latest copy of ASHRAE Guideline 3, contact ASHRAE Customer Service at 1791 Tullie Circle NE, Atlanta, GA 30329, or via the Web at www.ashrae.org. ■

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If you'd like to comment on this article, send a note to The Trane Company, Engineers Newsletter Editor, 3600 Pammel Creek Road, La Crosse WI 54601 or visit Trane on the Internet at www.trane.com.

ASHRAE "Guideline" Or "Standard"?

What's the difference? The following excerpts from the title page of ASHRAE Guideline 3–1996 describe why Guidelines are created and identifies how they differ from Standards.

ASHRAE Guidelines are developed under a review process, identifying a guideline for the design, testing, application, or evaluation of a specific product, concept, or practice. [Guidelines] are not definitive but encompass areas where there may be a variety of approaches, none of which must be precisely correct.

… Development of ASHRAE Guidelines follows procedures similar to those for ASHRAE Standards except that (a) committee balance is desired but not required, (b) an effort is made to achieve consensus but consensus is not required, (c) guidelines are not appealable, and (d) guidelines are not submitted to the American National Standards Institute, ANSI, for approval.

… (C)reation of ASHRAE Guidelines and Standards is determined by the need for them, and conformance to them is completely voluntary.