Refrigerant Changes Make R-410A Systems More

Used in refrigeration, industrial cooling, air-conditioning and heating applications for more than 50 years, the refrigerant R-22 is a hydrochlorofluorocarbon (HCFC). The chlorine component in R-22—which also consists of hydrogen, fluorine and carbon—is an element known to damage stratospheric ozone.

The Montreal Protocol, initially signed by 25 nations in 1987 and now ratified by nearly 170 countries, dictates that because it is a chlorinated refrigerant, R-22 production must be eliminated. The current schedule calls for halting production of units that use R-22 as of Jan. 1, 2010. While R-22 will still be available, the production of any new R-22 refrigerant will cease as of Jan. 1, 2020. *(Editors Note:* RSES Journal *subscribers can read more about the R-22 phase-out online at www.rsesjournal.com, where a white paper offers further information on the topic.)*

Today many homeowners are well-informed of the eco-friendly units available on the market. However, technicians may find a little more explaining is needed when installing or retrofitting a unit to R-410A.

In preparation for the R-22 phase out, most major equipment manufacturers have embraced R-410A as the chlorine-free refrigerant of choice.

Defining R-410A

Simply put, R-410A is a 50/50 blend of two hydrofluorocarbon (HFC) refrigerants, R-32 and R-125. R-410A is considered a near-azeotrope refrigerant, meaning that even though it is composed of two different refrigerants, it almost acts as a single compound when changing from liquid-to-vapor or vapor-to–liquid states. R-410A is not subject to fractionation, or breaking apart into the individual refrigerant components if a leak would occur in the system.

The color code for R-410A is rose. This coding is used on refrigerant cylinders, equipment labels and system components.

R-410A vs. R-22

A service technician must recognize R-410A systems, as there are specific service practices that must be adhered to in order to promote system efficiency and longevity.

There are two primary differences between working with R-410A systems:

Higher operating pressure: The operating pressures of R-410A are 50—70% higher that those of R-22. The higher pressures require that service tools used on the refrigerant side of the system are designed for the higher pressure, including the manifold gauge set as well as recovery machines and cylinders. Technicians must make sure that all system components are approved for use with the higher pressures of R-410A.

Polyol ester (POE) oil: POE oil is used with R-410A sys-

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Phase-out of R-22 production means today's technicians need to understand new refrigerant and system requirements.

BY SCOTT NELMARK AND MICKEY SMITH

Appealing Than Ever

The Montreal Protocol, now approved by nearly 170 nations, calls for the elimination of the production of units using R-22 refrigerant by 2010 since it contains chlorine, an element that is damaging to the ozone layer.

tems. In the past, R-22 systems used mineral oil (MO) or alkyl benzene (AB) oil as the system lubricant. POE oil is not compatible with the MO or AB oil. It is imperative that proper service practices are performed during installation and service—particularly in retrofit applications—to ensure there is absolutely no intermixing of oils. MO and AB oil will not mix with R-410A refrigerant and will be pushed through the system as a liquid blob, impeding refrigerant flow at the metering devices and creating subsequent pressure fluctuations.

POE oil readily absorbs moisture (hygroscopic) much faster than mineral oil. Proper system evacuation upon system installation and after opening the system for service is critical.

Under no circumstances should a technician leave an R-410A system open to the atmosphere. If left open, the POE oil in the system will absorb moisture from the air and will become trapped in the oil. Once absorbed, the moisture cannot be removed through system evacuation. This moisture can lead to the formation of sludge in the system, poor system performance and eventual system failure. Preventing moisture from entering the oil in the first place is the best method to avoid this problem.

Component considerations

With higher Seasonal Energy Efficiency Ratio (SEER) ratings and utility rebate program requirements, very specific equipment and metering device matches are required to attain the stated system SEER. Most HVAC systems operate at 10 SEER, while more advanced systems can reach 18 SEER or higher.

Technicians must make sure that metering devices designed and properly sized for R-410A are used on R-410A systems; Capillary-tube metering devices are not acceptable. Fixed-orifice metering devices may be used, but the technician should verify if the equipment-match will allow it.

Compressors used on R-410A systems use thicker metals to withstand the higher operating pressures. Therefore, only compressors designed for R-410A should be used with R-410A refrigerant.

Technicians must also make sure that refrigerant lines are properly sized for R-410A systems. On retrofit applications, the installer should replace the lineset to prevent cross-contamination of MO and AB oil from an old lineset into the R-410A system. It is possible to use existing refrigerant lines in an R-22 system with an R-410A system installation if they are the correct size; however, they must be cleaned of all debris and oil, usually through a commercially available flushing agent.

R-410A filter-driers are designed to withstand the higher pressures of R-410A. Only use filter-driers rated for use with R-410A, which can accommodate pressures of 600 psig or higher. Because of the hygroscopic nature of POE oil, it is particularly important that the technician replace the filter-drier every time the R-410A system is opened.

Other key considerations

Along with the differences between R-22 and R-410A, as well as the component considerations that technicians must remember, there are several other critical areas that need to be kept top-of mind.

Tools and test instruments: Because of the higher pressure and POE oil found in an R-410A system, any tool or test instrument that comes in contact with refrigerant

This manifold gauge set can handle both R-410A and R-22 refrigerants. If a "dual refrigerant" manifold gauge set is used, it should be used for only one refrigerant.

and/or oil in the system should be dedicated to R-410A systems. In addition, a dedicated manifold gauge set should be used with R-410A equipment. Manifold gauge sets exist that can handle both R-410A and R-22. However, if using a dual-refrigerant manifold gauge set, it is recommended that it is only used with one refrigerant.

Safety: Personal safety is always of utmost importance when working on any HVAC system. Safety glasses and gloves should be worn regardless of the refrigerant being used. If it is necessary to heat a cylinder of R-410A—to raise its pressure in cooler weather—heat the cylinder with water that is 90°F or lower; never heat a cylinder with a flame. Don't allow the cylinder to reach a temperature of more than 125°F during transport or storage. As a reminder, a cylinder of R-410A at 125°F exerts a cylinder pressure of 450 psig. Never exceed 80% of the capacity of a recovery cylinder. Doing so may cause the cylinder to rupture, causing possible physical injury or property damage. Recovery cylinders must be Department of Transportation rated for R-410A use.

Equipment selection: Transitioning to R-410A is not difficult for technicians who have a firm foundation and understanding of fundamental air-conditioning practices. However, failure to follow these recommendations can lead to misapplied equipment, reduced capacity, equipment failure, and in some cases, personal injury. Always perform a heat-loss/-gain load calculation to ensure the correct sized components are used. For residential and light-commercial HVAC applications, Manual J from Air Conditioning Contractors of America (ACCA) provides reliable and accurate results.

Existing evaporator coils, SEER and oil concerns: Depending on the age of the system being retrofitted, the indoor coil/outdoor unit combination may have provided 10, 8 or an even lower SEER value. The technician should change the evaporator coil to provide the customer with a properly matched SEER-rated system. A 13 SEER outdoor unit matched with a 10 SEER indoor coil will not provide 13 SEER. An installer should replace existing evaporator coils to remove the possibility of residual MO or AB oil moving from the coil and into the new system. For the latest coil and condensing unit combination ratings, visit the Air-Conditioning and Refrigeration Institute (ARI) at www.aridirectory.org.

Lineset considerations: Technicians should always replace linesets in retrofit applications to prevent intermixing of the MO or AB oil with the POE oils. If replacing the linesets is not practical, the following precautions should be taken:

- Inspect the linesets for kinks, sharp bends or other restrictions, and for corrosion;
- Determine if there are any low spots that might serve as oil traps;
- Flush the linesets with a flush kit (available commercially) to remove as much of the existing oil and contaminants as possible; and
- Install a suction line filter-drier to trap any remaining contaminants, and remove them after 50 hours of operation.

Because R-410A and POE oil mix so well together, oil-trap installation is generally not required on R-410A systems. However, technicians should always be sure to seal refrigerant lines by crimping them closed and brazing them if they will be exposed to the atmosphere for any length of time. Never leave refrigeration lines open to the atmosphere to prevent moisture and contaminants from entering the system.

Line connections and startup: When connecting lines, techs should not use soft solder. A brazing alloy with a minimum 5% silver content is recommended. A low-pressure flow of dry nitrogen should be used when brazing line connections in the field to prevent oxide formation on the interior walls of the copper tubing. POE lubricants used in R-410A systems are a form of a mild organic acid, which scrubs oxides and contaminants from the interior of refrigerant tubing walls. The oxides, once removed, will begin to circulate through the system and will likely end up in the metering device and create performance issues. Once installed, the start-up procedures for an R-410A system are identical to those of a traditional R-22 system.

Final thoughts

When industry-accepted service practices are followed, the R-410A system will provide the end user with many years of comfortable, reliable operation, while eliminating the possibility of ozone depletion during the installation and service of the system. As the deadline for compliance with the Montreal Protocol looms, it is more important than ever for technicians to understand this refrigerant, its properties and applications.◆

Scott Nelmark is the manager of training services and Mickey Smith is the York brand manager, both for Johnson Controls-Unitary Products in Norman, OK. For more information, e-mail scott.t.nelmark@jci.com or mickey.s.smith@jci.com.