

# Arkema's Forane® 427A Refrigerant – The Easy Retrofit™

## Dongxing Freezing Company, Taiwan



### BACKGROUND

As the HVACR industry continues to move away from R-22 due to regulatory pressures, Arkema's Forane® 427A refrigerant (R-427A) has proven itself as an excellent, easy-to-use, non-ozone depleting HFC refrigerant for air conditioning, heat pump, and refrigeration applications.

Forane® 427A refrigerant is a better match to R-22 than other retrofits over a wide range of applications, offering close capacity and pressures to R-22, with no oil change required in many installations. According to the Montreal Protocol, Taiwan reduced its HCFC availability by 35% in 2004. There was a further reduction of 75% in 2010, and 90% reduction in 2015. Finally, by 2020 the reduction is expected to be 99.5%. More stringent guidelines have been implemented since 2016 for the use and consumption of R-22 in Taiwan.

Yuging, a fishing company, which provides seafood from the Pacific Ocean and operates vessels on the sea for several days, must have a stable and reliable refrigeration system on board to ensure the delivery of fresh product. As such, the company has been resistant to changing their equipment to an R-22 retrofit refrigerant. As Dongxing Freezing Company's fishing vessel refrigerated warehouse has previously relied

entirely on R-22 refrigerant for refrigeration, it was directly affected by the R-22 phase-out. In this case, Dongxing Freezing Company persuaded Yuging to retrofit their equipment with Forane® 427A Refrigerant – the Easy - 22 Retrofit.

### RETROFIT APPLICATION

The system on the ship is equipped with a Carrier semi-hermetic reciprocating compressor with cooling power of 30 horsepower. A single freezing room is equipped with three circuits and forced convection equipment (air cooler) to accelerate the cooling speed as the seafood should be cooled to below -40°C in a very short period of time. Five frozen and refrigerated rooms with room temperature between -20°C ~ -40°C are equipped with 1-3 circuits each, with each circuit equipped with a direct expansion system (free convection) used to keep the seafood at a certain temperature. The cargo ship also had a back-up cold room.

In this system, the mineral oil was replaced by POE lubricant. All R-22 gas was removed from the system, and then vacuumed to check for any leaks. Forane® 427A Refrigerant was then added through a compressor suction

#### Project

Dongxing Freezing Company, Taiwan

#### Location

Donggang Township, Pingtung County, Taiwan

#### Application

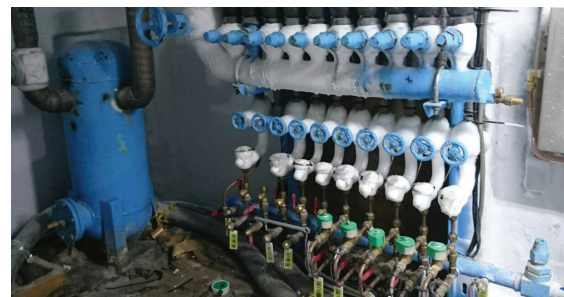
Refrigeration

#### Refrigerant

Forane® 427A (R-427A)

#### Lubricant

Polyolester (POE)



## APPLICATIONS (CONT.)

line until the system reached the desired superheat/subcooling and operating pressure setting. The expansion valve can be adjusted, if needed.

After the retrofitted system was running for 24 hours, the temperature of the cold rooms reached the set point.

## RESULTS

The refrigeration system is operating normally and within expectations.

- The compressor discharge temperature is significantly reduced compared to the R-22 system, which means improved reliability.
- The compressor suction superheat under the partial load conditions has been improved, with no liquid flood back to the compressor.
- The compressor oil level is normal, meaning the system oil turn rate is working to satisfaction.
- The fast and easy retrofit procedure reduced the expected workload, and the removal of the mineral oil with a one-time replacement of POE oil proved to be successful.
- There was no need to flush the system several times due to high tolerance of Forane® 427A Refrigerant.
- As Forane® 427A has similar pressure to R-22, there was no need to adjust pressure switch setting, and the identical mass flowrate required no change for the TXV.

Forane® 427A is a simplified and cost-effective retrofit solution for existing R-22 installations in a large range of applications. Forane® 427A is the closest match to R-22 in terms of performance, mass flow rates, and operating pressures over the whole

TABLE 1

### COMPARISON OF R-22 & FORANE® 427A PROPERTIES

|                                                             | R-22    | R-427A |
|-------------------------------------------------------------|---------|--------|
| Molecular Weight (g/mol)                                    | 86.5    | 90.4   |
| Boiling Point °C – Standard Atmospheric Pressure            | -40.8°C | -43°C  |
| Latent Heat of Vaporization – Standard Atmospheric Pressure | 234     | 236.8  |
| Critical Temperature (°C)                                   | 96.1°C  | 85.3°C |
| Critical Pressure (Bar)                                     | 49.3    | 43.3   |
| Density of Saturated Vapor (Kg/m³)                          | 4.7     | 4.85   |
| Density of Saturated Liquid (Kg/dm³)                        | 1.191   | 1.129  |
| Temperature Glide                                           | –       | 6.8°C  |
| Ozone Depletion Potential – ODP                             | 0.055   | 0      |
| Global Warming Potential – GWP                              | 1,760   | 2,024  |
| ASHRAE Classification                                       | A1      | A1     |

TABLE 2

### CHANGES IN THE SYSTEM

|                         | R-22                                                  | R-427A                                              |
|-------------------------|-------------------------------------------------------|-----------------------------------------------------|
| Refrigerant Charge (Kg) | 180                                                   | 192                                                 |
| Throttle Device         | TXV remain unchanged<br>(1 turn superheat adjustment) | Same with the left column<br>(superheat adjustment) |
| Lubricant               | 12L – Mineral Oil                                     | 12L – POE Oil                                       |

range of temperatures. R-427A has comparable capacity to R-22, and better efficiency than most other R-22 replacements. R-427A's discharge temperatures are typically 25o-45oF lower than those of R-22, and it has one of the lowest global warming potentials (GWP) of the R-22 retrofits. That is why more customers are considering Forane® 427A – The Easy R-22 Retrofit™. For more information on retrofit guidelines, case studies, and FAQs, please visit [www.r22retrofits.com](http://www.r22retrofits.com).

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