



# C A S E S T U D Y

## ComStar Conversion from R22 to RS-45 Refrigerants for a Direct Liquid Overfeed Ice Rink System



ComStar International Inc., the world’s most comprehensive manufacturer of environmentally safe, industrial strength chemical products, successfully introduced a turnkey system for ice rink managers to comply with the government-mandated phase-out of R22 refrigerant.

This case study details a recent ice rink project in Michigan and shows how easy the transition can be. Brownstown Sports Center is a 40-year-old sports complex with two full size ice sheets. The rink had a direct liquid overfeed refrigeration system with approximately 11,000 pounds of R22 refrigerant operating with mineral oil.



### SPECIFICATIONS OF CONVERTED R22 FLOODED SYSTEM

- Direct liquid overfeed refrigeration system
- R22 refrigerant charge of approximately 11,000 lbs
- Two reciprocating compressors; York GI-12 and an Emerson Vilter 450 XL
- Coalescing oil separator with line to an oil still on low side with lines from still to the two compressors
- System operation on mineral oil (no change out required)
- System has a manual expansion valve

Since the United States Environmental Protection Agency declared that new production and import of most R22 will cease by 2020, conventional refrigerant costs have risen and also left ice rink managers facing the prospect of depleted supplies.

ComStar, a 47-year-old U.S. company, manufactures the only R22 replacement refrigerant for use in flooded, R22 liquid overfeed ice rink





## BROWNSTOWN, MICHIGAN

systems without changing components or oil. ComStar’s RS-45 (R434a) refrigerant is a true drop-in replacement for R22 and blends with any remaining R22, with low glide for high performance applications.

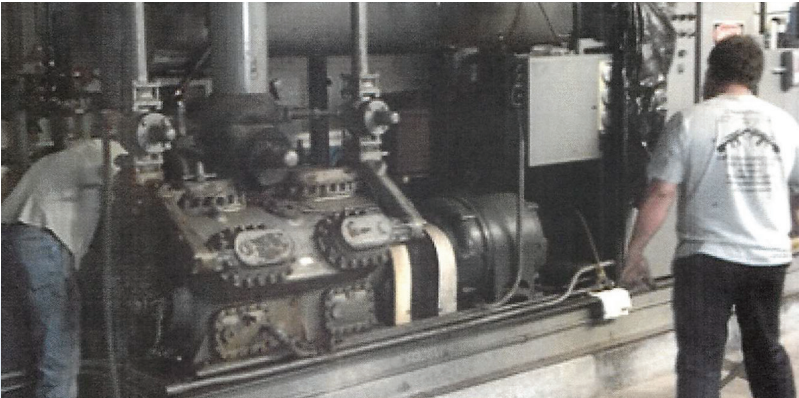
“We’re proud to offer an affordable solution to ice rink managers who are stuck in a tough situation. Our RS-45 refrigerant has all the qualities to make the conversion seamless,” said Steve Mella, CEO of ComStar.

Ron Zimmers, VP of Operations, said, “I did a fair amount of research and concluded the easiest and least expensive fix was to change out the R22 to ComStar’s RS-45 (R434a) drop-in replacement refrigerant. I breathed a sigh of relief knowing I wouldn’t be caught without any R22 options down the road.”

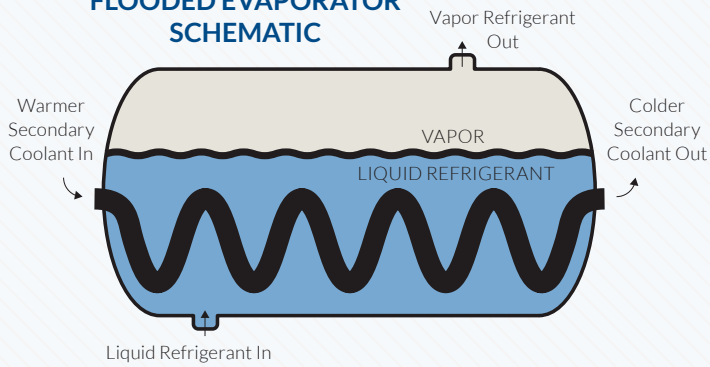
ComStar supplied the new RS-45 along with empty cylinders for the R22 that was removed from the system and subsequently purchased by ComStar. Serv-Ice

Refrigeration of Northville, Michigan evacuated the R22 and recharged the system with RS-45 for the two rinks over a four-day period in August. The cost of the RS-45 was offset by the R22 buyback, resulting in a small net cost to Brownstown. There was no maintenance performed on the system before or during the replacement of refrigerant.

Zimmers monitored the sequence of events and said, “We charged the first ice sheet system with approximately 5,000 pounds of RS-45 and the ice was good to go the next morning. The results were much better than I imagined.”

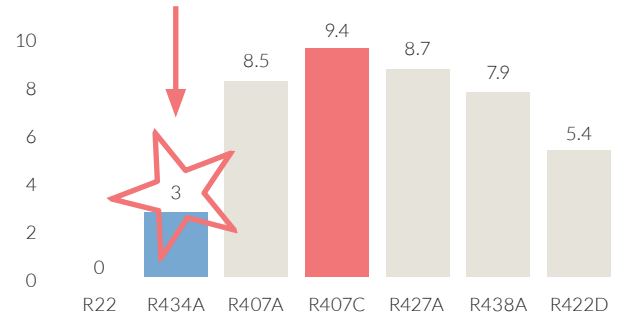


### FLOODED EVAPORATOR SCHEMATIC



- Note 1: Use in liquid overfeed, flooded, recirc and DX systems.
- Note 2: The system will not be harmed if RS45 is inadvertently mixed in with existing R22.
- Note 3: Since RS45 has greater mass flow than R22, the expansion device will need to accommodate greater mass flow, equal to R404.

### RS45 LOW GLIDE PERFORMANCE COMPARISON



Comparison of glide for common R22 alternatives at the same conditions. Flooded systems require ultra low glide refrigerants.

**Remarkably, the second ice sheet conversion began with no ice, just concrete. After observing the performance of the first sheet for two days, the crew charged the second rink with RS-45 in the afternoon and flooded the rink with water during the night. The next morning the ice was solid, ready to be painted and then re-flooded. Hockey players were skating on it the next day – an amazing 36-hour turn around.**

“I’ve never seen ice freeze that fast. The system actually runs a lot more efficient and smoother now,” Zimmers said.

Mella added, “The Brownstown conversion to RS-45 proves, without a doubt, that a sheet of ice can be changed out and operating in 24 hours or less. We’re excited to make this happen for rinks all around the country.”

### PREPARATION OF FLOODED R22 SYSTEM

- Took baseline readings operating with R22.
- Removed approximately 10,000 lbs. of R22 refrigerant from both ice sheets.
- Checked compressors.
- Performed leak checks.
- Performed vacuum/dehydration process, pulled system to depth of 2mm HG until a depth of 1.5mm HG was achieved.
- Holding period of four hours at a minimal rise of 100 microns.
- Charged first ice sheet with 5,000 lbs. of RS-45.
- Observed first sheet ice and system operation for 48 hours.
- Charged second sheet with 5,500 lbs. of RS-45.





## SERV-ICE REFRIGERATION'S CONCLUSIONS

After charging the first ice sheet with RS-45, the system was exposed to normal load conditions upon start up. Daytime ambient temperatures during the 4 days, two ice sheet conversion ranged from a high of 91 to a low of 81. Under normal operation the compressor performed load demand easily. Discharge pressure with RS-45 was lower than R22. Suction pressure was easily achievable and oil pressure was normal. The system was running smooth and efficient.

The second ice sheet was down to concrete at the time we charged it with RS-45. Starting early evening we began flooding the rink with water and started the system with the RS-45. Overnight the ice sheet was re-flooded to the desired depth. When we came in the next morning the ice was hard and ready to be painted. Based on this experience, it appears that the retrofit of a R22 direct system to RS-45 is a great alternative to maintain the existing power plant for many years to come. The change out from R22 to RS-45 was easy, fast and provided good results to everyone's satisfaction.



### COMPARATIVE RESULTS & COMMENTS

Table shows results of R22 prior to conversion and RS-45 post conversion

#### R22 to RS-45 (R434a) Comparison

	R22	RS-45 (R434a)
Suction pressure	32 PSIG @ 80° F	40 PSIG @ 90° F
Discharge	210 PSIG @ 80° F	250~60 PSIG @ 90° F
Evap Refrigerant temp	15° F	150° F
Oil pressure compressor #1	80 PSIG	same
Oil pressure compressor #2	80 PSIG	same
Oil type	Mineral	Mineral

**SPEED**

**PERFORMANCE**

**LOW INVESTMENT**

**SUSTAINABILITY**

### BENEFITS OF RS-45 (R434A) OVER OTHER ALTERNATIVES

As the working pressures of RS-45 (R434A) are lower than 24 bar, there was no need to change the safety valves and other parts rated to 24 bar (348 PSI) which would be necessary with a conversion to R507.

Since RS-45 (R434A) is compatible with all refrigeration oils, including mineral oils, installations using this lubricant do not need to move to a POE, which would be necessary with R507, thereby reducing the conversion time, cost of oil, emergence of new leaks and the constraints imposed by the use of very hygroscopic lubricants.

The RS-45 (R434A) low temperature glide of 3°F enables the system to be directly charged with RS45. From a technical standpoint, if all R22 cannot be evacuated from a system, no fractionation of the mixture would occur. However, the EPA guidelines call for refrigerants not to be knowingly mixed.

RS-45 (R434A) achieves good condensation and it is therefore unnecessary to change the condensers or make any changes in this regard as would be the case with R507.

Owners can continue to use an A1 safety classification product, thus avoiding toxic or flammable chemicals like ammonia and hydrocarbons, respectively, which, amongst other things, also requires a major overhaul of facilities.

RS45 (R434A) does not involve any significant loss of cooling power compared to R22.

Unlike R22, there is no phase-out plan for RS-45.