

CO2 For Your Ice Rink - Asked & Answered

What is the estimated life span of a transcritical CO2 compressor?

Compressor manufacturers generally recommend changing the compressor after a certain period - usually 10 years under correct operating conditions. It is a low-cost piece. Other equipment will last 20 years or longer.

I have seen these CO2 systems installed only in cold climates such as Alaska and the skating loop in Toronto. Are there any locations that have used this system to run summer ice successfully?

CO2 systems offer a better efficiency business case in cold climates, making it an easy business decision. However, they can be designed for warmer climates to provide high quality ice, and many locations in warmer climates *are* using them. South Africa and Australia are largely using CO2 systems now.

Is a CO2 system more expensive than a traditional system?

A CO2 system is comparable in installation costs to a traditional built up ammonia system, or packaged refrigeration systems using other refrigerants (such as ammonia and synthetic blends). They are similar to modern low-charge and efficient systems, but a direct floor system will have an increased cost of 25%, largely due to the special stainless steel floor construction.

How much does it add to the floor cost to do direct CO2?

The cost of the floor varies according to location, size, etc. Based on our last project, the cost of a welded stainless CO2 system floor piping can add \$150K - \$250K to the price of a normal plastic floor.

So, a direct CO2 system doesn't require an evaporator?

A direct floor pushes the CO2 directly from the flash tank with CO2 pumps and returns it to the same tank, then goes directly to the compressor. So no heat exchanger is required on the cold side.

Is it possible to retrofit an R-22 cooled glycol system? If so, what would be the cost?

Yes, it is possible to retrofit an R22 system with a CO2 system. However, most of the components from the R22 system would not be useable with CO2. The glycol room could be kept, if in good condition. The existing R22 system would need to be entirely changed. Depending on the size, the cost would range from \$800K to \$1M

Why use stainless steel materials in CO2? Without free water, CO2 is not corrosive.

The CO2 itself is non-corrosive; however, the materials in the concrete and rebar can cause corrosion. Carbon steel is not used because CO2 systems require the system to be very ""clean"" on the inside, and stainless is a cleaner fabrication process. Moreover, stainless steel is a good material to withstand the operating pressure of a CO2 system and since a smaller diameter pipe is required, the price remains very competitive.

Is it typical that the TD across the condenser is 5°F for ice rinks?

In a CO2 application, the gas cooler is selected at 5°F with the outdoor temperature and remains decent and very competitive in price. CO2 has a much better heat transfer efficiency, so smaller HX are needed.

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On the CO2 replacement where you showed 23% savings over an R-22 ice rink without heat reclaim, did the CO2 system have heat reclaim?

Yes, the CO2 system with 23% savings did have heat reclaim. CIMCO typically recommends heat reclaim be installed on any new refrigeration system, regardless of the type of refrigeration system used.

Does CO2 require 24/7 onsite engineering/tech staff like ammonia does?

Onsite operator requirements depend on the province, as different jurisdictions have different regulations. Typically, the requirements for operations staff are reduced for A1 refrigerants (such as CO2), compared to B2 refrigerants (such as ammonia). It may not completely eliminate the need for operators though.

Do you have a capital and long term cost comparison between CO2, ammonia, and various synthetics?

We normally do a complete simulation for each specific project, taking into account where it will be located (as this has a tremendous impact on performance).

Are 'transcritical direct' and 'one-stage transcritical' interchangeable terms?

Transcritical means that the system needs to condense at a temperature higher than 89°F; that is the limit for CO2 normal sub critical operation. When we get warmer than this, it becomes transcritical. This behaves differently than other refrigeration systems.

One stage means something different. Normally, we only have one temperature to serve. If we need freezer operation or air conditioning requirement, then we need a second stage of operation.

How energy efficient are the semi-hermetic TCCO2 compressors at part load?

Part load efficiency for these systems will usually be slightly higher than a typical unloaded reciprocating compressor. These compressors are smaller, allowing smaller steps, and 1 VFD on the lead compressor helps with load matching. Additionally, we do not use part load on rink controls. When the ice is satisfied, we shut down the system including the pumps. With CO2 system, smaller compressors allow the system to keep running at lower load requirement

What gas cooler technology do you primarily use: air cooled or adiabatic?

We typically use adiabatic gas coolers for the added efficiency during the summer and shoulder seasons. However, in low temperature climates and seasonal operation, an air-cooled gas cooler is usually suitable.

Have you tried micro channel?

We have not tried micro channel for in floor tubing. Standard tubing has proven to be successful for typical ice rink applications.

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Of the transcritical systems shown on the map, how many of those are actually rinks? I would assume most are supermarket applications, is that correct?

Yes, the majority of the installations that exist at present are in either cold storage applications or grocery stores, since they generally outnumber ice rinks. Having said that, Canada actually has over 60 CO2 rink systems in function currently. The U.S. now has over 10 systems in ice rinks.

How do you maintain <600psi (45F sat) when the system is not in use?

The pressure can be maintained by using a secondary cooling system, which would be used to maintain the pressure during the off-season. Alternatively, the charge can be stored in a location with a higher pressure rating to store it during an off-season.

Have you investigated designing the floor for 1750psi as well (for standstill conditions)?

The floor piping and tubing could be built for standstill pressures; however, some of the components attached to the floor (like pumps) are currently not available with the required pressure rating.

Can these systems be multi-staged for variable demands?

Yes, most CO2 ice rink systems will be designed with multiple compressors for variable demands. They can also use VFD for very precise capacity control.

How does CIMCO use the waste heat to provide heating into the skate rink building? Is it directly through a CO2 coil in the HVAC unit, or via hot water/heat exchanger?

This is normally achieved through a hot water heat exchanger, as this allows the building system to remain as simple as possible. It could also be used with a direct CO2 DX application for cooling coil and dehumidification coil in AHUs.