DOVER FOOD RETAIL

Hillphoenix

Refrigeration
Systems

CO_2 eXcellence™

What you need to know before making the transition.

Inside CO_2 vs HFC — The Differences At A Glance.

Today, regulations are driving retailers to transition from HFC (synthetic) refrigerants to Low GWP refrigerant systems. Yet, for many, the decision to switch is clouded by many questions about the hidden differences between the two and how a low GWP system (e.g. CO_2) may impact store design and product application, among other considerations.

This document contains answers and information critical to helping retailers understand the refrigerant nuances and make more informed transitions away from synthetic HFCs and toward natural refrigeration systems.

What is possible with one system may not apply or even be possible with the other. What can be done versus what should be done? What options are available and/or strongly recommended? These are all important questions and their answers are arranged inside in an easy-to-understand matrix of comparisons and considerations.

As always, please feel free to reach out to the experts at Hillphoenix to assist you as you make the transition from synthetic to natural refrigeration.

	HFC System Design Component	Standard with HFC	Option with HFC	Standard with CO_2	Option with CO_2	CO_2 System Consideration
BACKUP	Emergency backup / auxiliary condensing unit				✓	A small, backup refrigeration system is recommended for CO_2 racks to preserve the refrigerant charge during extended electrical power interruptions. The backup condensing unit ensures that the receiver pressure does not exceed the relief pressure during prolonged loss of electrical power.
COMPRESSORS	Low-Temp only rack	✓			✓	For maximum operating efficiency and the best value, we strongly advise the use of a dual suction CO_2 system when both MT and LT loads are available. Dual suction temperature CO_2 racks provide greater system stability with varying load conditions than comparably sized single suction racks. Although single suction temperatures can be used, they are not advised for CO_2 systems as LT applications require a booster compressor to function. The booster compressor is also referred to as a MT compressor which satisfies the MT suction requirement. The application of a single suction temperature CO_2 rack requires additional components to manage suction gas temperatures and ensure reliable operation.
COMPRESSORS	Med-Temp only rack	✓		✓		
COMPRESSORS	Dual Suction Group Rack		✓	✓		
COMPRESSORS	Med-Temp scroll compressors		✓			Medium-temp scroll compressors are not currently available for CO_2 applications.
COMPRESSORS	Cylinder unloading		✓		✓	Cylinder unloading is an optional feature for both HFC and CO_2 racks, but there is limited availability for CO_2 applications from compressor manufacturers.
CONDENSERS	Adiabatic condenser / gas cooler		✓		✓	Adiabatic gas coolers provide an efficiency benefit for both HFC and CO_2 racks. However, if ambient temperatures for the installation location will exceed 101°F, an adiabatic gas cooler is required to ensure reliable system performance.
CONDENSERS	Split Condenser		✓		✓	Split condensers are used in HFC refrigeration systems as a means of controlling head pressure in cooler weather. CO_2 systems rely on fan control and, in some colder locations, a gas cooler bypass valve is required to properly control the refrigerant pressure through the gas cooler.
CONTROLS	Mechanical Backup Control		✓	X	X	Conventional refrigeration systems sometimes include redundant mechanical controls that will allow the rack to operate in the event of an electronic rack control failure. This feature is typically referred to as "emergency" or "backup" controls. CO_2 refrigeration systems require a functioning electronic rack control to regulate the operation of various critical electromechanical devices to manage system pressures and compressor modulation. There is currently no viable means of operating a CO_2 refrigeration without a fully functional rack controller and downstream control devices. ***Mechanical backup controls provide no added benefit to a CO_2 system.***
CONTROLS	Failsafe / Watchdog EMS failure control		✓	X	X	
CONTROLS	Electronic level sensors on receivers / flash tanks		✓		✓	Receiver / flash tank liquid level sensors are available on both HFC and CO_2 Hillphoenix systems. However, when applied to a CO_2 system, the level sensor will be installed external to the flash tank.
CONTROLS	Mixing multiple controller brands / manufacturers on cases & rack		✓		✓	Hillphoenix strongly advises customers to avoid mixing controller brands due to interoperability and communication issues that can result from differing communication protocols and future firmware changes.
CONTROLS	Variable capacity control on lead Med-Temp compressor		✓	✓		On HFC refrigeration systems compressor staging can be used as a means of rack capacity control. CO_2 systems rely on individual compressor capacity control strategy to ensure optimal efficiently under all designed operating conditions.
CONTROLS	UPS for valve & rack control		✓	✓		Power to the valve is furnished from an uninterruptable power supply (UPS). The valves close in case of a power failure.

	HFC System Design Component	Standard with HFC	Option with HFC	Standard with CO2	Option with CO2	CO_2 System Consideration
DEFROST	Hot gas defrost		✓		✓	Electric defrost is recommended for CO_2 systems in order to minimize system complexity and up front cost. The preferred method of piping for CO_2 systems is loop piping. However, hot gas defrost requires circuit or branch piping. This piping approach increases material and installation costs and requires greater experience with CO_2 to execute reliably.
EVAPORATOR	EEV's		✓	✓		CO_2 systems require EEV's due to the significant operating pressure differentials and the components ability to regulate based on changes in load properly. Mechanical valves are effective in a limited pressure range, but will not provide the same level of system energy efficiency, particularly when used in systems with multiple evaporators.
PIPING	Liquid sub-cooling		✓		✓	Liquid sub-cooling is not necessary or recommended for CO_2 systems, as precise control of the flash tank and the use of EEVs minimize the impact of flash gas in the refrigerant.
	Ball valve and bypass check for isolation			✓		Isolation valves with bypass check valves are strongly recommended for CO_2 systems as they prevent an over pressurization condition that can occur if liquid refrigerant is trapped within a closed space. This trapped refrigerant may cause a rise in pressure that exceeds the rating of components.
	Loop piping	✓		✓		Because the line sizes for CO_2 systems are generally smaller than those found in HFC systems, due to CO_2's lower mass flow requirements, loop piping is the optimal cost-saving design.
	Circuit Piping		✓		✓	Although circuit piping is available with both HFC and CO_2 systems, Hillphoenix recommends loop piping for CO_2, due to the smaller line sizes and maximum installation cost-savings.
	Med-Temp discharge relief valve			✓		CO_2 systems employ relief valves on the MT discharge and the receiver.
	Med-Temp suction relief valve		✓	✓		On a CO_2 system, the MT suction pressure must be regulated in order to control the LT discharge pressure. The MT suction line is common to the LT discharge line. As such, a single relief valve protects both the MT suction and LT discharge lines.
	Low-Temp suction relief valve			✓		LT suction relief vales are standard and required on CO_2 systems, as the pressure rating of the LT suction is lower than the MT suction.
	High pressure control valve			✓		A high pressure control valve is required for CO_2 systems in order to manage gas cooler pressure and maintain optimal operating efficiency in varying ambient conditions.
	Flash gas bypass valve			✓		Because refrigerant leaving the gas cooler of a CO_2 system could be either liquid or gas, depending on ambient and operating conditions, a flashgas bypass valve is required on to maintain the flask tank pressure and ensure proper liquid quality leaving the flash tank.
	Head pressure control valve		✓			In an HFC system a head pressure control valve can be used in cooler ambient conditions to maintain sufficient head pressure. In a CO_2 system, the high-pressure control valve is required and serves this same function.
	Suction accumulators per suction group		✓		✓	Suction accumulators per suction group are not necessary or recommended for CO2 systems. Specifically, MT suction accumulators are not required as the LT discharge provides sufficient heat to maintain ideal MT compressor suction superheat.
	Suction mesh strainer/filter				✓	HFC systems use liquid line filter driers as this is the ideal place to remove moisture from the refrigerant. On a CO_2 system moisture can be removed more effectively through the use of suction line filter driers, while particulate is adequately removed via the use of liquid line strainers.
	Liquid mesh strainer/filter			✓		

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