AUTO-PURGER®

REMOVES AIR...
...SAVES ENERGY

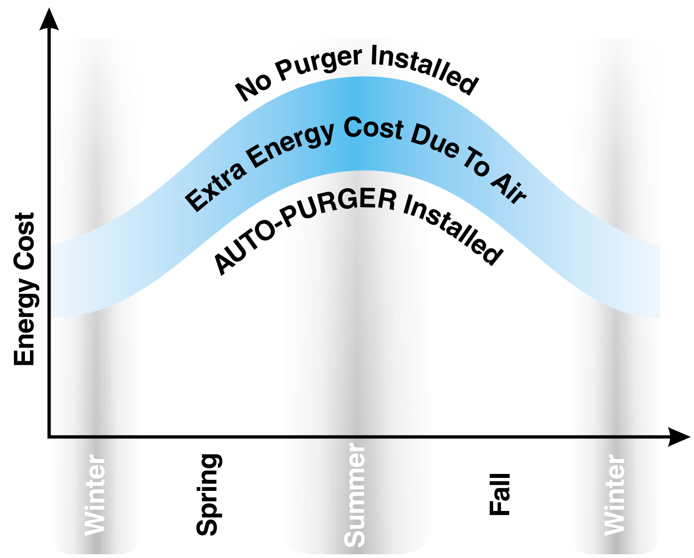
ALSO INCREASES SYSTEM CAPACITY, REDUCES RUN TIME, CUTS REPAIRS AND MAINTENANCE, REDUCES CORROSION, AND EXPELS FREE WATER VAPOR

HANSEN TECHNOLOGIES CORPORATION

Bulletin AP-a
May 1999

Installing an AUTO-PURGER Saves Money

An AUTO-PURGER noncondensible gas (air) purger quickly and efficiently removes air from a refrigeration system. Noncondensible gases, primarily air, present in a refrigeration system increase condensing pressures. Air also reduces the overall capacity of the refrigeration system by acting as an insulator, which increases the amount of time compressors must run. The increased run-time of compressors, in turn, increase the energy required to operate the system throughout the year. This is true not only during the hot ambient temperatures of summer days, but also during the cool ambient temperatures of night and the winter season. Eliminating air in the refrigeration system reduces the energy required to operate the system, resulting in lower electricity bills.



Installation of an AUTO-PURGER results in savings on energy costs all year.

Hansen AUTO-PURGERs are the Best Noncondensible Gas (Air) Purgers

The thousands of satisfied AUTO-PURGER customers are a testament to the quality and reliability of Hansen AUTO-PURGERs. The money saved in reduced energy costs alone will pay for the purchase and installation of an AUTO-PURGER.

Hansen AUTO-PURGERs are the leader in multipoint purging. Multipoint purging is the only effective method for removing all air from a refrigeration system. In addition, the large air-removal capacity of Hansen AUTO-PURGERs allows a very large amount of air to be removed quickly. This helps ensure that the refrigeration system runs at its design capacity, especially in hot weather months.

There are AUTO-PURGER models to match a variety of system requirements. From large ammonia or halocarbon systems, to single condenser operation, to hazardous locations, there is an AUTO-PURGER to meet your needs.

- **Large air removal capacity over a short time span**
- **Multipoint purging**
- **Payback typically within one year**
- **Flexible installation location**
- **Models to match a variety of system sizes and requirements**
- **Completely automatic startup**
- **Factory assembled and tested**
- **CSA and CE certification available**

A Wide Range of Models Meet Individual Needs

AUTO-PURGER AP

- ❍ For multiple purge points, up to 24 points
- ❍ Ideal for large systems up to 1500 tons (5300 kW) nominal capacity
- ❍ Total and rapid air removal
- ❍ Prewired, prepiped, and insulated
- ❍ Each unit tested on a real refrigeration system
- ❍ Solid-state controls
- ❍ Completely automatic
- ❍ Water bubbler included

AUTO-PURGER APM

- ❍ For multiple purge points, up to four points
- ❍ Ideal for medium-size systems up to 200 tons (700 kW) nominal capacity
- ❍ Solid-state controls sense the presence of air and purge for a longer time at those points
- ❍ Completely automatic with self-diagnostics
- ❍ Welded pipe construction
- ❍ Prewired, prepiped, and insulated
- ❍ Water bubbler included
- ❍ Functionally tested

(shown with optional valve package)

NON-ELECTRICAL AUTO-PURGER (NEAP)

- ❍ Low cost and very simple
- ❍ Typically used for a single purge point
- ❍ Ideal for small systems up to 100 tons (350 kW) nominal capacity
- ❍ Completely a nonelectric design
- ❍ Especially suited for installation in hazardous atmospheres
- ❍ Fully automatic
- ❍ Welded pipe construction
- ❍ Prepiped and assembled
- ❍ Functionally tested

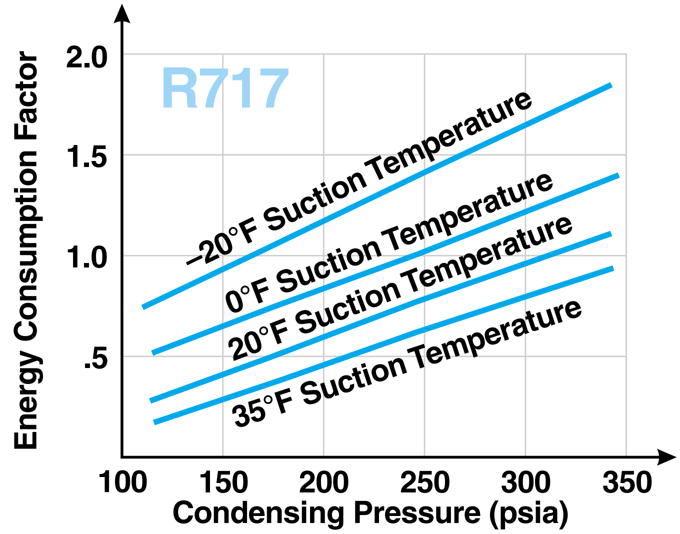
Cost Savings and Payback

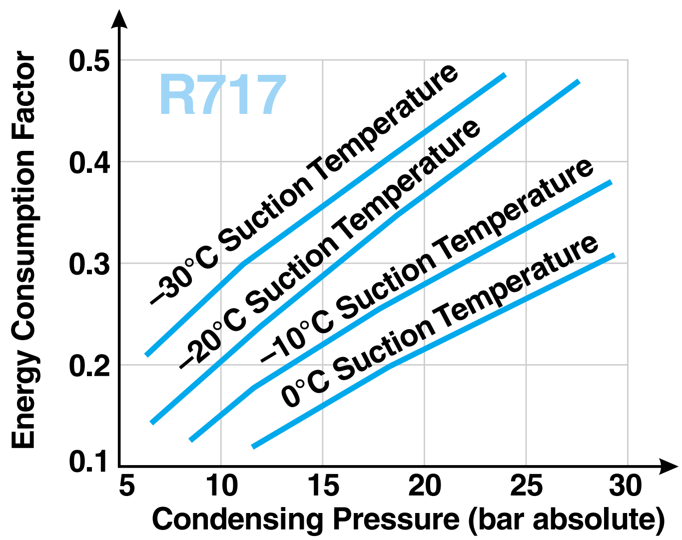
Cost of air

The presence of air in a refrigeration system increases the condensing pressure. As a result, the power requirement of the compressor also increases. The chart to the right shows the relationship between condensing pressure and power consumption of the compressor for a typical ammonia system.

For every 10 psi (0.7 bar) increase in condensing pressure, there is approximately a 6% increase in power consumption by the compressors. This, in turn, means the amount of money required to operate the system also increases.

An AUTO-PURGER quickly and effectively removes all air from the system. Therefore, for every 10 psi (0.7 bar) decrease in condensing pressure resulting from the installation of an AUTO-PURGER there is approximately a 6% decrease in power consumption by the system.





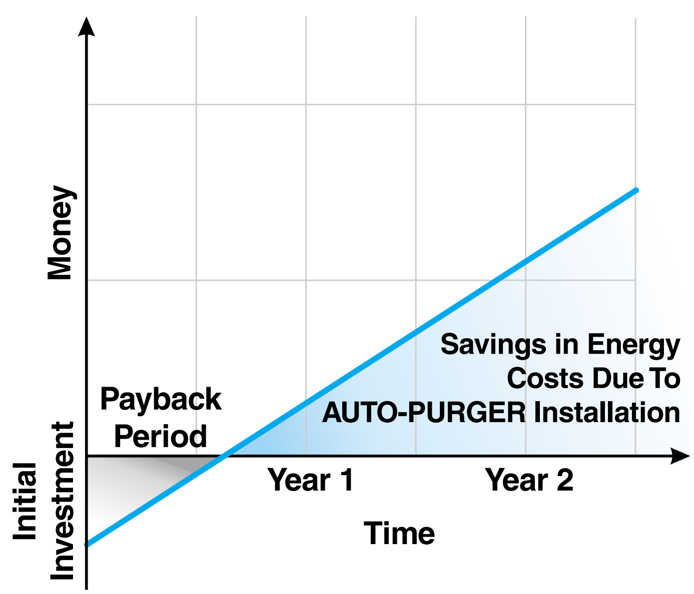
Energy consumption factor versus condensing pressure for an ammonia refrigeration system.

Return on investment

Since installing an AUTO-PURGER results in large savings in energy cost, the payback on the initial investment is very quick. For a typical installation, the payback is reached within one year.

Once the payback is reached, all of the money saved in energy cost represents a return on the initial investment. Since the payback is reached so quickly, the return is typically many times the cost associated with installing an AUTO-PURGER.

Year after year, the system condensing pressure is kept low by the AUTO-PURGER. In turn, energy costs are kept low resulting in more money added to profits.



Return on AUTO-PURGER investment.

$$\text{Savings} = \frac{P_a}{P_d} \times C \times H \times T \times M$$

P_a = Excess Pressure Due to Air

P_d = Pure Refrigerant Condensing Pressure (In Absolute Pressure)

C = System Capacity (Tons or kW)

H = Energy Consumption Factor (From the Chart Below)

T = Hours of Run-Time Per Year

M = Electric Rate Per Kilowatt-Hour

Energy Consumption Factor

US Customary		
Refrigerant	Suction Temp	Factor
Ammonia	–20°F	1.03
	0°F	.80
	20°F	.52
	35°F	.40
R22	–20°F	1.11
	0°F	.80
	20°F	.59
	35°F	.42
R134a	–20°F	1.13
	0°F	.83
	20°F	.58
	35°F	.41

Metric		
Refrigerant	Suction Temp	Factor
Ammonia	–30°C	.32
	–20°C	.24
	–10°C	.18
	0°C	.12
R22	–30°C	.33
	–20°C	.25
	–10°C	.18
	0°C	.13
R134a	–30°C	.33
	–20°C	.25
	–10°C	.19
	0°C	.13

Note: These factors are calculated at 86°F and 30°C condensing temperature.

Calculating savings

To calculate the approximate annual savings that can be realized by installing an AUTO-PURGER, use the formula at the left. Simply enter the values and complete the computation. To determine the condensing pressure of pure refrigerant, refer to a pressure-temperature chart for the refrigerant used. An ammonia pressure-temperature chart is on page 7. To determine the excess pressure due to air, refer to the explanation and examples on page 7.

US Customary

The conditions for this example are:

Refrigerant: **ammonia**

Suction temperature: **0°F**

Condensing temperature: **86°F**

Excess pressure due to air (P_a): **17 psi**

Pure refrigerant condensing pressure (P_d): **169.2 psia**

System capacity (C): **1500 tons**

Energy consumption factor (H): **.80**

Hours of run-time per year (T): **6500 hours**

Electric rate per kilowatt-hour (M): **.06 dollars**

$$\frac{17 \text{ psi}}{169.2 \text{ psia}} \times 1500 \text{ tons} \times .80 \times 6500 \text{ hours} \times \$.06/\text{kW-hr}$$

= $47,020/year

Metric

The conditions for this example are:

Refrigerant: **ammonia**

Suction temperature: **–30°C**

Condensing temperature: **30°C**

Excess pressure due to air (P_a): **1.2 bar**

Pure refrigerant condensing pressure (P_d): **11.6 bar**

System capacity (C): **5300 kW**

Energy consumption factor (H): **.32**

Hours of run-time per year (T): **6000 hours**

Electric rate per kilowatt-hour (M): **.08 dollars**

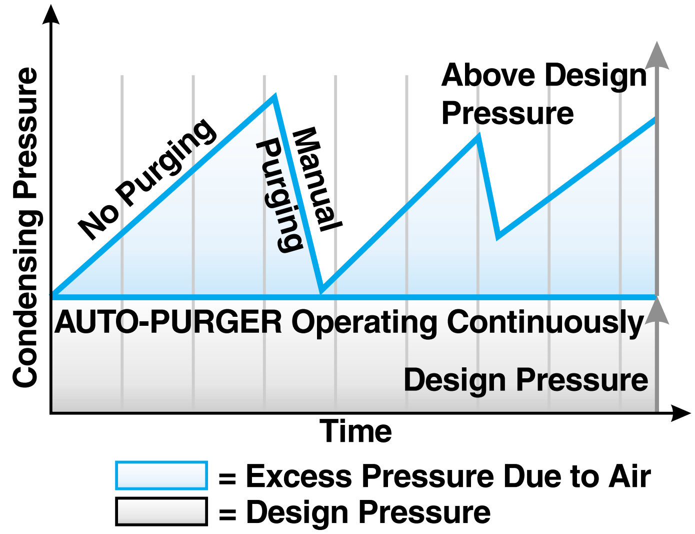
$$\frac{1.2 \text{ bar}}{11.6 \text{ bar}} \times 5300 \text{ kW} \times .32 \times 6000 \text{ hours} \times \$.08/\text{kW-hr}$$

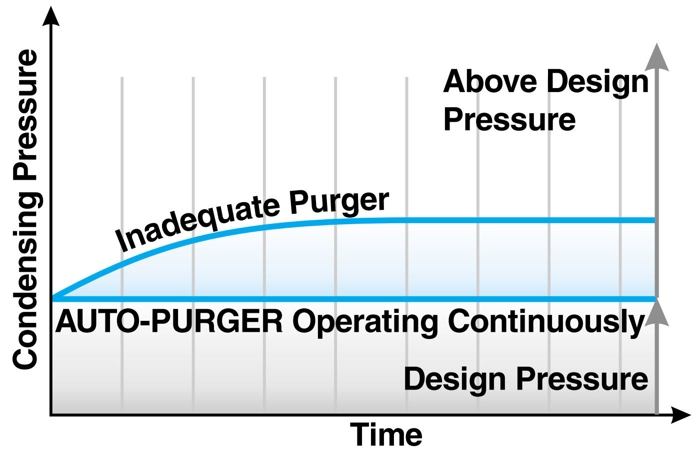
= $84,212/year

Purger Operation

Condensing pressure and purger operation

AUTO-PURGERs remove more air and over a shorter period of time than other purging methods or units to maintain the minimum possible condensing pressure. A refrigeration system without a purger or with an inadequate purger may allow fluctuations in condensing pressure or may not be able to maintain the minimum possible condensing pressure. The charts to the right illustrate this effect.





Pressure profiles for a system with an AUTO-PURGER versus manual purging and the same system with an AUTO-PURGER versus an inadequate purger.

How does air get into a system?

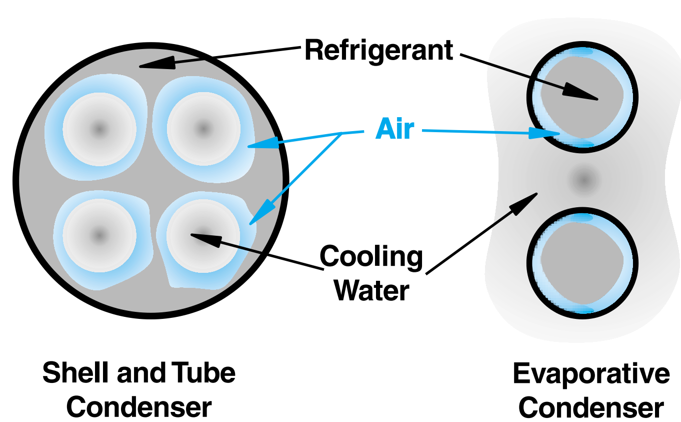
Air can enter a system in a number of ways. For systems operating in a vacuum, leaky gaskets and shaft seals allow air into the system. Other common ways for air to enter are during repairs and service, when adding refrigerant to the system, and through the chemical breakdown of refrigerant. Also, lubricating oils can breakdown under heat and high pressure to create noncondensible gases.

Where does air collect?

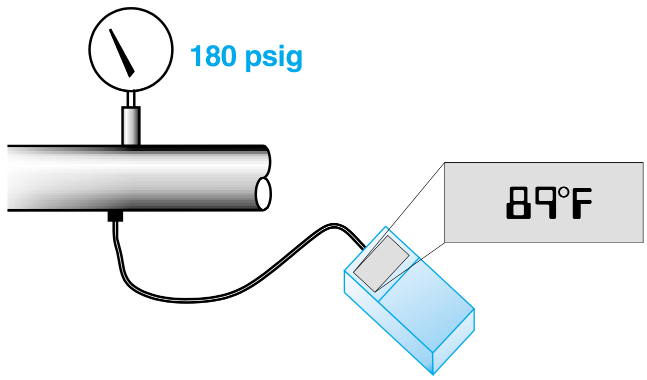
Air collects at various locations on the high-pressure side of the system. These locations are typically the lowest gas velocity and coolest temperature areas. High-pressure condensers, receivers, and heat reclaim heat exchangers are all likely locations where air will collect.

Air as an insulator

Air tends to act as insulation in refrigeration systems. A layer of air forms a blanket on the walls of the condensing surface, preventing refrigerant from making contact with the lower-temperature heat exchanger surface. This results in greatly reduced system efficiency.



Air acts as an insulator between the refrigerant and the cooling surface, greatly reducing condensing efficiency.



Measuring the excess pressure in a refrigeration system.

How do I know how much air is in the system?

The presence of air in a refrigeration system is indicated by excessively high head pressure. This may be indicated by a pressure gauge or by system compressors shutting down due to the high pressure. The amount of air in a system can also be measured by comparing the actual condensing pressure to the condensing pressure of pure refrigerant at a given temperature. Refer to the following examples using ammonia as the refrigerant.

Metric

Temperature at the
outlet of the condenser: **32°C**
Pressure at the
outlet of the condenser: 12.8 bar or **13.8 bar absolute**
Pressure of pure ammonia at 32°C: **12.3 bar absolute**
Excess pressure: 13.8 bar – 12.3 bar = **1.5 bar**

US Customary

Temperature at the
outlet of the condenser: **89°F**
Pressure at the
outlet of the condenser: 180 psig or **194.7 psia**
Pressure of pure ammonia at 89°F: **177.7 psia**
Excess pressure: 194.7 psia – 177.7 psia = **17 psi**

Temp	Psia	Temp	Psia	Temp	Psia
70°F	128.8	80°F	153.0	90°F	180.6
71°F	131.1	81°F	155.6	91°F	183.6
72°F	133.4	82°F	158.3	92°F	186.6
73°F	135.7	83°F	161.0	93°F	189.6
74°F	138.1	84°F	163.7	94°F	192.7
75°F	140.5	85°F	166.4	95°F	195.8
76°F	143.0	86°F	169.2	96°F	198.9
77°F	145.4	87°F	172.0	97°F	202.1
78°F	147.9	88°F	174.8	98°F	205.3
79°F	150.5	89°F	177.7	99°F	208.6

Temp	Bar*	Temp	Bar*	Temp	Bar*
20°C	8.6	30°C	11.6	40°C	15.5
21°C	8.8	31°C	11.9	41°C	15.9
22°C	9.1	32°C	12.3	42°C	16.4
23°C	9.4	33°C	12.7	43°C	16.8
24°C	9.7	34°C	13.1	44°C	17.3
25°C	10.0	35°C	13.5	45°C	17.8
26°C	10.3	36°C	13.8	46°C	18.2
27°C	10.6	37°C	14.2	47°C	18.7
28°C	10.9	38°C	14.7	48°C	19.2
29°C	11.3	39°C	15.1	49°C	19.7

Saturation pressure-temperature charts for pure ammonia (no air).

***absolute pressure**

The AUTO-PURGER Story

Hansen Technologies Corporation is the true pioneer and idea generator for modern industrial refrigeration air purging equipment. Recognizing that existing systems were inadequate and not being utilized, Hansen developed a range of AUTO-PURGERs which are recognized as the world standard.

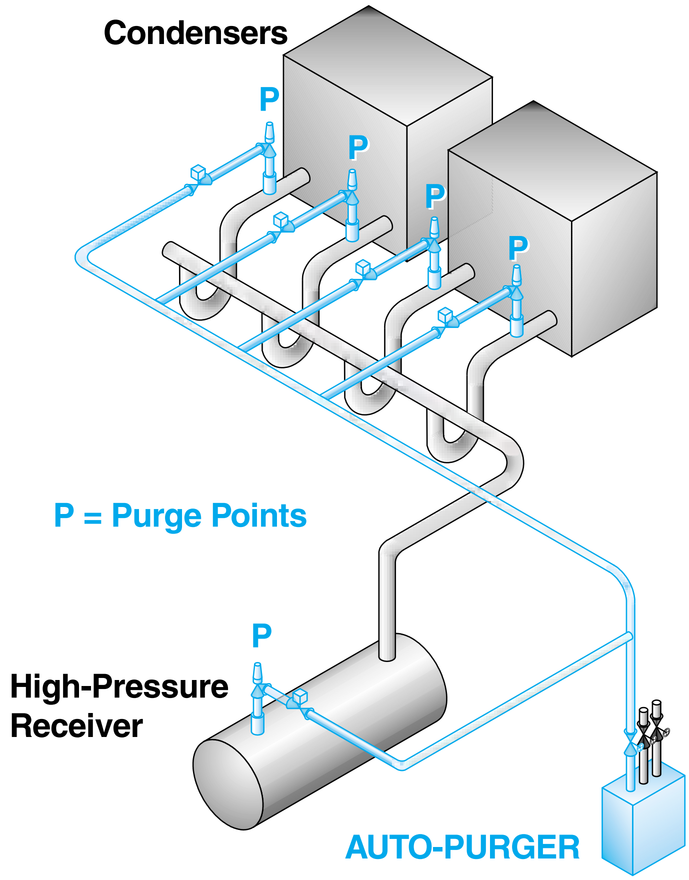
With nearly 10,000 AUTO-PURGERs installed throughout the world, Hansen customers collectively save approximately $100,000,000 (in US dollars) per year in electric power costs. As the number of installed AUTO-PURGERs continues to grow the savings in electric power costs per year continues to grow.

Multipoint purging

It is difficult to determine where air will collect in a system. There are typically several likely collection points. Multiple factors influence where air will collect. The number of condensers and receivers, condenser piping design, and component arrangement and operation all affect the location of air.

Seasonal weather can also affect where air collects. In hot summer weather, air may be driven to the lower-temperature, high-pressure receivers inside a building. In cold winter weather, the opposite may be true.

Therefore, it is important to purge from each possible air collection point one at a time. Multipoint purging is the only effective method to ensure complete air removal from the system.

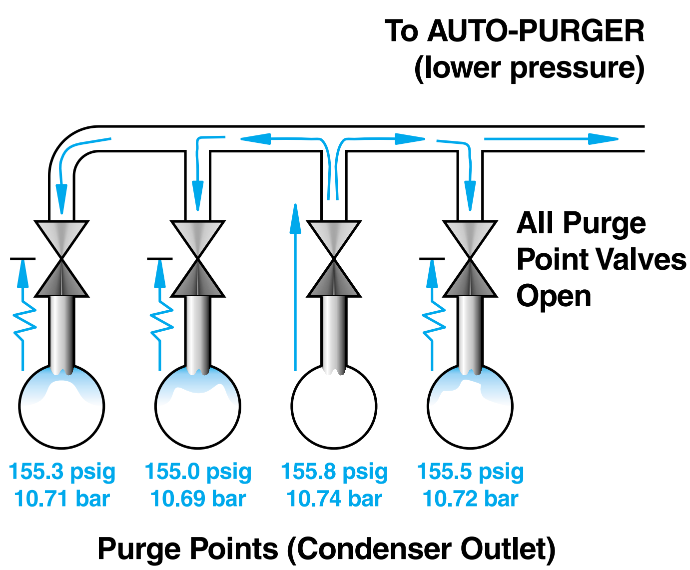


Multipoint purging.

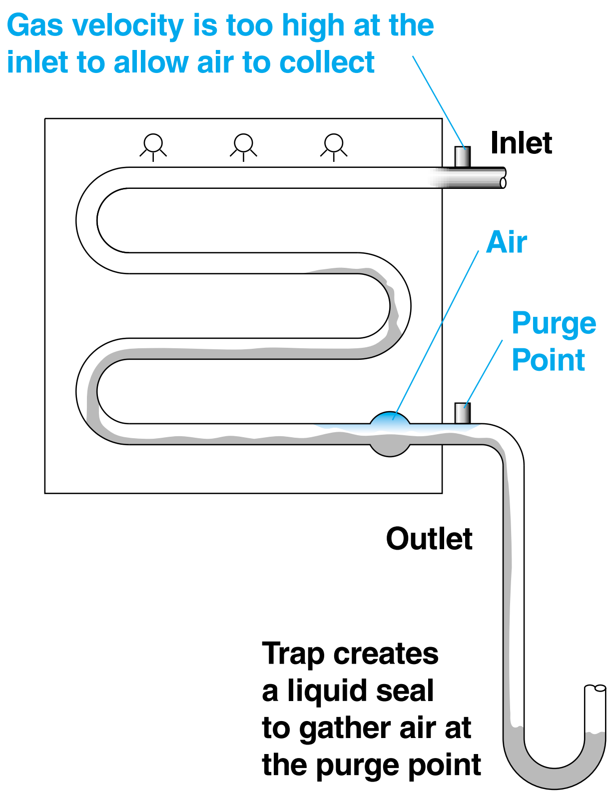
Purge one point at a time

Why not just open all purge points at the same time? If this is done, air is removed from only one of the points. Even though the pressure difference across the purge points may be as small as .25 psi (.02 bar), air will only be removed from the point that has the highest pressure. As a result, air will continue to collect in the other locations.

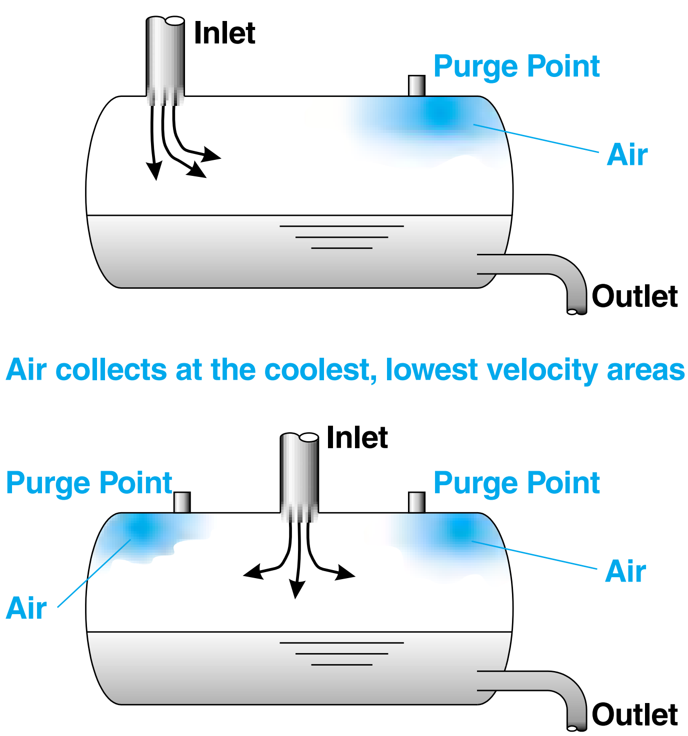
In addition, if the pressure difference is great enough, it is possible that air from the point with the highest pressure can be forced into the other condensers. By purging from each point one at a time, which is standard on AUTO-PURGERs, air is effectively removed from throughout the entire refrigeration system.



When multiple purge points are open simultaneously, air is purged from only the point with the highest pressure.



Purge point location for an evaporative condenser.



Purge point locations for horizontal receivers.

Purge point locations

Purge points should be installed at the most likely locations where air will collect. In general, these points are at the lowest-temperature, lowest-velocity areas of high-pressure receivers, condensers, and other high-pressure components.

Purge points should be located in such a way as to ensure liquid is not drawn into the purger. For example, locate the purge point on top of a pipe or receiver, not on the bottom.

The outlet piping of the purge point solenoid valves can be connected to a manifold to save on piping. However, only one point should be open at any given time. The manifold piping should pitch down toward the AUTO-PURGER to facilitate draining of any condensed refrigerant.

Evaporative condensers should be purged from the top of the outlet header of each circuit. Manufacturers often provide a connection at this location for a purge point. A trap should be installed in the condenser drain leg. This creates a liquid seal to trap air at the outlet of the condenser and prevent it from migrating to the receivers.

Receivers with the inlet at one end should have a purge point installed at the top of the opposite end. Receivers with the inlet in the middle should have a purge point at the top on each end. This applies to water-cooled condensers as well.

Purge point solenoid valves should be a minimum of ½² (13 mm) port size. The purge point piping should also be a minimum of ½² (13 mm) size. Piping should pitch down toward the purger to facilitate draining of any condensed refrigerant. No traps should be present in the piping or manifold. Avoid running purge point piping through refrigerated spaces to minimize condensing of any refrigerant present in the purge gas.

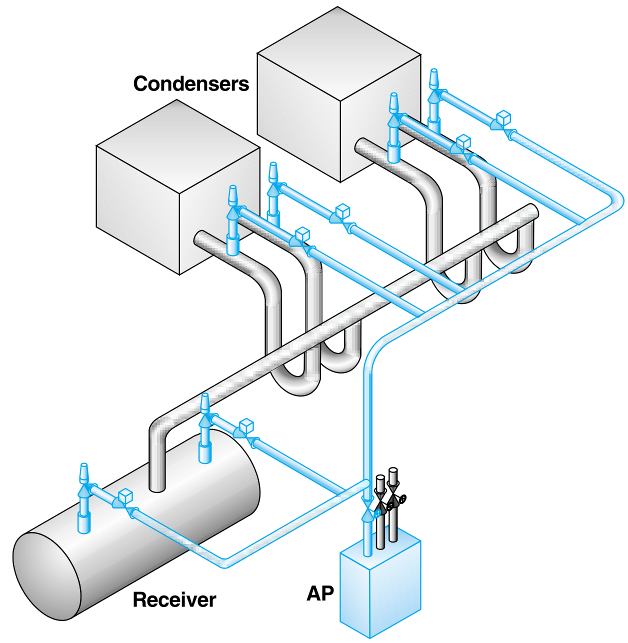
AUTO-PURGER Applications

AUTO-PURGER AP

Shown at the right is an AUTO-PURGER AP installed in a typical large industrial refrigeration system. The piping arrangement shown is typical high-side piping for two dual-circuit condensers and a receiver.

There is a total of six purge points on this system. Each circuit of each condenser is purged at the outlet. The inlet of the receiver is located in the middle. Therefore, a purge point is located at each end of the receiver. These purge points are the coolest, lowest-velocity areas of these components.

The AUTO-PURGER AP sequences the solenoid valves to purge from each point individually. Only one purge point solenoid valve is open at any given time. This ensures that air is efficiently removed from the system.



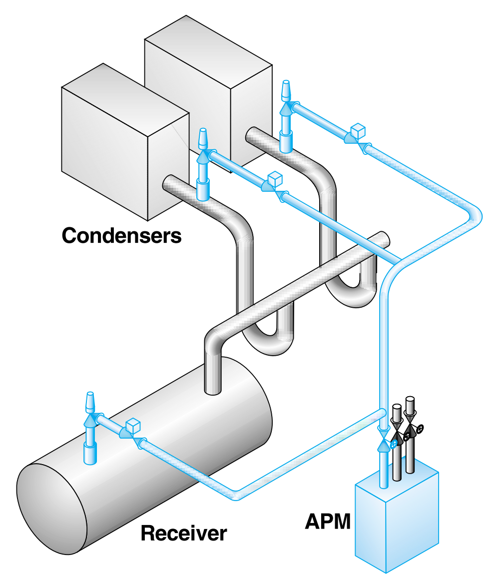
AUTO-PURGER AP application with six purge points.

AUTO-PURGER APM

Shown at the left is an AUTO-PURGER APM installed in a typical medium-size industrial refrigeration system. The piping arrangement shown is typical high-side piping for two single-circuit condensers and a receiver.

There is a total of three purge points utilized in this system. Each condenser is purged at the outlet. The inlet of the receiver is at one end. Therefore, the purge point is located at the other end of the vessel. This is the coolest, lowest-velocity area of the vessel.

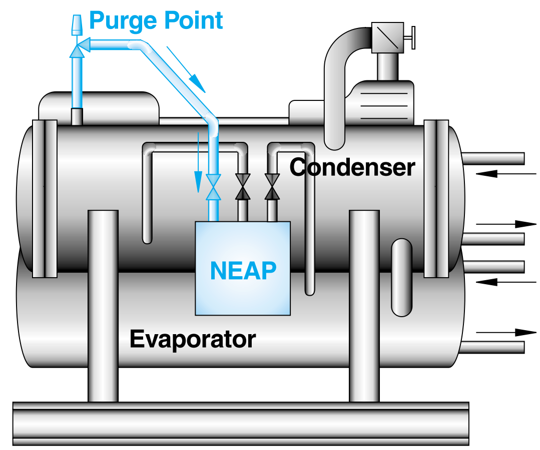
The AUTO-PURGER APM sequences the solenoid valves to purge from each point individually. Only one purge point solenoid valve is open at any given time. This ensures that air is efficiently removed from the system.



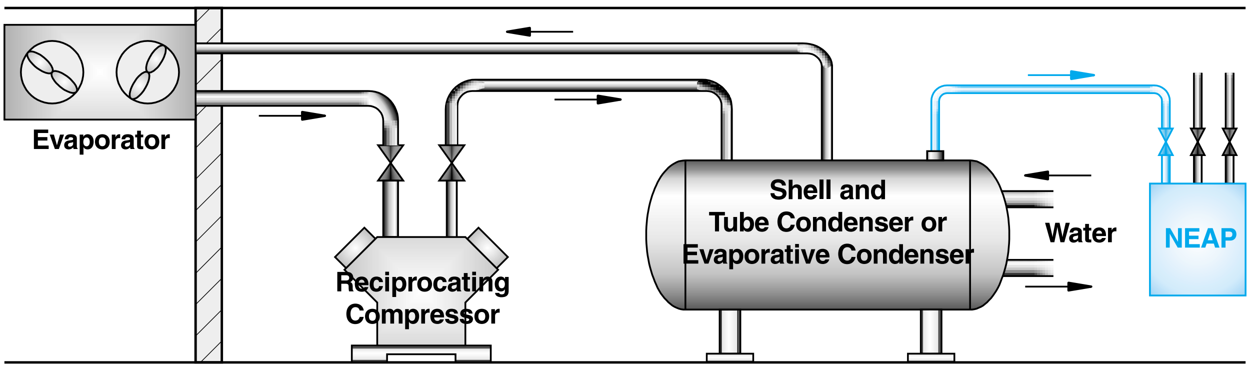
AUTO-PURGER APM application using three purge points.

NON-ELECTRICAL AUTO-PURGER (NEAP)

Shown at the right is a Non-Electrical AUTO-PURGER (NEAP) installed on a small industrial shell and tube skidded chiller package. The purge point is located on the condenser at the opposite end as the inlet. This is the coolest, lowest-velocity area of the condenser. Shown below is a simple system often found in geographically-remote installations. The simple design of the NEAP makes it especially suited for these installations.



AUTO-PURGER NEAP installed on a skidded chiller package for use in hazardous atmospheres.



AUTO-PURGER NEAP installed on a simple system in a geographically-remote area.

Selecting an AUTO-PURGER

- ❍ **System size?**
- ❍ **Suction above or in a vacuum?**

  Above vacuum (nominal capacity):
  - ❍ **AUTO-PURGER AP 1500 tons (5300 kW)**
  - ❍ **AUTO-PURGER APM 200 tons (700 kW)**
  - ❍ **Non-Electrical AUTO-PURGER 100 tons (350 kW) NEAP**

  In a vacuum (nominal capacity):
  - ❍ **AUTO-PURGER AP 750 tons (2600 kW)**
  - ❍ **AUTO-PURGER APM 100 tons (350 kW)**
  - ❍ **Non-Electrical AUTO-PURGER 75 tons (265 kW) NEAP**
- ❍ **Number of purge points?**
- ❍ **Electronic or nonelectric control?**
- ❍ **Hazardous atmosphere installation?**

Several factors are involved in selecting the correct AUTO-PURGER for an application. First, the system size needs to be considered. In general, for a system with a high potential for air entry, such as one with suction in a vacuum or frequently opened for repairs, the purger capacity must be derated. For example, the AUTO-PURGER AP is suited for systems up to 1500 tons (5300 kW) with suction above vacuum. For systems with suction in a vacuum, the AP is suited for systems up to 750 tons (2600 kW).

In addition, the total number of purge points must be considered. The AUTO-PURGER AP is suited for up to 24 purge points, the APM for up to four purge points, and the NEAP is typically used to purge a single point.

If nonelectric control is required, such as for hazardous atmospheres, the model NEAP should be installed. The simple, nonelectric design of the NEAP also makes it ideal for installation in geographically-remote locations.

AUTO-PURGER Refrigerant Compatibility

All AUTO-PURGERs are designed for use with ammonia refrigerant. In addition, Model APF is a variation of the AUTO-PURGER AP designed specifically for use with halocarbon refrigerants. The APF comes complete with a filter-dryer conditioning system on the foul gas and liquid lines. The filter-dryer system removes water from the refrigerant before it enters the purger. This prevents freeze-up at the expansion device, but also supplements the water removal of the system's main filter-dryers.

Ordering an AUTO-PURGER

AUTO-PURGER AP

Catalog Number	Description
AP08	AUTO-PURGER AP, 8 Points
AP16	AUTO-PURGER AP, 16 Points
AP24	AUTO-PURGER AP, 24 Points
APC	AUTO-PURGER for Computerized Plants
AP01	AUTO PURGER AP Basic, Single Point (see WBA and INS options below)
E	"European" construction
APF	For halocarbons; includes driers, specify refrigerant.
NEMA 4	"Watertight" construction option
HS8ST	Purge Point Solenoid Valve, Stainless Piston, $^{1}/_{2}$" (13 mm) Port with strainer, 115V, 50/60Hz, $^{1}/_{2}$" (13 mm) FPT or SW
OPTIONS	
WCH	Water Conditioning Housing for WCC below, $^{3}/_{4}$" (20 mm) FPT connection
WCC	Water Conditioning Cartridge, Replacement
WBA	Water Bubbler Flush System Option for AP01 only. (Standard on AP08, AP16, AP24, & APC)
INS	Insulation Option for AP01 only. (Standard on AP08, AP16, AP24, & APC)
H5600	Pressure Relief Valve, $^{1}/_{2}$" x $^{3}/_{4}$" (13 x 20 mm), for AUTO-PURGER set at 300 psig (20.7 bar)
DPS	Differential pressurestat system to detect loss of foul gas pressure

AUTO-PURGER APM

Catalog Number	Description
APM	AUTO-PURGER M, 4 Point
VPM	Valve package for above

Non-Electrical AUTO-PURGER (NEAP)

Catalog Number	Description
NEAP	Nonelectric AUTO-PURGER
VPM	Valve package for above

To order an AUTO-PURGER, specify the catalog number, refrigerant, voltage (if applicable), and any desired options.

All drawings in this bulletin are for illustration purposes only and should not be used for actual design.

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