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Legacy Chillers

Process Chiller Buyer's Guide

We are Challenging the Status Quo

Have Questions? Give Us a Call at: ***877-988-5464***

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After competing in the HVACR equipment market for over three decades, we have learned a lot and we want to share what we have learned with you.

On a regular basis, Legacy invests in extensive research to better understand market demands and how the US and foreign process chiller manufacturing community is addressing these demands.

In our most recent research cycle we noticed some concerning trends that, if not addressed, have the potential to impact users of process chillers in a negative way. We believe these trends may, in part, be a result of a sluggish economic recovery. More than ever before we are seeing the line between price and overall value getting very distorted. The result of this distortion is making it even more difficult to effectively shop for the best possible process chillers, and the best overall value.

Regardless of your experience we have structured this Buyer's Guide to provide easy to understand facts that should be considered when making your next investment in a process chiller.

I hope you find this Process Chiller Buyer's Guide to be helpful, and on behalf of my engineering, sales and manufacturing teams we look forward to working with you soon.

Legacy designed cooling for Advanced Laser System

Laser Applications: In the semiconductor and printed circuit board industries, lasers take on a crucial role. Lasers are also increasingly used for the production of flat panel displays, including high-resolution screens for smartphones and tablet computers, as well as large LCD and OLED displays for television sets. Another growing application field for laser micro processing is the production of solar cells, where laser structuring helps to increase cell efficiency. As the laser market evolves, the ability to remove heat becomes a critical challenge. **Process chillers** have become the main cooling apparatus the latest generation laser systems.

Food Production: Process chillers are in wide use throughout the world's food supply. In food processing, fluid cooling is needed for: milk (and other consumable drink pasteurization), washing of fruits and vegetables, baked goods, commercial/industrial ice machine pre-cooling, and jacket cooling.

Legacy designed cooling for milk and dairy production.

Legacy OEM designed cooling for the Patriot II Missile defense system

Military: Over the last two decades, leading military hardware producers, many within the United States, have been called to design even more durable systems for rapid deployments anywhere in the world. Unlike military hardware of two decades ago, these new systems are highly dependent on computers and other semiconductor based systems that are highly temperature sensitive. As these high-tech systems become an integrated part of the world defense, network cooling is critical. In these environments a new generation of highly durable, lightweight and compact process chillers are needed.

Semiconductor Test: As the processors that run inside popular electronic equipment such as smartphones, personal computers, servers, and industrial routers double their performance every 12-18 months, new fluid cooled test systems have entered the market. These test systems, and their extraordinary requirements for efficiency and reliability, have set the bar high for process chiller manufacturers.

Legacy OEM designed cooling for Hewlett Packard / Agilent 93000 SOC test system.

Legacy designed cooling for wine and beer production

Wine / Beer Production: Wine and beer production have become an increasingly competitive business over the last decade. Process chillers are used to control fermentation and condition products, such as white wine, before it can be sent off to market. As production operations grow, the need for reliable process chillers also grows. Downtime or inefficient operation of process chillers can make the difference in whether a company turns a profit.

Medical Imaging: As healthcare systems of the world evolve, diagnostic imaging has become a key factor in cost controls. As compared to performing more invasive procedures, such as exploratory surgery MRI, PET and other imaging systems can now be used to reduce risk and cost to efficiently diagnose and treat patients. Process chillers are commonly used to cool these highly advanced imaging systems. Process chillers used for imaging application is considered to be "Mission Critical" — meaning downtime must always be kept to a minimum.

Legacy OEM cooling application for Toshiba, Siemens, GE and Philips imaging systems

Legacy designed cooling for cellular and other remote, outdoor telecommunication shelters

Telecommunication Shelters: With the rapid expansion of cellular and data services worldwide, site owners are becoming increasingly concerned about external environmental impact issues such as sound and operating efficiency, as well as internal factors that can affect the life expectancy of the components inside these shelters.

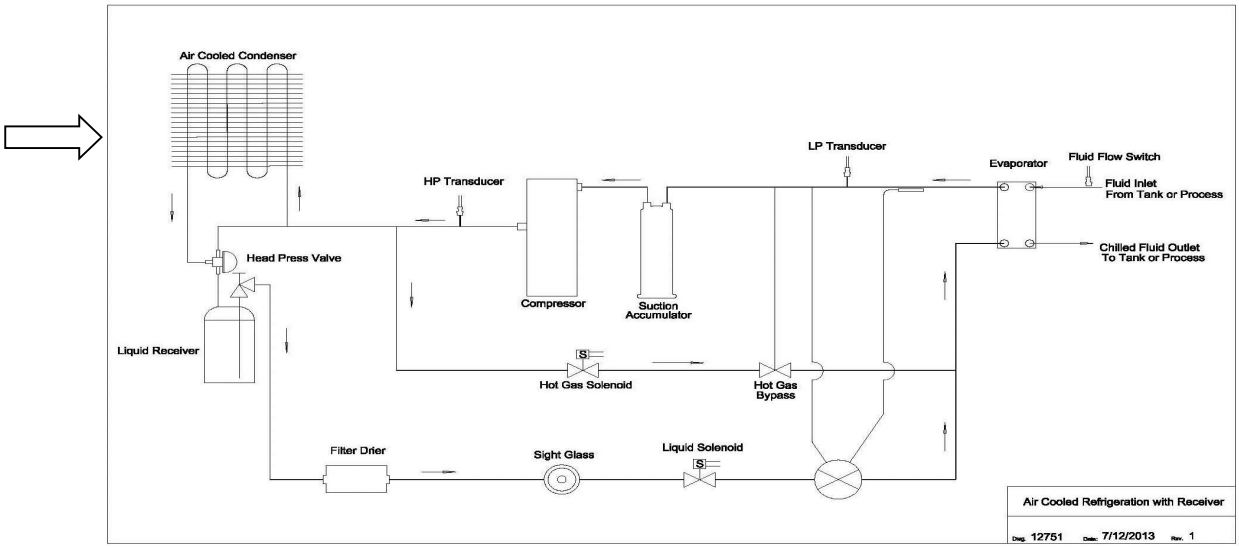
Data and Telecommunication Centers: With the ever increasing density of data and telecommunication centers, process chillers have proven to be the best overall solution for cooling. With recent trends increasing internal climate temperature to as high as 80F, chillers integrated with economizers can dramatically reduce cooling costs and reduce carbon footprint.

Legacy designed cooling and economizer systems for data and telecommunication centers

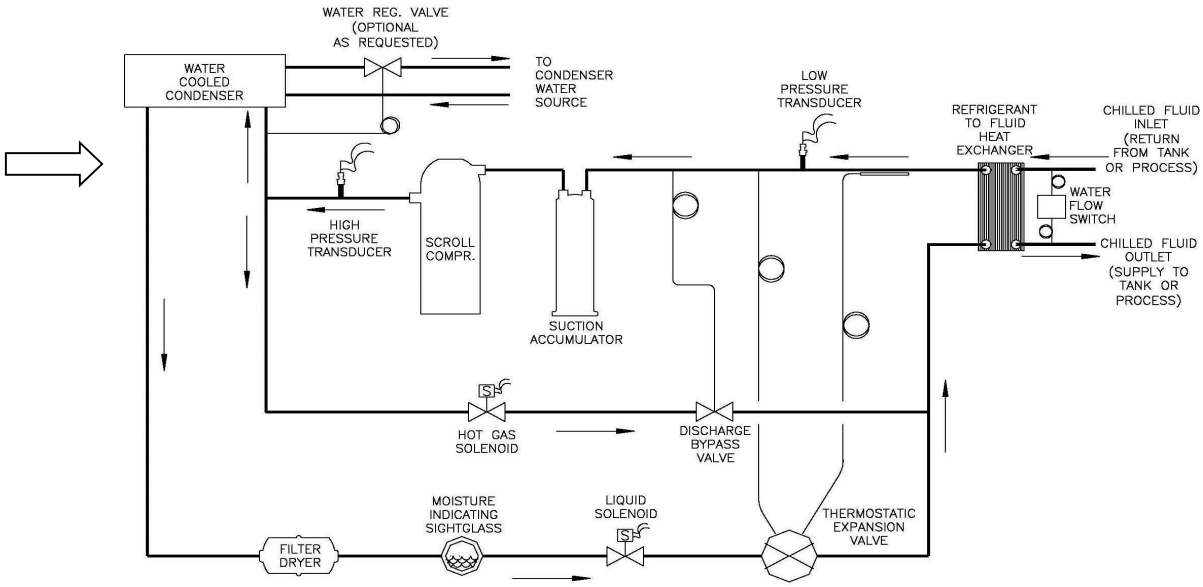
In the world of chillers, there are two major classifications (or duty cycles) that describe how a chiller is used. These duty cycles tend to be either **Process** or **Air Conditioning**. When buying a chiller it is important to first understand some of the key differences of these two classifications. We have illustrated some of the key differences in the table below. As with any machinery, it is very important to buy equipment that effectively addresses the operational requirements.

Operational Requirements	Air Conditioning Duty Chillers	Process Chillers
Annual usage hours	1080 Hours	2900 Hours
Operational conditions	Outdoor, rain, snow, wind, generally ground installed, coastal	Indoor (corrosive), outdoor, rain, snow, wind, ground installed, roof installed, coastal
Fluid pumping requirements	Narrow range generally between 20 and 50 PSI pump differential pressure	Wide range generally between 10 and 150 PSI pump differential pressure
Redundancy of both pumping and cooling	Moderate need	Critical need
Impact / cost of chiller downtime	Low to moderate	High to extremely high
Expected useful life of equipment with basic maintenance	10 to 15 years	20 to 25 years
Need for fluid freeze protection	Moderate need	Moderate to high

One of the most frequently asked questions by customers is, “What is the difference between an air-cooled vs a water-cooled chiller?” Below, you find an example of each. You will note that the refrigeration systems in these examples are virtually identical. On the top left of each drawing we have inserted an arrow indicating the one and only major difference in these two systems. In the case of an air-cooled chiller (example #1), heat is rejected to the outside air. This process is very similar to how an automobile rejects heat to the air by way of a radiator. In the case of a water-cooled chiller (example #2), heat is rejected to another water source such as a cooling tower.

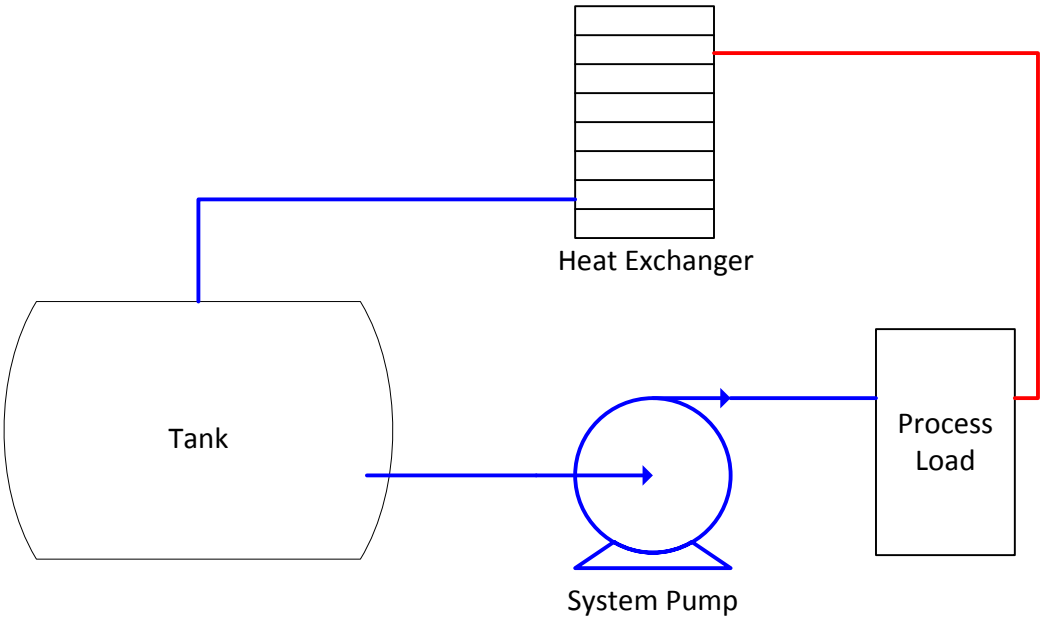


Example #1 : Air-Cooled Process Chiller System



Example #2 : Water-Cooled Process Chiller System

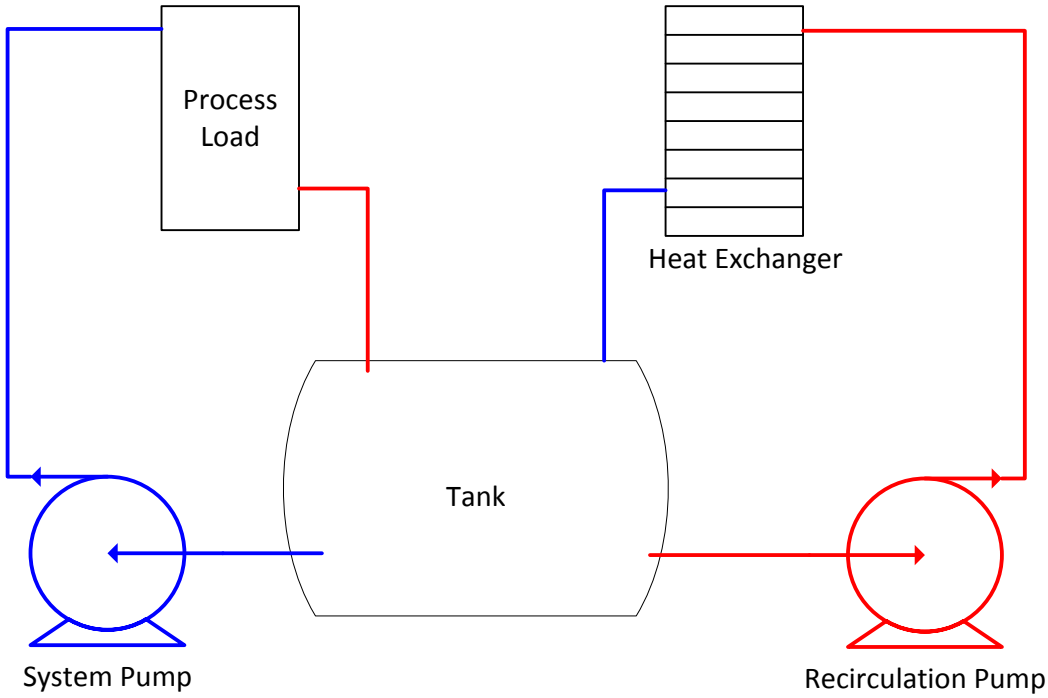
Once through: The illustration below represents a once through process cooling configuration. These applications are common for loads not especially susceptible to wide variations in process load inlet temperatures. Although this illustration shows an internal chiller tank, it is common for once through applications to not use a tank, provided the process loop has enough overall fluid volume.



Once Through System Considerations

Advantages	Disadvantages
• Total cost of chiller tends to be less • Lower energy costs • Slightly lower maintenance cost • Ideal for process loads that can handle a wide range of temperatures when load fluctuates	• Process inlet temperatures can fluctuate with changes in load. • Chiller's refrigeration system can be impacted by way of flow changes in process. If flow drops below minimum of 2.5 GPM per ton of cooling chiller may shut down. • Pressure drop of chiller's internal heat exchanger must be considered when sizing of system pump.

Recirculation: The illustration below represents a recirculation process cooling configuration. This configuration is by far the most popular for process fluid cooling by way of its overall flexibility and reliability.



Recirculation System Considerations

Advantages	Disadvantages
• Provided the process chiller is properly sized, recirculation systems can provide very stable inlet temperature to the process load • Chiller's refrigeration systems are not dependent on fluid demand (or changes) in the process fluid loop • The chiller's heat exchanger are not a factory when sizing the System pump • Process loads that require less than the minimum of 2.5 GPM per ton can be serviced with no impact on the chiller's cooling operation	• Slightly high maintenance costs • Higher initial investment

Our recent research has uncovered some concerning trends in the world of chiller manufacturing. On the following pages we will outline some of these trends and their impact on your chiller buying decision. As you review this information, please keep in mind that our intention is not to beat up on the competition. Our intention is to highlight key design items that, in our view, can have a moderate to significant impact on the value and

1. The ETL Listed Mark: Similar to the UL mark that is found on many consumer electronic items, the ETL mark is used by many refrigeration equipment manufacturers. The ETL mark is a critical certification that the prospective chiller buyer must look for assuring that every electrical component used in the subject equipment meets UL or ETL standards of performance and reliability. Unfortunately, there is a growing number of US and foreign chiller manufacturers that either do not bear the ETL mark, or in some extreme cases, display the mark and make claims such as "ETL / UL Listed" or "ETL / UL Certified" with no real listing. The process to legitimately bear the ETL mark requires extensive qualification and testing. Once a chiller line has been assigned the ETL mark, the manufacturer is required to maintain and submit to regular recertifications to maintain the ETL mark. If a process chiller project is to be permitted, many municipalities will require the ETL mark in order to approve the project. In some cases where electrical equipment is responsible for personal injury or property damage, insurance companies have been known to reject claims on the basis of non-ETL or UL listings.

2. The MIXED DESIGN System: In recent years, mixed design chillers have entered the market and they appear to be on the rise. These chillers are generally less expensive; however there are some tradeoffs that some manufacturers are reluctant to openly disclose.

The image to the left illustrates a mixed design chiller system. In this case, the chiller manufacturer has purchased a residential air conditioning duty condensing unit, mounted it to a manufactured frame with doors then installed a chiller barrel and a pump. Although mixed design chiller systems do have their place on the market, there are some things that an informed chiller buyer should know:

a. Although the condensing unit (top section) may openly display the ETL/UL mark, in most cases the entire chiller unit has not been ETL/UL listed.

b. Manufacturers of mixed design chillers may openly market these systems as process duty chillers; however a residential condensing unit is not engineered for a process duty workload. As a result, even with regular maintenance, air conditioning duty equipment has a life expectancy of about half compared to a process duty designed chiller.

c. Since mixed design chillers tend to be positioned in the market as a low cost alternative, manufacturers tend to use lower cost components and change vendors often. This can lead to more frequent breakdowns as well as longer lead times on replacement parts. Here are a few items to look out for:

⇒ **Pump Impellers:** Tend to be plastic or nylon. Over a relatively short period of time these tend to lose pumping capacity or break down.

⇒ **Pump seals:** Tend to be constructed of materials that can overheat or be susceptible to damage from some types of glycol or system cleaning chemicals.

⇒ **Evaporators:** The chiller evaporator is one of the most important components in the entire chiller system.

Its job is to remove heat energy from the process fluid. On mixed design systems, evaporators tend to be constructed of substandard materials such as all copper, brass or even steel in some cases. These materials tend to be susceptible to premature failures. In some cases a damaged evaporator can also damage the chiller's compressor requiring replacement of the entire chiller.

⇒ **Indoor rated:** Although the condensing unit (top section) may be outdoor rated, the lower section is commonly not. Since many of these lower sections are not cleared by way of the ETL/UL listing process, owners may not be aware that these mixed design machines are indoor rated only. Installing mixed design chillers outdoors can result in failure of the system. In some extreme cases, these systems can be considered unsafe for outdoor use.

⇒ **Replacement parts:** Loyalty between the chiller manufacturer and component vendors is critical. Unfortunately, it is common for manufacturer**s** of mixed design chillers to change component vendors regularly to maintain the best possible price point. Customers who choose to purchase mixed design chillers can run into difficulties getting the parts they need quickly, leading to extending downtime. It is also common to have manufacturer provided replacement parts show up that do not match the original part. This can also lead to extended downtime and increased repair costs.

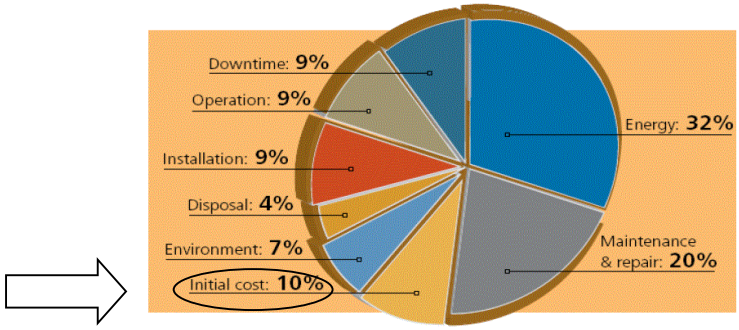
3. Made in the USA?: Over the last two decades, some USA based chiller manufacturers have moved some or all of their production offshore to gain a competitive edge here at home. It has been argued that finding ways to make more profit, by way of getting workers to build things at a lower cost, is good for business. When it comes to process chillers, and the end users that depend on fluid cooling for their business operations, there is a growing argument that lower initial investments costs may not equal the best overall value. Here are a few things to consider:

⇒ **Design flexibility:** Producing products offshore naturally results in communication challenges. A customer's design request needs to travel long distances, time zones and in some case language barriers to get addressed. To offset these challenges, many companies who produce offshore dramatically limit their offering to a very narrow set of designs. These limitations may not be known until the end of a purchase and can add to the overall cost of the equipment.

⇒ **Security:** In the case of Mission Critical process systems that are highly dependent on the application and overall reliability of a process chiller, customers may need to share sensitive information with a chiller manufacturer. Chiller buyers who share such information, regardless of a Non-Disclosure Agreement (NDA), may be at risk if the design information happens to be shared with other (offshore) subsidiaries who are not subject to US laws. In some cases manufacturers may not fully disclose who the information is being shared with, creating an atmosphere of risk.

⇒ **Lead times:** The more geographical distance between the manufacturer and the chiller's final destination naturally requires a more extensive supply chain. The more complex the chain, the more potential for interruptions and increased lead times. These potential interruptions can happen as a result of many factors, including but not limited to weather, geopolitical problems, and customs. When these interruptions happen, lead times tend to increase which can add to project delays, or in the case of replacement parts, extended downtime.

Life Cycle Costs Matter: With the number of choices out there it can be a challenge to uncover the best overall value of a process chiller. One of the most effective ways to analyze the value of an investment is to first look at the initial investment versus the life cycle costs. In the graphic below, we have provided a breakdown of the eight major cost categories for a process chiller. Interestingly, the **initial cost** to purchase a process chiller is only about **10%** of the overall cost throughout the equipment's life cycle .



Plant Performance Services Group, ITT

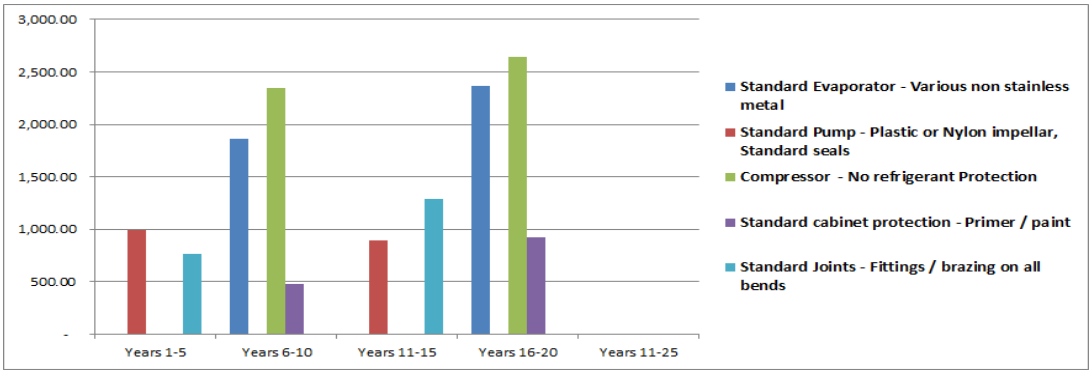
Features Matter: Based on extensive market research, we have identified specific process chiller features known to increase the overall reliability and extend its life cycle. In the table below, we have identified each of these key features and their application within a process chiller.

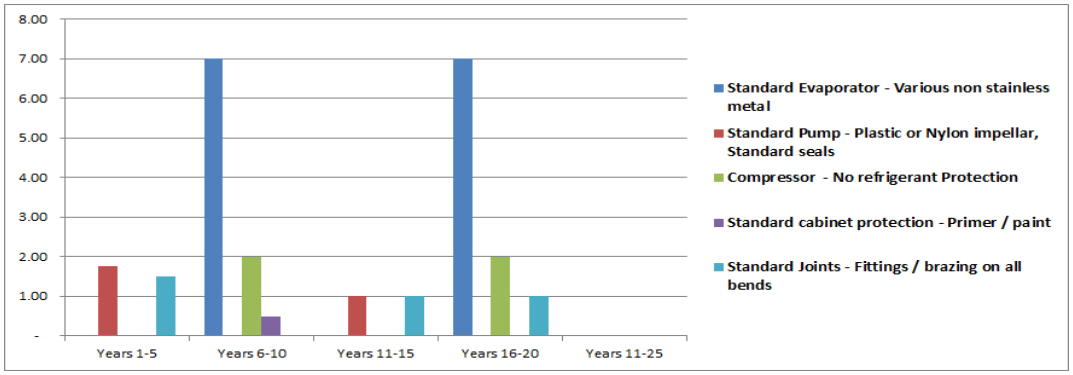
Key Feature	Feature Application
Stainless Steel Evaporator	A chiller's evaporator is a critical component that removes heat from the process fluid. Constantly exposed to the process fluid, stainless steel (especially grade 316) is the most durable material to be used for fluid process cooling.
Stainless Steel Pump Impellers	Like the chiller's evaporator, the pumps impeller is constantly exposed to the process fluid. Stainless steel (especially grade 316) can dramatically extend the life cycle of a chiller.
Liquid Line Solenoid	In the refrigeration system, having an automatic liquid line solenoid valve in the system prevents migration of refrigerant in the off cycle. This prevention reduces wear on the chiller's compressor.
Powder Coated Painted Cabinet	A cabinet's paint coating is the first line of defense in protecting the chiller's internal components from the elements. The powder coating process prevents peeling or flaking paint protection.
Suction Accumulator	In the refrigeration system, a suction accumulator mounted between the chiller's evaporator outlet and the compressor provides an additional layer of protection to the chiller's compressor.
Machine Bent Copper Tubing	Copper joints in the chiller's fluid and refrigeration systems have the highest possibility of leaks. Machine bending can reduce the number of fittings by 60%, also reducing leak potential.
Hot Gas Bypass	Under low load conditions, the hot gas bypass feature provides capacity control. Additionally, this feature provides an additional level of freeze protection helping to prevent catastrophic failures.

chiller options.

Graph indicates potential **REPAIR COSTS** for a chiller deployed in a process application equipped with standard features . In this graph, the total potential repair expenditures in its life is:

$14,568.00





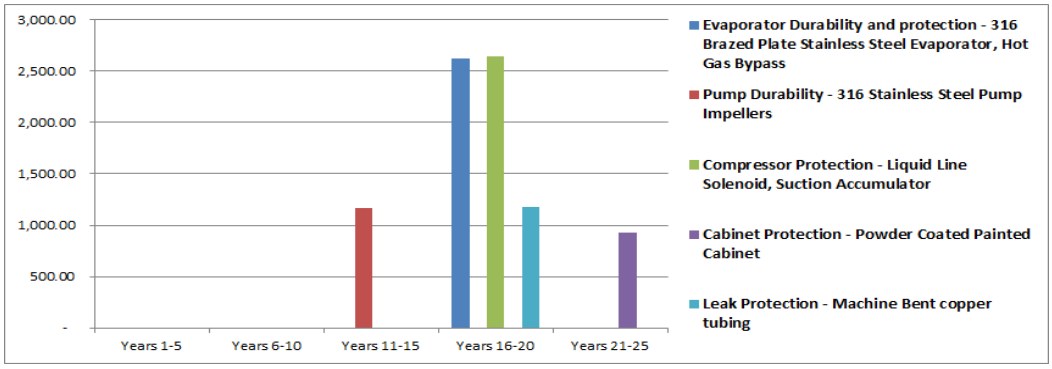
Graph indicates potential **Downtime Days** for a chiller deployed in a process application equipped with standard features . In this graph, the total potential repair expenditures in its life is:

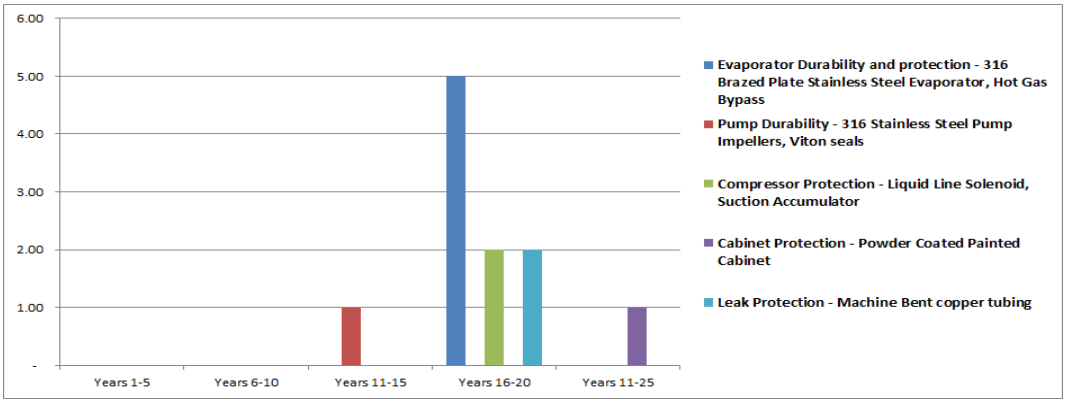
24.75 DAYS

Graph indicates potential **REPAIR COSTS** for a chiller deployed in a process application equipped with upgraded features . In this graph, the total potential repair expenditures in its life is:

*** $8,535.00**

*** 59% reduction in repair costs**





Graph indicates potential **Downtime Days** for a chiller deployed in a process application equipped with standard features . In this graph, the total potential repair expenditures on its life is:

*** 11 DAYS**

*** 44% reduction in downtime days**

Controls Matter: As micro processers have evolved over the last few decades, process chiller manufacturers now have unique opportunities to provide enhanced control features in a cost effective way. In this table we have listed features considered to be **CRITICAL** in today's process chiller market. We have placed these items in order of importance based on extensive customer interviews and 2013 market research. As with products that use programmable controls, developments can occur at a very fast pace. For this reason, we encourage our customers to look for future updates to the Process Chiller Buyer's Guide for the latest trends.

CRITICAL - Control Features

Control Key Feature	Feature Application
In-Place Screen and PLC Software Updates	The ability to update the control interface (screen) and / or the programmable logic controller without needing to remove these devices from the chiller. A common method is to download updates, ideally at no cost to the customer, from the manufacturer's website and transfer the files to the chiller's equipment via a USB jump drive.
Multi **COMPRESSOR** Automatic Lag/Lead	This critical feature assures equal wear and tear on the chiller's compressor(s). Once the lead compressor run hours have extended past the lag compressor hours by approximately 500 hours, service duty of the compressors will switch.
Multi **PUMP** Automatic Lag/Lead	This critical feature assures equal wear and tear on the chiller's system pumps. Once the lead pump run hours have extended past the lag pump hours by approximately 500 hours, service duty of the pumps will switch.
Remote Start / Stop	In some cases, process chillers are mounted in remote locations. In these cases, it may be advantageous to have the capability to turn the chiller on / off remotely. Having an input on the chiller's control system to perform start / stop is a critical feature.
Intranet Remote Control Access via Browser	Using a standard Internet browser, such as Internet Explorer or Firefox, user has the ability to access and control the chiller over a local area network. Note: In most cases this will require custom IP addressing.
Internet Remote Control Access	Using a standard Internet browser, such as Internet Explorer or Firefox, user has the ability to access and control the chiller over a wide area network. Note: In most cases this will require custom IP addressing and firewall port forwarding.
VPN Secure Remote Connectivity	Virtual Private Networking (VPN) is used to connect a process chiller remotely over a secure network connection. A VPN can be used to remotely connect to a chiller via an Intranet or Internet connection. VPN typically does not require firewall configuration.
Replaceable Plugin Control Relays	Process chiller control systems use pilot duty relays to control the various systems within the chiller such as compressors, pumps, fans and economizers. When these relays are board mounts it requires replacement of the entire board as compared to field replaceable plugin relays that result in much less downtime and cost.
Remote Alarming via Email or Text	Should a process chiller's operating condition become unstable, it is considered ideal for the chiller's control system to broadcast a trouble email or text. Note: In order to broadcast the chiller must be connected to the host building's network with access to the Internet. Some firewall configuration or VPN connection may be required.

Controls Matter (Continued): The table below represents features to be considered by the process chiller market to be **IMPORTANT** but not yet a critical need. According to our research many of these items are expected to become considered as critical control features over time. We have BOLDED control features most likely to make the jump from important to critical in the next 24 to 36 months.

IMPORTANT - Control Features

Control Key Feature	Feature Application
Highly Visible User Interface	Process chillers operate in many indoor and outdoor applications. It is important that the user interface is visible, especially in bright sunlight situations, in order to easily control the features of the chiller control system.
On-Screen User Help Information	It's a common occurrence for the chiller control and other documentation to disappear during or shortly after the chiller installation. An important feature is to have electronically stored use and troubleshooting documentation available on the process chiller's user interface.
On - Screen Event Logging	An important feature is to have event history stored on the process chiller's user interface. The information can dramatically reduce diagnostics time especially when intermittent issues occur.
Expandable Memory	As new process chiller control enhancements become available, demands on internal memory will inherently increase as well. As demand for memory grows, it is very important to have the capability to expand the control system memory.
Multi-Chiller Lag Lead	In Mission Critical process chiller applications it is common to deploy multiple chillers to achieve cooling redundancy. In these circumstances multiple chillers must communicate and have the ability to perform lag-lead functions.
Open Modbus (SLAVE) Register Availably via TCP or RTU (Serial)	Since most process chillers are deployed within modern buildings that are equipped with building automation systems it is important to be able to read in, and in some cases control chiller functions from these building systems.
Expandable Controller I/O	It is becoming more common for process chillers, post installation to require enhancements to meet site specific requirements. In many cases these enhancements will require more I/O. It is considered an important feature to have the ability to expand a process chiller's control system at any time.

Use of this scorecard: As process chillers buyers search to find the best overall best value, we have provided this unique scoring system to help Buyers ask the right questions and compare key features across the various process chiller brands being researched.

Feature	Legacy	1:	2:	3:
In-place Screen and PLC Software Updates	Standard			
Multi **COMPRESSOR** Automatic Lag/Lead	Standard			
Multi **PUMP** Automatic Lag/Lead	Standard			
Remote Start / Stop	Standard			
Intranet Remote Control Access via Browser	Standard			
Internet Remote Control Access	Standard			
VPN Secure Remote Connectivity	Optional			
Replaceable Plugin Control Relays	Standard			
Remote Alarming via Email or Text	Standard			
Highly Visible User Interface	Standard			
On-Screen User Help Information	Standard			
On - Screen Event Logging	Standard			
Expandable Memory	Standard			
Multi-Chiller Lag Led	Standard			
Open Modbus (SLAVE) Register Availably via TCP or RTU (Serial)	Standard			
Expandable Controller I/O	Standard			

How to use this scorecard: Simply ask perspectives about the key items listed on these two sheets. In the boxes provided, simply make a note if the item or feature is "Standard," "Optional" or "Not available." As you plug in your own data you will gain a better perspective of overall value.

Feature	Legacy	1:	2:	3:
ETL Listed	Standard			
Designed and Manufactured in the USA	Standard			
316 Stainless Steel Evaporator	Standard			
316 Stainless Steel Pump Impellers	Standard			
Liquid Line Solenoid	Standard			
Powder Coated Painted Cabinet	Standard			
Suction Accumulator	Standard			
Machine Bent Copper Tubing	Standard			
Hot Gas Bypass	Standard			
Indoor / Outdoor Rated	Standard			
Lead Time	3-4 weeks - Scroll 5-6 weeks - Semi			
Warranty - Labor Allowances	12 months			
Warranty - Parts	18 months			
Warranty - Compressor	18 Months on Scrolls 12 Months Semi's			
Technical Support	24/7/365			
Factory Startup Services	Optional			

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