CSZ

A GENTHERM COMPANY

Points to Consider when Purchasing & Installing Environmental Chambers

Table of Contents

Cincinnati Sub-Zero Products, LLC ■ 12011 Mosteller Road ■ Cincinnati, Ohio ■ 513-772-8810
www.cszindustrial.com

Temperature Range

A distinction between test chambers is the temperature range in which the chamber will operate. Most manufacturers have a standard high temperature range of 177˚C to 190˚C (350˚F to 375˚F) for reach-in chambers and welded walk-ins. Temperatures up to 260˚C (500˚F) and even higher, can be achieved with special insulation and construction. At the other end of the spectrum, the extremes are determined by the type of cooling system used. Again, construction methods and type of insulation is affected by the extreme needed.

Types of Chamber Cooling Systems

The two major categories are expendable refrigerants and mechanically cooled.

Expendable Refrigerants

Expendable refrigerants are liquid/gases that can be injected directly into the space being cooled or into heat exchangers, similar to mechanical systems. As the liquid enters the chamber (directly or through a fin coil) it absorbs heat and flashes to a gas. The gas is then vented out of the chamber and should be ducted outdoors. The two most popular refrigerants are liquid nitrogen (LN2) and liquid carbon dioxide (CO2). Cryogenic temperatures down to -184˚C (-300˚F) can be achieved with LN2. CO2 on the other hand can only achieve temperature down to -68˚C (-90˚F). Both of these gases are environmental safe and can be vented to the atmosphere. Note: it is imperative that the gases be vented outdoors. These gases displace oxygen and asphyxia can occur if the chamber is not properly vented.

Types of Mechanical Cooling Systems

Mechanically-cooled refrigeration systems are fundamentally the same as those used in home refrigerators. They utilize a compressor and circulate a refrigerant around a closed loop system. The ultimate low temperature required by your testing determines the type of refrigeration system needed.

Single Stage

Single-stage refrigeration systems typically can pull the temperature in the chamber down to -34˚C (-30˚F). Some manufacturers rate their single stage systems down to -40˚C (-40˚F). However, due to the refrigerant used there is very little cooling capacity available at -40˚C and can be difficult to achieve. For continuous operation at -40˚C and below most manufacturers recommend a cascade refrigeration system.

Cascade

Cascade refrigeration systems have two separate refrigeration systems working to cool the chamber down to an ultimate low of -73˚C (-100˚F) and -85˚C on industrial freezer models. The first stage refrigeration system cools and condenses the refrigerant in the second stage. The second stage refrigerant flows through an evaporator located in the chamber which cools the air. These systems can become very complex depending on your application.

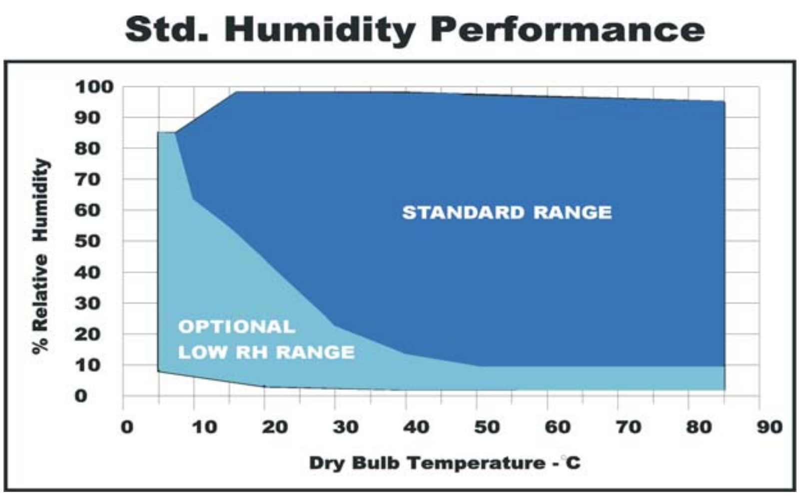
Tundra®

The Tundra refrigeration system is a patented, single-stage refrigeration system that can efficiently cool the chamber down to -45˚C (-50˚F). It utilizes a common refrigerant and is able to operate continuously at -40˚C. Since most low temperature environmental testing is done at -40˚C, it is a good alternative to buying a cascade system. It uses less energy (up to 40% less) and is less complex than a cascade system. There are also fewer parts compared to the cascade system which means lower maintenance & utility costs over time. At warmer temperatures, this system can also handle large live load conditions generated from testing electronics.

Humidity Range

This is probably one of the most misunderstood topics when it comes to environmental test chambers. This is due to the fact that Relative Humidity percentage is temperature specific. For example, the amount of moisture in the air at 20˚C (68°F) and 50% RH is not the same as 10˚C (50°F) and 50% RH. As the temperature of air is reduced its ability to hold moisture is also reduced. Thus, for a given amount of water vapor in the air - the lower the temperature, the higher the RH.

The standard controllable temperature/humidity range for most manufacturers is 5˚C (41°F) to 85˚C (185°F) with 10% to 98% RH, limited by a 7˚C (44˚F) dew point. The limitation of a 7°C (44°F) dew point can be very confusing. Since the amount of moisture varies at every temperature, the chamber manufacturers use dew point to describe the RH limitation. Inside the chamber there is a refrigerated coil that is controlled at a temperature very close to the freezing point, i.e. 0˚C (32°F). Moisture in the chamber will be attracted to the cold surface and condense, but not freeze. The accumulated water is drained out of the chamber thereby lowering the relative humidity. The refrigerated coil is never below freezing so frost will not develop. The best way to understand this is to refer to the graph below. If you follow the bottom line of the standard range section of the graph, those temperatures and humidities represent the 7˚C dew point. For example, the lowest humidity level achievable at 20˚C is 43% RH with a dew point very near the 7˚C lower limit. At 50˚C the chamber will be able achieve 10% RH. The chamber must be operated within the limits set by the manufacturer. Damage to the refrigeration system can occur if points outside of the standard range are attempted.



Types of Humidity Systems

There are various types of humidity systems used on test chambers today such as a water bath, boiler/steam generator and atomizing system.

- Water Pan - Very stable, but slow response
- Boiler - Standard on most CSZ chambers. The advantages of this system are that it can attain 98% humidity and has large capacity to work in any size unit. The disadvantages of this system is that live load from boiler can cause problems at lower temperatures when the DUT generates heat.
- Atomizer - This system sprays very fine drops of water into the air stream. The advantages of this system are that it provides good control with live loads. CSZ typically uses this type of humidity systems for devices under test that are over 500 watts, with the exception of larger chambers.

Low Humidity (Dew Points below 7˚C)

To achieve lower humidity levels down to 5% RH most manufacturers offer a low RH package. It normally includes a dry air purge system and refrigeration valves to allow the refrigerated coil to go below freezing. However, the dry air purge helps to offset this by maintaining a positive pressure in the chamber and sublimating some of the accumulating frost off the coil.

Humidity Water

De-ionized (DI) water is recommended for use with our humidity systems. Water should be provided within 0.05 to 2M□Ω resistivity. Distilled water or reverse osmosis (RO) water exceeding of these limits may cause corrosion.

For customers using tap water an optional Demineralizer Filtration System should be used to remove water impurities and minerals that can harm your test chamber. This is not needed for those customers that already have a de-ionized water supply.

A Re-circulating Humidity Water Supply System is also available for customers without a plumbed water supply to the chamber. You can keep this filled with tap water along with a DI filter or you can fill it with DI water. This system is also collects condensate from the chamber, filters it, and stores it in a reservoir for reuse. Note: If products being tested emit a harmful vapor or other contaminates, these can be picked up by the condensate and reused by the re-circulating system. This may damage your device under test.

Note: If using a city water line, a water pressure regulator is highly recommended to lower the water pressure to 25 PSIG for steam generator/boiler systems and 10 PSIG for atomizing humidity systems. High water pressure may cause the top or bottom cap (white) on the water filter to crack. This may result in water leakage that can damage the unit and/ or customer property. Water regulators are available through CSZ.

If your water supply has a lot of particulate matter you may need an additional inline pre-filter such as a 5 or 25-micron polypropylene pre-filter. Other filters are recommended if your water source has a lot of organic, free chlorine and chloramines, phosphate complexes such as a roughing filter (US Filter Model: Absorber). Be sure to occasionally check your water supply for contaminants and resistivity.

How Much Water Does the Humidity System Need?

CSZ reach-in chambers typically use anywhere between 0.5 GPH to 3 GPH. Large chambers like walk-ins may require much more. The amount of water used will vary depending on the size of the chamber, conditions being run and usage of the chamber humidity system.

Water Quality Conversion Chart

Microohms – µmhos – ppm – ppb - GPG

Note: * pH ranges used for ph adjustments

Resistivity Megohms/cm3	Conductivity Microseimens (Microhms/cm3)	Dissolved Solids (as CaCO3)			Maximum pH Possible*	Minimum pH Possible*
@ 25 degC	@ 25 degC	ppm	ppb	GPG	pH	pH
18.0	0.056	0.03	28		7.8	6.2
16.0	0.063	0.03	31		7.9	6.1
14.0	0.071	0.04	36		7.9	6.1
12.0	0.083	0.04	42		8.0	6.0
10.0	0.100	0.05	50		8.1	5.9
8.0	0.125	0.06	63		8.2	5.8
6.0	0.170	0.08	83		8.3	5.7
5.0	0.200	0.10	100		8.4	5.6
4.0	0.250	0.13	125		8.5	5.5
3.0	0.334	0.17	167		8.6	5.4
2.0	0.5	0.25	250		8.8	5.2
1.0	1	0.50	500		9.1	4.9
0.500	2	1	1000		9.4	4.6
0.250	4	2		0.1	9.7	4.3
0.167	6	3		0.2	9.9	4.1
0.125	8	4		0.2	10.0	4.0
0.100	10	5		0.3	10.1	3.9
0.083	12	6		0.4	10.2	3.8
0.071	14	7		0.4	10.2	3.8
0.063	16	8		0.5	10.3	3.7
0.056	18	9		0.5	10.4	3.6
0.050	20	10		0.6	10.4	3.6
0.045	22	11		0.6	10.4	3.6
0.038	26	13		0.8	10.5	3.5
0.036	28	14		0.8	10.5	3.5
0.033	30	15		0.9	10.6	3.4
0.025	40	20		1.2	10.7	3.3
0.020	50	25		1.5	10.8	3.2
0.013	76	38		2.2	11.0	3.0
0.007	150	75		4.4	11.3	2.7
0.004	250	125		7	11.5	2.5
0.003	400	200		12	11.7	2.3
0.002	500	250		15	11.8	2.2
0.001	700	350		20	12.0	2.0
0.001	1000	500		29	12.1	1.9
0.000	2500	1250		73	12.5	1.5

High Resistivity
= Lower Minerals/solid levels (i.e. ultra pure water)
= Potential for more acidic pH and therefore more corrosive to metals, such as brass, copper, and even stainless steel.
= Very difficult to measure pH accurately.

CSZ Specified Resistivity Range
= .05 to 2.0 Megohms/cm3

High Conductivity
= More minerals/solid levels
= More potential for mineral scale build up on metal and glass surfaces.

Other Water and Treatment Information

DI Systems - Chemically attempts to pull out all incoming minerals. Not effective on silica which can leave white deposits on glass.
Lower initial cost but service life is measured in weeks or months and DI can fail without warning

RO System passes some minerals and works to separate and split minerals from the water molecules. Known to be effective on silica removal.
Higher initial cost but provides 3-5 years service life before filter change.
The performance of RO is stated as % rejection i.e. 80-95% is typical.

pH
- Important to be between 6.5 and 7.5 to avoid corrosion.
- The correction for low pH is adding a calcite cartridge that fits in a standard filter housing.
  - The calcite is designed to slowly dissolve which increases the pH back to neutral.

Temperature Change Rate

The requirements for temperature change rates continue to get faster and faster. By incorporating faster change rates, total test time can be reduced. Products can also be thermally stressed at faster change rates which can identify reliability problems. However, be careful assuming the part temperature is changing at the same rate as the air.

Every chamber manufacturer has different air flow volumes inside their chambers. The air flow must have enough volume to support the refrigeration system. The typical air velocity in most reach-in type chambers is approximately 100 Feet/Minute (average) through the work space. This velocity works well for steady state and temperature cycling testing. However, the part temperature will lag behind the air temperature with this air flow.

Air velocity across the part should be much higher to keep it closer to the chamber air temperature during transitions. Typically 500 Feet/Minute or more is required to move the part temperature at a similar rate to the air temperature. It is a necessity in thermal shock applications to have air flow this high.

For most temperature and humidity applications the air flow in reach-in type chambers is adequate for the test.

Product in Chamber

It is important to inform the chamber manufacturer of the type of product being test in the chamber. However, if all the details are not given to the chamber manufacturer, the resulting selection may not be best for your application and could cause safety risks. The chamber manufacturer should understand your test objectives as well as you do. The more information he has regarding your product and your test requirements, the better equipped he will be in either selecting a standard product to meet your needs or proposing a custom chamber designed to meet the special requirements of your product testing.

For example, hydraulic valves under pressure are being test at various temperatures. Hydraulic lines enter and exit the chamber through an access port. Rarely, if ever, a fluid leak occurs in the chamber. This does not concern the operator since the warmest temperature achieved in the chamber is well below the auto-ignition point of the fluid. However, if a leak occurs the chamber will be at risk for an explosion. This is due to the fact that the standard nichrome wire heater used in most chambers can exceed 1000˚F surface temperature. For this type of application temperature limited sheath heaters must be used at a minimum. Depending on the application, a classified explosion proof chamber may be required.

There are many scenarios which could be used for examples, but the bottom line is to make sure you have given your chamber manufacturer all the details of your tests.

Product Load

How much space do I need around my product?
CSZ as well as many MIL-Standards specify approximately 1/3 product and 2/3 empty space around your product for adequate air flow. This may slightly vary with the design of the chamber. In some custom chambers, the work area is effectively an air duct and is almost

100% filled with product. Again, this is another area underlining the importance of the chamber manufacture understanding as much as there is to know of your product and test objectives.

Static (Dead) Load

The static load is any mass that is in the chamber that does not produce added heat. In order for CSZ to size the correct system to meet your needs, we have to determine the dead load mass of the DUT along with any shelving, fixturing, etc. We would also need the type of material the DUT is made of to determine the specific heat. This will determine how easily your DUT gives up its heat during transitions from hot to cold and helps us accurately size the refrigeration system to meet your specific performance requirements.

Live Load

The live load is any mass that is in the chamber that produces heat. Any live load that is in the chamber will have to be measured (watts) to determine the correct refrigeration system to overcome that added load.

What is your maximum dead load?
What is your maximum live load?
What type of material is your DUT?
How many shelves would you be using to support your DUT?
Do you have any fixtures to mount your DUT?

The more information that you can supply to the manufacturer will assure that your chamber will meet your specific applications requirements with a system that is not oversized, which can have a significant impact on price.

Construction – The difference is in the details

Chamber construction is a critical area that needs to be evaluated when making a chamber purchase. When looking at the various chamber manufacturers' brochures or products on-line, they all look very similar, they're typically boxes with doors and some may even be more attractive than others, but there is more to consider than just looks. Most have painted exteriors and stainless steel chambers. It is easy to believe they are all built the same way. However, when you evaluate the details you will see differences that can greatly affect the long term reliability of the chamber.

Most of these differences relate to the way seams are constructed for the stainless steel liner. Are the seams welded, pop-riveted or screwed together? How are the ports fastened to the stainless steel liner and to the outer cabinet?

Earlier in this document the topic of pressure within the chamber was addressed. Over the life of a test chamber the temperature is raised and lowered thousands of times. This stresses all the seams and connections in the chamber. The better the seams are bonded together the longer the chamber will operate dependably.

When leaks occur in the stainless steel liner this opens a path for moisture to travel in and out of the chamber. The worse of these is when the chamber runs temperature and humidity test. The humid air in the chamber finds the leak and condenses in the insulated area. Most chamber manufacturers use fiberglass insulation similar to what is installed in the walls of your house. When moisture condenses on the insulation it becomes saturated like a sponge and loses its insulating ability. The walls of the chamber then have less insulation which can affect the temperature and humidity performance. The water in the insulated space will eventually rust the outer sheet metal and allow water to leak on to the facility floor.

A chamber with continuously welded seams is much less likely to develop leaks than a chamber assembled with other methods.

Another point of consideration should be the access ports. As the pressure in the chamber goes up and down during temperature transitions the walls will deflect. The ports connect the inside chamber to the external cabinet. As the inside walls move from the expansion and contraction of air, the port transfers that movement to the outer cabinet. Therefore, the connection between the port and the chamber must be extremely durable to withstand the frequent movement.

There are several methods used to install ports by the chamber manufacturers. They range from pop-riveted and caulked to fully welded methods. Again, a welded port will hold up better than other fastening methods.

Another area that can be compromised over time is where the refrigeration lines penetrate the stainless steel chamber. The refrigeration lines are generally copper tubing. If any sharp edges touch the tubing a refrigerant leak will develop. A good method to eliminate the possibility of abrasion is to install the tubing in sleeves where it penetrates the chamber. The tubes should be stainless and continuously welded to the chamber linear. The copper refrigeration lines pass through the sleeves and the gaps filled with RTV which not only seals the penetration, but also provides a degree of resiliency to accommodate the movement generated as the chamber expands and contracts during temperature changes. As movement occurs the lines will not be exposed to sharp edges.

What type of Cooling system is best for my application (air-cooled or water-cooled)?

The refrigeration system removes heat from the product and the air which lowers the temperature in the chamber. The heat is moved through the refrigeration system and rejected at the condenser. There are two choices when it comes to condensers, air-cooled or water-cooled. Each one has its positives and negatives.

Integral Air-Cooled Chambers

Many small chambers come standard as air-cooled. The only utility connection required for temperature cycling chambers without humidity is power. This is very convenient for moving a chamber from one area to another. However, there are some items need to be considered with air-cooled units.

First of all is the heat that is introduced into the room where the chamber is located. This is due to the fact that most chambers are located in air conditioned areas and can have a bearing on the faculties' ability to absorb this additional load. For example, a chamber that has a 2 HP cascade system can reject 24,000 Btu/Hr or more into the room under full load. When the chamber is at set-point, it can reject between 12,000 to 15,000 Btu/Hr into the room. The smaller the room where the chamber is located, the more critical it is that the air conditioning system can handle the additional heat load. A general "rule of thumb" for heat of rejection is: 1 Horsepower of refrigeration system is equal to 12,000 Btu/Hr. If a chamber is going to be installed in an area that is not air conditioned tell the chamber manufacturer.

The chamber's performance will be reduced if the ambient environment where the chamber will be located exceeds 30°C. In some cases, the chamber will not operate. Condensers must be oversized to operate in high ambient room conditions.

Second item to consider for an air-cooled system is dirt. Large volumes of air are passed through the condenser constantly. Most condensers are located near the floor which allows them to pick up dirt easily. The condenser must be clean for the system to perform and work efficiently. This requires someone to clean the condenser at regular intervals. If the chamber is located in a dirty environment the condenser can become clogged very quickly. Restricted air flow will cause the refrigeration system to run at high pressure which will cause the high pressure safety to trip. If the environment described above is the destination for a test chamber, a remote air-cooled condenser (see below) or water-cooled should be considered.

Remote Air-Cooled Chambers

Another type of air-cooled condenser is remote air-cooled. The air-cooled condenser is removed from the chamber and is placed in another location, normally outdoors. On the surface this sounds like the best option since the heat and noise is moved outdoors. However, this type of system is more complicated and expensive to install. This is due to several items: refrigeration piping must be sized and installed properly for the application, penetrations through the building roof or wall must be done by qualified personnel, a concrete pad or proper mounting (on roof) for the remote air-cooled condenser must be installed, and the roof must be able to support the weight of the remote air cooled condenser. This type of installation will normally require bids from the following contractors: Refrigeration, Electrician and Roofer. As you can see this type of installation can become very involved.

Water-Cooled Chambers

Larger chambers with refrigeration systems 6 horsepower or over are typically water cooled chambers. If your facility has process water that is pumped throughout the building and is routed to a cooling tower / dry cooler, a water-cooled chamber may be installed. A water-cooled unit is easy to install and maintain. Be sure to ask your chamber supplier for the water flow and pressure requirements for the unit. The capacity of the process water system should be verified before purchasing the chamber. Most problems with water-cooled systems are due to inadequate water flow and/or differential water pressure supplied to the chamber.

If water cooled, provide and connect water supply and return lines to the inlet and outlet for the condenser. The line size should be equal to or larger than the inlet fitting provided on the chamber.

Note: Water cooled systems require a minimum of 40 PSI differential pressure (supply pressure minus return pressure) on the water system. Where water discharges to an open drain or non-pressurized return, supply must be 40 PSIG minimum. On systems using a closed loop cooling water system with a pressurized return, supply pressure must be at least 40 PSI greater than return pressure. Maximum water pressure should not exceed 80 PSI.

Water Usage

The tables below are representative of the requirements for most low temperature single stage or cascade systems. There are many applications where the refrigeration system demands fall into what is referred to as medium or high temperature applications. In these cases, the requirements identified below are inadequate. The chamber manufacture should supply these requirements to you when quoting so as you will know whether you have an adequate supply or not.

Water Usage Chart for Water Cooled Chambers

GPM Maximum at 40 PSIG Minimum Supply Differential

LOW TEMP HERMETIC & SEMI-HERMETIC COMPRESSORS ONLY

WATER TEMP	1 HP		1.5 HP	
Deg C / Deg F	**GPM**	**LPM**	**GPM**	**LPM**
7 / 45	0.9	3.4	1.3	4.9
13 / 55	1.1	4.2	1.6	6.1
18 / 65	1.4	5.3	2	7.6
24 / 75	2	7.6	2.8	10.6
29 / 85	3.3	12.5	4.8	18.2
CONN. SIZE NPT	**3/8"**		**1/2"**	

WATER TEMP	2 HP		3 HP	
Deg C / Deg F	**GPM**	**LPM**	**GPM**	**LPM**
7 / 45	2.4	9.1	3	11.4
13 / 55	3	11.4	3.8	14.4
18 / 65	3.8	14.4	4.7	17.8
24 / 75	5.2	19.7	6.5	24.6
29 / 85	8.9	33.7	11	41.6
CONN. SIZE NPT	**1/2"**		**3/4"**	

WATER TEMP	6 HP		7.5 HP	
Deg C / Deg F	**GPM**	**LPM**	**GPM**	**LPM**
7 / 45	5.5	20.8	6.5	24.6
13 / 55	6.8	25.7	8.1	30.7
18 / 65	8.5	32.2	10.1	38.2
24 / 75	11.8	44.7	14.1	53.4
29 / 85	20	75.7	23.8	90.1
CONN. SIZE NPT	**3/4"**		**1"**	

WATER TEMP	10 HP		15 HP	
Deg C / Deg F	**GPM**	**LPM**	**GPM**	**LPM**
7 / 45	9.3	35.2	12.1	45.8
13 / 55	11.6	43.9	15.1	57.2
18 / 65	14.5	54.9	18.8	71.2
24 / 75	20.2	76.5	26.2	99.2
29 / 85	34.2	129.4	44.4	168.1
CONN. SIZE NPT	**1"**		**1 1/4"**	

WATER TEMP	22 HP		27 HP		30 HP		
Deg C / Deg F	**GPM**	**LPM**	**GPM**	**LPM**	**GPM**	**LPM**	
7 / 45	14.7	55.6	18.5	70.0	21.4	81.0	306.6
13 / 55	18.3	69.3	23.1	87.4	26.8	101.4	383.9
18 / 65	22.8	86.3	28.7	108.6	33.4	126.4	478.5
24 / 75	31.7	120.0	40	151.4	46.5	176.0	666.2
29 / 85	53.7	203.3	67.7	256.2	78.6	297.5	1126.0
CONN. SIZE NPT	**1 1/2"**		**1 1/2"**		**2"**		

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LOW TEMP SCROLL COMPRESSORS ONLY

WATER TEMP	2 HP		3 HP	
Deg C / Deg F	GPM	LPM	GPM	LPM
7 / 45	1.3	4.9	1.8	6.8
13 / 55	1.6	6.1	2.2	8.3
18 / 65	2	7.6	2.7	10.2
24 / 75	2.8	10.6	3.8	14.4
29 / 85	4.8	18.2	6.4	24.2
CONN. SIZE NPT	1/2"		1/2"	

WATER TEMP	3.5 HP		5 HP	
Deg C / Deg F	GPM	LPM	GPM	LPM
7 / 45	2.2	8.3	3	11.4
13 / 55	2.7	10.2	3.8	14.4
18 / 65	3.4	12.9	4.7	17.8
24 / 75	4.7	17.8	6.5	24.6
29 / 85	7.9	29.9	11	41.6
CONN. SIZE NPT	1/2"		3/4"	

WATER TEMP	6 HP		7.5 HP	
Deg C / Deg F	GPM	LPM	GPM	LPM
7 / 45	3.6	13.6	4.4	16.7
13 / 55	4.5	17.0	5.5	20.8
18 / 65	5.6	21.2	6.8	25.7
24 / 75	7.8	29.5	9.5	36.0
29 / 85	13.2	50.0	16.1	60.9
CONN. SIZE NPT	3/4"			

WATER TEMP	10 HP		13 HP	
Deg C / Deg F	GPM	LPM	GPM	LPM
7 / 45	6.3	23.8	7.7	29.1
13 / 55	7.8	29.5	9.6	36.3
18 / 65	9.7	36.7	11.9	45.0
24 / 75	13.6	51.5	16.6	62.8
29 / 85	22.9	86.7	28.2	106.7
CONN. SIZE NPT	1"			

WATER TEMP	15 HP	
Deg C / Deg F	GPM	LPM
7 / 45	9.1	34.4
13 / 55	11.4	43.1
18 / 65	14.1	53.4
24 / 75	19.7	74.6
29 / 85	33.3	126.0
CONN. SIZE NPT	1"	

Ways to help prevent chamber condensation on part

Air contracts as it cools. When a chamber is pulling down, it actually causes outside room air to be "sucked" into the chamber workspace. The moisture in the air will be drawn to and freeze on the cooling coil. The moisture will then vaporize into the air when the chamber is heated up and that moisture can end up as condensation on the test product.

Dry Air Purge or Gaseous Nitrogen (GN2) may be used to minimize condensation. Purging the chamber with either of the two maintaining a slight positive pressure on the chamber and minimizes the moisture infiltration into the chamber. The dry air or GN2 contains very little moisture so the chamber air can stay "dry".

To help avoid condensation on the walls and product with humidity chambers, bring up the air temperature first, let the walls and product stabilize, then raise humidity. If the chamber air temperature and humidity levels are raised faster than the wall and product temperature, moisture will condense on the cooler surfaces. By maintaining the dew point of the air below the surface temperature of the walls and product, moisture will not condense on the surfaces. In most cases you can run a characterization test or two first, to determine how long it takes the largest mass (be it product or wall) to stabilize.

CSZ controllers offer cascade control and guaranteed soak capabilities. A separate sensor can be used to monitor, for example, the product. The controller can be programmed to enable a certain event, only after a certain condition has been met. In this case, we're telling the controller to delay the ramp up of humidity until the sensor placed on the product reaches a point within x number of degrees of set point.

LN2 Boost

LN2 Boost is designed to provide approximately 20,000 Btu/h of additional cooling to -73°C (-100°F).

The LN2 Boost function will only initiate if the controller is programmed with this option and the LN2 boost event is initiated. This event will allow the controlling solenoid(s) to open during a programmed test profile. The controller will only turn on the LN2 solenoid(s) if the demand for cooling exceeds the refrigeration systems capacity. This is to ensure that there is no excess LN2 wasted during a profile.

It is the customer's responsibility to supply the LN2 boost assembly with a maximum regulated pressure of 25 psig pressure from their supply tank.

How it works

LN2 is injected into the air stream through a small distribution tube located inside the plenum. As the LN2 is injected it immediately expands into a gaseous vapor. This expanding process absorbs heat, causing the cooling effect. The gaseous vapor is pure GN2 which can be dangerous if allowed to collect in a small area.

Safety Concerns

Venting the GN2 is ultimately the customer's decision but it is CSZ's recommendation that all systems with LN2 boost be vented to an outside environment. If GN2 is allowed to collect in small labs or areas around the chamber, the results can be very harmful or even fatal. GN2 will displace the oxygen in the environment, resulting in low levels of oxygen in or around the chamber making breathing difficult and even causing asphyxiation. GN2 should be vented directly to the outside environment through an insulated duct. This duct can be attached to the vented port located on the top of the chamber.

Shipping Information

Our terms are FOB Origin/Title Transfer Point is our plant, Cincinnati, Ohio. For U.S. shipments, CSZ requires that all chambers be shipped air-ride in order for the chamber to arrive in good condition.

Customers should note any damages, notify the responsible trucking company and file claim immediately. When received, inspect the outside packaging for damage. Document, record and photograph any visible damage on the receipt you sign from the trucker. It's wise to take pictures of the damaged area and to keep the damaged packing material.

If you unpack the unit and find concealed damage once the trucker has left, document, record, photograph the damage and contact the trucking company immediately to file a concealed damage claim.

Installation

Move-in & Installation Customer Checklist

- ❑ All necessary permits and compliance to local and on site codes.
- ❑ Provide and coordinate rigging of equipment, uncrating and pallet removal, moving the chamber in the building and placing equipment at permanent location.
- ❑ Be sure to request a truck with a lift gate if there is not dock available.
- ❑ All chambers are shipped on pallets and a forklift will be needed to remove it from the pallet to move into your building. It is critical to know the exterior dimension of your chamber in order to move it into your building clearing doorways, etc.
- ❑ Installation of equipment, if not purchased from Cincinnati Sub-Zero.
- ❑ Proper power and voltage must be supplied for the chamber. The data plate label located in the back of the chamber describes the proper power information needed to operate the chamber.
- ❑ If the ambient environment of the area where the chamber will be installed exceeds 30°C (85°F), CSZ recommends a chamber with a water cooled condenser. Air-cooled chambers will lose capacity and damage can occur to the unit if the ambient room temperature is too high.

- A minimum of three feet clearance around the chamber is recommended for service and proper ventilation.
- If chamber is not on ground floor, ensure floor can handle the weight of the chamber and its components.
- Provide electrical disconnect, if needed, unless specified and included in quotation.
- Provide compressed air 80-110 psig, if needed, free of oil and entrained water.
- Provide water regulator (Humidity Chambers Only) and tap or de-ionized water.
- Connection of hose from chamber drain(s) to either floor drain or customer supplied condensate pump.
- A qualified professional must make final connections, in accordance with local and on site codes.
- Anchoring of any component to building floor where bolt down holes are present.
- If the chamber is and integral air-cooled unit, make sure the air-conditioning system in the area has enough capacity to remove that heat. The heat rejection information for the chamber will be listed in the chamber quotation and drawings located in the manual.
- For roof-mounted components, ensure that the building roof will support the added load of the components. Roof mounted components must meet local and on site codes.
- For roof-mounted components, provide all roof curbs and/or structure to support roof-mounted components.
- Provide all penetrations and sealing of penetrations through the roof for refrigeration and electrical runs.
- Location of air-cooled condenser must allow adequate space for free air circulation and maintenance.
- Ground level components must be mounted on customer supplied concrete pad or equivalent.

CSZ can also help you with your installation and start-up along with calibration, preventative maintenance programs and more.