Webinar Follow-Up:
Why All Oil-free Chillers are Not Created Equal

QUESTION & ANSWER | FEBRUARY 2017

IDEA hosted a webinar presented by Johnson Controls January 26, 2017 called "Why all oil-free chillers are not created equal". During and after the webinar there has been some great discussions, so the following question and answer document was compiled.

If you missed the webinar or want to re-visit the content, you can access the recording and slides here:
http://www.districtenergy.org/past-webinars-2/

MAGNETIC BEARINGS

AT VARYING MOTOR SPEED DOES THE MAGNETIC BEARING SHAFT STAY ELEVATED OR DOES IT SETTLE?
The shaft always stays levitated, even at varying motor speeds.

HOW IS THE MAGNETIC BEARING MOTOR COOLED?
The motor used in the YMC^2 is cooled with suction gas.

DOES THE MAGNETIC BEARING CHILLER UTILIZE ELECTRONICS FOR MAGNETIZING THE BEARINGS? AND WHAT IMPACT DO THESE ELECTRONICS HAVE ON SERVICE AND MAINTENANCE OF THE CHILLER?
There are electronics present to magnetize the bearings. Long ago there was initially some skepticism on the reliability and life of magnetic bearings. However, we have been very thrilled with the reliability and extremely low failure rates of these magnetic bearings. Of all the bearing types applied in YORK chillers, magnetic bearings have the lowest failure rate on a chiller.

WHAT IMPACTS WILL NEW REFRIGERANTS, SUCH AS R-513A HAVE ON MAGNETIC BEARINGS?
Different refrigerants do not affect the bearings themselves since they are not lubricated in any way by the refrigerant. The YMC^2 chiller is compatible with R-134A as well as R-513A. The YMC^2 chiller is future compatible with R-513A if R-134a becomes too costly or unavailable in the future. There may be an effect on performance depending on the application, but we can work with customers directly to discuss refrigerant replacements. Contact BE-Refrigerants@jci.com with questions.

YORK YMC^2 CHILLER GENERAL

WHAT IS THE UPPER LIMIT CAPACITY ON THE YMC^2?
The cooling capacity range of the YMC^2 chiller is 165 to 1000 TR (580-3500 kW).

IS THE COST OF THE YMC^2 CHILLER COMPARABLE TO OTHER BASE CHILLER COSTS?
There is a premium for a YMC^2 chiller compared to a typical centrifugal chiller. Many customers are focused on the total cost of ownership of a product, making this product popular among our customers. Payback can be provided in less than a year in some cases for the YMC^2 chiller.

ARE THE YMC^2 CHILLERS AVAILABLE IN BOTH CANADA AND THE US?
The YMC^2 chiller is a global product with global availability. It is available for purchase in both Canada and the US. A variable speed drive (VSD) transformer is required for the specific voltage needs in Canada.

WITH WHAT INPUT VOLTAGES (480V / 600V / 4160V) ARE THE YMC^2 CHILLERS AVAILABLE?
The YMC^2 chillers are available to be rated at 60HZ for 380V or 460V and 50HZ for 400V or 415V.

SOME MANUFACTURERS REQUIRE PERIODIC BEARING INSPECTIONS OR TEARDOWNS. ARE THERE ANY SIMILAR INSPECTIONS OR TEARDOWNS REQUIRED FOR THE MAGNETIC BEARINGS ON THE YMC² CHILLER?

Magnetic bearings have a theoretical infinite life. There is no scheduled or routine maintenance scheduled for YORK magnetic bearings. The expectation is that these bearings will be operational for the life of the chiller without requiring replacement.

AT WHAT DISTANCE ARE YOU MEASURING 70 DBA ON THE YMC² CHILLER?

This sound level was measured using the AHRI 575 standard. Sound data was taken from a meter away at multiple points around the chiller. 70 dBA is a weighted average of all of those points.

CAN I RUN THE CHILLER LIMITING THE ENERGY INPUT? FOR EXAMPLE, A 200 TR (700 KW/TR) CHILLER WITH A FULL POWER LOAD 100 KW ALLOWING JUST 50 KW OF ENERGY TO THE CHILLER. CAN YOU LIMIT THE CHILLER PERFORMANCE BY MANAGING THE INPUT ENERGY/ELECTRIC LOAD OF THE CHILLER?

Yes, the demand limit feature is incorporated into all YORK chillers, which allows the user flexibility to set electrical load limits. All chillers have the capability to set a maximum current and ramp rates can be adjusted.

HOW DO YOU HANDLE A LOSS OF POWER SHUTDOWN?

The YMC² chiller has an integrated UPS (uninterrupted power supply) backup built into the design. In the event of a power loss we can provide power to the controls, and coast down to a slow speed to de-levitate and rest on touchdown bearings. Additionally, the YMC² chiller comes with the Quick Start feature, which allows the chiller to restart in 45 seconds after power is restored and return to pre-power failure operating capacity in 3 minutes and 30 seconds.

HOW DO THESE CHILLERS PERFORM FOR ICE DUTY? AT 22˚F (-6˚C) BRINE, IS THIS A POSSIBLE APPLICATION?

Yes, we are able to utilize brine down to 10˚F (-12˚C) leaving evaporator. If you are able to get condenser water that low, we are able to operate 30˚F (-1˚C) below the set point.

CASE STUDY: INVERTED OPERATION

WHAT IS THE MAXIMUM (ENTERING CONDENSER WATER TEMPERATURE) ECWT THIS MACHINE CAN OPERATE WITH?

The maximum entering condenser water temperature is based upon the pressure limits of the shells. The chiller can operate as long as you are within the acceptable lift range for the impeller. The YMC² chiller can be used as a heat pump with ECWT temperatures around 140˚F (60˚C) with leaving temperatures around 150˚F (66˚C).

DOES A MAGNETIC BEARING UNIT OPERATE WITH ENTERING CONDENSER WATER ABOVE 90˚F (32˚C)? HOW DOES INVERTED OPERATION FIT INTO THE CHALLENGING CONDITIONS IN THE MIDDLE EAST?

Lift can be reduced on the chiller in multiple ways. Data centers may be using a 70˚F (21˚C) leaving condenser water. In the ME, the design condition is for 90˚F (32˚C), but there will be many operating hours below this condition. You could still utilize lower ECWT. It is still possible for the chiller to run in an inverted manner.

I DO NOT THINK THAT 0.1 KW/TR IS A REALISTIC VALUE FOR A CHILLER. ARE THESE RATINGS AHRI CERTIFIED?

These ratings fall within AHRI standards based on percent load values, but the application rating table for the AHRI program does not extend below 50-55˚F (10-13˚C) ECWT. AHRI does not typically test at these conditions with low entering condenser water temperature because in the past chiller technology did not allow operation at these temperatures. We stand behind all of our ratings, and would test for these points at the factory with customers present on their YMC² chiller.

IS THE EFFICIENCY IN THIS STUDY AFFECTED BY A PRIMARY VARIABLE SYSTEM?

Constant pumping values were used on the slides for simplicity, but the case study with the third party consulting engineering firm used variable primary flow on the evaporator. Variable primary flow can also be used on the condenser, but you need to weigh the savings on the pump versus the energy savings on the chiller.

AT VERY LOW LOADS SUCH AS INVERTED DUTY, ARE THERE CONTROL ALGORITHMS THAT OPEN THE FLOW METER TO ALLOW FOR GAS EXCHANGE? WILL THE GAS TEND TO STAY IN THE COLDER CONDENSER?

At very low loads we are still running and spinning the impeller. Liquid refrigerant is moving from the condenser to the evaporator. The refrigeration cycle is still being completed as it would at 50% load, just with lower water temperatures.

DOES THE BASIC REFRIGERATION CYCLE REMAIN THE SAME WHEN RUNNING INVERTED? IS IT THE SAME FOR VARIABLE FLOW?

If your pressures are inverted, then you will stack refrigerant in your condenser until you starve your evaporator and trip on low pressure to save the chiller from freezing tubes in the evaporator water circuit. However, when the chiller is running inverted the refrigerant temperatures and pressures are not inverted, just the entering condenser and leaving evaporator temperatures. This means the basic refrigeration cycle is operating the same during inverted duty.

YORK®

Project:
Unit Tag:
Engineer:
Customer:

Rating Program: LTS 1.0.6005
Software Version: YW 16.03b
Date: 08/22/2016 08:05:51

Partload Data (Minimum Condenser Water Temperature)										
CEFT (°F)	% LOAD									
	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%
85.00°	0.5287	0.5142	0.5000	0.4930	0.4965	0.5096	0.5386	0.5960	0.7973	-
80.00°	0.4737	0.4554	0.4427	0.4348	0.4322	0.4386	0.4578	0.5068	0.6508	1.303
75.00°	0.4202	0.4015	0.3882	0.3796	0.3712	0.3767	0.3925	0.4221	0.5351	1.068
70.00°	0.3707	0.3516	0.3368	0.3253	0.3174	0.3147	0.3250	0.3495	0.4032	0.8147
65.00°	0.3277	0.3062	0.2894	0.2760	0.2663	0.2589	0.2623	0.2807	0.3197	0.6510
60.00°	0.2885	0.2654	0.2457	0.2299	0.2181	0.2097	0.2066	0.2181	0.2470	0.3751
55.00°	0.2526	0.2281	0.2062	0.1880	0.1739	0.1642	0.1577	0.1616	0.1804	0.2564
50.00°	0.2229	0.1948	0.1708	0.1510	0.1347	0.1209	0.1125	0.1088	0.1181	0.1600
45.00°	0.2054	0.1749	0.1472	0.1271	0.1040	0.08943	0.07931	0.08274	0.1253	0.2173
40.00°	0.2008	0.1737	0.1487	0.1259	0.09605	0.08181	0.07299	0.08996	0.1443	0.2232
39.00°	0.2007	0.1739	0.1489	0.1267	0.09634	0.08219	0.07118	0.08874	0.1430	0.2228
38.00°	0.2009	0.1742	0.1492	0.1272	0.09691	0.08300	0.07124	0.08753	0.1414	0.2224
37.00°	0.2014	0.1747	0.1496	0.1278	0.09816	0.08435	0.07236	0.08634	0.1398	0.2220
36.00°	0.2021	0.1754	0.1502	0.1284	0.1012	0.08573	0.07350	0.08517	0.1381	0.2216
*Values are in kW/Ton.R										

FOR THE 1,000 TON AT NEAR 0 HEAT BALANCE, WHAT WAS THE LOWEST KW/TON?

Looking at our 500 Ton example, we see that the lowest kW/Ton is 0.07118kW/TR occurring at 40% load with 39˚F (4˚C) CEFT. These values will vary depending on the capacity and application of the chiller.

CAN THE CHILLER DELIVER 100% CAPACITY WHEN RUNNING INVERTED?

Yes it can. The table where we showed performance demonstrated the 100% load point with varying water temperatures down to 36˚F (2˚C). We can achieve 100% load at 40˚F (4˚C) CEFT for 0.2008 kW/Ton.

WHAT IS THE UNLOADING CAPABILITY OF THE YMC² CHILLER AT CONSTANT ECWT?

On this table, we can see at 85˚F (29˚C) ECWT that we can get down to a minimum load of 10-15%. It is going to vary based on the application and the chiller you have selected, but we typically see turndown to 10% on the YMC² chiller.

WERE CUSTOM CHILLER UNLOADING CURVES MODELED IN EQUEST OR WERE STANDARD UNLOADING CURVES APPLIED TO OBTAIN THE FINANCIAL COMPARISON IN THE CASE STUDY?

We used standard ratings similar to what was shown previously on the matrix. The ratings were utilized from the chiller software that our engineers use.

HOW IS IT POSSIBLE TO OPERATE IN AN INVERTED MANNER AND STILL CIRCULATE THE REFRIGERANT?

Typically, the customer is concerned about water temperatures but we are concerned about refrigerant temperatures and pressures. Just because the temperatures entering and leaving the chiller are inverted does not mean the saturation temperatures inside the chiller are inverted. We are always maintaining a positive pressure differential between the condenser and evaporator. Because of this we are always able to move refrigerant throughout the system to maintain these conditions.

PRESCRIPTIVE REQUIREMENTS OF ASHRAE SAY THE WATERSIDE ECONOMIZER MUST BE PIPED IN AN INTEGRATED ARRANGEMENT. IT CANNOT RUN IN PARALLEL AS YOUR CASE STUDY DESCRIBES. DOES AN INTEGRATED WATERSIDE ECONOMIZER YIELD DIFFERENT RESULTS?

The slide was simplified for visual purposes. Compliance with ASHRAE depends on your climate and location, but there are many ways you can comply. Using a non-prescriptive path in our case study, we could show that the waterside economizer was not required.

HAVE YOU SOLD THIS CONCEPT OF ELIMINATING THE WATERSIDE ECONOMIZER IN THE PUBLIC SECTOR, WHERE COMPETITOR BIDS ARE REQUIRED? DO YOU HAVE A SOLE SOURCE JUSTIFICATION SINCE YOU ARE THE ONLY ONE THAT CAN RUN CONTINUOUSLY INVERTED?

We typically encourage the owner to look at these cases from a system standpoint. There is a specific need that must be met and solutions may involve a chiller and waterside economizer or just a chiller. At the end of the day, the customer is buying a system and not just a chiller so the owner needs to take into account all of the system costs and their operating costs. There are many ways to solve a system problem and we just want to help find the best way to do it.

If you have additional questions, please contact BE-ChillerSolutionsMarketing@jci.com