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VTech e-news

vtech e-news | winter 2009 | 1

#10

Customer Focus

Kaori Heat Treatment adds Second MasSpec

The recent installation of the second VTech MasSpec Automatic Outside-in Helium Leak Test System at Kaori Heat Treatment in Taiwan, shows that leading manufacturers are sold on the idea of leak free coils and the leak detection technology VTech can provide.

The differences between the second and first machine are in the application and the design of the machine itself. Luckily we're flexible enough to have the ability to provide customer-intimate solutions.

The application involves heat exchangers that have three independent circuits, some of them quite large, which need to be tested for external as well as internal leaks. Cycle times run anywhere between 1-2 minutes, depending on the size of the part.

On the design side, special tooling of the test hoses makes independent circuit testing possible. Another design enhancement involves a variable hood volume, to further aid in helium concentration efficiency, so extra gas is not wasted by testing small parts inside a large containment hood.

Our Technical who supervised the installation, says "Compared to inside-out helium leak testing, also known as vacuum chamber testing, the outside-in test is cost-effective both from an investment standpoint but also on a helium consumption basis. The machine doesn't need costly roots blowers and a steel vacuum chamber. We are pulling a vacuum through the coil being tested and looking for any helium molecules that might come through a leaking coil."


Large Heat Exchangers to be tested

Industry News

Getting Ready for R410a

By January 1, 2010, new refrigeration and air conditioning equipment will no longer be produced using R-22 as a refrigerant. R22 will still be produced for servicing existing equipment, but by the year 2020, R22 will only be available from previously recovered and recycled sources and will no longer be produced.

If you currently use R22 and are faced with issue of the changeover, R410a may be a refrigerant you are considering. R410a is very different from R22 and so there are various issues associated with the changeover, namely the much higher discharge pressure.

The first rule of thumb is that there is no "drop-in" replacement for any refrigerant currently being used. Each substitute refrigerant used will require some design changes in the refrigeration system. An R22 system cannot be charged with R410a since the components were not rated for the higher pressures associated with it.

There are several reasons why R410a is being considered as a suitable replacement for R22:

- High cooling capacity: equipment designed for R410a has been shown to have up to a 40% higher capacity compared to R22.
- Easy servicing: While R410a is a blend, it behaves more like a pure refrigerant and therefore it can be re-charged into the system repeatedly with danger of inconsistent mixing.
- Safe: R410a has an A1 ASHRAE safety classification

Most manufacturers who will be

(Continued on page 4)

Technical Focus

Sizing of Vacuum Pumps: How Big Should I go?

Pumping speed, or capacity, is measured in terms of gas volume drawn in a length of time. Cubic Feet per Minute (CFM) or Cubic Meters per Hour (m^3/h) are the two standard measurements. The number corresponds to the volume of the suction chamber multiplied by the pump revolutions in the time unit and by a correction coefficient which is usually 0.85.

Conductance

As and example, for a pipe with a constant gas flow of Q, the quantity of conductance, C, can be expressed by:

$$C = \frac{Q}{P_2 - P_1}$$

Where P2 and P1 are the pressures at pipe sections 2 and 1 respectively. From a physical standpoint, conductance equates a resistance and expresses the ease in which the gas flow Q passes along the pipe itself.

Conductance is a function of two factors, circuit configuration and pressure. Conductance is relatively high when pump-down beings, and decreases progressively. Its values are particularly low for vacuum levels better than 1 mbar. For a typical straight tube with round sections, having a length (L) much larger than the diameter (D) conductance is calculated by means of the following formulae:

Viscous or Laminar Flow: When P x D > 5x10-1 torr x cm:

$$C = \frac{12.1xD^3}{L} \qquad [1 \bullet s^{-1}]$$

Molecular flow: When P x D < 1x10-2 torr x cm

$$C = \frac{135xD^4}{L}xP \qquad [1 \bullet s^{-1}]$$

It is understood that conductance under molecular flow is independent of the pressure P, not included in the second formula. So, the Viscous or Laminar flow is used most of the time when talking about conductance.

Actual Speed

The actual speed at a specific point of the circuit A never matches the nominal pumping speed *S* due to the constrictions and pressure fluctuations in the circuit itself. The actual speed looks more like this:

$$\frac{1}{A} = \frac{1}{S} + \frac{1}{C}$$

A refers to the hypothetical point in the circuit where the actual speed is present, where *C* is the conductance of the circuit between the pump inlet and section A of the circuit.

Assessing Optimum Pumping Capacity for Evacuating Refrigeration Circuits

Assuming a vacuum pump and standard refrigeration circuit, connected by means of quick release couplers and vacuum hoses to a tube 40 cm long x 1 cm in diameter, the conductance is considered to be 1 mbar.

The conductance is calculated from the Viscous or Laminar Flow formula, by adding the coefficient 3.6 the units l/s are converted to m^3/h

$$C = \frac{135x3.6x1^4}{40}x1 = 12.15m^3/h \qquad \text{(7.2 CFM)}$$

Example 1

A pump having a nominal pumping speed (S) of 100 m3/h and tube conductance (C) of 12.5 m^3/h, the actual speed, as determined by the formula above, at the service port is:

$$A = \frac{SxC}{S+C} = \frac{100x12.15}{112.15} = 10.8m^3/h \qquad \text{(6.4 CFM)}$$

Example 2

A pump having nominal pumping speed (S) of 20 m3/h and the same tube conductance of 12.15 m^3/h, the actual speed is:

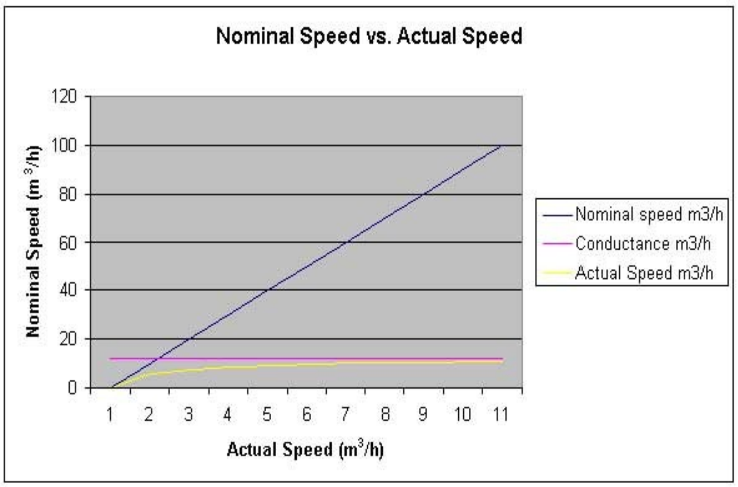
$$A = \frac{20x12.15}{32.15} = 7.56m^3/h \qquad \text{(4.5 CFM)}$$

(Continued on page 3)

Pump Sizing Continued from page 2

It is clear to see from these two examples that it is pointless to employ large capacity pumps where smaller ones will sufficient. High capacity pumps have other applications, such as those using large vacuum chambers, but in a smaller refrigeration circuit, a 100 m³/h pump will generate only 30% more pumping capacity at 5 times the size of a 20 m³/h pump. In business language, that is a poor return on investment. Conversely, an undersized pump, less than 10 m³/h would involve a much longer initial pump-down time to reach the required pressure of 1 mbar from atmospheric pressure.

The optimum capacity is from 10 to 20 m³/h (5.9 to 11.8 CFM), allowing the desired vacuum level of 1 mbar to be obtained in a reasonable amount of time.



Using pumps that are too large is not only wasteful but may be dangerous as the larger suction capacity during initial pump-down causes an accelerated evaporation of moisture inside the system, causing freezing inside the circuit tubes. The heat involved in vaporizing moisture within the system can only be drawn from its surroundings, namely the water inside the system. Ice crystals thus formed would stay in the circuit throughout the evacuation process and pose a threat to the functioning of the refrigeration system.

The good news is that most of this work has been done for you by the manufacturer of the vacuum pump. Today's dual stage rotary vane pumps are designed more or less to meet the needs of the industry. Most manufacturers carry 5 to 7 sizes of vacuum pumps, ranging between 6.5 m³/h (3.8 CFM) to 145 m³/h (85 CFM). Ideally, the small to intermediate sized pumps are best suited (11.5 m³/h or 6.8 CFM to 18.0 m³/h or 10.6 CFM for instance).

Next time we'll look at pump-down time and the considerations that are made when determining how much time is required as well as how exactly to best employ the pumps.

This article is excerpted from VTech's publication "High Vacuum and the Refrigeration Industry." Copies are available upon request.

Galileo Galilei and the Vacuum Pump

By the 17th century, water pump designs had improved to the point that they produced measurable vacuums, but this was not immediately understood. What was known was that suction pumps could not pull water beyond a certain height: 18 Florentine yards according to a measurement taken around 1635 (about 9 or 10 meters). This limit was a concern to irrigation projects, mine drainage, and decorative water fountains planned by the Duke of Tuscany, so the Duke commissioned Galileo to investigate the problem. Galileo advertised the puzzle to other scientists, including Gaspar Berti who replicated it by building the first water barometer in Rome in 1639. Berti's barometer produced a vacuum above the water column, but he could not explain it. The breakthrough was made by Evangelista Torricelli in 1643. Building upon Galileo's notes, he built the first mercury barometer and wrote a convincing argument that the space at the top was a vacuum.

Industry Trends

Profiling: The Science Art of a Good Pressure Decay Test

A problem occurs when a unit under test, a refrigerant coil for instance, fails the initial pressure decay test but after the coil has undergone subsequent cooling, passes a retest. Temperature's impact on the test results is important, but what one is really looking for is consistency. Letting the coils cool down immediately after brazing is a good idea, but it doesn't end there.

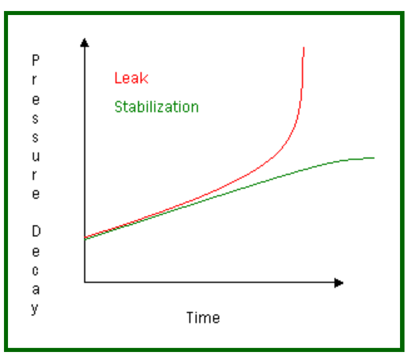
Profiling is a task that involves creating unit-specific parameters for the leak test, including testing pressure, the speed at which the dry air is introduced into the refrigeration circuit, stabilization time and test time.

The testing pressure is usually decided by the user's design specification. As an example, let's say it is 450 psig. Based on the size of the coil, the pressure will need to be set a little higher, say 465 psig. Once the pressure in the circuit stabilizes, it should level out at the desired test pressure. The speed at which the circuit is pressurized can have an effect on stabilization time. Pressurizing it too fast will show you larger fluctuations during stabilization.

The test time is the length of time the system monitors for any pressure drops (the VTech system can detect .010 psi drops in pressure). While the curve of the pressure drop will continue to fall incrementally the longer the test, there comes a point when the line is primarily flat. Depending again on the size of the coil, the profiler can fine tune the test time so that no extra time is wasted. See the chart at bottom right for more information.

Profiling for each individual coil is a critical step in fine-tuning your pressure decay leak test. While it is part trial and error, and part craft, there are a few concrete ideas that one must apply when profiling:

- The first is that one must assume the coil or part they have is a good unit.
- Next, make sure the fittings aren't leaking. You can run a "blank" test without the couplers hooked up to see if perhaps they have a leak.
- Realize that pressure decay is a gross leak test only and is limited in sensitivity by physics.



In profiling you are looking for the "sweet spot", so the target leak rate can be zeroed in by adding 50% of the actual leak rate at the time of the test's conclusion.

R410a Ready

(Continued from page 1)

switching to R410a will need to replace their existing charging equipment. VTech makes that easy with a high pressure filling head capable of charging all other common HFC refrigerants. Also, the machine has all of the refrigerant temperature and pressure data stored in its program logic. You've done all the design work necessary for the switch, so there's no need to worry about anything else. Basically, that means we're ready when you're ready. Contact us today for more details.

VTech's light and compact Refrigerant filling head

In the next issue:

- Alternative refrigerants: We take a look at other refrigerants besides R410a, including Hydrocarbon refrigerants and what's involved in creating a production line for them.
- Our technical series on vacuum continues with more information on pumping, specifically pump down times.
- Installation updates and more.