UNITED TECHNOLOGIES CARRIER

SERVICE BULLETIN

Title: 19DR DUAL COMPRESSOR SURGE (STALL)

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Models Affected: 17/19DR'S WITH DUAL COMPRESSORS

Purpose: To explain the difference between surging of single and dual compressor chillers and to explain 19DR surge control logic in the 3200MP microprocessor.

Single Compressor Surge

When the lift, (the pressure difference between the condenser and the cooler), imposed on a centrifugal compressor's impeller is greater than the impeller can maintain, the refrigerant flows from the condenser, back through the impeller to the cooler. The amps and the condenser pressure drop, while the cooler pressure rises and the noise level changes. As the pressure diff. decreases, it reaches a point where the impeller starts lifting again. If the cause of the high lift remains uncorrected, the surge continues in a cyclic pattern that repeats at a frequency dependent on the lift, but usually several times per minute.

Dual Compressor Chiller Surge

Although there are many similarities between surge on single and dual compressor chillers, there is a major difference. If surge occurred simultaneously in both compressors, the symtoms would be similar to those stated above, but, because of manufacturing and control differences, the two compressors do not surge at the same instant. When one of the compressors surges or stalls, its amps drop, the noise changes, and the gas flow reverses through the impeller. However, the second compressor keeps the lift up so the surging compressor stays in the stall condition for minutes, confusing those of us familiar with a rapid cycling surge. "Dual compressor surge" has been misdiagnosed as:

"One compressor is hogging all the gas."
"The other compressor won't load up."
"The check valve failed and is blocking the flow."
"The impeller clearance must be wrong."
"The guide vanes are broken."
"The compressors are fighting each other."
"The 3200MP boards have failed."

The surge or stall condition continues until the other compressor closes its guide vanes, reducing the system's lift, so the stalling impeller can pump again.

File Instructions: Installation, Start-Up, Operation

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19DR Control Concept - General

- Although their capacity may be a 60%-40% split, both compressors are designed for equal lift with impeller tip speeds the same.
- The lead compressor is controlled relative to chilled water temperature while the lag compressor tries to match the percent amps of the lead, playing "follow the leader" rather than looking at leaving water temperature. This makes motor current calibration of both compressors very important.
- With a decrease in load (amps) and/or an increase in lift (temperature difference between the condenser liquid and cooler liquid sensors), the 19DM diffuser wall algorithm gradually closes the wall, reducing the chance for surging, or stall.

Lead Compressor Surge (Stall) - Both Compressors Operating

- Lead amps drop off (even with guide vanes open or moving open).
- Lag compressor still not surging, keeps lift up so lead stays in stall for a long period of time (minutes-not seconds).
- Lag compressor sees low lead compressor amps, tries to match by closing guide vanes.
- Tons drop off and lift drops off.
- Lead comes out of stall and both load up again.
- Acts like single compressor machine except cycle time is minutes, not seconds.

Lag Compressor Surge (Stall)

- Lag amps drop off.
- Lag guide vanes open to try to match lead amps with no effect.
- Lead guide vanes will also open in attempt to make leaving chilled water temperature since lag isn't helping.
- Lead keeps lift up so lag stays in surge or stall.
- Anti-surging algorithm takes over.

Anti-Surge Algorithm - Lag Compressor Surge

Time	Event
0	Lag compressor surges. Recognized by control if lag compresor amps are 20% less than lead compressor amps.
2 min	If still surging, lead guide vanes close to drop off lift.
5 min	If still surging, shut down lag and display Code 88.

If between 2-5 minutes lag pops out of surge, resume normal temperature control.

If surge re-occurs, repeat sequence. After 3rd surge, in 1/2 hour, shut down lag.

Troubleshooting Surging 19DR

The items that historically have caused rapid cycling surge in a single compressor chiller will cause the slow cycling surge (stall) of a dual compressor chiller. These include, air (noncondensibles), fouled tubes, low condenser water flow, high condenser water temperature, division plate bypass, low refrigerant charge, etc..

Note, a 19DR purges fastest with just the "A" compressor on because the purge probe is on the "B" compressor end of the condenser and is more effective when there is less turbulence in that area.

Surging can be aggravated if the diffuser walls of 19DM compressors are too far open for the load and the lift conditions. Reconfiguring to a lower impeller diameter code will tend to move the wall closed.

Limiting the guide vane travel (with the actuator vane "open limit" microswitch) to that needed for full load at design suction pressure can help minimize the large amperage swings that can occur when the surging compressor comes out of surge with its vanes "open".

Software changes have been made to minimize surge problem and are included in the HK98EZ034 EPROM.

Lead amps hold for 2 min at 75% after lag start - were able to increase before lag caught up
Stop wall from opening if amps are 105% - high amps didn't limit wall opening.
Ensure lag diffuser wall closes for 4 minutes prior to start - insufficient closing time could result in Code 85.