Revision date: 4/21/2020

Category: I & O Manual Supplemental Guidelines

Subject: Split Refrigeration System Operation with Reduced Minimum Head Pressure

These guidelines are for Heatcraft refrigeration systems with air-cooled condensing units. Heatcraft included changes to the following head pressure settings for minimum Annual Walk-In Energy Factor (AWEF) compliant condensing units to reach efficiency levels mandated by the US Department of Energy (DOE) and Natural Resources Canada (NRCan):

- Medium temperature (and low temperature with hermetic reciprocating compressor)
  - 150 psi (from June 2017)
- Low temperature (except hermetic reciprocating compressor)
  - 150 psi (June 2017-November 2019)
  - 100 psi (from November 2019)

Typical minimum head pressure settings were 170-180 psi prior to implementation dates.

Outline

I. Important considerations for system installation and adjustment

Heatcraft's condensing unit installation manual (H-IM-CU) and unit cooler installation manual (H-IM-UC) are excellent sources of information for proper system installation and adjustment.
Please contact Heatcraft technical support for further assistance.

System General:

- Refrigerant charging (refer to H-IM-CU):
  - Follow the system charging guidelines in the installation manual. Insufficient refrigerant charge can significantly affect system operation in low ambient temperature conditions. Overcharge may not be evident until warmer ambient temperatures are experienced if guidelines are not followed.
  - The presence of refrigerant leaks may also result in insufficient refrigerant charge.

Condensing unit:

- Low pressure switch settings (refer to H-IM-CU) Page 17:
    - Follow the low pressure switch setting guidance in the installation manual. During startup, verify the cut-in and cut-out settings with a gauge of known accuracy.

- Optional low ambient kit (refer to H-IM-UC):
    - A low ambient kit (heated, insulated receiver and adjustable low pressure switch bypass time delay) are recommended for systems where ambient temperatures may fall below 0°F (-18°C). The factory-installed kit also includes a check valve between the condenser and the head pressure valve.

      The kit functions by elevating liquid receiver pressure during cold ambient temperatures which improves system startup reliability. The low pressure switch bypass time delay keeps the system running until head pressure can build sufficiently to maintain operation. The check valve prevents the condenser from reducing receiver pressure while the system is off.

- Head pressure valve operation:
    - Heatcraft employs thermostatic head pressure valves that flood a portion of the condenser to maintain a minimum head pressure during lower ambient conditions.
    - These valves may yield discharge pressures as much as 10% below their marked settings due to tolerances and thermostatic setpoint drift during lower ambient temperatures. This reduction has not caused system performance problems in Heatcraft laboratory testing.
    - Heatcraft has received field reports that the insulation of head pressure valves can be effective in reducing thermostatic setpoint drift. While not harmful to system operation, Heatcraft has not detected a head pressure increase in laboratory trials.

- Air-cooled condensing unit placement:
    - System starting and running reliability may be impacted by the presence of strong prevailing winds if they blow through the air-cooled condensing unit during extreme low ambient conditions. Providing a wind barrier that complies with Heatcraft clearance guidelines (refer to H-IM-CU) could be beneficial.
    - Heatcraft laboratory testing simulated moderate winds (up to 15 MPH) and they did not cause measurable negative effects to low ambient system operation.

- Condenser fan cycling:
    - The use of condenser pressure fan cycling control(s) may provide some benefit to system running reliability during extreme low ambient conditions. The control must be adjusted to turn the fan on above the head pressure valve setpoint and to turn off below the setpoint. This ensures that the head pressure valve is ultimately controlling the minimum head pressure during operation.

Unit Cooler:

- Evaporator superheat adjustment (refer to H-IM-UC):
    - Set expansion valve superheat when the system is near the box temperature setpoint. During cold ambient temperature start-up, raise the condensing pressure to the equivalent of 105°F (41°C) (during superheat adjustment) by restricting airflow to a portion of the condenser.

- Electronic expansion valves:
    - Electronic expansion valves do not rely on a pressure differential to operate the valve mechanism. They provide more precise control than a thermostatic expansion valve with reduced minimum head pressure systems and are a recommended system upgrade.
    - Heatcraft offers three system solutions with electronic expansion valves (intelliGen™ Refrigeration Controller, Beacon II Controller, and Quick Response Controller).

- Field-selected thermostatic expansion valve (refer to H-IM-UC):
    - Use an externally-equalized, balanced port expansion valve
    - Expansion valve power element must be suitable for the application range and refrigerant used.
    - Strap expansion valve sensing bulb to the suction line per the manual guidelines and insulate.
    - Expansion valve must have sufficient capacity at minimum head pressure (with the selected distributor nozzle) to work reliably. Using expansion valve manufacturer selection software or online programs is recommended to fully simulate summer and winter design conditions.
    - Default winter liquid refrigerant temperatures:
        - 60°F (16°C) for medium temperature (150 psi minimum head pressure).
        - 38°F (3°C) for low temperature (100 psi minimum head pressure).
    - Default summer liquid temperature: 95°F (35°C).
    - To avoid excessive oversize of the expansion valve at higher ambient conditions; the expansion valve should be sized for no less than 35% of its design capacity.

- Factory selected expansion valves (thermostatic and electronic)
    - Standard option packages for DOE/NRCan-compliant Heatcraft unit coolers are compatible with compliant Heatcraft condensing unit minimum head pressures for both thermostatic and electronic expansion valves. Valves for air defrost unit coolers are sized for medium temperature; electric and hot gas defrost unit coolers are sized for low temperature.
        - Alternate selections can be provided.
    - For legacy Heatcraft unit coolers, the compatibility with reduced minimum head pressures should be checked. Please consult Heatcraft Technical Support (ref: Heatcraft Engineering Bulletin 19002).

- Refrigerant distributor nozzle (when required by coil circuiting) DOE/NRCan-compliant Heatcraft unit coolers:
    - Heatcraft air defrost unit coolers are provided with nozzle kits that are compatible with selections for 150 psi minimum head pressure systems when used in medium temperature applications with typical refrigerants, evaporator TDs and liquid refrigerant temperatures.
        - Nozzles will also function acceptably at traditional (180 psi) minimum head pressure settings if compliance is not required.
    - Heatcraft electric and hot gas defrost unit coolers are provided with nozzle kits that include the optimized selections for 100 psi minimum head pressure systems when used in low temperature freezers with typical refrigerants, evaporator TDs and liquid refrigerant temperatures.
        - If nozzles are supplied for medium temperature applications (greater than 25°F (-4°F) room temperature), they are sized for 150 psi minimum head pressure.
        - Nozzles will also function acceptably at traditional (180 psi) minimum head pressure settings which can only be used if compliance is not required.
    - Nozzle kits for legacy Heatcraft unit coolers are compatible with DOE/NRCan-compliant Heatcraft condensing units.
    - Consult Heatcraft Application Engineering for non-standard selection assistance.

II. Potential problems associated with reduced head pressure and recommended actions

REDUCED HEAD PRESSURE LOW AMBIENT TROUBLESHOOTING (SUPPLEMENT TO TROUBLESHOOTING GUIDE IN H-IM-CU) PAGE 21			
Assumptions: Expansion valves and distributor nozzles are properly sized for seasonal operation. This should be checked first.			
Proceed to next check if symptoms are not alleviated.			
General Symptoms	**System will not start in lower ambient conditions**	**System will not run reliably in lower ambient conditions**	**Low compressor superheat observed during system operation**
Low Pressure Switch Symptoms	During cooling cycle start-up, suction pressure never reaches the low pressure switch cut-in setting.	During cooling cycle start-up, the low pressure switch short-cycles and never runs continuously.	N/A
Head Pressure Symptoms	N/A	Head pressure never increases to within 10% of minimum psi setpoint	N/A
Compressor Symptoms	OFF	Short Cycles, either after initial startup or continuously	Compressor runs, system may trip on oil pressure switch (if equipped)
Check #1	Check low pressure switch for correct settings, refer to Heatcraft manual H-IM-CU Page 17 for recommended adjustment procedure	Check low pressure switch for correct settings, refer to Heatcraft manual H-IM-CU Page 17 for recommended adjustment procedure	Check unit cooler for ice accumulation. Defrost if ice is present on the evaporator coil
Check #2	Lower the low-pressure switch cut-in setting until system starts reliably as a short-term remedy.	Check refrigerant charge	Check superheat at unit cooler, raise if below 6-8°F (3-4°C)
Action #2	If the system operates reliably, install a low ambient kit and re-adjust the low-pressure switch to recommended settings.	Correct refrigerant charge quantity / complete any necessary repairs	Raise superheat at unit cooler by 5°F(3°C)

Check #3	Call Heatcraft Tech Support	Lower the low-pressure switch cut-out setting until system runs reliably as a short-term remedy.	If the system does not have a suction accumulator and the superheat at compressor observed below 3°F(2°C) during operation
Action #3	---	If the system operates reliably, install a low ambient kit and re-adjust the low-pressure switch to recommended settings.	Install suction accumulator before the compressor