

5. Energy-Efficient Operation

Mindset: Be best prepared and be safe.

OBJECTIVE

Follow proper maintenance procedures for refrigeration systems to operate energy efficiently.

CHILLED-WATER SYSTEMS WITH AIR-COOLED CHILLERS

☐ General Observations

Refrigerant
Visual condition of condenser coil: clean/needs cleaning
Visual condition of chiller and piping installation
Compressor/motor vibrations/noise
Visual condition of adiabatic cooling system (pad or mist) (if installed) for condenser air cooling

☐ Measurement of Operating Parameters

Saturated evaporating pressure kg/cm² (psig)
Saturated condensing pressure, kg/cm² (psig)
Heat exchanger inlet/outlet temperatures, °C (°F)
Evaporator water inlet/outlet temperature, °C (°F)
Evaporator liquid flow, l/s (gpm)
Pressure at evaporator liquid inlet and outlet, kg/cm² (psig)
Pressure drop through evaporator, kg/cm² (psig)
Condenser air inlet/outlet temperature (TD), °C (°F)
Condenser airflow, m³/h (cfm)
Refrigerant temperature at condenser inlet/outlet, °C (°F)
Degree of superheat at inlet, °C (°F)
Degree of subcooling at outlet, °C (°F)

☐ Power Consumption Readings

Compressor power consumption

- At full load, kW/hp/(Btu/h)
- At partial load (%) kW (Btu/h)

Condenser fan power, kW (Btu/h)
Number of fans × power of each in kW = total kW (Btu/h)
VFDs, kW (Btu/h)
Belt drive loss, kW (Btu/h)

MEASURES OF SUCCESS

- ✓ Minimizing total energy use: kWh, kWh per year (Btu/h, Btu/y)
- ✓ Minimizing operation costs: energy, water, maintenance, etc.

CHILLED-WATER SYSTEMS WITH AIR-COOLED CHILLERS

☐ General Observations

Refrigerant
Visual condition of chiller and piping insulation
Compressor/motor vibrations/noise

☐ Measurement of Operating Parameters

Evaporating pressure, kg/cm² (psig)
Condensing pressure, kg/cm² (psig)
Heat exchanger inlet/outlet temperatures, °C (°F)
Evaporator liquid flow, L/s (gpm)
Pressure at evaporator liquid inlet and outlet, kg/cm² (psig)
Pressure drop through evaporator, kg/cm² (psig)
Water temperature at condenser inlet/outlet (TD), °C (°F)
Water flow through condenser, L/s (gpm)
Water pressure at condenser inlet and outlet, kg/cm² (psig)
Pressure drop through condenser, kg/cm² (psi)
Condenser water pump discharge pressure, kg/cm² (psig)
Refrigerant temperature at condenser inlet/outlet, °C (°F)
Degree of superheat at inlet, °C (°F)
Degree of subcooling at outlet, °C (°F)
Evaporator water inlet/outlet temperature, °C (°F)

☐ Power Consumption Readings

Compressor power consumption

- At full load, kW (Btu/h)
- At partial load (%) kW (Btu/h)

Chilled-water pumps, kW (Btu/h)
Condenser water pump, kW (Btu/h) Cooling tower fans, kW (Btu/h)

For additional guidance and resources, see *Assessing RAC Plant Sustainability*.



5. Energy-Efficient Operation

Mindset: Be best prepared and be safe.

CHILLED-WATER SYSTEMS: AHUS/FCUS FOR WATER-COOLED SYSTEMS

- ☐ **General Observations**
 - Visual condition of AHU insulation
 - Noise and vibration of the AHU/FCU
 - Filter condition
 - Cooling coil condition
- ☐ **Measurement of Operating Parameters**
 - Air inlet/outlet temperature (TD), °C (°F)
 - Water temperature at coil inlet/outlet (TD), °C (°F)
 - Water flow, l/s (gpm)
 - Water pressure drop through coil, kg/cm² (psig)
- ☐ **Power Consumption Readings**
 - AHu/FCU power consumption
 - At full load, kW/hp/(Btu/h)
 - At partial load (%) kW (Btu/h)
 - VFDs, kW (Btu/h)

VRF/VRV CENTRALIZED DX SYSTEMS

- ☐ **Outdoor Unit**
 - Main power source voltage
 - Operation circuit voltage
 - Fan noise and vibration
 - Fan operating current, amp
 - Outlet air temperature—inlet air temperature (TD), °C (°F)
 - Suction pressure, kg/cm² (psig)
 - Discharge pipe temperature, °C (°F)
 - Compressor operating current, amp
 - Oil sump heater
- ☐ **Indoor Unit**
 - Power source voltage
 - Room temperature, °C (°F)
 - Supply air temperature, °C (°F)
 - Fan rotation direction
 - Fan noise and vibration

CENTRALIZED DX SYSTEMS: AHUS/FCUS AND AIR COOLERS FOR COLD STORES FOR DX SYSTEMS

- ☐ **General Observations**
 - Visual condition of insulation on AHU
 - Noise and vibration of the AHU/FCU
 - Filter condition check
 - Coil condition check
- ☐ **Measurement of Operating Parameters**
 - Evaporating pressure, kg/cm² (psig)
 - Air inlet/outlet temperature (dry-bulb), °C (°F)
 - Air inlet/outlet temperature (wet-bulb), °C (°F)
- ☐ **Power Consumption Readings**
 - AHU/FCU motor power consumption
 - At full load, kW (Btu/h)
 - At partial load (%) kW (Btu/h)
 - VFDs, kW (Btu/h)

AIR-COOLED REFRIGERATION SYSTEMS

- ☐ **Refrigeration System**
 - Compressor suction pressure, kg/cm² (psig)
 - Compressor discharge pressure, kg/cm² (psig)
 - Compressor oil pressure, kg/cm² (psig)
 - Compressor motor current, amp
 - Condenser fan motor current, amp
 - Air-cooling unit fan motor current, amp
 - Ambient air temperature, °C (°F)
 - Airflow of ACU, m³/h (cfm)

For additional guidance and resources, see *Assessing RAC Plant Sustainability*.

