

# Integrated solutions to optimize your building's performance

## HVAC equipment systems

### YORK® water-cooled chillers

- Scroll (YCWL)**  
50–200 tons, HFC-410A refrigerant.
- Variable-Speed Screw (YVWA\*)**  
125–300 tons, HFC-134a refrigerant, future compatible with R-513A.
- Magnetic bearing variable-speed centrifugal (YMC2\*)**  
165–1,000 tons, permanent magnet motor, HFC-134a refrigerant, future compatible with R-513A.
- Magnetic bearing variable-speed centrifugal (YZ)**  
YZ tonnage range: 150 – 2020 tons, fully optimized for R-1233zd refrigerant.
- Variable-speed centrifugal (YK\*,†)**  
250–3,000 tons, HFC-134a refrigerant, future compatible with R-513A.
- Large capacity centrifugal chillers (YD, YK-EP, CYK\*, OM\*)**  
Up to 6,000 tons, HFC-134a refrigerant, future compatible with R-513A.
- Steam-turbine driven centrifugal (YST)**  
700–2,800 tons, HFC-134a refrigerant, future compatible with R-513A.

\*Heat Pump Option †Heat Recovery Option

### YORK® absorption chillers

- Absorption chillers/heat pumps (YHAU/YHAP\*)**  
30–2000 tons, water refrigerant, hot water, steam, natural gas, light oil.

\*Heat Pump Option

### YORK® air-cooled chillers

- Scroll (YCAL & YLAA†)**  
15–230 tons, HFC-410A refrigerant.
- Variable-speed screw (YVAA†, YCIV†)**  
150–500 tons, HFC-134a refrigerant, future compatible with R-513A.
- Free-cooling variable-speed screw (YVFA)**  
115–500 tons, free-cooling with integrated waterside economizer, HFC-134a refrigerant, future compatible with R-513A.

†Heat Recovery Option

### Energy recovery systems

- Energy recovery ventilators**  
200–40,000 CFM, indoor/outdoor energy recovery ventilation with *Metasys* control and BACnet® capability and a range of heating and cooling options.

### YORK® air handling units & coils

- YORK Solution™ Indoor air handling units**  
2,000–120,000 CFM, 2" foam double-wall panels with external frame, variable aspect, factory controls.
- YORK Solution™ Outdoor air handling units**  
2,000–50,000 CFM, 2" foam double-wall panels with external frame, variable aspect, factory controls. Membrane roof system with 10 year warranty, 2000 hr. salt spray exterior coating system, optional full-length service vestibule.
- YORK Custom air handling units**  
2,000–200,000 CFM, indoor and outdoor, 2", 3" or 4" foam double-wall panels with integral frame and high-strength base, full thermal break options, fully customizable.
- Coils**  
Max 48" fin height x 168" fin length, 1–12 rows deep, stackable water, glycol, steam, refrigerant, booster, aluminum or copper fins, special coatings available.

- Filtration**  
Complete line of commercial and industrial filters. Ranging from disposable to HEPA applications.

### Chilled beams

- Active chilled beams**  
Up to 1,700 BTU/h and 40 CFM per linear foot 9 active models for concealed, exposed, recessed applications. Available in 2 – 10 foot lengths.
- Passive chilled beams**  
Up to 500 BTU/h per linear foot. Exposed and recessed models available in 2 – 10 foot lengths.

### Terminal units & fans

- Fan-Coil units**  
200–2,000 CFM, exposed and concealed, horizontal and vertical, vertical stack, variable cabinet sizing, direct-drive, flexible factory-packaged valves and controls.
- VAV terminal boxes**  
75–8,000 CFM, single or dual-duct, series or parallel fan-powered, flexible factory-packaged controls, water and electric heat options.
- Direct Drive Blower Coils**  
150–5,500 CFM, for high capacity single and multi-zone use. Horizontal, vertical configurations utilizing direct drive ECM technology, single and three phase applications.
- Industrial and commercial fans**  
25–325,000 CFM, complete line of commercial, industrial, supply and exhaust fans.
- Laboratory exhaust**  
220–84,000 CFM, supplied with AMCA B Spark resistant construction. Configured into single double or triple fan systems for full redundancy.
- Fan arrays**  
250–200,000 CFM with static pressures up to 10 inwc. Great for new or retrofitting existing AHUs. Balance grade down to 1.0/ BV-5.

### Packaged & split ducted systems

- Packaged rooftop units**  
Several tiers of efficiency, multiple configurations, direct replacement options. 3–150 Tons.
- Dedicated outside air systems**  
Up to 18,000 CFM 100% outside air. High efficiency DX, energy recovery wheel and hot gas reheat options.
- Commercial split systems**  
1.5–50 tons, cooling only or heat pump outdoor units with matching cooling only, heat pump or electric heat indoor air handling units.
- Air-cooled condensing units**  
15–160 tons, HFC-410A refrigerant.

### Indoor packaged equipment

- Water source heat pumps (water-to-air)**  
0.5–25 tons, horizontal and vertical, console, and rooftop configurations; geothermal capable; up to 30 EER.
- Water source heat pumps (water-to-water)**  
3–70 tons, multiple units can be utilized as a system, geothermal capable; up to 18.4 EER.
- Water-cooled self-contained units**  
Cooling capacities (25 to 105 tons), modular design fits easily into tight spaces, indoor, heating options, factory mounted controls.

### YORK® variable refrigerant flow (VRF) systems

- Air-cooled condensing units**  
3–36 tons, heat recovery and heat pump modules and low ambient type for extreme climates. Air-cooled condensing units with all inverter scroll compressors and extended operating ranges.
- Water source units**  
6–48 tons, compact, lightweight and highly efficient unified heat pump and heat recovery units install indoors. Inverter scroll compressors and generous connection ratios.
- Indoor units**  
0.5–8 tons, fan coil units in multiple styles (concealed, wall mount, ceiling cassette); ducted and non-ducted; sensor options.

### YORK® mini-split systems

- Single zone**  
0.75–4 tons, single condensing unit with single indoor unit. Multiple styles, control options, capacities, operating ranges and efficiency ratings. Wi-Fi capable; Energy Star rated on select models. Inverter compressor standard on all models.
- Multi zone**  
1.5–3.5 tons, single condensing unit with 2–5 indoor units. Multiple styles, control options, capacities, operating ranges and efficiency ratings. Wi-Fi capable; Energy Star rated on select models. Inverter compressor standard on all models.

## Monitoring, Management, Automation and Repair Services

### Tailored Maintenance and Repair Services

- As the largest service organization in North America, we help your facility perform at optimum levels with predictive and diagnostic services, tailored to your facilities' need that can extend asset life, reduce repair costs and realize energy savings.

### Energy & optimization

- Enterprise Management**  
Advanced enterprise platform with apps for building & asset performance visualization, analytics and optimization to advance insights into action.
- Companion app & space performance**  
Occupant-facing mobile app for personalized control of lighting, temperature and space reservation with wayfinding and kiosk interactions.
- Central plant optimization**  
Every 15 minutes our algorithms automatically generate optimization decisions and implement them so you can minimize utility costs and maximize available utility incentives.

### Building automation & controls

- Metasys system**  
Metasys interface, servers, next-gen network engines and equipment controllers; designed for complex building environments. With wireless components for local room control or for Metasys field bus applications.
- Verasys system**  
Configurable building control system with embedded Smart Equipment technology designed for Light Commercial.
- Valves & actuators**  
Global product family offering for an end-to-end efficient HVAC system, including factory mounted six-way valves for FCUs and chilled beams.
- Sensors & thermostats**  
Specialized or general-purpose sensors and thermostats for Metasys, Verasys or other applications.
- Airflow control & other specialty products**  
Accurate, reliable airflow measurement to meet today's requirements.
- Variable speed drives**  
Variable speed drives sold individually or factory-mounted with a variety of HVAC equipment.
- Critical environment controls**  
Room pressure monitoring and controls, Venturi air valves, fume hood controls, high performance fume hoods, and lighting controls.
- PENN® Commercial Refrigeration**  
Full range of commercial refrigeration control solutions for temperature, pressure, humidity, airflow, and compressor/system lubrication.

### Remote Services

- Smart connected chillers**  
Remote monitoring and predictive diagnostics enabling condition-based maintenance for improving uptime, reliability and efficiency of chillers.
- Building asset mapping & health monitoring**  
24/7/365 monitoring of geo-spatially mapped assets on building floorplans to help facility and security operators identify devices out of health and risk compliance.
- Remote Operations Center – HVAC & BAS Monitoring**  
24/7 monitoring of the specified number of user-defined points by our UL-listed and FM-approved, CSAA Five Diamond remote operations center (ROC). Our center can securely record and report all event activity, respond following a customer-defined plan and optionally troubleshoot site issues and provide corrective recommendations.

# Psychrometric chart for HVAC analysis

## Air-conditioning formulas and conversion factors

Atmospheric pressure = 29.921" Hg. at sea level

1 BTU = Amount of heat required to raise (or lower)

the temperature of one pound of water 1°F

1 ton of refrigeration = 12,000 Btu/hr = 200 Btu/min

1 watt = 3.414 Btu/hr

1 horsepower = 2545.6 Btu/hr

1 ft (head) = 0.433 psi (at 62°F)

1 boiler horsepower = 33,475 Btu/hr

Air changes per hour (N) in a space

$$N = (60 \times \text{CFM}) / \text{space ft}^3$$

CFM = airflow rate (ft<sup>3</sup>/min)

Water quantity (GPM) required for heating and cooling

$$\text{GPM} = q / (500 \times \Delta t)$$

q = load in Btu/hr

t = water temperature

Chiller capacity (Tons)

$$\text{Tons} = (\text{GPM} \times \Delta t) / 24$$

GPM = gallons per minute of chilled water

t = water temperature

$$\text{Pump hp} = \frac{\text{GPM} \times \text{ft head}}{3960 \times \text{efficiency}} \times \text{specific gravity}$$

$$\text{Fan hp} = \frac{\text{CFM} \times \text{static pressure (in. W.G.)}}{6356 \times \text{efficiency}} \times \frac{\text{density of air}}{\text{density of standard air}}$$

Altitude Air density ratio at 70°F

2000 ft	0.930
4000 ft	0.864
6000 ft	0.801
8000 ft	0.743

Total cooling (Btu/hr) = CFM x 4.5 x Δh

Sensible cooling (Btu/hr) = CFM x 1.085 x Δt

Latent cooling (Btu/hr) = CFM x 4840 x Δw

CFM = airflow rate (ft<sup>3</sup>/min)

h = enthalpy (Btu/lb)

t = dry bulb air temperature (°F)

w = humidity ratio (lb water / lb dry air)

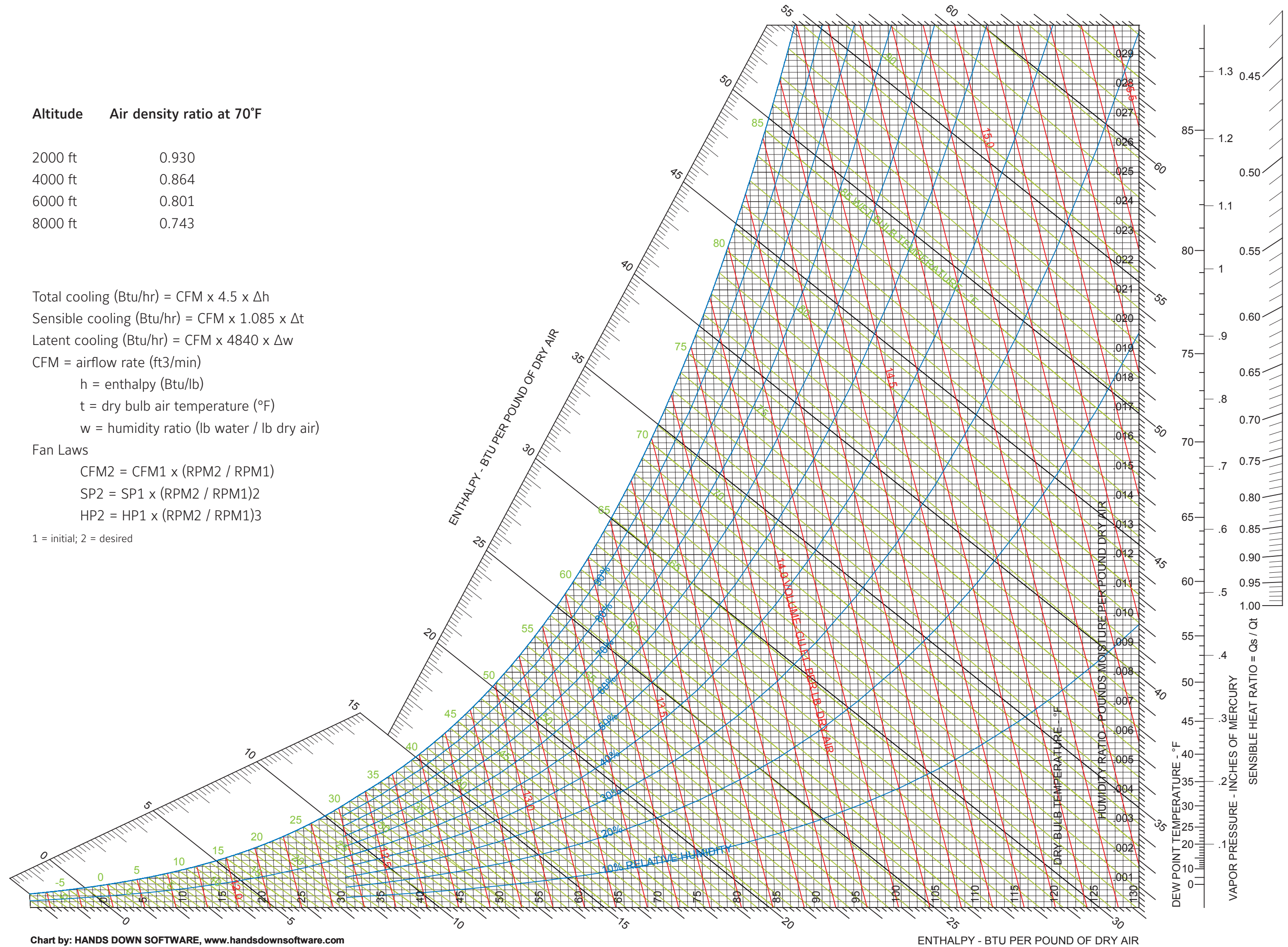
Fan Laws

$$\text{CFM}_2 = \text{CFM}_1 \times (\text{RPM}_2 / \text{RPM}_1)$$

$$\text{SP}_2 = \text{SP}_1 \times (\text{RPM}_2 / \text{RPM}_1)^2$$

$$\text{HP}_2 = \text{HP}_1 \times (\text{RPM}_2 / \text{RPM}_1)^3$$

1 = initial; 2 = desired



## About Johnson Controls Building Technologies & Solutions

Johnson Controls Building Technologies & Solutions is making the world safer, smarter and more sustainable – one building at a time. Our technology portfolio integrates every aspect of a building – whether security systems, energy management, fire protection or HVACR – to ensure that we exceed customer expectations at all times. We operate in more than 150 countries through our unmatched network of branches and distribution channels, helping building owners, operators, engineers and contractors enhance the full lifecycle of any facility. Our arsenal of brands includes some of the most trusted names in the industry, such as Tyco®, YORK®, Metasys®, Ruskin®, Titus®, Frick®, PENN®, Sabroe®, Simplex® and Grinnell®. **For more information, visit [www.johnsoncontrols.com](http://www.johnsoncontrols.com) or follow @johnsoncontrols on Twitter.**

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