MEP

CHEAT SHEET

USE THIS MEP REFERENCE GUIDE FOR HELPFUL INFORMATION AND ANSWERS TO COMMON QUESTIONS RELATED TO COMMERCIAL DESIGN PROJECTS.

For more information, go to

WilsonGirgenti.com

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**THIS REFERENCE GUIDE USES MOST COMMON OR TYPICAL ESTIMATES. DO NOT USE AS ACTUAL REQUIREMENTS WITHOUT FIRST CONSULTING WITH WG.*

HVAC

Estimated Square Footage Per Ton

Office: 250–350 sq.ft./ton
Restaurant: 100–200 sq.ft./ton
Residential: 400–500 sq.ft./ton
Warehouse (A/C 75°F): 400–500 sq.ft./ton
Warehouse (Tempered 85°F): 800–1000 sq.ft./ton

CFM Per Supply Diffuser Neck Size

6" neck: 0-120 CFM
8" neck: 121-250 CFM
10" neck: 251-400 CFM
12" neck: 401-650 CFM

VAV & Parallel PIU
(Heater sized to ~75% of design CFM):
Valve CFM = Design CFM

VAV/PIU CFM Per Inlet Size

6" inlet: 500 CFM max.
8" inlet: 900 CFM max.
10" inlet: 1400 CFM max.
12" inlet: 2000 CFM max.

Series PIU
(Primary valve air ~75% of fan CFM):
Fan CFM = Design CFM

Residential vs. Commercial A/C Unit Types

1. **Residential/Light Commercial**
   - Single-phase power, off-the shelf units: 1-5 tons
   - Most common systems: split systems, heat pumps, ductless split systems, VRF/VRV, packaged/RTU
2. **Commercial Range**
   - Three-phase power: 6+ tons
   - Dual-stage refrigeration circuits with dual-speed evaporator fan: 7.5+ tons
   - Most common systems: split systems, heat pumps, VRF/VRV, packaged/RTU, VAVRTU, condenser water system, chilled-water systems

Fan-Powered Unit (FPU) Types

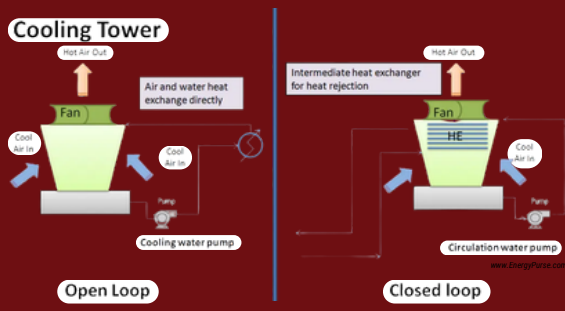
1. **Parallel** (more common, less expensive)
   Cooling mode acts as a single duct VAV (fan off), modulating valve air from the air handler. In **heating** mode, the fan activates and draws in space air temperature from the plenum for reheating using an electric coil heater or hot water coil.
2. **Series** (higher air quality/ventilation)
   In both **cooling** and **heating** mode, the fan operates continuously using a mixture of plenum and valve air to provide additional static pressure to the duct system. It modulates valve air from the air handler and plenum air. This allows for more air changes to the system than other terminal units.

Chiller/Condenser Water Systems

Most commonly designed for a 10°F ΔT (water)

1. **Condenser Water System with Water Source Heat Pumps**
   - Water source heat pumps reject heat to a water loop connected to an outdoor cooling tower
   - A heat exchanger can be introduced to separate the cooling water from the indoor equipment to the outdoor cooling tower (closed loop)
   - Most commonly operates with a water temperature range of 85-95°F
2. **Chiller System, Water-Cooled** (located indoors)
   - AHUs reject heat via a chilled water loop to the chiller, which then rejects heat to a condenser water loop connected to an outdoor cooling tower
   - Chilled water loops most commonly operate with a water temperature of 45-55°F
3. **Chiller System, Air-Cooled** (located outdoors)
   - AHUs reject heat via a chilled water loop to the chiller, which then rejects heat to the exterior environment
   - Chilled water loops most commonly operate with a water temperature of 45-55°F

Open Loop vs. Closed Loop Cooling Tower



*1 PSI = 2.31 ft. of height/head (used to calculate pumps)
2.5-3 GPM of water flow = Approx. 1 Ton of cooling
BTU per hour = **500 X GPM X ΔT** of water/change in water

After-hours Cooling

1. **Option 1: Pay for extra use**
   Because building HVAC systems shut down in an unoccupied mode outside of building operating hours, tenants pay for cooling/heating typically by an hourly charge to operate the building's HVAC system before or after those hours.
2. **Option 2: Tenant-supplied supplemental A/C**
   Tenant provides supplemental A/C system that is electrically submetered, allowing for cooling and heating outside building operating hours.

Acronym Definitions

HVAC = Heating, Ventilation and Air Conditioning
CFM = Cubic Feet Per Minute
VAV = Variable Air Volume
PIU = Powered Induction Unit
VRF = Variable Refrigerant Flow
VRV = Variable Refrigerant Volume
RTU = Rooftop Unit
VAVRTU = Variable Air Volume Rooftop Unit
ΔT = Delta T (temperature difference)
PSI = Pounds Per Square Inch (force exerted)
GPM = Gallons Per Minute
BTU = British Thermal Unit (a unit of heat energy)

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ELECTRICAL

POWER CONVERSION

KiloWatts (kW) = Voltage (V) * Amperage (A) * Phase (Ph)
For single-phase power: **kW = V * A * 1Ph**
For three-phase power: **kW = V * A * 1.73Ph**
1kW = kVA * pf (We can typically assume a 1pf.)

The same load (kW) powered at higher voltage draws lower amperage. We use higher voltage for higher amounts of power and farther distances to minimize amperage for smaller wire and gear sizes.

1 KILOWATTT =

- 8.3A for 120V/1Ph
- 4.2A for 240V/1Ph
- 2.4A for 240V/3Ph
- 1.2A for 480V/3Ph
- 4.8A for 208V/1Ph
- 2.8A for 208V/3Ph
- 3.6A for 277V/1Ph

1 TON OF A/C =

- ~1.5kW for DX cooling/heat pump.
- ~1.2kW for condenser water cooling.
- ~1kW for chilled water cooling.
- ~2kW for electric heating.

Power Density/Demand (approximate)

OFFICE

20-25 W/sq. ft.

Tenant Lighting: 1W/sq. ft.
Receptacles/Outlets: 5W/sq. ft.
HVAC: 10-20W/sq. ft.

Medical Office (no imaging equipment): 25-30W/sq. ft.
Medical Office (with imaging equpiment): Varies significantly. Consult with WG.

RETAIL

25-30 W/sq. ft.

For amperage at 208V/3Ph:

SERVICE SIZE	AMPS
0-2500 sq. ft.	200A
2501-5000 sq. ft.	400A
5001-8500 sq. ft.	600A
8501-11500 sq. ft.	800A

Consult with WG for other voltages 240V/1Ph, 240V/3Ph, 480V/3Ph.

RESTAURANT

50-75 W/sq. ft.

For amperage at 208V/3Ph:

SERVICE SIZE	AMPS
0-1500 sq. ft.	225A
1501-3000 sq. ft.	400A
3001-4500 sq. ft.	600A
4501-8000 sq. ft.	800A

Consult with WG for other voltages 240V/1Ph, 240V/3Ph, 480V/3Ph.

MULTIFAMILY

27-33 W/sq. ft.

Building voltages:
240V 1Ph, 208V 3Ph, 480V 3Ph

Dwelling unit voltages:
208V 1Ph, 240V 1Ph

Dwelling unit electrical panel size:
0-1500 sq. ft. = 100-150A

NEC allows for reduction in building service size based on increased number of dwelling units.

Site Lighting Design Information Needed

- Civil CAD
- Landscaping CAD/PDF
- Identify if buildings need perimeter lighting.
- Identify if lighting will be owned or rented from a utility company.

Metering (Varies By Utility/Jurisdiction)

- Up to 200A, direct read metter
- 201-400A, direct read or CT meter
- Over 400A, CT meter

Digital submetering is available for individual tenant/loads.

Backup Power*

*Varies by tenant usage and typically sized at 60-75% of the connected load, or 1.5x max of historical demand.

1. **Option 1: UPS -** Provides uninterrupted short-term backup power (typically seconds to a few minutes).
2. **Option 2: Generator -** Provides fast, but non-instantaneous long-term backup power.
3. **Option 3: Combination of UPS and Generator -** Provides uninterrupted and long-term backup power.

Lighting Power Allpowances*

*Based on International Energy Conservation Code

- Bar/Lounge/Leisure: 0.90 W/sq. ft.
- Cafeteria, Fast Food: 0.79 W/sq. ft.
- Family Dining: 0.78 W/sq. ft.
- Health Care Clinic: 0.82 W/sq. ft.
- Hospital: 1.05 W/sq. ft.
- Office: 0.79 W/sq. ft.
- Retail: 1.06 W/sq.ft.
- Warehouse: 0.48 W/sq. ft.
- Workshop: 0.90 W/sq.ft.

Occupant Sensor Controls*

*Based on International Energy Conservation Code

Occupancy sensors are typically required in:

- Classrooms/Lecture/Training Rooms
- Conference/Meeting/Multipurpose Areas
- Copy/Print Rooms and Lounges/Break Rooms
- Enclosed or Open-plan Offices
- Restrooms and Locker Rooms
- Corridors
- Storage Rooms or Warehouse Storage Areas
- Other spaces 300 sq. ft. or less enclosed by floor-to-ceiling height partitions

Acronym Definitions

- kW = Kilowatts
- V = Voltage
- A = Amperage
- Ph = Phase
- kVA = Kilovolt-ampere
- pf = Power Factor
- DX = Direct Expansion Cooling
- W = Watt
- NEC = National Energy Code
- CT = Current Transformer
- UPS = Uninterruptible Power Supply

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PLUMBING

HOT WATER SYSTEMS

TANK

- Requires more storage space.
- Weight makes wall-mounting difficult.
- Requires low gas or electric input due to stored hot water.

VS

TANKLESS

- Requires less space.
- Mounted on a wall or outside.
- Requires higher gas or electric input due to on-demand heating.

GAS

Tank and Tankless
- Natural gas or propane options.
- Requires venting and intake air for combustion.
- Electric power is only required for control.

Tankless only
- Can be installed in series of multiple heaters for larger loads.

VS

ELECTRIC

Tank and Tankless
- Does not require venting to outdoors.
- Needs significant electric power for higher heating capacity.

Tankless only (not recirculated)
- AKA Point-of-use/Instahot.
- Common sizes for break room:
  - **Single sink:** 3-4kW
  - **Single sink + dishwasher:** 9kW

RECIRCULATION:
Most hot water systems require recirculation, but it depends on the distance from the source to the fixtures.

Water Distribution Systems*
*Based on International Plumbing Code

WSFU for common fixtures:

Public lavatory: 2 WSFU
Urinal: 5 WSFU (¾" water supply).
Water closet flush valve: 10 WSFU (1" water supply).
Water closet tank type: 5 WSFU

Flush Valves and Tanks:

Flush valve water closets require larger water mains than tanks.
A 2 in. line will serve 5-12 flush valves.

Flush tanks can be pressure assisted to help with better drainage.

Drainage*
*Based on Uniform Plumbing Code

Minimum pipe slope:

- **2% slope:** 2 ½ in. or less pipe diameter is minimum of ¼ in. per ft. of pipe length.
- **1% slope:** 3-6 in. is min. ⅛ in. per ft.
- **0.5% slope:** 8 in. and above is min. 1/16 in. per ft.

General calculations:

2 in. pipe diameter: 6 DFU max for a horizontal branch.
3 in. pipe diameter: 20 DFU max for a horizontal branch, 36 DFU max for a main building line.
4 in. pipe diameter: 180 DFU max for main building line.
6 in. pipe diameter: 700 DFU max for main building line.

General calculations:

Lavatory: 1 DFU | Urinal: 4 DFU | Water closet: 4 DFU

Gas Pipe Sizing*
*Based on Uniform Plumbing Code

Gas piping is sized based on the total load of connected equipment and the distance the meter is from the point of use. The further away the meter is, the larger the piping will be. Different gas pressures also affect the size of piping. A higher pressure will permit smaller piping mains, where a lower pressure will use larger piping mains.

Common pressures: 0.5 PSI, 2 PSI, 5 PSI

Storm Drain Calculations
*Based on Uniform Plumbing Code

GPM is used to select pipe sizes. A quick GPM estimate for locations with 4.4 in. per/hr. of rainfall (like in central Texas) is approximately 0.046 GPM per sq. ft.

Grease Seperation Devices

GREASE INTERCEPTOR (GGI)

- More traditional choice using precast concrete which degrades and collapses over time, resulting in a shorter life span.
- Less expensive, but more difficult to install.
- Typically installed outside the facility.
- Sizing based on time retention, yielding a larger interceptor.
- Universally accepted by municipalities.

Min. size: ≤750 gallons | Max size: ≤1250 gallons
For >1250 gallons, multi-chambered grease interceptors or grease interceptors in a series are required.

Consult with WG for sizing calculations.

VS

GREASE TRAP (HGI)

- Newer methodology using a synthetic material (longer life span).
- More expensive, but has a longer lifespan.
- Can be installed outside or inside of a facility.
- Sizing based on flow rate/grease storage, yielding a smaller trap.
- Not all municipalities accept it yet.

Min. size: ≤10 gallons (Schier GB-1 model)
Max size: ≤1000 gallons (Schier GB-1000 model)
For >1000 gallons, grease traps in a series are required.

Consult with WG for sizing calculations.

Although **grease interceptor** and **grease trap** are commonly used interchangeably, they are two different device types for grease storage/removal.

Acronym Definitions

AKA = Also Known As
IPC = International Plumbing Code
WSFU = Water Supply Fixture Units
gpf - Gallons Per Flush
DFU = Drain Fixture Units
PSI = Pounds Per Square Inch
GPM = Gallons Per Minute
AHJ = Authority Having Jurisdictions
L = Length
W = Width
D = Depth
GGI = Gravity Grease Interceptor
HGI = Hydromechanical Grease Interceptor