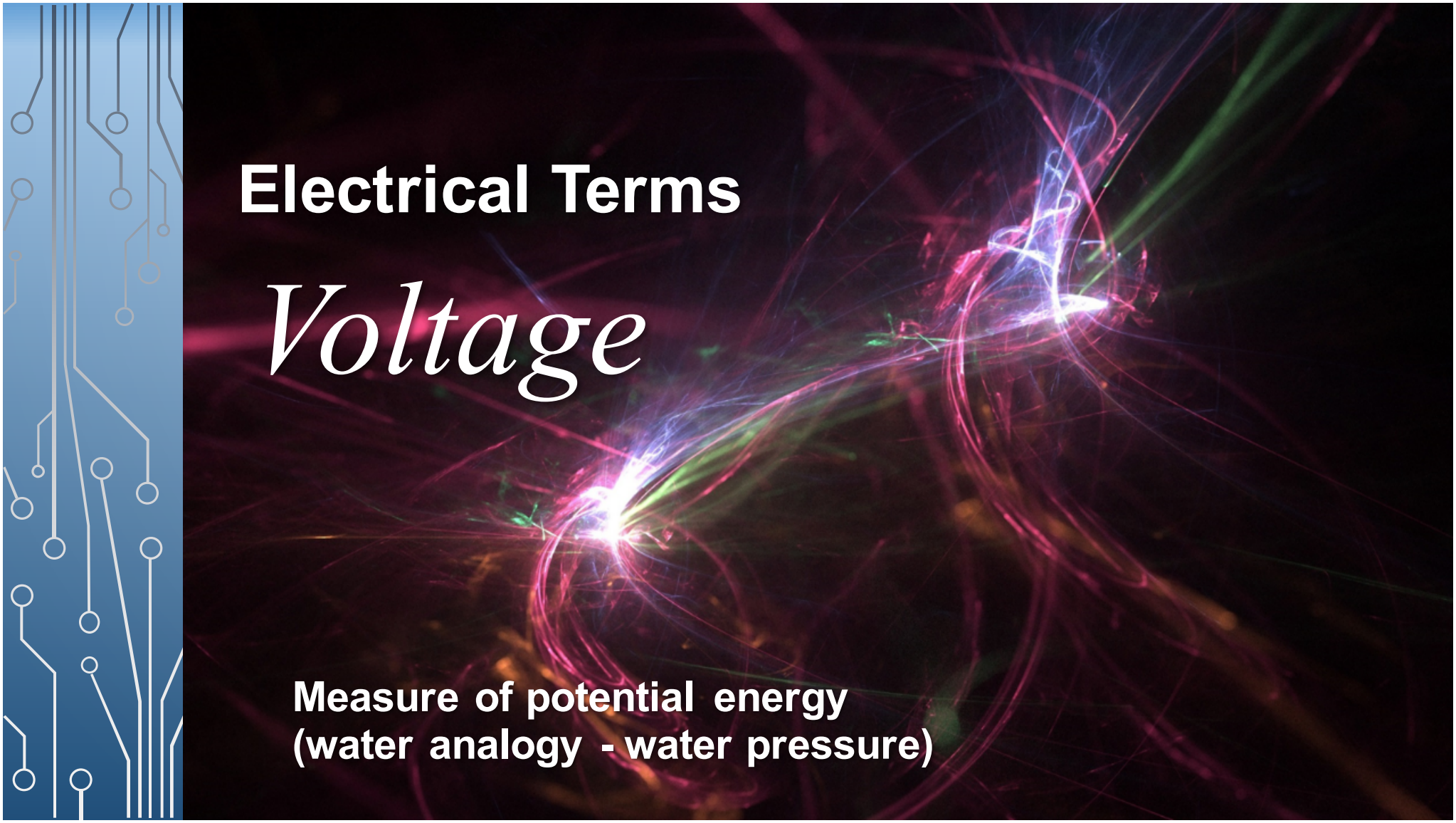

FCSI
LIVE FROM NASHVILLE
APRIL 14 -16 2016
Intro Breakout
MEP/HVAC/123
Steve Carlson, FCSI
Saturday, April 16 – 10:30-11:45 a.m.

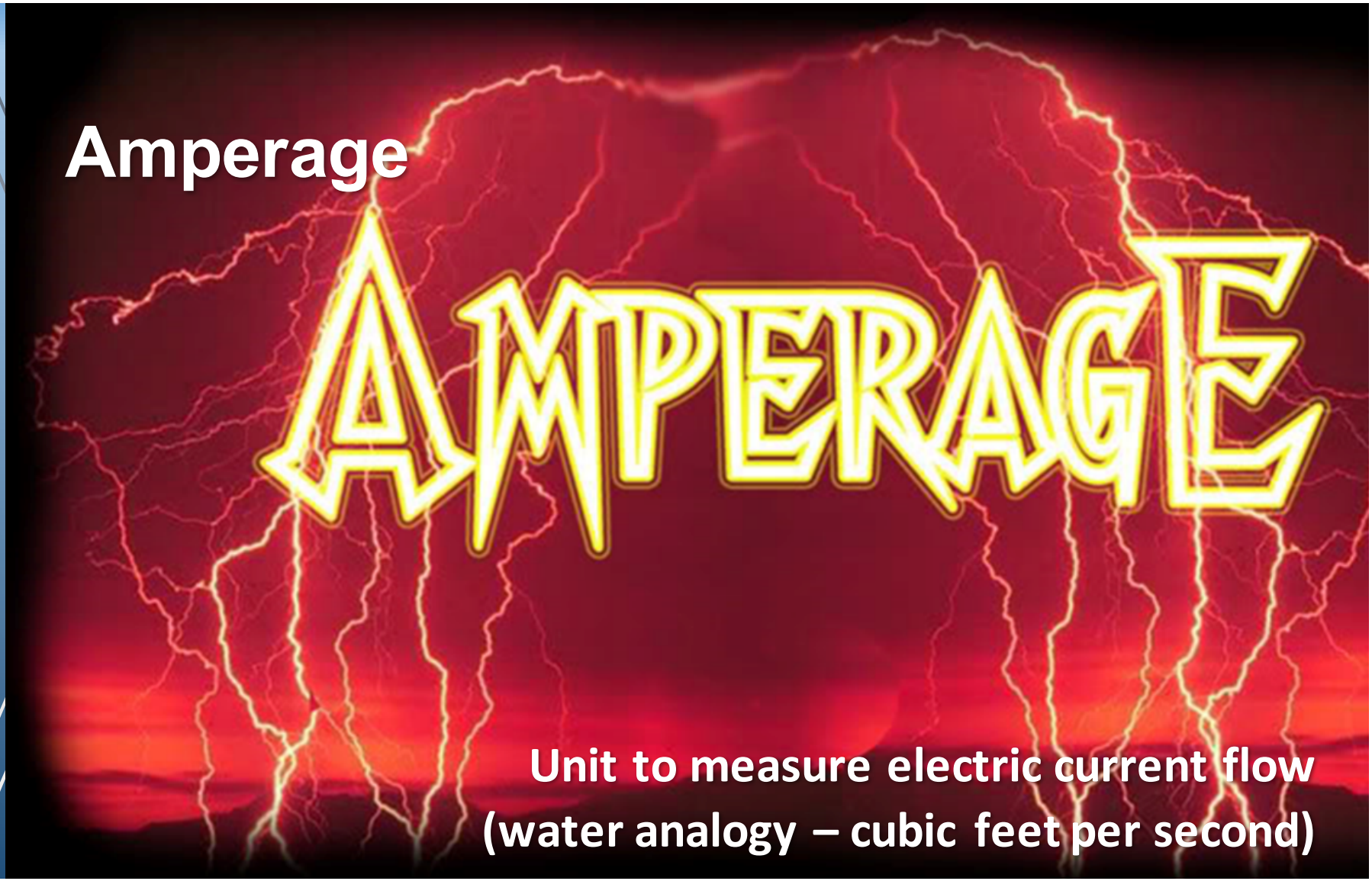

MEP HVAC
123

What we will cover

- Electricity
- Plumbing
  - Water
  - Gas
  - Drains/waste
  - Steam
  - Refrigeration
  - Chilled water
  - Exhaust


Electrical Terms
Voltage
Measure of potential energy
(water analogy - water pressure)

Amperage


AMPERAGE
Unit to measure electric current flow
(water analogy – cubic feet per second)

Watt-A

Unit of electrical power, amount of energy expended per second (electrical push)

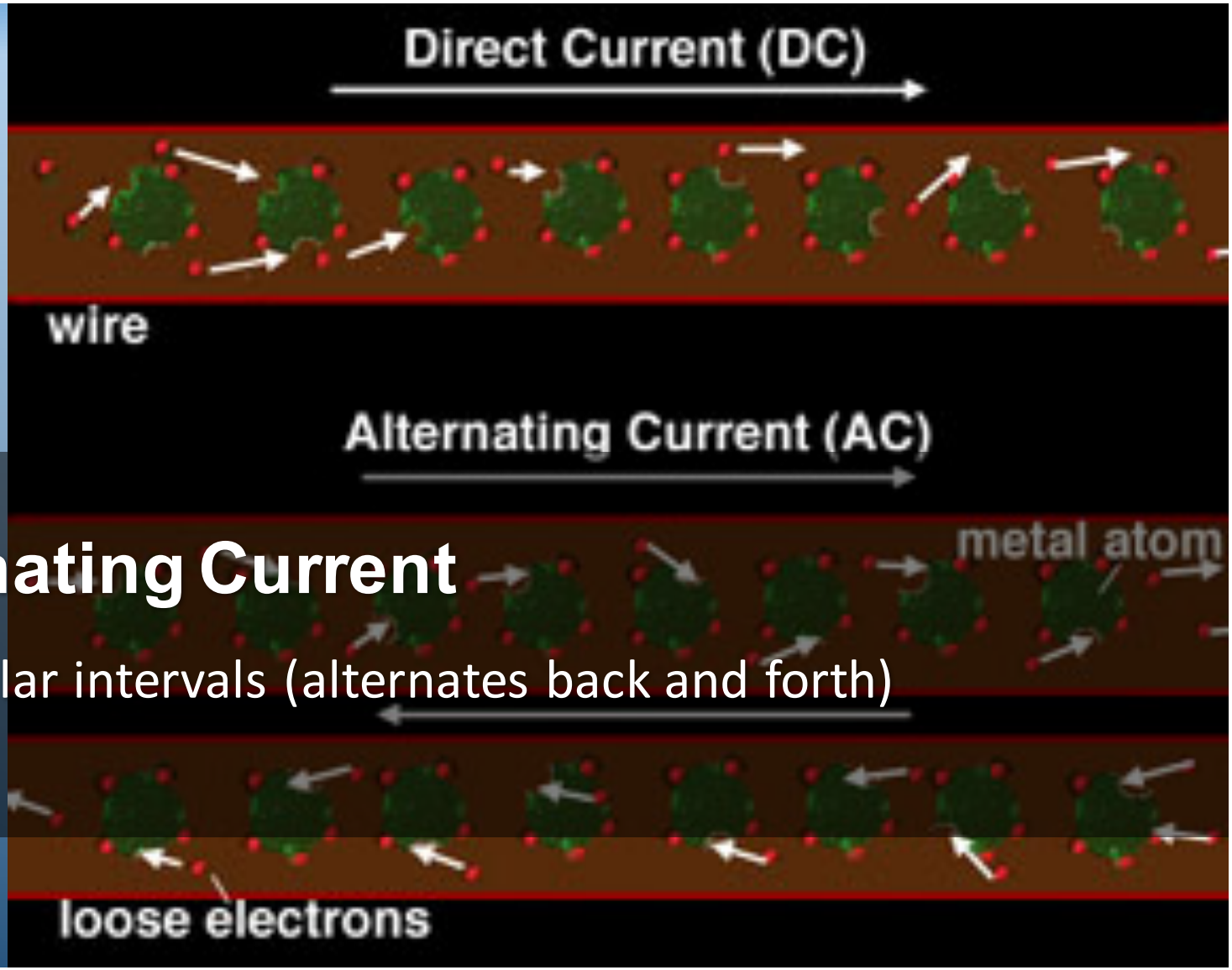
DC - Direct Current

Consistent current flowing in one direction (i.e. battery or solar power)

Used for some elevators in Chicago Loop area

AC - Alternating Current

Reverses at regular intervals (alternates back and forth)



Voltages

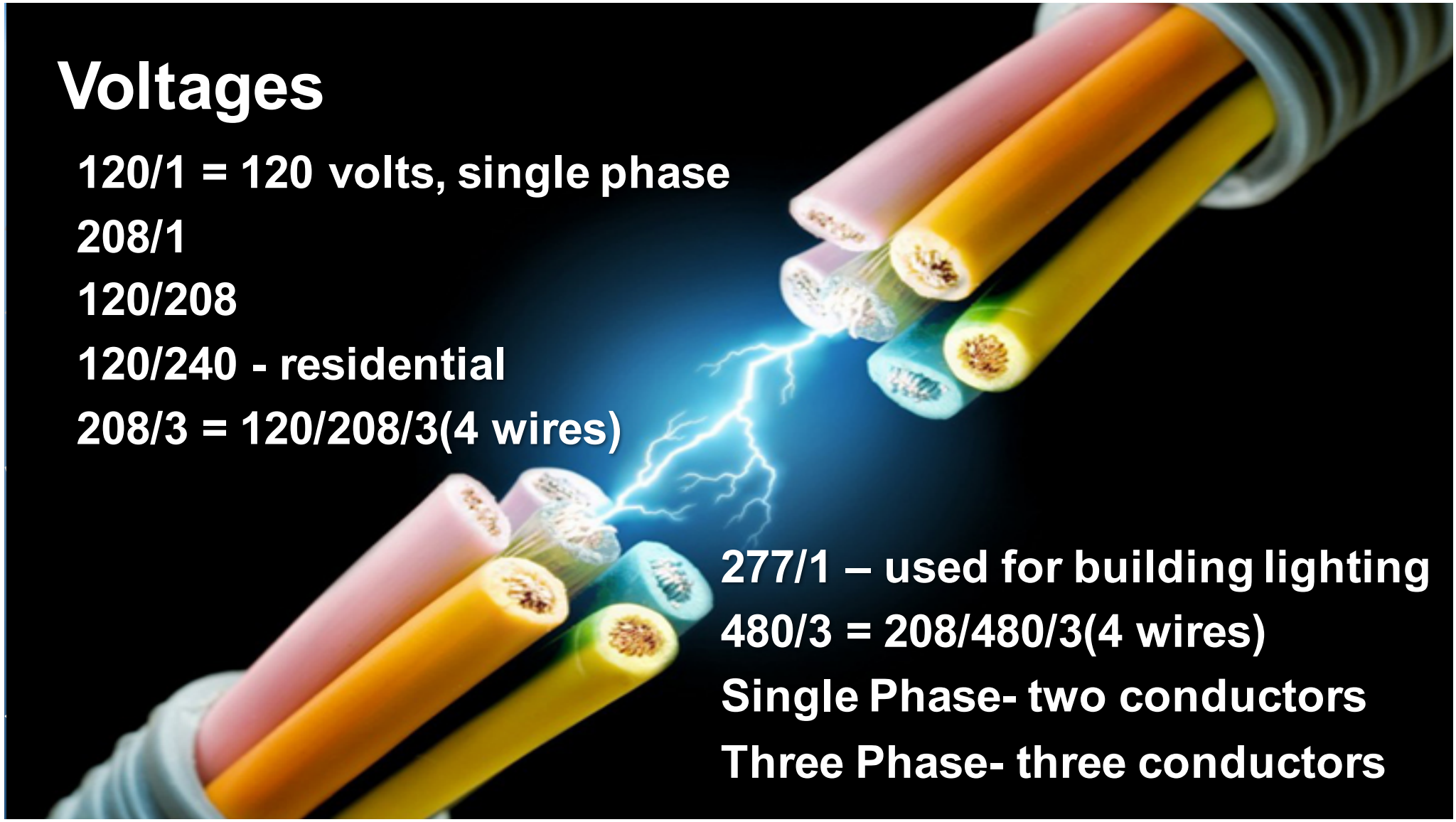
120/1 = 120 volts, single phase

208/1

120/208

120/240 - residential

208/3 = 120/208/3(4 wires)



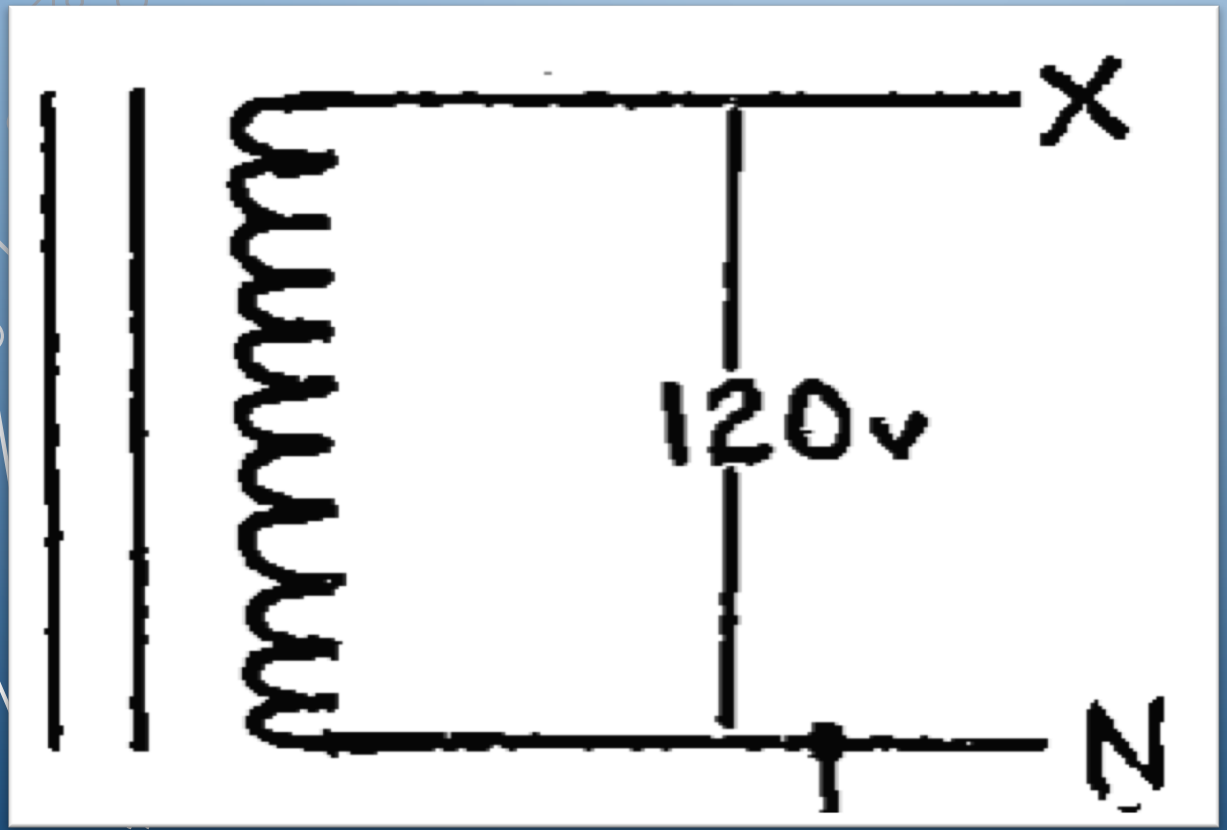
277/1 – used for building lighting

480/3 = 208/480/3(4 wires)

Single Phase- two conductors

Three Phase- three conductors

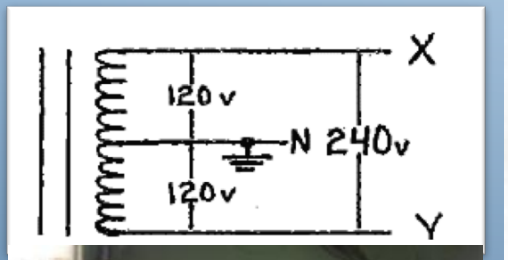
120 V/1



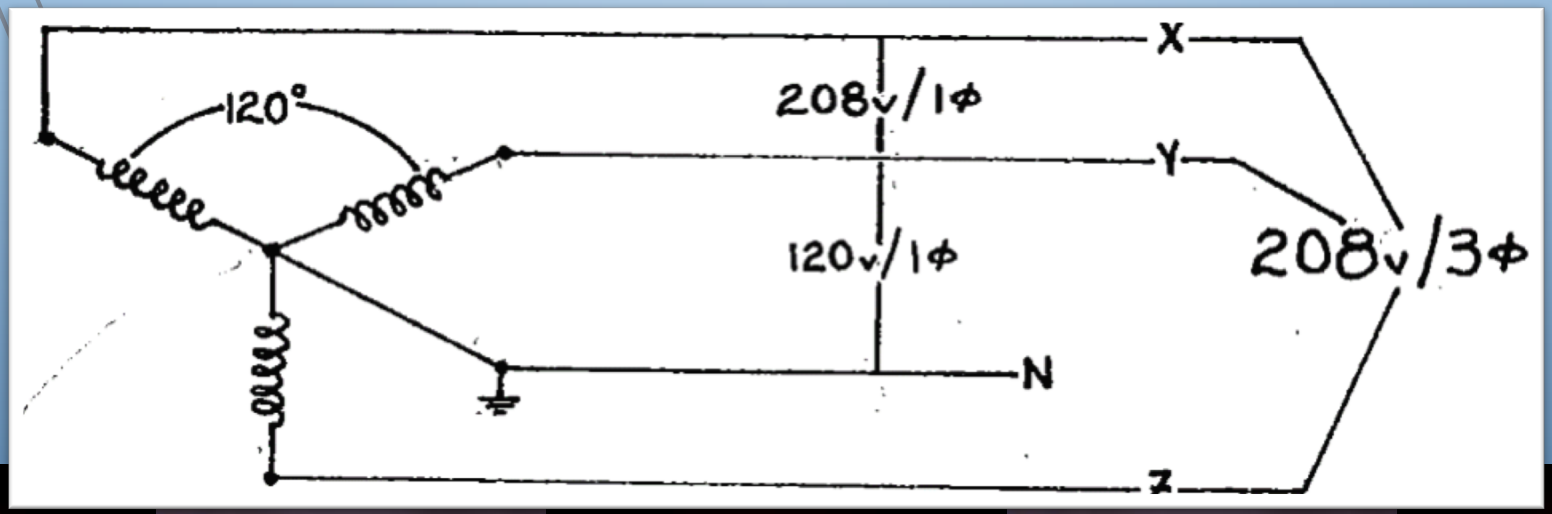
120/1 3 Wires	Hot 120 Neutral Ground
208/1 3 Wires	Hot 120 Hot 120 Ground
120/208/1 4 Wires	Hot 120 Hot 120 Neutral Ground
208/3	Hot 120 Hot 120 Hot 120 Ground
120/208/3	Hot 120 Hot 120 Hot 120 Ground Neutral
480/1	Hot 208/240 Hot 208/240 Ground
480/3	Hot 208/240 Hot 208/240 Hot 208/240 Ground

120/240 V

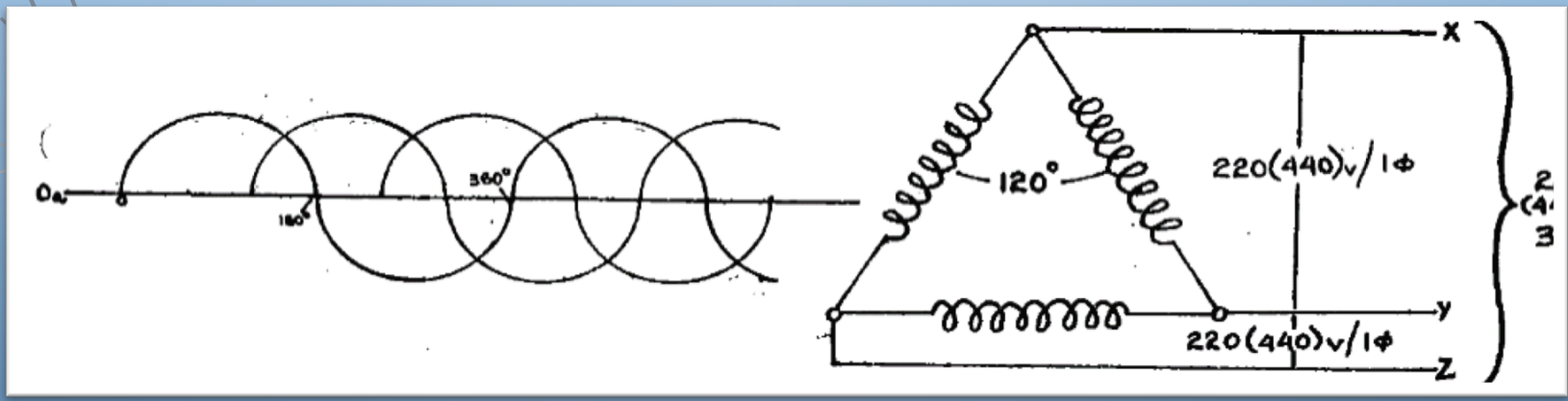
(What's in your home)



120/208/3 – “Y” Configuration



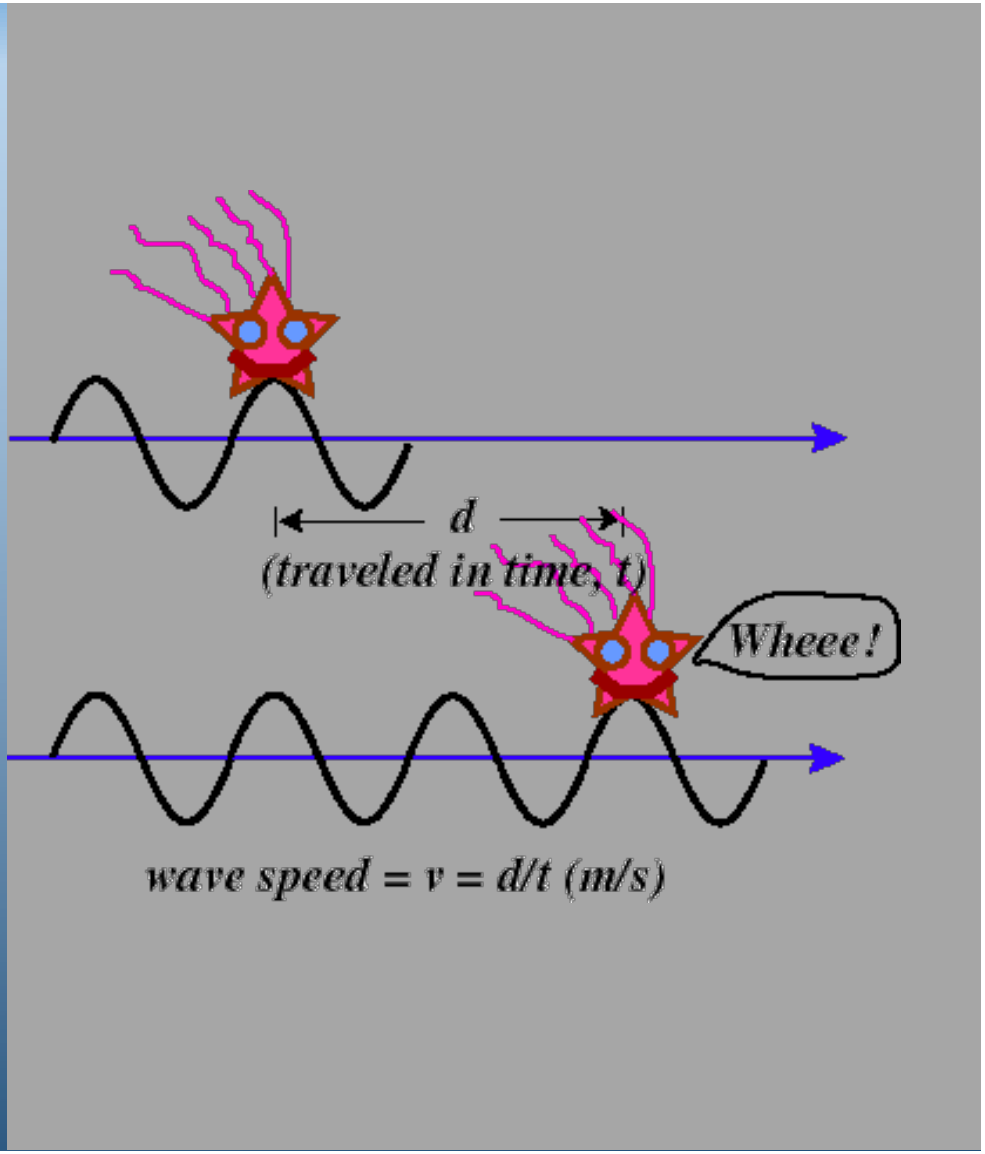
120/208/3 – “Delta” Configuration



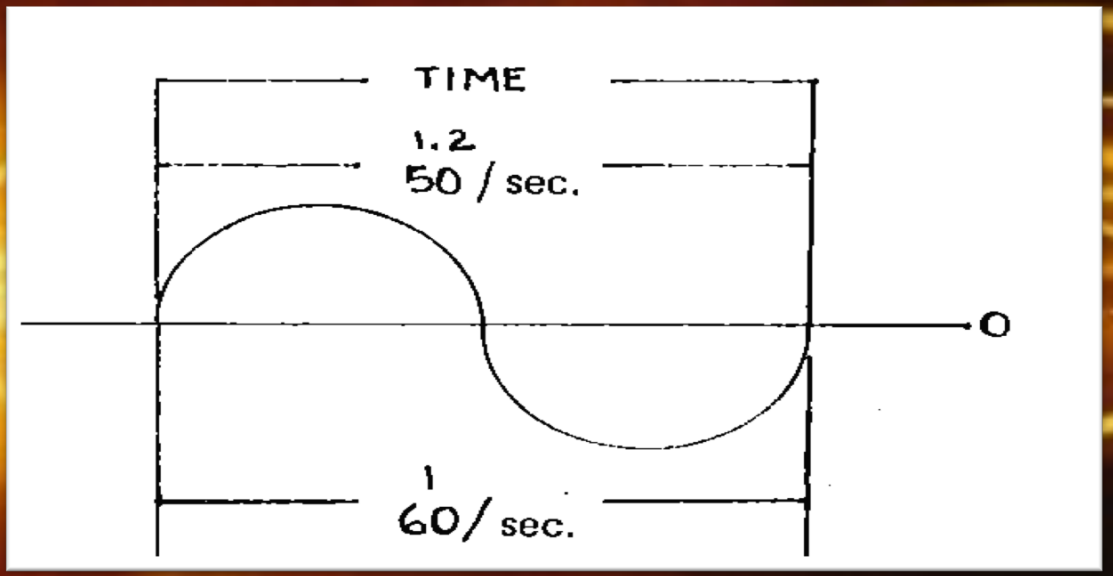
Hertz

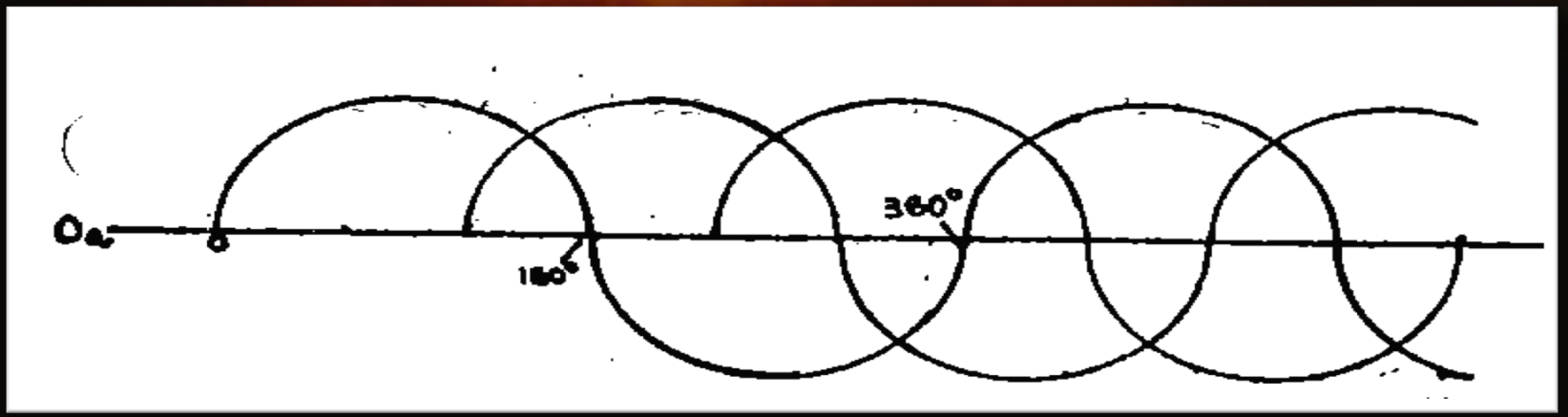
Frequency of alternating current (number of times AC cycles per second)

60 in US, 50 in Europe & Asia

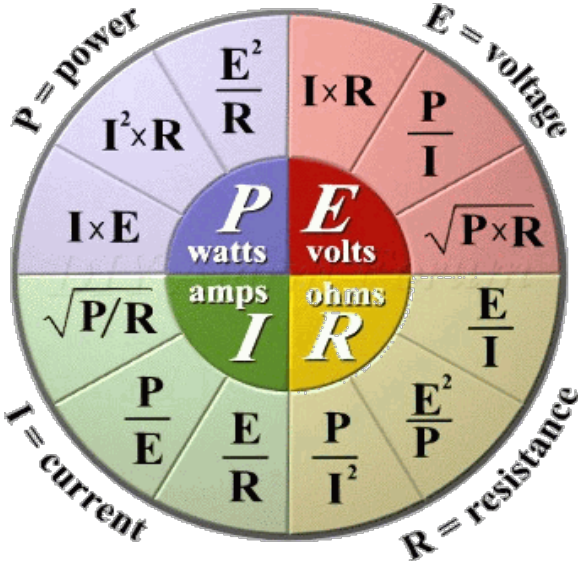


3 Phase





OHMS LAW



Volts (E) * Amps (I) = Watts (P) 120/1V x 10.OA = 1,200 W or 1.2 KW

Use Ohm's Law to Calculate Amperage from Wattage

Voltage	Divide by	Watts	Amps
120	**120**	3600	**30.00**
208	**208**	3600	**17.31**
120/208	**208**	3600	**17.31**
208/3	***360***	3600	**10.00**
480/1	**480**	3600	**7.50**
480/3	***831***	3600	**4.33**

When to Use Different Voltages

- 3-phase better for large motors
- 480/3 better for large loads, like heaters
- 480/3 doesn’t need to go through a secondary transformer
- Consider availability of replacement motors or heaters before specifying 480/3

Temperature - hot or cold

Pressure

Size - inches NPT

Quality - hardness, chlorine, etc.

Protection from contamination

Flow control/shut-offs

Hot Water Temperature

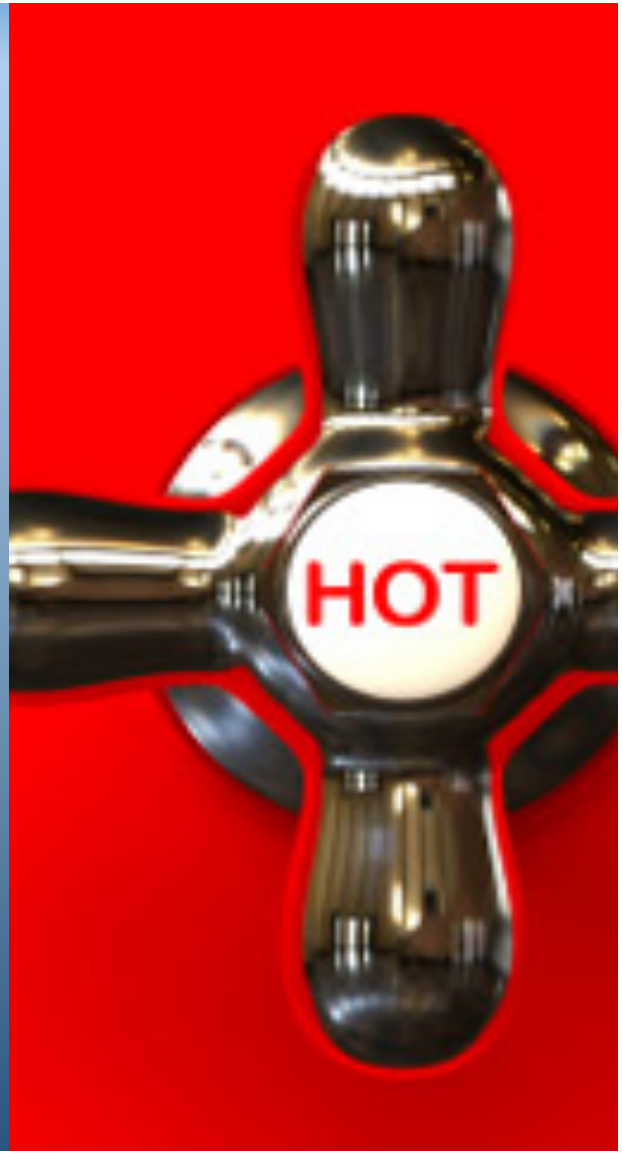
Minimum incoming temperatures for warewashing equipment

Booster heaters required to raise temperature to 180º, sometimes for lower temperatures

Some elementary schools only provide 90º-110º hot water, always ask!

Temperature for food prep & pot washing 110º minimum

Chemical sanitizing needs 75º-120º water



Cold Water

Sometimes cold is not so cold, find out summer water temperatures when sizing ice makers

Shouldn’t have problems with water being too cold

Water Pressure

Always check manufacture's cut sheet

- Warewashing equipment 20-25 psi
- Cooking equipment 30-60
- Beverage equipment up to 80-90 psi
- Ideal water pressure 40 -55 psi
- Tell engineers what pressure equipment needs, they should specify pressure reducing valves at equipment

Flow / Control Faucets

Shut-off should be provided at all water connections

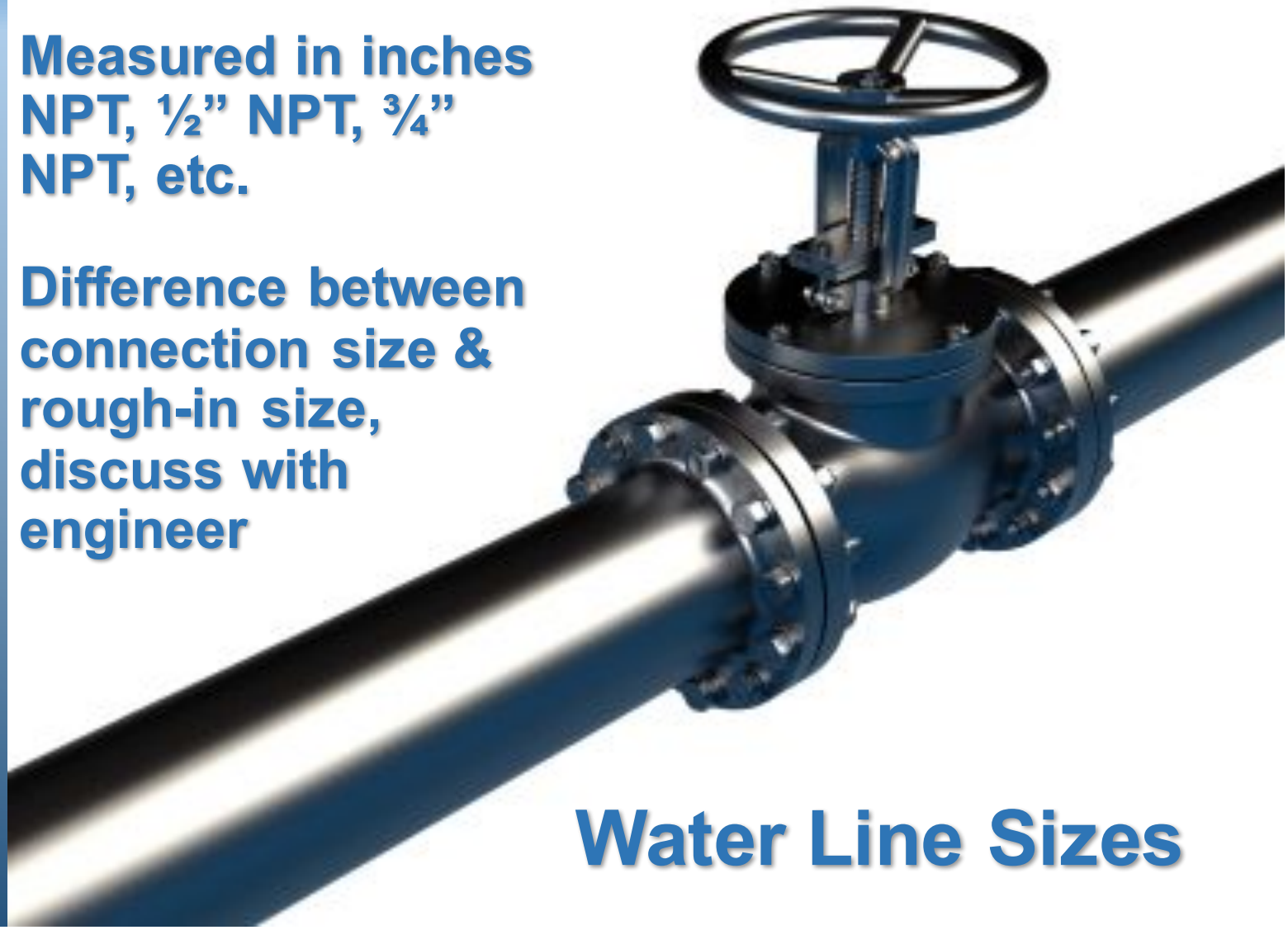
Engineer to specify, mechanical contractor to install

Types-gate valves, ¼ turn ball valves (troughs & hot food wells), angle stops (faucets)

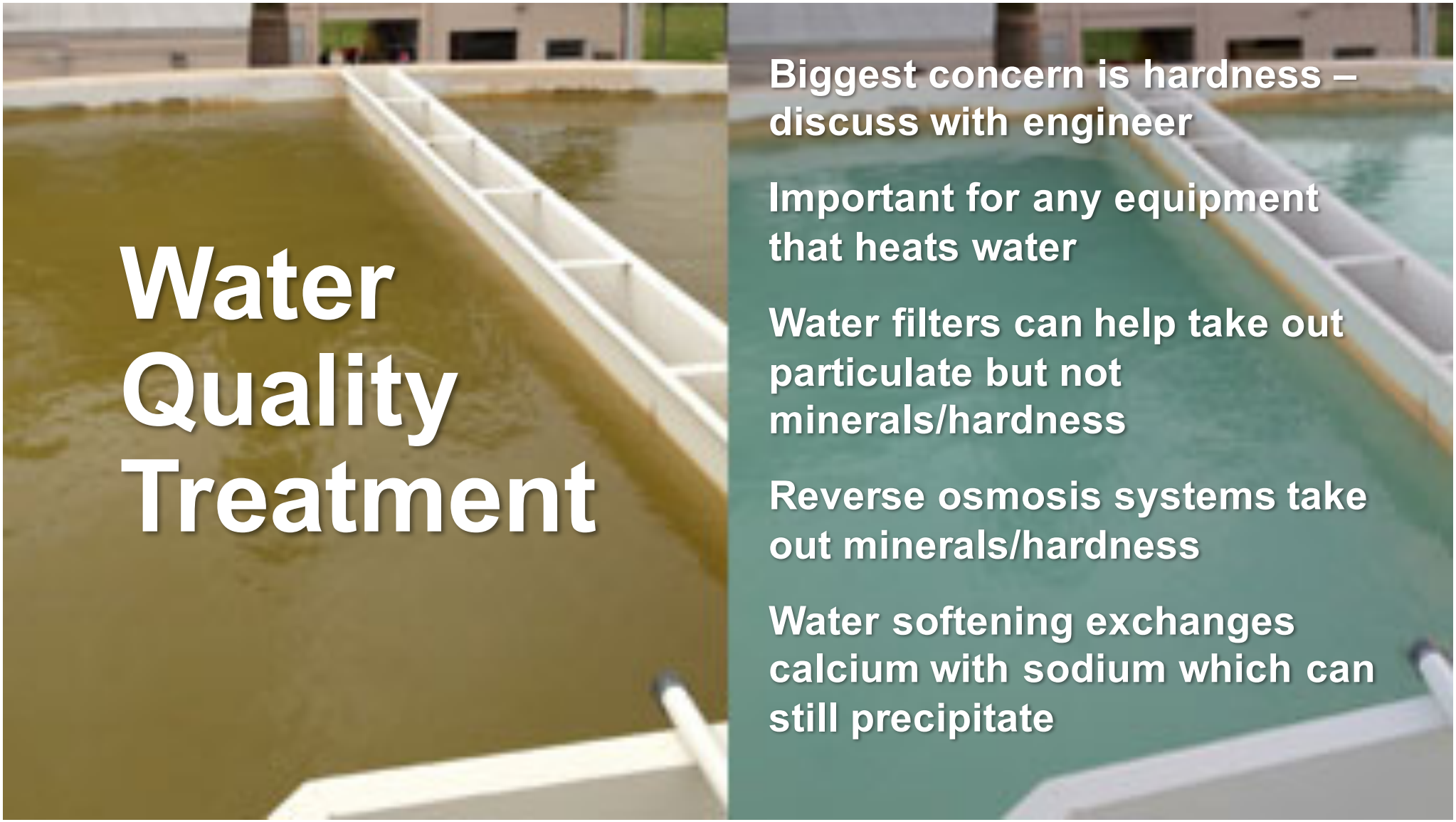
Faucets typically furnished loose for installation by mechanical

Measured in inches NPT, ½” NPT, ¾” NPT, etc.

Difference between connection size & rough-in size, discuss with engineer



Water Line Sizes



Water Quality Treatment

- Biggest concern is hardness – discuss with engineer
- Important for any equipment that heats water
- Water filters can help take out particulate but not minerals/hardness
- Reverse osmosis systems take out minerals/hardness
- Water softening exchanges calcium with sodium which can still precipitate

Water Quality - Chlorine

Problem for ice makers

Prevents water from freezing

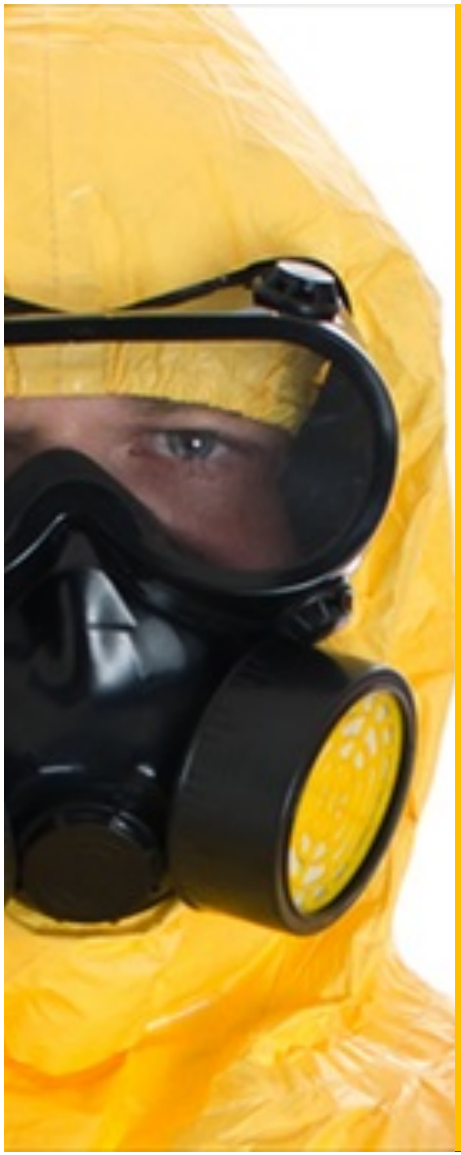
Affects flavor

Charcoal filter removes chlorine

Water Quality – Softened Water

Affects taste of soda & coffee

Problem for low sodium diets



Protection from Contamination

Backflow prevents/anti-siphon devices

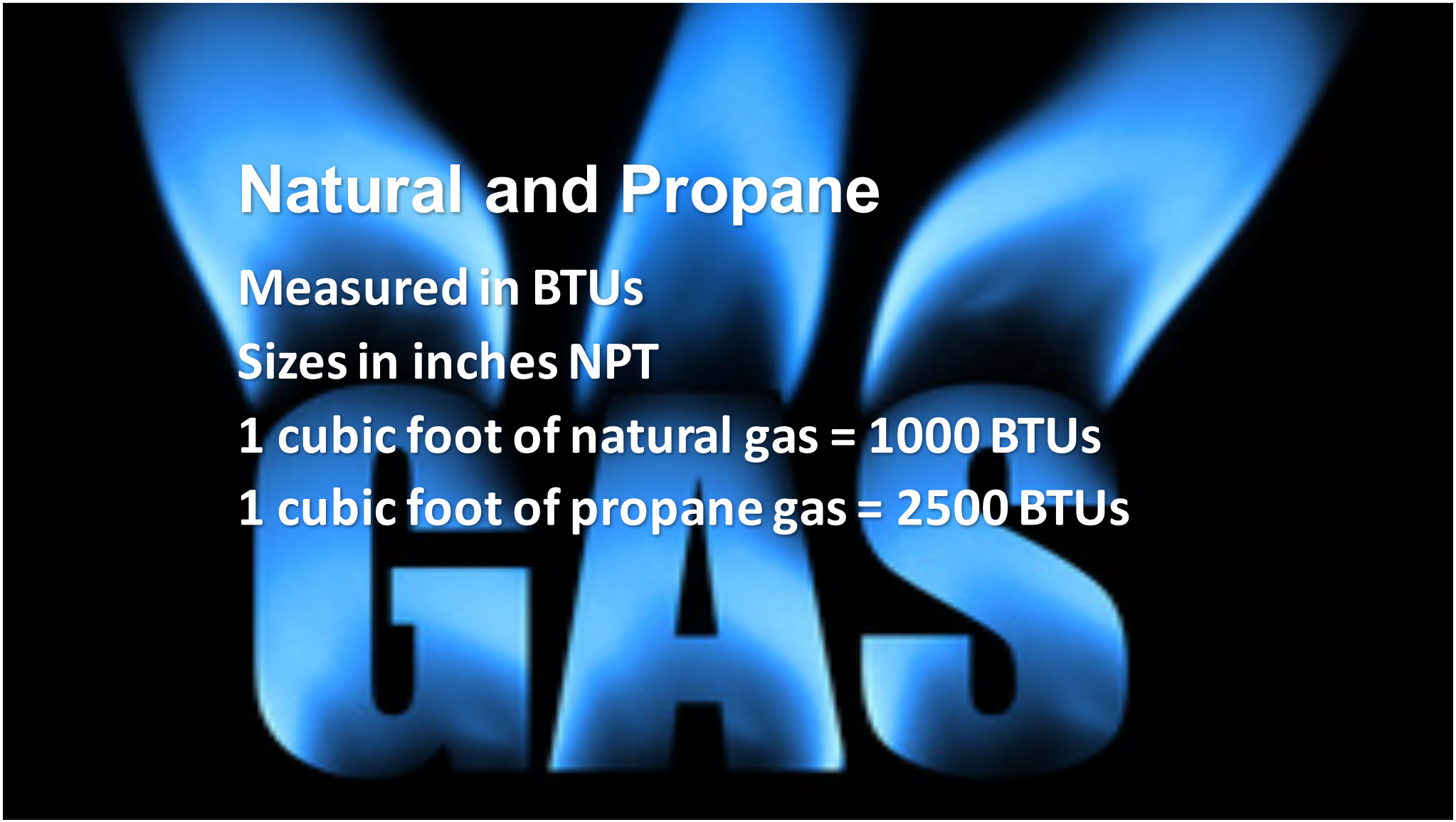
Required for ‘submerged inlets’ like disposer water inlets, spray rinses, etc.

Prevent waste water from siphoning back into water supply if water pressure drops

Water wash hoods require ‘reduce pressure principal backflow device’ or RPZ (WI, CO & Chicago)

Backflow

GONE WILD


Natural and Propane
Measured in BTUs
Sizes in inches NPT
1 cubic foot of natural gas = 1000 BTUs
1 cubic foot of propane gas = 2500 BTUs
GAS

Gas Pressure

Gas pressure for cooking equipment listed as inches/water column, w.c.

Typical pressures 3.5-7 w.c.

Gas piping in commercial building is 2 psi or higher

1 psi = 27” w.c.

Engineer needs to specify ‘pounds to inches’ pressure reducing valve

Cooking equipment should have “inches to inches” pressure reducing valve

Gas Quick Disconnects

DISCONNECT

Drains / Waste Systems

Direct-hard piped

Indirect-piped to floor sink or floor drain with air-gap

Local codes determine which type of connection

Most states require food prep sinks to have an indirect waste connection

Floor Sink Locations

Codes require access for cleaning

May need ½ of floor sink outside counter!

Direct Waste Connections

Handsinks/non-food sink

When food prep sinks are direct connected, ‘tell-tale’ floor drain is required

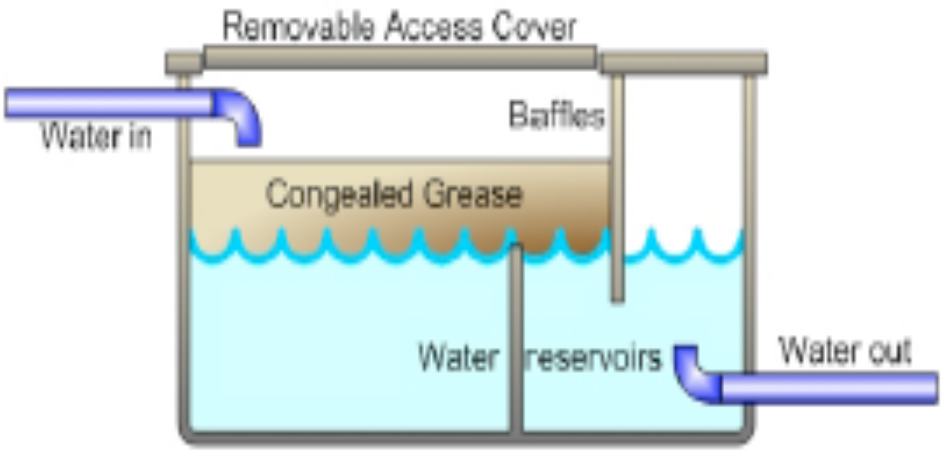
Require tail-piece and ‘P-trap’ typically furnished by mechanical

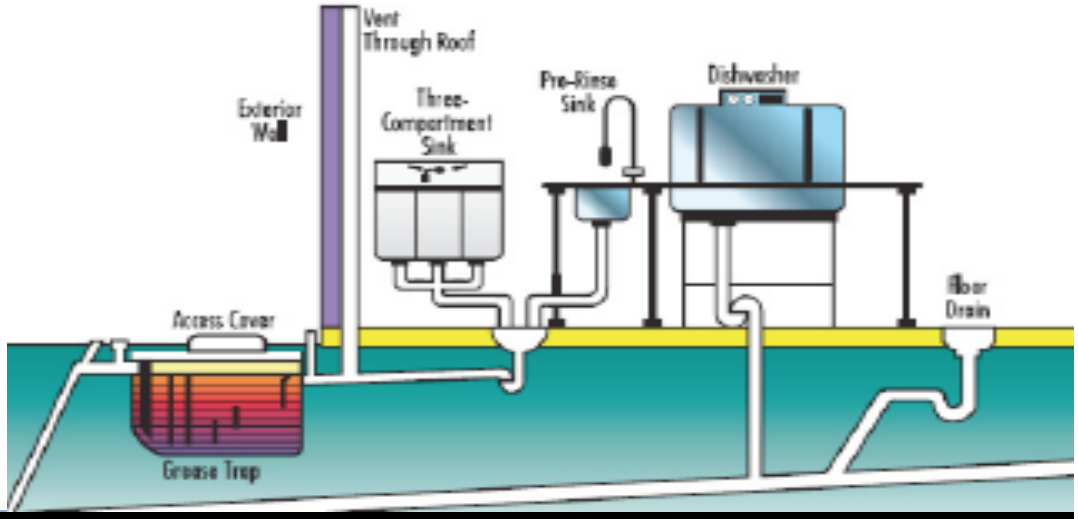
Drains usually furnished loose by FSEC

Strainer, removable basket, lever or pop-up waste

Indirect Waste Connections

- Food prep sinks
- Hot Food Wells, Cold Pans, Ice Makers
- Only require tail-piece typically furnished by mechanical
- Drains usually furnished loose by FSEC
- Strainer, removable basket, lever or pop-up waste





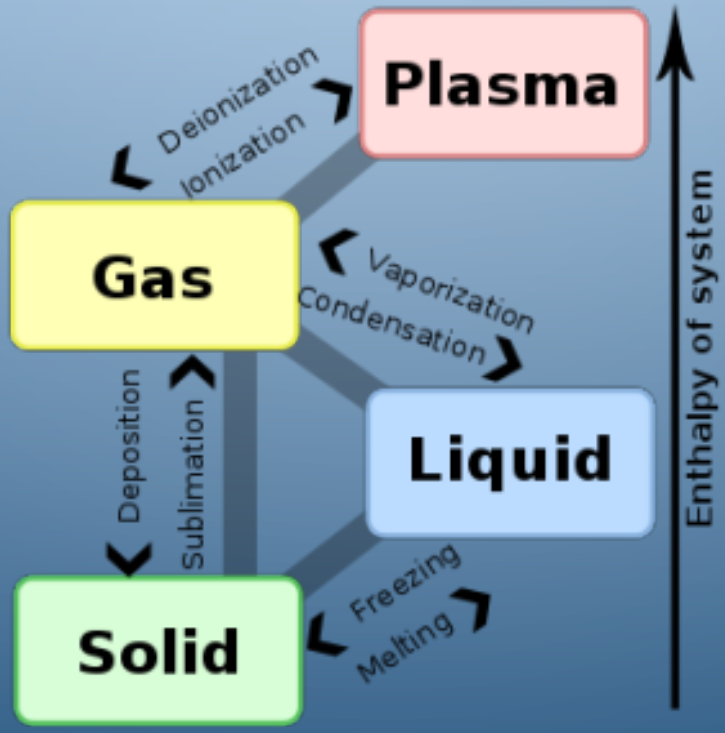
Grease traps far away from kitchen

Required for ‘greasy waste’

Fixtures that need to be connected vary by code and inspector

If you can’t get them out of the kitchen try to flush with floor

Changes of State




Steam
Water vapor
Transfers heat by condensing from vapor to water
Five times as much heat in steam as boiling water
Most efficient way to transfer heat/cook
Can be hotter than 212⁰
Brown meat in steam kettle with 50 psi steam

Steam

Requirements listed as inches NPT, psi, and pounds/hour or boiler horsepower

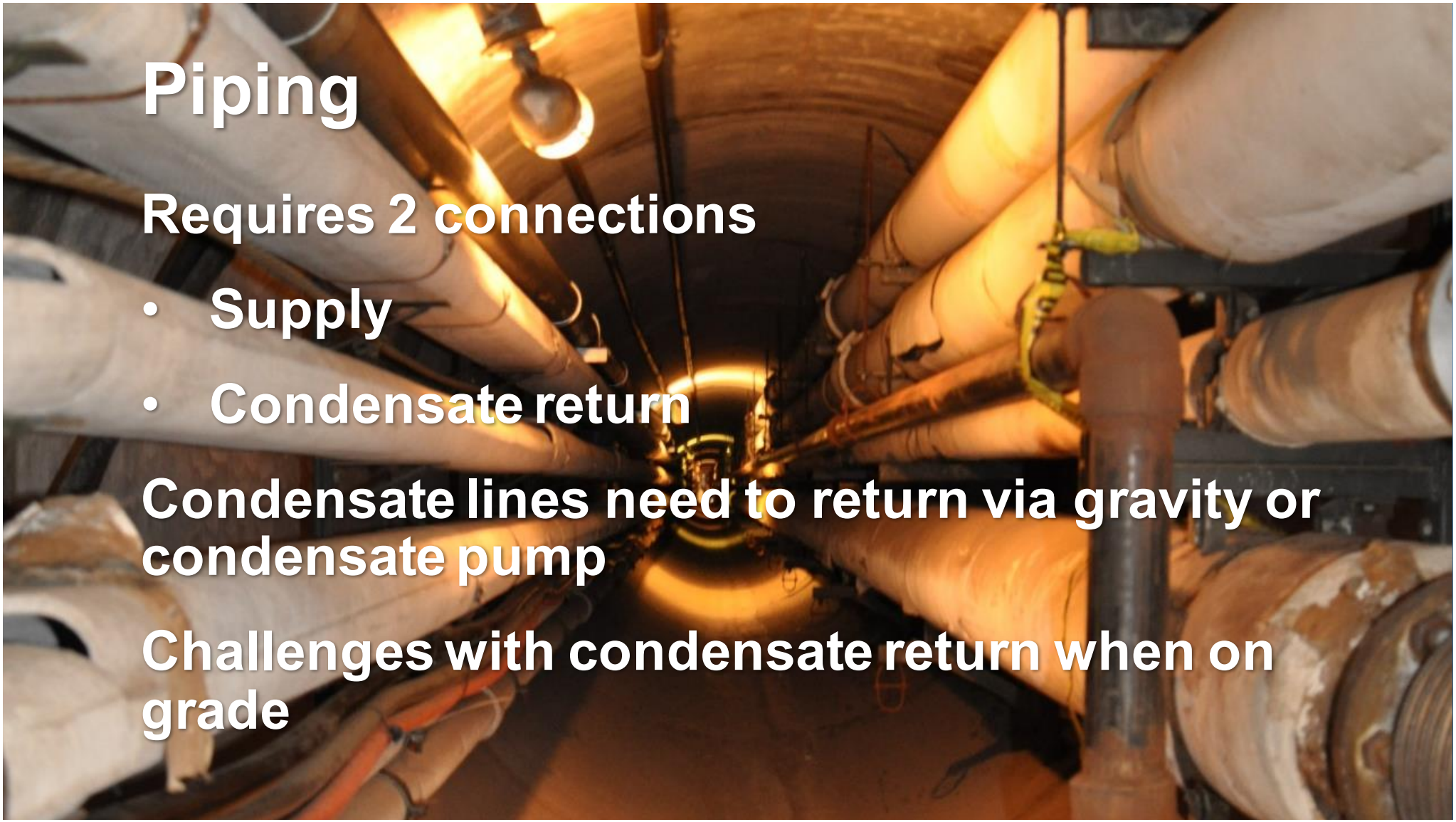
1 boiler horsepower = 34.5 pounds/ hour

Typical steam pressures are 15-45 psi

Boiler license required on site if steam over 15 psi

Some cook/chill use 100 psi steam

Higher pressure faster cooking



Piping

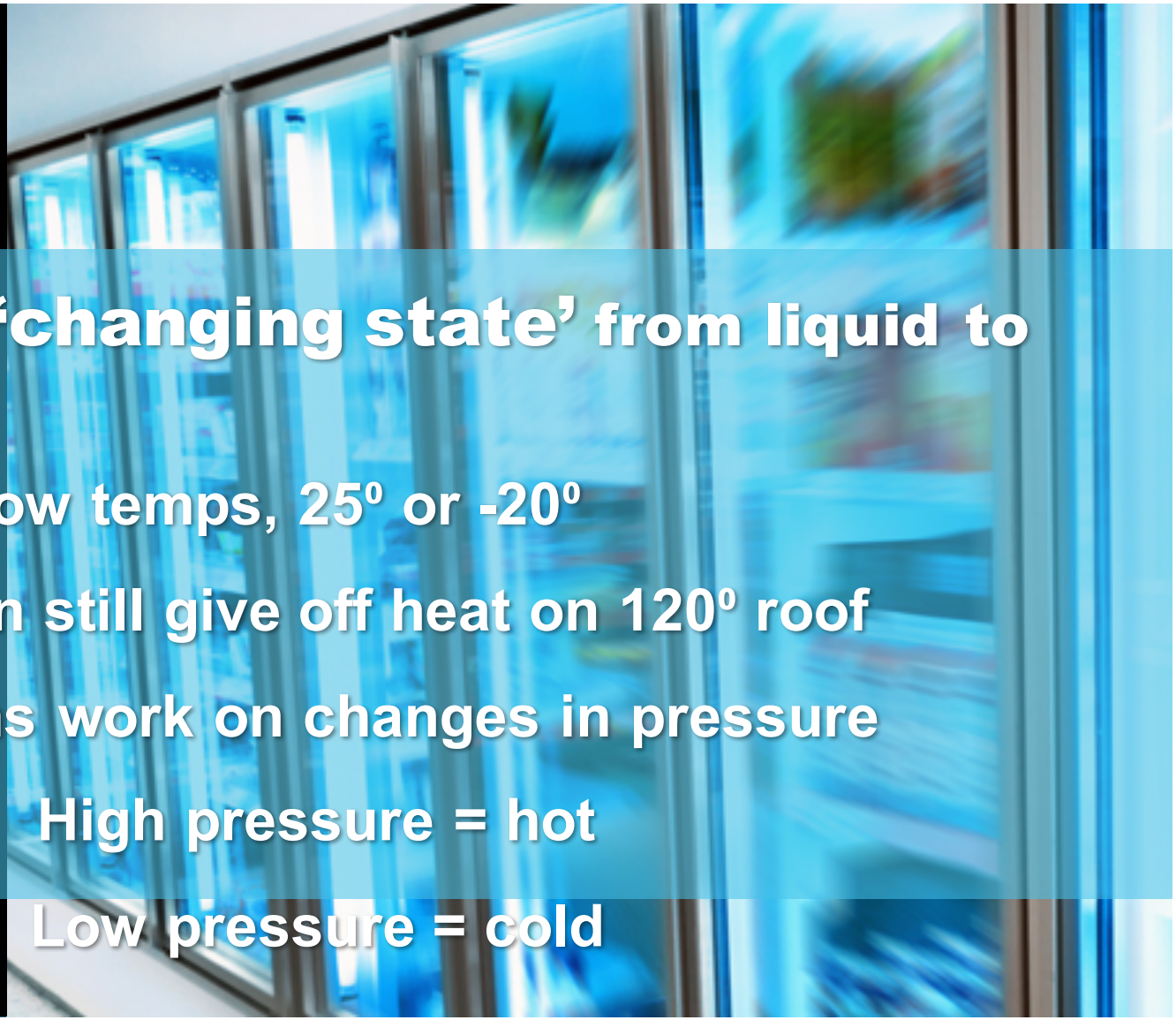
Requires 2 connections

- Supply
- Condensate return

Condensate lines need to return via gravity or condensate pump

Challenges with condensate return when on grade

Refrigeration



Removes heat by 'changing state' from liquid to vapor or gas

Refrigerant boils at low temps, 25º or -20º

Liquid refrigerant can still give off heat on 120º roof

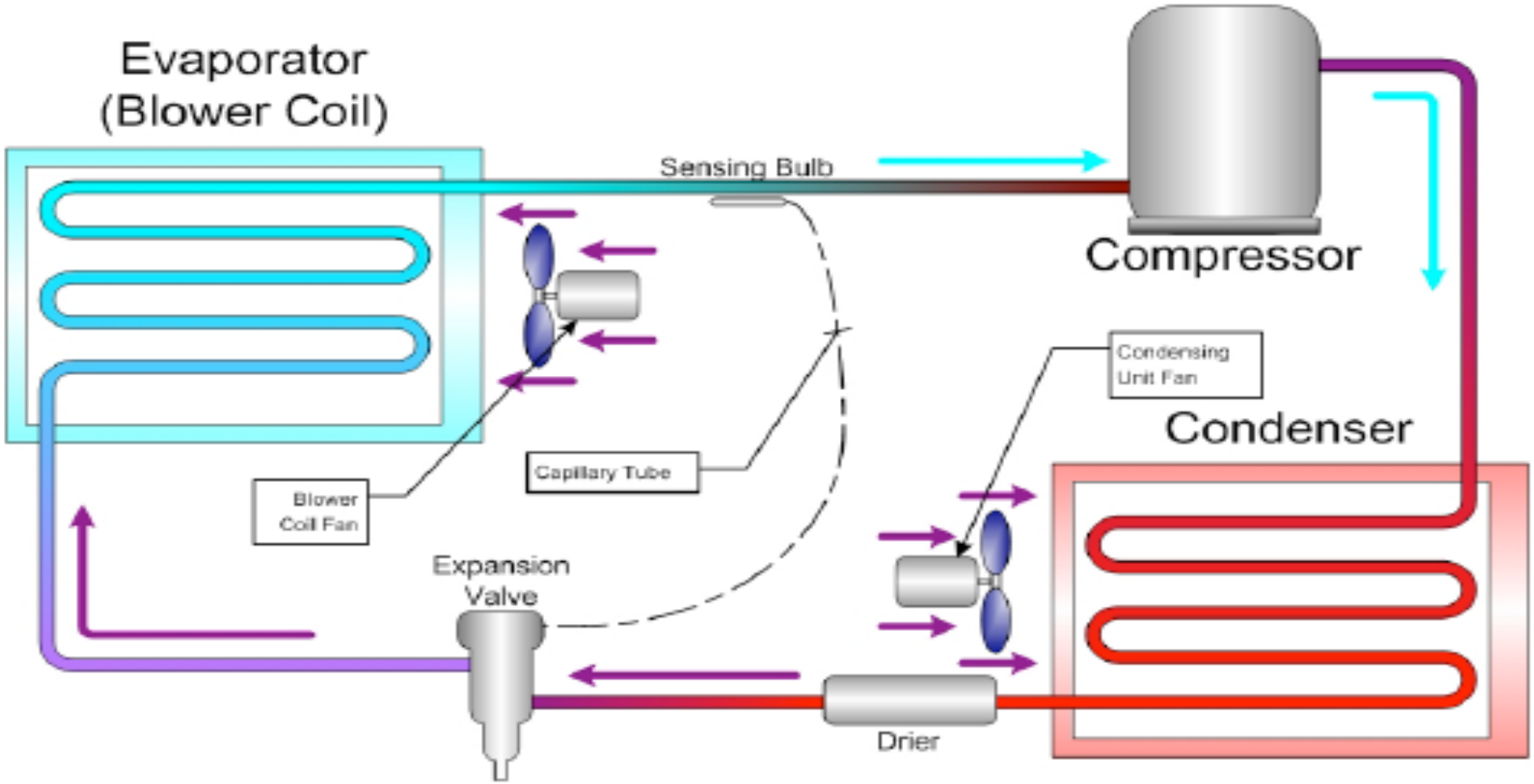
Refrigeration systems work on changes in pressure

High pressure = hot

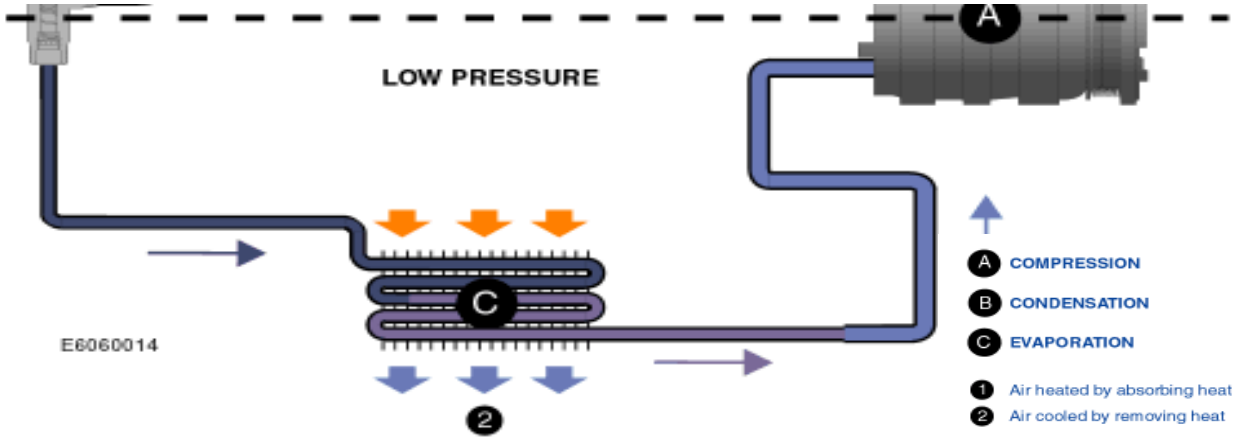
Low pressure = cold

Refrigeration

IF PRESSURE/VOLUME CHANGES SO DOES TEMPERATURE


Evaporator
(Blower Coil)
Sensing Bulb
Compressor
Condensing
Unit Fan
Condenser
Capillary Tube
Blower
Coil Fan
Expansion
Valve
Drier

The Low Pressure Side



Expansion valve releases high pressure liquid refrigerant into evaporator coil

So little pressure in coil, refrigerant boiling point is so low that it absorbs heat from air & turns into 'super-heated' gas

Refrigerant gas 'sucked' onto compressor/also known as 'suction or gas' side

The ‘High’ Side

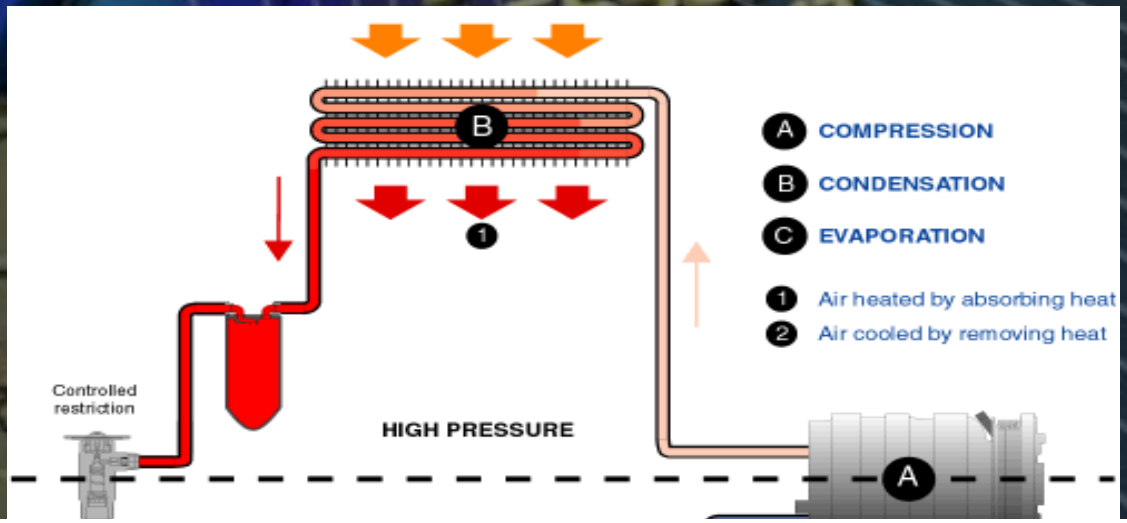
Compressor ‘compresses’ gas increases temperate to 90º-130º

Gas proceeds to condenser, like a radiator, gives off heat to atmosphere

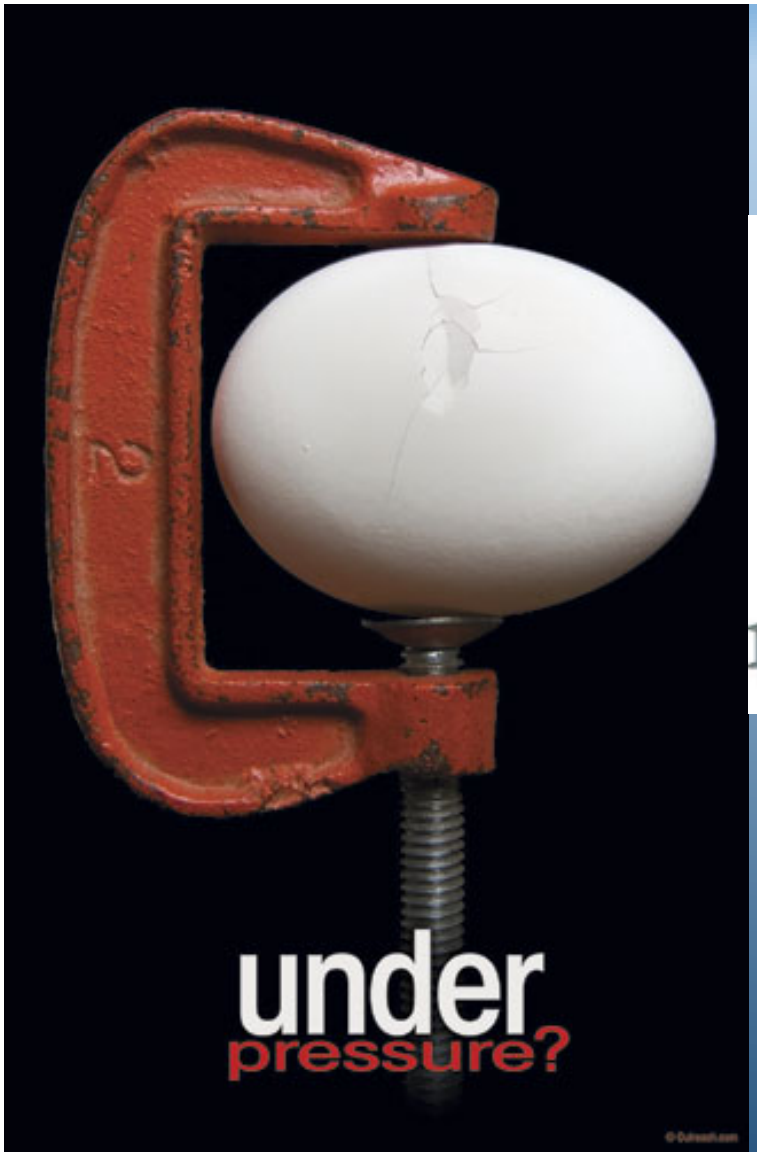
Onto receiver, has reserve of liquid refrigerant ready to meet demand

Back to expansion valve

Condensing unit refers to compressor, condenser & controls



Compressor



Pressure Controls

Refrigeration systems are activated by changes in pressure

No wiring required between the coil & condensing unit

Defrost

Electric heaters controlled by a timer for freezer

Need to wire from time clock to coil (double check shops)

Air defrost for refrigerators

Other Components

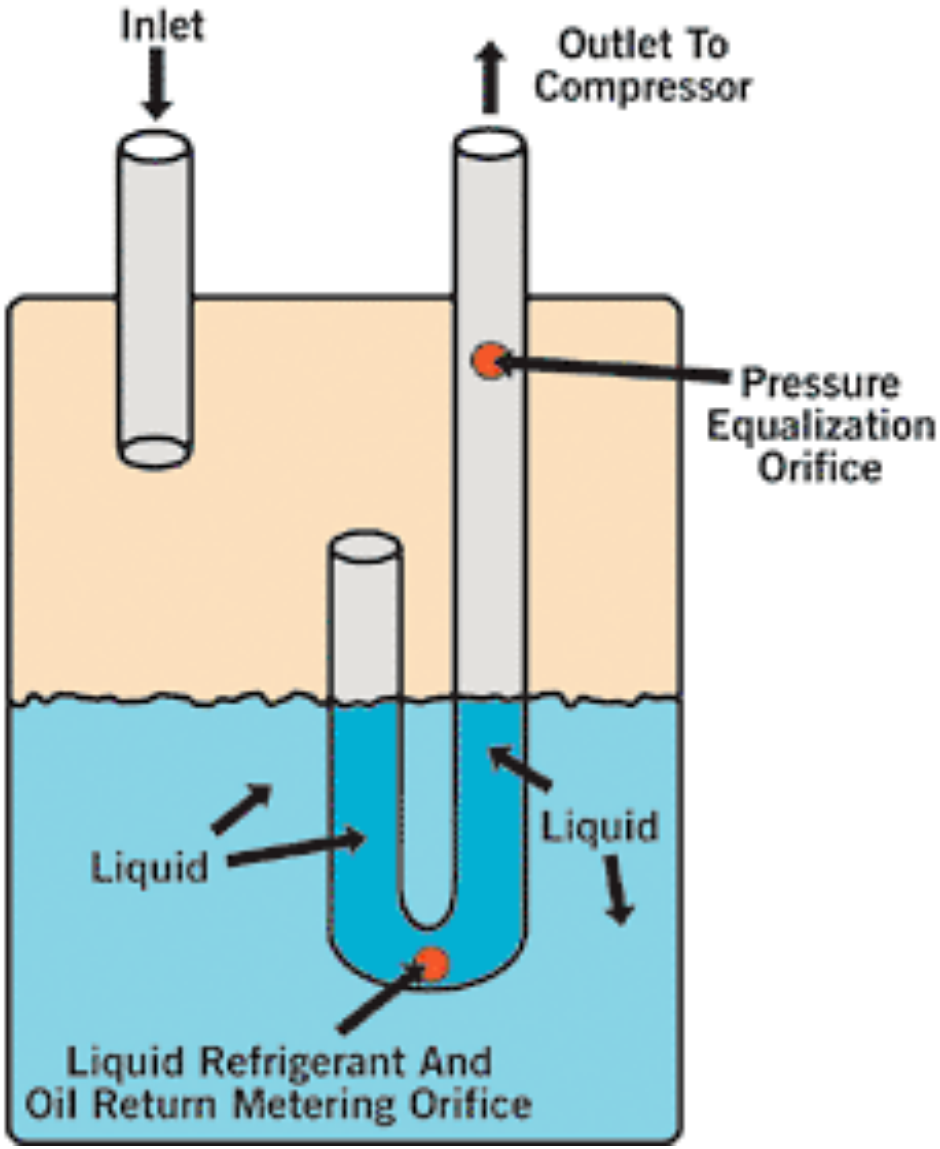
Suction line accumulator/filter-prevents liquid from getting into compressor

Liquid line filter/drier-collects moisture & debris before expansion valve

Liquid line site glass-for inspection

Low ambient controls

- Headmaster controls-regulates how much heat needs to be given off when cold outside
- Crankcase heater



Water Cooling

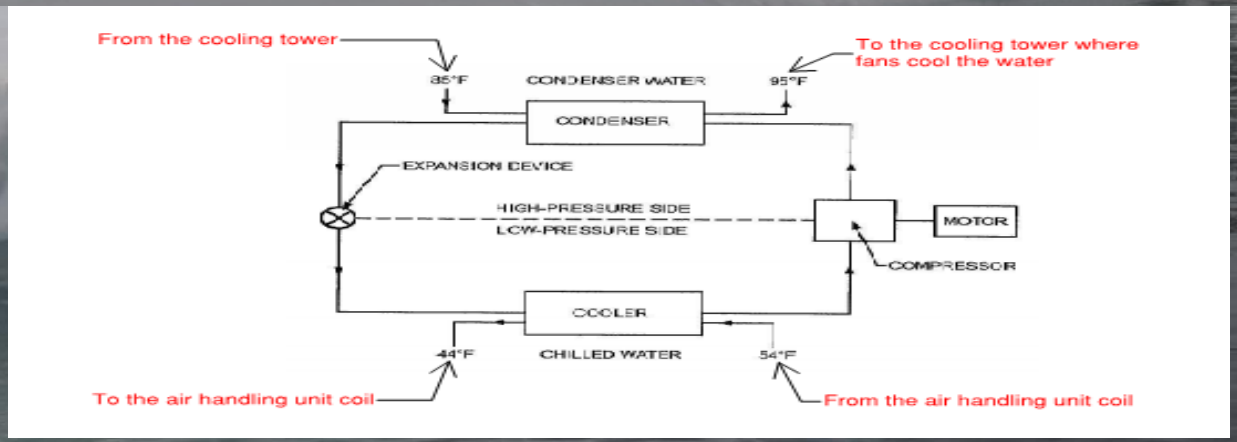
Use for refrigeration, ice makers, beer systems

Sources of water for cooling

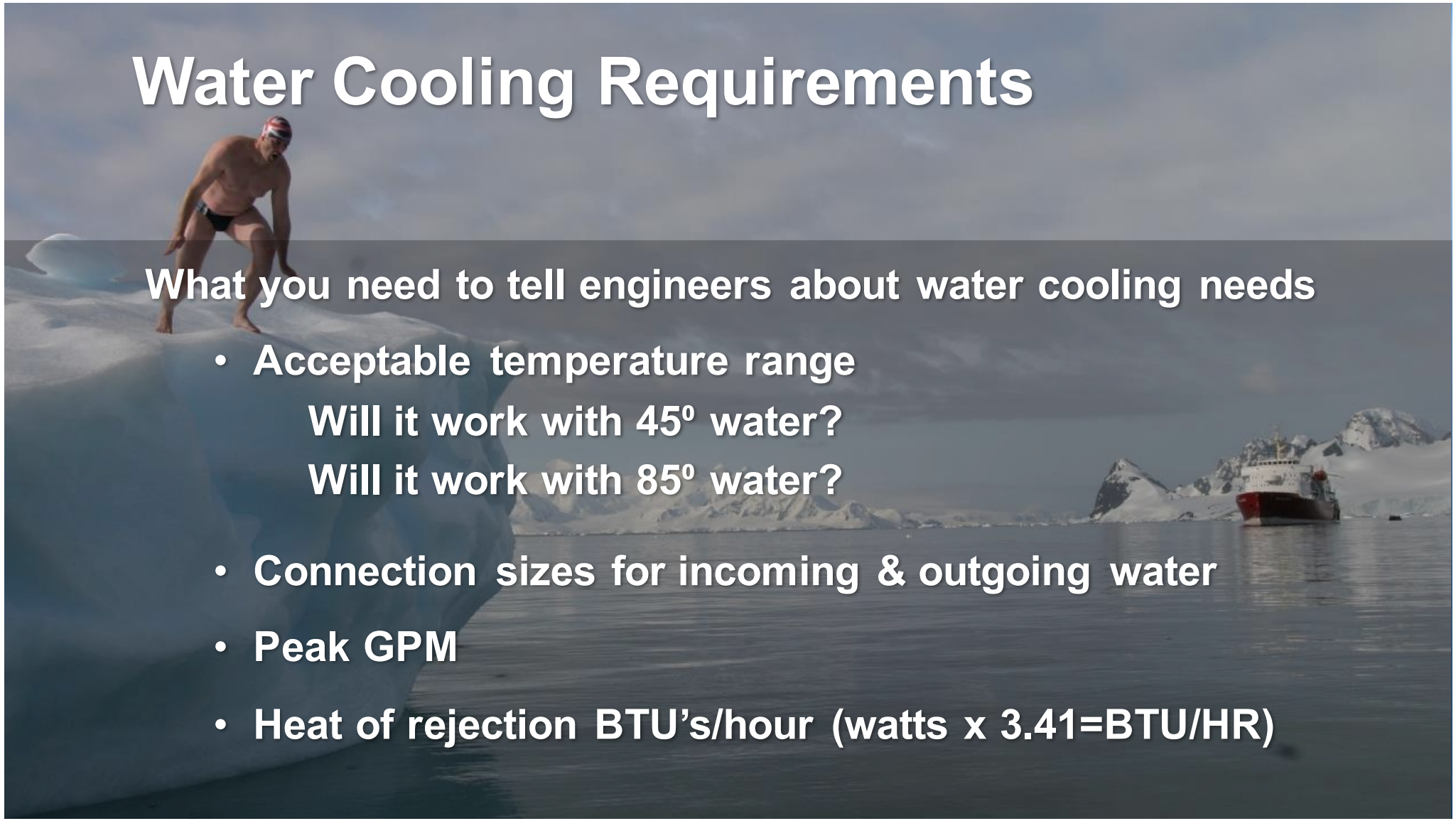
Cooling tower or condenser water (85º-95º F)

Chilled water (44º-54º F)

Domestic water (not recommended)



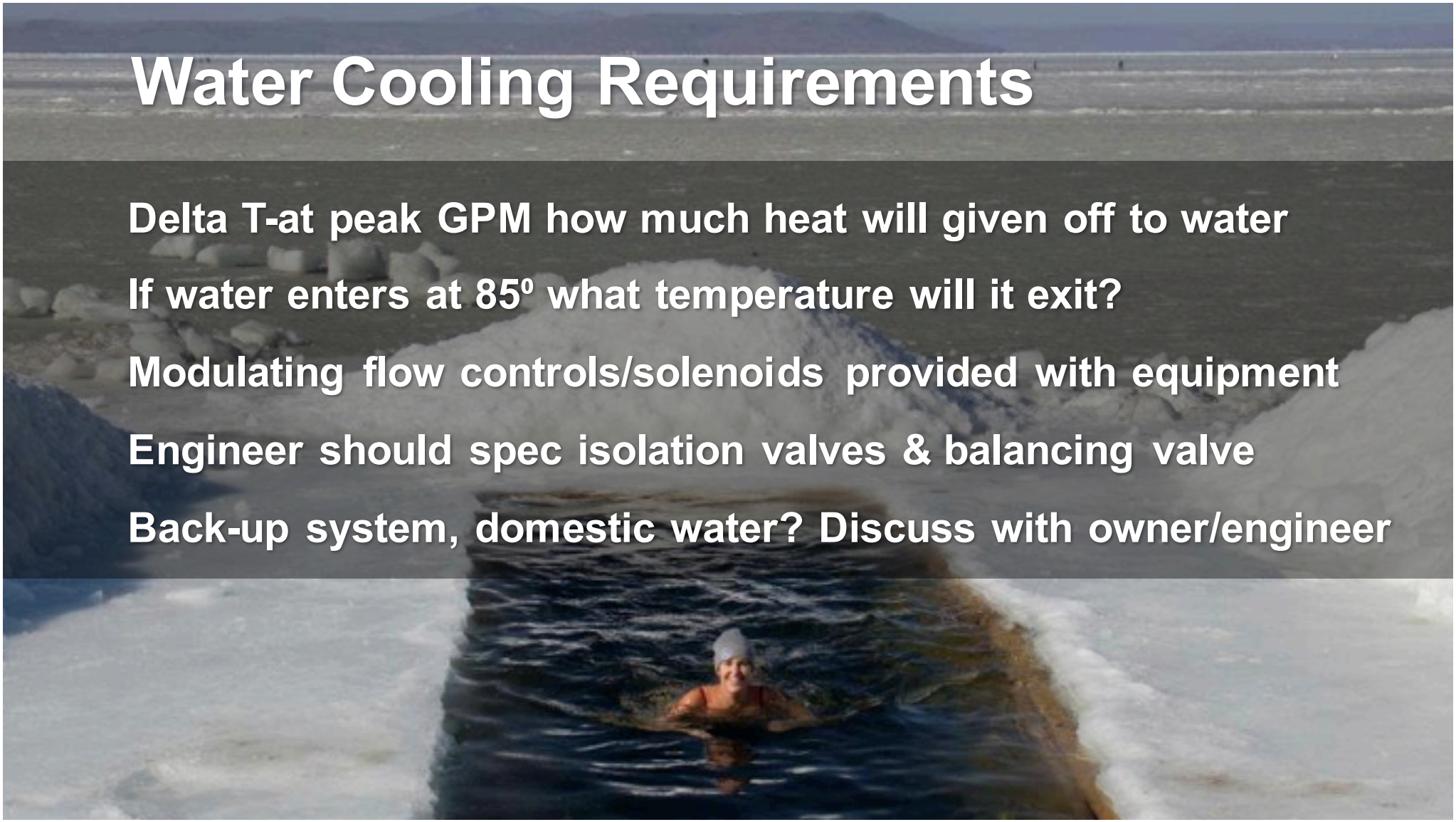
Water Cooling Requirements



What you need to tell engineers about water cooling needs

- Acceptable temperature range
  - Will it work with 45⁰ water?
  - Will it work with 85⁰ water?
- Connection sizes for incoming & outgoing water
- Peak GPM
- Heat of rejection BTU's/hour (watts x 3.41=BTU/HR)

Water Cooling Requirements



Delta T-at peak GPM how much heat will given off to water

If water enters at 85^0 what temperature will it exit?

Modulating flow controls/solenoids provided with equipment

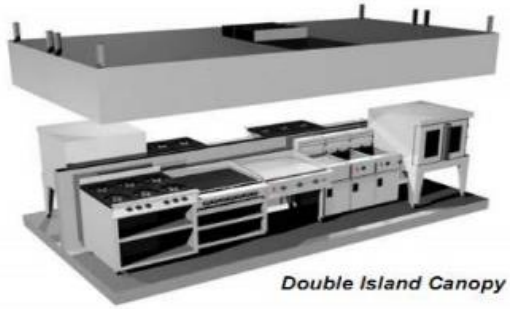
Engineer should spec isolation valves & balancing valve

Back-up system, domestic water? Discuss with owner/engineer

Exhaust Hoods


Back Shelf


Single Island Canopy


Double Island Canopy


Wall Mounted Canopy

Type I-grease exhaust

Type II-steam & vapor-limited uses

Hood types

- Wall canopy
- Island, single & double
- Backshelf or low proximity

Exhaust Volumes

How low is low volume?

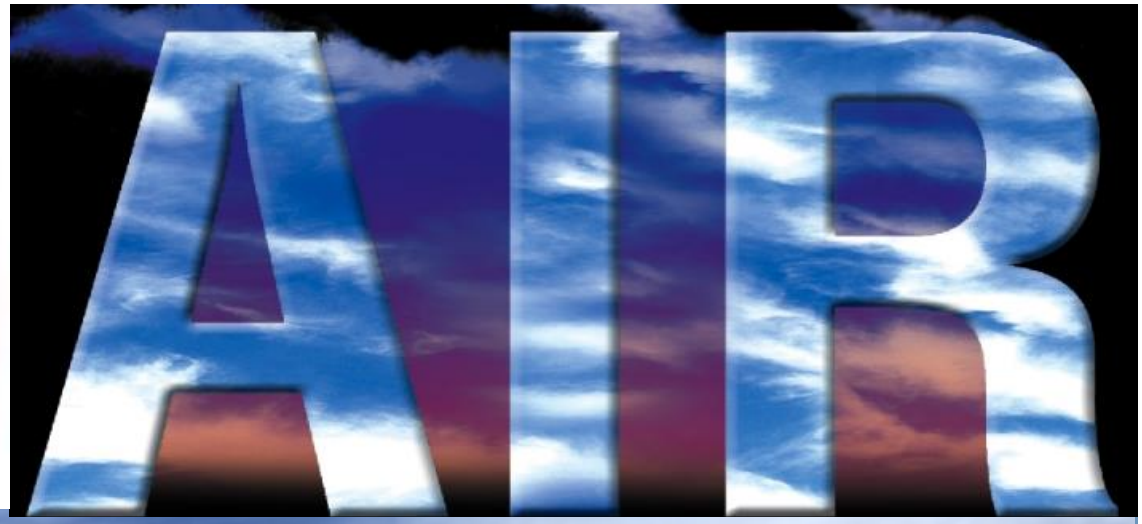
Caveat Emptor - see Fishnick.com fishnick.com/publications/applianc ereports/hoods/disclaimer.php

The more ends of hood that are enclosed, lower volume can be

Island hoods require most exhaust

Backshelf hoods use lowest amounts -McDonalds fryer line

Make Up AIR



What goes out must come in

Has to come from room, not hood

Replaces air that rises from cooking equipment

How make-up air is supplied affects exhaust performance more than hood design

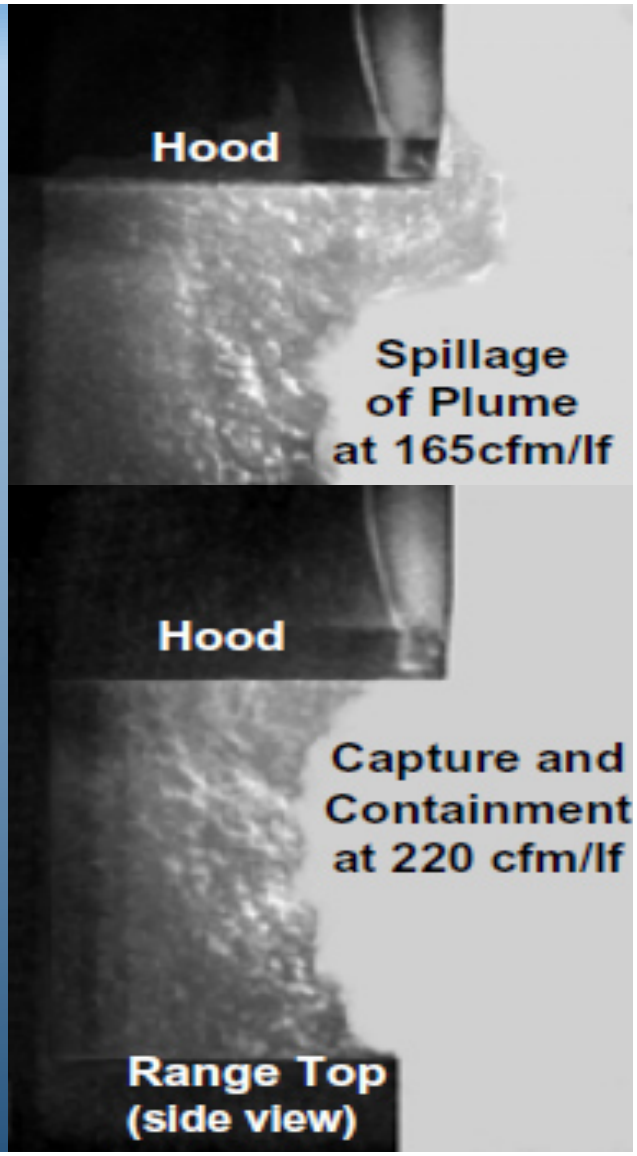
Guidelines

Farther away the better

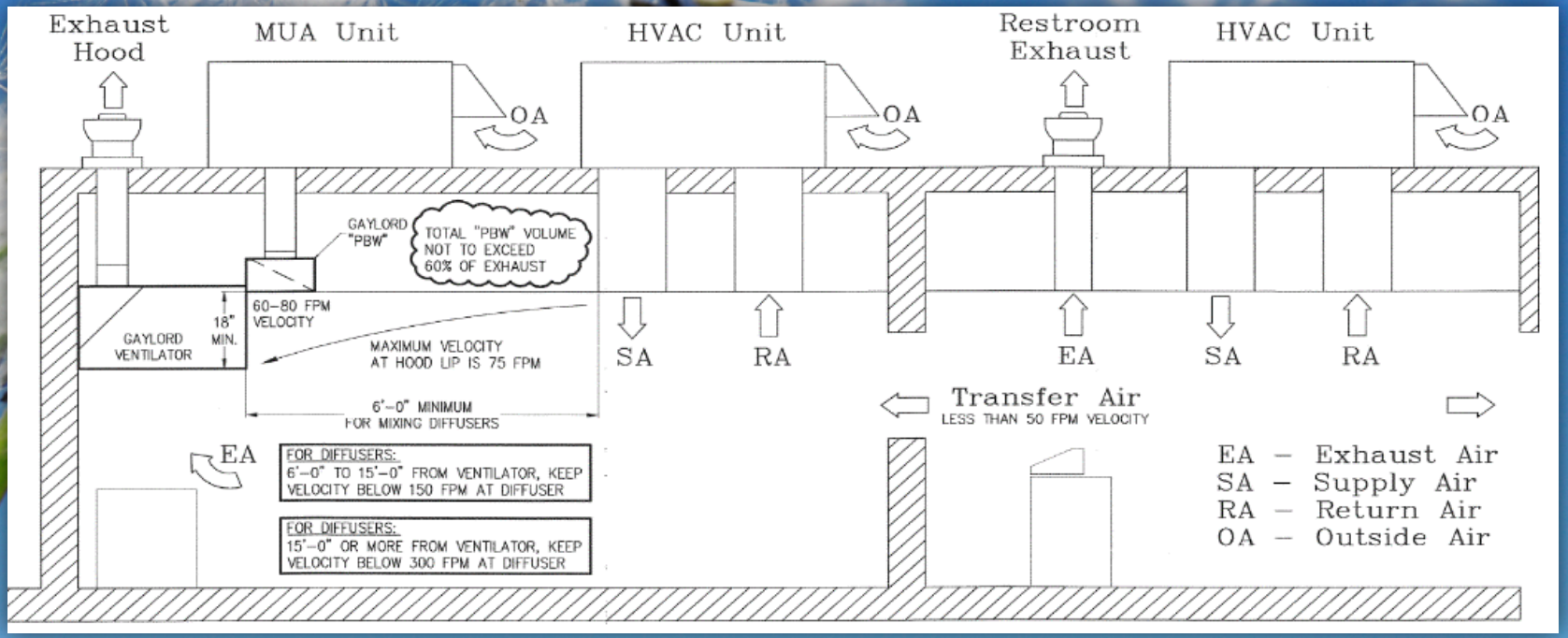
Lowest velocity possible

Some make-up air systems at hood do work, be cautious

Schlieren tests
http://www.fishnick.com/ventilation/ventilationlab/



Make-up Air Guidelines



Make-up Air Code

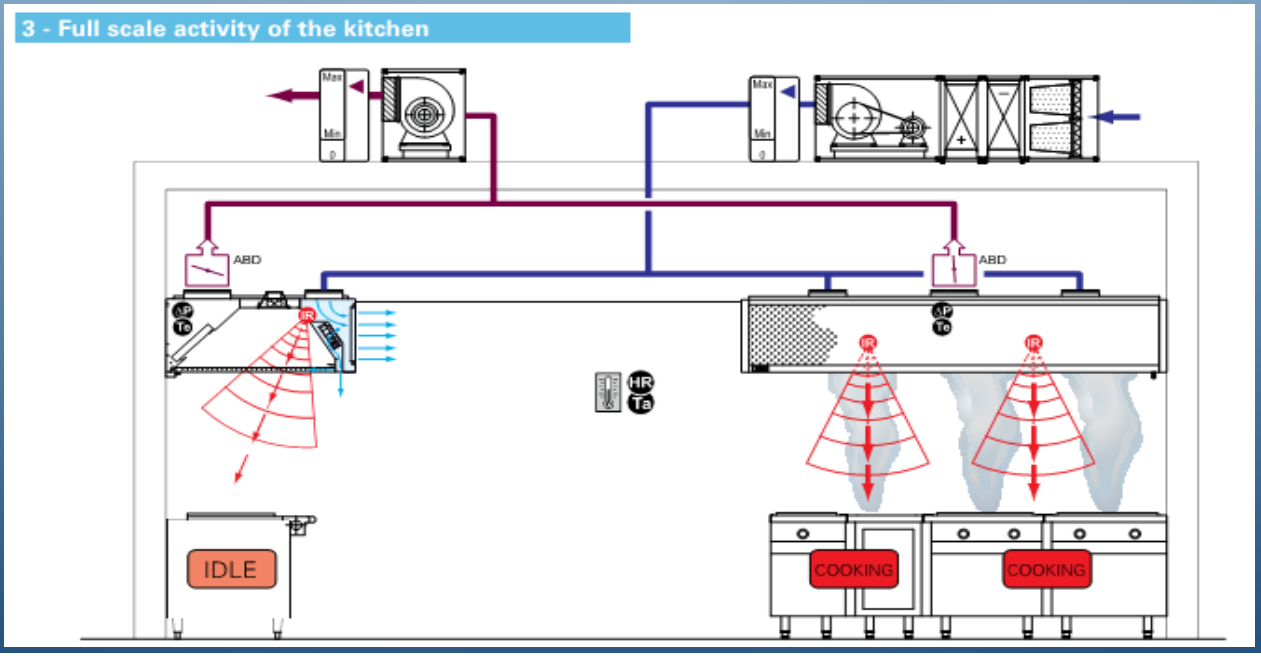
2006 IMC

Commercial Kitchen Makeup Air

- **508.1.1 Makeup Air temperature.** The temperature differential between makeup air and the air in the conditioned space shall not exceed 10°F.
- **Exceptions:**
  1. Makeup air that is part of the air-conditioning system
  2. Makeup air that does not decrease the co conditions of the occupied space

Demand control Ventilation

Ability to control exhaust fan and make air speed/ volume during operation through a Variable frequency Drive (VFD) or Variable Speed Drive (VSD)



CONTROL Strategies

- Time of day
- Appliance energy use
- Sensing exhaust air temperature
- Sensing smoke or steam
- Monitor surface temperature
- Direct communication from cooking equipment

Source ASHRAE Journal 2/13, Don Fisher & Rich Swierczyna

How does it work?

The system can measure temperature, smoke / steam vapor in hood, adjust fan speed to save energy, reduce heating and cooling load on make-up air unit

Sensing Exhaust Air Temperature

Least expensive option

Detects heat with duct collar sensor

Least complex wiring / installation

Sensing Smoke & Steam

- Moderately expensive
- Detects heat with duct collar sensor
- Detects smoke & steam vapor with optic sensor
- Simple installation

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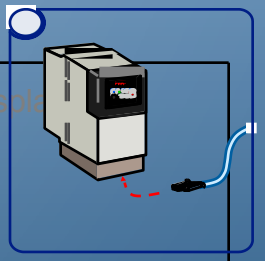


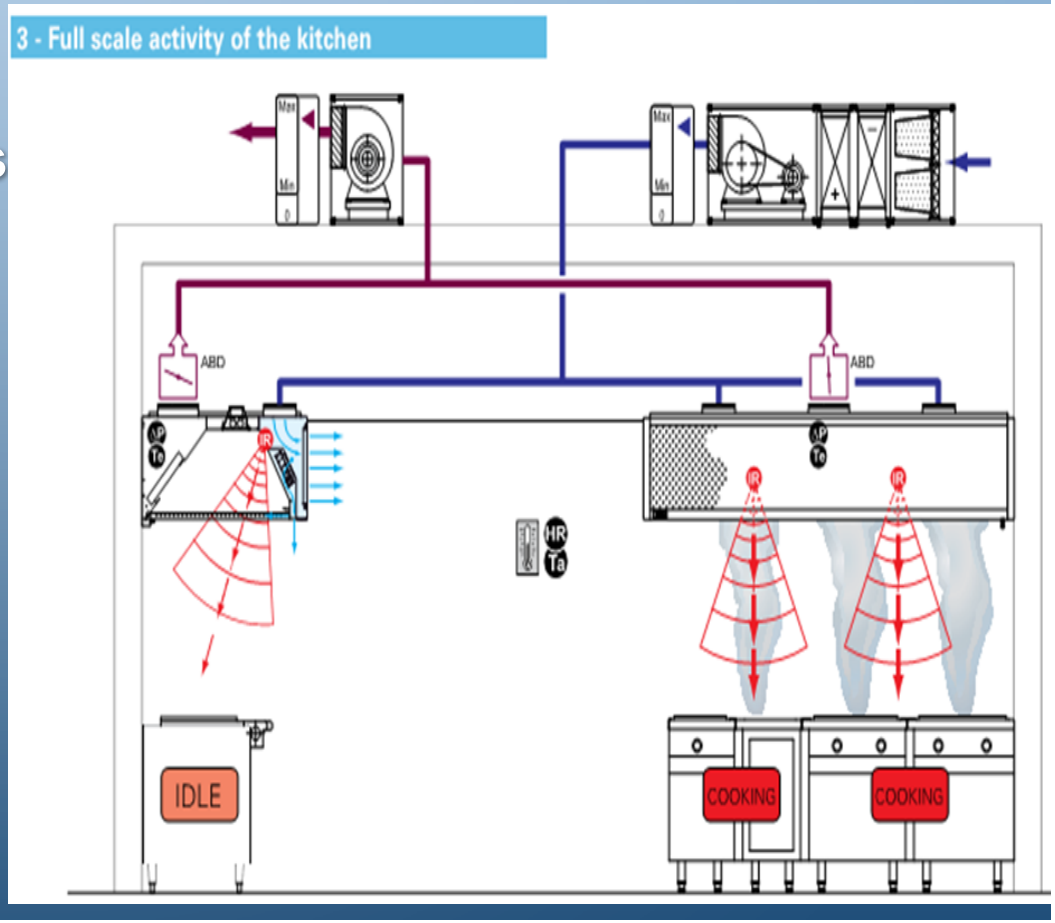
Sensing Surface Temperature

More expensive

Detects heat with multiple infrared sensors in hood canopy

Room temperature sensor (activates fan when duct collar sensor is 9⁰+ above the room temperature sensor)

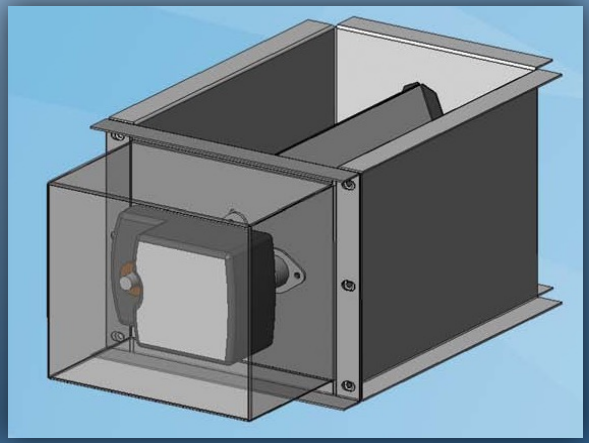
Complex installation (lots of inter-wiring, standard & low voltage)



Motorized Exhaust Dampers

Most expensive

Adds additional level of control



Demand Control Ventilation

Factors affecting length of payback

- Number of hoods
- Total amount of exhaust
- Geographic location – annual heating and cooling cost
- Accuracy of input data
- Baseline used for comparison


TWENTY QUESTIONS
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VAN
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