

ASHRAE Boston Chapter Meeting
Refrigerant Update
November 10, 2015

Outline

- Refrigerant cycle- 10 minutes
- Ozone depletion- 10 minutes
- Global warming- 5 minutes
- Refrigerant terminology- 10 minutes
- Temperature glide- 10 minutes
- Refrigerant phase-out- 5 minutes
- Review of EPA SNAP form- 10 minutes
- Quiz and Questions- 5 minutes

Basic Refrigeration System

- Air-cooled
- Water-cooled
- Evaporative

Condenser

Compressor

- Scroll
- Reciprocating
- Helical rotary (screw)
- Centrifugal

Metering Device

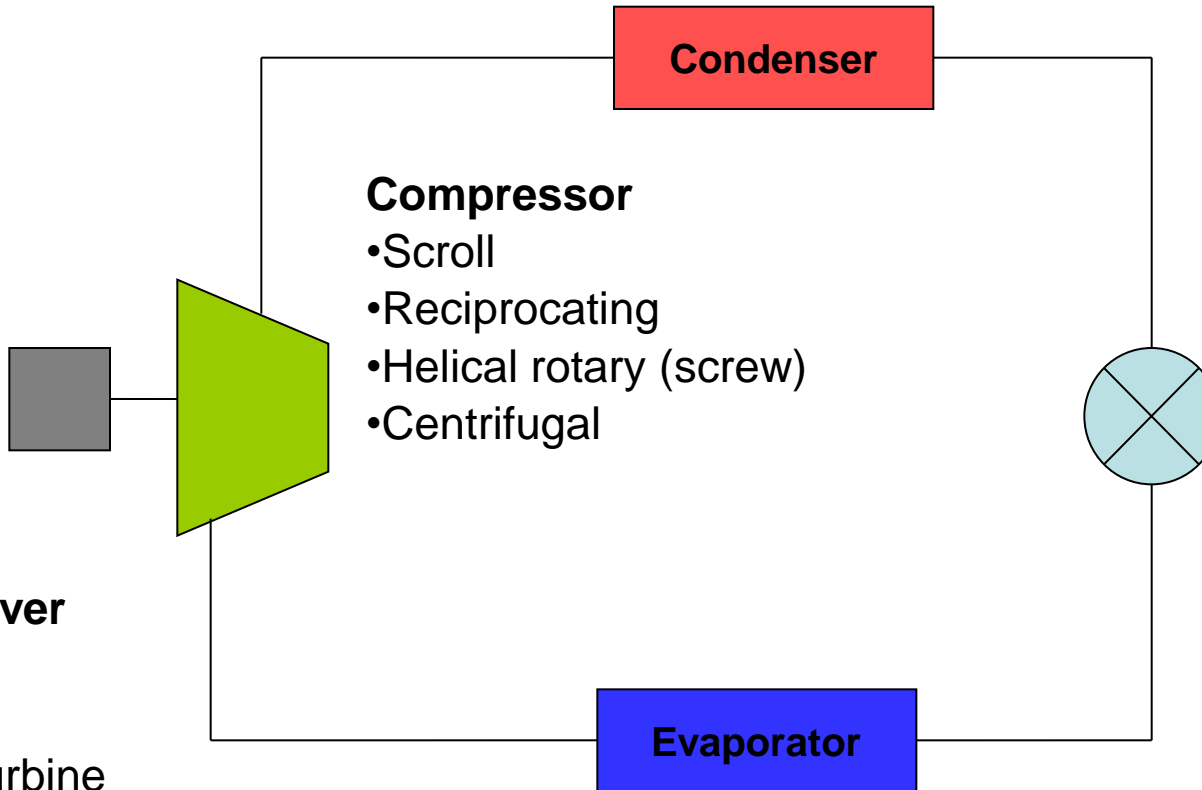
- Capillary tube
- Orifice
- TXV
- Level control
- Electronic

Evaporator

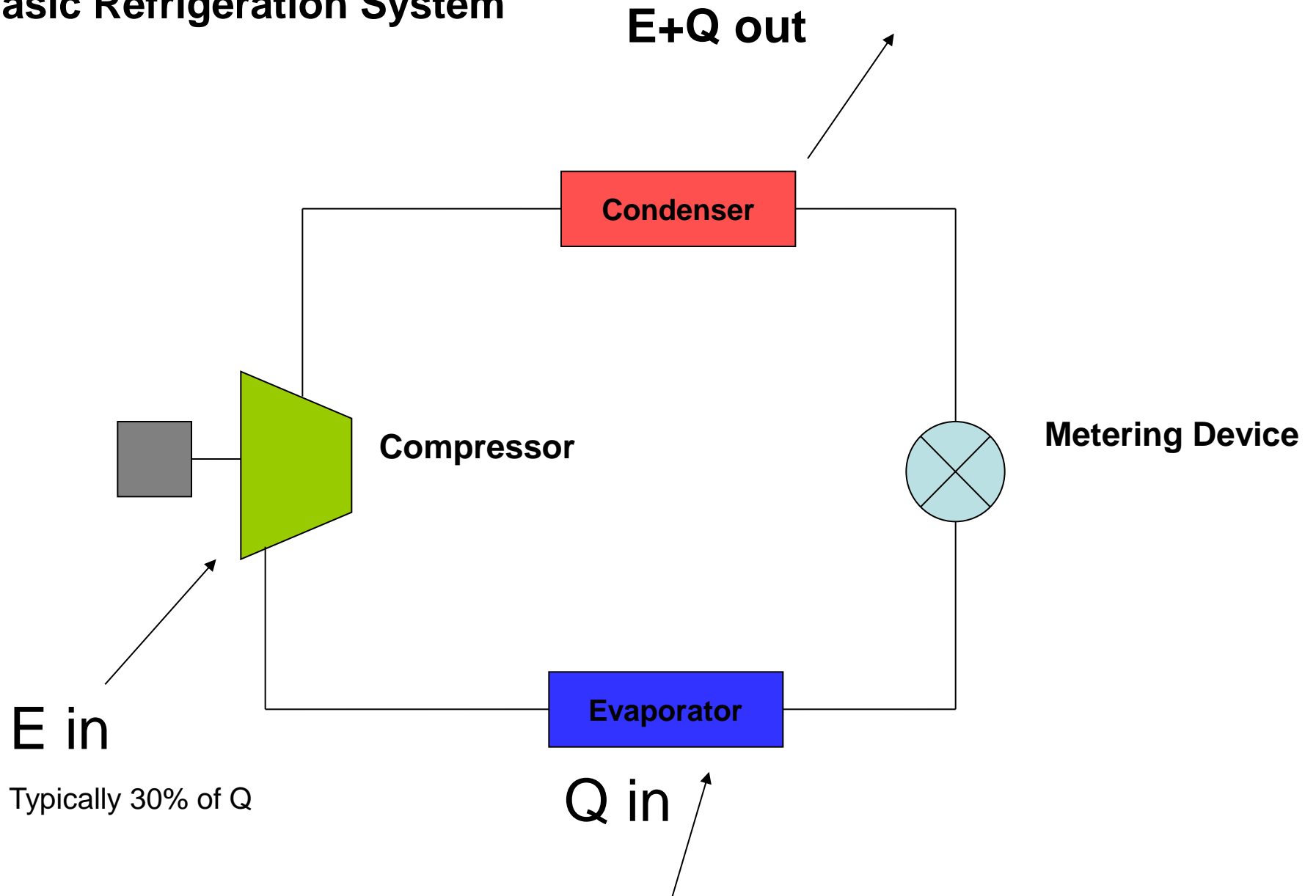
- Air cooling coil
- Shell & tube (liquid chiller)
- Special (process)

Prime Mover

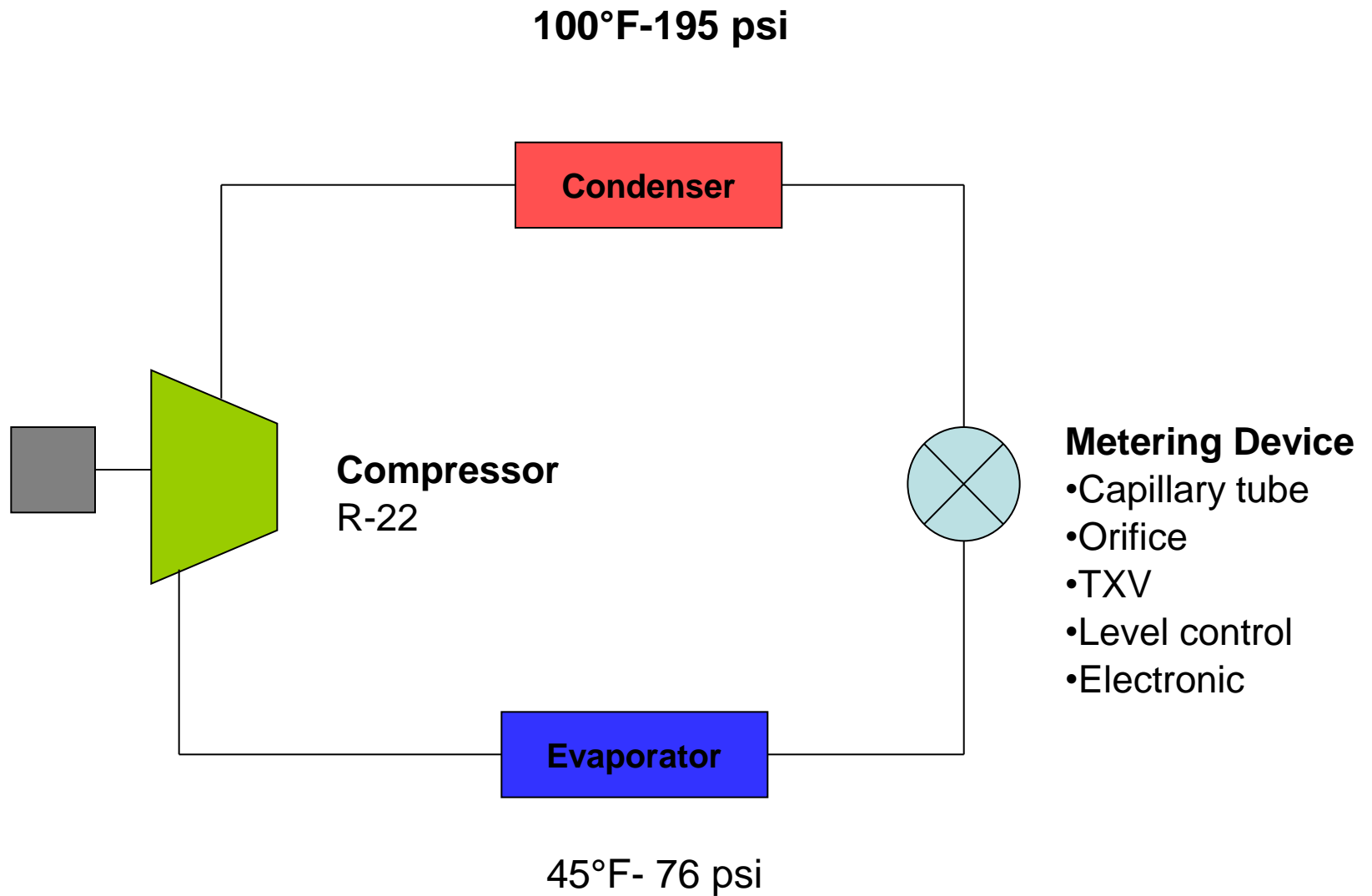
- Motor
- Engine
- Steam Turbine



Basic Refrigeration System



Basic Refrigeration System



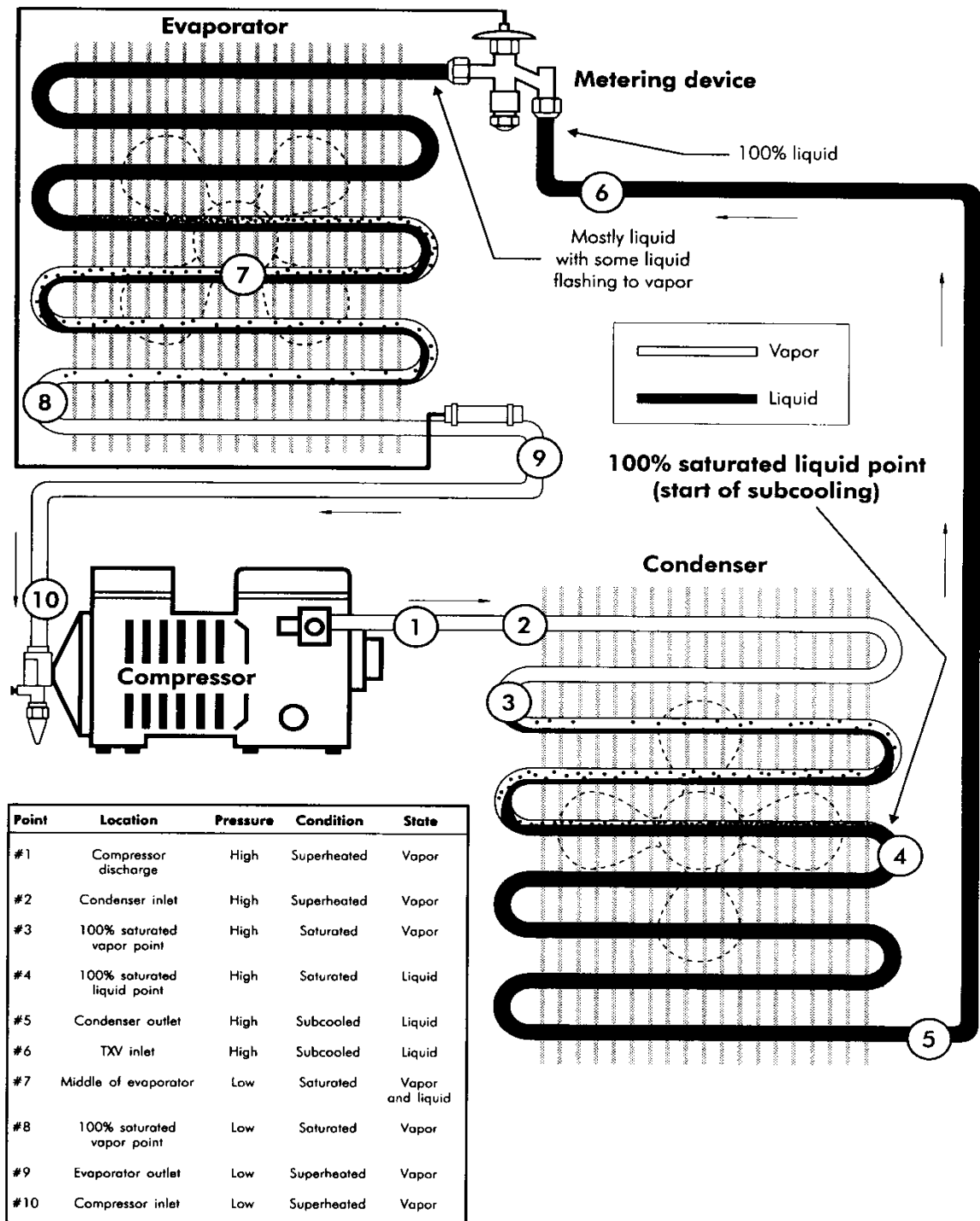
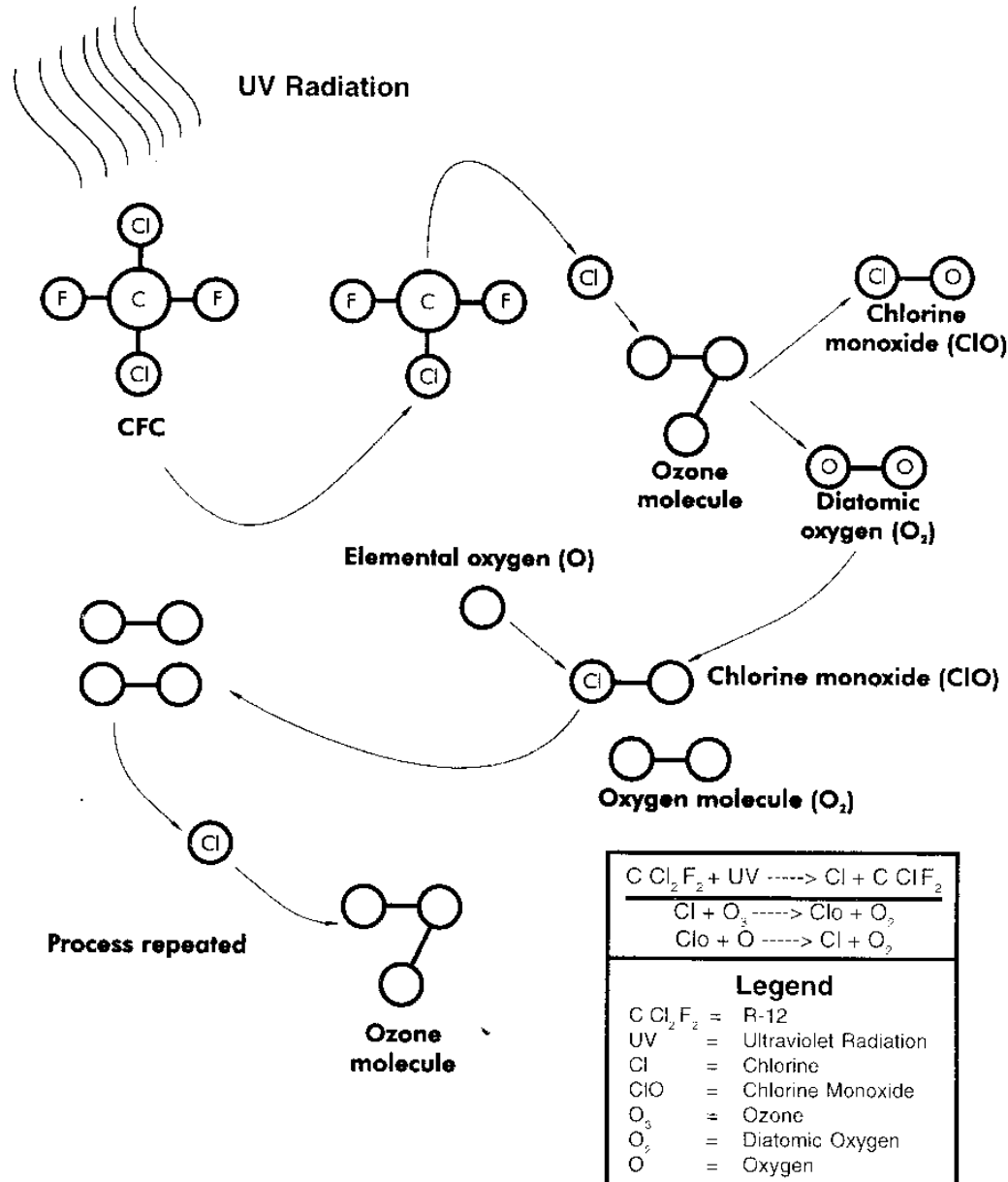


Figure 1-8. Basic refrigeration system showing refrigerant pressures, states, and condition locations

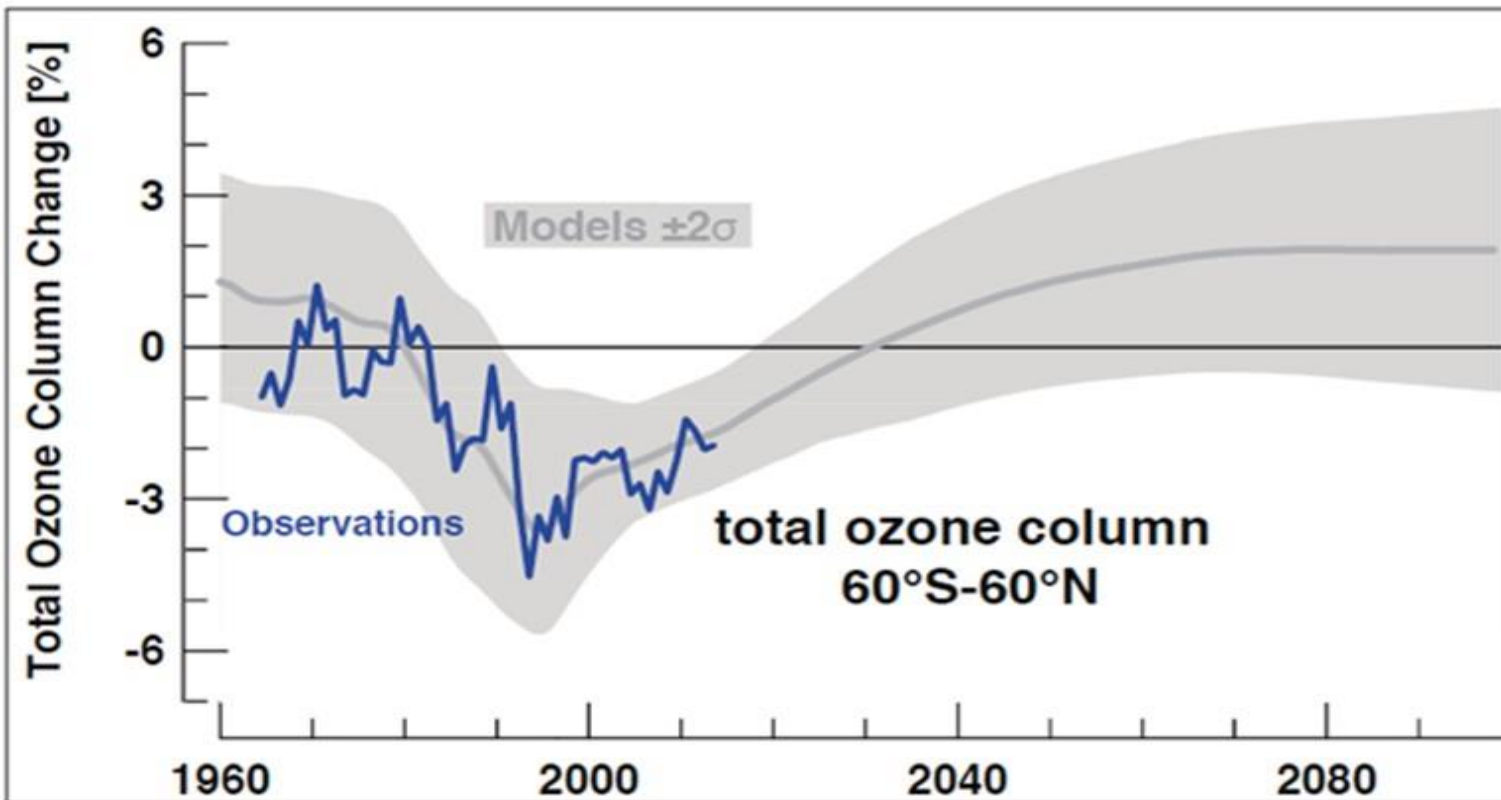
Ozone Depletion

- ***Bad Ozone - Tropospheric - 0 to 7 miles above Earth***
- ***Good Ozone - Stratosphere - 7 to 30 miles above Earth***
- **Tropospheric Ozone**
 - Caused from sun acting on air contaminants causing smog
- **Stratospheric Ozone**
 - Filters ultraviolet rays UV shielding
 - Earth of ultraviolet radiation, fortunately, 90% of ozone is found here
 - Types of radiation
 - UV-A - not harmful
 - UV-B - harmful if not filtered in stratosphere
 - UV-C - not harmful

Stratospheric Ozone Depletion



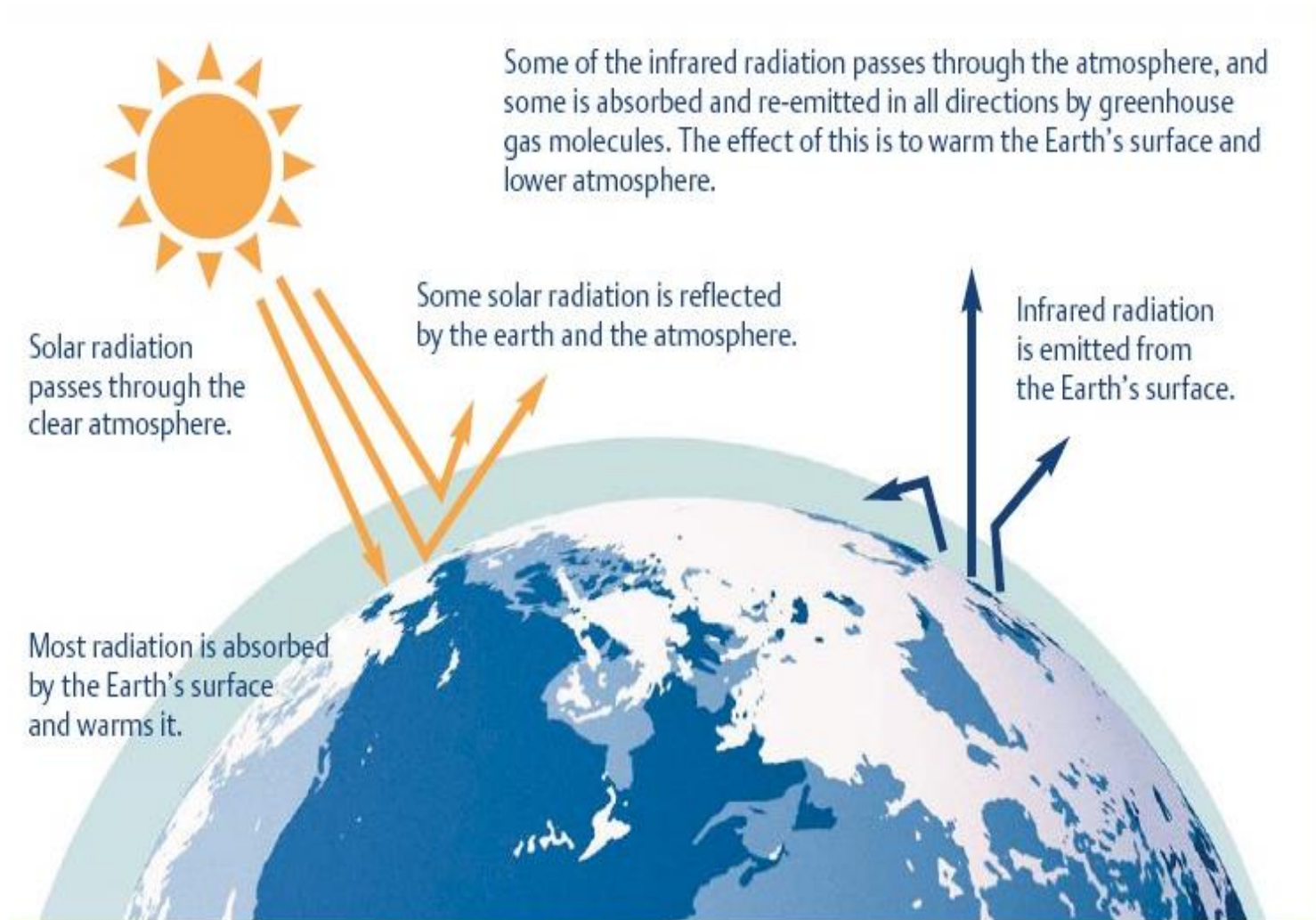
Montreal Protocol's Positive Impact on Ozone Hole



Ozone hole still large, but healing; full recovery expected ~2070

Source: NASA. Image from Nov. 2, 2014

Global Warming



Desired Refrigerant Properties

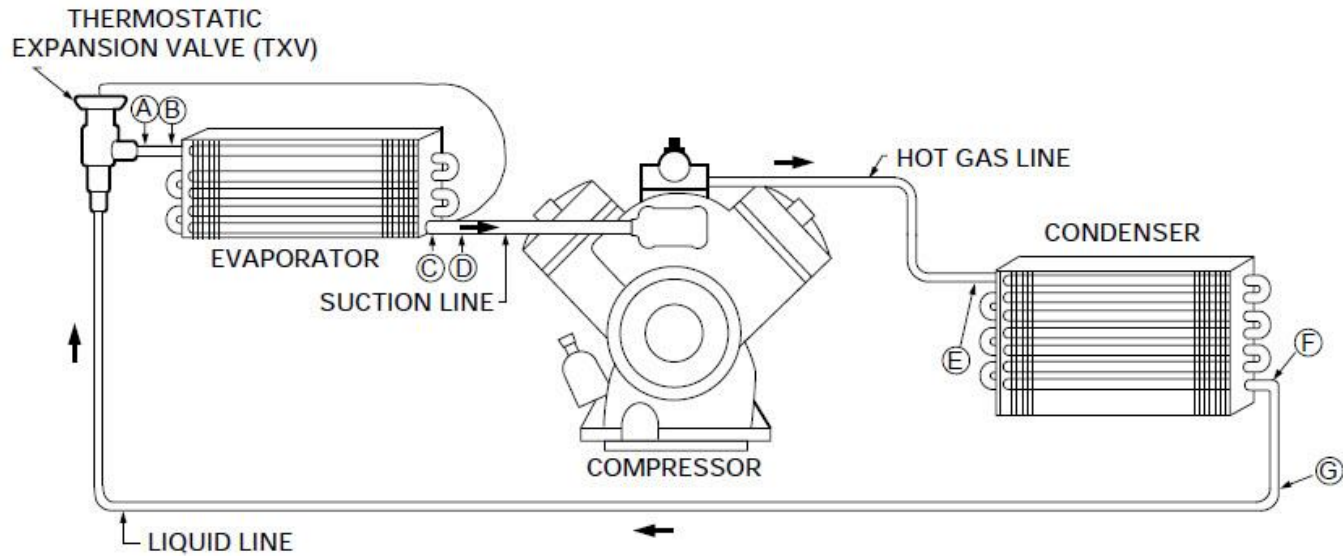
- **Environmentally Acceptable**
- **Non-toxic**
- **Non-flammable**
- **High latent heat of vaporization**
- **Chemically stable**
- **Material of construction compatible**
- **Lubricant soluble**
- **Low moisture solubility**
- **High dielectric strength**
- **Ease of transport handling**
- **Capable of recycling**
- **Detectable at low concentrations**
- **Reasonable cost**
- **Readily available**
- **Field system charging capability**

REFRIGERANT ACRONYMS

- **CFCs - Chlorofluorocarbons**
 - Atmospheric Life of 75 to 120 years
 - High ODP (Ozone Depletion Potential)
 - CFC-11, 12, 113, 114, 115 (and many more)
- **HCFCs - Hydro chlorofluorocarbons**
 - Have shorter atmospheric lives
 - Less chlorine than CFCs
 - HCFC-22, 124, 123
- **HFCs - Hydro fluorocarbons**
 - Have shorter atmospheric lives
 - Have "zero" ozone depletion potentials
 - Contain no chlorine atoms
 - HFCs are: HFC-134a, 152a, 125, 143a, 32

Azeotrope vs Blend

- Azeotrope- a mixture of 2 or more refrigerants that act as one
 - One boiling and one condensing temp
 - Example is R410A
- Blend- a mixture of 2 or more refrigerants that do not chemically combine
 - Must be charged as a liquid
 - Can leak out of a system in different quantities
 - Has a temperature glide



Evaporator at 12 psig for Suva® MP39 and CFC-12

- (A) Saturated liquid at evaporator pressure
- (B) Evaporator inlet (liquid/vapor mixture)
- (C) Evaporator exit (saturated vapor)
- (D) Compressor suction (superheated vapor)

Average Evaporator Temperature:
 Evaporator Temperature Glide:
 Amount of Vapor Superheat at (D) :

	Temperature, °F	
	Suva® MP39	CFC-12
(A)	-2.5	5
(B)	1.0	5
(C)	9.0	5
(D)	14.0	14
Average Evaporator Temperature:	5.0	5
Evaporator Temperature Glide:	8.0	0
Amount of Vapor Superheat at (D) :	5.0	9

**Condenser at 163 psig for Suva® MP39;
 at 142 psig for CFC-12**

- (E) Condenser inlet (saturated vapor)
- (F) Condenser exit (saturated liquid)
- (G) Liquid line to TXV (subcooled liquid)

Average Condenser Temperature:
 Condenser Temperature Glide:
 Amount of Liquid Subcool at (G) :

	Temperature, °F	
	Suva® MP39	CFC-12
(E)	117	113
(F)	109	113
(G)	104	104
Average Condenser Temperature:	113	113
Condenser Temperature Glide:	8	0
Amount of Liquid Subcool at (G) :	5	9

Phase-out

- 9/87- Montreal Protocol Signed
- 1/96- CFC production stopped
- 2010- No new R-22 equipment made
- 2020- No new R-22 for service
- 2020- No new R-123 equipment

[View EPA Snap PDF](#)

Questions

- 1. What year was the Montreal Protocol signed?
- 2. What does CFC stand for?
- 3. What does HCFC stand for?
- 4. What does HFC stand for?
- 5. What was the last year new equipment using R-22 was manufactured?
- 6. How does ozone help us?
- 7. How does ozone hurt us?
- 8. Name 3 desirable properties of a refrigerant.
- 9. What is an Azeotrope?
- 10. What is a temperature glide?