

P/T CHART (Pressure)

Temp	°F	°C	PSIG	BAR	MM Hg
100	37.8	3.9	0.34	0.023	2.5
150	65.6	18.7	0.69	0.047	5.0
200	93.3	34.4	1.03	0.071	7.5
250	121.1	50.6	1.38	0.094	10.0
300	148.9	66.1	1.72	0.118	12.5
350	176.7	81.5	2.07	0.142	15.0
400	204.4	96.4	2.41	0.165	17.5
450	232.2	111.8	2.76	0.189	20.0
500	260.0	126.7	3.10	0.213	22.5
550	287.8	141.0	3.45	0.236	25.0
600	315.6	155.9	3.79	0.260	27.5
650	343.3	170.2	4.14	0.283	30.0
700	371.1	185.1	4.48	0.307	32.5
750	398.9	199.4	4.83	0.330	35.0
800	426.7	214.3	5.17	0.354	37.5
850	454.4	229.1	5.52	0.377	40.0
900	482.2	244.0	5.86	0.401	42.5
950	510.0	258.9	6.21	0.424	45.0
1000	537.8	273.2	6.55	0.448	47.5

Key Topics for EPA 608

Category	Key Info
Refrigerant	Refrigerant is the substance that circulates through the system, absorbing and releasing heat. It is contained within a closed loop.
Refrigerant & Environmental Effects	Refrigerants can deplete the ozone layer and contribute to global warming. Proper handling is crucial to minimize these effects.
Refrigerant Types	Common types include R-22, R-410A, R-134a, and R-407C. Each has specific properties and uses.
Refrigerant Properties	Key properties include boiling point, critical temperature, and pressure. These determine the system's operating conditions.
Refrigerant Blends	Blends like R-407C and R-507B are used for specific applications. They have unique phase diagrams.
Recovery Procedures	Proper recovery involves using a recovery machine to safely remove refrigerant from the system.
Equipment & Tools	Essential tools include manifold gauges, vacuum pumps, and recovery machines.
System Components	Components include the compressor, condenser, evaporator, and expansion valve.
Legal Requirements	EPA 608 certification is required for anyone working with refrigerants. Proper labeling and documentation are also required.

Other HVAC Common Reference Diagram/Table

Heating Cycle

208V 1PH Control Wiring Diagram

Symptoms

- Refrigerant level low
- Compressor not running
- High head pressure
- Low head pressure
- Overheating
- Low voltage
- Defrost heater not working

HVAC Engineering I

1. REFRIGERATION CYCLE
• In a refrigeration cycle, the refrigerant circulates through a closed loop, absorbing heat from the space being cooled and releasing it to the condenser.
• Refrigerant Temperature: The temperature of the refrigerant at different stages of the cycle.
• Expansion: The process where the refrigerant expands, causing a drop in pressure and temperature.
• Condensing: The process where the refrigerant condenses, releasing heat to the condenser.
• Evaporating: The process where the refrigerant evaporates, absorbing heat from the space being cooled.
• Refrigerant Flow: The direction of flow of the refrigerant through the cycle.
• Coefficient of Performance (COP): A measure of the efficiency of a refrigeration system.
• Energy Efficiency Ratio (EER): A measure of the efficiency of an air conditioning system.
2. HEAT EXCHANGE
• Heat exchangers transfer heat between two fluids without mixing them.
• Counterflow: A type of heat exchanger where the two fluids flow in opposite directions.
• Parallelflow: A type of heat exchanger where the two fluids flow in the same direction.
• Crossflow: A type of heat exchanger where the two fluids flow perpendicular to each other.
• Shell and Tube: A common type of heat exchanger consisting of a shell and a bundle of tubes.
• Plate Heat Exchanger: A compact heat exchanger consisting of a series of plates.
• Air-to-Air: A heat exchanger used to pre-heat or pre-cool incoming air.
• Water-to-Water: A heat exchanger used to transfer heat between two water loops.
• Evaporator: A heat exchanger where the refrigerant evaporates, absorbing heat from the space being cooled.
• Condenser: A heat exchanger where the refrigerant condenses, releasing heat to the condenser.
3. ELECTRICAL CALCULATIONS
• Power (Watts): The rate at which energy is transferred.
• Voltage (Volts): The electrical potential difference.
• Current (Amperes): The flow of electric charge.
• Resistance (Ohms): The opposition to the flow of electric current.
• Power Factor: A measure of the efficiency of power usage in AC systems.
• Energy Consumption (kWh): The total amount of energy used over a period of time.
4. GAS FOR SPECIFIC PURPOSES
• Natural Gas: A common fuel source for heating and cooking.
• Propane Gas: A portable fuel source used in various applications.
• Refrigerant Gas: Gases used in refrigeration and air conditioning systems.
• Inert Gas: Gases that do not react with other substances, used in welding and manufacturing.
• Flammable Gas: Gases that can catch fire, requiring special handling.
• Corrosive Gas: Gases that can damage materials, requiring special equipment.
5. AIRFLOW AND DUCT DESIGN
• Airflow Rate (CFM): The volume of air moving through a duct per minute.
• Static Pressure: The resistance to airflow in a duct system.
• Velocity: The speed at which air is moving through a duct.
• Duct Sizing: The process of determining the appropriate duct size for a given airflow rate and static pressure.
• Air Filter: A device used to remove dust and debris from the air.
• Air Handler: The unit that moves air through the duct system.
• Air Leakage: Unintended air escaping from or entering a building.
• Air Quality: The condition of the air, including factors like temperature, humidity, and pollutants.

HVAC Preventive Maintenance

Preventive Maintenance Checklist
1. Air Handler/Filter Maintenance - Check and replace air filters regularly. - Inspect and clean the blower wheel. - Check the blower motor for proper operation. - Inspect the ductwork for leaks and insulation. 2. Condenser Coils - Clean the condenser coils to improve efficiency. - Check the coil fins for damage and straighten them if necessary. 3. Evaporator Coils - Clean the evaporator coils to prevent icing. - Check the coil for proper operation. 4. Refrigerant Levels - Check the refrigerant level and top up if necessary. - Inspect for leaks and repair them. 5. Electrical Components - Check the electrical connections for tightness. - Inspect the wiring for damage and insulation. - Check the capacitors and replace them if necessary. 6. Thermostat - Check the thermostat for proper operation. - Calibrate the thermostat if necessary. 7. Safety Checks - Check the gas valves for proper operation. - Inspect the venting system for leaks and blockages.

HVAC Preventive Maintenance Guide (2/2)

Preventive Maintenance Checklist
1. System Overview - Identify the system type and components. - Check the system for proper operation. 2. Condenser Coils - Clean the condenser coils to improve efficiency. - Check the coil fins for damage and straighten them if necessary. 3. Evaporator Coils - Clean the evaporator coils to prevent icing. - Check the coil for proper operation. 4. Refrigerant Levels - Check the refrigerant level and top up if necessary. - Inspect for leaks and repair them. 5. Electrical Components - Check the electrical connections for tightness. - Inspect the wiring for damage and insulation. - Check the capacitors and replace them if necessary. 6. Thermostat - Check the thermostat for proper operation. - Calibrate the thermostat if necessary. 7. Safety Checks - Check the gas valves for proper operation. - Inspect the venting system for leaks and blockages.

Common troubleshooting checklist

Symptom	Possible Causes	Checkpoints	Priority
No Cooling	Refrigerant level low, Compressor not running, Dirty condenser coils, Thermostat set incorrectly	Check refrigerant level, Check compressor operation, Clean condenser coils, Check thermostat settings	High
Poor Cooling	Dirty air filter, Low airflow, Dirty evaporator coils, Low refrigerant level	Replace air filter, Check airflow, Clean evaporator coils, Check refrigerant level	Medium
Compressor won't start	Bad capacitor, Bad contactor, Low voltage, Bad compressor	Check capacitor, Check contactor, Check voltage, Check compressor	High
Hot Water System	Dirty tank, Bad venting, Bad pressure relief valve	Flush tank, Check venting, Check pressure relief valve	Medium
Boiling/Freezing	Bad thermostat, Dirty coils, Low refrigerant level	Check thermostat, Clean coils, Check refrigerant level	Medium
Leaking Water	Refrigerant leak, Condenser coil leak, Drain pan overflow	Check for leaks, Repair leaks, Clean drain pan	High
Indoor Air Quality Issues	Dirty air filter, Dirty evaporator coils, Dirty condenser coils	Replace air filter, Clean evaporator coils, Clean condenser coils	Medium
Short Cycling	Dirty air filter, Low airflow, Dirty evaporator coils	Replace air filter, Check airflow, Clean evaporator coils	Medium
Not in Operation	Bad capacitor, Bad contactor, Low voltage, Bad compressor	Check capacitor, Check contactor, Check voltage, Check compressor	High

Refrigerant Parameters and Operation Guide

Parameter	R-22	R-410A	Key Difference
Operating Pressure	Low	High	R-410A operates at higher pressures.
Refrigerant Flow	Low	High	R-410A has a higher flow rate.
Changing Method	Easy	Difficult	R-410A requires special equipment for recovery.
Oil Compatibility	Mineral oil	Polyester oil	R-410A requires polyester oil.
Changing State	Easy	Difficult	R-410A has a higher boiling point.
Charge Rate	Fast	Slow	R-410A has a lower charge rate.
System Design	Simple	Complex	R-410A requires more complex system design.

Superheated Calculations

Superheated temperature = Saturated temperature + Superheat

Example: Saturated temperature = 40°F, Superheat = 10°F, Superheated temperature = 50°F

Subcooled Calculations

Subcooled temperature = Saturated temperature - Subcooling

Example: Saturated temperature = 40°F, Subcooling = 5°F, Subcooled temperature = 35°F

Changing Indication Table

Condition	Superheat	Subcooling	Library	Action
High Superheat	High	Low	High	Check for leaks, add refrigerant
Low Superheat	Low	High	Low	Check for leaks, add refrigerant
High Subcooling	High	High	High	Check for leaks, add refrigerant
Low Subcooling	Low	Low	Low	Check for leaks, add refrigerant

Refrigerant Injection/Recovery Methods

Method	Procedure
Refrigerant Injection	Inject refrigerant into the system through a service port.
Refrigerant Recovery	Recover refrigerant from the system using a recovery machine.
Refrigerant Exchange	Exchange the refrigerant in the system with a new refrigerant.
Refrigerant Purge	Purge the system of non-condensable gases.
Refrigerant Flush	Flush the system with a cleaning agent.

Hvac Tech Troubleshooting Guide

Zhe Xu



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