


Fundamentals of Refrigeration

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1

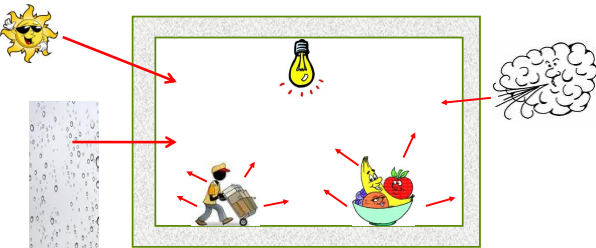

Contents..

- Refrigeration
- Refrigeration cycle .. P – h chart
- Classification of Refrigeration Systems
- Refrigerants
- Environmental Issues & Refrigerant Phase Out
- Types of Industrial Refrigeration Plants
- Questions & Answers



2

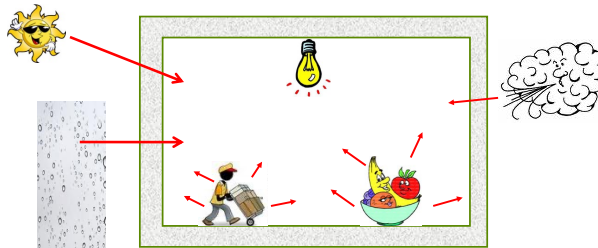

Refrigeration... Definition

3

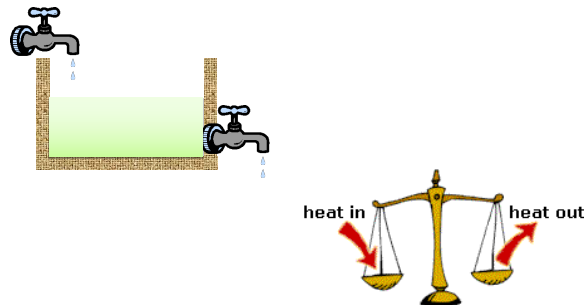

Refrigeration... Definition

Method of maintaining the temperature of the object below the surrounding ambient temperature.



4

Refrigeration.. Principle of Refrigeration

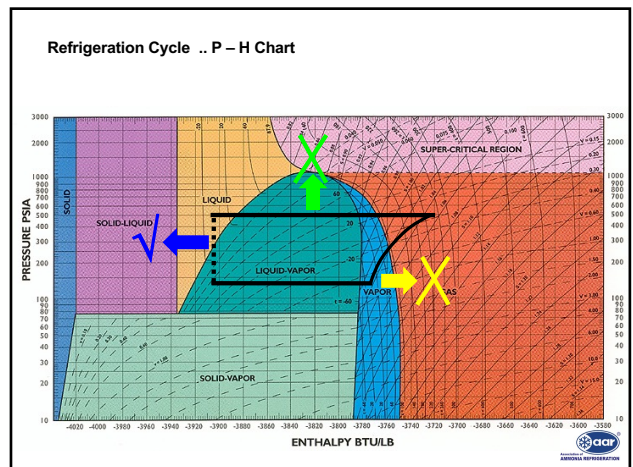
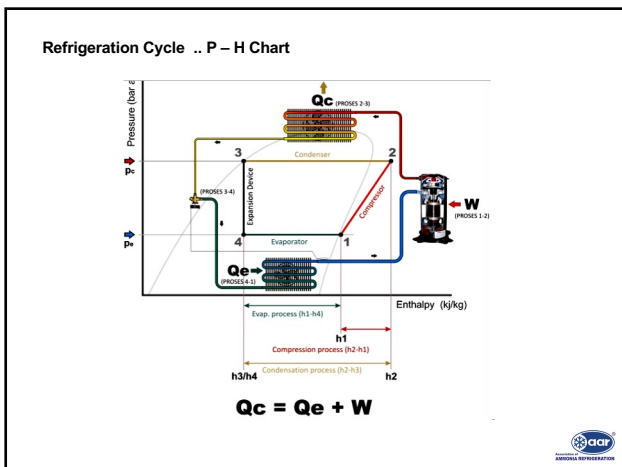
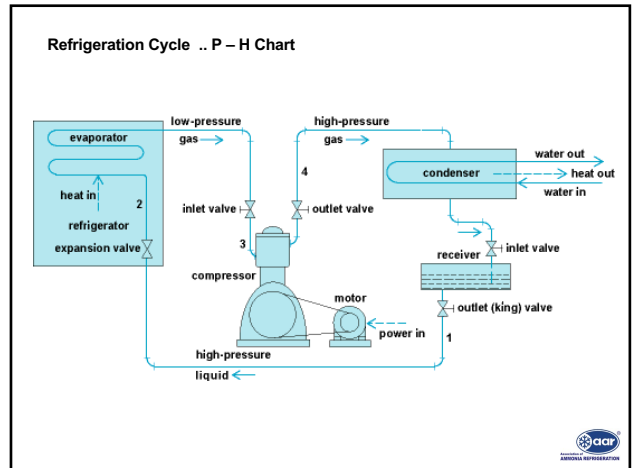
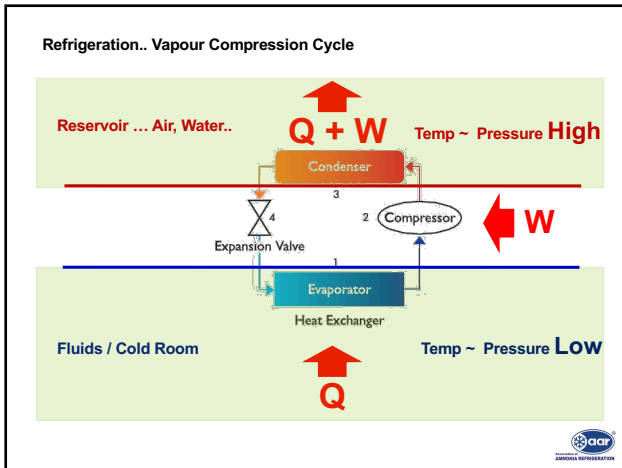
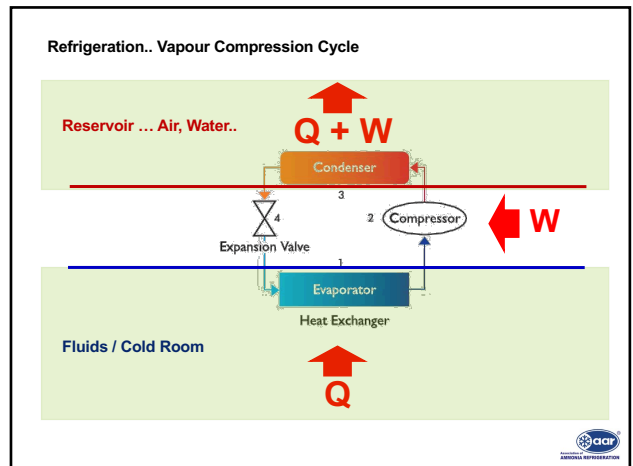
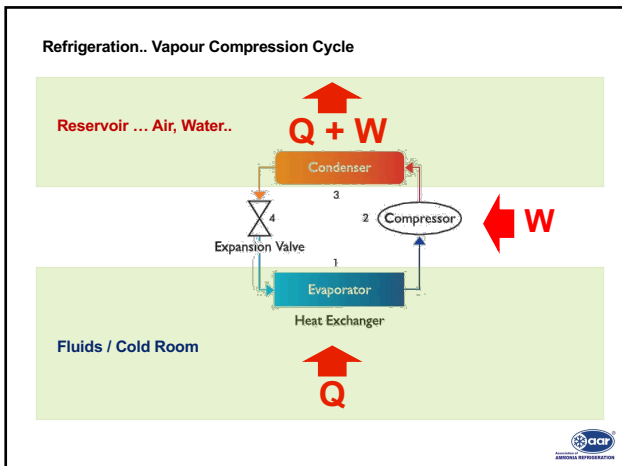



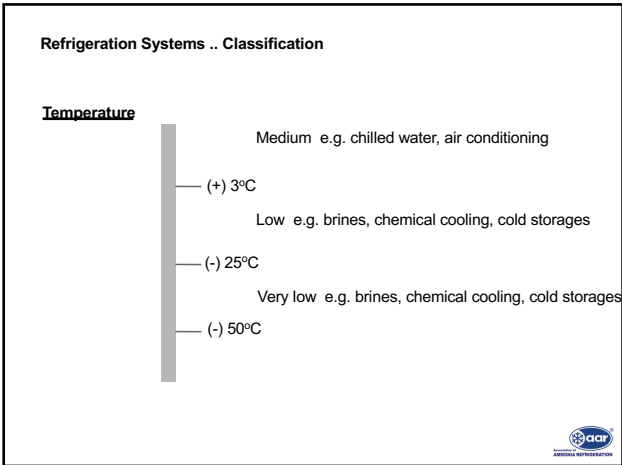
5

Refrigeration.. Vapour Compression Cycle

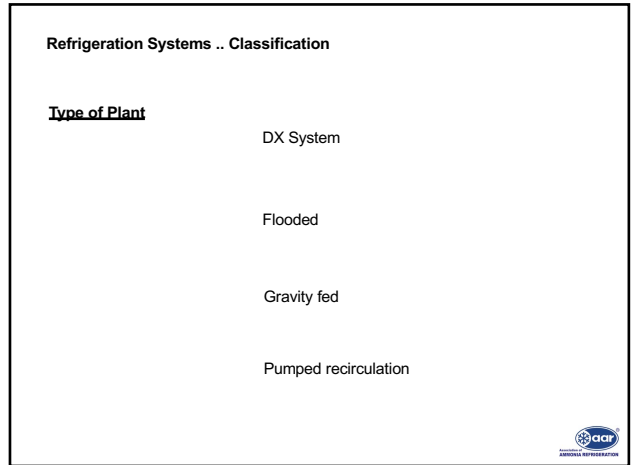



7

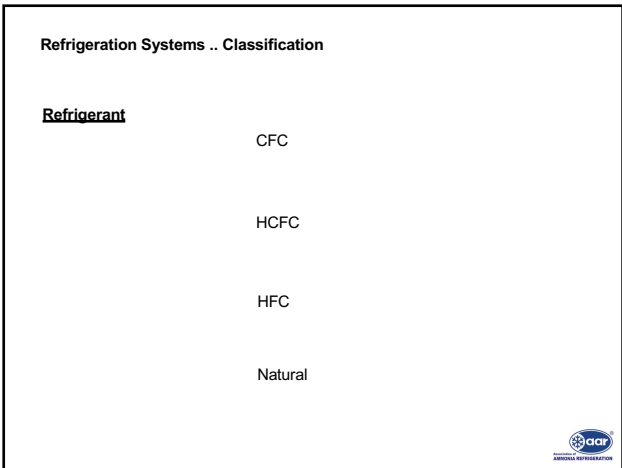




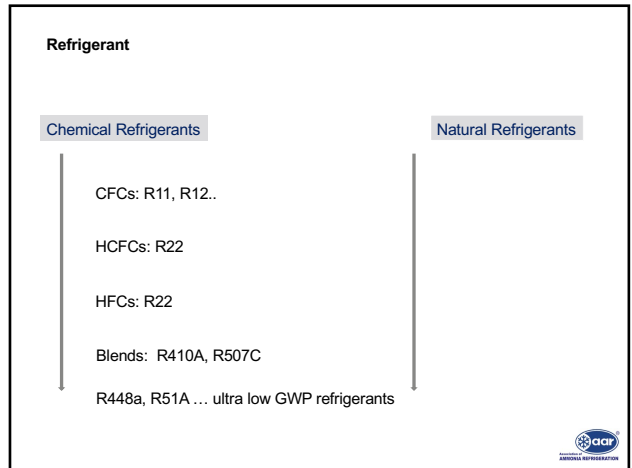
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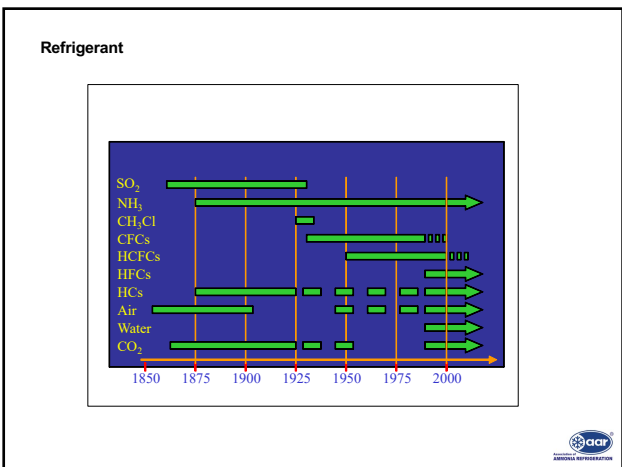
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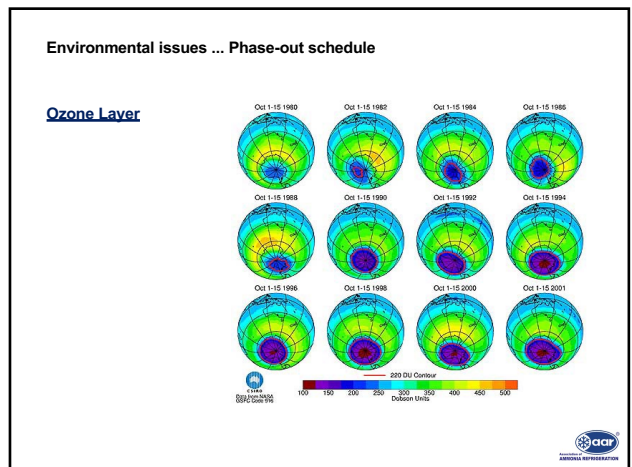
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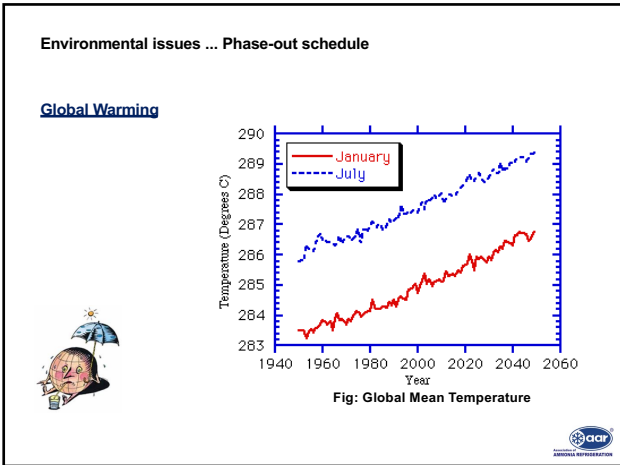
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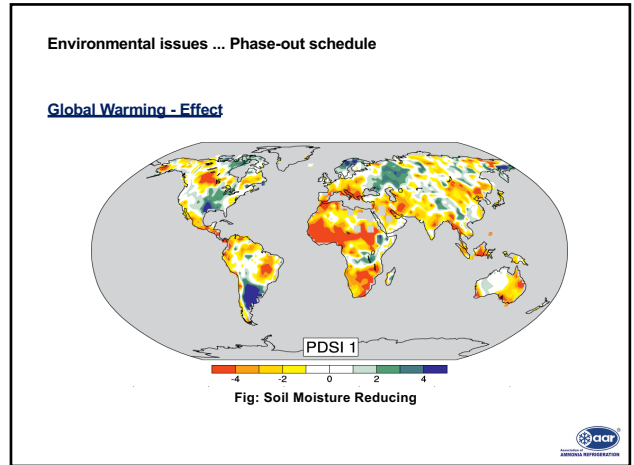
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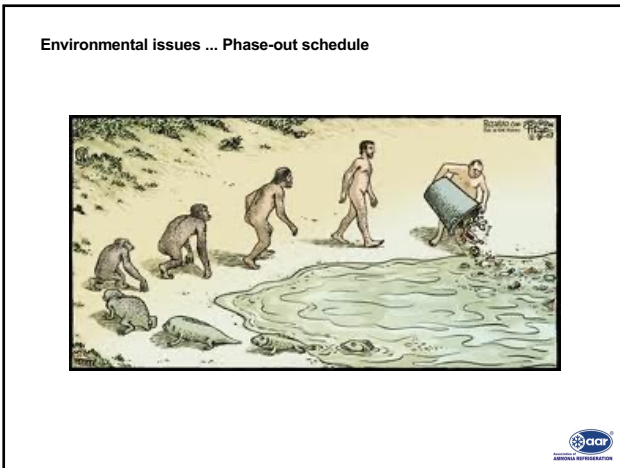
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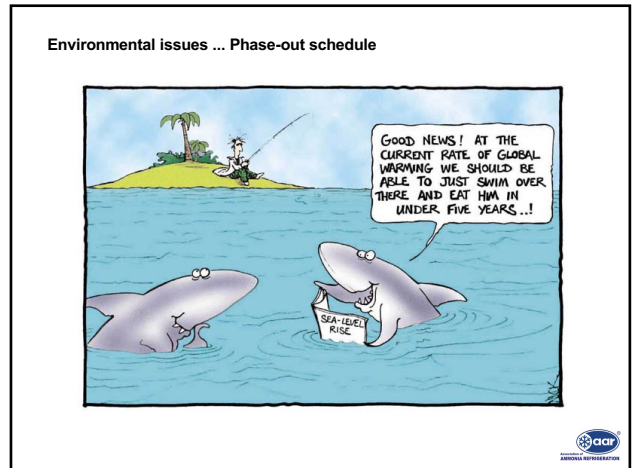
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21



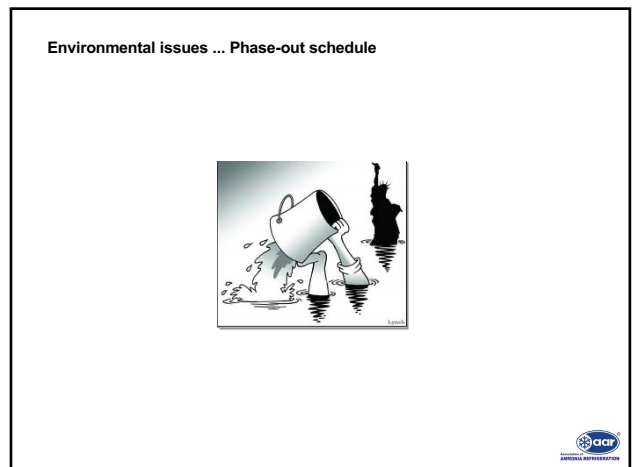
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23



24



25

Environmental issues ... Phase-out schedule

Climate Tour specials
get there before it's gone!

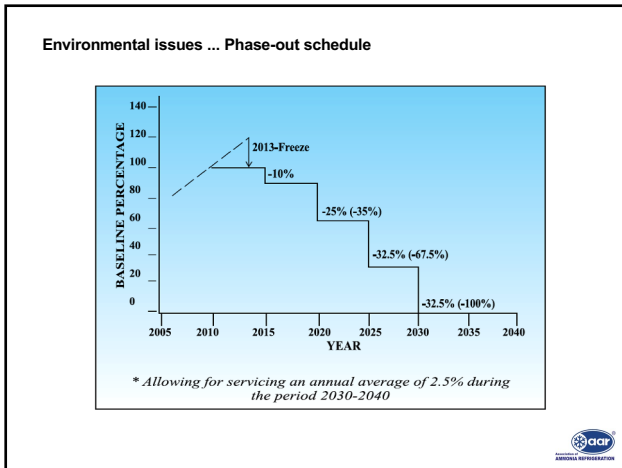
Wave goodbye to world history!

26

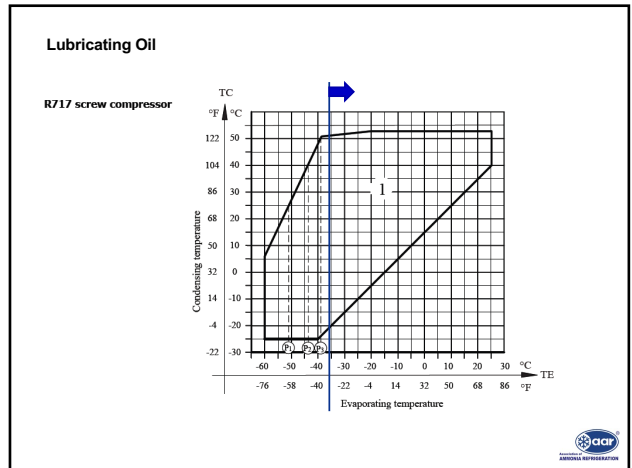
Environmental issues ... Phase-out schedule

Refrigerant	Formula	Lifetime	ODP	GWP (CO ₂)	GWP (R11)
CFC-11	CCl ₃ F	50	1.000	1500	1.000
CFC-12	CCl ₂ F ₂	120	1.000	4500	2.090
CFC-113	CCl ₂ FCClF ₂	90	0.800	2100	1.400
CFC-114	CClFCClF ₂	200	0.700	5500	3.667
CFC-115	CClF ₂ CF ₂	100	0.900	7400	4.933
HCFC-22	CHClF ₂	15	0.055	1700	0.430
HCFC-123	CF ₃ CHCl ₂	2	0.020	29	0.019
HCFC-124	CHClCF ₃	7	0.020	150	0.120
HCFC-141b	CH ₃ CCl ₂ F	8	0.100	150	0.100
HCFC-142b	CH ₃ CClF ₂	19	0.060	540	0.360
HFC-32	CH ₂ F ₂	6	0.000	225	0.150
HFC-125	CHF ₂ CF ₃	28	0.000	860	0.573
HFC-134a	CF ₂ CH ₂ F	16	0.000	420	0.340
HFC-143a	CH ₃ CF ₃	41	0.000	1000	1.100
HFC-152a	CH ₃ CHF ₂	2	0.000	47	0.040
R-717	NH ₃	0	0.000	0	0.000
R-718	H ₂ O	0	0.000	0	0.000
HC-290	C ₃ H ₈	0	0.000	0	0.000

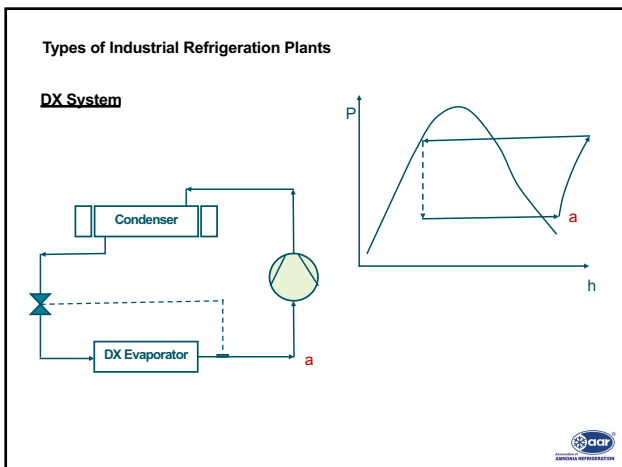
27



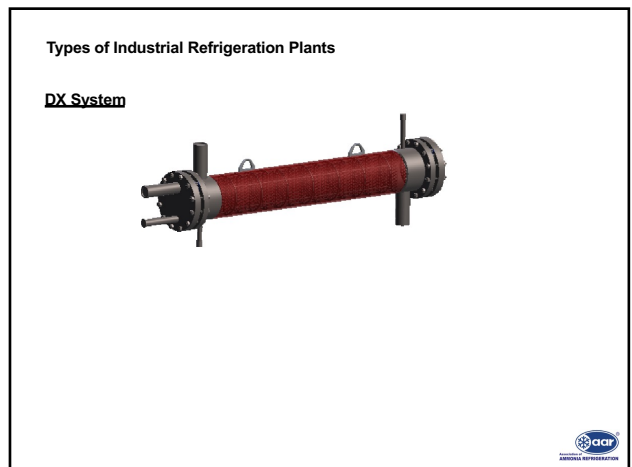
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29



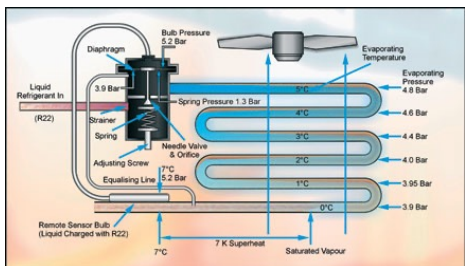
30



31

Types of Industrial Refrigeration Plants

Expansion Valves



32

Types of Industrial Refrigeration Plants

Expansion Valves

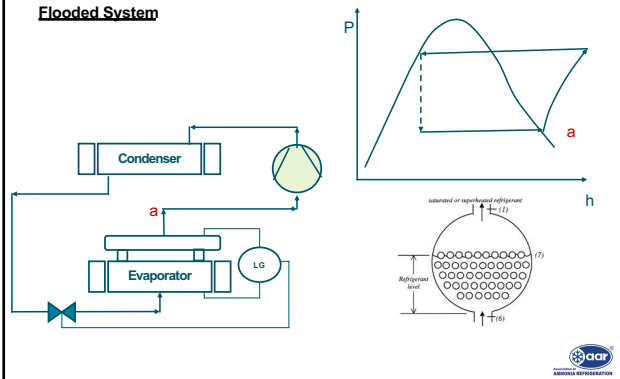
	Fixed Orifice (Capillary Tube)	TXV (Thermostatic)	EXV (Stepper Motor)
Technology	Seamless tubing with small and accurate diameters	Mechanical device driven by sensing bulb and system pressures	Stepper motor with electronic control. Like a conventional DC motor, it has a permanent magnet and a stator
Advantages	Cost No moving parts	Self adjusting flow control over limited range	Autonomous flow control over a wide operating range
Limitations	Very limited capabilities for energy efficiency improvement No flow control capabilities	Control hardware refrigerant dependent Performance degradation over time (mechanical wear) Several moving parts Limited installation flexibility (bulb location & mounting) Limited capabilities for further efficiency improvement Limited capacity modulation	Complex electronic control Slow response Scalability limited by cost and size Control software refrigerant dependent Mechanical component reliability issues (needle)



33

Types of Industrial Refrigeration Plants

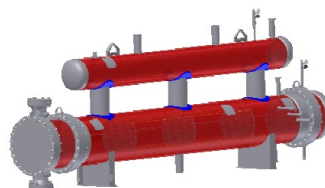
Flooded System



34

Types of Industrial Refrigeration Plants

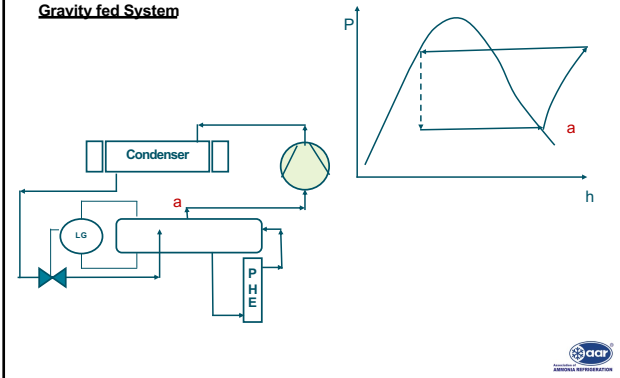
Flooded System



35

Types of Industrial Refrigeration Plants

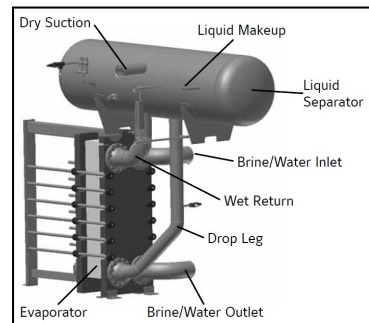
Gravity fed System



36

Types of Industrial Refrigeration Plants

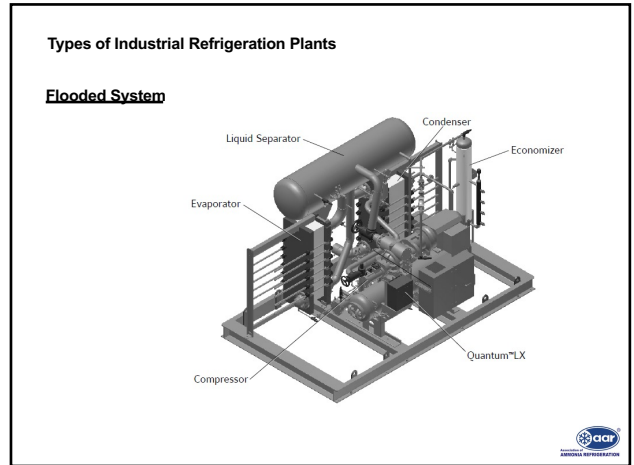
Flooded System



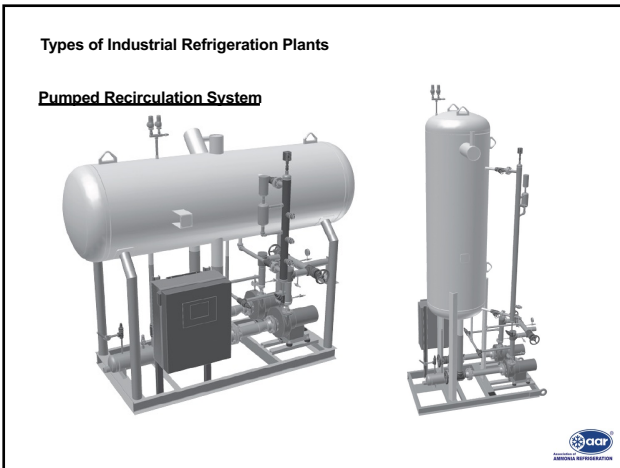
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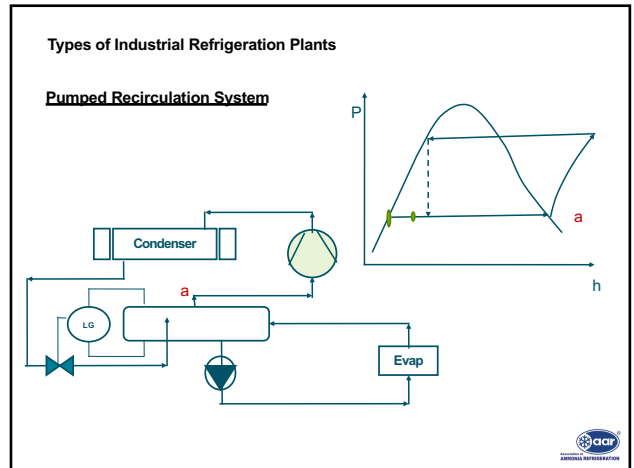
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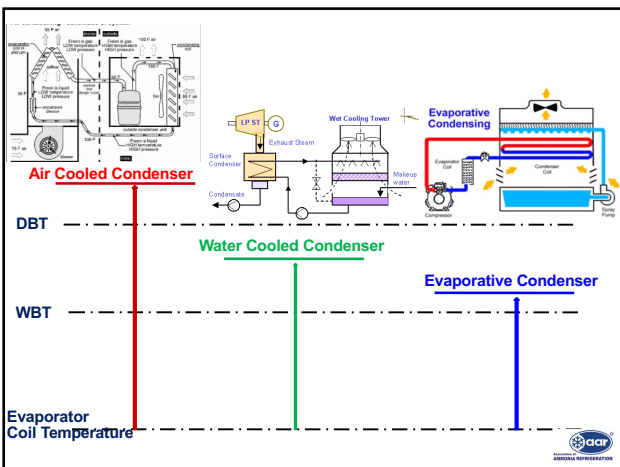
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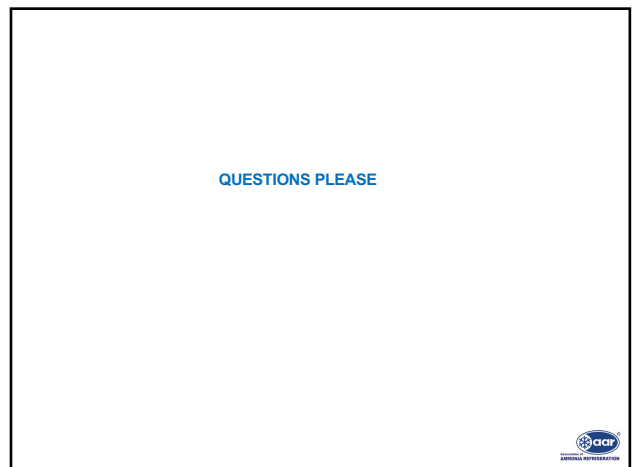
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41



42



43