

Vacuum

How It Relates to Refrigeration
And Air Conditioning Service



Moisture In A Refrigeration System

- Visible Moisture
 - Water Droplets
 - Uncommon, but it can occur
- Invisible Moisture
 - Water Vapor
 - Found in all gasses
 - Found in all solids

Visible Moisture Problems

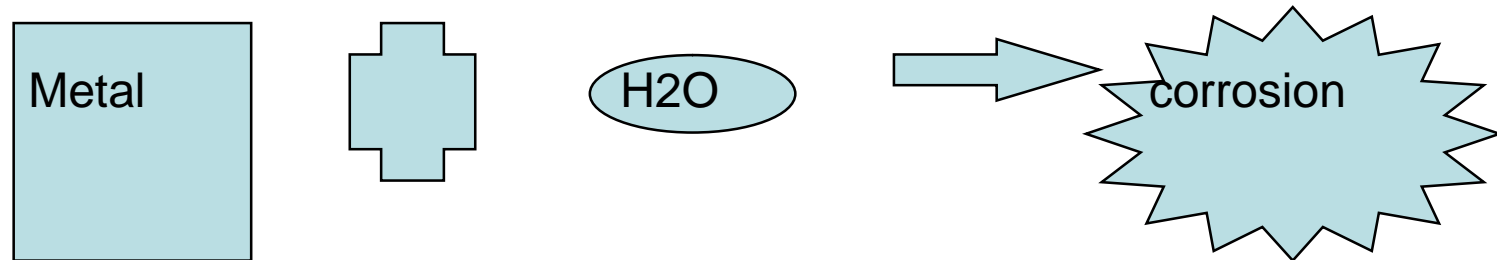
- Freeze Ups
 - Ice crystal formation at the point of expansion
 - Cap Tube blocked
 - TXV
 - Flow Rator
- The problems will be intermittent
 - When the system warms up the problem

Invisible Moisture

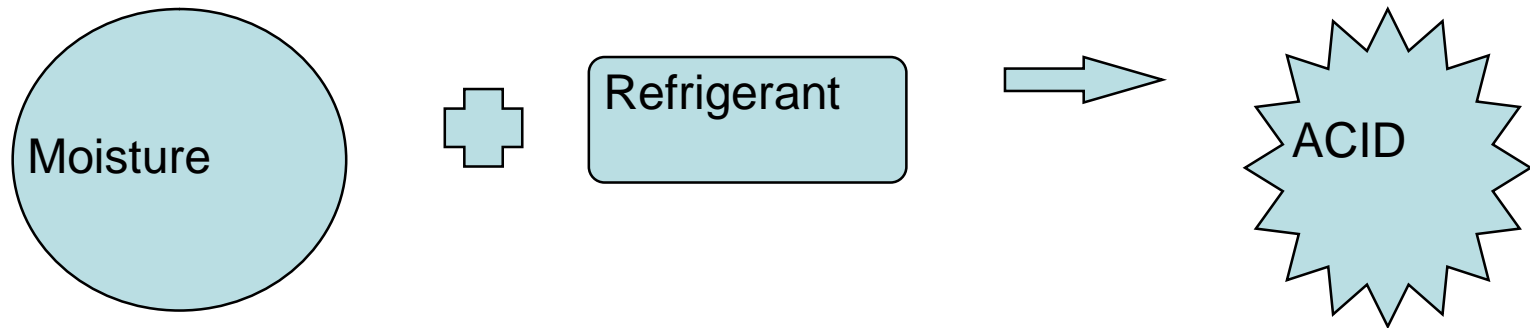
- Air in the piping
- “Wet” Refrigerant
- Leaks Under a Vacuum Condition
- Copper and Brass Components
- System Components exposed to atmosphere during assembly

Invisible Moisture

- Causes Corrosion
 - Moisture Reacts With The Metals



Moisture & Refrigerant



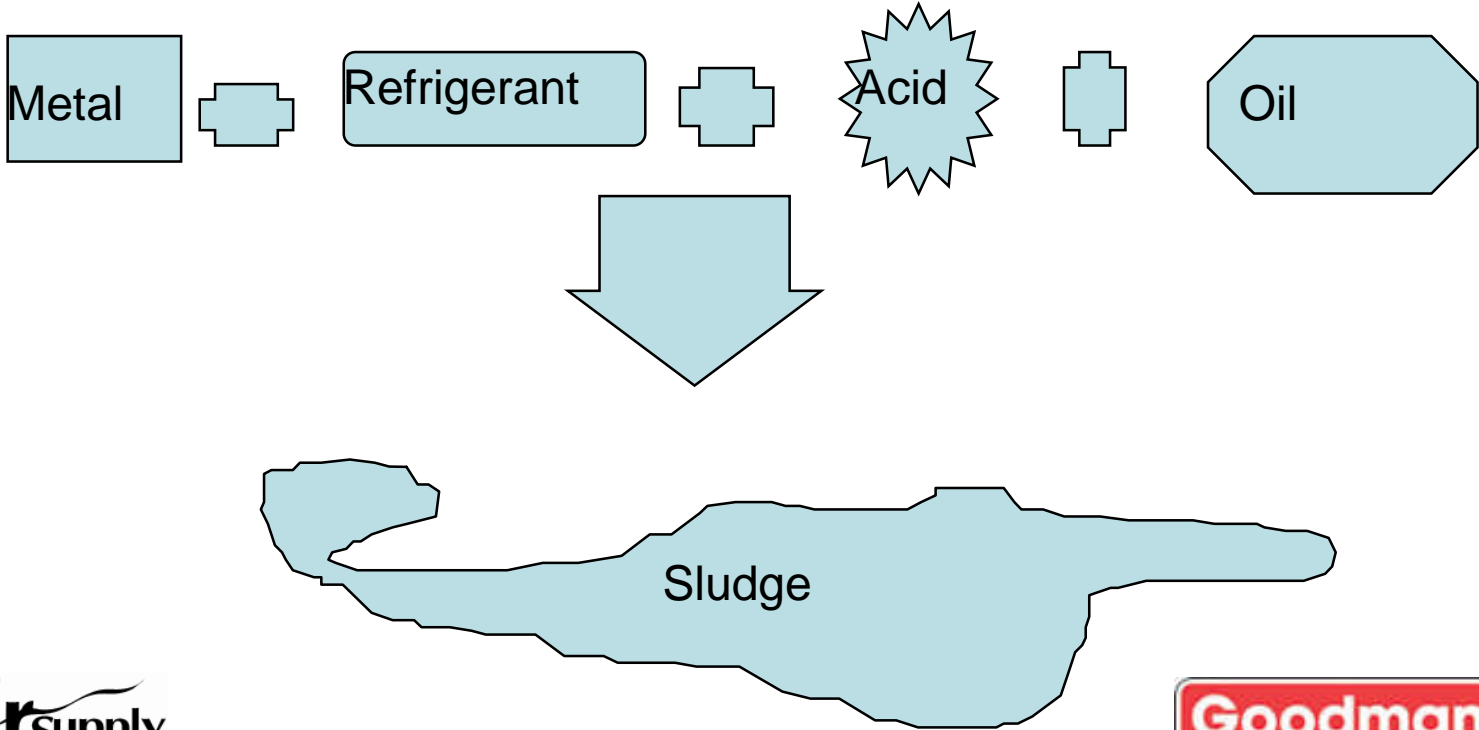
Moisture & Refrigerant

- CFC & HCFC & HFC
 - Hydrolyze to form Hydrochloric Acid
 - Hydrofluoric Acid
- Acid Formation Is Accelerated By Heat
- Copper and Brass Will Be Attacked
 - Plates Hot Surfaces
 - Bearings Seize

Copper Plating



Moisture & Refrigerant & Oil



How Do You Get The Water Out?

- We Boil It
- We Can't Raise The System Temperature To 212
- We Lower the System Pressure To A Point That Water Boils At Ambient Temperatures

Pressure VS. Boiling Point

- Physics 101
 - As Pressure Decreased - The Boiling Point Decreases
- To Decrease The Pressure We Can Raise The System To A Higher Altitude
 - There Is Less Atmosphere Above Us On Mt. Evans
 - Less Weight Of Air = Lower Air Pressure

Pressure VS. Boiling Point

- Sea Level
 - Pressure = 14.7 PSI.
 - Boiling Point = 212 F.
- Pike's Peak (14000 + Elevation)
 - Pressure = 8.32 PSI.
 - Boiling Point = 184 F.
- Still Not Low Enough

Pressure VS. Boiling Point

- To Boil Water @ 80 F.
 - The Pressure Has To be Lowered To 28.92 Inches Of Mercury
- To Boil Water @ 45F
 - The Pressure Has To Be Lowered To 29.62 Inches Of Mercury Vacuum
 - or 7620 Microns

What The Heck Is A Micron?

- 1 Inch = 25400 Microns
- .039 Inch = 1000 Microns = 1 Millimeter
- 1 Micron = 1/1,000,000 meter
- Too Small To Measure With A Gauge.

How Is Vacuum Measured?



25400 microns between each mark

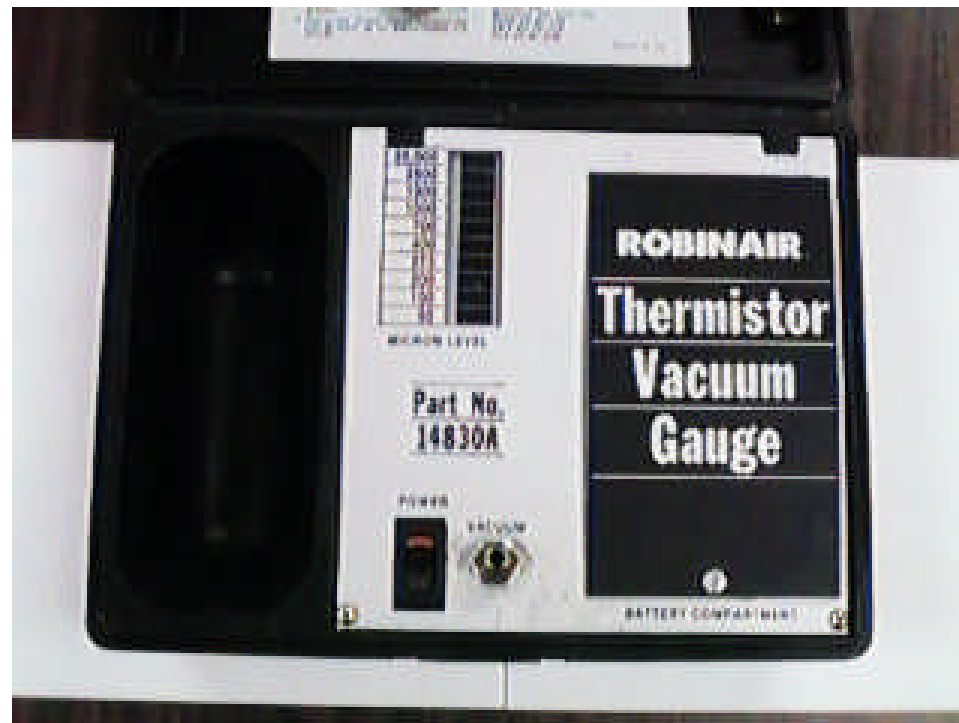
How Is Vacuum Measured?

- Compound Gauge
 - Impossible
- Vacuum Gauge
 - Resolution Is Not Suitable
 - Reading Changes with Altitude (pressure)
- U Tube Manometer
 - Resolution To 1 MM of Mercury (1000 Microns)

How Is Vacuum Measured?

- Thermistor Micron Gauge
 - Measures The Last Inch Of Vacuum
 - Regardless of Atmospheric Pressure
 - High Resolution
 - Readings To 1 Micron

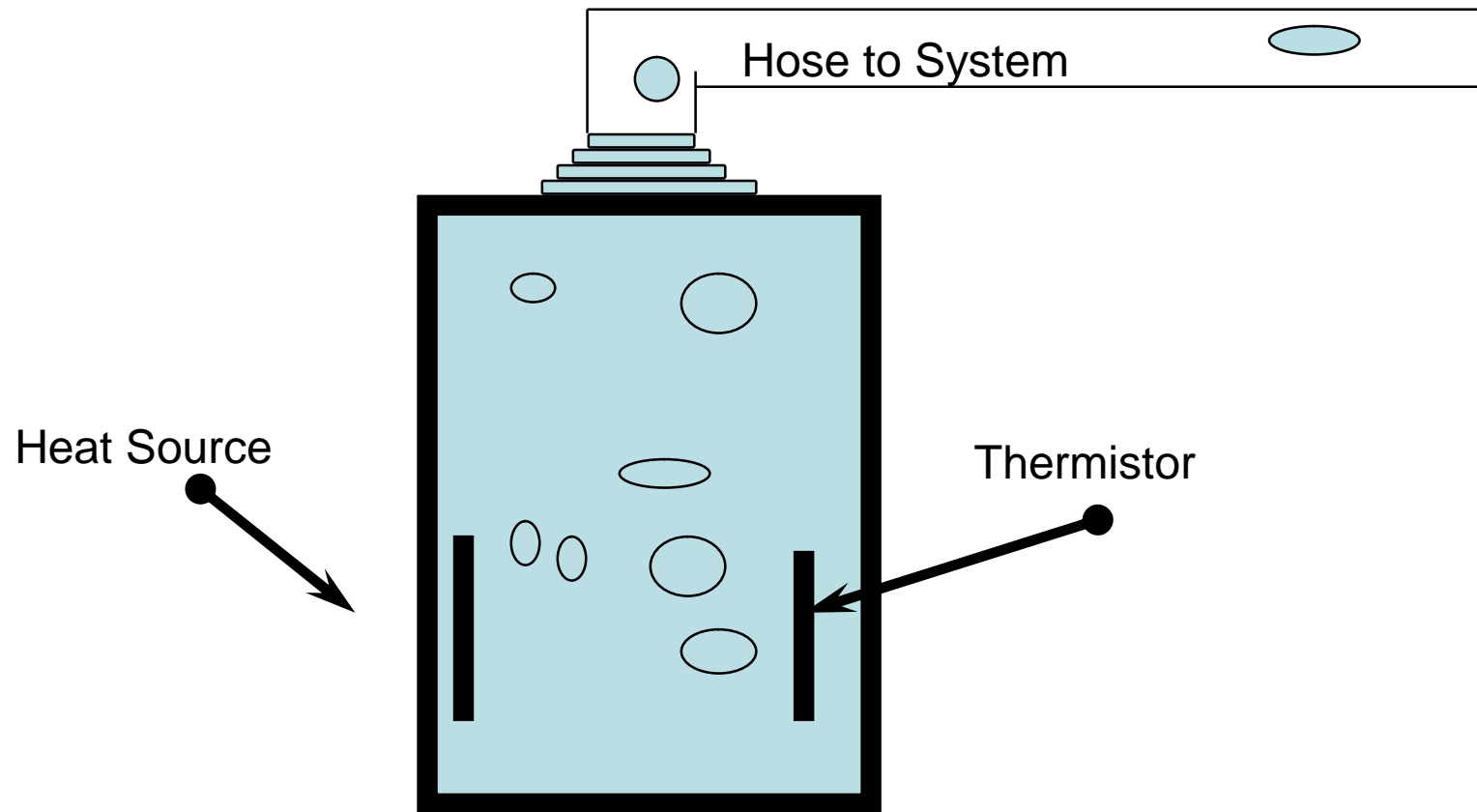
How Is Vacuum Measured?



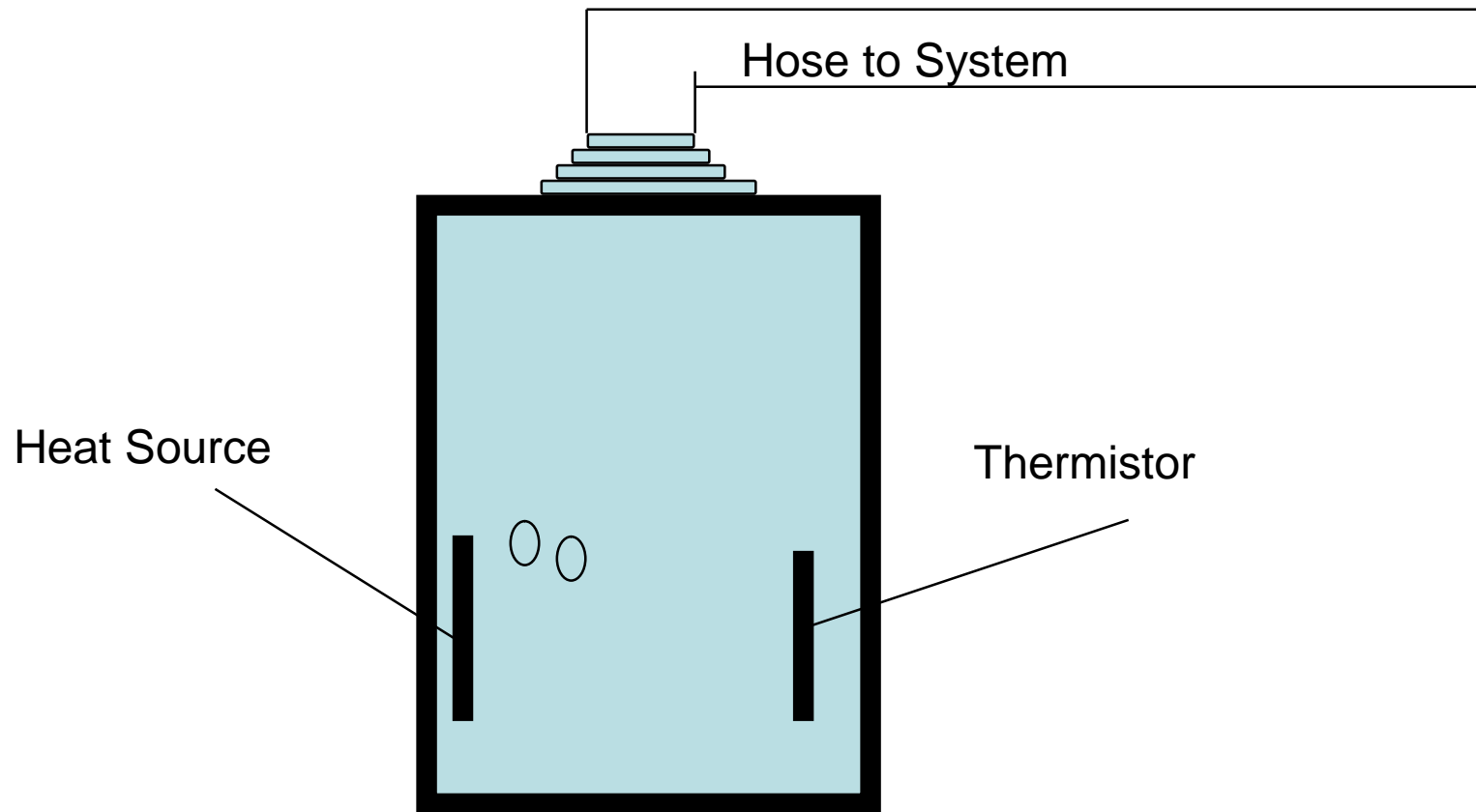
Thermistor Micron Gauge

- Measures The Thermal Conductivity Of The Gas Remaining in the Refrigeration System
- Has A Source Of Heat
- Has A Heat Receptor
 - The Thermistor

Thermistor Micron Gauge



Thermistor Micron Gauge



Vacuum Pumps

- Air Compressor Type
 - Moves Large Volume Of Air
 - At Low Pressures (Can't Achieve Deep Vacuum)
 - At Best 28" of Mercury
 - No water Boiled

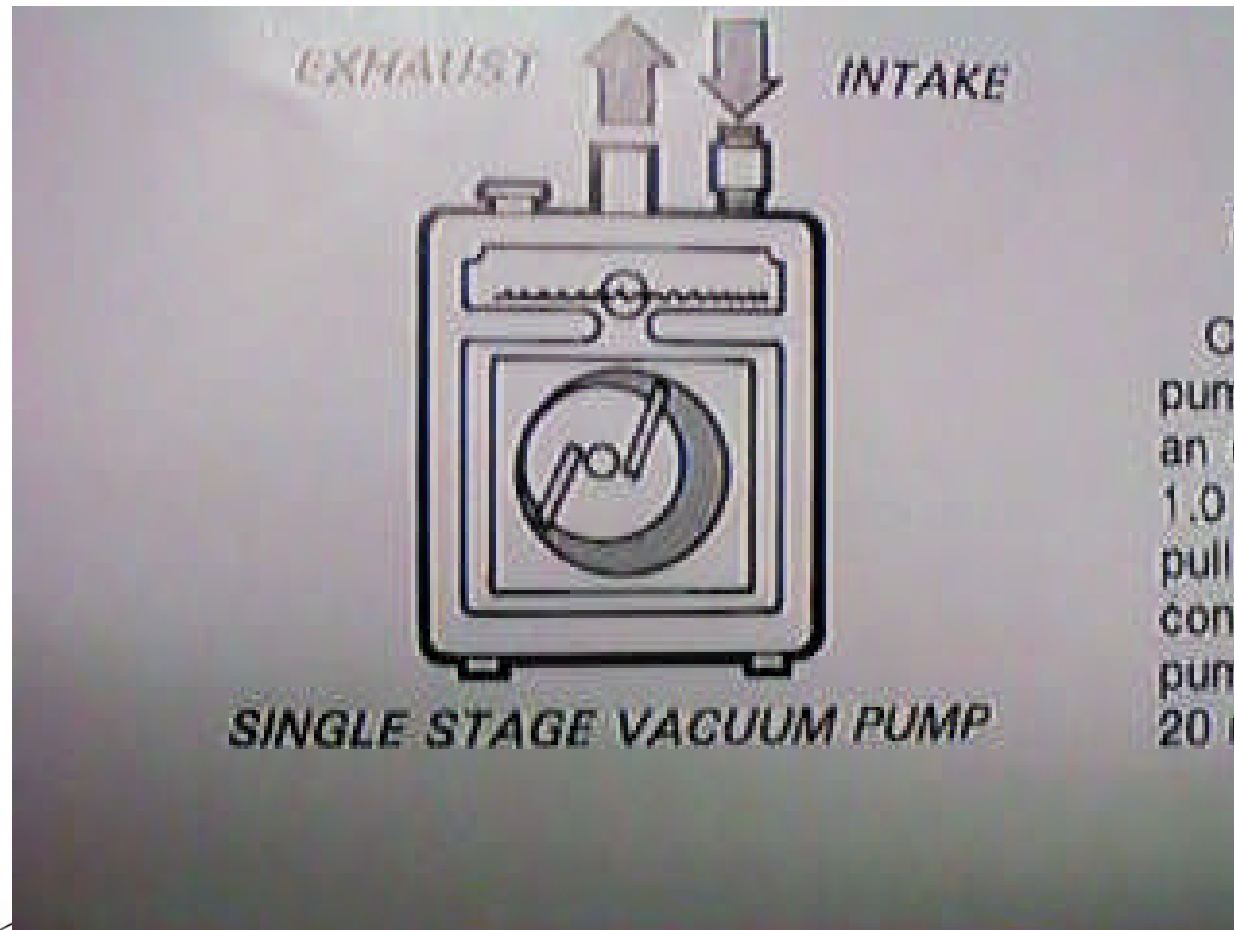
Vacuum Pumps

- Piston Compressor Type
 - At Best 29” (at Sea Level)
 - That Won’t Boil Water Under 80F
- Rotary Compressor Type
 - 29.63” (at Sea Level)
 - Water Boils @ 45F
 - Unsuitable For Systems Larger Than Household Refrigerators

High Vacuum Rotary Vane Pumps

- Single Stage
 - Smaller
 - Light Weight
 - 1000 Microns
 - Robinair down to 200 Microns

Single Stage



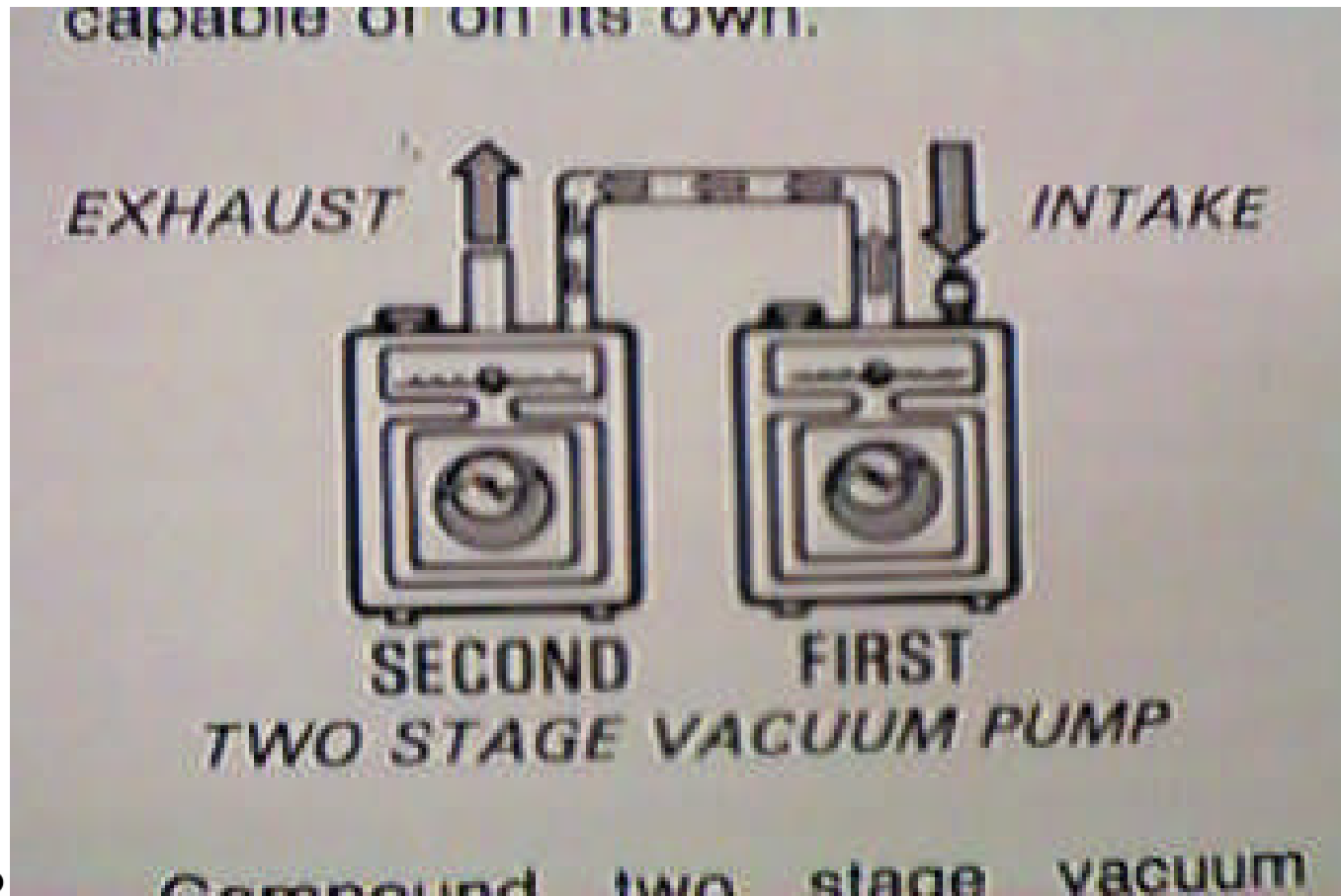
High Vacuum Rotary Vane Pumps

- Two Stage Vacuum Pumps
 - Most Common For Service
 - Larger CFM Capacity
 - Slightly Heavier Than Single Stage Of Same Capacity
 - Can Achieve Deeper Vacuum Than Single Stage Because Second Stage Takes Over At The Level 1st Stage Stops

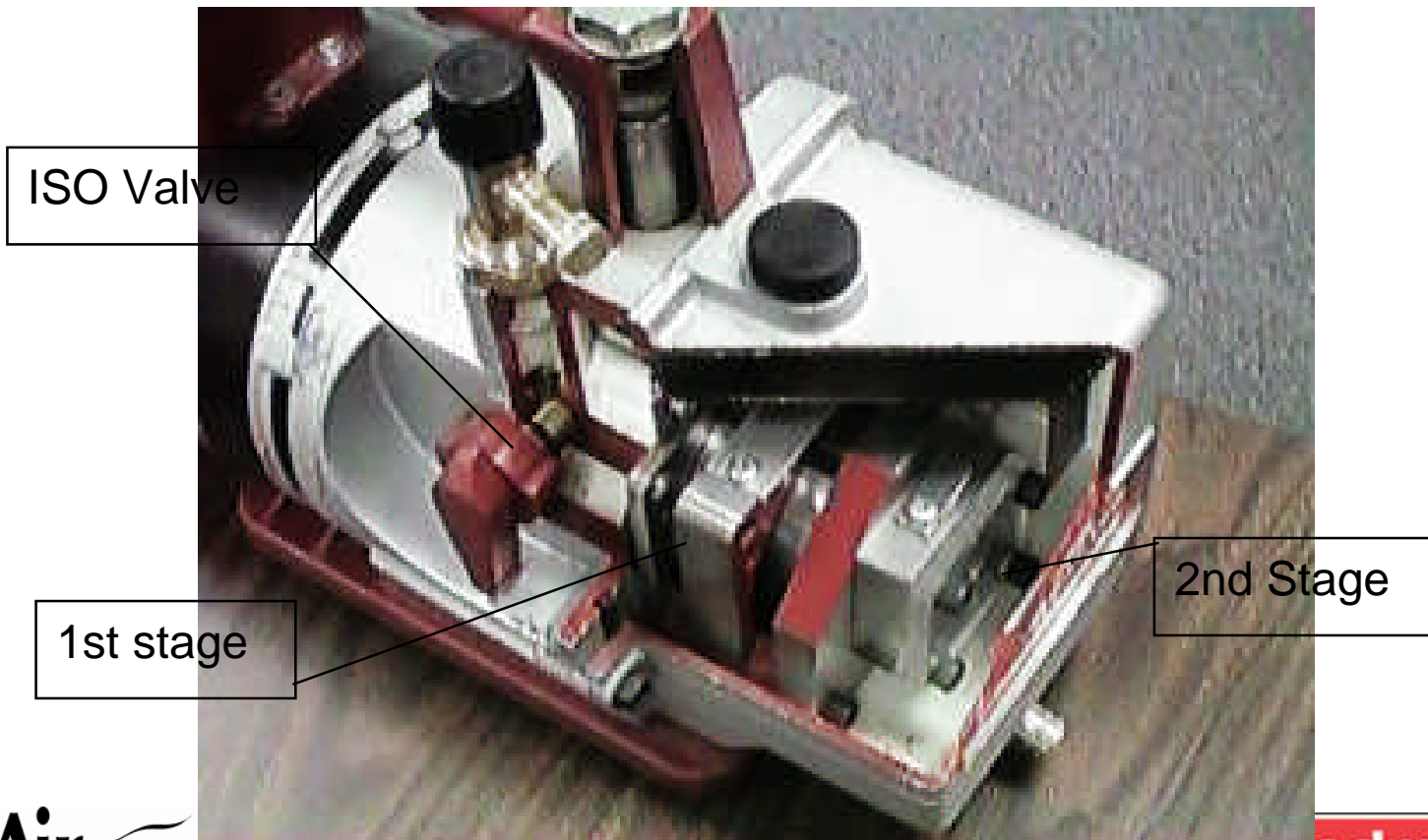
High Vacuum Rotary Vane Pumps

- Two Stage (cont..)
 - Can Pull To One Micron
 - Robinair Guaranty 20 Microns

Two Stage Vacuum Pumps



Two Stage Vacuum Pumps

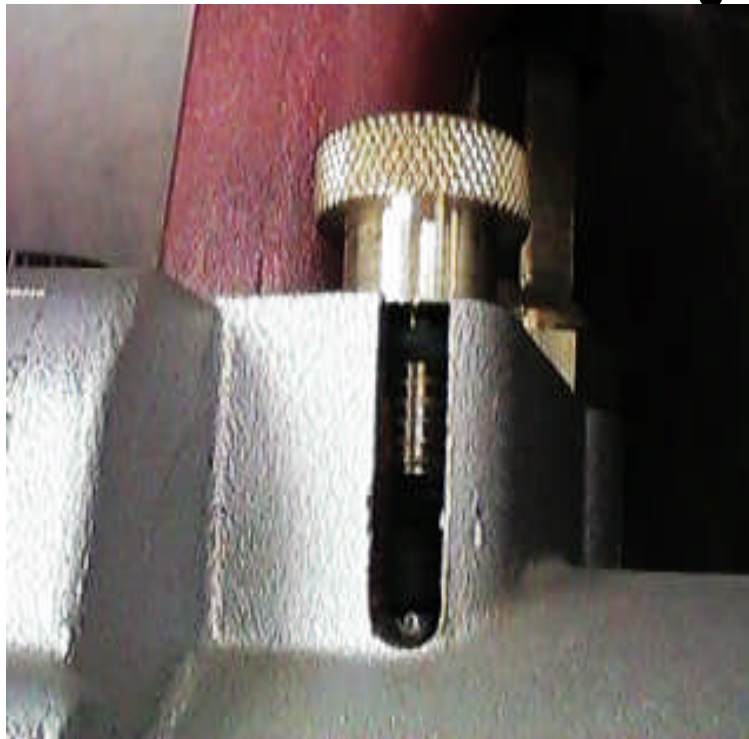


Rotor & Vanes



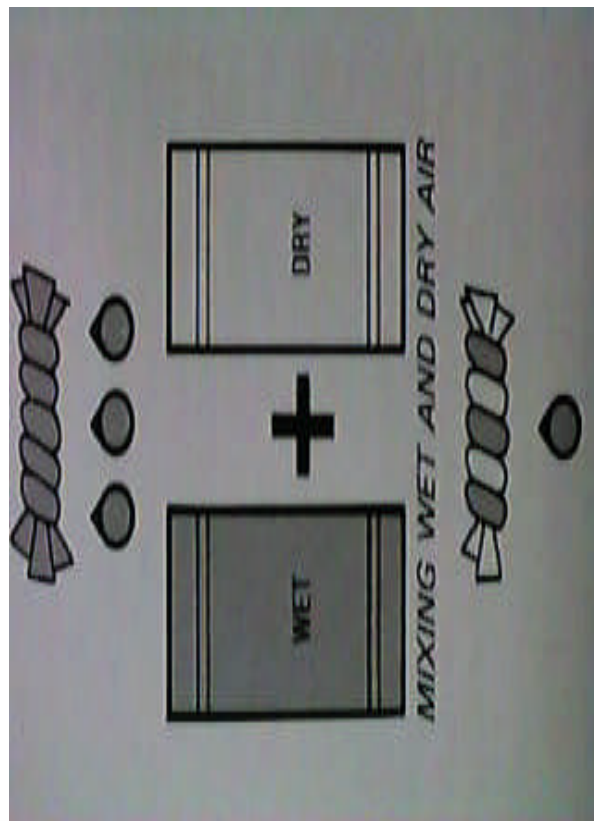
- Off Set Construction
Vanes Come Out At Low RPM To wipe The Interior Of Pump
- 1st Stage Are Ceramic Vanes
- 2nd Stage Are Aluminum

Gas Ballast Valve



- Mixes Dry Air With High Humidity Air
Reduces Moisture That Is Condensed Into The Oil
Makes Oil Last Longer

Gas Ballast Valve



- Open Valve At Beginning Evacuation
- When A level Of 1000 Microns Is Achieved, Close Valve

Speed Of Evacuation

- Size Of System
- Complexity Of Piping
- System Components
 - Oil Separators
 - Accumulators
 - Valves
- Ambient Temperature
- Size Of Pump
- How You are Hooked Up To the System
 - High & Low Side
- Size Of Hoses
- Access Fitting?

Speed Of Evacuation

- Use Largest Hoses You Can
- Add Heat To Areas Of Restriction
- Get the Access Fittings Out Of Way
- Measure Vacuum At The System
- Isolate The System And Equalize To Get A True Reading

Access Core Removal Tool

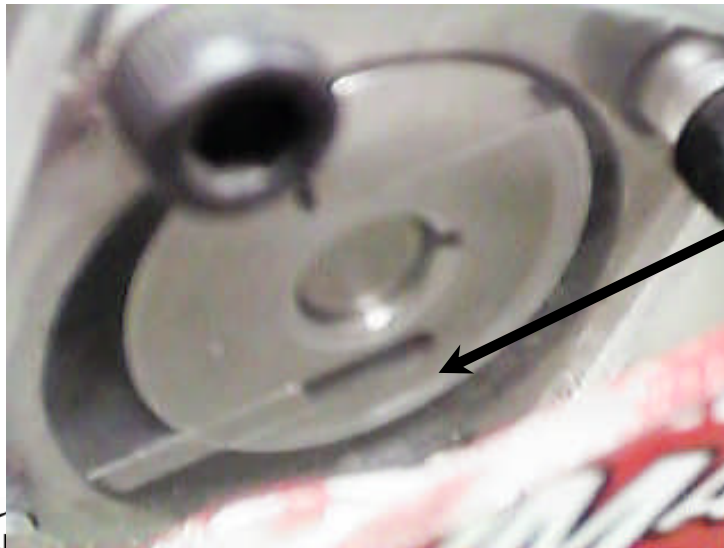


How Much Pump?

- Vacuum Pumps Are Rated In Cubic Feet Per Minute Of Free Air Through the Pump
- As A Rule Of thumb
 - 1 CFM Per 7 Tons Of System
- I.E. A 6 CFM Rated Pump Will Be Good For 42 Tons Of System Capacity
- Multiple Pumps OK

Make Your Pump Last 25 Years

- Keep Your Pump Warm
 - Cold Starts Are Hard On The Pump
- Don't Start Or Stop Pump In A Vacuum



Vane Pocket Fill
With Oil If The
Pump Is Shut Down
In A Vacuum

Make Your Pump Last 25 Years

- Always Expose Pump To Atmosphere On Shut Down
- **Change The Oil Every Time**