

# Association of Energy Engineers (AEE)

Jarred Walker, Sales Engineer

**TECHNICAL**

**S Y S T E M S**

DIVISION RAE CORPORATION



# Agenda

- **About RAE Corporation**
  - Our history and experience
- **About Technical Systems**
  - The Gray Space
- **Chiller Operation and Selection**
  - Basis of selection
  - Fundamental chiller design
- **Energy Efficient Chiller Solutions**
  - Components
  - Economizer Coils
  - Evaporative Cooled Condenser
  - Adiabatic Chillers

# RAE Corporation

- **RAE Coils** - Commercial and Industrial coils for the replacement and OEM markets
- **Century Refrigeration**– Low temperature refrigeration equipment (-40 to +40 refrigeration systems)
- **RSI** - Refrigeration systems for the bulk storage market
- **Technical Systems** - Built to Order Mechanical cooling equipment



# Technical Systems & RAE Corporation



DIVISIONS OF RAE CORPORATION



# Technical Systems Energy Efficient Products

## Built to Order Energy efficient equipment

- Fluid Coolers, Remote Condensers, Condensing Units, Chillers
- Air Cooled and Evaporative Cooled Options
- APEX™ Evaporative Pre-Cooling Technology

## Systems level approach

- Understand systems and refrigeration
- Large swings in loads (MRI, Linac's, production batch processes)
- Dehumidification & environment control (Clean rooms, Pharma)
- Year round cooling (Data centers)

**“Mission Critical”** *When loss of cooling means a loss of revenue or loss of life*

- Data centers, Pharma production, Manufacturing processes, MRI and Linacs, Class I, Div II Explosion Resistant applications
- Hospital care facilities, operating room cooling systems

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# THE GRAY SPACE.

Somewhere in between standard off-the-shelf products  
and start-from-scratch white paper designs.

That is where you find Technical Systems.

**WE ARE SOLUTIONS BUILT TO ORDER.**

# When GRAY Matters

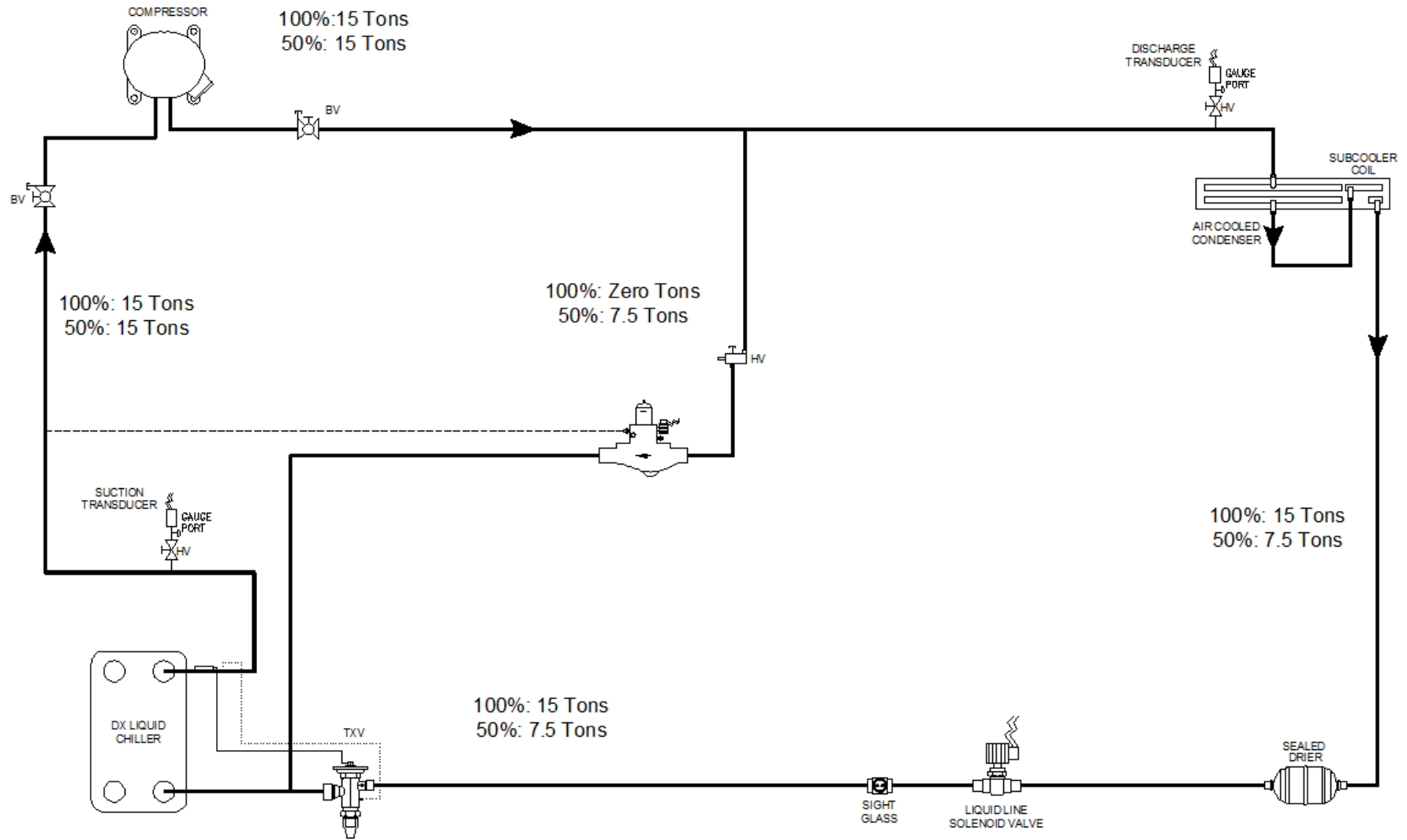
- **“Mission Critical”** *When loss of cooling means a loss of revenue or loss of life*
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# Chiller considerations

- Application
  - Comfort or Process
  - 24/7 - 365 Operation
  - Clean or Dirty Environment
  - Noise and/or Efficiency Requirements
  - Physical Restrictions
- Cost Considerations
  - Life Cycle Cost
    - Initial Cost of Equipment
    - Installation Cost
    - Operational Costs
    - Maintenance Costs



# Chiller Operation

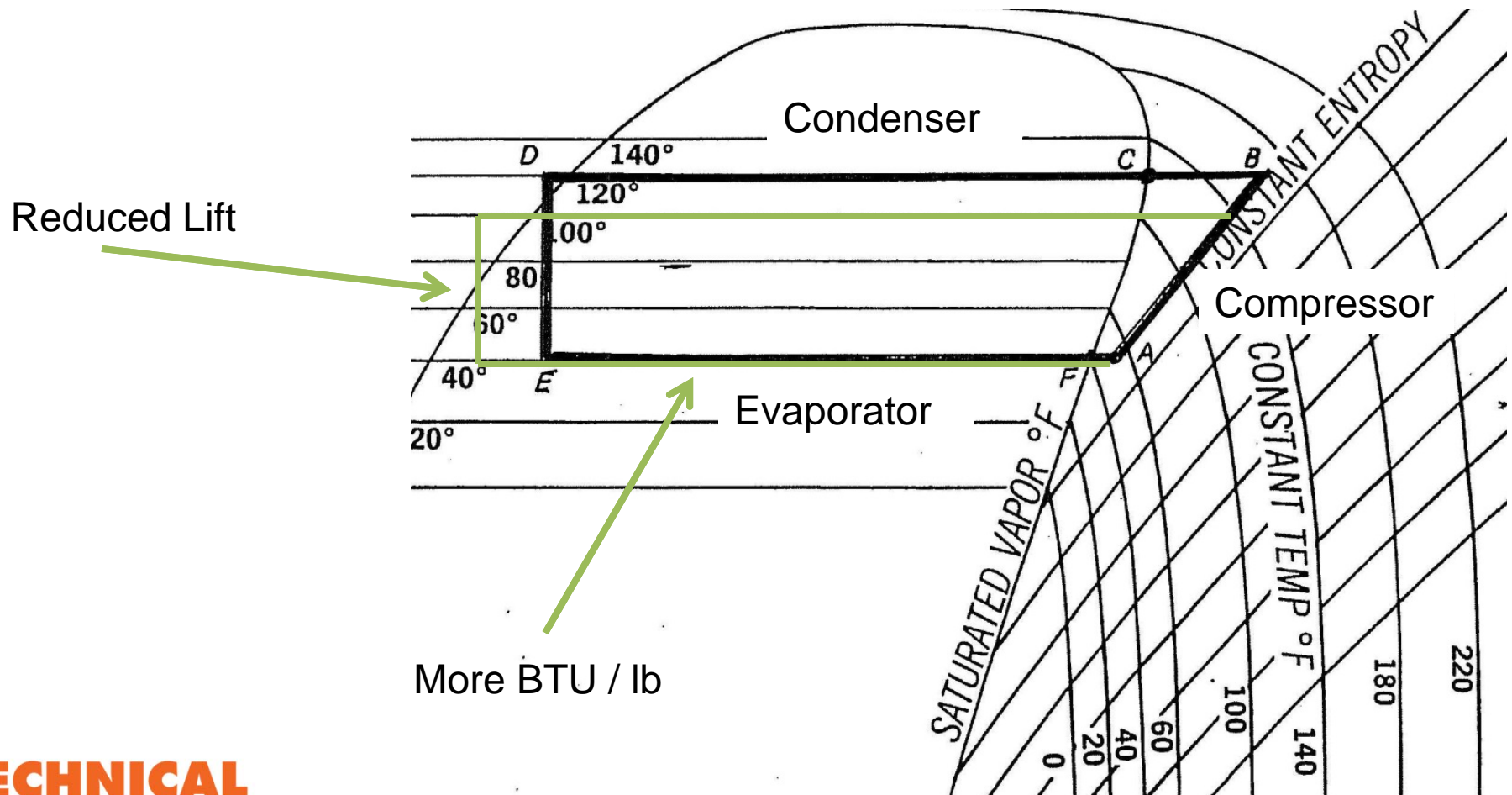


# Increasing Efficiency

- Use effective capacity control method
  - Match compressor output to actual load as closely as possible.
- Reduce compressor lift (decrease delta P on suction to discharge pressure)
  - Increases output and moves more refrigerant
  - Reduces work energy and amps
- Increase sub-cooling
  - Increases the enthalpy change of the refrigerant without increasing lift
- Reduce energy of other system components
  - Condenser Fans
  - Compressors
- Water Side Economizer Coils
  - Take advantage of low ambient conditions

# P-H Diagram

- Increased sub-cooling from 10 to 20°F
- Reduce condenser temp from 120 to 100°F



# Energy Efficient Chiller Solutions

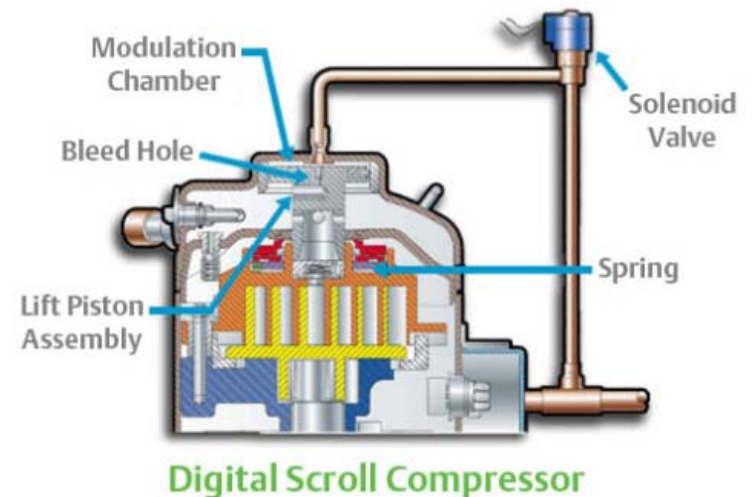
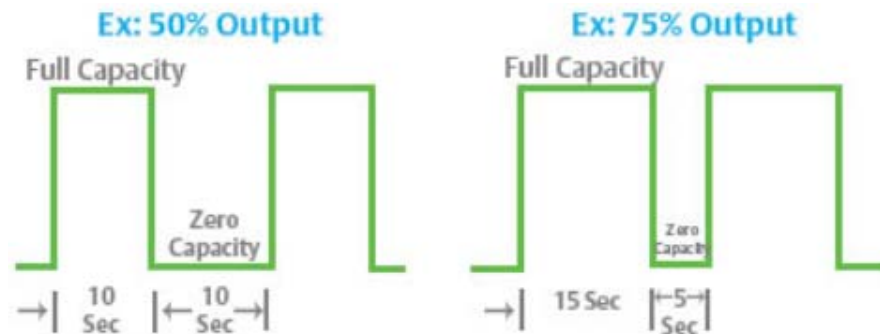
## Components

# Condenser Fan Control

- Fan Cycling
  - Fans cycled on / off in stages according to head pressure
  - Swings in compressor lift affect system operation.
  - Noise is more noticeable.
  - Frequent motor starting wears out faster
- Variable Speed Drives
  - Fan speed reduced as head pressure drops to minimum levels
  - 10% reduction in speed = 33% reduction in power
  - Stabilizes compressor operation
- Electrically Commutated (EC) Motors
  - Integral AC / DC converter.
  - Permanent magnet motors remove induction losses.
  - Digital controller optimizes operation for minimal energy
  - +95% motor efficiency

# Scroll Compressor Control

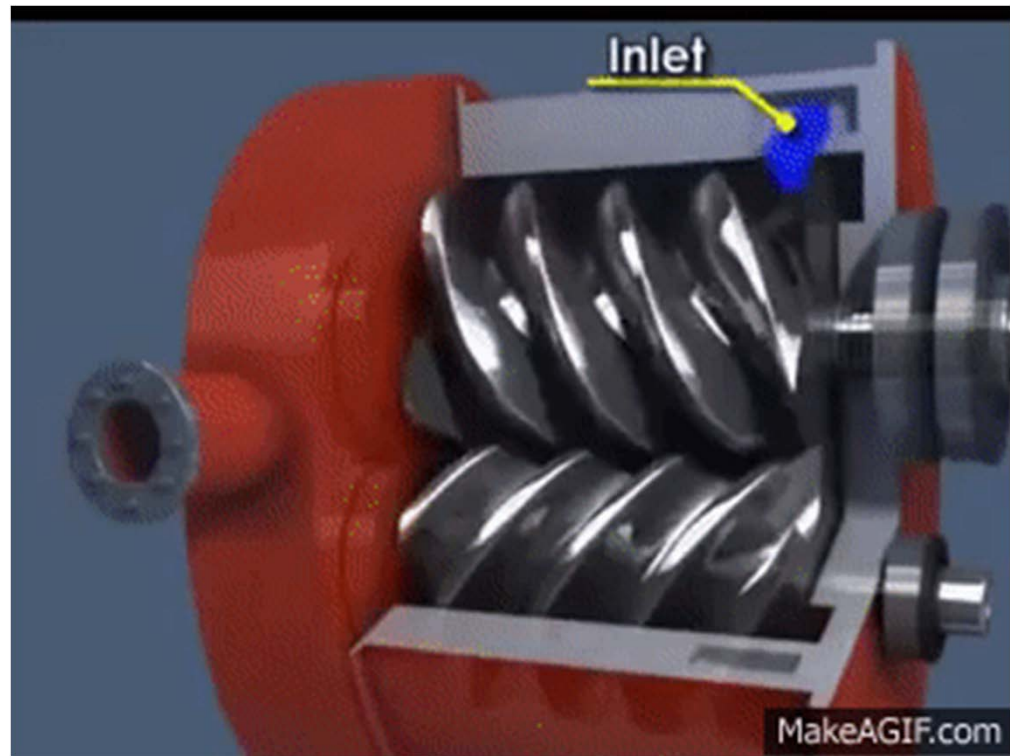
- Tandem or Trio Compressors
- Digital Scroll
  - Internal piping and control valve allows scrolls to separate.
  - Controller pulses solenoid in 20 second cycles
  - Limited in size (15hp max single, 30hp tandem)



- Variable Speed Compressor
  - VFD matched to compressors. Drive signal by unit controller.
  - 30-75hz typical range (50-125%) for standard AC motors
  - Speed controlled directly by LAT or LFT. Accurate load tracking.
  - Reduce energy by reducing motor speed

# Screw Compressor

- Low temp applications
- Large capacity machines
- Slide unloading
- VFD motor



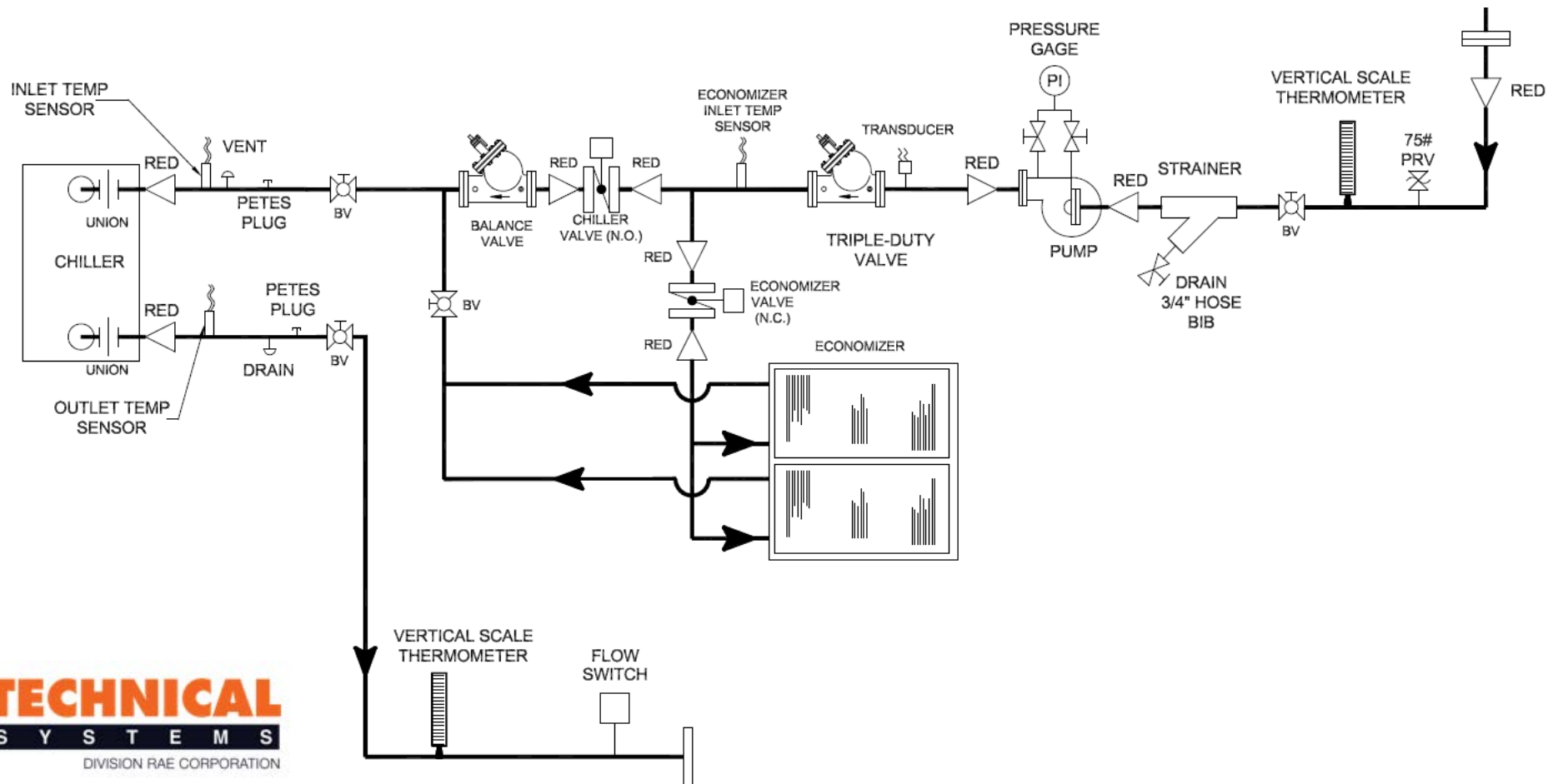
# Energy Efficient Chiller Solutions

## Water Side Economizer Coils



# Air Cooled Economizer Chillers

- Energy savings for any “year round” process cooling
- Integral free cooling coils use ambient air to pre-cool fluid before entering the evaporator
- Condenser fans are used for both condensing and free cooling



# Air Cooled Economizer Chillers

- Capacity range of 10-300 Tons
- Both Partial and Full free cooling
- Components (fans, coils) designed to operate together
  - Size coils for actual winter load required
  - Fans designed to handle additional coil rows
  - Independent coil casings – no cross heat transfer, easier service and maint.
- UL and ETL listed



# Energy Efficient Chiller Solutions

## Evaporative Cooling

# Evaporative Condensing Chillers

- Evaporating water cools the tubes. Condenser is rated at the wet bulb temp instead of dry bulb.
  - Cooler refrigerant condensing temperature and pressure
  - Lower condensing pressure results in reduced compressor horse power
  - Lower pressure = less energy
- Up to +30% reduced energy
- 30-40% Lower MCA amps (smaller wire, breakers, ect.)
- Longer compressor life
- Smaller footprint
- Great for climates with low RH



# Evap Condensing Chiller Comparison

## Air Cooled

- **Performance**
  - 95°F dry bulb
  - 183 Tons
  - 124°F Cond Temp (182 psi)
  - Comp EER = 11.5 (1.04 kW / ton)
  - Unit EER = 10.4 (1.15 kW / ton)
  - MCA amps: 405 (MOP: 500)
  - Wire Feed MCM 600
  - Total Max kW: 210 kW
- **Components**
  - Rated at 0 Altitude
  - 240 Compressor HP
  - (18) 1HP 28" Propeller Fans
    - 18 Fan HP
  - Total HP = 258
  - Total CFM = 152,439
- **Foot Print = 96W x 324L x 102H**
  - (216 ft<sup>2</sup>)

## Evap. Condensing

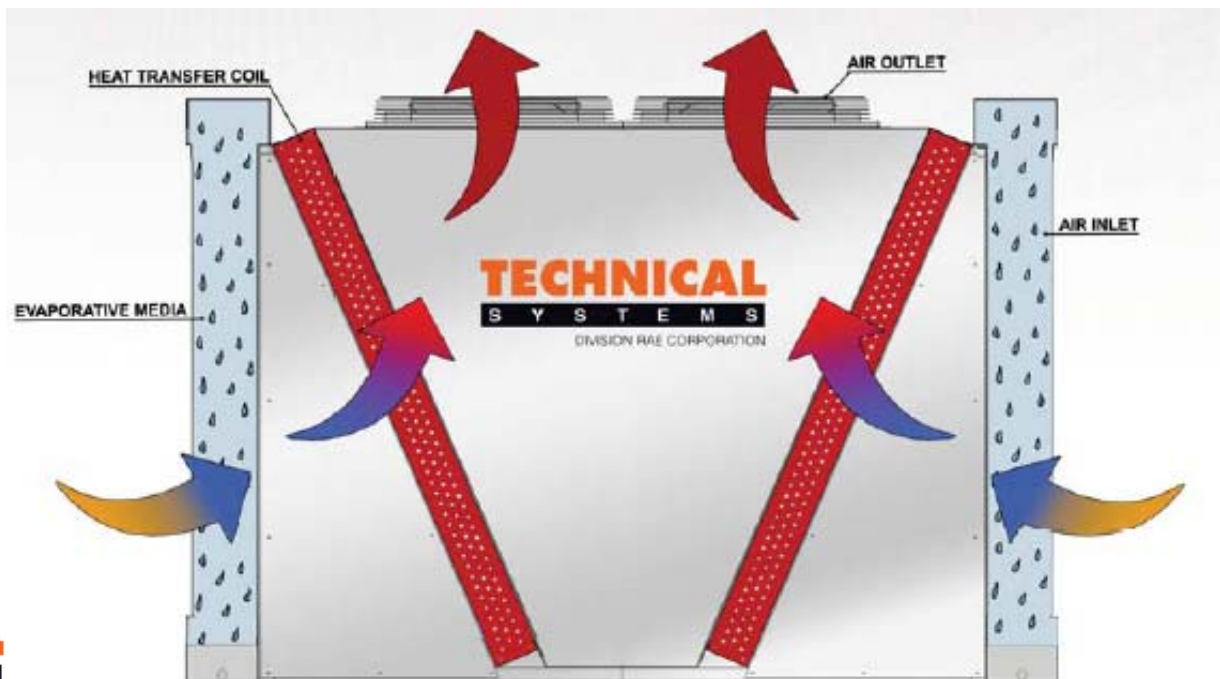
- **Performance**
  - 78°F wet bulb
  - 185 Tons
  - 101°F Cond Temp (124 psi)
  - Comp EER = 15.1 (0.80 kW / ton)
  - Unit EER = 14 (0.86 kW / ton)
  - MCA amps: 266 (MOP: 350)
  - Wire Feed MCM 300
  - Total Max kW: 159 kW
- **Components**
  - Not impacted by altitude
  - 180 Compressor HP
  - (1) 10HP Fan Motor
  - (1) 1 ½ HP Spray Pump
  - Total HP = 192
  - Total CFM = 35,700
- **Foot Print = 120W x 204L x 110H**
  - (170 ft<sup>2</sup>)

# Energy Efficient Chiller Solutions

## Evaporative Cooling

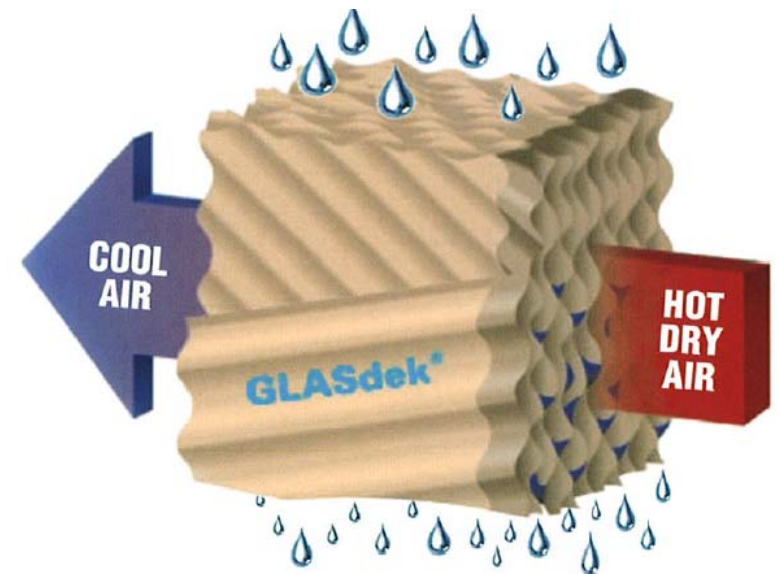
# APEX Technology™

- Adiabatic Pre-cooling Evaporative X-change
  - Combines evaporative cooling with simplicity of dry air cooled equipment
  - High efficiency performance with reduced operations costs and maintenance
- Evaporative section humidifies and cools ambient air as much as 20°F or more
  - No moisture carryover. Heat transfer coil remains completely dry. No coil scaling.
- Able to **run dry** when dry bulb reaches the design wet-bulb (75-78°F for Ohio.)



# APEX Technology™

- Municipal city water supplies are best.
  - Avoid RO, DI, and softened water. Simple is best.
- Actual site water sample analyzed during order
- Self contained controls via microprocessor
  - Sump water conductivity control with bleed and feed
  - Automatic sump drain based on ambient. No risk of freeze.
  - Daily dry out cycle controls biological growth
- Circulated water design pushes dirt into sumps (1.5 GPM / sq. Ft.)
- Less maintenance than misted or “once through” systems
- Hardened edge coating on media
  - Resists algae growth
  - Able to be brushed and cleaned





# APEX Technology™

- Save Electrical Energy When It Costs the Most
  - Savings are best when peak demand charges are highest
  - Combine with VFD or EC fans for optimal efficiency
- Colder air means less airflow, reduced fan HP, lower sound.
- Water usage optimized for minimal utilities
  - 6,900 Hours (80%) at or below 70°F DB (Denver CO)



# APEX Technology™

- 120 Ton system
  - Tandem R-410a Scrolls
- 105° DB and 65°F WB... 5400 FT Elevation... 45°F Sat Suction
  - Evaporative cooled includes tower fan and pump

	Std. Air Cooled	Evap Cooled	Air Cooled APEX
Full Load UNIT kW / Ton:	1.3	0.77	<u>0.81</u>
Total Unit KW:	160 kW	82 kW	<u>96 kW</u>
Unit MCA:	290 amps	229 amps	<u>229 amps</u>
Breaker Feed:	350 amp	250 amp	<u>250 amp</u>
Single Point Power Wire Size (75°C):	(1) 350 MCM – 3" Conduit	(1) #4/0 – 2" Cond	<u>(1) #4/0 – 2" Cond</u>
# Hours Running Dry:	Zero	Few or Zero	<u>6,900 (80%)</u>
Run Dry Temperature:	93°F	Below Zero	<u>+70°F DB</u>

- Simplicity of air cooled, yet efficiency near water cooled.
- No chemical treatment. Minimal maintenance over air cooled.

# Conclusion

- **Efficiency is defined as:**
  - The ability to produce a desired effect, product, etc. with a minimum of effort, expense, or waste. *(Collins English Dictionary)*
- **Potential Efficiency Gains in Chiller Selection**
  - Reduce Compressor Lift
  - Increase Sub cooling
  - Increase Turndown Capability
  - Increase Component Efficiency
  - Lower Ambient Air Temperature with Adiabatic Cooling
- **Increased Chiller Efficiency Leads To**
  - Savings On Electricity Expenses
  - Reduced Strain on Power Grid
  - Smaller Environmental Footprint

Thank you!

*Visit [www.RAECorp.com](http://www.RAECorp.com)*

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