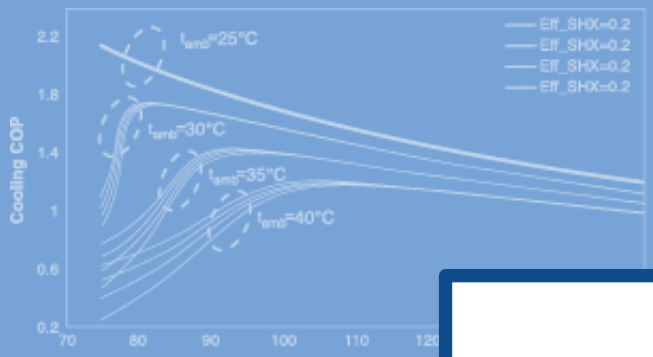
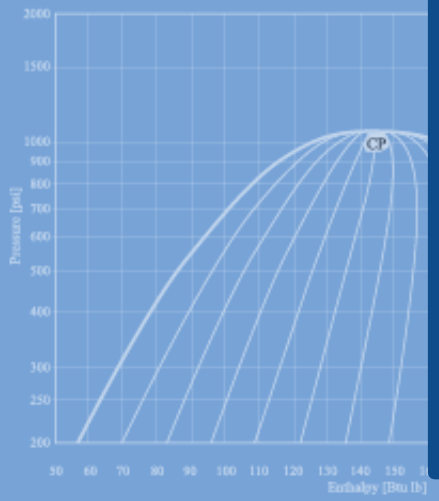
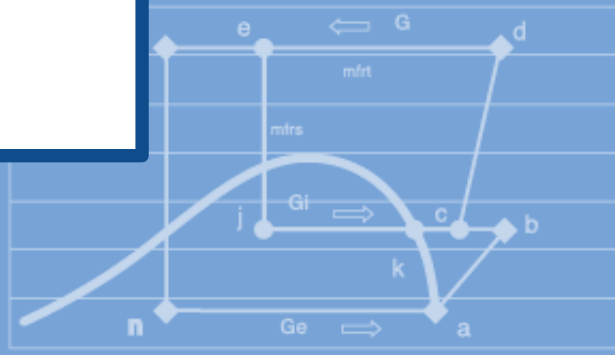


$$COP \equiv \frac{T_m}{T_m - T_o}$$

Making Sense

Webinar Series



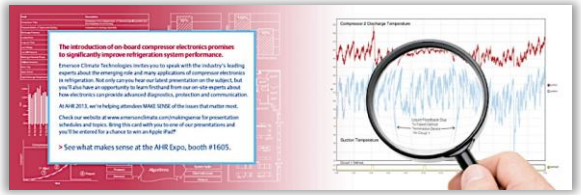


$$D = \frac{1.86 \;\; 10^{-3} T^{3/2} \sqrt{1/M_1 + 1/M_2}}{p \sigma_{12}^2 \Omega}$$

EMERSON
Climate Technologies

Making Sense Webinars

Emerson and Our Partners Giving Insight on the Three Most Important Issues in Refrigeration



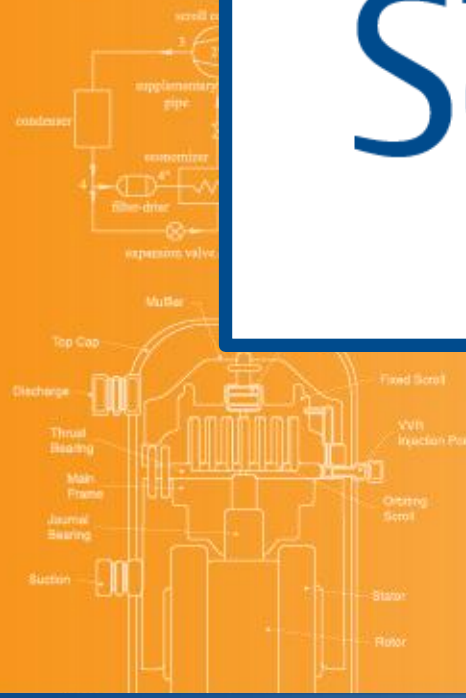
Making Sense

Making Sense Webinars

Making Sense

$$V_s = V_d \sqrt[k]{Pd/Ps}$$

Making Sense of innovations in energy-reduction technologies.



$$F_B = \frac{\pi}{4}(P_H - P_L)(d_2^2$$

Making Sense Webinar Series

EMERSON Climate Technologies

A case for case control and electronic expansion valves

November 19, 2013

Presented By:

John Wallace
Director of Product Management,
Retail Solutions
Emerson Climate Technologies

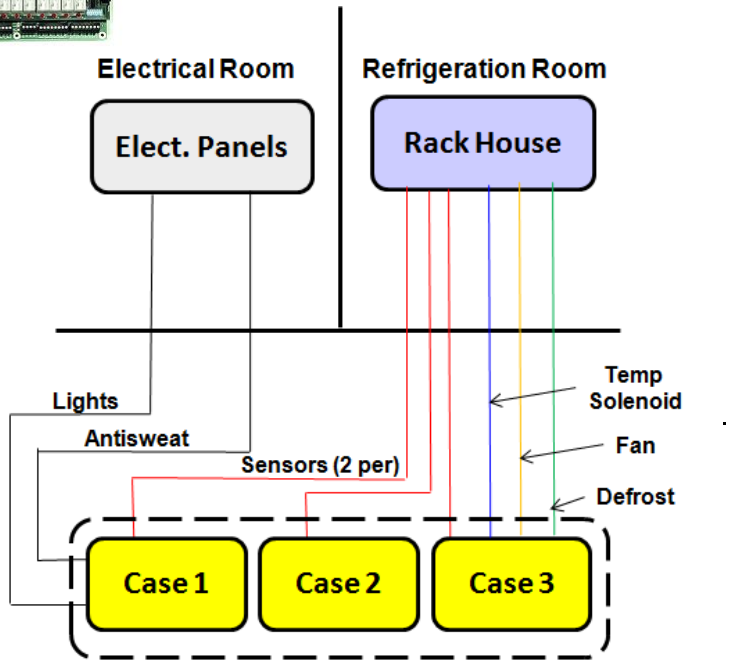
Seth Hoehn
Product Planner – Expansion Devices,
Flow Controls
Emerson Climate Technologies

Discussion Topics

1. Overview and Background
2. Benefits
3. Expansion Valve Comparison
4. Summary

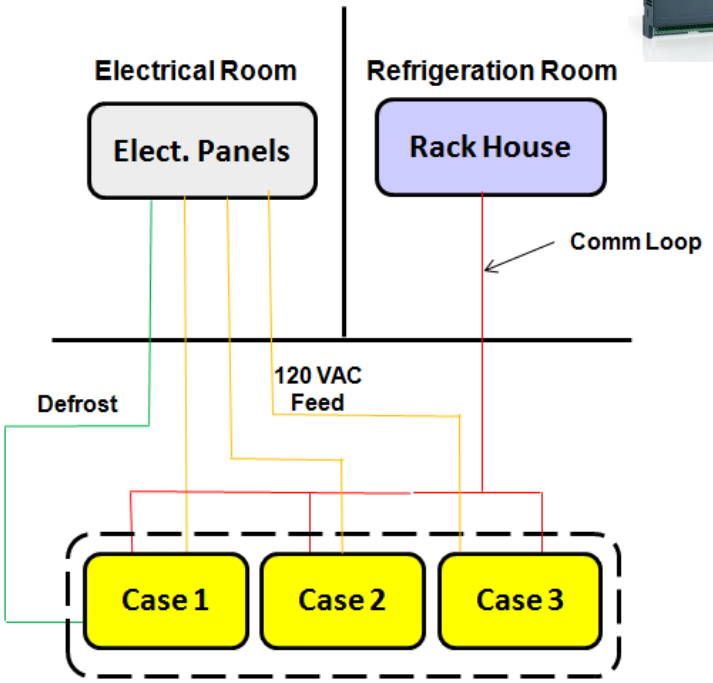
Overview

Centralized Control



- Control Elements at Refrigeration Rack or Electrical Panel
- "Home Runs" for Sensors
- Separate Electrical Circuits for Loads

Case Control



- Control Elements at Case
- Communication "Daisy Chain" to Supervisory System
- Load Control at Refrigeration Case

Making Sense

Flexibility in Case Control Functionality

	Control Types		
Functionality	**Temp Control Only**	**Superheat Control**	**ESR Control**
Temp Control	✓	✓	✓
Defrost Control	✓	✓	✓
Load Control	✓	✓	✓
Superheat Control (EXV or EEV)		✓	
Electronic Suction Regulator (ESR or EEPR)			✓

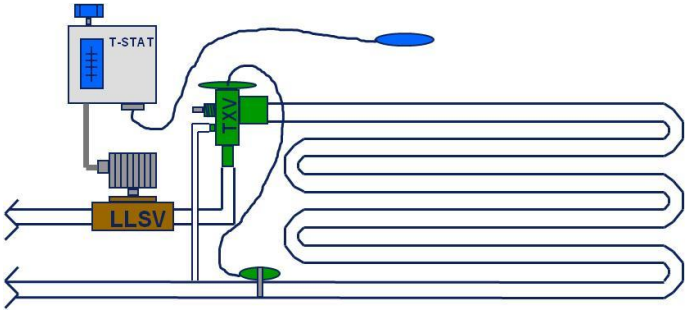
Load Control Includes Lights, Fans, Antisweats

A B C

Making Sense

Case Evaporator Control Types

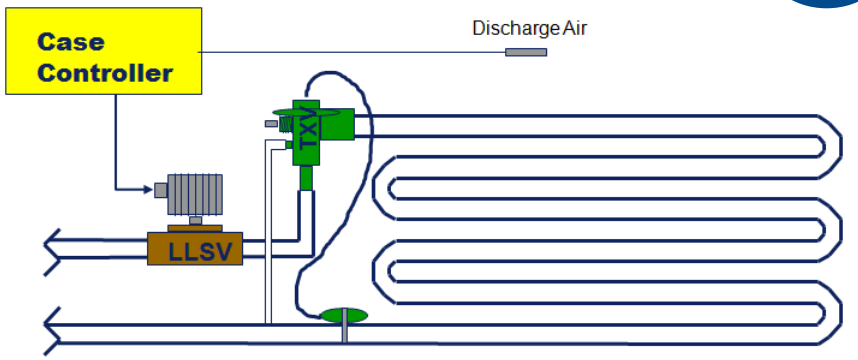
Conventional/Mechanical



TXV and Thermostat

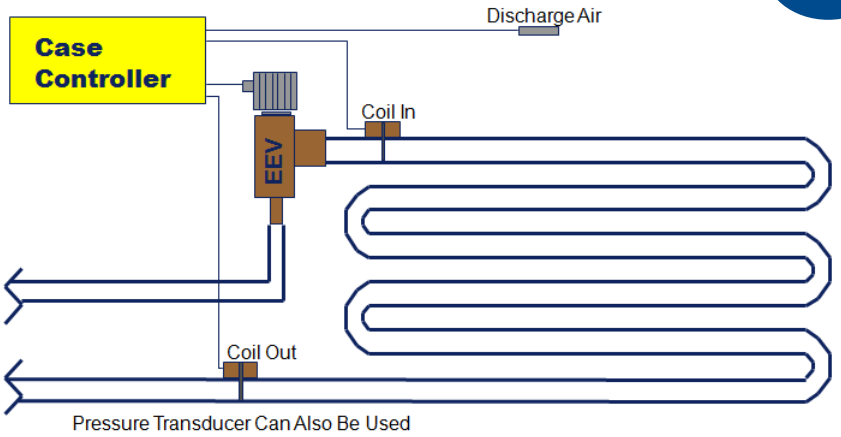
Case Control With TXV

A



Case Control With EEV

B



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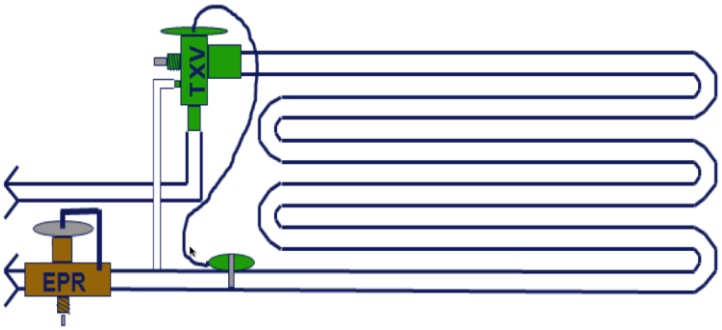
Case Control With ESR Valve

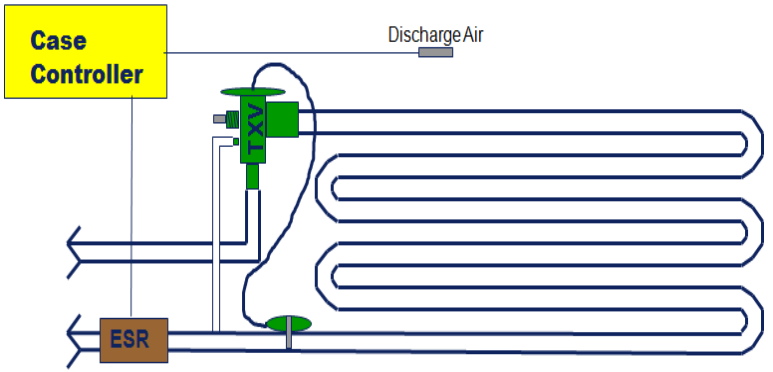
Conventional/Mechanical



TXV and EPR

Case Control With ESR

C



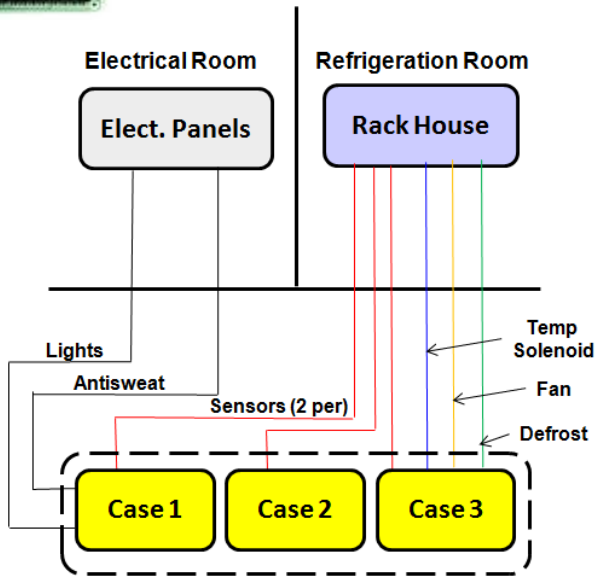
Making Sense

Case Controls Provide First Cost Savings and Ongoing Benefits

- **Electrical**
  - Eliminates Sensor Home Runs
  - Reduces Electrical Distribution Feeds and Conduit
  - Shifts Field Wiring to OEM
- **Maintenance and Commissioning**
  - Startup Time Reduced by 2–3 Days (EEV Control)
  - Eliminates Need for Yearly Check/Setting of TXVs
  - “Visibility” Into Operation
- **Refrigerant and Piping**
  - “Loop Piping” Reduces Copper
  - Lower Refrigerant Charge
  - Reduced Leak Rates
- **Energy**
  - Continuously Optimized Superheat
  - Lower/Floating Condensing Pressure

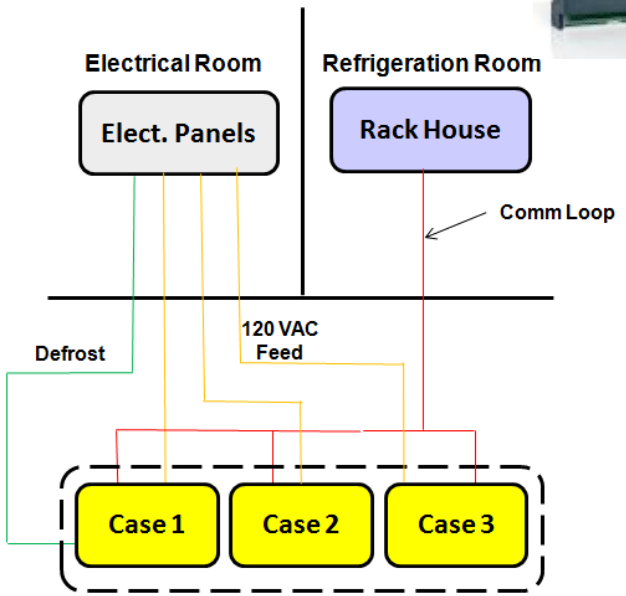
Case Control Shifts Electronics From Electrical/Rack Rooms to Case

Centralized Control



	Rack	Case
Sensors		✓
Input Boards	✓	
Relay Boards	✓	
Case Electronics	N/A	N/A
EEV	N/A	N/A

Case Control



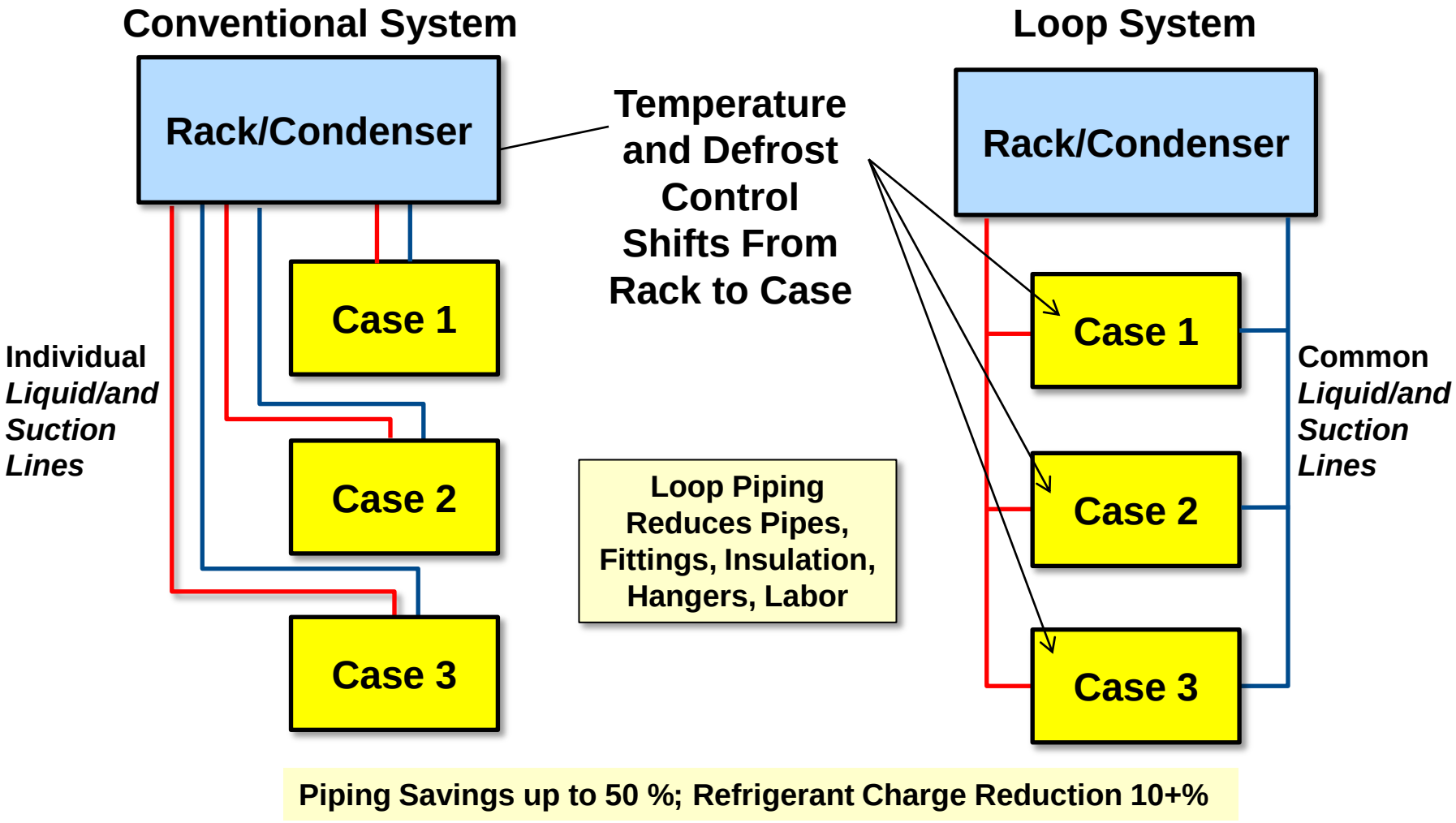
	Rack	Case
Sensors		✓
Input Boards	N/A	N/A
Relay Boards	N/A	N/A
Case Electronics		✓
EEV		✓

Making Sense

Case Control Architecture Reduces Field Wiring and Provides Electrical Savings

- **Reduce Line Voltage Wiring**
  - Reduce Branch Feeder Wiring by 30% or More
  - Reduce or Eliminate Circuit Panels and Breakers
  - Reduce Branch Feeder Distance: Distributed Design
  - Eliminate Line Voltage Control Home Runs to Rack
  - Simplified Power Connections at Case
- **Reduce Low Voltage Wiring**
  - Eliminate Low Voltage Control Home Runs to Rack
  - Simplified Low Voltage Control Connections at Case
- **Reduce Case Field Wiring**
  - OEM Factory Wiring of Control and Sensors
  - Facilitates Factory Checkout Versus Field Troubleshooting

Case Control Enables Loop Piping, Which Reduces Piping and Leak Rates

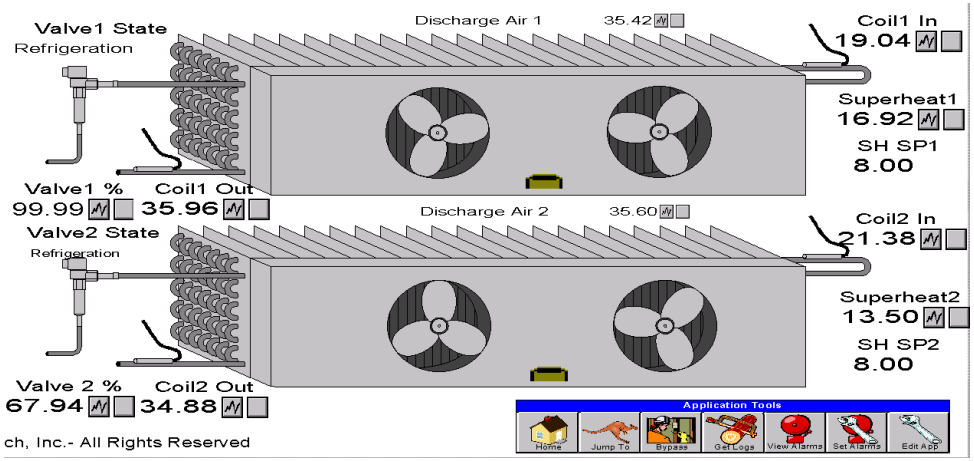


Piping Savings up to 50 %; Refrigerant Charge Reduction 10+%

Making Sense

Case Controls Facilitate Faster Startups

- **Reduced Startup Time Due to**
  - Quicker Leak Checks: Less Joints
  - Reduced Refrigerant Charge
  - Quicker Startup: No Superheats to Set — All Electronic
- **Utilize Data Generated to Shorten Commissioning Cycle**
  - Graphing and Data Analysis Reducing Commissioning/Measurement Time

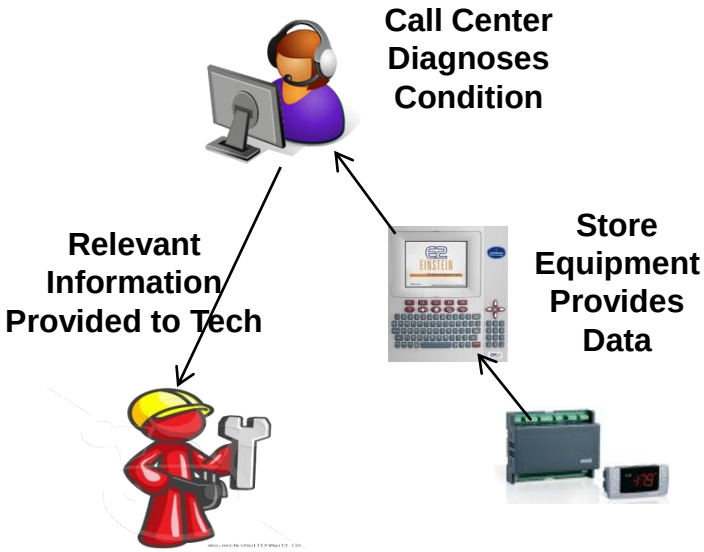


Reduced Commissioning and Startup Time Results in Faster Store Openings

Making Sense

Operational Cost Reduction — Maintenance Savings

- **Reduce Labor Costs**
  - Additional Sensors Enable Remote Diagnostics and Facilitate Faster and More Reliable Troubleshooting
  - Remote Setpoint Adjustment Can Eliminate Service Calls
  - No Seasonal Expansion Valve/EPR/ Temperature Adjustments
- **Reduce Material Costs**
  - Much Lower Refrigerant Leak Rate
- **Reduce Inventory Carrying Costs**
  - Commonality of Parts
- **Use Technology to Supplement Technicians**
  - Reduced Technician Knowledge Base



Remote Troubleshooting

Making Sense

Continuously Optimized Control Provides Ongoing Energy Savings

- **Reduce Energy Used at the Evaporator**
  - Precise Control Eliminates Mechanical Valve “Parasitic Losses”
  - Optimized Valve Control Insures Refrigeration System Operating at Peak Efficiency
- **Reduce Energy Used at the Rack**
  - Electronic Valve Facilitates Much Lower Condensing Pressures
  - Approximately 1% of Compressor Energy Savings per 2 psig Increase in Suction
- **Other Savings Opportunities**
  - “Localized” Antisweat Heater Control
  - Case Lighting Controlled via Occupancy Schedule
  - Defrost Termination Shortens Defrost Time

Electronic Expansion Valves (EXV)

- **An Electronic Expansion Valve (EXV) Solution Measures and Controls System Superheat Electronically**
  - An EXV Solution Is More Than Just a Valve
    - Controller
    - Temperature Sensor(s)
    - Pressure Transducer/Sensor
  - Types of EXVs
    - Stepper Motor, PMV
    - PWM
    - New/Unique Technologies (MEMS, etc.)

Why Use an EXV?

- **Improved System Performance**
  - Efficiency
    - Less Hunting Than Mechanical Valves —Tight Superheat Control
    - Can Achieve Lower Superheat Settings — Better Utilization of Evaporator — Low, Stable SH
    - Floating Head Pressure
  - Wide Operating Range
    - Better Control at Low Load Conditions
      - Fine Control Resolution
    - Digital, Variable Speed, and Screw Compressors
    - Controls Can Be Configured to Certain Conditions
    - Superheat Setting Maintained Over Varying Conditions

Why Use an EXV?

- **Can Be Used With Multiple Refrigerants**
  - No Bulb/Mechanical Charge
  - Refrigerant Is Simply a Parameter in the Controls
- **Faster Pull-Downs, Faster Recovery**
  - Better Control in Transient Conditions (Startup)
- **Communication/Networking Capability**
- **Multiple Applications**
  - Shut-Off
  - Hot Gas Bypass
  - Evaporator Pressure Regulator
  - Liquid Injection
  - Head Pressure Control

Making Sense

From the Field…
Meat Packing/Storage Facility

- **Customer Pain**
  - Slow Temperature Pull-Down
  - Unit Runs 24 Hours/Day
  - High Energy Bills
- **Execution**
  - Added “EX” With Dixell XEV to Every Evaporator
  - 23 Units
  - Dropped the Head Pressure From 110°F to 70°F SCT
- **Results**
  - Compressor Amp Draw Fell from 39.9 to 31.2 (28% Reduction)
  - Removed 26 lbs of R-22 From System
  - Unit Cycled Off on Temperature for the First Time

- **End User Benefit**
  - Faster Pull-Down
  - Significant Energy Savings
  - OPA Energy Rebate
- **Contractor Benefit**
  - Got an Order on the Spot to Retrofit
  - 20 More Systems at That Facility
  - Secured Service Contract

Making Sense

The Trend Toward EXVs

- Government Regulations
- Customer Demand
- Connectivity Capability
- Digital/Variable Speed Compressors
- Electronics Already Onboard
- CO_2
- Familiarity With Electronics
- Improved/Specific Algorithms
- Product Differentiation

Making Sense

Case Controls and Expansion Valves Enable Ongoing Savings

Life Cycle Savings

Savings

Electrical Installation

Piping and Refrigerant

Maintenance and Leak Reduction

Energy

Cost

"One Time"

Increased Equipment Cost

Questions

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