The MN Chapter of ASHRAE Presents:

2024 Refrigeration Seminar

Tuesday, February 27, 2024

Controls for Refrigeration Systems

Refrigeration Seminar

ASHRAE Minnesota Chapter

Presenter Introduction

Heath Schaefer

Business Unit Leader - Controls

heath.schaefer@parker.com

Refrigeration Seminar

ASHRAE Minnesota Chapter

Agenda

- Types of Controls
- Controller applications
- System transitions
- Sensor selection & placement
- Communications
- Data, data, data!
- Pro/cons of using controllers

Types of Controls

- Stand alone
  - Controllers are designed to operate independently and have all the inputs required for operation
  - They are usually located near their area of control
  - They can range from simple to complex
  - They depend on other parts of the system to do their jobs
    - Poor control may be a result of a deficiency somewhere else in the system

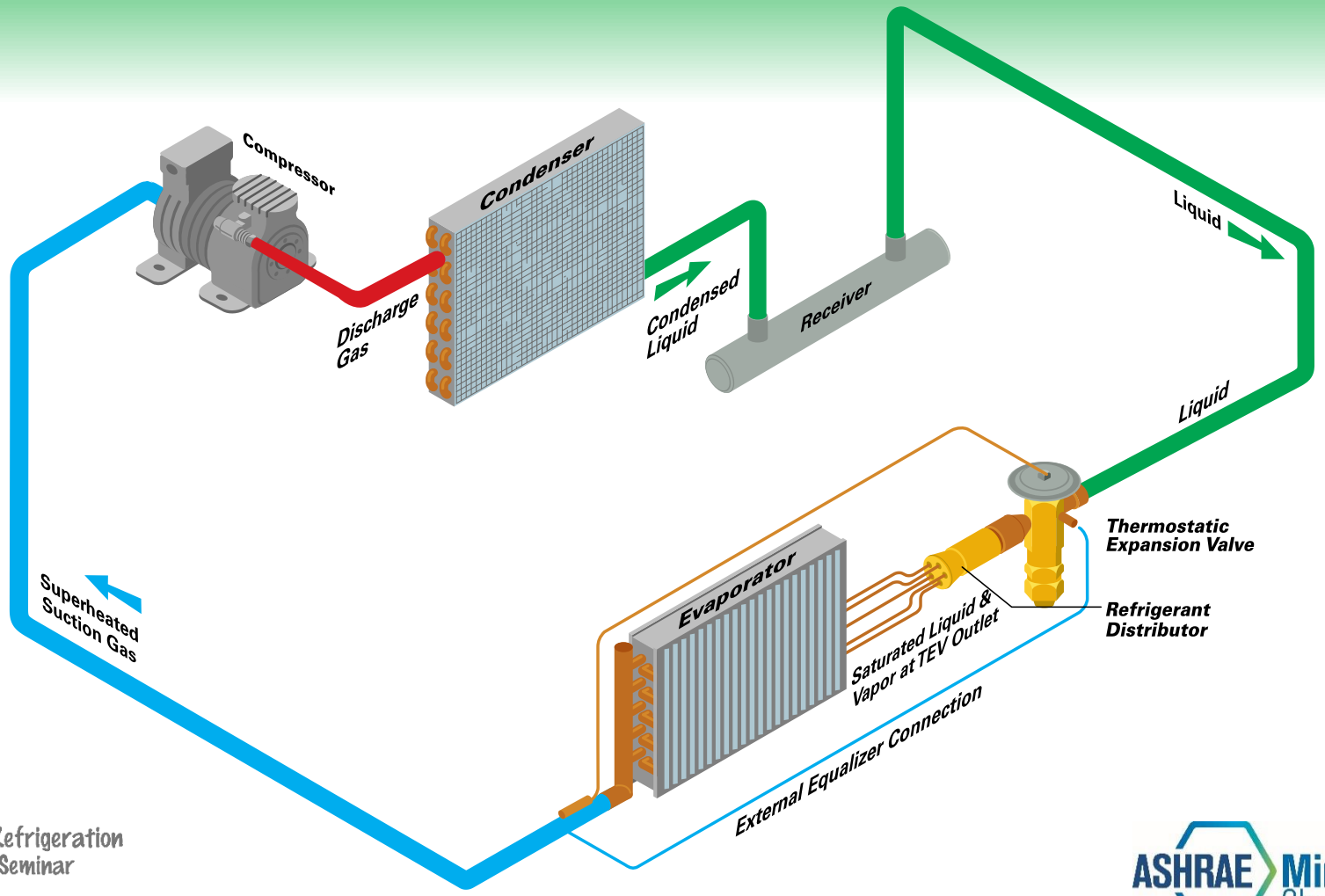
Types of Controls

- Centralized
  - Controllers are installed in a central location (rack room, mech room, etc)
  - Input/Outputs are wired to their respective locations
    - Could be short or long pulls
  - Technician can open a couple panels and have access to most of your controls
  - May simplify power runs/requirements

Types of Controls

- Distributed
  - Controllers are located near their area of control
  - May minimizes wire pulls
  - System can become more complicated in tracing down problems
- Networked
  - Controls have their communication busses connected together to share information and data
  - This feature can be applied to any of the above types but may not be required

Basic Refrigeration System Components
What can be controlled?



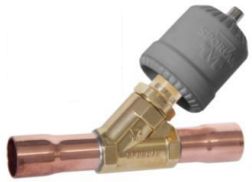
Refrigeration Seminar

ASHRAE Minnesota Chapter

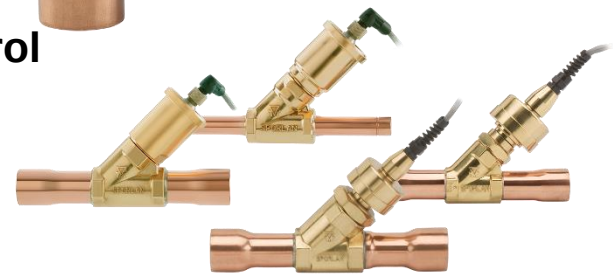
Basic Refrigeration System Components
What can be controlled?

EEVs for Superheat Control

Hot Gas Bypass



Glycol Flow



Evaporator Pressure

Refrigeration Seminar

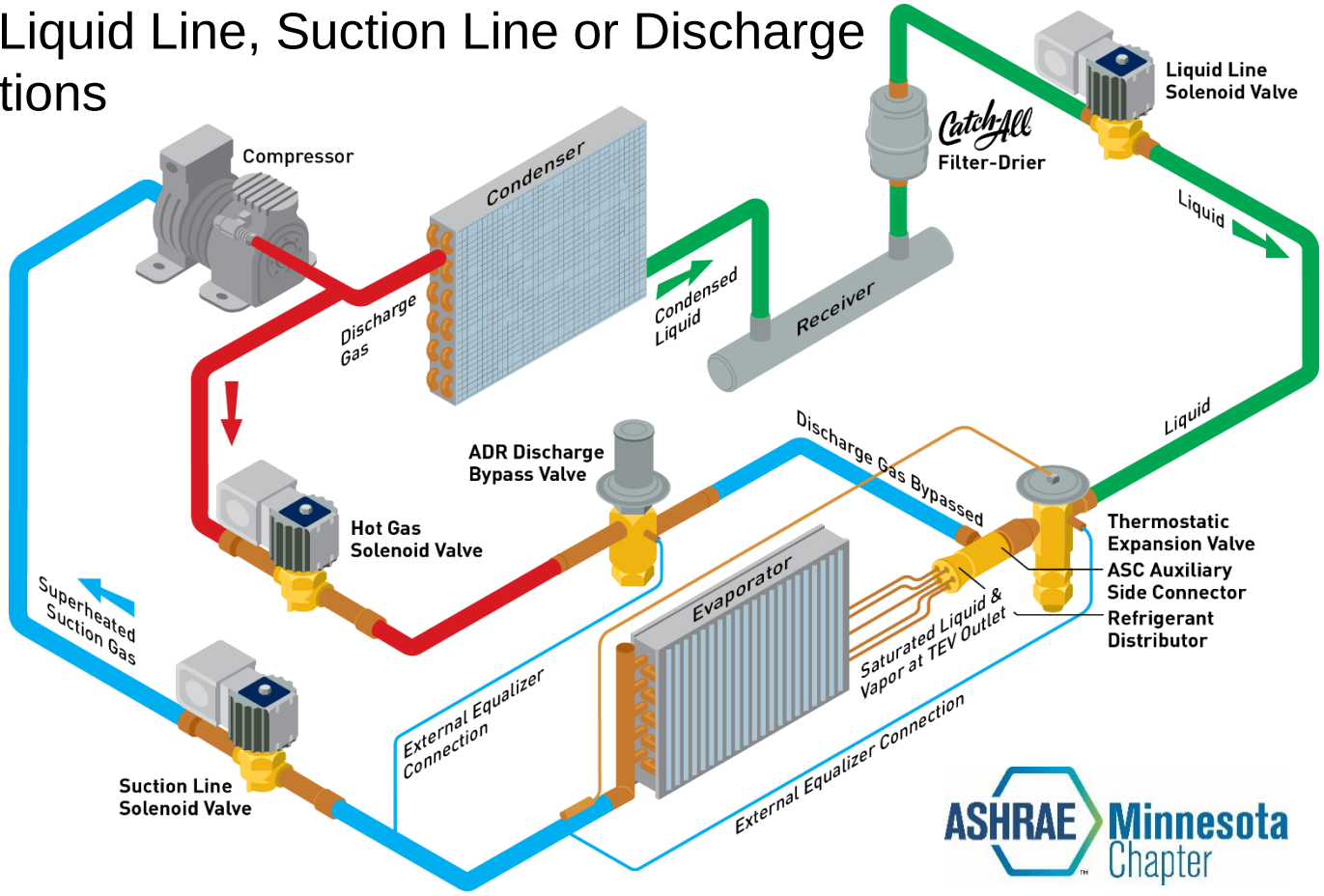
ASHRAE Minnesota Chapter

Control Applications

- Controllers can be everywhere throughout your refrigeration system
  - Determine your needs and what you're looking to accomplish
- Controllers can range from simple to complex
- Common basic applications:
  - Superheat
  - Subcooling
  - **Temperature**
  - Pressure
  - **Flow**
- Common advanced applications:
  - Rack
  - Case / Coil
  - Condenser

Application: Flow Control

- May be used for Liquid Line, Suction Line or Discharge Gas Line applications

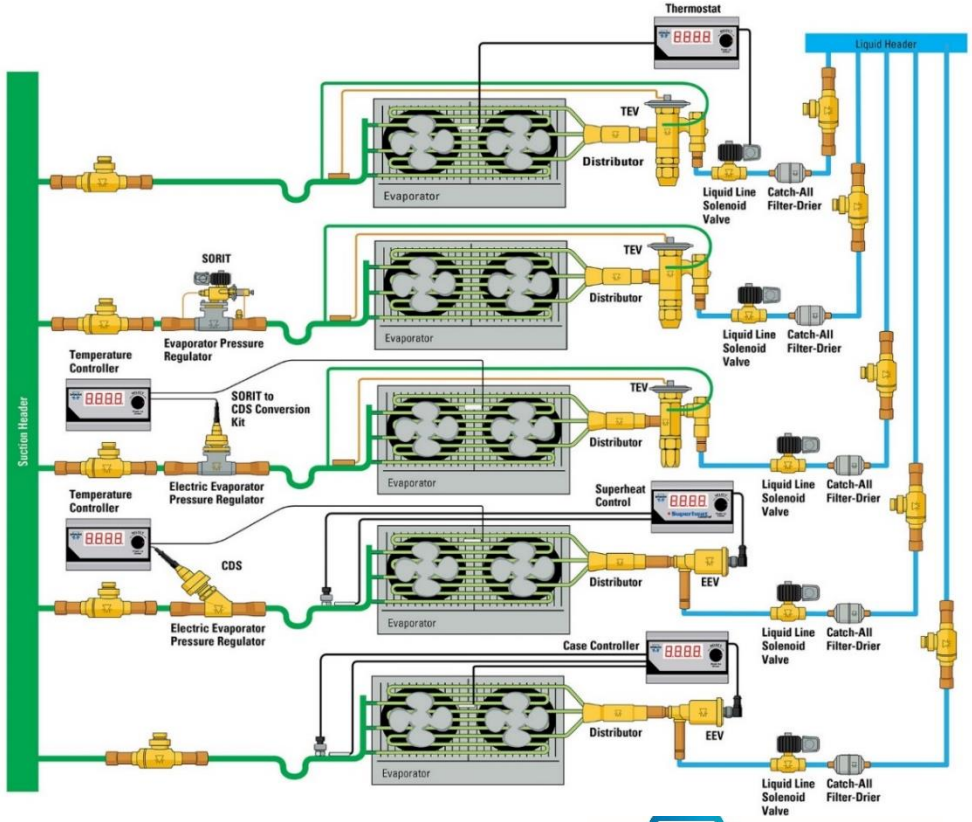


Refrigeration Seminar

ASHRAE Minnesota Chapter

Application: Temperature Control

- Control Strategies:
  - Solenoid Valves and Thermostats
  - Evaporator Pressure Regulators (EPRs)
  - Electric Evaporator Pressure Regulators
  - EEVs Controlling Discharge Air Temperature



Refrigeration Seminar

ASHRAE Minnesota Chapter

Application: Temperature Control

Stand Alone

- Temperature Control (Simple, cheap, less options)
- Case Controllers (More complex, more expensive, more options)
- Others

EMS Controllers

- CPC
- Danfoss
- Micro Thermo (Part of Sporlan)
- Novar

Refrigeration Seminar

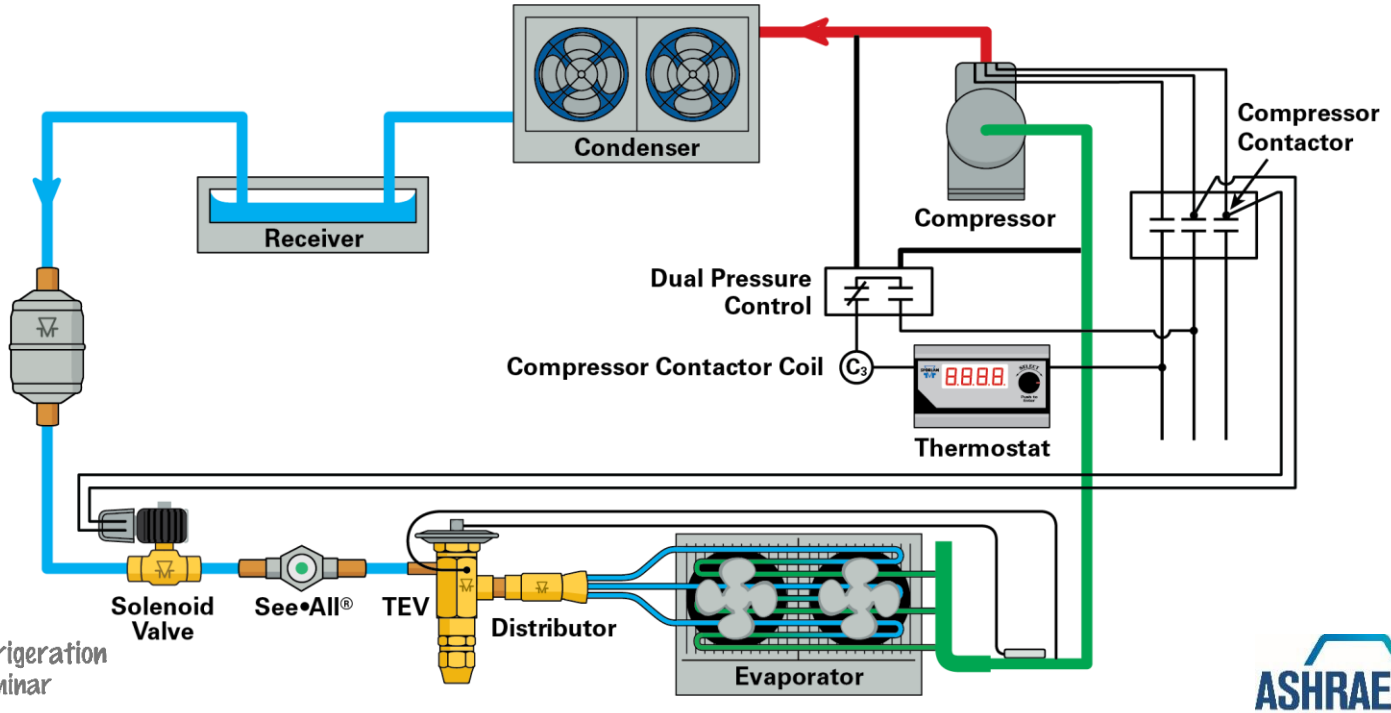
ASHRAE Minnesota Chapter

Application: Temperature Control

- Why use a controller in this application?
  - Simplified set up
  - Refrigerant compatibility (if used for low SH protection)
  - Wider range of control envelope which may provide tighter control
  - Remote monitoring capability
  - Remote alarming capability

Application: Temperature Control

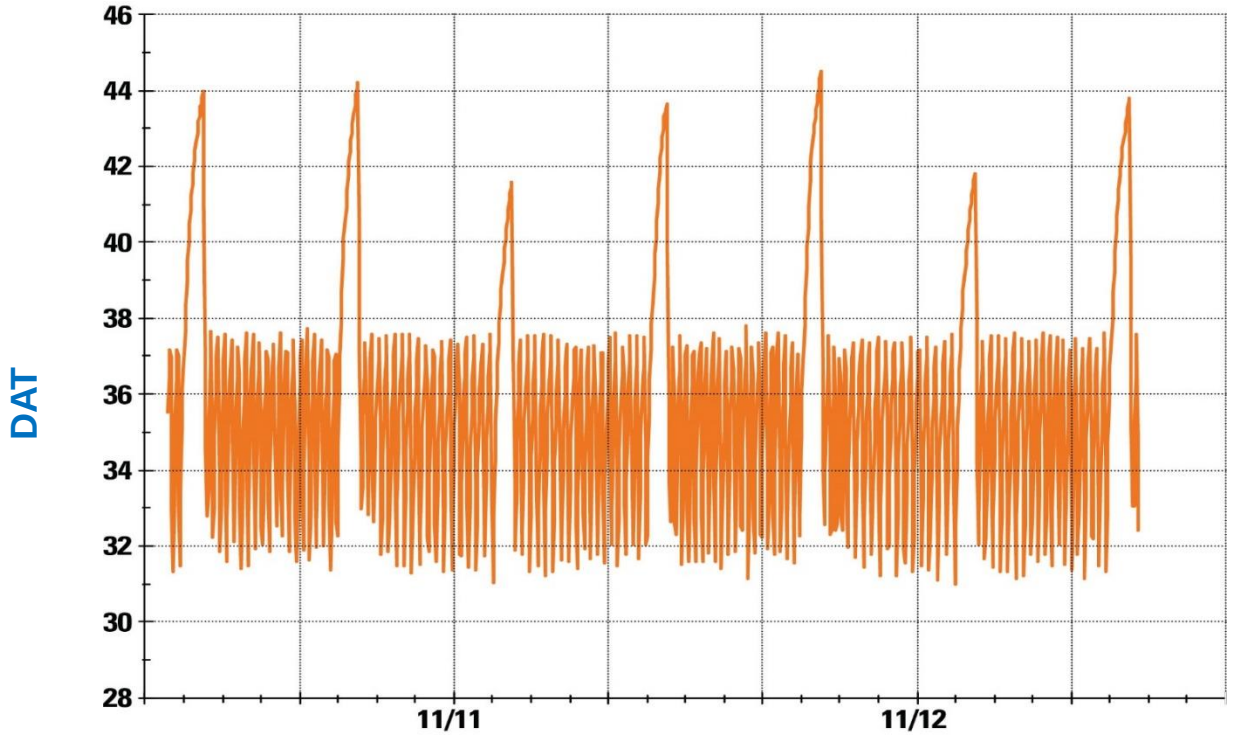
- How can this be used?
  - Modulate solenoid to maintain desired discharge air temperature.



Refrigeration Seminar

ASHRAE Minnesota Chapter

Application: Temperature Control (Solenoid)

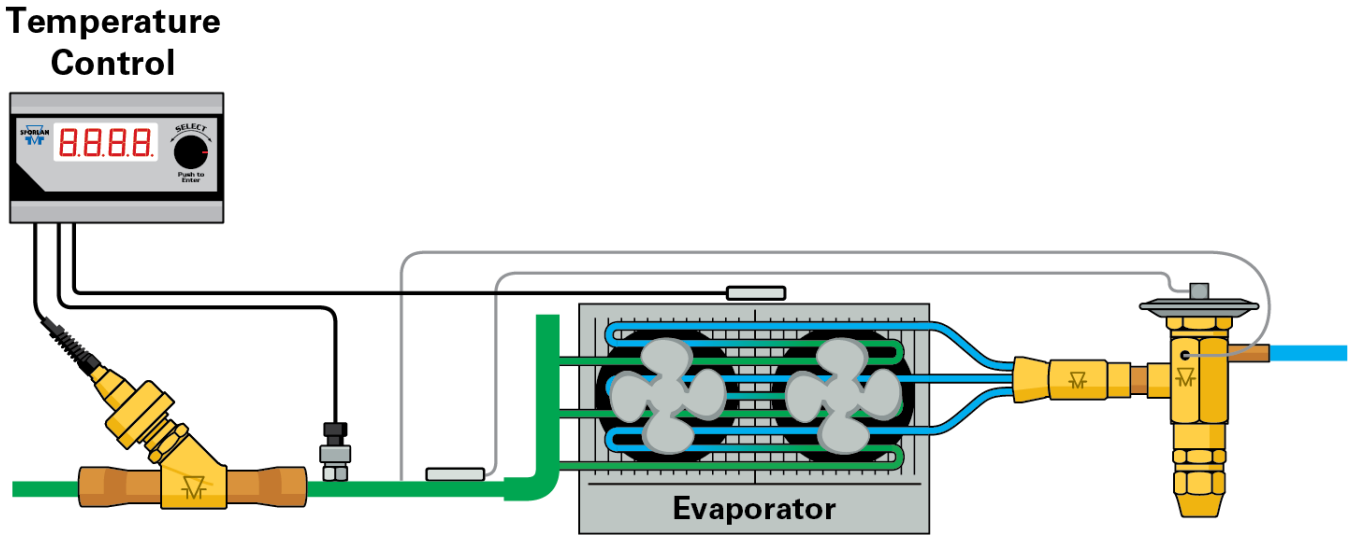


Refrigeration Seminar

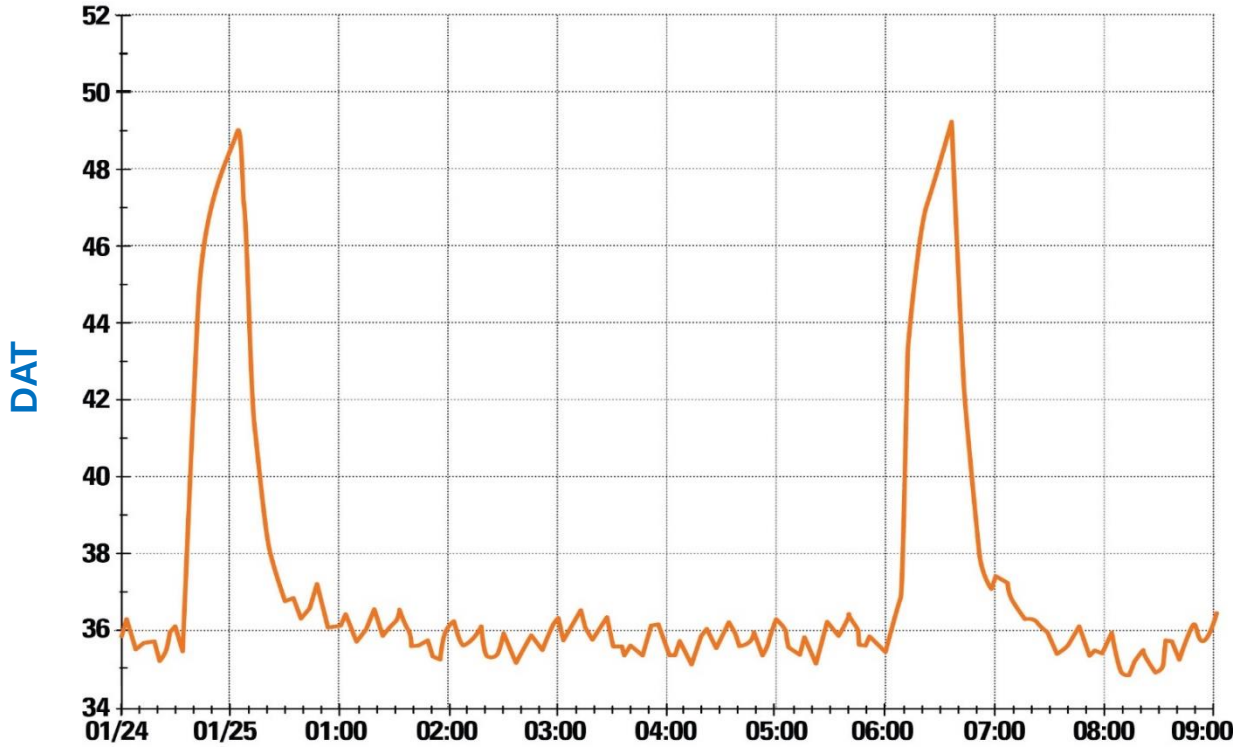
ASHRAE Minnesota Chapter

Application: Temperature Control

- How can this be used?
  - Modulate pressure to maintain desired discharge air temperature (requires controller to drive EEPR).



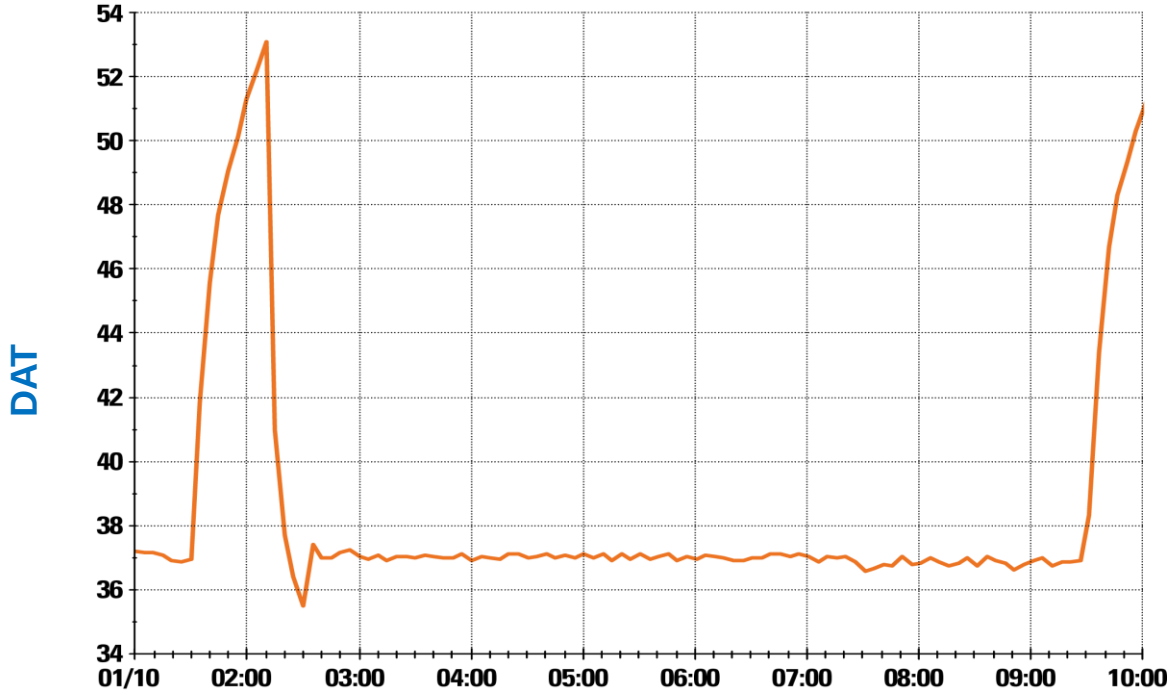
Application: Temperature Control (mech EPR)



Refrigeration Seminar

ASHRAE Minnesota Chapter

Application: Temperature Control (EEPR)

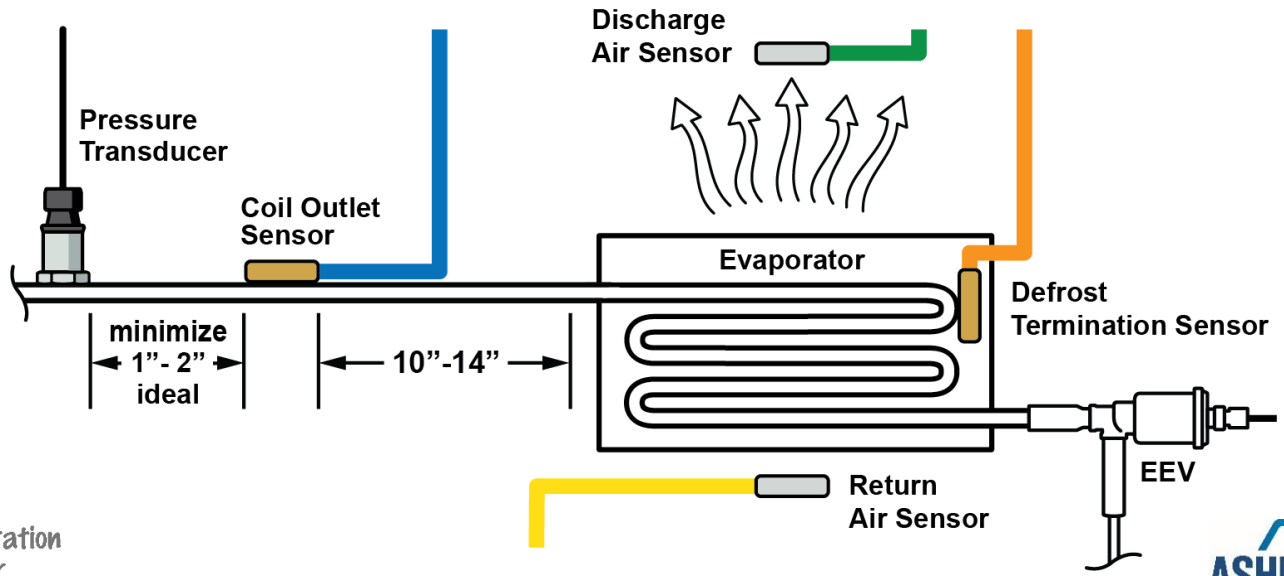


Refrigeration Seminar

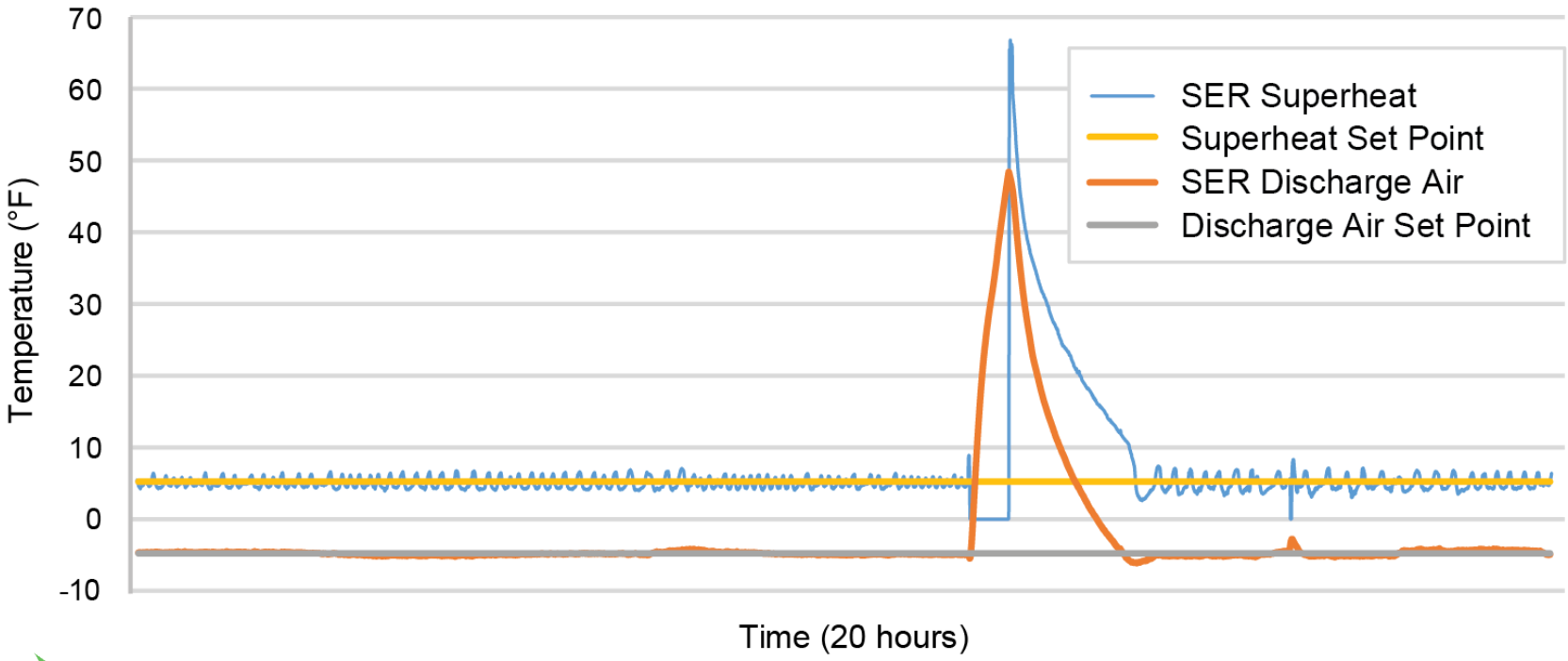
ASHRAE Minnesota Chapter

Application: Temperature Control

- How can this be used?
  - Modulate EEV to maintain desired discharge air temperature.



Application: Temperature Control (EEV)



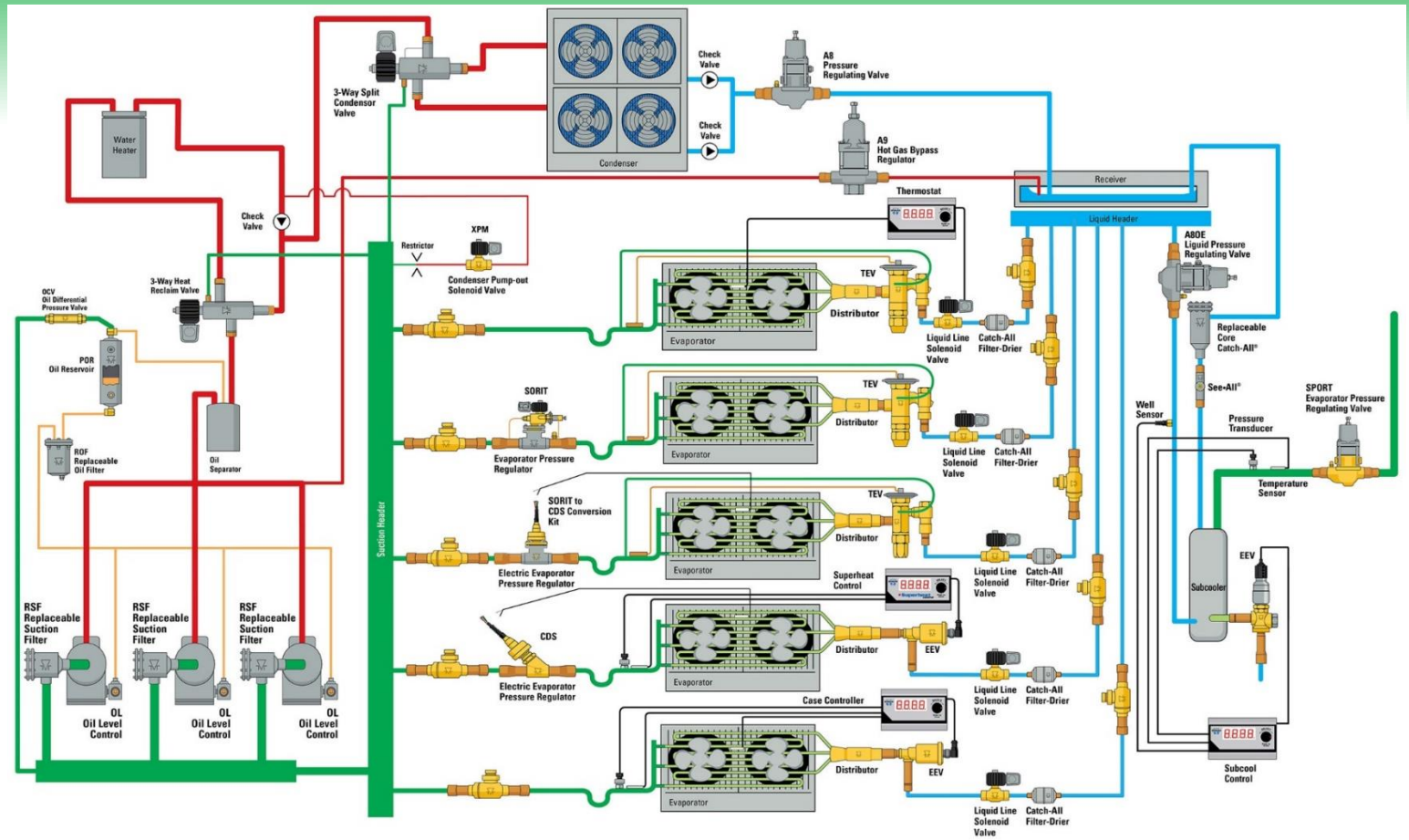
Refrigeration Seminar

ASHRAE Minnesota Chapter

System transitions

- Systems can be transitioned from mechanical to electronic controls
- Complexity varies depending on the application and type of control
  - Simple: (S)ORIT to CDS conversion
  - Involved: TEV to Case Controller

Transition example



Refrigeration Seminar

ASHRAE Minnesota Chapter

Sensor selection and placement

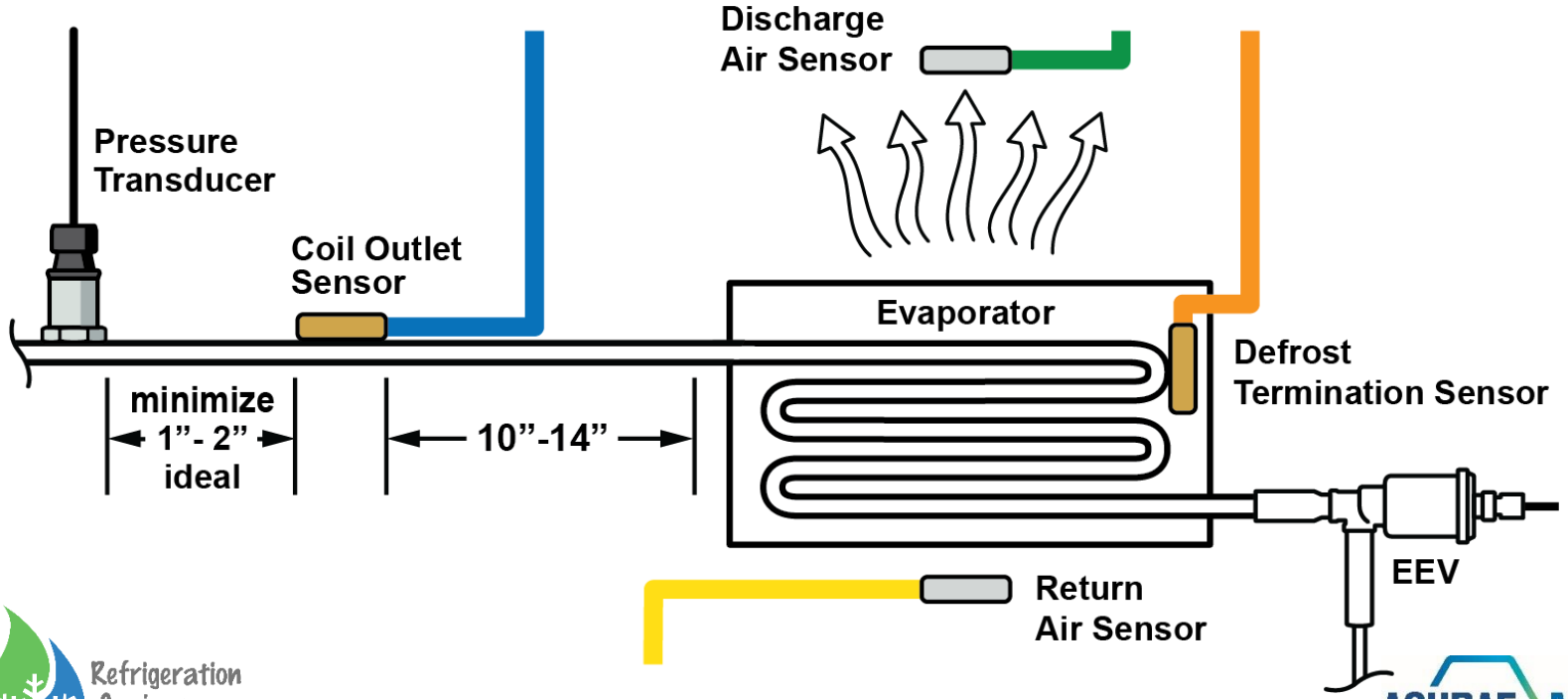
- When controllers are used the right sensors must be selected and compatible with the controller
- Many controllers support a wide range of sensor types and values
  - Ex. Temperature 2k, 3k, 10k, 98.6k, etc.
  - Ex. Pressure Absolute, Gauge, 150, 500, 2000, etc.
  - Humidity
  - Occupancy
  - Current Sensing

Sensor selection and placement

- Sensors should be selected to obtain the desired resolution
- Different sensor types and algorithms used to obtain the sensor reading have different response times. Often times, these response times are accounted for in the controller that you're using or they are small enough to be inconsequential.
- Some controllers allow you to adjust how these values are fed into the control algorithms (avg, max, min, etc)

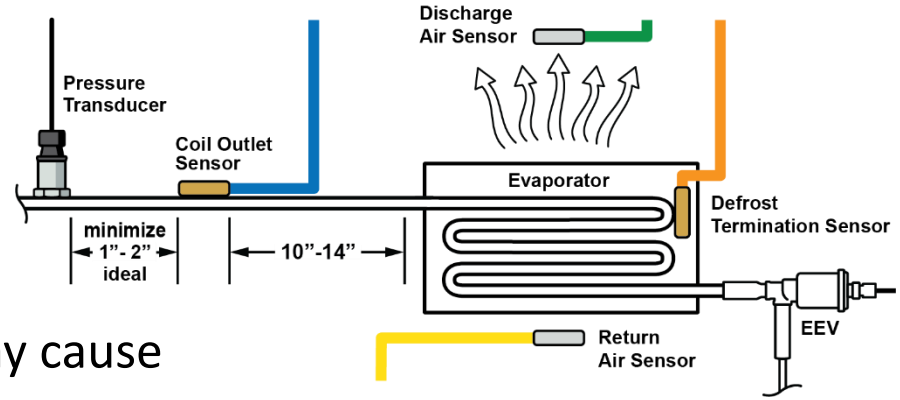
Sensor Placement

- Sensor placement for controllers to achieve optimum performance are defined in the controller's manual



Sensor Placement and landing

- Wrong sensor placement may cause:
  - Longer defrost times
  - Incomplete defrosts
  - Poor temperature/SH control
- Wrong sensor landing on controller may cause undesired behavior



Communications

- In some applications, communications may be required for controller operation. Be sure to pick the right one.
- Controllers may offer communication conversation options to provide a wider range of
- For most applications that aren't stand alone, communications is preferred.
  - Monitoring
  - Alarming
  - Trouble shooting
- Many controllers support various communication protocols
  - BACnet, MODBUS, Lonworks, etc

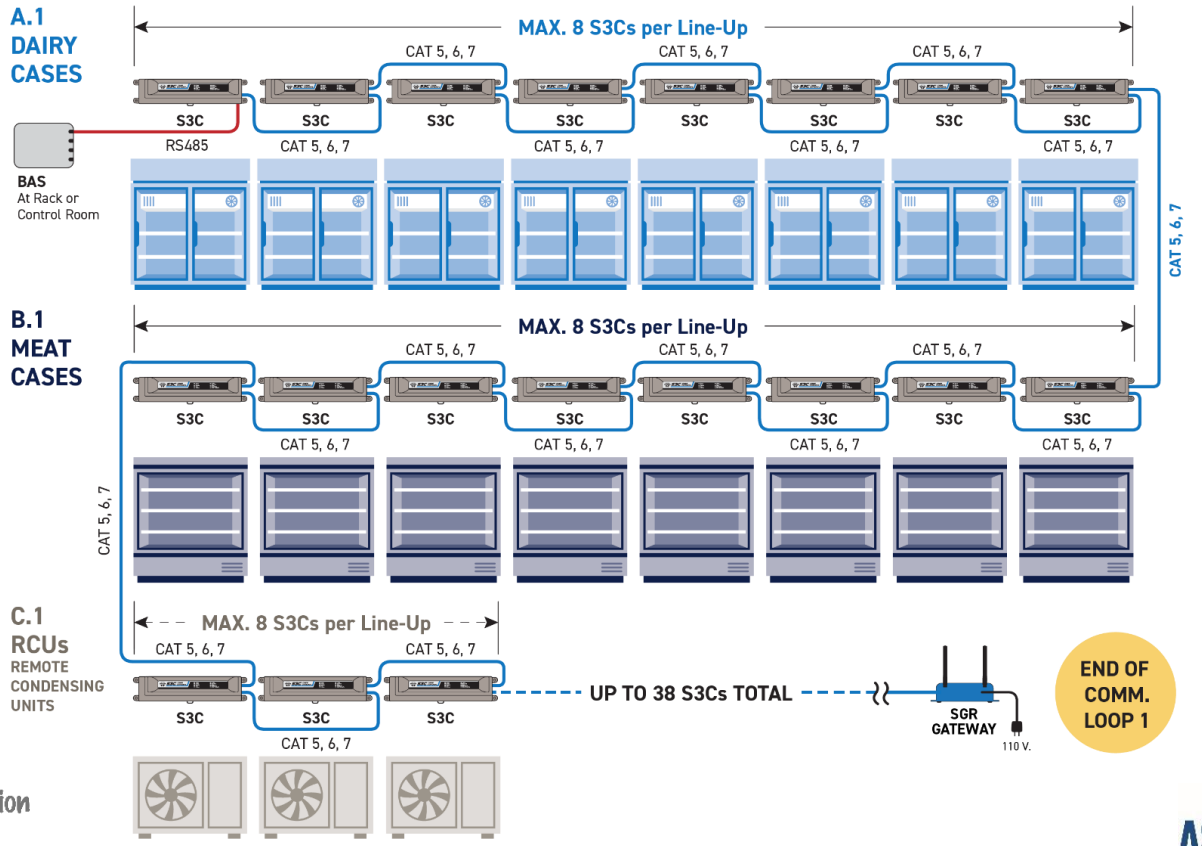
Communications

- Wiring and cabling should be tested and verified to prevent:
  - Data loss
  - Timeouts
  - Nuisance alarms
  - Food loss

Communications

- Some cabling options:
  - RS-485 (twisted pair cable)
  - Ethernet
- Wireless
- Which one is right for your control applications?
  - Depends!

Communications



Refrigeration Seminar

ASHRAE Minnesota Chapter

Data

- Data should be very valuable to users and controllers enable more points
- Some items that data can help you with:
  - Food loss
  - Troubleshooting (remote or local)
  - Equipment analysis in real world applications
  - Food product packaging analysis
  - Preventative maintenance

Maintaining control systems

- Tuning your control systems – how can you do it?
- How often do I need to check in on my systems?
- Check with your manufacturer on upgrading your control systems
- New technology and algorithms become available. Some of free, some are licensed. Consideration when picking a control solution
- Understand your hardware cost and your software cost
  - How will you receive upgrades?
  - How much will they cost?
- Refrigerant retrofits – does your control system support his?

Thank you for your time!

Comments / Questions?

Refrigeration Seminar

ASHRAE Minnesota Chapter