CROP STORAGE FACILITIES

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Storage Facilities Maintain Crops

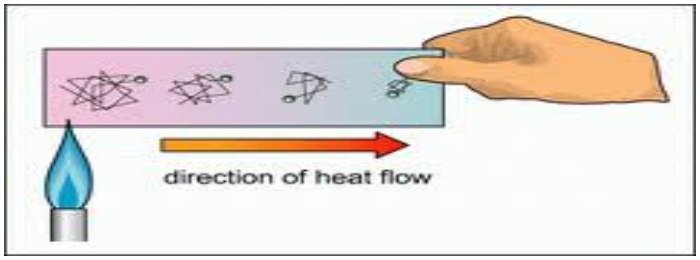
- What you put in determines what you get out!
  - Minimize loss by controlling the environment
- Optimal crops are Clean & Disease Free
- Storage is a period of rest for crops
  - Not too warm/not too cold
  - Not too humid/not too dry
- For best results emphasis must be on crop quality AND storage environmental control.

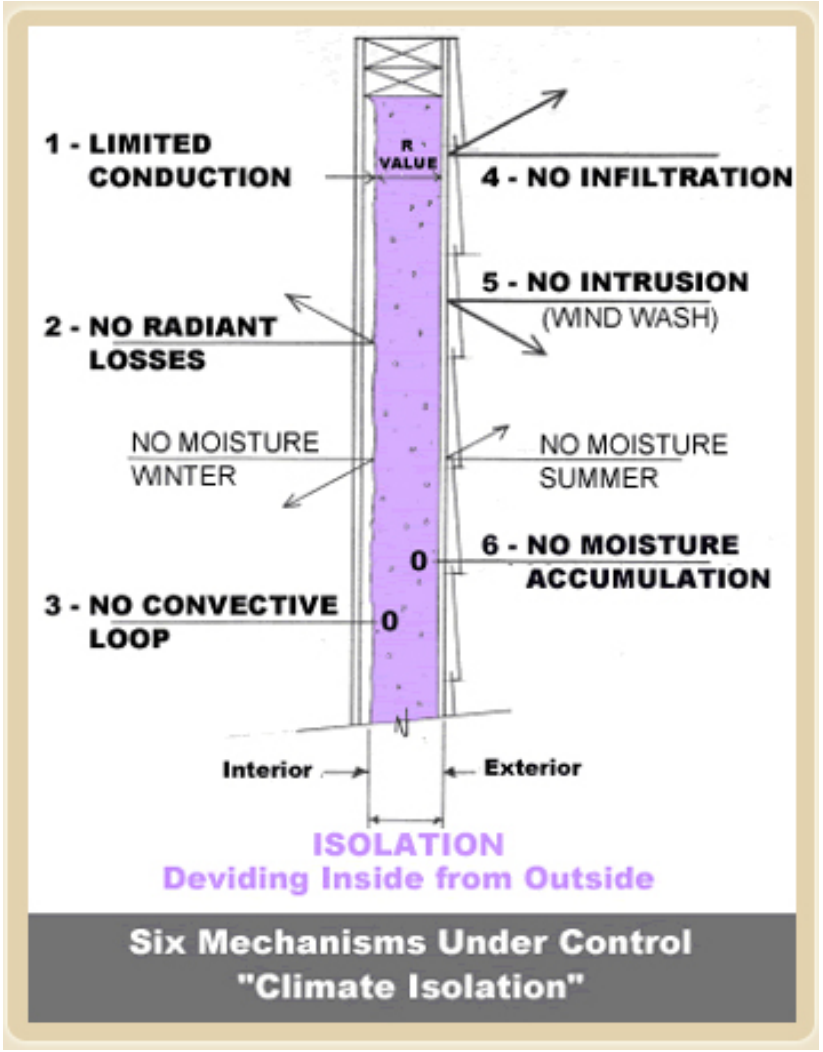
Components of a Quality Storage

- Ability to Control and Maintain Temperature
- Ability to Control and Maintain Relative Humidity
- Adequate Ventilation and Air Circulation
- Energy and Cost Efficient

Controlling Storage Environment

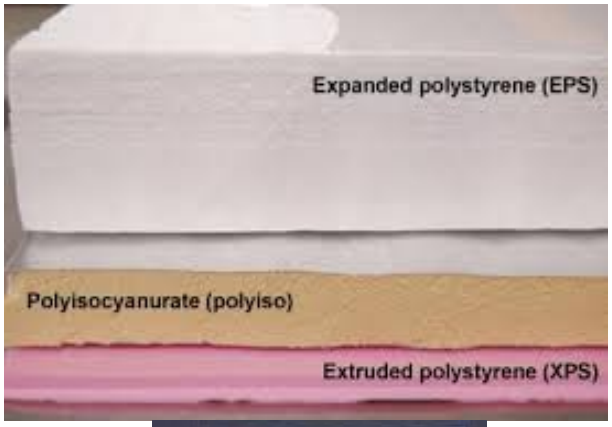
- Start with a Tight Box
  - Heat moves in three ways: Conduction, Convection and Radiation
    - Prevent air leakage to minimize convection
    - Adequate Vapor Barrier
    - Insulate to minimize conduction





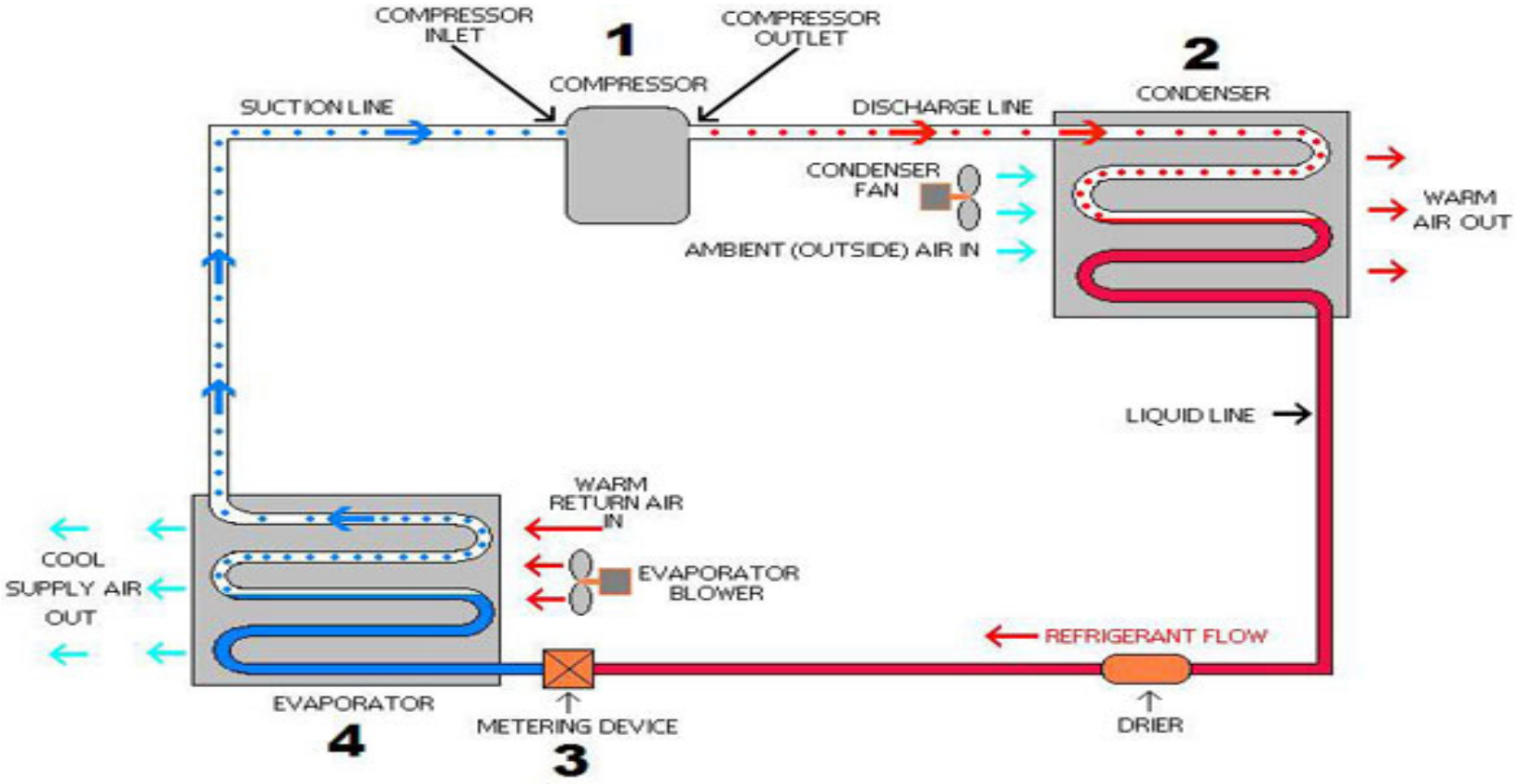
Controlling Storage Environment

- Achieving a Tight Box
  - R-20 Walls and R-30 Ceilings
  - Caulk and spray foam
  - Protect Insulation
    - Plywood or metal sheathing
    - Board around perimeter
  - Doors work and seal properly
    - Convection occurs at doors
    - Easily knocked out of adjustment



Creating the Storage Environment: Temperature

- Vapor Compression Refrigeration Cycle



Controlling the Storage Environment: Temperature

Evaporator

Condenser Unit

- Keep Serviced and Clean
- Attention to Coils in Both Units

Creating the Storage Environment: Temperature

- Cool Bots
  - Manipulated Air Conditioners
    - Tricked to cool below “human comfort” design
  - Work well with smaller storage units
  - Can be noisy
  - Reject heat to outside space
  - Overload on AC units
    - May have to replace often-every couple years

Creating the Storage Environment: Temperature

- Outdoor Air
  - Duct outdoor air into storage when temperatures allow
  - Thermostats inside and outside
    - Compressor turns on when desired temp is less than outdoor temp
  - Energy efficient & cost effective
  - Winter air has low relative humidity

Creating the Storage Environment: Humidity

- Crops generally like to be stored at specific levels of relative humidity(RH)
- Know the desired RH of crop and maintain in storage
- Accurate humidity sensing
  - Hygrometer
  - Digital Psychrometer
  - Humidistat
- Check sensors against each other for accuracy

Controlling Humidity

- Humidifiers
  - Household
  - Centrifugal

- Fine misters

- Water on the floor

Controlling the Storage Environment: Adding Heat

- For winter storage of some crops adding heat is required i.e. Squash

- Methods of Heating
  - Electric Space Heaters
    - Small well insulated storages
  - Propane and Oil Units
    - Larger Storages
  - Solar

- Don’t forget about RH!
  - Heating will lower RH

Controlling the Storage Environment: Adding Heat

- Greenhouses
  - Squash
  - Onions
  - Infrastructure often not in use during early fall

Ventilation and Air Circulation

- Keep air moving
  - Stagnant air promotes disease
  - Keeps temps constant throughout storage
  - Use breathable storage containers

- Ventilation
  - Removes ethylene and other off gases
  - Source of cooling during winter months
  - Rate of ventilation varies with type and amount of produce
    - Measured in CFM or ACH

Example Projects

- Recycled Cooler with insulated floor
- Panels with cam-lock system
- Self contained refrigeration mechanics
- They're around!

Example Projects

- New Insulated Panel System
- Custom Built and Sized
- Mechanics Separate
- Clean and Easy

Resources for Crop Storage Needs

- **US Handbook 66**

- **UMass Agricultural Extension Vegetable Program Website**
- Engineering Winter Storage Facilities for Vegetable Crops

  Stephen Belyea

  Maine Department of Agriculture, Food, and Rural Resources

  Great resource for cooling load calculations!

Questions and Comments

Thank you

Good luck this winter!