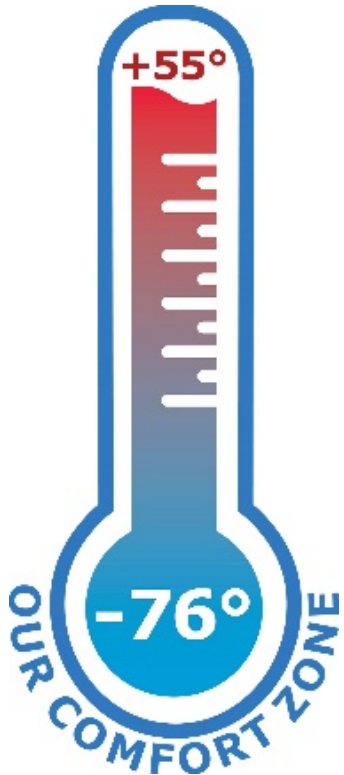




Authorities in Agricultural Cooling Systems

COOLING and FREEZING AUTHORITIES

FRUITS, VEGETABLES, WINES & BEVERAGES, DAIRY, HERBS and FLORALS



PACKAGED SYSTEMS – PLUG and PLAY!
DUAL-KOOL – ENERGY EFFICIENCY!
FREE-COOLING – AUTOMATICALLY!

COLD-STORAGE WAREHOUSES
BEVERAGE WAREHOUSES
HIGH-HUMIDITY GROWING ENVIRONMENTS
FROZEN FOODS – DOWN TO MINUS 76°F
CUSTOM REFRIGERATION ENGINEERING
COMPLETE CA ENVIRONMENTS





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**SKID MOUNTED
THROUGH-THE-DOOR
MOVE COOLING AROUND
PLUG and PLAY!
POWERFUL COOLING
HIGH VOLUME AIR THROW
PROVEN TECHNOLOGY**





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HYDRO-COOLING SYSTEMS



RAPID FIELD-HEAT REMOVAL



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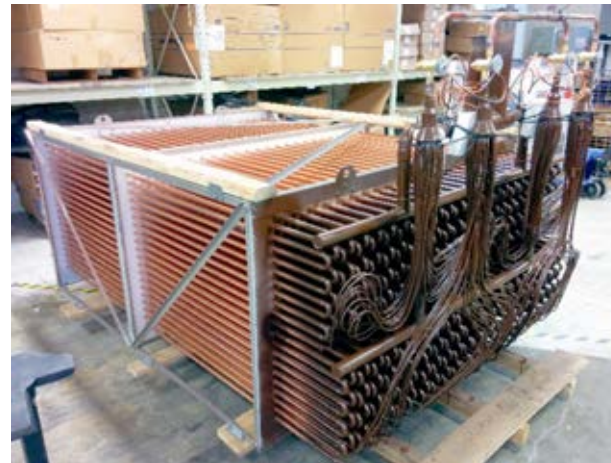


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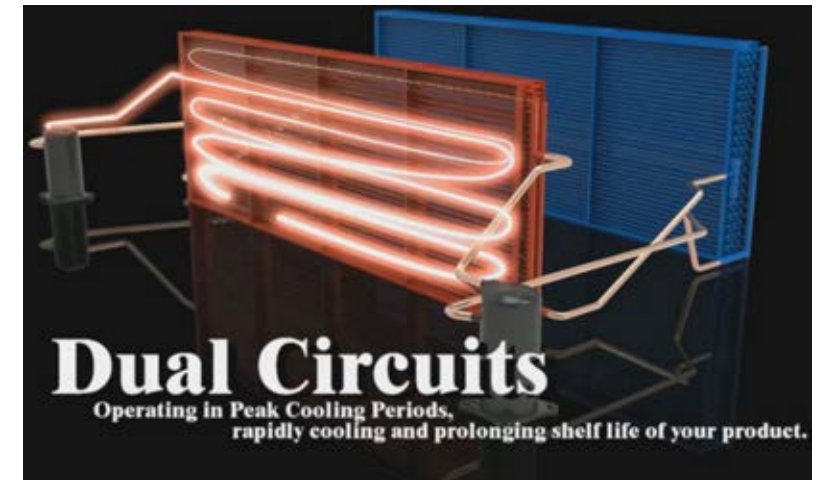


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**PACKAGED DESIGN
THROUGH-THE-WALL
CUT a HOLE – PLUG n PLAY!
POWERFUL COOLING
HIGH VOLUME AIR THROW
PROVEN TECHNOLOGY**

**PLUG
AND
PLAY**





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Potato Heat - kcal/tonne/day
Used in USDA Calculations

20°C

4941

15°C

3477

10°C

2440

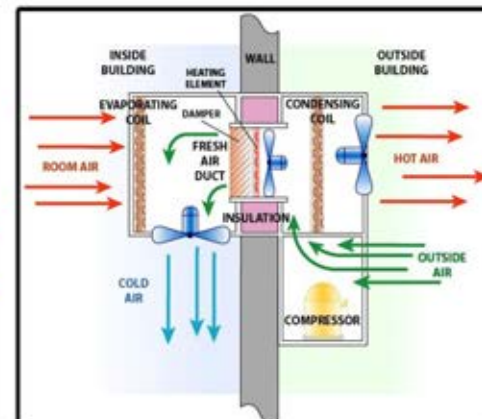
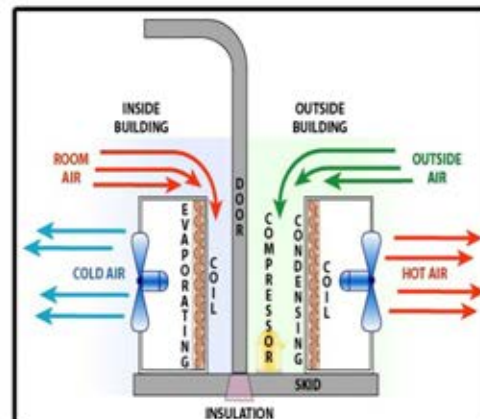
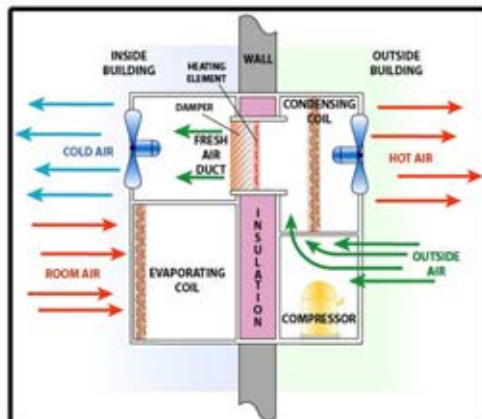
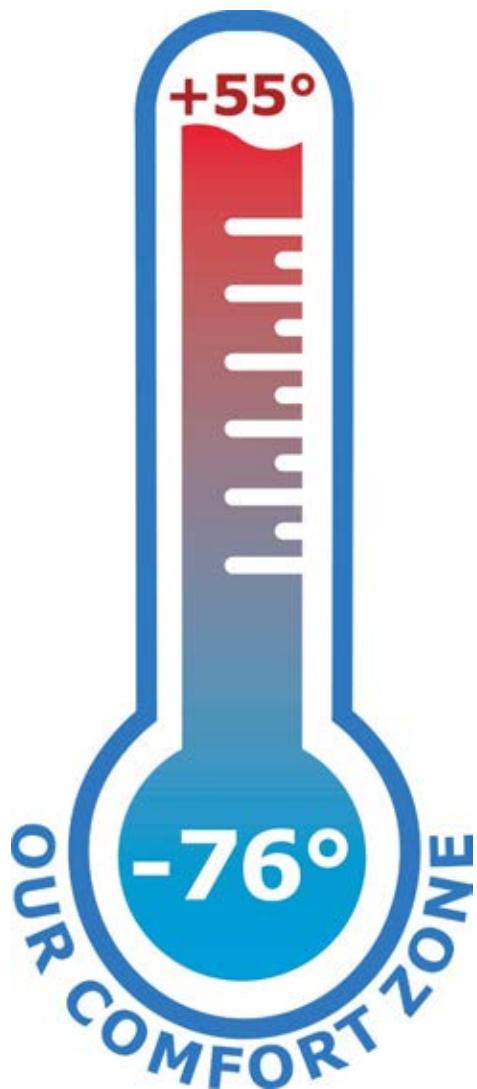
5°C

1464



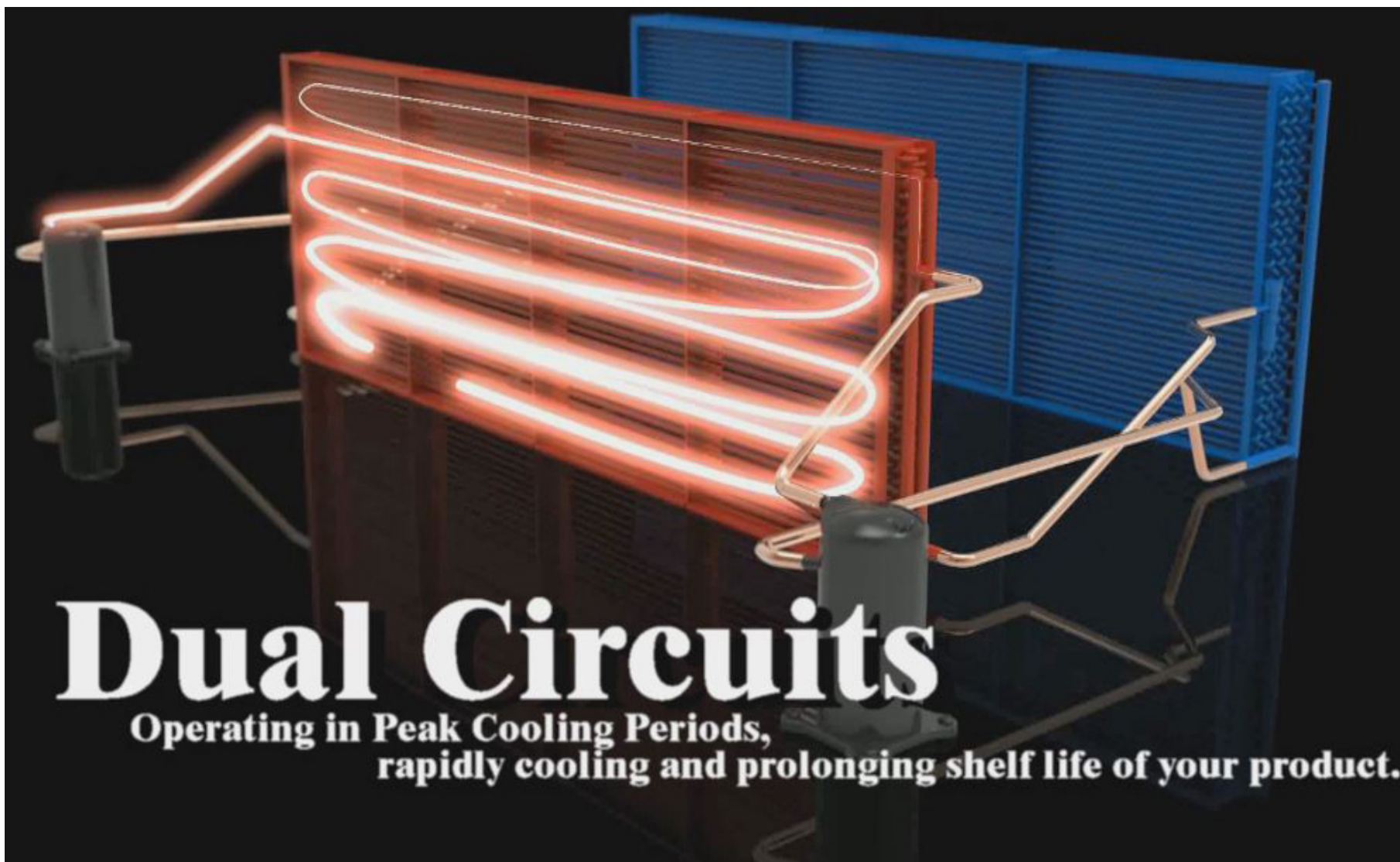
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ONE PIECE DESIGNS





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Dual Circuits

**Operating in Peak Cooling Periods,
rapidly cooling and prolonging shelf life of your product.**



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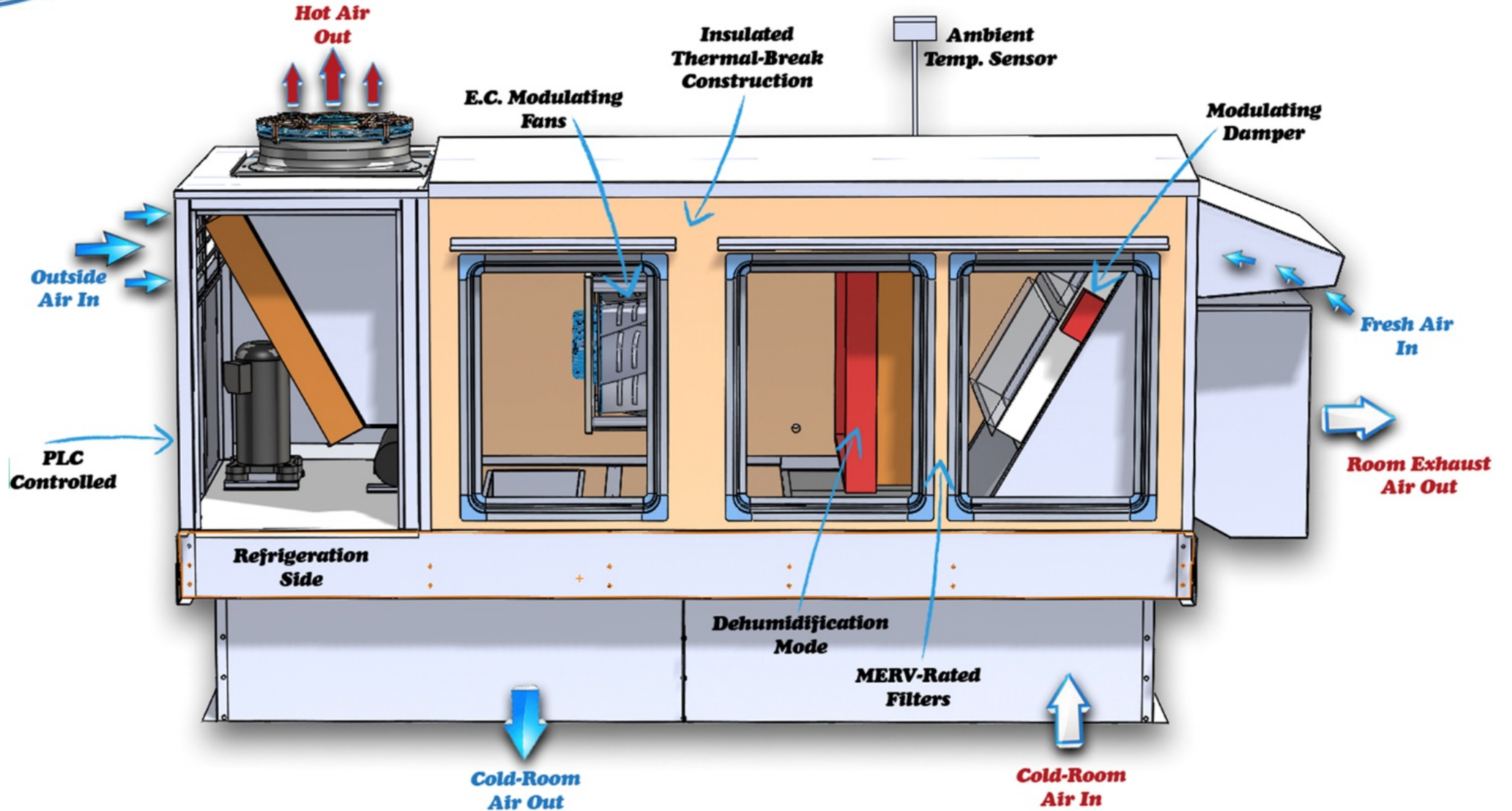


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**PLUG
AND
PLAY**

**FREE
COOLING**





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**PACKAGED DESIGN
THROUGH-THE-WALL
CUT a HOLE – PLUG n PLAY!
POWERFUL COOLING
HIGH VOLUME AIR THROW
PROVEN TECHNOLOGY**





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IN-THE-DUCT

PACKAGED DESIGN

PLUG and PLAY!

POWERFUL COOLING

PROVEN TECHNOLOGY



**PLUG
AND
PLAY**



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Wine Tanks with Jackets and manifold



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Respiration Rate and Decay



Temperature	Q-10 Value
0 to 10° C	2.5 to 4.0
10 to 20° C	2.0 to 2.5
20 to 30° C	1.5 to 2.0
30 to 40° C	1.0 to 1.5

Temperature	Q-10 Value	Relative Velocity of Deterioration	Relative Shelf Life
0° C	-	1	100
10° C	3.0	3	33
20° C	2.5	7.5	13
30° C	2.0	15	7
40° C	1.5	22.5	4

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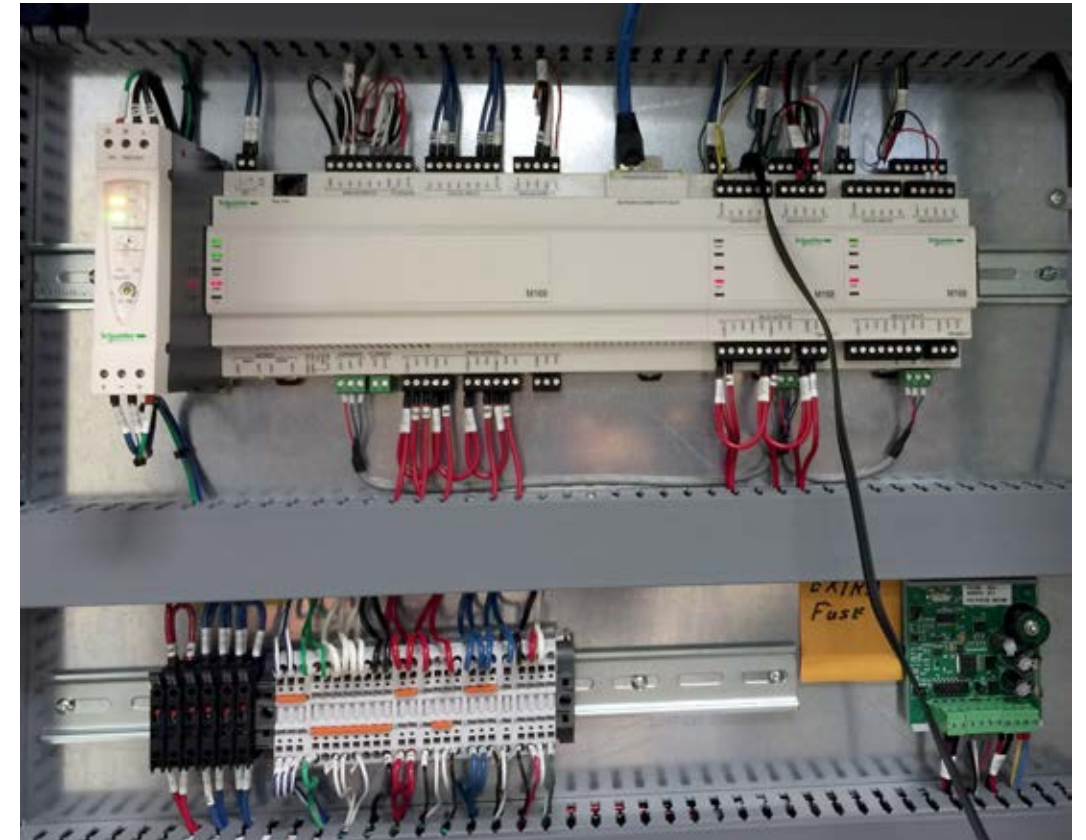
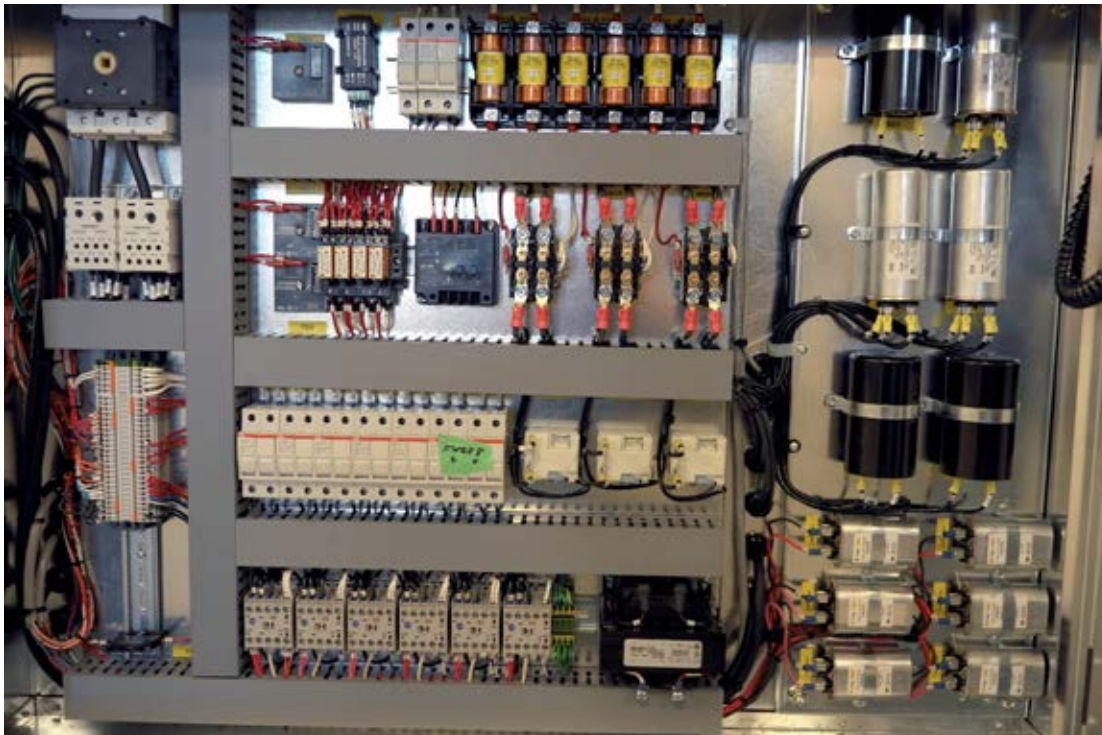
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ANALOG and PLC CONTROL SYSTEMS
KOOLJET PANELS ARE UL-CERTIFIED



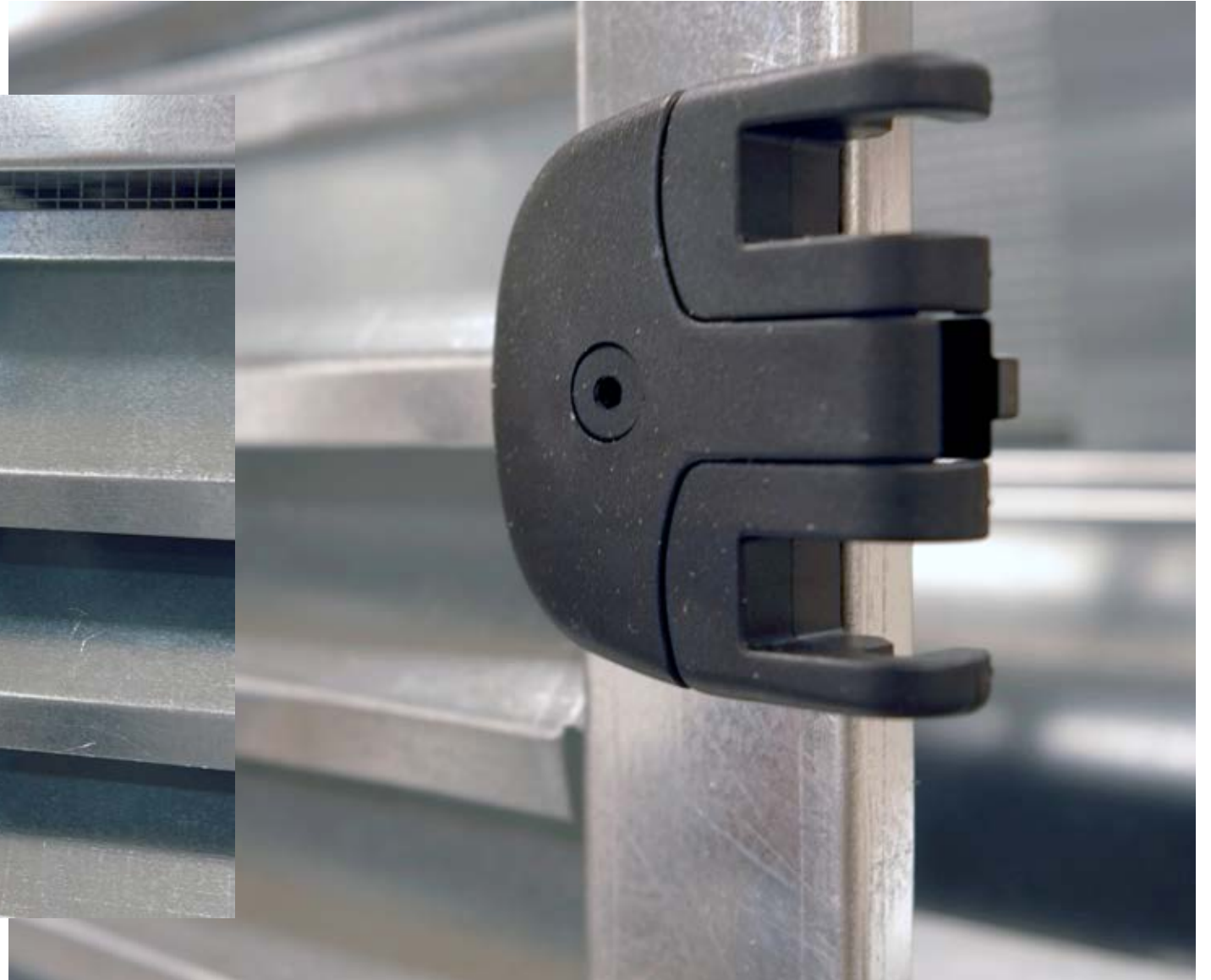


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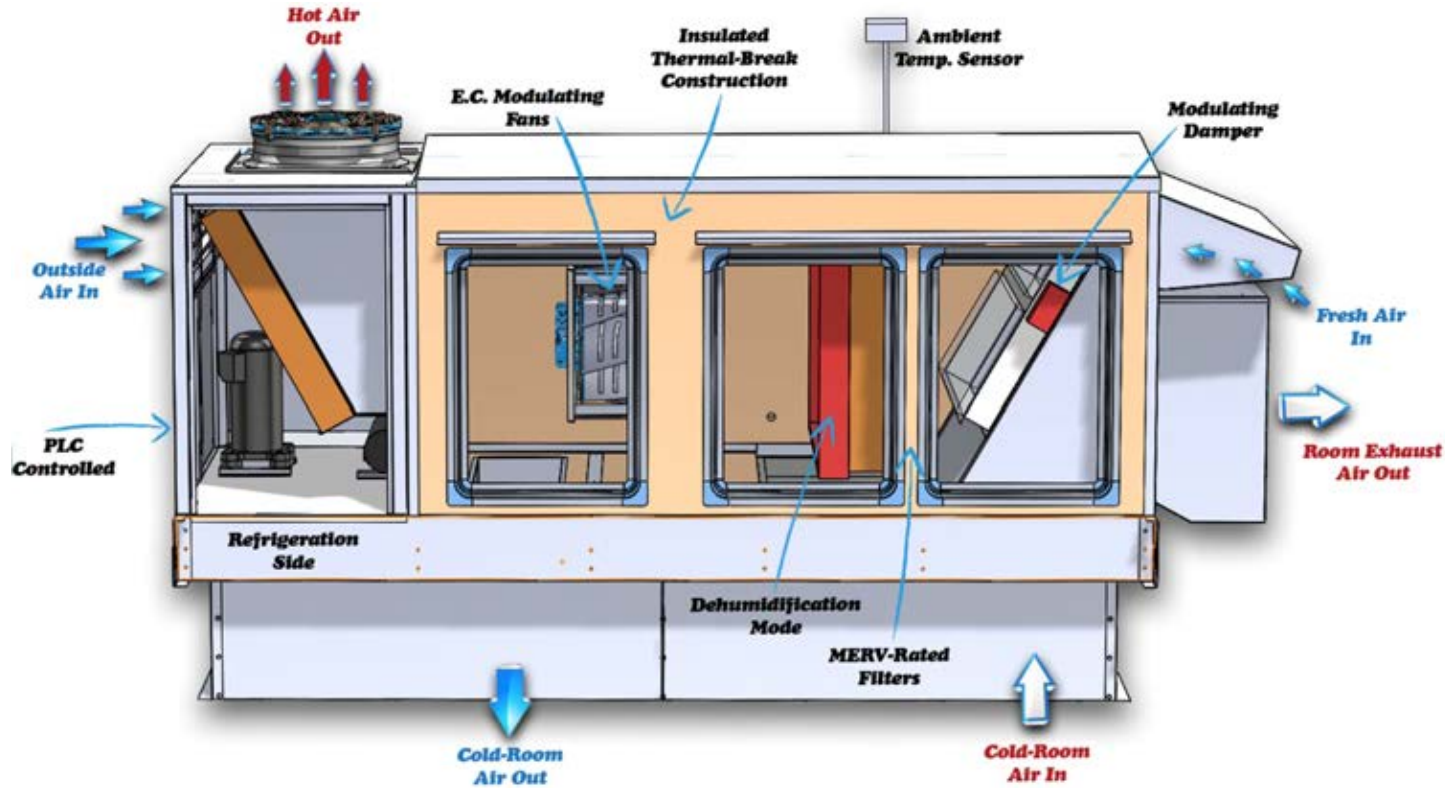


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The Food Loss - How Big is it?



31% - 133 BILLION POUNDS - WORLDWIDE

Two-thirds of this 133-billion-pound loss occurred in homes, restaurants, and other away-from-home eating places, and one-third occurred in grocery stores and other food retailers. - United Nations Study

• LESS-DEVELOPED COUNTRIES

- Food loss occurs closer to the farm and retail segments with relatively little wasted by the consumer.
- These countries tend to have relatively inadequate cold storage, cold-transportation and access to close markets.
- Intermediate packing and sorting houses lack effective Cold-Chain capabilities.
- Often utilize sun-drying of grains which increases the risks of pest infestation and damage from unfavorable weather.
- Access to effective technologies to reduce loss, track inventory and management are often lacking or poorly implemented

• DEVELOPED COUNTRIES

- A relatively larger share of food loss occurs at the consumer end of the spectrum.
- Food accounts for a relatively smaller share of household incomes.
- Demand for wide variety of high-quality, cosmetically appealing.
- The impact of convenience and snack foods.
- There is a higher waste associated with restaurant versus home consumption

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Five Common Cooling Methods



Room Cooling 20-100 hours	Forced Air Cooling 1-10 hours	Hydrocooling 0.1-1 hour	Flake Ice Cooling 0.1-0.3 hours	Vacuum Cooling 0.3-2 hours
Artichoke, Banana, Dry Beans, Beet, Cabbage, Cactus, Cassava, Coconut, Garlic, Ginger, Horseradish, Kumquat, Lime, Lemon, Melons, Onion, Orange, Cucumber, Pineapple, Potato, Pumpkin, Radish, Sweet Potato, Turnip, Watermelon	Avocado, Banana, Berries, Brussel Sprouts, Cassava, Coconut, Cucumber, Eggplant, Fig, Ginger, Grape, Guava, Kiwi, Lima Bea, Mango, Melons, Mushroom, Okra, Orange, Papaya, Passion Fruit, Bell Pepper, Pumpkin, Snap Beans, Snow Peas, Summer Squash, Tangerine, Tomato	Artichoke, Asparagus, Beet, Endive, Broccoli, Brussel Sprouts, Cantaloupe, Cauliflower, Carrot, Celery, Cucumber, Eggplant, Escarole, Kiwi, Leek, Lima Beans, Orange, Parsley, Peas, Pomegranate, Spinach, Sweet Corn, Watercress	Endive, Broccoli, Brussel Sprouts, Carrot, Cauliflower, Cabbage, Escarole, Leek, Lettuce, Lima Beans, Green Onion, Spinach, Snap Peas, Snow Peas, Sweet Corn, Watercress	Endive, Broccoli, Brussel Sprouts, Carrot, Cauliflower, Cabbage, Escarole, Leek, Lettuce, Lima Beans, Mushroom, Snap Peas, Snow Peas, Swiss Chard, Watercress

*Recirculated water must be constantly sanitized to minimize accumulation of decay-causing pathogens." Thompson et al. 1998



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Common Storage Temperatures



Produce Type	0-2°C 32-36°F	4-7°F 40-45°F	7-10°C 45-50°F	13-18°C 55-65°F
Vegetables Not ethylene sensitive	Alfalfa, Artichoke, Bean Sprouts, Beet, Radicchio, Shallot, Sweet Corn, Chard, Turnip, Watercress		Calabaza, Haricot Vert, Bell Pepper	Cassava, Jicama, Sweet Potato, Taro, Yam, Tomato, ripe
Fruits & Melons Low ethylene sensitive	Cherry, Blackberry, Blueberry, Coconut, Current, Date, Grape	Cactus Pear, Kumquat, Olive, Pomegranate, Tamarind, Tangerine	Tangelo, Casaba, Cranberry, Grapefruit, Lemon, Lime, Pineapple	Breadfruit, Canistel, Grapefruit CA,
Fruits & Melons Ethylene Producing	Apple, Apricot, Ripe Avocado, Cantaloupe, Cut Fruits, Kiwi, Nectarine, Pear, Plum, Prune, Quince	Feijoa, Guava, Honeydew, Persian Melon	Unripened, Crenshaw Melon, Passion Fruit, Sugar Apple	Banana, Jackfruit, Mango, Mangosteen, Plantain, Sapote
Dry Vegetables	Dry Onion, Garlic			Ginger, Pumpkin, Squash
Vegetables ethylene sensitive	Arugula, Asparagus, Endive, Broccoli, Cabbage, Carrot, Cauliflower, Celery, Chard, Onion, Mushroom	Snap Beans, Cactus, Fava Bean, Lima Bean, Potato, Peas	Basil, Cucumber, Eggplant, Kiwano, Chile Pepper, Tomatillo, Watermelon	Early Crop Potato, Mature Green Tomato

Ethylene sensitive Vegetables should not be mixed with Ethylene producing fruits during transportation and storage.

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Effective Cold-Chain Technology



- **TEMPERATURE**

- Field-Heat Pull-Down Rate
- Holding Temperature

- **RELATIVE HUMIDITY**

- Adding and Removing Vapor

- **AIR MOVEMENT**

- Precise Delta-T across the Product
- Ethylene Balance

- **O₂ and CO₂ BALANCE**

- Facilitate Respiration Gas Exchange
- Eliminate O₂ buildup



- **SELLABLE SHELF LIFE**

- Size, Weight and Appearance
- Color, shrivel, crispness

- **RETAINED NUTRITION**

- 80% nutrition retained

- **REDUCED RETAILER SCRAP**

- Reduced decay rate

- **MARKET REPUTATION**

- Known for quality in the home
- Ability to store more days

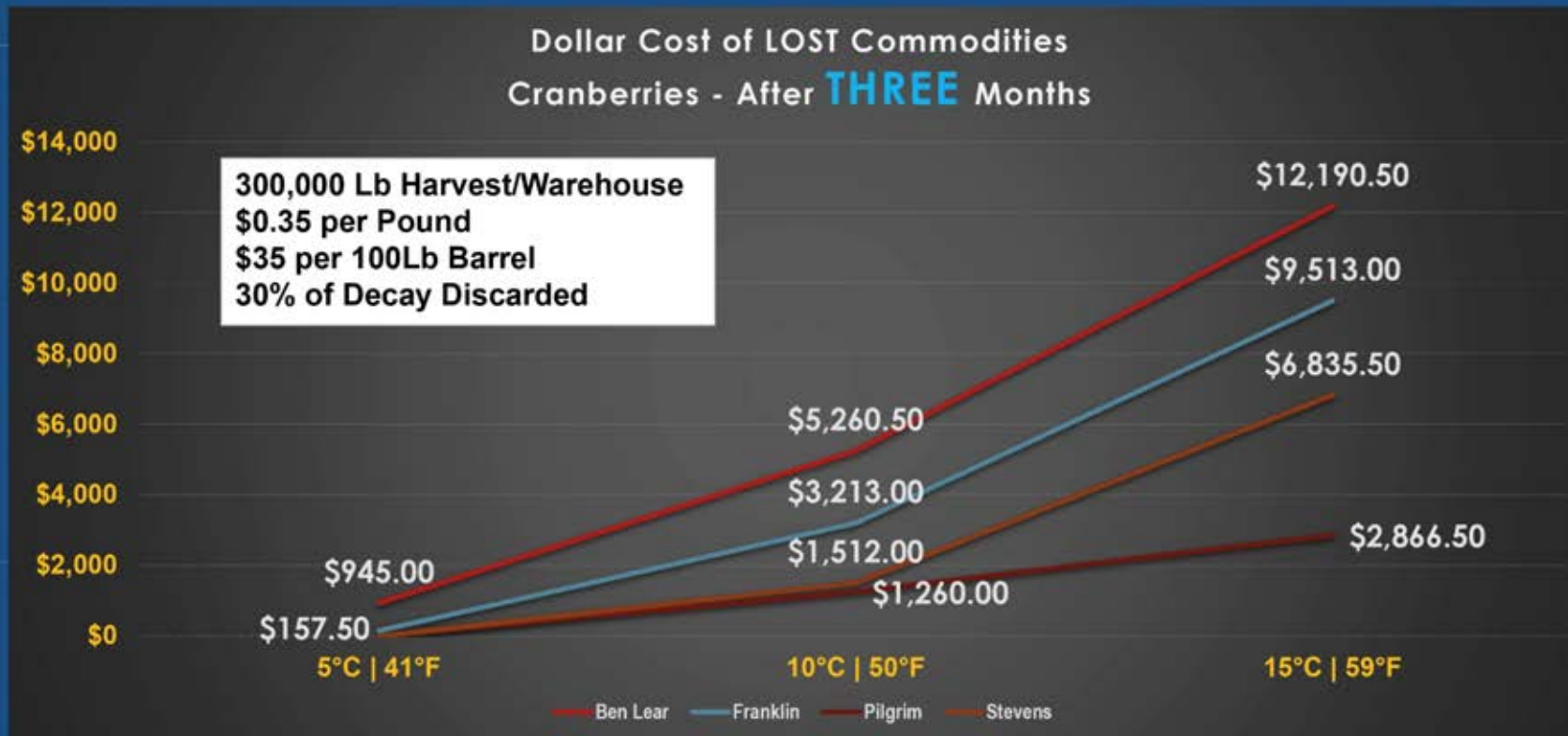
ALLOWS FARMER TO HARVEST AT THE OPTIMUM TIME FOR THE BEST CONSUMER EXPERIENCE

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Decay - Holding Time and Temp

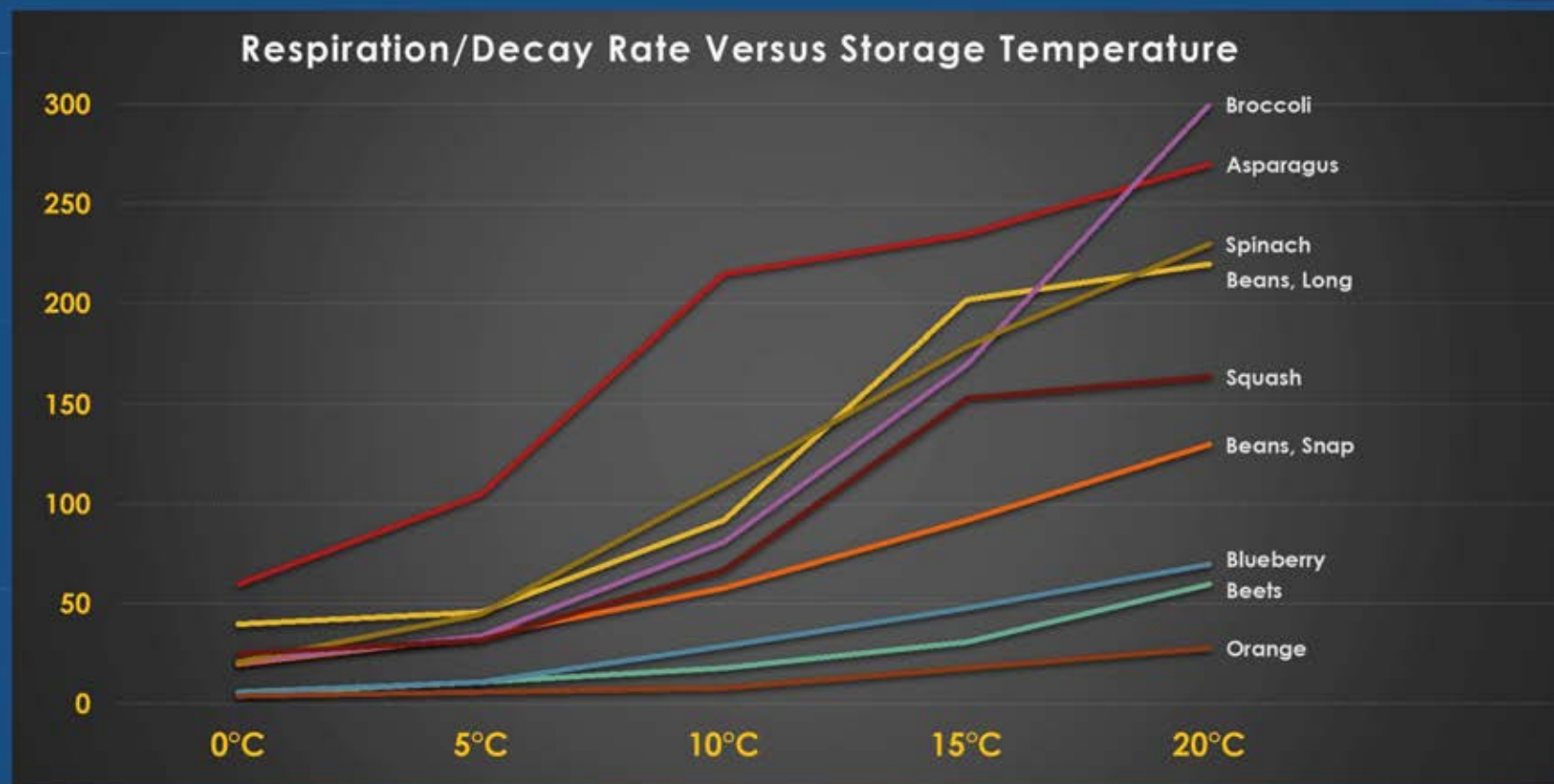


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Cold-Storage Requirements

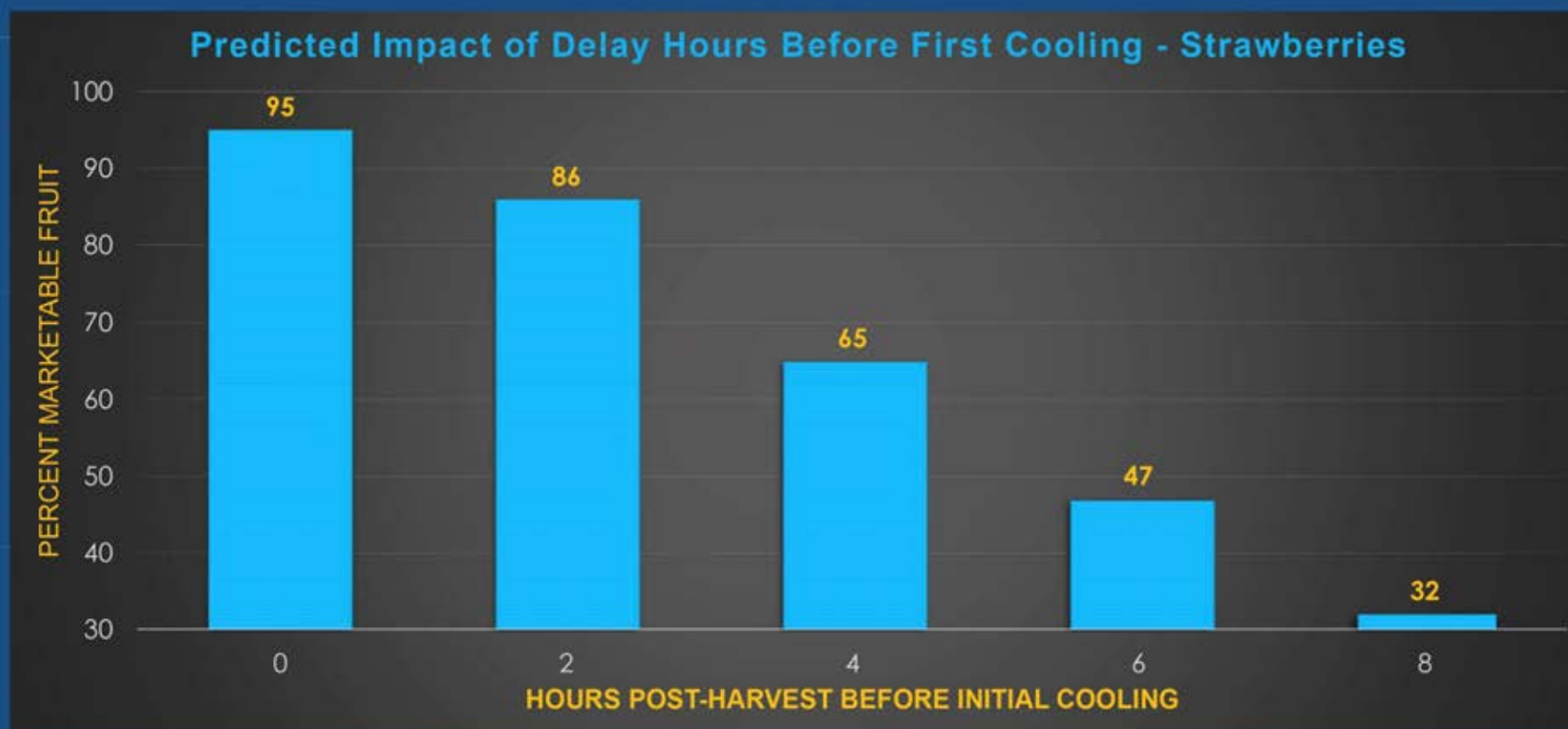


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The High Cost of Cooling Delay



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COLD-STORAGE CALCULATOR MODELED ON USDA FORMULAS

KOOLJET.COM



CUSTOMER NAME
PROJECT NAME
DATE

Progress Food Corp
Asparagus Storage
August 21 2017

COMMODITY

Asparagus Select

Specific Heat of Product
kJ Factor
Average Respiration Day One
Average Respiration Day Two
Respiration at Final Holding Temp

0.86
4.186
14355 kJ/tonne/day
13115 kJ/tonne/day
3660 kJ/tonne/day

STORAGE SIZE

Length
Width
Height
Wall Thickness
Refrigeration Hours Per Day

15 m
15 m
4.5 m
0.3 m
18

INSULATION

Conductivity Value (k)
Coefficient of Transmission (U)

1.3 kJ
1.1 U-Value

AMBIENT TEMPERATURE
PRODUCE TEMPERATURE

Harvest Temp
Final Storage Temp
Storage Temp Target - First Day

30 °C
25 °C
2 °C
10 °C

HARVEST SIZE

Total Harvest
Per-Day for Cooling

300000 kg
100000 kg

HARVEST BINS

Total Quantity of Bins
Weight of Bins, each
Bin Material
Specific Heat of Bins

600
63.5 kg
Wood
0.5

Per Day

AIR CHANGES

During Harvest
During Storage

6 per day
2 per day

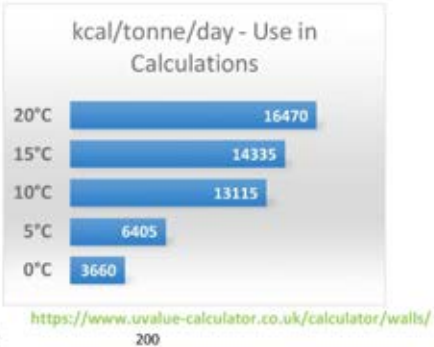
OTHER HEAT LOADS

Lights, Total Watts
Fans, Total HP
Fan Hours/Day
Electric Forklift Quantity
Forklift Hours/Day
Harvest Workers, Quantity
Harvest Workers, Hours per Day
Storage Workers, Quantity
Storage Workers, Hours per Day

2400 Watts
3
24
1
8
2
8
1
4

Light during Worker Hours

USDA DATA			
Recommended Storage Temp		2°C	
Recommended Humidity		95%	
Product Specific Heat		0.94	
USDA Page Ref		Page 211	
		61	
Respiration kcal/tonne/dt		CO2/kg/h	
0°C	3660	60	
5°C	6405	105	
10°C	13115	215	
15°C	14335	235	
20°C	16470	270	
CONTROLLED ATMOSPHERE		5 to 10% CO2	
Minimum Oxygen for Product		Above 10%	
Ethylene Production		2.6 (20°C)	
Thermal Treatment		HWT, 47°C, 2-5 Min	



COLD STORAGE CALCULATIONS

Storage Room External Surface, Sq. m	720	Product:	Asparagus	Ambient:	30
Storage Room Internal Volume, m3	972	Harvest:	300,000	Storage:	2°C

BUILDING TRANSMISSION HEAT LOAD	532,224
AIR CHANGE HEAT LOAD	434,665
FIELD-HEAT REMOVAL LOAD - DAY ONE	
Product	5,399,940
Bins	398,717
PRODUCT HEAT LOAD - DAY TWO	
Product	2,879,968
Bins	212,649
HEAT OF RESPIRATION - VITAL HEAT DAY ONE	1,435,500
HEAT OF RESPIRATION - VITAL HEAT DAY TWO	1,311,500
TRANSITION ACCUMULATED HEAT DURING LOAD	366,000
LIGHT FIXTURE HEAT	69,120
FAN MOTOR HEAT	224,064
FORKLIFT HEAT	295,360
WORKER HEAT	16000

TOTAL HEAT LOAD DURING FIELD-HEAT REMOVAL, kJ/24 hours:	13,209,706 kJ / 24 hours
Building Transmission	532,224
Air Change	434,665
Product Cooling	8,891,273
Product Respiration	2,747,000
Operations	604,544

TONS OF REFRIGERATION REQUIRED DURING HARVEST 58.2 Tons

HEAT LOAD DURING STORAGE MODE	1,922,604 kJ / 24 hours
Building Transmission	532,224
Air Change	29,756
Product Cooling	1,098,000
Product Respiration	0
Operations	262624

TONS OF REFRIGERATION REQUIRED DURING STORAGE 8.4 Tons

USDA CONTROLLED ATMOSPHERE:	5 to 10% CO2
Minimum Oxygen Level:	Above 10%
Ethylene Production Rate:	2.6 (20°C)
Thermal Treatment Regime:	HWT, 47°C, 2-5 Min



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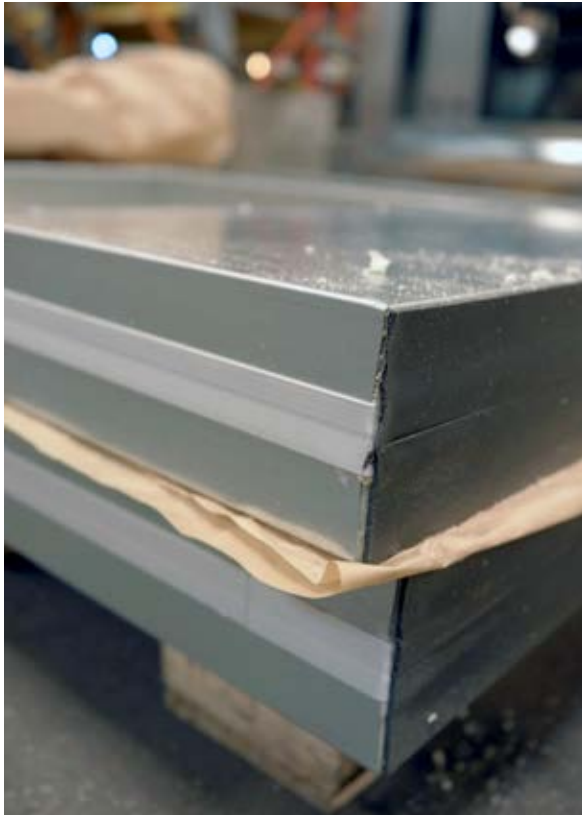
**DUAL INTERLEAVED CIRCUITS
CLOSER APPROACH TEMP
BEST ENERGY EFFICIENCY
REDUNDANT CAPACITY**





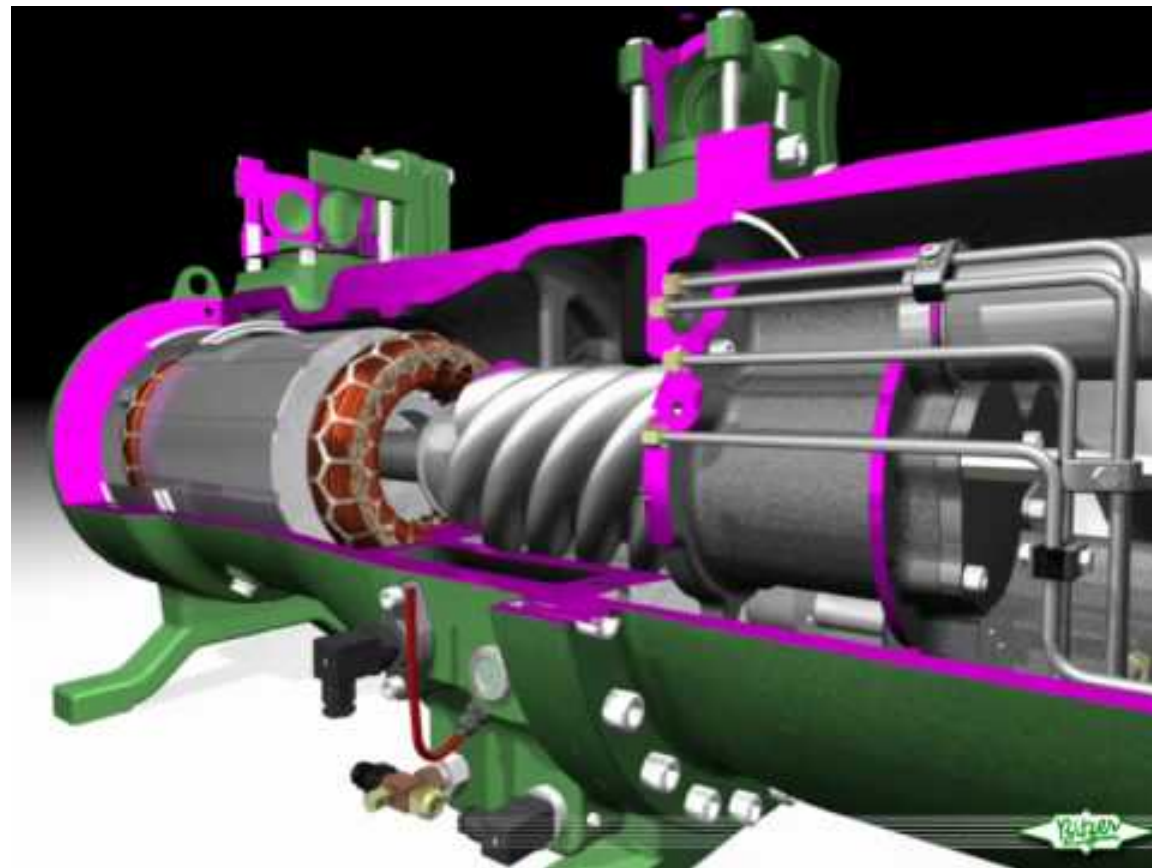
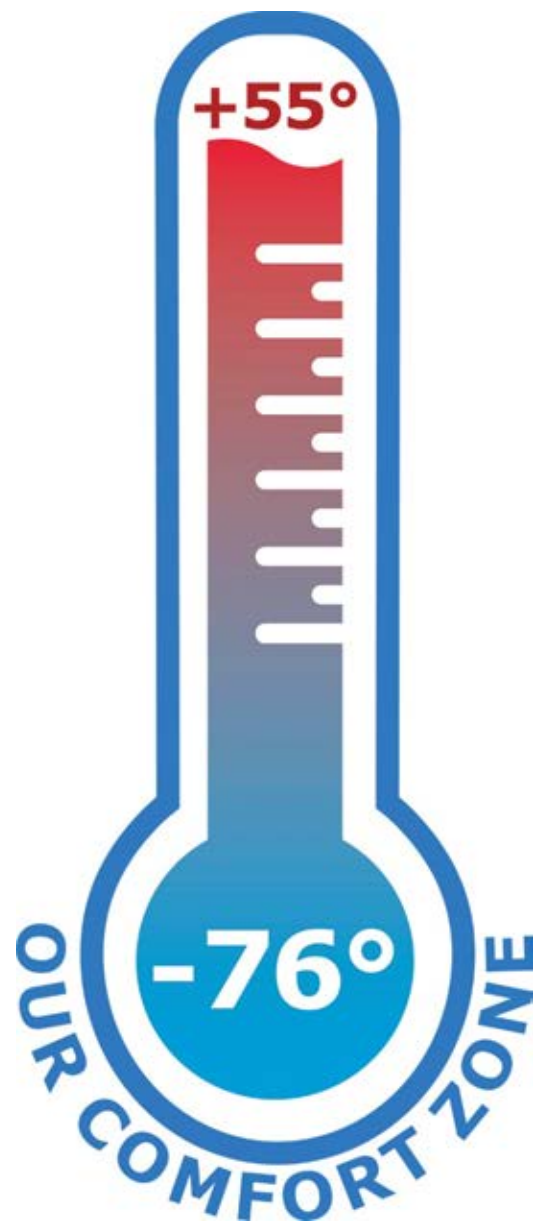
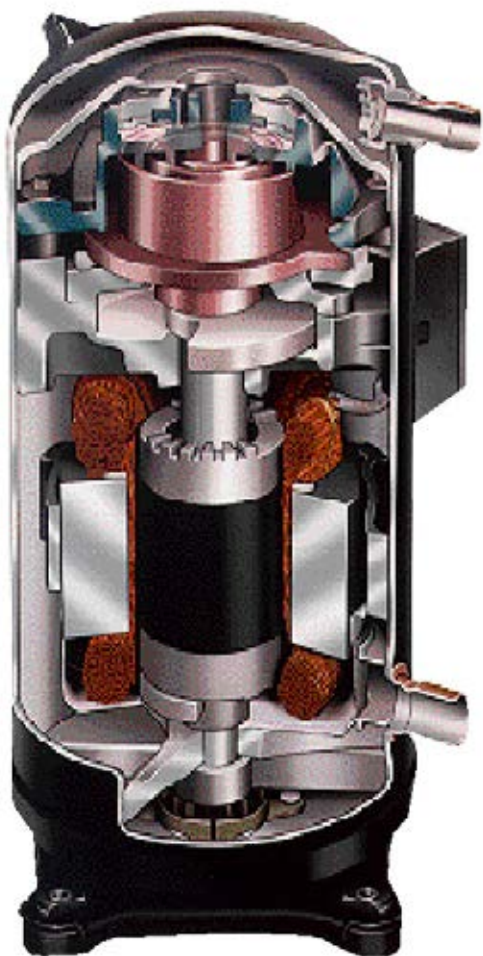
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STAINLESS STEEL DRIP PAN





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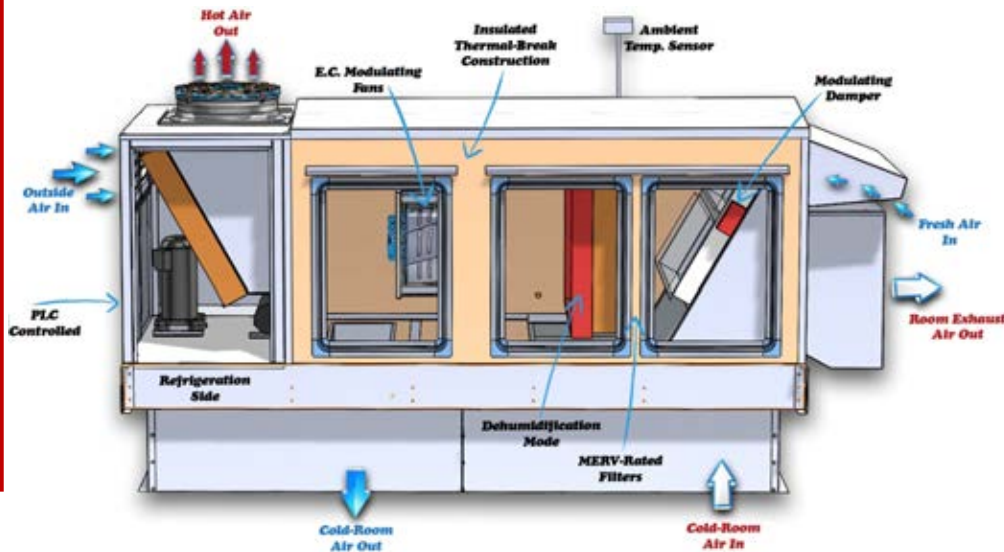


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COIL COATINGS
ANTI-CORROSION
RESIST CHLORIDES





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