System 003 - Site 501534, Canby OR

Site 501534 is a grocery store located in Canby, OR. There are seven refrigeration circuits that have been monitored. Circuits 1 and 2 (medium temperature Rack 1) and Circuit 3 (low temperature Rack 2) were installed in the 1990s. Circuits 4 and 5 are new medium and low temperature racks, respectively, installed more recently. Circuits 6 and 7 are medium temperature circuits, each with one compressor. Circuits 1, 2 and 3 share a single Emerson E2 refrigeration system controller. Control system information was not available for Circuits 4 to 7.

Circuit 3, Low Temperature, Split Suction Rack 2

Circuit 3 (Rack 2) is a low temperature multiplex system with R404a, four compressors (200 MBH total capacity) and 167 MBH total design load located in Canby, OR. The discharge line has a desuperheater that recovers heat from the hot discharge gas to heat hot water and decrease the gas temperature before entering the condenser, increasing refrigeration efficiency. The compressors cycle to maintain a suction pressure setpoint and evaporative midpoint temperature.

This system uses a Tyler "Enviroguard" refrigerant control system to balance the refrigerant and achieve subcooling. The Enviroguard system allows for liquid storage in a "contingency receiver" when very hot conditions occur. Overflow liquid refrigerant is metered through a heat exchange coil at the discharge manifold and returned back to the suction manifold, bypassing evaporator coils.

Table 1. Measured data on Circuit 3

Measured Data	Variable Name(s)	Point Number
Outdoor Temperature	TT_OUTDOOR	--
Discharge Temperatures after Compressors 1 to 4	MISC1 to MISC4	2
Common Discharge Temperature, Before Enviroguard coil	TT_RCOMP_OUT	2
Common Discharge Temperature, After Enviroguard coil	AI_X11	--
Compressor Suction Temperatures	MISC7 to MISC10	1
Compressor Power, Comp 1 to 4	EP_COMP	--
Low Pressure, Suction Manifold	PT_RLP	1
High Pressure, Discharge Manifold	PT_RHP	2
Temperature in Enviroguard charge balancing loop after capillary tube	AI_X12	--
Condenser Entering Temperature	TT_RCOND_IN	--
Condenser Fan Power	EP_AUX_SECW	--
Liquid Line Temperature entering expansion device	TT_REXP_IN	7

Table 2. Calculated values on Circuit 3

Calculated/Derived Values	Variable Name	Measured Temperatures Used in Calculations	Point Number/ Process
Isentropic Compressor Efficiency	COMP_EFF_ISEN	Discharge and suction manifold conditions	1 to 2
Condensing Temperature	RHP_TCOND_MID	Dew point and bubble point temperatures at PT_RHP	c
Evaporator Temperature	RLP_TEVAP_MID	Dew point and bubble point temperatures temperature at PT_RLP	e
Desuperheater Capacity	RCAP_DESUPERHEAT	AI_X11*, TT_RCOND_IN	--
Heating COP	RCOP_HEAT	TT_RCOND_IN, TT_REXP_IN, Discharge and suction manifold conditions	3 to 6
Condenser Capacity	RCAP_HEAT_COND	TT_RCOND_IN, TT_REXP_IN	
Heating Capacity	RCAP_HEAT	TT_RCOND_IN, TT_REXP_IN	
Cooling COP	RCOP_COOL	TT_REXP_IN, Discharge and Suction conditions	8 to 1
Cooling Capacity	RCAP_COOL	TT_REXP_IN, Suction conditions	
Subcooling	RSUBCOOL	TT_REXP_IN, , Bubble point temperature at PT_RHP	5 to 7
Superheat	RSUPERHEAT	Suction temperatures, , Dew point temperature at PT_RLP	9 to 1

Figure 1. Pressure-enthalpy diagram for basic refrigeration cycle, neglecting pressure losses.

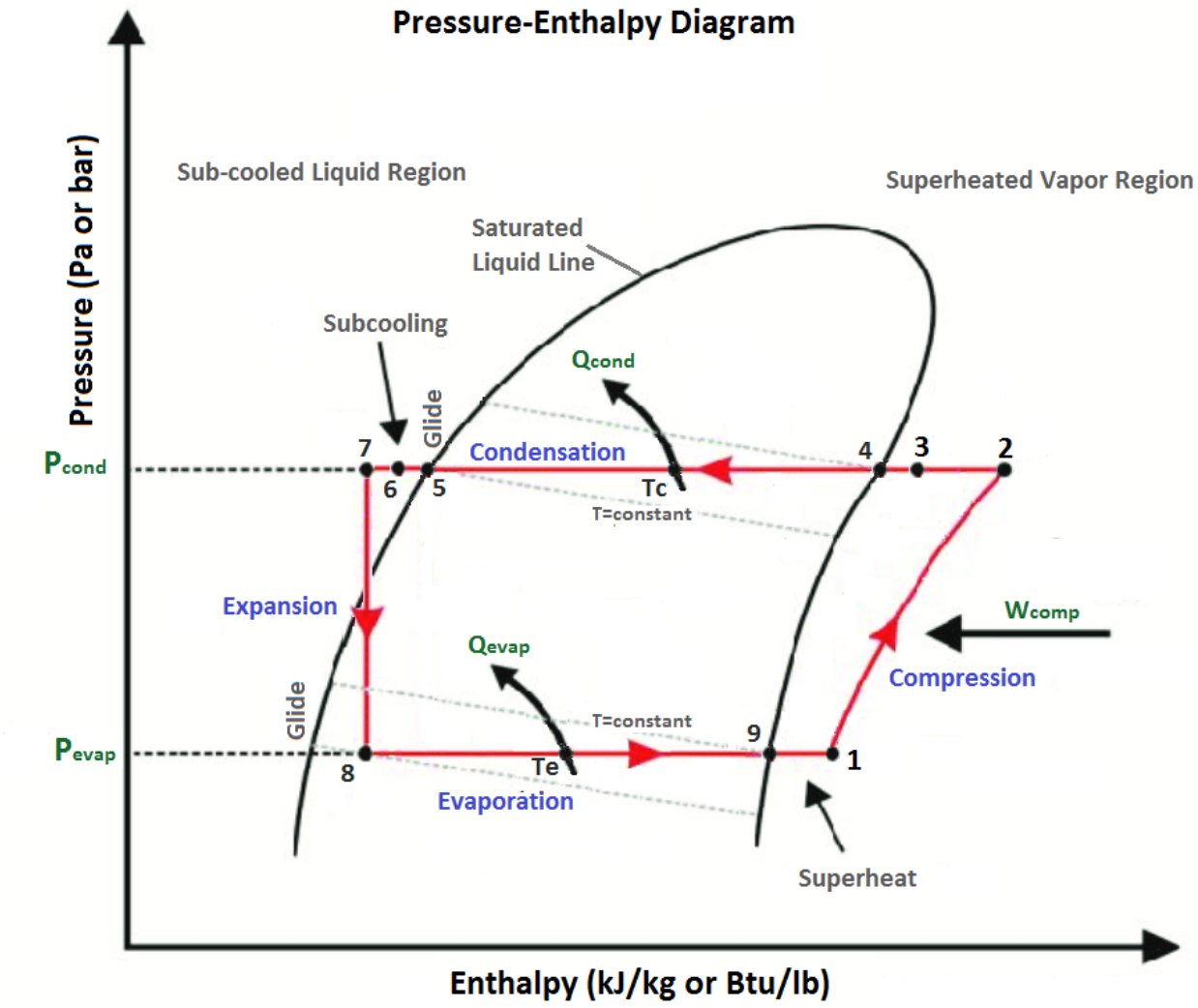

Figure 2. Circuit 3 ClimaCheck system diagram

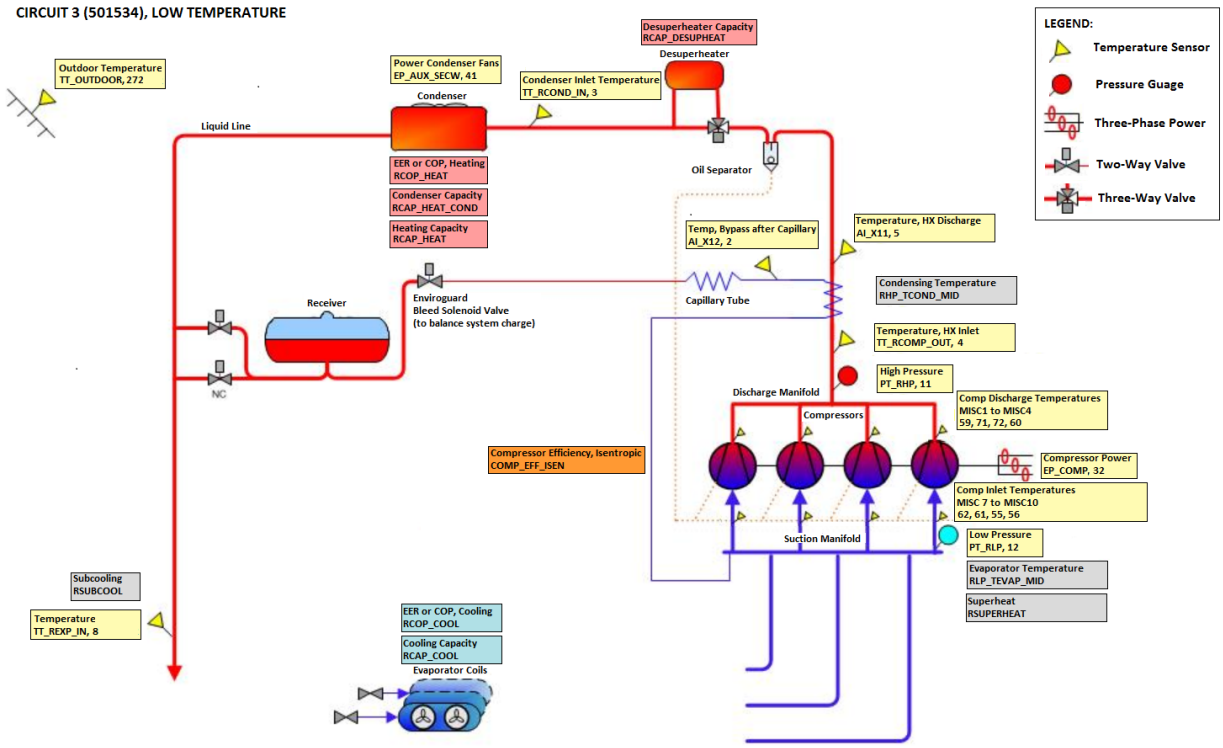

Table 3. Compressor design data, Circuit 3

COMPRESSOR DATA, Low Temperature, Circuit 3, Rack 2			
Compressor Model Number	**Capacity (Btu/h)**	**Total Heat of Rejection * (Btu/h)**	**Type**
SPLIT SUCTION RACK "2" @-23 R-404A			
3DB3-0750	35,258	56,824	RECIP
3DS3-1000	46,780	75,915	RECIP
4DT3-2200	79,715	128,825	RECIP
SPLIT SUCTION RACK "2" @-30 R-404A			
3DS3-1000	38,400	64,575	RECIP
CAPACITY:	200,153		

Total heat of rejection (THR) is the heat rejected by refrigeration system compressors at design conditions, consisting of the design cooling capacity plus the heat of compression added by the compressors.

Table 4. Case descriptions and design parameters, Circuit 3

	Case Descriptions, Low Temperature Circuit 3, Rack 2								Design parameters		
SYS	**SYSTEM DESCRIPTION**	**Line UP**	**L**	**W**	**H**	**Qty**	**Model Number**	**Btu /ft**	**Suct Temp**	**Type**	**Total Btuh**
	SPLIT SUCTION RACK "2" @-23 R-404A										
2-2A	FROZEN FOOD		4		1	5	Tyler D5FG	1560	-16	EL	35,880

2-2B	MEAT END Med Temp				1	1	Hill O5M	1300	+26	OC	2,600
2-3	FROZEN FOOD		2		2	4	Tyler D5FG	1560	-16	EL	23,400
2-4	FROZEN FOOD		4		1	5	Tyler D5FG	1560	-16	EL	35,880
2-5A	BAKERY FREEZER		8	8					-25	EL	8,000
2-5B	GROCERY FREEZER		10	8	8				-25	EL	19,300
2-6	DELI FREEZER		14	24	9				-20	EL	8,000
	SPLIT SUCTION RACK "2" @-30 R-404A										
2-7	ICE CREAM		8	9	8	1	Bohn LET-120	1800	-23	EL	21,600
2-8	ICE CREAM FREEZER		2		1	3	Tyler D5FG		-30	EL	13,100
							TOTAL SPLIT SUCTION LOAD=				167,760