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Covered Processes - Hybrid Condensers

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Pre-Rulemaking Workshop
Hearing Room B
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Acknowledgements

California Utilities Statewide Codes and Standards Team

and

CASE Team

- Doug Scott (VaCom)
- Trevor Bellon (VaCom)
- Catherine Chappell (TRC)

Background

- 2008 Building Energy Efficiency Standards
  - Refrigerated Warehouses
  - Condensing temperatures specific to condenser type
    - Evaporative cooled
    - Air cooled
  - Variable speed condenser fans
  - Split Capacitor or electronically commutated motors

Background

- 2013 Building Energy Efficiency Standards
  - Refrigerated Warehouses
  - Changes to condenser requirements
    - Removed the split capacitor/electronically commutated motor requirement
    - Added condensing temperature reset requirements
    - Added condenser specific efficiency
    - Added minimum fin density

Background

- 2013 Building Energy Efficiency Standards
  - Expanded the covered process section in 120.6
  - Commercial refrigeration
    - Similar condenser requirements as refrigerated warehouses
    - Differences in specific condenser efficiency
    - The CASE team discussed including hybrid condensers
      - Limited product information to determining cost and energy savings

Background

- 2016 Building Energy Efficiency Standards
  - No changes to sections 120.6 a or b
  - Industry issues
    - Rise in hybrid condenser use
      - Large water savings compared with evaporative condensers
      - Large kW savings and potential kWh savings compared to air-cooled condensers
    - How does the condenser requirements apply to hybrid condensers?

Current Industry Practice

Commercial Refrigeration

- Both air-cooled and evaporative condensers used throughout California with some use of hybrid condensers beginning with market entry ~5 years ago
- Increase in transcritical CO_2 system installations employing air- cooled gas coolers or hybrid gas coolers

Refrigerated Warehouses

- Historic use of only evaporative condensers for ammonia systems
- Recent interest in air cooled systems to reduce water use and cost

Proposed Code Change

- Description of change
  - Add hybrid condensers in addition to current requirements for air cooled and evaporative condensers
  - Include CO_2 as a refrigerant
    - Include current condenser requirements (minimum SCT, variable speed fans, variable setpoint) during subcritical operation
    - Exemption from condenser sizing and specific efficiency requirements

Proposed Code Change

- CASE Team analysis
  - Prototypes used
    - Large Supermarket (60,700 ft^2)
    - Small Refrigerated Warehouse (26,000 ft^2)
    - Large Refrigerated Warehouse (92,000 ft^2)
  - Condensing temperature (SCT) set point control logic
    - Option A: reset SCT set point based on drybulb temperature, independent of mode of operation
    - Option B: reset SCT set point based on drybulb temperature with fixed 70F SCT during adiabatic operation
    - Option C: reset SCT set point based on pre-coil inlet air (i.e. after adiabatic pads)
  - Maximum dry mode TD (sizing) requirement
  - Minimum dry mode specific efficiency requirement

Proposed Conditions Compared to the Hybrid Condenser Base Case

Variable	Base Case	Variable SCT Setpoint	Dry Mode Sizing	Dry Mode Minimum Specific Efficiency
Condensing Temperature Reset	70F Fixed SCT	**Option A:** Drybulb both wet and dry mode) **Option B:** Drybulb (dry mode); Fixed 70F SCT (adiabatic mode) **Option C:** Condenser Inlet Air (independent of operation mode)	Same as Base Case	Same as Base Case
Rating Temperature Difference (TD)	10 TD (dry mode) 30 TD (wet mode)	Same as Base Case	Varies from 12°F LT/18°F MT to 24°F LT/36°F MT (dry mode)	Same as Base Case
Minimum Efficiency	35 Btuh/W (ammonia) 45 Btuh/W (halocarbon)	Same as Base Case	Same as Base Case	Comparing values from 25 Btuh/W to 65 Btuh/W

Analysis Results SCT

- All three SCT conditions achieved TDV Energy savings compared to base case.
- Proposed code language is based on Option B to ensure that the code does not inhibit innovation for control in precool mode
  - Variable setpoint in dry mode (same as current air-cooled)
  - Fixed setpoint in wet mode
    - Multiple methods of optimizing adiabatic condenser in wet mode
    - Methods are still evolving

Annual Energy Savings Per SF, Variable SCT Setpoint

Climate Zone	LSM (60,700SF)		SRWH (26,000SF)		LRWH (92,000SF)	
	TDV Energy Savings (TDV kBtu/yr)	15 Year TDV Energy Cost Savings ($2020)	TDV Energy Savings (TDV kBtu/yr)	15 Year TDV Energy Cost Savings ($2020)	TDV Energy Savings (TDV kBtu/yr)	15 Year TDV Energy Cost Savings ($2020)
1	0.57	$0.05	(0.95)	($0.08)	(24.56)	($2.19)
3	10.81	$0.96	14.75	$1.31	(11.91)	($1.06)
5	10.72	$0.95	16.05	$1.43	(10.47)	($0.93)
7	37.76	$3.36	62.37	$5.55	34.77	$3.09
8	22.97	$2.04	31.67	$2.82	19.16	$1.70
10	11.61	$1.03	17.88	$1.59	11.39	$1.01
12	9.15	$0.81	7.05	$0.63	(7.16)	($0.64)
13	8.63	$0.77	9.94	$0.88	10.54	$0.94
14	2.61	$0.23	(3.43)	($0.31)	(5.64)	($0.50)
15	4.23	$0.38	2.90	$0.26	21.08	$1.88

Lifecycle Cost Effectiveness, Variable SCT Setpoint

CZ	LSM			SRWH			LRWH		
	TDV Energy Cost Savings ($2020)	IC $2020	B/C Ratio	TDV Energy Cost Savings ($2020)	IC $2020	B/C Ratio	TDV Energy Cost Savings ($2020)	IC $2020	B/C Ratio
1	$3,052.70	$867	3.5	($2,207.20)	$867	0.00	($201,077.70)	$867	0.00
3	$58,384.00	$867	67.3	$34,131.50	$867	39.44	($97490.60)	$867	0.00
5	$57,921.20	$867	66.8	$37,148.60	$867	42.88	($85,689.20)	$867	0.00
7	$204,005.80	$867	235.2	$144,322.40	$867	166.44	$284,693.20	$867	328.33
8	$124,092.70	$867	143.1	$73,282.60	$867	84.55	$156,853.60	$867	180.99
10	$62,727.20	$867	72.3	$41,385.00	$867	47.77	$93,263.10	$867	107.55
12	$49,421.70	$867	57.0	$16322.60	$867	18.88	($58,624.30)	$867	0.00
13	$46,609.30	$867	53.7	$22,997.60	$867	26.55	$86,276.60	$867	99.55
14	$14,124.30	$867	16.3	($7938.80)	$867	0.00	($46,146.50)	$867	0.00
15	$22,855.20	$867	26.4	$6,701.70	$867	7.77	$172,588.80	$867	199.00

Analysis Results, Condenser Sizing

- Various Condenser sizes were used in the analysis
  - 12ºF low temperature (LT) / 18ºF medium temperature (MT)
  - 16ºF low temperature (LT) / 24ºF medium temperature (MT)
  - 18ºF low temperature (LT) / 27ºF medium temperature (MT)
  - 20ºF low temperature (LT) / 30ºF medium temperature (MT)
  - 24ºF low temperature (LT) / 36ºF medium temperature (MT)
- LSM
  - CZ 7,8,10,12,13,14,15 – TDV Energy savings range from -18.941 and 9.97 $kBtu/yr/ft^2$
  - CZ 1, 3 and 5 – TDV Energy savings range from -9.19 and 1.68 $kBtu/yr/ft^2$
- SRWH
  - CZ 7,8,10,12,13,14,15 – TDV Energy savings range from -43.69 and 16.02 $kBtu/yr/ft^2$
  - CZ 1, 3 and 5 – TDV Energy savings range from -50.5 and 0 $kBtu/yr/ft^2$
- LRWH
  - CZ 7,8,10,12,13,14,15 – TDV Energy savings range from -20.14 and 22.87 $kBtu/yr/ft^2$
  - CZ 1, 3 and 5 – TDV Energy savings range from 0 and 53.67 $kBtu/yr/ft^2$

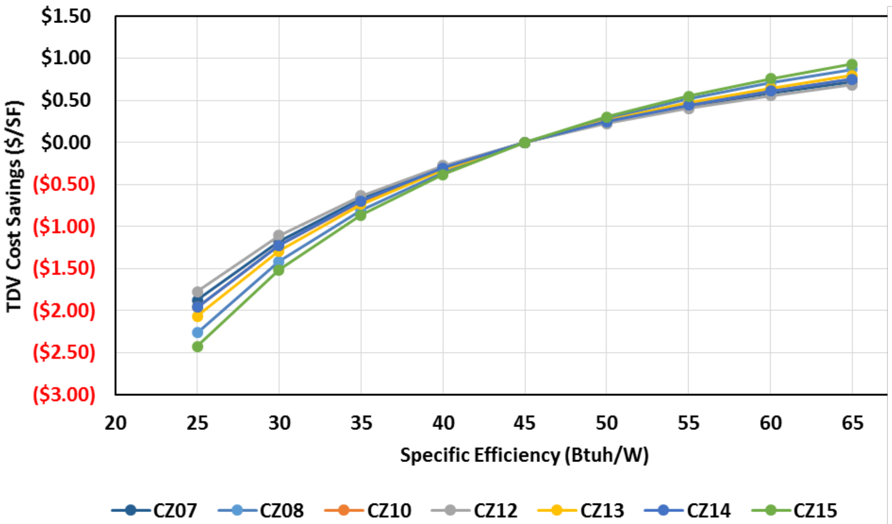
Incremental Cost for Dry-mode Sizing

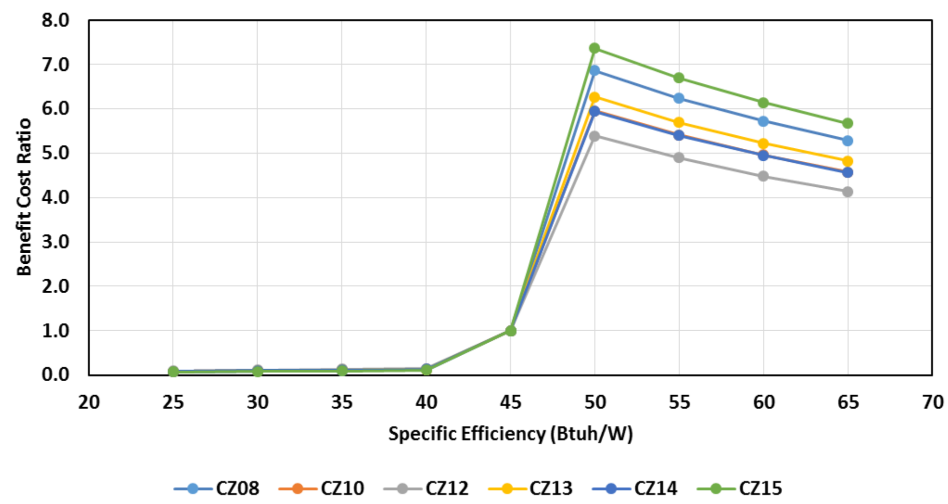
LSM				
Rated TD (LT,MT)	THR (MBH)	MBH/˚F	$/MBH/˚F	**First cost (2020$)**
12,18	1920	114.08	$127.90	**$145,918.55**
16,24	1920	85.56	$127.90	**$109,438.92**
18,27	1920	76.04	$127.90	**$97,259.77**
20,30	1920	68.45	$127.90	**$87,551.13**
24,36	1920	57.02	$127.90	**$72,937.61**
SRWH				
Rated TD (LT,MT)	THR (MBH)	MBH/˚F	$/MBH/˚F	**First cost (2020$)**
12,18	1981	114.08	$127.90	**$150,554.51**
16,24	1981	85.56	$127.90	**$112,915.88**
18,27	1981	76.04	$127.90	**$100,349.80**
20,30	1981	68.45	$127.90	**$90,332.71**
24,36	1981	57.02	$127.90	**$75,254.90**
LRWH				
Rated TD (LT,MT)	THR (MBH)	MBH/˚F	$/MBH/˚F	**First cost (2020$)**
12,18	6238	114.08	$124.39	**$461,047.67**
16,24	6238	85.56	$124.39	**$345,785.75**
18,27	6238	76.04	$124.39	**$307,304.25**
20,30	6238	68.45	$124.39	**$276,628.60**
24,36	**6238**	**57.02**	**$124.39**	**$230,455.37**

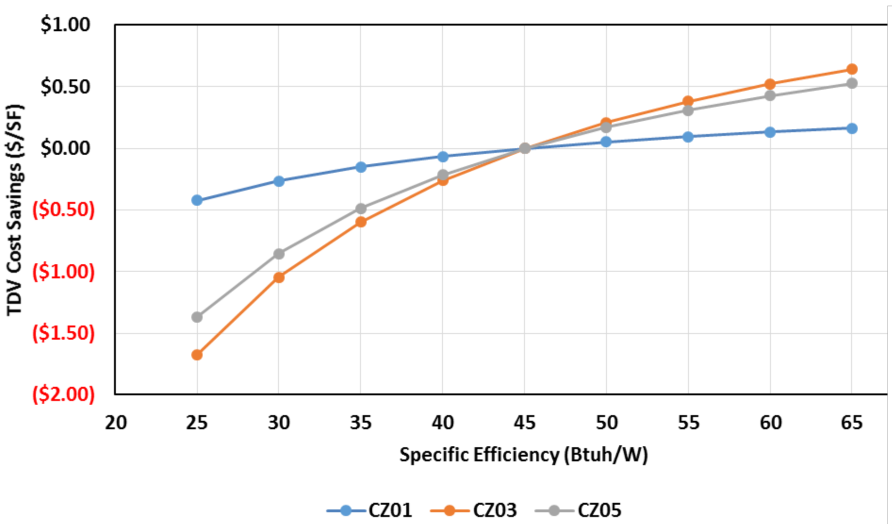
Lifecycle Cost Effectiveness, Condenser Sizing

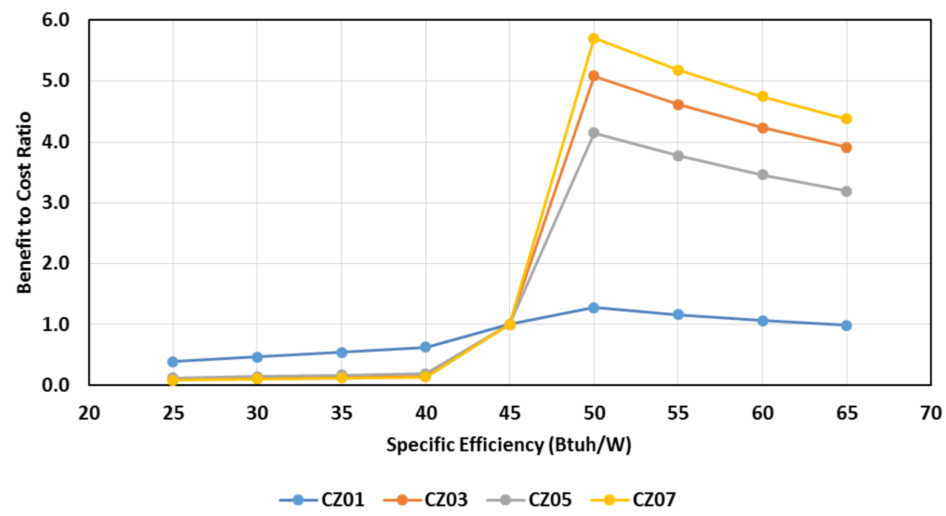
CZ	LSM			SRWH			LRWH		
	TDV Energy Cost Savings ($2020)	IC $2020	B/C Ratio	TDV Energy Cost Savings ($2020)	IC $2020	B/C Ratio	TDV Energy Cost Savings ($2020)	IC $2020	B/C Ratio
1	$162,845	$87,551	1.86	$74,073	$90,333	0.82	$987,564	$276,629	3.57
3	$3,959,938	$87,551	45.23	$99,366	$90,333	1.1	$871,380	$276,629	3.15
5	$431,627	$87,551	4.93	$64,136	$90,333	0.71	$879,679	$276,629	3.18
7	$127,825	$87,551	1.46	$97,559	$90,333	1.08	$276,629	$276,629	1
8	$84,925	$87,551	0.97	$122,853	$90,333	1.36	$276,629	$276,629	1
10	$87,551	$87,551	1	$107,496	$90,333	1.19	$276,629	$276,629	1
12	$87,551	$87,551	1	$90,333	$90,333	1	$522,828	$276,629	1.89
13	$87,551	$87,551	1	$90,333	$90,333	1	$276,629	$276,629	1
14	$119,070	$87,551	1.36	$131,886	$90,333	1.46	$508,997	$276,629	1.84
15	$243,392	$87,551	2.78	$102,979	$90,333	1.14	$484,100	$276,629	1.75

Analysis Results, Condenser Specific Efficiency (LSM)

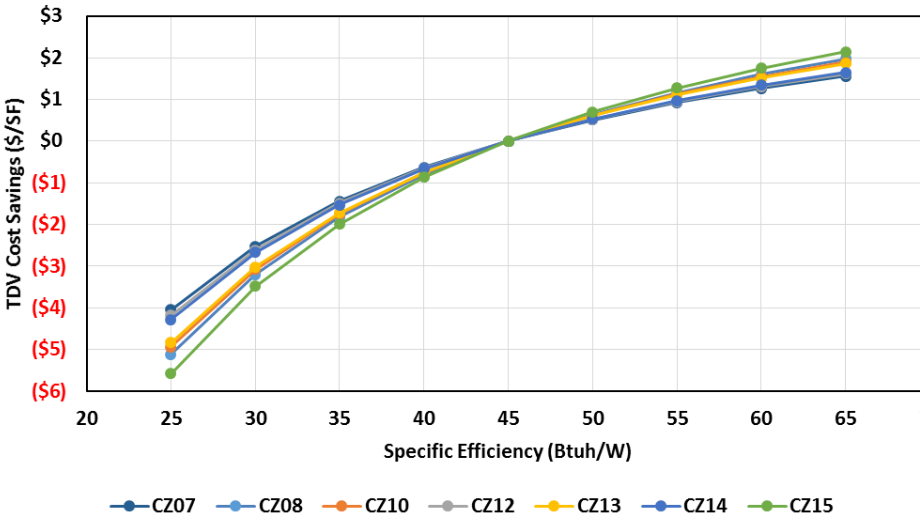


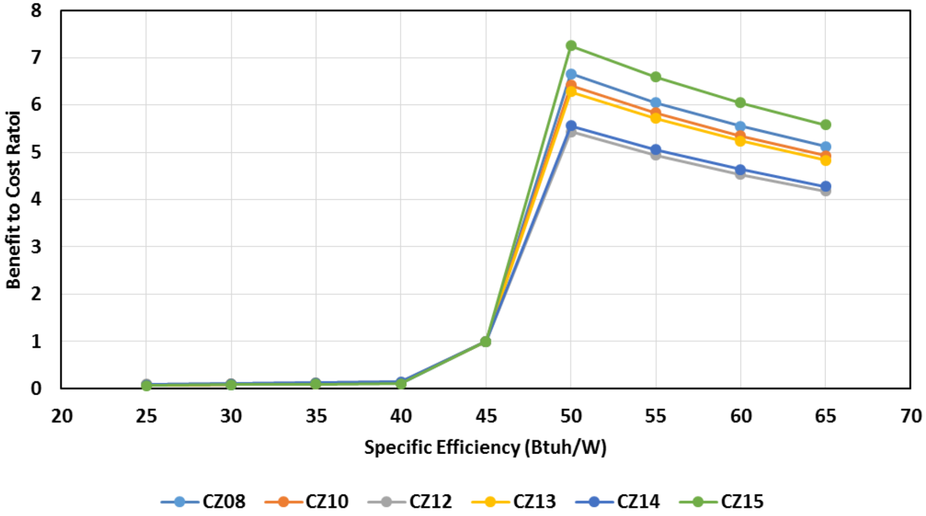


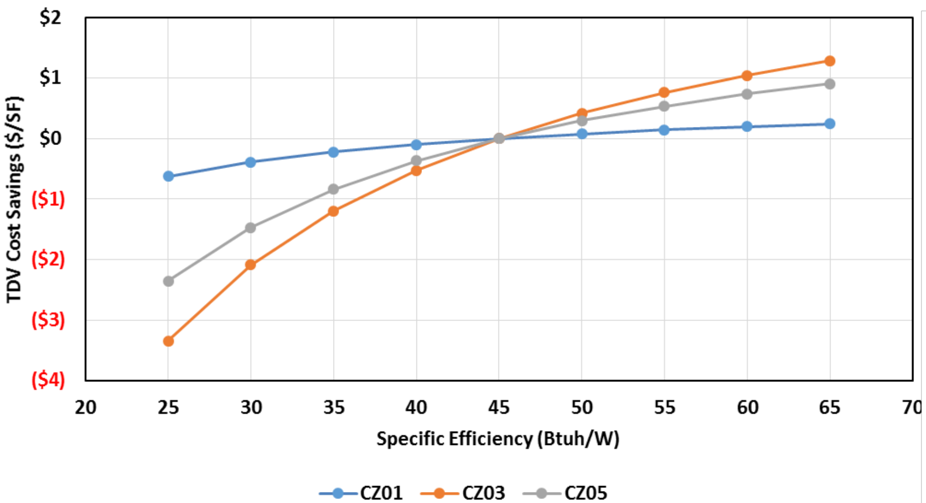


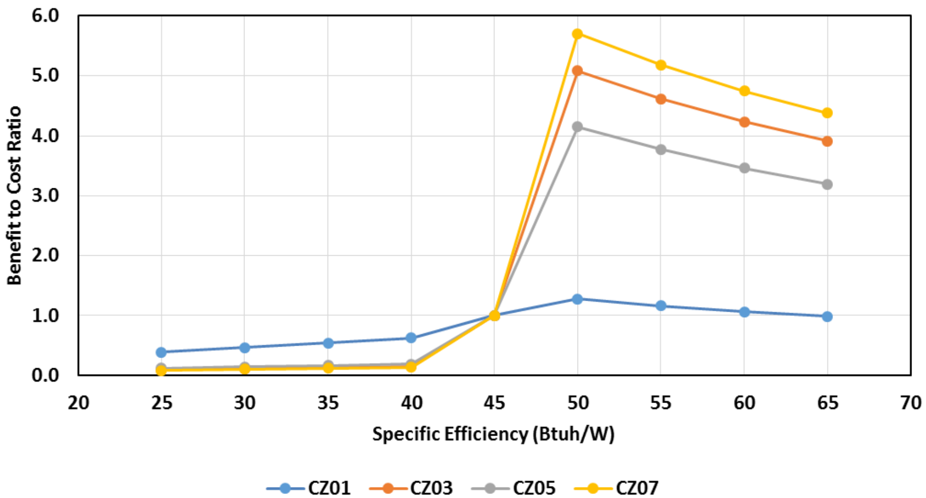


Analysis Results, Condenser Specific Efficiency (SRWH)

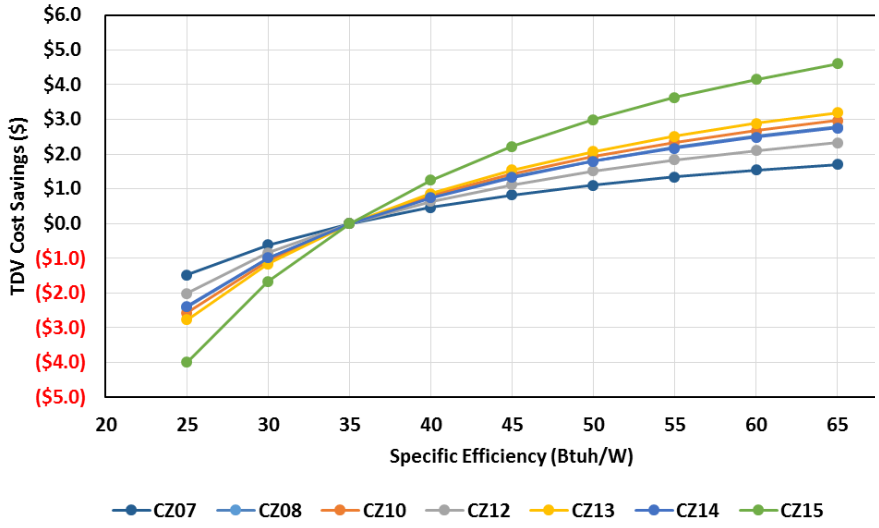


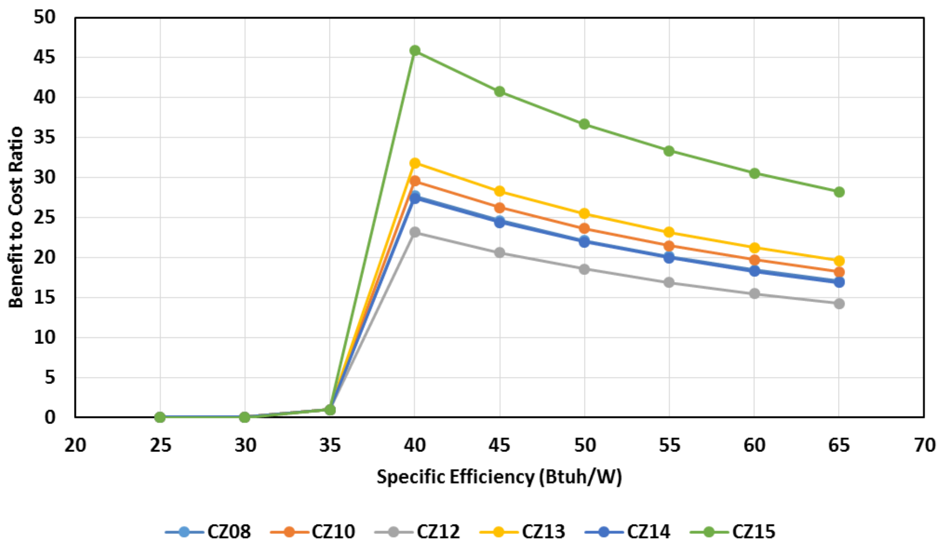


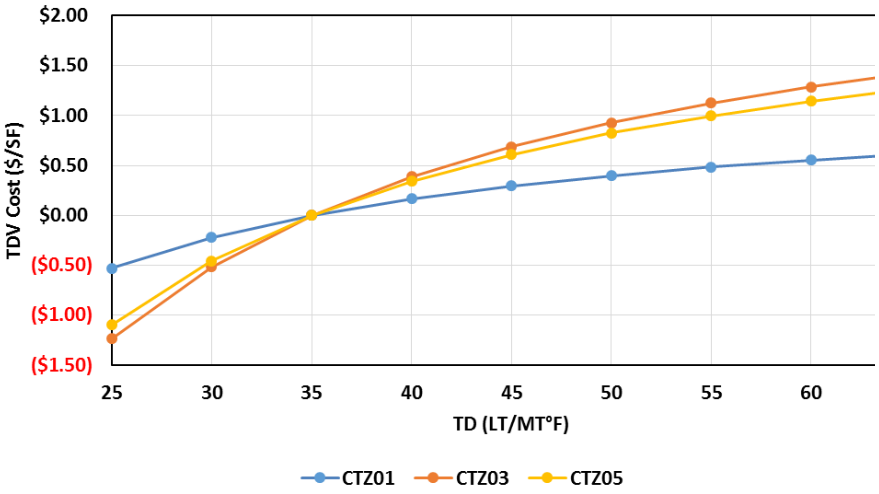


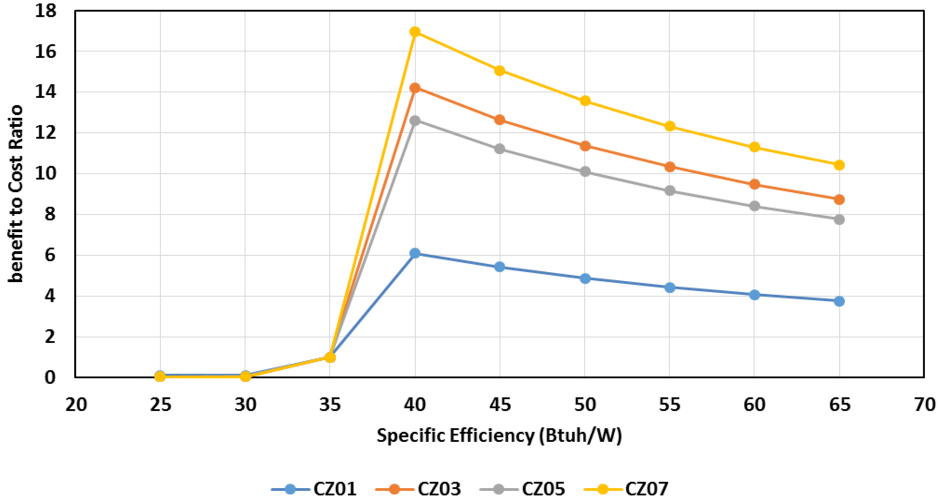


Analysis Results, Condenser Specific Efficiency (LRWH)









Proposed Code Language

6.3 Statewide Material Impacts

There are no statewide material impacts.

6.4 Other Non-Energy Impacts

There are no other impacts.

7. Proposed Revisions to Code Language

The proposed changes to the standards, Reference Appendices, and the ACM Reference Manuals are provided below. Changes to the 2016 documents are marked with underlining (new language) and ~~strikethroughs~~ (deletions).

7.1 Standards

SECTION 101 – DEFINITIONS

CONDENSER is a refrigeration component that condenses refrigerant vapor by rejecting heat to air mechanically circulated over its heat transfer surface.

ADIABATIC CONDENSER is a condenser that has the ability to use two heat transfer processes in series as accomplished by a single factory-made unit. The first heat transfer process is the pre-cooling of the entering air by lowering the entering air drybulb temperature. The second heat transfer process is forced-air circulation cooling over the heat transfer surface of the condenser. Also known as a hybrid condenser.

> DRY MODE is an operating condition of an adiabatic condenser wherein the only means of heat transfer is accomplished through forced-air circulation over the heat transfer surface of the condenser without any pre-cooling of the entering air.
>
> PRE-COOL MODE is an operating condition of an adiabatic condenser wherein the entering air is pre-cooled.

ADIABATIC PAD is a material located before the heat transfer surface of an adiabatic condenser, which precools the ambient air by becoming fully wetted during pre-cool mode operation.

TRANSCRITICAL CO_2 REFRIGERATION SYSTEM is a type of refrigeration system that uses CO_2 as the refrigerant where the ultimate heat rejection to ambient air can take place above the critical point.

> TRANSCRITICAL MODE is a system operating condition for a refrigeration system wherein the refrigerant pressure and temperature leaving the compressor is such that the refrigerant is at or above the critical point. Typically used in reference to CO_2 refrigeration systems.
>
> SUBCRITICAL MODE is a system operating condition for a refrigeration system wherein the refrigerant pressure and temperature leaving the compressor is such that the refrigerant is below the critical point. Typically used in reference to CO_2 refrigeration systems.

CASCADE REFRIGERATION SYSTEM is a type of refrigeration system that uses a low-stage refrigerant where the heat rejected from condensing the low-stage refrigerant is absorbed by a separate high-stage refrigerant, and the ultimate heat rejection to ambient air is accomplished through the separate high-stage refrigerant.

6.3 Statewide Material Impacts

There are no statewide material impacts.

6.4 Other Non-Energy Impacts

There are no other impacts.

7. PROPOSED REVISIONS TO CODE LANGUAGE

The proposed changes to the standards, Reference Appendices, and the ACM Reference Manuals are provided below. Changes to the 2016 documents are marked with underlining (new language) and ~~strikethroughs~~ (deletions).

7.1 Standards

SECTION 101 – DEFINITIONS

CONDENSER is a refrigeration component that condenses refrigerant vapor by rejecting heat to air mechanically circulated over its heat transfer surface.

ADIABATIC CONDENSER is a condenser that has the ability to use two heat transfer processes in series as accomplished by a single factory-made unit. The first heat transfer process is the pre-cooling of the entering air by lowering the entering air drybulb temperature. The second heat transfer process is forced-air circulation cooling over the heat transfer surface of the condenser. Also known as a hybrid condenser.

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>
> **PRE-COOL MODE** is an operating condition of an adiabatic condenser wherein the entering air is pre-cooled.

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TRANSCRITICAL CO_2 REFRIGERATION SYSTEM is a type of refrigeration system that uses CO_2 as the refrigerant where the ultimate heat rejection to ambient air can take place above the critical point.

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>
> **SUBCRITICAL MODE** is a system operating condition for a refrigeration system wherein the refrigerant pressure and temperature leaving the compressor is such that the refrigerant is below the critical point. Typically used in reference to CO_2 refrigeration systems.

CASCADE REFRIGERATION SYSTEM is a type of refrigeration system that uses a low-stage refrigerant where the heat rejected from condensing the low-stage refrigerant is absorbed by a separate high-stage refrigerant, and the ultimate heat rejection to ambient air is accomplished through the separate high-stage refrigerant.

CRITICAL POINT is a thermodynamic state point for pure substances defined by its pressure and temperature wherein the distinction between the liquid phase and gas phase no longer exists.

GAS COOLER is a refrigeration component that reduces the temperature of a refrigerant vapor by rejecting heat to air mechanically circulated over its heat transfer surface.

SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

(a) **Mandatory Requirements for Refrigerated Warehouses**

4. **Condensers**. New fan-powered condensers on new refrigeration systems shall conform to the following:

A. Design saturated condensing temperatures for evaporative-cooled condensers and water-cooled condensers served by fluid coolers or cooling towers shall be less than or equal to:
   i. The design wetbulb temperature plus 20°F in locations where the design wetbulb temperature is less than or equal to 76°F; or
   ii. The design wetbulb temperature plus 19°F in locations where the design wetbulb temperature is between 76°F and 78°F; or
   iii. The design wetbulb temperature plus 18°F in locations were the design wetbulb temperature is greater than or equal to 78°F.

   EXCEPTION 1 to Section 120.6(a) 4A: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

   EXCEPTION 2 to Section 120.6(a) 4A: Transcritical CO2 refrigeration systems.

B. Design saturated condensing temperatures for air-cooled condensers shall be less than or equal to the design drybulb temperature plus 10°F for systems serving freezers and shall be less than or equal to the design drybulb temperature plus 15°F for systems serving coolers.

   EXCEPTION 1 to Section 120.6(a) 4B: Condensing units with a total compressor horsepower less than 100 HP.

   EXCEPTION 2 to Section 120.6(a) 4B: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

   EXCEPTION 3 to Section 120.6(a) 4B: Transcritical CO2 refrigeration systems.

C. The saturated condensing temperature necessary for adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to the design drybulb temperature plus 20°F for systems serving freezers and shall be less than or equal to the design drybulb temperature plus 30°F for systems serving coolers.

   EXCEPTION 1 to Section 120.6(a) 4C: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

   EXCEPTION 2 to Section 120.6(a) 4C: Transcritical CO2 refrigeration systems.

D. All condenser fans for evaporative-cooled condensers or fans on cooling towers or fluid coolers shall be continuously variable speed, and the condensing temperature control system shall control the speed of all fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

EXCEPTION to Section 120.6(a) 4D: Transcritical CO_2 refrigeration systems while operating in transcritical mode.

E. All condenser fans for air-cooled condensers shall be continuously variable speed and the condensing temperature or pressure control system shall control the speed of all condenser fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

EXCEPTION to Section 120.6(a) 4E: Transcritical CO_2 refrigeration systems while operating in transcritical mode.

F. All condenser fans for adiabatic condensers shall be continuously variable speed and the condensing temperature or pressure control system shall control the speed of all condenser fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

EXCEPTION to Section 120.6(a) 4F: Transcritical CO_2 refrigeration systems while operating in transcritical mode.

G. Condensing temperature reset. The condensing temperature set point of systems served by air-cooled condensers shall be reset in response to ambient drybulb temperature. The condensing temperature set point of systems served by evaporative-cooled condensers or water-cooled condensers (via cooling towers or fluid coolers) shall be reset in response to ambient wetbulb temperatures. The condensing temperature set point for systems served by adiabatic condensers shall be reset in response to ambient drybulb temperature while operating in dry mode.

EXCEPTION 1 to Section 120.6(a) 4G: Condensing temperature control strategies approved by the Executive Director that have been demonstrated to provide at least equal energy savings.

EXCEPTION 2 to Section 120.6(a) 4G: Transcritical CO_2 refrigeration systems while operating in transcritical mode.

EXCEPTION 3 to Section 120.6(a) 4G: Systems served by adiabatic condensers in Climate Zones 1, 3, 5, 12, and 14.

H. Fan-powered condensers shall meet the condenser efficiency requirements listed in TABLE 120.6-B. Condenser efficiency is defined as the Total Heat of Rejection (THR) capacity divided by all electrical input power including fan power at 100 percent fan speed, and power of spray/water pumps for evaporative condensers or adiabatic condensers.

EXCEPTION 1 to Section 120.6(b) 4H: Transcritical CO2 refrigeration systems.

EXCEPTION 2 to Section 120.6(b) 4H: Adiabatic condensers with ammonia as refrigerant.

I. Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

EXCEPTION to Section 120.6(a) 4G: Micro-channel condensers

TABLE 120.6-B FAN-POWERED CONDENSERS-MINIMUM EFFICIENCY REQUIREMENTS

CONDENSER TYPE	REFRIGERANT TYPE	MINIMUM SPECIFIC EFFICIENCY*	RATING CONDITION
Outdoor Evaporative-Cooled with THR Capacity > 8,000 MBH	All	350 Btuh/W	100°F Saturated Condensing Temperature (SCT), 70°F Outdoor Wetbulb Temperature
Outdoor Evaporative-Cooled with THR	All	160 Btuh/W	

Capacity < 8,000 MBH and Indoor Evaporative-Cooled			
Outdoor Air-Cooled	Ammonia	75 Btuh/W	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
	Halocarbon	65 Btuh/W	
Adiabatic Dry Mode	Halocarbon	45 Btuh/W	105°F Saturated Condensing Temperature (SCT), 95°F Outdoor Drybulb Temperature
Indoor Air-Cooled	All	Exempt	

(a) **Mandatory Requirements for Commercial Refrigeration**

Retail food stores with 8,000 square feet or more of conditioned area, and that utilize either: refrigerated display cases, or walk-in coolers or freezers connected to remote compressor units or condensing units, shall meet the requirements of Subsections 1 through 4.

1. **Condensers serving refrigeration systems.** Fan-powered condensers shall conform to the following requirements:

A. All condenser fans for air-cooled condensers, evaporative-cooled condensers, adiabatic condensers, gas coolers, air or water-cooled fluid coolers or cooling towers shall be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.

B. The refrigeration system condenser controls for systems with air-cooled condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature.

C. The refrigeration system condenser controls for systems with evaporative-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient wetbulb temperature.

D. The refrigeration system condenser controls for systems with adiabatic condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature while operating in dry mode.

EXCEPTION 1 to Section 120.6(b) 1B, ~~and~~ C, and D: Condensing temperature control strategies approved by the executive director that have been demonstrated to provide equal energy savings.

EXCEPTION 2 to Section 120.6(b) 1B, ~~and~~ C, and D: Transcritical CO_2 refrigeration while operating in transcritical mode.

E. The saturated condensing temperature necessary for adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to the design drybulb temperature plus 20°F for systems serving freezers and shall be less than or equal to the design drybulb temperature plus 30°F for systems serving coolers.

EXCEPTION to Section 120.6(a) 1E: Transcritical CO_2 refrigeration systems.

F. The minimum condensing temperature setpoint shall be less than or equal to 70°F.
G. Fan-powered condensers shall meet the specific efficiency requirements listed in Table 120.6-C.

EXCEPTION to Section 120.6(b) 1G: Transcritical CO_2 refrigeration systems.

TABLE 120.6-C FAN-POWERED CONDENSERS-SPECFIC EFFICIENCY REQUIREMENTS

CONDENSER TYPE	MINIMUM SPECIFIC EFFICIENCY*	RATING CONDITION
Evaporative-Cooled	160 Btuh/W	100°F Saturated Condensing Temperature (SCT), 70°F Entering Wetbulb Temperature
Air-Cooled	65 Btuh/W	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature
Adiabatic Dry Mode	45 Btuh/W (Halocarbon)	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature
*See Section 100.1 for definition of condenser specific efficiency		

7.2 Reference Appendices

Terms will need to be added to JA – Glossary.

The proposed requirements will add a new section to NA7.10.3 to address hybrid condensers.

7.3 ACM Reference Manual

There are no proposed changes to the ACM Reference Manual.

7.4 Compliance Manuals

Subsections 10.5 Commercial Refrigeration and 10.6 Refrigerated Warehouse of Chapter 10 and Chapter 13 of the Nonresidential Compliance Manual will need to be revised.

7.5 Compliance Forms

A new form NRCA-PRC will need to be created to address adiabatic compressor requirements.

8. BIBLIOGRAPHY

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Questions?

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