

ZERO ZONE USER GUIDE TO THE 2017 EPA RETAIL FOOD REFRIGERATION REGULATIONS

Per the EPA: “Retail food refrigeration, or commercial refrigeration, includes equipment designed to store and display chilled or frozen goods for commercial sale. This end-use includes the following categories of equipment: stand-alone equipment, remote condensing units, and supermarket systems.”

Zero Zone acknowledges that the 2017 EPA requirements can be difficult to understand and apply to store design needs. In an effort to sort through all the possibilities, we offer this document which will help you narrow down the available options. A methodical approach is recommended. Four critical steps of the process include:

1. Determine if the system is a **supermarket system** (rack) or **remote condensing unit**.
2. Identify the date it will become **operational**.
3. Determine if it's a **new** or a **retrofit** system.
4. Apply EPA rules to the system design.

Since 1961, Zero Zone has been a leading manufacturer of high quality, energy-efficient refrigerated display cases and commercial and industrial refrigeration systems. All of our display merchandisers are remote cases designed to be connected to individual condensing units, rack systems, or top-mount, field-installed condensing unit kits (Hybrid™ Display Cases). The display case installation should conform to local codes including necessary permits for remote installations. This document is designed for supermarket and related food retailers to help determine the best EPA approved refrigerant to use to suite the retailer's specific goals, based on comparisons of energy efficiency, GWP, refrigerant costs. etc.

Step 1: Determine if the system is a **supermarket system** (rack) or **remote condensing unit**.

EPA **retail food refrigeration** rulemaking focuses on the type of system being installed and not the fixtures themselves. EPA has divided the rule into two categories: **supermarket systems** (rack) and **remote condensing unit systems**. EPA defines **supermarket systems** as having multiple compressors without an attached condenser. EPA defines a **remote condensing unit** as two or less compressors attached to a condenser. According to the EPA:

“The EPA draws a distinction between **supermarket systems** and **remote condensing units** based on the number of compressors in the remote condensing system. **Supermarket systems** generally have more than two compressors arranged in a “rack” whereas **remote condensing units** typically have only one or two compressors **linked** to a single condenser.” [EPA SNAP Regulations Rule 20 Page 42901](#)

It's easy to apply this rule to the small condensing units provided by various manufacturers and traditional rack systems.

- If the compressor is not connected (*linked*) to a condenser at the factory and not shipped as a single unit, it is a **supermarket system** (rack), regardless of the number of compressors.
- If there are one or two compressors, and it is connected (*linked*) to a condenser at the factory and shipped as a single unit, it is a **condensing unit**.
- If it has three or more compressors, it is a **supermarket system** (rack), regardless of being attached (*linked*) or not being attached (*linked*) to a condenser.

Step 2: Identify the date it will become *operational*.

The date that the system is *operational* is the date used to determine which rules apply. For example, if a *supermarket system* (rack) is shipped from a manufacturer on September 1, 2016 and the system is ready for operation: “The EPA will consider a system to be *new* for purposes of these SNAP determinations as of the date upon which the refrigerant circuit is complete, the system can function, the system holds a full refrigerant charge, and the system is ready for use for its intended purposes.” (Page 42903)

If the operational date is after January 1, 2017 the system refrigerant must meet the new EPA guidelines, e.g., no R404a or R507a. If the system was operational before January 1, 2017, but was turned off and then restarted in 2017, the 2016 rules would apply. **The manufacturing date of the equipment does not determine which refrigerant is allowable.**

Step 3: Determine if it’s a *new* or a *retrofit* system.

Expansions to the refrigeration system capacity on existing systems changes them to *new* systems. Systems made operational in 2016, but expanded in 2017 or beyond, will also be considered *new* systems.

“On the other hand, if a supermarket remodel or expansion changes the intended purpose of the original equipment, for instance by adding additional cases, compressors, and refrigerant that were not supported by the original compressor system, EPA would consider the expanded system a *new* system. In that situation, a supermarket would not be allowed to use a refrigerant that was listed as unacceptable as of the date that *new* system was expanded or remodeled, even if the system had been using that refrigerant before the expansion or remodel.” (Page 42903)

The EPA considers a *retrofit* a change in refrigerant, not a change in equipment.

“The EPA uses the term *retrofit* to indicate the use of a refrigerant in an appliance (such as a supermarket system) that was designed for and originally operated using a different refrigerant and does not use the term to apply to upgrades to existing equipment where the refrigerant is not changed.” (Page 42903)

Step 4: Applying EPA rules to the system design.

Specific refrigerant phase-out dates are as follows:

REFRIGERATION AND AIR CONDITIONING - UNACCEPTABLE REFRIGERANTS		
RETAIL FOOD REFRIGERATION	UNACCEPTABLE REFRIGERANTS	FURTHER INFORMATION
Supermarket Systems - RETROFIT	R-404a, R-407b, R-421b, R-422a, R-422c, R-422d, R-428a, R-434a, R-507a Unacceptable As Of: July 20, 2016.	These refrigerants have GWPs ranging from 2,729 to 3,985. Other substitutes will be available for this end-use with lower overall risk to human health and the environment by the status change date.
Remote Condensing Units - RETROFIT	R-404a, R-407b, R-421b, R-422a, R-422c, R-422d, R-428a, R-434a, R-507a Unacceptable As Of: July 20, 2016.	
Supermarket Systems - NEW	HFC-227ea, R-404a, R-407b, R-421b, R-422a, R-422c, R-422d, R-428a, R-434a, R-507a Unacceptable As Of: January 1, 2017.	
Remote Condensing Units - NEW	HFC-227ea, R-404a, R-407b, R-421b, R-422a, R-422c, R-422d, R-428a, R-434a, R-507a Unacceptable As Of: January 1, 2018.	

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A single refrigerant is not the best fit for all applications. The tables below provide comparisons of the different refrigerants. However as a general rule, Zero Zone recommends R448a /R449a or R407a for central rack systems or distributed refrigeration systems. This is based on GWP levels and system efficiency. Discharge temperatures will be higher than with R404a systems and compressors may require additional cooling. Users may want to evaluate the costs of the refrigerants. We'll work with customers to make the best selection for their systems.

For small retail format stores, we are working with manufacturers of small condensing units and evaluating refrigerant choices for these units (that we purchase and resell).

MEDIUM TEMPERATURE PERFORMANCE PARAMETERS												
Refrigerant	Notes	GWP	Mass Flow Rate [lb/s]	Volumetric Capacity [btu/ft ³]	Power [kW]	Cooling COP	Heating COP	EER [btu/w]	Compressor Displacement [ft ³ /min]	Displacement % of R134a	Efficiency % of R134a	Estimated Refrigerant Cost Comparison % of R134a
R448a	ZZ recommended	1273	2.74703	65.836	65.25	2.695	3.695	9.196	151.79	59	95	252
R449a	ZZ recommended	1397	2.79825	68.6	65.72	2.676	3.676	9.13	153.35	60	94	303
R407a	ZZ recommended	1923	2.82132	64.742	65.28	2.694	3.694	9.191	154.35	60	95	146
R450a	alternate refrigerant	547	2.99684	33.592	62.18	2.828	3.828	9.649	297.49	116	99	189
R407c	alternate refrigerant	1624	2.57384	62.629	63.97	2.749	3.749	9.38	159.56	62	97	146
R407f	alternate refrigerant	1674	2.52425	69.446	64.59	2.723	3.723	9.29	143.9	56	96	164
R410a	alternate refrigerant	1924	2.54075	92.172	66.93	2.627	3.627	8.964	108.42	42	92	106
R513a	alternate refrigerant	631	3.2935	41.5	63.97	2.75	3.75	9.38	253.61	99	97	329
R134a	being phased out	1300	2.80613	38.924	61.78	2.846	3.846	9.712	256.74	100	100	100
R404a	being phased out	3943	3.7872	62.199	70.35	2.5	3.5	8.529	160.67	63	88	146
R507a	being phased out	3985	3.93546	63.051	71.12	2.473	3.473	8.437	158.49	62	87	146
AMMONIA	toxic-mildly flammable	0	0.36488	71.512	58.75	2.993	3.993	10.212	139.74	54	105	42
R1234yf	mildly flammable not EPA SNAP approved for supermarket systems	0	3.72113	36.406	65.78	2.673	3.673	9.121	274.49	107	94	2253
R1234ze	mildly flammable not EPA SNAP approved for supermarket systems	1	3.11036	28.521	62.25	2.825	3.825	9.639	350.38	136	99	633
PROPANE	flammable	3	1.49045	54.56	62.87	2.797	3.797	9.544	183.16	71	98	633

NOTES:

Cooling Capacity [btu/hr] = 600,000
 Evaporator Superheat = 10°F
 Compressor Superheat = 10°F

Condenser Subcooling = 0°F
 Volumetric Efficiency = 95%
 Isentropic Efficiency = 70%

LOW TEMPERATURE PERFORMANCE PARAMETERS

Refrigerant	Notes	GWP	Mass Flow Rate [lb/s]	Volumetric Capacity [btu/ft ³]	Power [kW]	Cooling COP	Heating COP	EER [btu/w]	Compressor Displacement [ft ³ /min]	Displacement % of R134a	Efficiency % of R134a	Estimated Refrigerant Cost Comparison % of R134a
R448a	ZZ recommended	1273	0.58163	27.014	21.69	1.622	2.622	5.533	73.99	55	95	252
R449a	ZZ recommended	1397	0.5935	28.1	21.86	1.607	2.608	5.49	75.04	56	94	303
R407a	ZZ recommended	1923	0.59784	26.143	21.75	1.617	2.617	5.518	76.45	57	95	146
R450a	alternate refrigerant	547	0.6557	12.542	20.94	1.679	2.679	5.73	159.36	118	99	189
R407c	alternate refrigerant	1624	0.54322	25.175	21.23	1.657	2.657	5.652	79.39	59	97	146
R407f	alternate refrigerant	1674	0.52937	28.466	21.38	1.645	2.645	5.613	70.21	52	97	164
R410a	alternate refrigerant	1924	0.52334	40.328	21.98	1.6	2.6	5.46	49.56	37	94	106
R513a	alternate refrigerant	631	0.72537	16.1	21.66	1.624	2.623	5.54	131.13	97	95	328
R134a	being phased out	1300	0.60466	14.8	20.64	1.704	2.704	5.814	135.04	100	100	100
R404a	being phased out	3943	0.82327	25.878	23.91	1.471	2.471	5.019	77.23	57	86	146
R507a	being phased out	3985	0.85744	26.334	24.21	1.452	2.452	4.956	75.9	56	85	146
AMMONIA	toxic-mildly flammable	0	0.07418	28.314	19.48	1.806	2.806	6.161	70.59	52	106	0.42
R1234yf	mildly flammable not EPA SNAP approved for supermarket systems	0	0.83397	14.14	22.61	1.556	2.556	5.308	141.35	105	91	2253
R1234ze	mildly flammable not EPA SNAP approved for supermarket systems	1	0.68833	10.446	21.09	1.667	2.667	5.689	191.33	142	98	633
PROPANE	flammable	3	0.32093	24.137	20.90	1.683	2.683	5.743	82.81	61	99	633

NOTES:

Cooling Capacity [btu/hr] = 120,000
 Evaporator Superheat = 10°F
 Compressor Superheat = 10°F

Condenser Subcooling = 0°F
 Volumetric Efficiency = 95%
 Isentropic Efficiency = 70%

For more information about this White Paper, contact:

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