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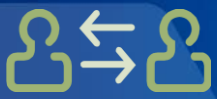

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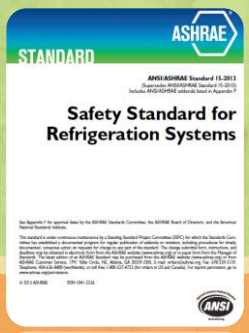
3

ASHRAE Standard 15

A review and update on what's new?



Douglas Reindl, Ph.D., P.E.
ASHRAE Fellow
Director, IRC and HVAC&R Center
Professor, University of Wisconsin-Madison

4

During this presentation

- Brief history of Standard 15
- Discuss the purpose and scope
- Provide an overview of the standard
- Recent changes and status

5

A bit of history,

1914 1919 1932 1939 1950 1953 1958 1964 1971

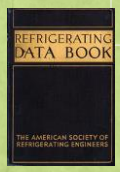
Refrigeration System Safety Timeline

Code expands to regulate refrigerating machines & refrigerants

ASRE engineers initiate development of 1st refrigeration safety code for NYC

ASRE publishes and ASA approves B9 the "*American Standard Safety Code for Mech. Refrigeration*"

ASRE publishes updated versions of ASA B9



ASRE re-designates B9 to B9.1 publishing updated versions.

Merger of ASRE and ASHAE leads ASHRAE to publish as B9.1

ANSI approves ASHRAE B9.1

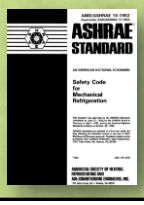
6

A bit of history,

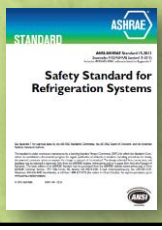
1978 1989 1992 1994 2001 2004 2007 2010 2013

Refrigeration System Safety Timeline

ASHRAE publishes 1st version of ANSI/ASHRAE 15



ASHRAE publishes revised versions of ANSI/ASHRAE Standard 15



7

ASHRAE 15 today

- Purpose: *specifies safe design, construction, installation, and operation of refrigeration systems*
- Scope: *establishes safeguards for life, limb, health, and property and prescribes safety requirements*

8

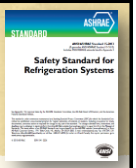
Fundamental goals of Std. 15

1. Keep refrigerants contained within their refrigeration systems
2. In the event when a refrigerant might be released, mitigate its impact on people
   a) By limiting refrigerant quantity in direct systems
   b) Locating refrigeration systems within machinery rooms when system charge is too large



9

ASHRAE 15



- Applications:
  a) *design, construction, test, installation, operation, and inspection of **mechanical** and **absorption** refrigeration systems, including heat-pump systems used in **stationary applications**;*
  b) *modifications, including replacement of parts or components if they are not identical in function and capacity; and*
  c) *refrigerant substitutions with a different designation*

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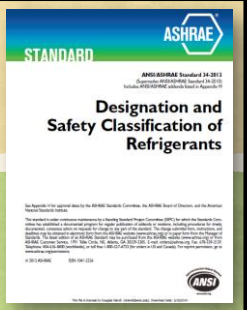
ASHRAE 34



- Companion to ASHRAE 15

Purpose: *establish a system to uniquely identify refrigerants, assign reference numbers to refrigerants, establishes safety classification and refrigerant concentration limits*

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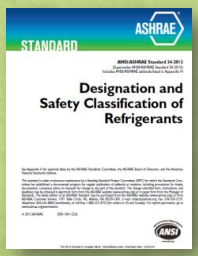
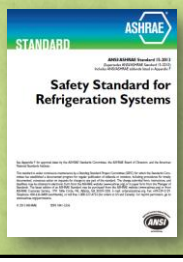
ASHRAE 15 and ASHRAE 34

- ASHRAE 15 defers to ASHRAE 34 on:
  - *Refrigerant safety classifications*
  - *Refrigerant concentration limits (RCLs)*
  - *Key refrigerant property information that must be submitted with an application for designation*





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ASHRAE 34

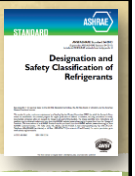

TABLE 4-2 Data and Safety Classifications for Refrigerant Blends

Refrigerant Number	Composition (Mass %)	Composition Tolerances	OEL[h], ppm v/v	Safety Group	RCL[a] (ppm v/v)	RCL[a] (lb/Mcf)	RCL[a] (g/m^3)	Highly Toxic or Toxic[f] Under Code Classification
Zeotropes								
406A	R-22/600a/142b (55.0/4.0/41.0)	(±2.0/±1.0/±1.0)	1000	A2	21,000	4.7	25	Neither
407A[g]	R-32/125/134a (20.0/40.0/40.0)	(±2.0/±2.0/±2.0)	1000	A1	83,000	19	300	Neither
407B[g]	R-32/125/134a (10.0/70.0/20.0)	(±2.0/±2.0/±2.0)	1000	A1	79,000	21	330	Neither
407C[g]	R-32/125/134a (23.0/25.0/52.0)	(±2.0/±2.0/±2.0)	1000	A1	81,000	18	290	Neither
407D	R-32/125/134a (15.0/15.0/70.0)	(±2.0/±2.0/±2.0)	1000	A1	68,000	16	250	Neither
407E[g]	R-32/125/134a (25.0/15.0/60.0)	(±2.0/±2.0/±2.0)	1000	A1	80,000	17	280	Neither
407F	R-32/125/134a (30.0/30.0/40.0)	(±2.0/±2.0/±2.0)	1000	A1	95,000	20	320	Neither
408A[g]	R-125/143a/22 (7.0/46.0/47.0)	(±2.0/±1.0/±2.0)	1000	A1	95,000	21	340	Neither
409A	R-22/124/142b (60.0/25.0/15.0)	(±2.0/±2.0/±1.0)	1000	A1	29,000	7.1	110	Neither
409B	R-22/124/142b (65.0/25.0/10.0)	(±2.0/±2.0/±1.0)	1000	A1	30,000	7.3	120	Neither
410A[i]	R-32/125 (50.0/50.0)	(+0.5, –1.5/+1.5, –0.5)	1000	A1	140,000	26	420	Neither
410B[i]	R-32/125 (45.0/55.0)	(±1.0/±1.0)		A1	140,000	27	430	Neither

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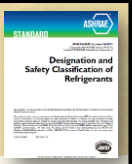
ASHRAE 34



- ***Toxicity classifications***
  - **Class A** signifies refrigerants where toxicity has not been identified at concentrations ≥ 400 ppm_v based on TLV–TWA data or consistent indices
  - **Class B** signifies refrigerants for where there is evidence of toxicity at concentrations < 400 ppm, based on TLV-TWA data or other consistent indices

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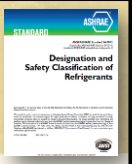
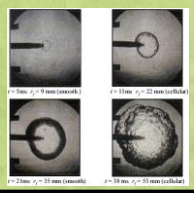
ASHRAE 34



- ***Flammability classifications***
  - 1 – No flame propagation
  - 2 – Exhibits flame propagation, a LFL > 0.10 kg/m^3 and heat of combustion < 19,000 kJ/kg
  - **2L** – burning velocity not greater than 10 cm/s*
  - 3 – Exhibits flame propagation, a LFL ≤ 0.10 kg/m^3 and heat of combustion ≥ 19,000 kJ/kg

NEW



* per ASTM E 681

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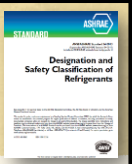
ASHRAE 34



- **Refrigerant safety classifications**
  - A1
    - R22, R134a
  - A2L
    - R32, R143a, R1234yf
  - B2L
    - R717 (ammonia)
  - A3
    - R600a (isobutane), R290 (propane)

Safety Group Classification		
Higher Flammability	A3	B3
Lower Flammability	A2	B2
	A2L	*B2L*
No Flame Propagation	A1	B1
	Lower Toxicity	Higher Toxicity

The 2L refrigerants have a burning velocity of 10 cm/s or slower.

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Standard 15 content

- **Classifications**
  - Section 4 – Occupancy
  - Section 5 – Refrigerating systems
  - Section 6 – Refrigerant safety

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Standard 15 content

- **Restrictions**
  - Section 7 – Refrigerant use
  - Section 8 – Installation

- **Design, construction, & operation**
  - Section 9 – Equipment and Systems
  - Section 10 – Operation and testing

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Standard 15 content

- **General**
  - Section 11 – General requirements
  - Section 12 – Precedence with conflicts
  - Section 13 – Listed equipment

- **Normative appendices**
  - Appendix B – References
  - Appendix D – Relief vent line lengths

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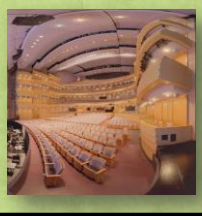
Occupancy classifications

- Relates to restrictions on refrigerants and refrigerating systems usage
  - **Institutional** – hospitals, nursing homes, prisons
  - **Public assembly** – auditoriums, classrooms, restaurants, theaters
  - **Residential** – dormitories, hotels, apartments, private residences



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Occupancy classifications

- Relates to restrictions on refrigerants and refrigerating systems usage
  - **Commercial** – office, professional buildings
  - **Large mercantile** – large stores
  - **Industrial** – food production, storage, chemical process
  - **Mixed** – two or more occupancies in same building

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Refrig system classifications

Paragraph	Designation	Cooling or Heating Source	Air or Substance to be Cooled or Heated
5.1.1	Direct system		

High probability systems

Low probability systems

FIGURE 5.1 Refrigerating system designation.

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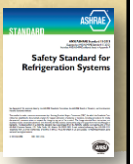
Restrictions on use



I. Determine refrigerant concentration from complete discharge of largest independent refrigerant circuit

II. Resulting concentration cannot exceed the refrigerant's RCL from ASHRAE 34 (institutional occupancies @ 50% of RCL)

Exceptions:
1. **Listed equipment not containing more than 6.6 lb.**
2. **Listed equipment for use in laboratories with more than 100 ft²/person**

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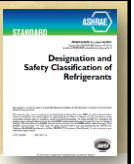
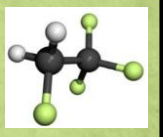
RCLs are found in ASHRAE 34



- **R**efrigerant **C**oncentration **L**imit (RCL) is the **min**(ATEL, ODL, FCL)
  - **A**cute-**T**oxicity **E**xposure **L**imit (ATEL)
    - Basis: mortality, cardiac sensitization, anesthetic/ nervous system impacts or other escape-impairing effects
  - **O**xygen **D**eprivation **L**imit (ODL)
  - **F**lammable **C**oncentration **L**imit (FCL) set at 25% of LFL



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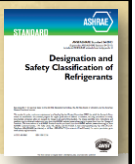
What is RCL?



- ASHRAE 34
  - RCL is the refrigerant concentration limit in air that is intended to reduce the risks of acute toxicity, asphyxiation, and flammability hazards in normally occupied, enclosed spaces
- Concentration is based on
  - full vaporization of the refrigerant in the space to which it is released with complete mixing and no removal by ventilation, dissolution, reaction, or decomposition

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ASHRAE 34 RCL excerpt

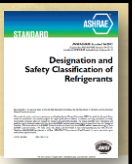

TABLE 2 Data and Safety Classifications for Refrigerant Blends

Refrigerant Number	Composition (Mass %)	Composition Tolerances	OEL[i], ppm v/v	Safety Group	RCL[a] (ppm v/v)	RCL[a] (g/m^3)	RCL[a] (lb/Mcf)	Highly Toxic or Toxic[g] Under Code Classification
Zeotropes								
400	R-12/114 (must be specified)			A1				Neither
	(50.0/50.0)		1000	A1	28,000	160	10	
	(60.0/40.0)		1000	A1	30,000	170	11	
401A	R-22/152a/124 (53.0/13.0/34.0)	(±2.0/+0.5, –1.5/±1.0)	1000	A1	27,000	110	6.6	Neither
401B	R-22/152a/124 (61.0/11.0/28.0)	(±2.0/+0.5, –1.5/±1.0)	1000	A1	30,000	120	7.2	Neither
401C	R-22/152a/124 (33.0/15.0/52.0)	(±2.0/+0.5, –1.5/±1.0)	1000	A1	20,000	84	5.2	Neither
402A	R-125/290/22 (60.0/2.0/38.0)	(±2.0/+0.1,–1.0/±2.0)	1000	A1	33,000	140	8.5	Neither
402B	R-125/290/22 (38.0/2.0/60.0)	(±2.0/+0.1,–1.0/±2.0)	1000	A1	63,000	240	15	Neither
403A	R-290/22/218 (5.0/75.0/20.0)	(+0.2, –2.0/±2.0/±2.0)	1000	A2	33,000	120	7.6	Neither
403B[h]	R-290/22/218 (5.0/56.0/39.0)	(+0.2, –2.0/±2.0/±2.0)	1000	A1	70,000	290	18	Neither
404A[j]	R-125/143a/134a (44.0/52.0/4.0)	(±2.0/±1.0/±2.0)	1000	A1	130,000	500	31	Neither
405A[e]	R-22/152a/142b/C318 (45.0/7.0/5.5/42.5)	individual components = (±2.0/±1.0/±1.0/±2.0); sum of R-152a and R-142b = (+0.0, –2.0)	1000		57,000	260	16	Neither
406A	R-22/600a/142b (55.0/4.0/41.0)	(±2.0/±1.0/±1.0)	1000	A2	21,000	25	4.7	Neither
407A[h]	R-32/125/134a (20.0/40.0/40.0)	(±2.0/±2.0/±2.0)	1000	A1	78,000	290	18	Neither

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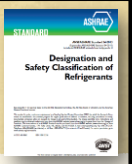
Volume for determining RC



- Volume of space to which refrigerant disperses in the event of a refrigerant leak [§7.3]
  - Occupied spaces that do not connect through permanent openings or HVAC ducts, use the volume of the smallest occupied space [§7.3.1]
  - When refrigerant is in an air-handler, duct, or space served by mechanical ventilation, the entire air distribution system must be analyzed

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ASHRAE 15 – Interpretation

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 15-2013, Sections 7.3.2.2 and 7.3.2.3, regarding plenums and ductwork in the calculation of volume for refrigerant concentration limit (RCL).

Background: A VRF system in which indoor terminal units are installed in a variety of locations (ceiling, wall, or floor) is used to condition air in the occupied space. A separate, dedicated outdoor air system (DOAS) is used to deliver conditioned outside air to the same space. The DOAS has a ducted supply and plenum return. The VRF terminal units take air from the occupied space and return conditioned air to the occupied space, but are not directly connected to the plenum or other ductwork. The DOAS system is not operated continuously. Since the VRF terminal units are not in the supply ductwork or plenum return, refrigerant could potentially leak directly into the occupied space without traveling through ductwork or plenum.

Interpretation: Section 7.3.2.3 specifically states that supply and return ducts and plenums shall be included when calculating refrigerant quantity limits. This means these volumes can be used in the calculation even if the leak potential components are not located within these specific ducts/plenums.

Question: Is this Interpretation correct?

March 5, 2015 28

ASHRAE 15 – Interpretation

Answer: No

Comment: The **Background** describes two independent refrigerating systems, namely a DOAS system and a VRF system employing multiple indoor terminal units. The refrigerant concentration in the occupied space is computed separately for each system and compared to the RCL. The **Background** states that the DOAS system is not operated continuously and may be 'off'. The DOAS system is therefore controlled in such a way that it would not always act to disperse refrigerant that may leak from VRF indoor terminal units into the plenum or ductwork. If the refrigerant concentration is based on these additional volumes, leaking refrigerant from the indoor terminal units could concentrate in the occupied space alone, and could rise to a level that poses a danger to occupants who may be present.

Please note that there is an editorial error in Sections 7.3.2.2 and 7.3.2.3; "refrigerant quantity limit" should read "refrigerant concentration limit" or RCL.

March 5, 2015 29

ASHRAE 15 – Interpretation

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 15-2010, Section 7.3.1, regarding volume calculations and "permanent openings".

Background: The definition of term permanent openings is a major consideration in the application of Section 7.3.1 of the standard.

Interpretation: It is our interpretation that NOT only doorways without doors, or "cased openings", but undercut doors, and/or transfer grilles (if large enough) located near the floor could meet the requirment of this portion of the standard.

Also, there is NO indication of the how to determine the required size of the permanent openings of any type. Any guidance the committee could provide in this area would be most helpful.

Question: Is this Interpretation correct?

June 24, 2012 30

ASHRAE 15 – Interpretation

Answer: No.

Comment: The code is currently written in performance text and allows the designer to determine what constitutes suitably interconnected spaces. There are many factors to consider, and the code currently leaves this to the designer and the AHJ rather than specifying prescriptive considerations or rules.

ASHRAE 15 – Interpretation

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 15-2007, Section 7.3, regarding volume calculations for heavier than air refrigerants.

Background: Hotel/motel guest rooms typically consist of a sleeping room and connecting toilet room. Variable refrigerant flow systems applied to guest rooms have the potential to have relatively large quantities of refrigerant discharged into the guest room. The greatest risk for life safety occurs when the guests are sleeping and their location is within the bottom 3 feet or ~1 meter of the guest room, where heavier than air refrigerants such as R-410A would collect; displacing all of the oxygen.

Interpretation: It is Hilton Worldwide's interpretation that volume calcualtions should only include the lowest volume of the room in which the guest is supine and sleeping when determining the allowable refrigerant limits.

Question: Is this Interpretation correct?

ASHRAE 15 – Interpretation

Answer: No.

Comment: The designer is free to be more conservative, by using a smaller volume.

ASHRAE 15 – Interpretation

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 15-2007, Section 7.3, regarding volume calculations for heavier than air refrigerants.

Background: Hotel/motel guest rooms typically consist of a sleeping room and connecting toilet room. Variable refrigerant flow systems applied to guest rooms have the potential to have relatively large quantities of refrigerant discharged into the guest room. The greatest risk for life safety occurs when the guests are sleeping and their location is within the bottom 3 feet or ~1 meter of the guest room, where heavier than air refrigerants such as R-410A would collect; displacing all of the oxygen.

Interpretation: It is Hilton Worldwide's interpretation that volume calcualtions should only include the lowest volume of the room in which the guest is supine and sleeping when determining the allowable refrigerant limits.

Question: Is this Interpretation correct?

ASHRAE 15 – Interpretation

Answer: If there are no permanent openings connecting the guest room to the bath room, then yes this interpretation is correct.

Comment: See Section 7.3.2.1 regarding closures and exclusions of certain volumes.

ASHRAE 15 – Interpretation

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 15-2007, Section 7.3.2, regarding ventilated spaces and volume calculations.

Background: Most hotel/motel guest rooms include a bathhroom connected to the guest room with a door. Toilet exhaust systems may be continuous or intermittently operated depending on the design. ASHRAE Standard 62.1-2007 allows continuous ventilation rates of 25 CFM (12.5 LPS) that could be considered for increasing the allowable limits of refrigerant R-410A in variable refrigerant flow systems. Similarly, the guest room may be equipped with ventilation supply air (0.04 CFM/ft² 0.3 LPS/m²) from a dedicated outdoor air system that would also increase the allowable limits. However, these supply and exhaust air systems are typically never provided with emergency power or supervised monitoring systems to maintain their operation continuously, and may be inoperative or shut off for various reasons.

Interpretation: It is Hilton Worldwide's interpretation that increasing the allowable refrigerant limits for R-410A in a variable refrigerant flow system due to dilution by supply and/or exhaust air ventilation should not be considered due to risk of asphyxiation of the occupants.

Question: Is this Interpretation correct?

ASHRAE 15 – Interpretation

Answer: Yes.

Comment: The RCL is calculated on the basis of the room volume and permanently connected spaces, see Section 7.3.

January 30, 2014

A machinery room required when,

a. the quantity of refrigerant exceeds the limits for a given occupancy

b. direct-fired absorption equipment is used

When required, all refrigerant-containing components containing shall be located in a machinery room or outdoors

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Other restrictions

- **Flammable refrigerants (group 2 & 3)**
  - Total quantity not to exceed 1,100 lb
  - Higher flammability (group 3) restricted to laboratories or industrial if charge is > 150 grams
- **Refrigerants**
  - Minimum purity requirements
  - Re-use and recycled limited to system from which it was removed
  - Reclaimed refrigerants must meet AHRI 700

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Installation considerations

- Need adequate foundations, guarding, safe access
- Piping – several specific requirements apply
  - Prohibited from being installed in enclosed public stairway, stair landing or any means of egress
  - Restrictions on pipe penetrations through ceilings, roofs, and floors

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Installation considerations

- Machinery rooms
  - Tight fitting construction
  - Refrigerant detection requirements
  - Dedicated ventilation: normal & emergency operation
  - Restricted access to authorized personnel
  - No open flames using combustion air from room
  - Other

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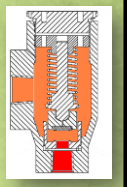
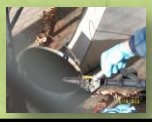
Design

- Materials of construction
- Design pressure not be less than pressure during maximum operating, standby, or shipping conditions
- Pressure relief protection
- Serviceable components provided with safe access
- Shut-off valves – number and location
- Other





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Operation, testing, and general

- For field-erected parts of system, pressure testing is required
- Refrigerating equipment must be properly guarded from impact damage
- Refrigerant circuit access ports located outdoors must be secured
- Equipment must be properly labeled

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ASHRAE 15 - 2013

- ***Highlights of what's new in the 2013 edition:***
  - Clarifies requirements for machinery room ventilation (8.11.4)
  - Explicitly states design pressure requirements are expressed as gauge pressure (Section 3)
  - Adds locking cap requirement to harmonize with IMC (11.3)
  - Removes methods for determining RCL and defers to Std. 34 (Appendix A)
  - Removes requirement for manual discharge of ammonia "fireman's control box" (8.13)
  - Clarifies relief requirements (Addendum a)

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ASHRAE 15 - 2013

- *§8.11.4*
  - Mechanical ventilation referred to in Section 8.11.3 shall be by one or more power-driven fans capable of exhausting air from the machinery room at least in the amount given in the formula in Section 8.11.5…

    The mechanical exhaust inlet(s) shall be located in an area where refrigerant from a leak is likely to concentrate, in consideration of the location of the replacement air path(s), refrigerating machine(s), and the density of the refrigerant relative to air.

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ASHRAE 15 - 2013

- *Definitions (Section 3)*
  - ***design pressure:*** the maximum gauge pressure for which a specific part of a refrigerating system is designed.

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ASHRAE 15 - 2013

- *11.3 Charging, Withdrawal, and Disposition of Refrigerants*
  - ***11.3.1 Refrigerant Access*** *Refrigerant circuit access ports located outdoors shall be secured to prevent unauthorized access.*

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ASHRAE 15 - 2013

- *Appendix A is deleted in its entirety*
  - ~~INFORMATIVE APPENDIX A—~~

    ~~CALCULATIONS OF THE MAXIMUM ALLOWABLE CONCENTRATION (Cm) OF A BLEND~~

    ~~A1. FOR 100 lb OF BLEND, DETERMINE THE IDEAL GAS VOLUMES OCCUPIED BY EACHCOMPONENT AND BY THE BLEND AT 70°F AND 1 atm …~~

    ~~A2. DETERMINE THE DILUTION VOLUME REQUIRED FOR THE 100 lb OF BLEND AND EACH COMPONENT THEREIN …~~

    ~~A3. DETERMINE THE MAXIMUM ALLOWABLE CONCENTRATION (Cm) OF A BLEND~~

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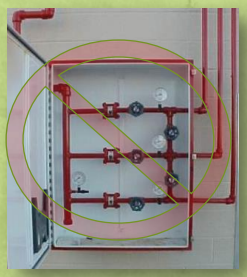
ASHRAE 15 - 2013

- *Section 8.13 is deleted in its entirety*
  - ~~**8.13 Manual Emergency Discharge of Ammonia Refrigerant.** When required by the AHJ, manual emergency discharge or diffusion arrangements for ammonia refrigerants shall be provided.~~



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ASHRAE 15 - 2013

- *Addendum a*
  - Clarifies safety relief system discharge requirements
  - Removes requirements for sulfur dioxide because refrigerant is no longer in use
  - Revised and clarified requirements for relief systems

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ASHRAE 15 - 2013

- *Addendum a*
  - Outdoor systems containing Group A1 refrigerant shall be permitted to discharge [safety relief] at any elevation where the point of discharge is located in an access-controlled area accessible to authorized personnel only.

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ASHRAE 15 - 2013

- *Addendum a*
  - For heavier-than-air refrigerants, point of vent discharge shall not be less than 20 ft from:
    - Below-grade walkways, pits, or ramps if a release of entire system charge can result in a concentration greater than the RCL
    - Direct discharge into an enclosed outdoor space such as a courtyard is prohibited if the resulting concentration is greater than the RCL

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- *Addendum a*
  - Drip pockets
    - Relief vent lines that terminate vertically upward and subject to moisture entry shall be provided with a drip pocket at least 24" deep and of vent pipe size
    - Located at first change in vent pipe direction
    - Fitted with a valve or drain plug to permit drainage

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ASHRAE 15 - 2013

- *Addendum a*
  - Relief valve back-pressure
    - When outlets of two or more relief devices or fusible plugs, which are expected to operate simultaneously connect to a common discharge pipe, the common pipe shall be sized large enough to prevent the outlet pressure at each relief device from exceeding the maximum allowable outlet pressure.

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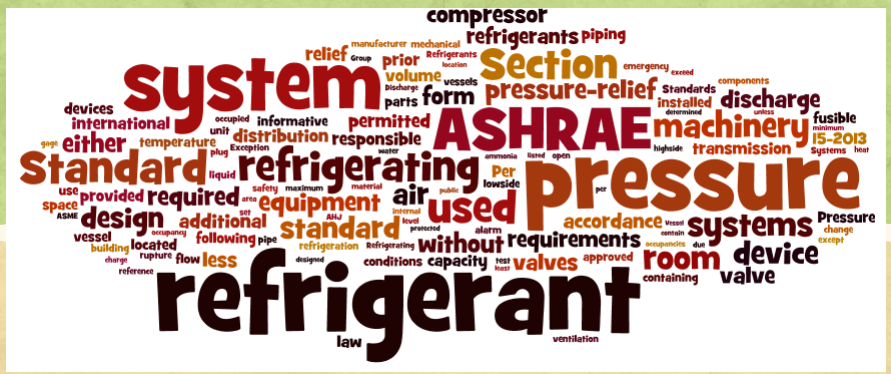
Questions on Std. 15?



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Let's look at some refrigerant safety issues inside and outside the machinery room.

56

Safeguarding piping & equipment

11.1 General Restrictions—Safeguards.

Means shall be taken to safeguard piping, controls, and other refrigerating equipment to minimize possible accidental damage or rupture by external sources.

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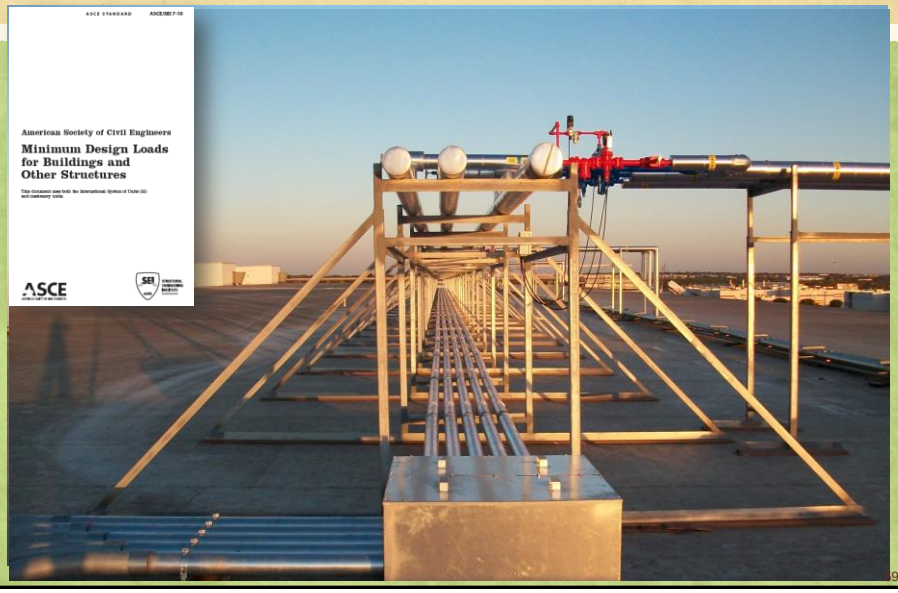
Result of improper pipe support

58

Proper pipe support!



Equipment access requirements

8.3 Safe Access.

- A clear and unobstructed approach and space shall be provided
  - Inspection, service, and emergency shutdown
  - Applies to condensing units, compressor units, condensers, stop valves,
  - Permanent ladders, platforms, or portable access equipment shall be provided

Equipment clearance

8.11.1

A machinery room shall be dimensioned so parts are accessible with space for service, maintenance, and operations. There shall be clear head room of not less than 7.25 ft (2.2 m) below equipment situated over passageways.

61

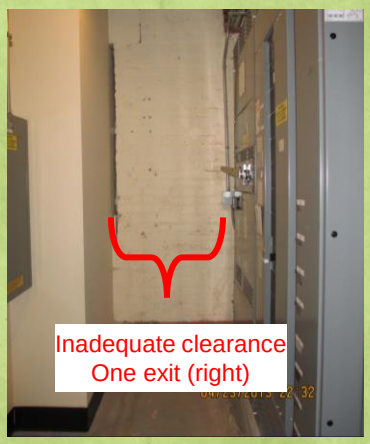
Inadequate equipment clearances

New chiller installation

About 20” (0.5 m) was clearance provided.

J. Vu 62

Inadequate electrical equipment clearance



800 AMP service panel

J. Vu 63

Inadequate equipment clearance

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No safe access for service

Return fan located 20 ft (6 m) off floor

Return fan located 30 ft (9 m) off floor

No provisions made for safe service access other than technicians working from ladders.

Owner required fixed platforms in this instance!

J. Vu 65

Machinery room, general

- **8.11.2** With the exception of access doors and panels in air ducts and air-handling units conforming to Section 8.11.7, there shall be **no openings that will permit passage of escaping refrigerant to other parts of the building**.

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Improperly sealed machinery room piping penetrations

All roof, wall, and floor penetrations of a machinery room are to be properly sealed to ensure compliance with ventilation requirements.

67

Pressure relief outlets plugged

PRV outlets plugged & relief vent piping not intact.

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No relief piping

High pressure receiver in machinery room with no vent piping connected

69

Vent piping not intact – not compliant

70

Pressure relief vents to unsafe location

Pressure relief vent outlet closer than 6 m to make-up air intake.

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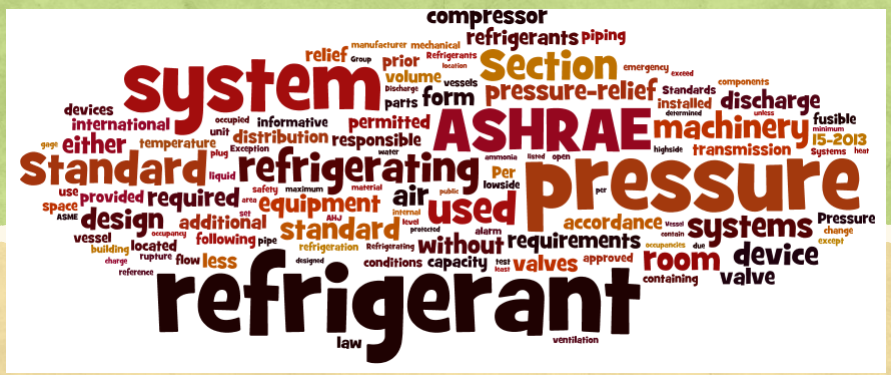
Questions on Std. 15?



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