Human Exposure to Ammonia

Burns of the Eye

Ammonia, as is the case with other strong alkalis, can be very damaging to the eye. Gaseous ammonia is slightly irritating to human eyes at concentrations in the 100 to 200 ppm range and is immediately irritating to most people at concentrations of 500 ppm or more. In humans, chronic exposure to ammonia gas at or below these irritation levels does not seem to cause any permanent eye damage. However, a forceful blast of concentrated ammonia gas directed into the eyes can cause severe eye damage similar to that caused by liquefied or aqueous ammonia.

Effects on Skin

Although odor, respiratory irritation, and eye irritation typically precede skin irritation, skin irritation will also occur at relatively low concentrations of ammonia. Ammonia gas is quickly absorbed on moist body surfaces and results in an alkali burn. Contact with liquid anhydrous ammonia also produces a burn by its freezing effect. Contact with liquid anhydrous ammonia or ammonia gas under pressure results in second-degree burns, with formation of blisters that, if extensive, may be fatal.

Although there is some disagreement on the exact concentrations of gaseous ammonia which will cause damage to exposed skin, 5,000 ppm seems to be a broadly accepted concentration level above which personnel require some special type of impervious apparel such as a full-body chemical suit. Immediate treatment after contact with either liquid ammonia or very high levels of gaseous ammonia consists of flushing of the skin with water, carefully removing clothing (if not frozen to skin), and seeking medical attention if any burns are apparent after the water flushing.

Effects on Upper Respiratory Tract and Lungs

Ammonia vapor has a sharp, irritating, pungent odor that acts as a warning of potentially dangerous exposure. Odor threshold concentrations have been reported to be as low as 1 ppm and as high as 50 ppm. One study indicated that the average odor threshold was 5 ppm. It is well known that acclimation occurs with chronic exposure to low concentrations, thereby resulting in an increased odor threshold for those individuals frequently exposed to the odor.

Effects of ammonia on the respiratory tract include mild irritation, hoarseness, excess salivation, sneezing, coughing, productive coughing, hemoptysis, rales, and the more severe respiratory symptoms of laryngeal edema with asphyxia, pulmonary edema, and bronchopneumonia. Very high concentrations of ammonia produce laryngeal spasm and reflex bronchoconstriction.

Emergency and First-Aid Procedures

Inhalation

1. Remove from exposure; seek fresh air.
2. Administer artificial respiration or oxygen if breathing has stopped.
3. Seek medical aid.

Skin contact

1. Immediately flush with large quantities of water for at least 15 minutes. Do not remove clothing if frozen to skin.
2. Seek medical aid.

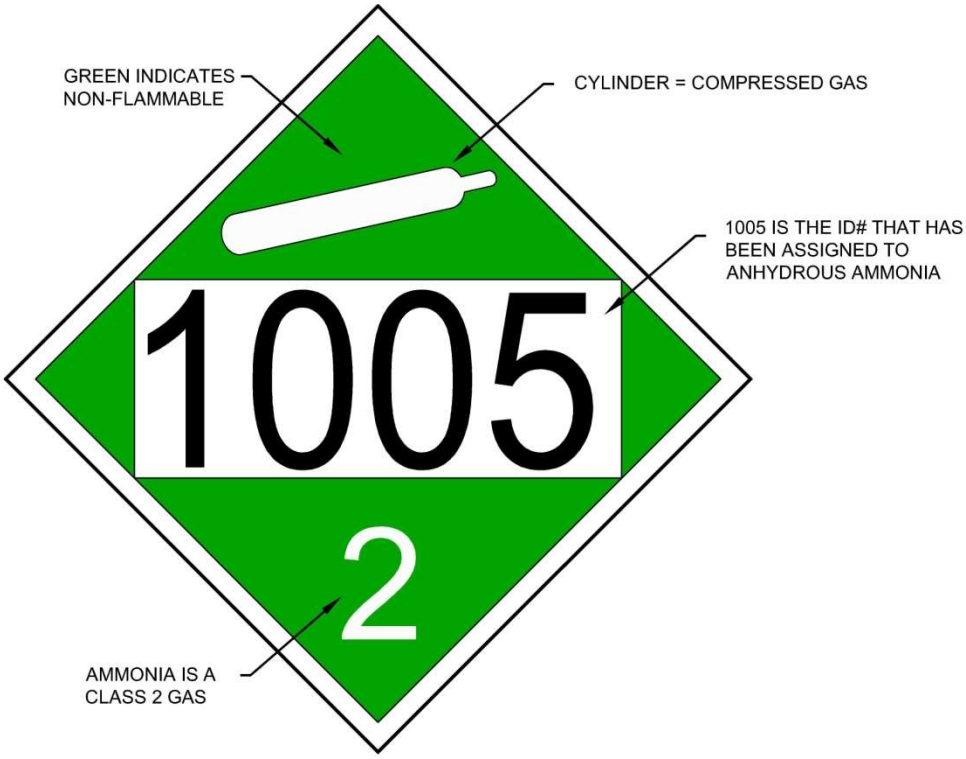
Eye Contact

1. Flush with large quantities of water for at least 15 minutes.
2. Seek medical aid.

Ingestion

1. Do not induce vomiting. Give 1-2 glasses of milk or water.
2. Seek medical aid.

Ammonia Labeling – Department of Transportation

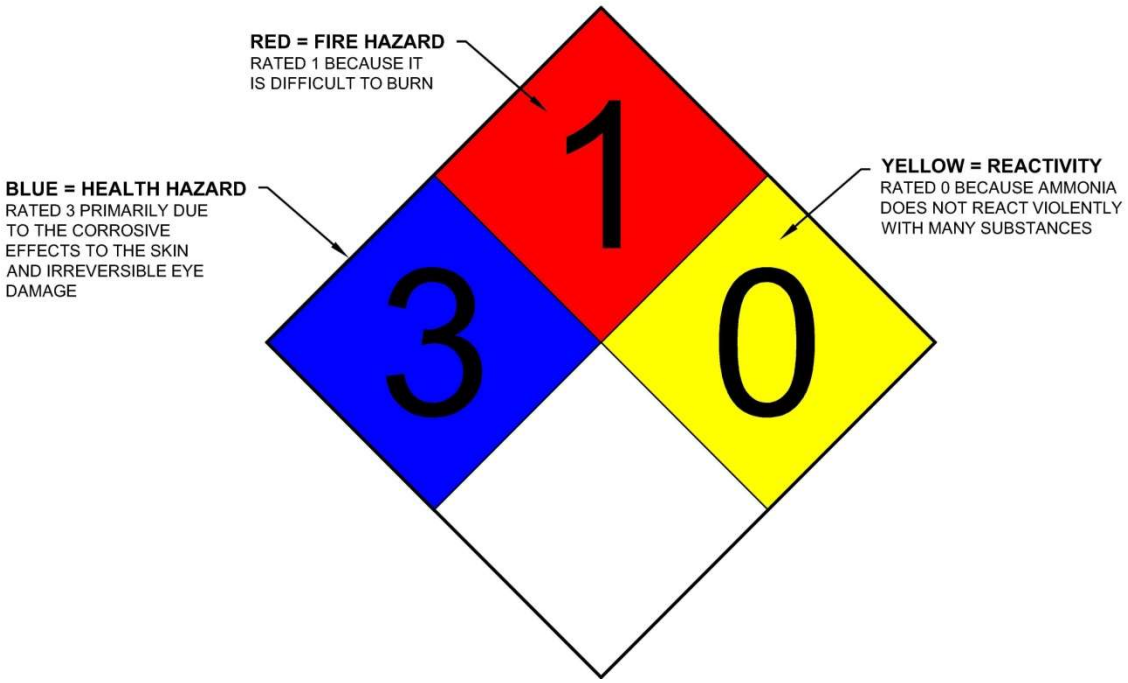


Anhydrous ammonia is classified by both the United Nations and the U.S. Department of Transportation as a non-flammable gas for transportation purposes because of the limited flammability range exhibited by ammonia.

The international classification system has nine material divisions. Ammonia is considered a Class 2 gas. Ammonia is further classified as a Division 2.2 material meaning it is a nonflammable gas for shipping purposes. It is considered nonflammable because the accepted span of its flammability range is not more than 12%. Ammonia has been assigned an ID number of 1005 that applies to anhydrous ammonia gas, liquid and to ammonia solutions containing more than 50% ammonia. The U.S. Department of Transportation also requires that ammonia shipments be labeled as an inhalation hazard.

The resultant symbol used to label ammonia is shown below. The gas cylinder represents the fact that the ammonia is a compressed gas; the “2” indicates that ammonia is a Class 2 gas; a green background indicate that ammonia is considered to be nonflammable; the 1005 is the material ID number unique to ammonia. Inhalation hazard is self-explanatory.

Ammonia Labeling – National Fire Protection Association



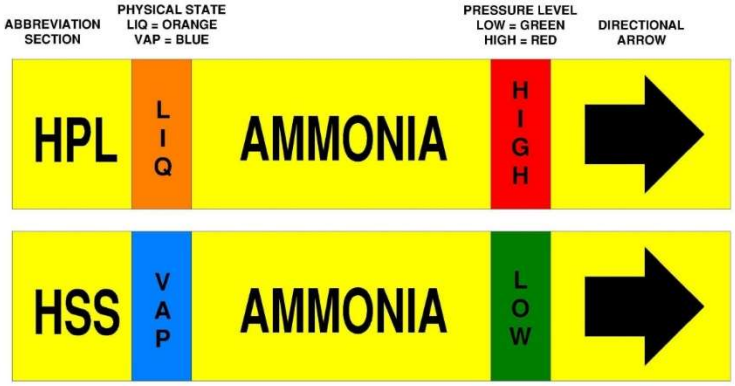
The NFPA has assigned the following hazard ratings to ammonia when **it is stored outdoors:**

Hazard Type	Rating	Explanation of Rating
Health	3	Primarily due to the corrosive effects to skin and irreversible eye damage
Fire	1	Because although the gas does have a flammable range, “it is difficult to burn”
Reactivity	0	Because ammonia does not react violently with many substances

The NFPA has assigned the following hazard ratings to ammonia when **it is stored indoors:**

Hazard Type	Rating	Explanation of Rating
Health	3	Primarily due to the corrosive effects to skin and irreversible eye damage
Fire	3	An indoor environment is more susceptible to being exposed to the flammable range of ammonia (15-28%)
Reactivity	0	Because ammonia does not react violently with many substances

Ammonia Labeling – IIAR Pipe Labeling



IIAR APPROVED ABBREVIATIONS

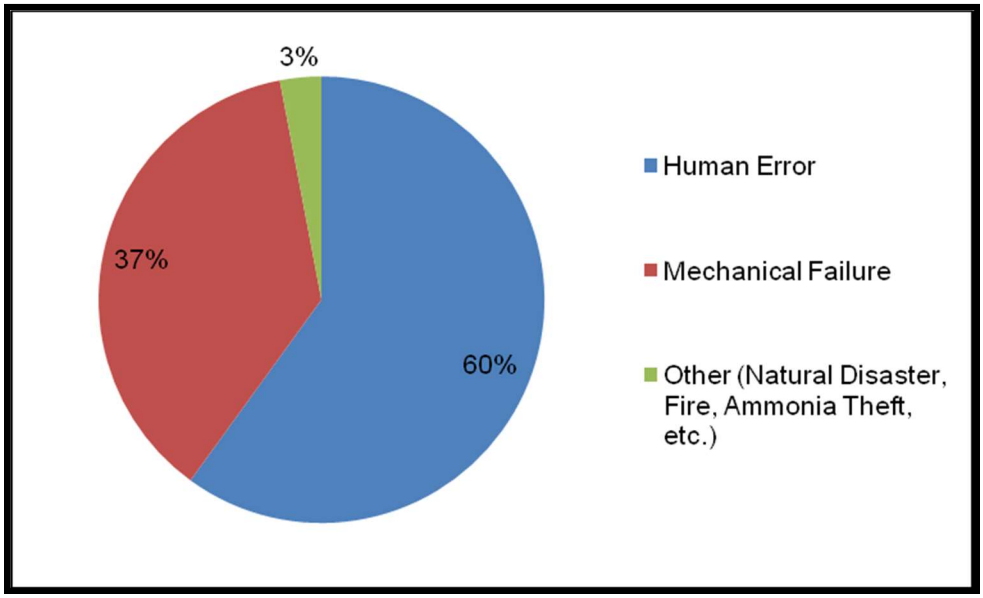
BOOSTER DISCHARGE	BD
CONDENSER DRAIN	CD
DEFROST CONDENSATE	DC
ECONOMIZER SUCTION	ES
HOT GAS DEFROST	HGD
HIGH PRESSURE LIQUID	HPL
HIGH STAGE DISCHARGE	HSD
HIGH STAGE SUCTION	HSS
HIGH TEMPERATURE RECIRCULATED LIQUID	HTRL
HIGH TEMPERATURE RECIRCULATED SUCTION	HTRS
LOW TEMPERATURE RECIRCULATED LIQUID	LTRL
LOW TEMPERATURE RECIRCULATED SUCTION	LTRS
LIQUID INJECTION COOLING	LIC
LOW STAGE SUCTION	LSS
RELIEF VENT	RV
THERMOSYPHON RETURN	TRS
THERMOSYPHON SUPPLY	TSS

Location and Cause of Ammonia Accidents

In the May 2010 issue of *Condenser* (a publication of the International Institute of Ammonia Refrigeration) an article titled, *Low Charge Systems May Be the Answer*, summarized the results of a 12-questions survey about ammonia releases from over 700 respondents. The survey found the following about the location of leaks in ammonia refrigeration systems:

	Responses	Percentage
Flanges/Joints	110	23
Control Valves	96	20
Pumps	58	12
Pressure Relief Valves	43	9
Compressors	41	9
Oil Pots	40	8
Piping	35	7
Charging Transfer	21	5
Evaporators	19	4
Sight Glass	7	1
Storage Tank/Receiver	1	-
Total	471	100

In addition, the survey found the following about the cause of ammonia leaks in refrigeration systems:



The team used the information provided in this article to assist in assigning risk rankings and determining the probability of scenarios taking place at their facility.

Ammonia Safety Checklist

Question	Compliant?	Comment
Is the ammonia mechanical room or equipment area clearly marked as “authorized personnel only”?	☐ Yes ☐ No ☐ N/A	
Have you performed an evacuation drill/training with all facility employees? Evacuation training should include consideration of wind direction.	☐ Yes ☐ No ☐ N/A	
Does the ammonia system have any known leaks?	☐ Yes ☐ No ☐ N/A	
Are all drain/purge valves plugged or capped?	☐ Yes ☐ No ☐ N/A	
Are all ammonia pipes and valves clearly distinguished from water/gas/air pipe and valves?	☐ Yes ☐ No ☐ N/A	
Does the ammonia pipe or equipment have any unusual vibration or hammering?	☐ Yes ☐ No ☐ N/A	
Does the ammonia pipe or equipment have any extensive corrosion?	☐ Yes ☐ No ☐ N/A	
Have forklift drivers been trained to take extra care when operating around the ammonia equipment?	☐ Yes ☐ No ☐ N/A	
Are all ammonia related confined spaces (bunkers, evaporative condensers, etc.) clearly labeled?	☐ Yes ☐ No ☐ N/A	
Is there a shower and eyewash station located in close proximity to the ammonia equipment (10 seconds or 100 feet)?	☐ Yes ☐ No ☐ N/A	
Are all operational employees fully aware of their responsibilities in the event of an ammonia leak?	☐ Yes ☐ No ☐ N/A	
In the event of a catastrophic ammonia leak, do you know who to notify?	☐ Yes ☐ No ☐ N/A	
Have all compressor safeties been tested within the last 12 months?	☐ Yes ☐ No ☐ N/A	
Does the facility have an ammonia detection system that is calibrated and operational?	☐ Yes ☐ No ☐ N/A	
Is the RMP/PSM/CalARP program prepared and being implemented?	☐ Yes ☐ No ☐ N/A	
If an ammonia leak occurs at your facility on a Saturday night at 11pm, do you have a contingency plan in place?	☐ Yes ☐ No ☐ N/A	

After completion of this form, please email it to ntorres@resourcecompliance.com or fax it to (559) 591-8896 and we will upload the information into PSMWriter.