


Association of AMMONIA REFRIGERATION

## Advantage Ammonia

### Emergency Response

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### AMMONIA PROPERTIES

- AMMONIA IN LIQUID FORM IS COLORLESS BUT GIVES WHITE EXPANDING CLOUDS WHEN VAPORIZED IN ATMOSPHERE.
- AMMONIA READILY DISSOLVES IN WATER.
- UNDER NORMAL ATMOSPHERIC PRESSURE & TEMP., AMMONIA IS PRESENT IN GASEOUS FORM
- AMMONIA HAS GOT A PUNGENT SMELL & CAN BE SMELT AT AS LOW A LEVEL AS 1 PART PER MILLION.
- AMMONIA IS LIGHTER THAN AIR & THEREFORE GETS DISPERSED EASILY.
- FIRE HAZARD IS EXTREMELY LOW THE FLAMMABLE RANGE OF AMMONIA IS 16 TO 25 PERCENT BY VOLUME IN AIR.

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### Misconceptions: Ammonia Is Flammable ?

Ammonia is extremely hard to ignite ( above 650°C) and breaks down above 450°C

Pure ammonia is considered flammable between the 16% and 27% atmospheric pressure


Ammonia is classified as Class B2L and hence not considered as highly flammable refrigerant.

Ammonia is less flammable as compared with many hydrocarbons and other fuels which are used in Day to Day life.

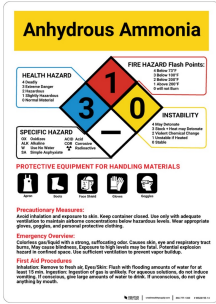
Its ignition energy is 50 times higher than the natural gas and ammonia cannot burn without presence of supporting flame.

Ammonia in vapor state will not sustain a flame.

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### Ammonia Hazard Rating



**Anhydrous Ammonia**

**HEALTH HAZARD**  
4: Fatal  
3: Extreme Danger  
2: Serious  
1: Irritant  
0: Non-Hazardous

**FIRE HAZARD** Flash Point:  
0: Below 23°F  
1: Below 100°F  
2: Below 200°F  
3: Above 200°F  
4: Not Flammable

**INSTABILITY**  
4: Very unstable  
3: Unstable  
2: Moderately stable  
1: Stable  
0: Very stable

**SPECIFIC HAZARD**  
OX: Oxidizer  
AK: Air Pollution  
W: Water Reactive  
SA: Simple Asphyxiant  
COR: Corrosive  
C: Compressed Gas  
F: Flammable  
T: Toxic


**PROTECTIVE EQUIPMENT FOR HANDLING MATERIALS**

**Precautionary Measures:**  
Avoid contact and exposure to skin. Keep container closed. Use only with adequate ventilation and proper safety procedures. Use appropriate personal protective clothing.


**Emergency Overview:**  
Container can react with a strong oxidizing agent. Causes skin, eye and respiratory tract injury. The usual practice is to spray with water to cool the container and to prevent further leakage.

**First Aid Procedures:**  
Inhalation: Remove to fresh air. Give O<sub>2</sub> if breathing apparatus is available. If not, give artificial respiration. If not, give mouth-to-mouth respiration.

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### Hazard Rating Guide



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**CONSULT MSDS FOR FURTHER INSTRUCTIONS**

| RATING EXPLANATION GUIDE  |   |   |
|---|---|---|
| HEALTH  | FLAMMABLE   | INSTABILITY   |
| Recommended Protection  | Susceptibility to Burning                         | Susceptibility to Energy Release                    |
| 4<br>Special full protective suit and breathing apparatus must be worn. | 4<br>Very flammable.                              | 4<br>May detonate under normal conditions.          |
| 3<br>Full protective suit and breathing apparatus should be worn.       | 3<br>Ignites under normal temperature conditions. | 3<br>May detonate with shock or heat.               |
| 2<br>Breathing apparatus with full face mask should be worn.            | 2<br>Ignites with moderate heating.               | 2<br>Violent chemical change but does not detonate. |
| 1<br>Breathing apparatus may be worn.                                   | 1<br>Ignites when preheated.                      | 1<br>Not stable if heated use precautions.          |
| 0<br>No precautions necessary.  | 0<br>Will not ignite.                             | 0<br>Normally stable.                               |

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### Possible locations of ammonia leaks

- 1.Storage tanks/vessels/Receivers
- 2.Flanges –Joints
- 3.Pressure Relief Valves
- 4.Piping-Charging methods
- 5.Manually operated valves-Oil drain
- 6.Oil Pots
- 7.Compressors/Pumps
- 8.Sight Glass

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**Ammonia leaks**

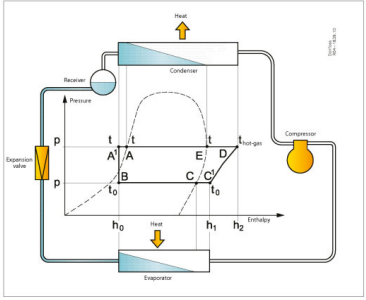
1. Ammonia Liquid Leaks - Density @ 40 deg C - 579.4 kg/m<sup>3</sup>
2. Ammonia Vapour Leaks - Density @ 40 deg C - 12 kg/m<sup>3</sup>
3. Liquid Density 48.22 Times more

**Liquid Ammonia Leaks are More Dangerous Than Vapour**

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TYPICAL REFRIGERATION CYCLE WITH PH DIAGRAM



$t_1$  = condensing temperature  
 $p_1$  = condensing pressure  
 $t_2$  = liquid temperature  
 $t_0$  = evaporating temperature  
 $p_0$  = evaporating pressure


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Emergency action plan SOP

- Means of reporting leakages / fires and other emergencies . . .
- Evacuation procedures and emergency escape route assignments .
- Procedures to be followed by employees who remain to operate critical plant operations before they evacuate . .
- Procedures to account for all employees after an emergency evacuation has been completed . .
- Rescue and medical duties for those employees who are to perform them.
- Names or job titles of persons to be contacted for further information or explanations of duties under the plan .


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Operational leaks from refrigeration systems are not uncommon.

- The established exposure limit for ammonia is 25 ppm . .
- Hand held ammonia leak detector should always be available .
- Sulphur powder or Yellow paper can also be used to identify leak location . .
- Trained refrigeration operators should only attempt to repair leak . .
- Higher technical authorities should be informed about leak and repair procedure planned .


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Procedure for handling Small Leaks .

- The operator will attempt to identify leak location . .
- Nearest valves to leak points should be closed to minimise leak .
- Ventilation should be used to reduce ammonia concentration in area of leak .
- Operator will wear appropriate PPE like gloves , respirator , face mask , long rope etc .
- A backup person should be available as a standby .
- Never spray water directly on liquid ammonia as it will form Gas cloud which when inhaled is dangerous.


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LEVEL 1 LEAKS .

- Activation at 50 ppm .
- Alarm sounds locally .
- Higher technical authorities should be informed about leak and repair procedure planned .
- Non trained personnel should leave area immediately .
- Trained personnel should respond to leak and make repairs .
- Emergency response personnel be alerted to stand by or assist
- At least one emergency exhaust fan must be operational at full speed .


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**LEVEL 2 LEAKS .**

- Activation at 300 ppm .
- Alarm sounds throughout plant .
- Higher technical authorities should be informed about leak and repair procedure planned .
- Non trained personel should leave area immediatly .
- Trained emergency response personnel with complete PPE should respond to leak and make reapiers .
- All emergency exhaust fan must be operational at full speed .


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**LEVEL 3 LEAKS .**

- Activation at 5000 ppm .
- Alarm sounds throughout plant .
- Higher technical authorities should be informed about leak and repair procedure planned .
- Notification to public agencies for assistance .
- Compressors, pumps should be shut down and system isolation valves closed .
- Trained emergency response personnel with complete PPE should respond to leak and make reapiers .
- All emergency exhaust fan must be operational at full speed .


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**LEAKS BEYOND LEVEL 3.**

- Stop all electrical equipments by emergency stop button provided outside machine room .
- Alarm sounds throughout plant .
- All emergency exhaust fan must be operational at full speed .
- Water sprinklers should be activated .
- Near by fire station to be informed . .
- PA system to be used to inform about emergency .
- Evacuate all personnel in affected area to designated assembly point .
- Take a head count to ensure no one has left behind .
- Check rooms and other enclosed spaces for personnel who may have trapped or otherwise unable to evacuate .


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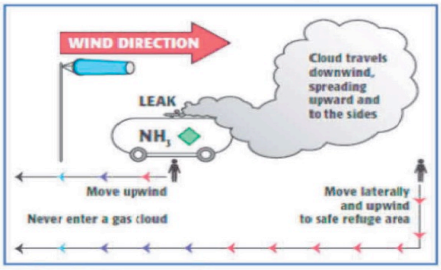
**LEAKS BEYOND LEVEL 3**

- While evacuating follow designated route only and in case of blockage of route due to smoke follow route opposite to wind direction.
- Under no circumstances any one who does not have assigned duty be allowed to return to evacuated area unless area is declared safe .
- Never ever enter cloud or fog of ammonia . Ammonia in cloud form is very concentrated and it can burn the skin .

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**Evacuation Strategy**

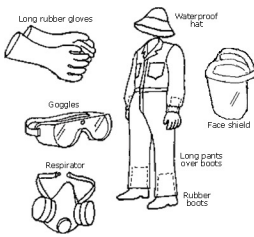


The diagram illustrates an ammonia leak scenario. A red arrow labeled 'WIND DIRECTION' points to the right. A source labeled 'LEAK NH<sub>3</sub>' is shown with a cloud of gas spreading downwind, upward, and to the sides. A person is shown moving upwind and laterally away from the cloud. Text instructions include: 'Move upwind', 'Never enter a gas cloud', and 'Move laterally and upwind to safe refuge area'. A note states: 'Cloud travels downwind, spreading upward and to the sides'.

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**RECOMMENDED MINIMUM PERSONNEL PROTECTION EQUIPMENT**



The diagram shows a person wearing full protective gear. The equipment listed includes: Long rubber gloves, Goggles, Respirator, Waterproof Tuit, Face shield, Long pants over boots, and Rubber boots.

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**Effect on Human being in case of Ammonia exposure**

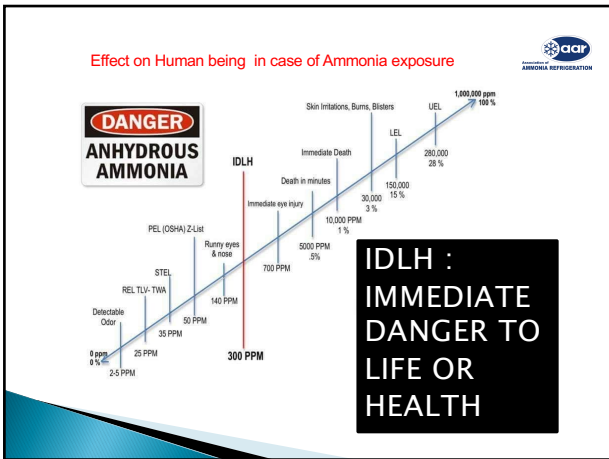
|             |  |  |
|-------------|--|--|
| 25 PPM      | Odour detectable by most persons   | Max. 8 Hrs.  |
| 100 PPM     | 1. Eye irritation.<br>2. Conjunctivitis.<br>3. Swelling of eye lids.<br>4. Lips dry.<br>5. Red mouth/Throat burning. | Deliberate exposure for long period not permitted. |
| 400-700 PPM | Immediate eye and respiratory tract irritation.  | No serious effect up to 1 hr.                      |

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**Effect on Human being in case of Ammonia exposure**

|                |  |                                |
|----------------|--|--------------------------------|
| 1700 PPM       | Coughing severe eye and respiratory tract irritation | Could be fatal after ½ an Hrs. |
| 2000-3000 PPM  |  | Could be fatal after 15 Min.   |
| 5000-10000 PPM |  | Fatal within minutes.          |

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- First Aid in case of Ammonia exposure**
- 
- Flush eyes with water. Keep eyelids open while flushing.
  - Eyes can be washed with 0.5-1% alum.
  - Neutralize ammonia by mouthwash gargle & with a mixture of one part of vinegar with four parts of warm water.
  - Thoroughly wash the affected skin with running water for at least 10 min.
  - Drink plenty of water at regular intervals.
  - Inhale warm water vapours
  - In case of severe discomfort, consult a doctor.

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**ACKNOWLEDGEMENTS .**

- Various AAR Publications .
- OSHA
- Past presentations of AAR

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**Thank You**

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