CUSTOMER MANUAL – AQUA AMMONIA

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AQUA AMMONIA PROPERTIES

Aqua ammonia, also called ammoniacal liquor, ammonia liquor or ammonia water is produced by dissolving ammonia gas in water. Its proper chemical name is Ammonium Hydroxide.

The grades, or strength of Ammonium Hydroxide usually available commercially are 26° and 21° Baumé. However, Tanner Industries can produce any strength to meet our customers requirements. The Baumé reading refers to a specific gravity scale. A 26° Baumé solution is equivalent to 29.4% and 21° Baumé solution is equivalent to 19.68%, both by weight of ammonia dissolved in water. Since the Baumé reading varies with temperature, the reading is standardized at 60°F. The density of the material compared to water is 0.8974. See Aqua Ammonia Table.

Aqua ammonia is corrosive to copper, cooper alloys, aluminum alloys and galvanized surfaces. Aqua ammonia is an excellent acid neutralizer. Its pH varies with concentration. Typical values are 11.7 at 1%, 12.2 at 5%, 12.4 at 10% and 13.5 at 30%.

The freezing point of a 26° Baumé solution is about -110°F. The freezing point of other concentrations is in the table below.

*** SPECIFIC GRAVITY, BOILING POINTS AND FREEZING POINTS OF VARIOUS AQUA AMMONIA SOLUTIONS**

		AMMONIA CONCENTRATION				
°BAUMÉ 60° F	SP. GR. 60°/60°F	$\%NH_3$ BY WT. IN SOLUTION	LBS. NH_3 PER CU. FT SOLUTION	LBS. NH_3 PER GAL. SOLUTION	APPROXIMATE BOILING PT. °F AT ONE ATMOS OF PRES.	APPROXIMATE FREEZING PT. °F
10	1.0000	0.00	0.0000	0.0000	212	+32
11	0.9929	1.62	0.7504	0.1003	195	+28
12	0.9859	3.30	2.0289	0.2712	186	+25
13	0.9790	5.02	3.0652	0.4097	177	+20
14	0.9722	6.74	4.0871	0.5463	171	+16
15	0.9655	8.49	5.1122	0.6834	163	+10
16	0.9589	10.28	6.1479	0.8218	156	+6
17	0.9524	12.10	7.1873	0.9608	149	-2
18	0.9459	13.96	8.2355	1.1009	142	-11
19	0.9396	15.84	9.2824	1.2409	134	-15
20	0.9333	17.76	10.337	1.3819	127	-26
21	0.9272	19.68	11.380	1.5213	120	-31
22	0.9211	21.60	12.408	1.6587	111	-46
23	0.9150	23.52	13.422	1.7942	103	-56
24	0.9091	25.48	14.446	1.9312	95	-69
25	0.9032	27.44	15.456	2.0662	88	-89
26	0.8974	29.40	16.454	2.1996	85	-110
27	0.8917	31.36	17.439	2.3313	73	-123
28	0.8861	33.32	18.413	2.4615	66	-148
29	0.8805	35.28	19.375	2.5901	59	-143

An aqua ammonia solution has a vapor pressure which varies with temperatures. At ambient temperatures, the vapor pressure of 26° Baumé material just about equals atmospheric pressure. Aqua ammonia should be stored in a closed container and kept cool, otherwise, the ammonia gas will come out of solution and the material strength will be reduced.

TOTAL VAPOR PRESSURE OF AQUA AMMONIA SOLUTIONS (Expressed in Pounds Absolute):

	TEMPERATURE OF SOLUTION IN °F									
% NH_3	32	40	50	60	70	80	90	100	110	120
2	.2	---	.3	.5	.7	1.0	1.3	1.7	2.2	2.8
4	.3	.4	.5	.7	1.0	1.3	1.8	2.4	3.1	3.9
6	.4	.6	.7	.9	1.2	1.8	2.3	3.0	3.8	4.8
8	.6	.7	.8	1.2	1.5	2.2	2.8	3.6	4.5	5.8
10	.7	.8	1.1	1.5	1.9	2.5	3.3	4.2	5.3	6.8
12	.8	1.0	1.2	1.7	2.3	3.1	4.0	5.1	6.4	7.9
14	1.0	1.2	1.6	2.2	2.8	3.7	4.8	6.1	7.6	9.4
16	1.2	1.5	1.9	2.7	3.5	4.4	5.6	7.2	9.0	11.1
18	1.4	1.8	2.3	3.2	4.2	5.3	6.7	8.5	10.6	13.2
20	1.8	2.2	2.9	3.8	5.0	6.4	8.1	10.1	12.5	15.6
22	2.2	2.7	3.6	4.6	6.0	7.7	9.6	12.1	14.9	18.3
24	2.6	3.3	4.3	5.6	7.1	9.1	11.4	14.2	17.6	21.5
26	3.2	4.0	5.2	6.7	8.7	10.8	13.8	17.0	20.8	25.6
28	3.9	4.8	6.3	8.1	10.3	12.8	16.2	20.2	24.7	30.0
29.4	4.4	5.5	7.2	9.1	11.7	14.6	18.2	22.8	27.8	---
30	4.7	5.8	7.7	9.7	12.3	15.3	19.1	24.0	29.3	---
32	5.7	7.0	9.1	11.6	14.6	18.1	22.4	28.1	---	---
34	6.8	8.3	10.7	13.6	17.0	21.3	26.3	---	---	---
36	8.1	9.8	12.7	15.8	19.7	24.9	30.2	---	---	---
38	9.5	11.5	14.8	18.6	22.9	28.6	---	---	---	---
40	11.0	13.3	17.2	21.6	27.1	32.3	---	---	---	---

AQUA AMMONIA QUALITY

Aqua ammonia is produced by dissolving anhydrous ammonia in water. There are various manufacturing processes to produce aqua ammonia. A commonly used method is the batch method. This is done in batch quantities of approximately 10,000 gallons with successive batches being stored in larger tanks for repackaging and distribution.

Tanner Industries offers both technical grade and reagent grade aqua ammonia. For technical grade material, the incoming water is initially softened in a resin exchange softener, and meets the National Formulary, Federal Specification A-A-59370, and Food Chemical Codex specifications. For reagent grade material, the incoming water is de-ionized through a cationic and anionic medias, and meets USP Reagent Grade and American Chemical Society Reagent Chemicals specifications.

Your process requirements will determine which grade of material you will need.

The softening or de-ionized water is introduced into a holding or absorber tank. Ammonia is injected and the mixture circulated through a cooler to minimize the temperature rise resulting from the chemical reaction. During circulation, a ten micron filter continuously removes any precipitating solids from the solution to meet our rigid product quality standards.

Quality control consists of insuring that the water is properly softened or de-ionized, that the final ammonia concentration meets specifications and checking the material color and clarity to insure proper filtration.

Trace elements introduced by the water are periodically analyzed by an outside laboratory. Typical elements tested for include iron, heavy metals such as lead, chloride, carbonate, sulfate, arsenic, zinc, chromate, non-volatile residue and substances reducing permanganates (organics). Where customers are interested in the quantities of trace elements other than those listed, specialized testing can be requested.

Dedicated containers are maintained in the distribution process to minimize the possibility of contamination.

Questions concerning product quality, strength measurement, etc. are welcomed. Please contact us at 1-800-643-6226.

HAZARDOUS PROPERTIES

Ammonia, as a gas or in aqueous solution is an irritant and corrosive to the skin, eyes, respiratory tract and mucous membranes. It may cause severe burns, eye or lung injuries. Skin and respiratory related diseases are aggravated by exposure.

Ammonia vapor, when mixed with air, may be flammable within certain limits (15% to 28% gaseous ammonia by volume). Such concentrations are seldom encountered in practical handling; however, extreme caution should be exercised when welding on or near tanks containing or which formerly contained aqua ammonia. Aqua ammonia tanks, lines and equipment should be thoroughly purged of both aqua ammonia and ammonia vapors. The common metals are not affected by dry ammonia. Moist ammonia will not corrode iron or steel but will react rapidly with copper, brass, zinc and many alloys, especially those containing copper. Only steel or ductile iron should be used for ammonia containers, valves, fittings and piping.

AQUA AMMONIA – STRENGTH DETERMINATION

A convenient method for measuring the strength of aqua ammonia is to measure its density by means of a hydrometer containing a thermometer. Since the density of a given strength of aqua varies with temperature, both density and temperature measurements must be taken. Density may be expressed in either specific gravity or degrees Baumé; degrees Baumé is usually used.

Note the degree of accuracy that is necessary when taking the readings. A 0.1 Degree error in Baumé reading results in a 0.2% error in ammonia content. A 1.0 Degree error in temperature reading results in a 0.1% error in ammonia content. Note also that an error in the reading of each could be additive.

Care must be taken when obtaining the readings to be sure that the aqua sample does not lose strength due to the ammonia coming out of solution before the reading is taken. To obtain the most accurate determination of aqua strength, the following procedures should be followed.

The aqua sample should be of sufficient quantity to minimize the effect of ammonia vapor loss and temperature variation. We recommend the use of a 50x400 mm hydrometer cylinder.

Proper handling procedures including use of safety goggles, rubber gloves and other protective equipment should be observed. Testing should be performed in a well-ventilated area. The sample should be taken directly into the hydrometer cylinder in such a manner that the formulation of entrained bubbles is minimized. These bubbles of ammonia vapor rise to the surface and are lost, thus reducing the strength of the aqua sample. The use of a rubber hose on the sampling spigot might help to prevent this loss.

The Baumé reading should be taken at the liquid surface immediately. Every second delay results in a reduction in strength of the ammonia sample.

The temperature should be taken last with sufficient time allowed to permit the thermometer to stabilize. This may take as long as 45 seconds to a minute. Experience has shown that the temperature reading is a major source of error.

SHIPPING CONTAINERS FOR AQUA AMMONIA

Aqua ammonia is usually shipped in either cargo tanks, polyethylene drums or composite drums.

Aqua ammonia drums should be stored out of the sun and away from heat. Drums should not be subjected to rough handling or to abnormal mechanical shock such as dropping or bumping. They should be opened carefully to permit the venting of any ammonia vapors which may have formed in the container. Use a wrench with a long handle, stand to one side and face away during the operation. Chemical safety goggles, face shield, rubber aprons and gloves should be worn. Allow accumulated pressure to vent before removing plug completely.

Drums should be emptied by gravity only. Use a faucet or safety siphon made of material resistant to ammonia; no brass or bronze. Application of pressure to the drum for unloading is dangerous and should not be attempted.

Ammonia solutions in water with concentrations between 10% and 35% have a DOT hazard classification of 8 and are to be labeled as Corrosive. Their identification number is UN2672 and are to be packaged in Group III containers. As of October 1, 1996 when HM-181 became effective, all Group III containers have to conform to UN specifications and standards. These requirements are outlined in CFR 173.24a(b)(4): Packaging tested as prescribed in CFR 178.605 of this subchapter may be used for liquids only when the vapor pressure of liquid conforms to one of the following:

> (b)(4)(i) The vapor pressure must be such that the total pressure in packaging (i.e. the vapor pressure of liquid plus the partial pressure of air or other inert

gases, less 15 psi at 131°F, determined on the basis of maximum degree of filling in accordance with paragraph (d) of this section) and a filling temperature of 59°F, will not exceed two-thirds of the marked test pressure, or

(b)(4)(ii) The vapor pressure must be such that the total pressure in packaging at 122°F must be less than four-sevenths of the sum of marked test pressure plus 15 psi, or

(b)(4)(iii) The vapor pressure must be such that the total pressure in packaging at 131°F must be less than two-thirds of the sum of marked test pressure plus 15 psi.

STORAGE OF AQUA AMMONIA

Because the vapor pressure of aqua ammonia is about equal to the atmospheric pressure, it must be stored in closed containers.

The storage area should be dry and cool. If housed in a closed building, ventilation should be provided; either natural or mechanical. Avoid pocketing of ammonia vapor under floors, roofs or similar structures.

Remember, ammonia vapor will burn when mixed in air at concentrations between 15% to 28%. Sparks or ignition sources must be excluded wherever concentrations in this range could exist.

AQUA AMMONIA STORAGE TANKS

Carbon steel or stainless steel construction for the tank is recommended. If other materials are used, their compatibility with aqua ammonia should be verified by the tank manufacturer. Tanks should have a 30 psi pressure rating. They should be equipped with safety relief valves rated for that pressure and they should also be equipped with a vacuum breaker. Steel tanks should be grounded. Other tanks constructed of different material or with lower pressure ratings require careful design. Please contact us for further assistance.

BULK DELIVERIES BY CARGO TANK TRUCK

Deliveries to aqua ammonia storage tanks are made by bulk transport of approximately 6,700 gallons. A storage tank should be sized to hold at least one and a half times this amount or about 10,000 gallons.

Transfer of material from the cargo tank transport to the stationary storage tank may be accomplished by various methods.

Compressor Method

Tanner Industries' tractors are equipped with PTO powered compressors which can produce about 10 psig differential pressure. Air or vapor pressure is used to push the material out of the cargo tank into the storage tank. Some provision must be made to prevent the buildup of pressure in storage tanks rated less than 30 psi as they are being filled. This can be done by permitting the compressor vapor to escape to a scrubber system and also through the compressor back to the cargo tank.

If a scrubber system is used, it can be constructed using a properly labeled water container. The vapors are introduced into the water through a sparger to produce small bubbles for easier absorption. Disposal of the weak aqua solution produced may present a problem. Many of our customers recycle the solution back into their storage tank.

If the vapor is fed through the compressor back to the cargo tank, precautions should be taken to insure that the storage tank is not exposed to substantial vacuum. A vacuum on the storage tank could result in its collapse or in a reduction in strength of aqua ammonia which it contains. To prevent the possibility of a vacuum occurring in the storage tank, a supplementary vacuum breaker is used. Our drivers are equipped with a special fitting for this purpose.

Pump Method

The pump method is also used with the PTO shaft driving the liquid pump. When using a pump, it should be kept in mind that the vapor pressure of the aqua ammonia is about equal to atmospheric pressure and that any suction pressure will cause the ammonia vapor to come out of solution and vapor lock will occur. Systems should be designed so that the pump is as near to the hose connection as possible and that the hose length required will be as short as possible, twenty feet or less.

Gravity Method

This method simply uses the force of gravity to move product from the delivery unit to the receiving tank. It usually only requires the use of one transfer hose for liquid aqua ammonia. There is no vapor connection. For this method of delivery, the storage tank would have to be a lower level than the delivery unit.

MATERIALS FOR PIPING & FITTINGS

Vapor lines should be sized at 1 or 1-1/4" and liquid lines at 2 inches. Schedule 40 or 80 steel pipe and malleable iron pipe fittings are acceptable. Do not use galvanized pipe or fittings and make sure the unions do not have brass seats. Make sure that other fittings such as valves, pressure reliefs and back checks are suitable for ammonia service. Plastic pipe and fittings (with manufacturer's approval) may also be used. Hose connectors need not be provided as Tanner Industries' transports carry adapters to fit standard pipe threads.

SYSTEM DESIGN

Unlike Anhydrous Ammonia, Ammonium Hydroxide storage systems do not have to comply with any published regulatory standards or specifications.

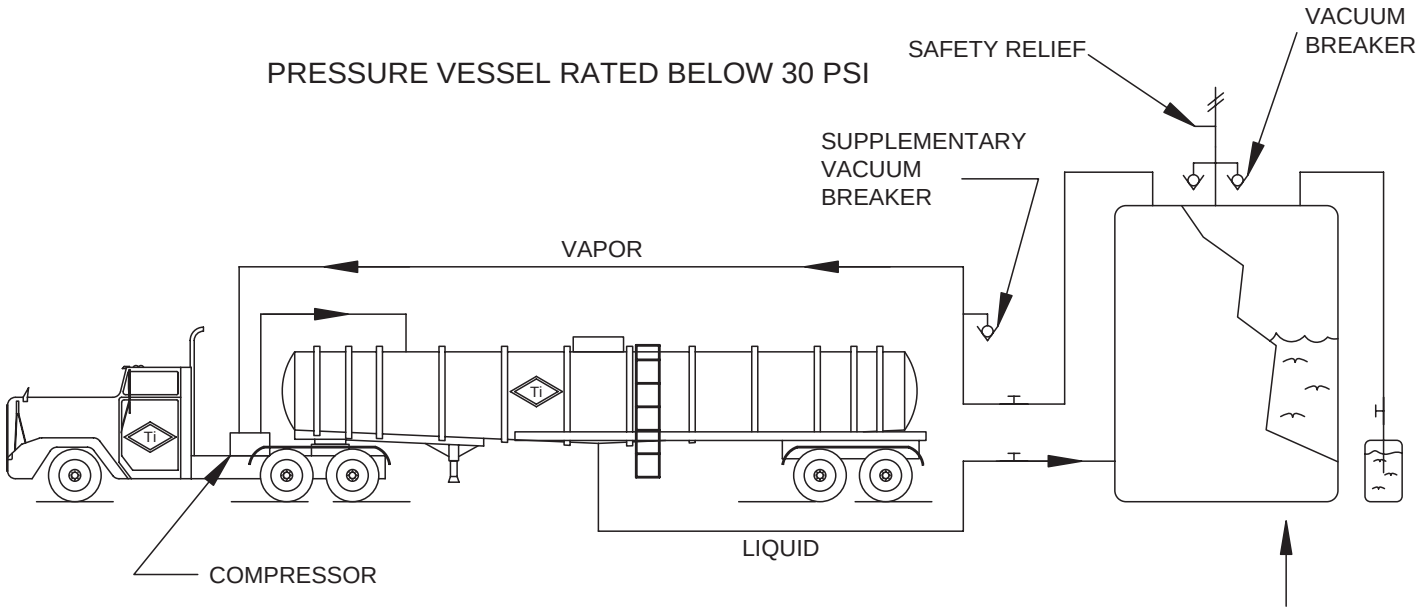
Therefore, it is imperative that these systems are designed by qualified personnel having prior experience with the product. Tanner Industries, Inc. can assist you in designing or modifying your system to operate in a safe, efficient and environmentally responsible manner.

Notice

We believe the information contained in this manual to be accurate and reliable; however, Tanner Industries, Inc. assumes no liability or responsibility in connection with the information or suggestions herein contained. Moreover, it should not be assumed that every acceptable test or safety procedure or method, precaution, equipment or device is contained within, or that abnormal or unusual circumstances may not warrant or suggest further requirements or additional procedures.

The information contained in this manual should not be confused with federal, state, municipal, or insurance requirements, or with national safety or building codes, and no representations or warranties are made with respect thereto.

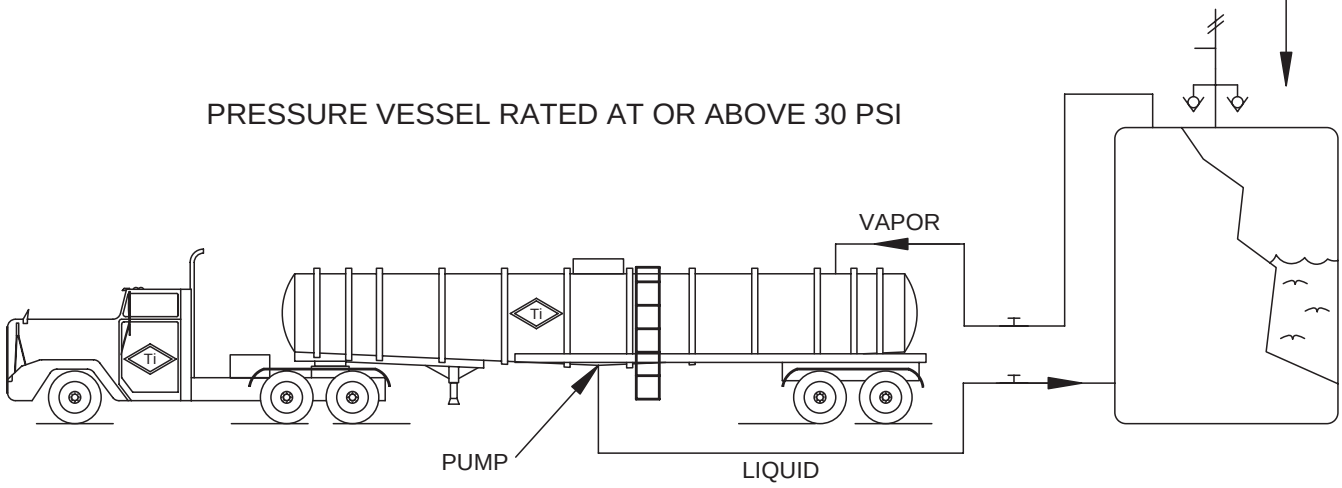
PRESSURE VESSEL RATED BELOW 30 PSI



COMPRESSOR METHOD

CARBON OR STAINLESS

PRESSURE VESSEL RATED AT OR ABOVE 30 PSI



PUMP METHOD