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Instruction Manual
Model 2100
The Nold DeAerator™



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1. INTRODUCTION

The following manual is extracted from a longer version written by the inventor of the DeAerator – Walter Nold, (1914-2002). The reader will find that this manual, while it covers all the relevant points for the installation and operation of the DeAerator, lacks the in-depth discussion of background information, the humorous asides and the passionate explication of related topics so characteristic of the original. The full manual is included with this condensed manual; read and enjoy.

2. THEORY OF OPERATION

The Nold DeAerator™ is designed for the rapid degassing of liquids at ambient temperatures by means of cavitation and nucleation produced by violently agitating the liquid while it is held under a vacuum. The agitation is produced by means of an impeller coupled by a magnetic clutch to an electric motor. Cavitation occurs behind the blades of the rapidly rotating impeller causing the liquid to vaporize into a fine mist-like spray, (nucleation). Gases released from this spray are hurled outwards by centrifugal forces and bubble upwards into the evacuated space above the liquid from whence they are removed.

3. INSTALLATION

The Nold DeAerator™ comes equipped with rubber feet designed to sit on a flat surface. In some cases the phenomenon of “bumping,” described later in section 4.2, may cause the DeAerator to walk over this surface so it will be wise to trap the DeAerator in some way so that it cannot move around.

3.1 Power Requirements

DeAerators may be powered by 115V 60Hz or 230V 50/60Hz. The 115V models are equipped with a power cord and 3-pin plug. The 230V models are equipped with a power cord that terminates to bare wires. The wiring code is as follows:

Wire Color	115V	230V
Black (BK)	Line, L	Line, L
White (WT)	Neutral, N	Line, L
Green/Yellow (GN+YL)	Ground, PG, or PE	Ground, PG, or PE

Each DeAerator motor has a built in thermostat, which automatically turns the motor off if it gets over-heated. Upon cooling to normal temperatures the motor will restart.

3.2 Vacuum Requirements

For correct operation of the DeAerator it is critical that the applied vacuum be better than 12 Torr, (12mm Hg, 12,000 microns absolute, or 740mmHg, 29.5inches Hg gage), The vacuum source may be either a vacuum pump, (not supplied), or a water aspirator supplied with the equipment.

3.2.1 Vacuum Pumps

A belt-driven, two-stage, oil-filled vacuum pump with a capacity of 25 liters per minute is best. Pump oil should be carefully watched and changed regularly. Water traps are strongly recommended, installed between the DeAerator and the pump, so that the pump cannot suck water directly from the DeAerator - especially possible when the liquid being degassed foams excessively. (A suitable pump is Welch Model 1400).

3.2.2 Water Aspirator

The water aspirator supplied with the equipment should be connected to a water supply with a pressure of at least 450 KPa, (65 psi). The water should have a temperature of around 15°C for best operation. The connection to the aspirator requires a 3/8 NPT female connector adapted to the water outlet. The barb fitting can be connected to a plastic or rubber tube leading to a drain. The smaller barb fitting is connected to the DeAerator. Operation of the aspirator will consume a total of around 12 liters of water.

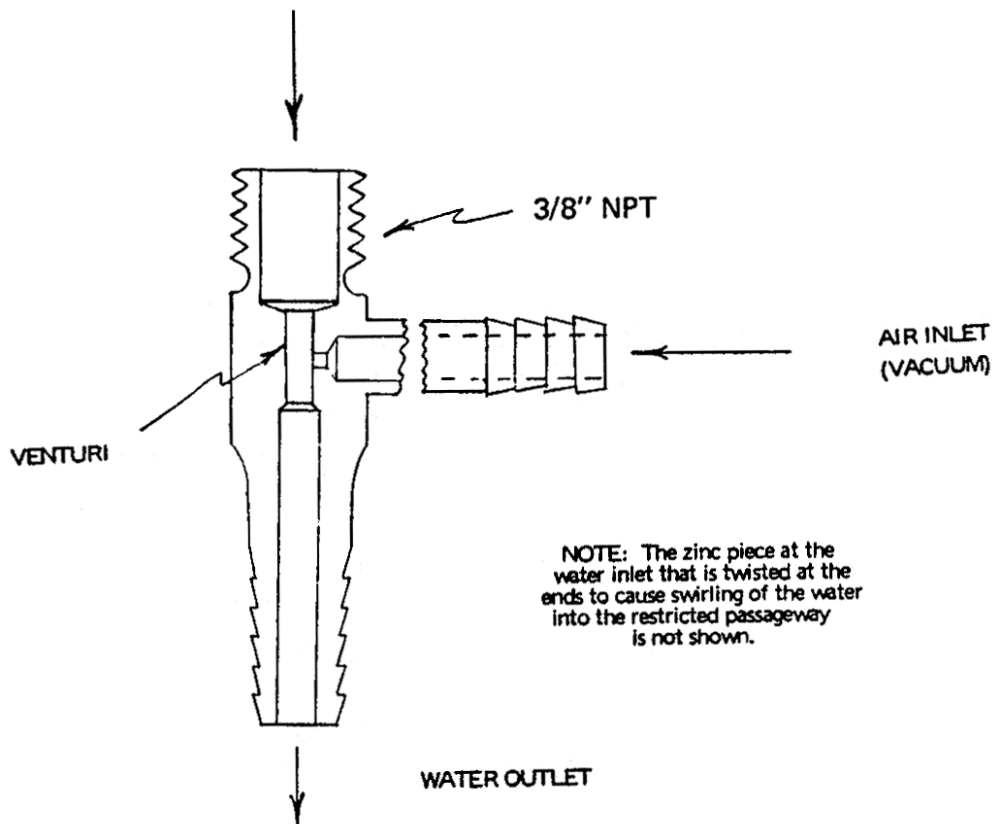


Figure 1 - The Water Aspirator

3.2.3 Vacuum Gages

Vacuum gages are not strictly required since the presence or absence of "bumping" (see section 4.2), will serve as an indication that the required level of vacuum has not been reached. Many vacuum gages are susceptible to damage by water vapor so select a type that can be used with water, and use a moisture trap. Connect the vacuum gage to the second vacuum line on the DeAerator. A Vacuum gage measuring in Torr, or mm Hg, is to be preferred.

4. OPERATION

The full DeAerator set up is shown in figure 5. Valving is accomplished by use of the pinch clamps supplied with the DeAerator. Two lengths of PVC plastic tubing, with connectors, are supplied with the equipment. Three fittings are to be found on either side of the DeAerator: two of these fittings, (one on either side), are blanked off for use with other possible configurations.

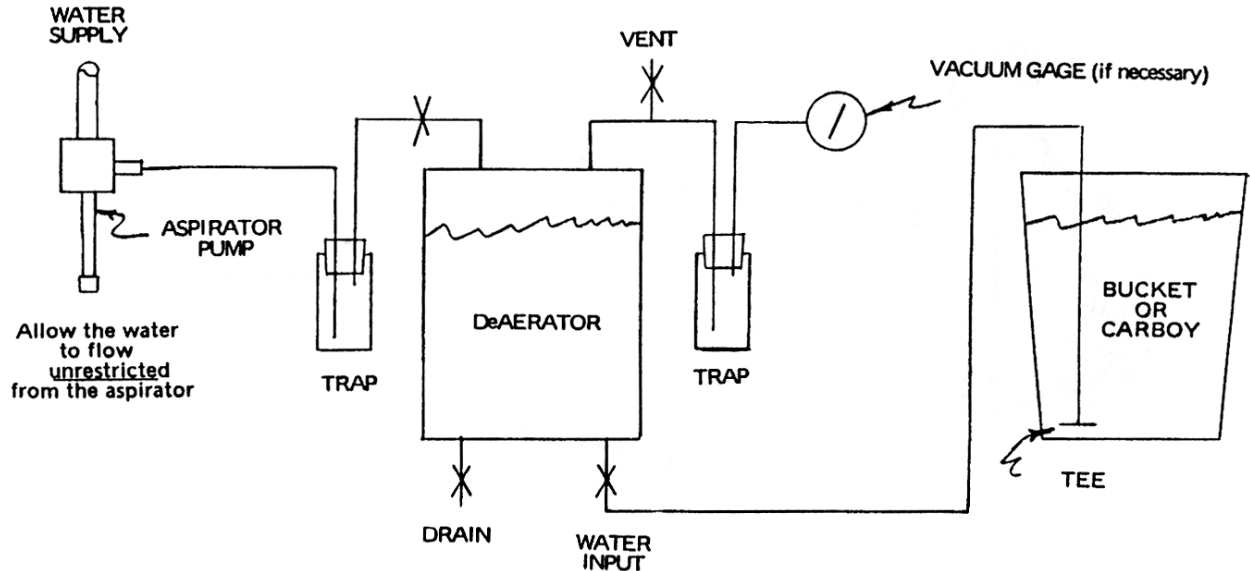


Figure 2 - The DeAerator System with Aspirator

The moisture trap is not essential but it will prevent water from being drawn into the vacuum pump if the DeAerator is inadvertently allowed to overflow or if excessive foaming is not controlled (see section 4.2).

4.1 Filling the DeAerator

Connect the filling tube to the fitting on the DeAerator, which leads into the bottom of the tank. The other end of the filling tube goes inside the vessel containing the liquid to be degassed. A Tee fitting, placed on the end of the filling tube will help to keep the end of the filling tube in place on the bottom of the vessel. Water is drawn into the DeAerator by applying a vacuum to one of the vacuum connections on the DeAerator. (The vacuum connections lead to two long tubes, which terminate at the top of the DeAerator tank). The latex drain tube remains pinched off, as does the second vacuum tube if a vacuum gage is not connected. (**Note: the DeAerator is NOT designed to allow filling from high-pressure sources**).

Fill the DeAerator to a level no more than 2 to 3 inches from the Top Plate. Do not overflow; space must be left to accommodate for frothing and expansion. For glycol solutions, which have a greater tendency to foam, this distance may need to be greater.

Always have at least 15 to 20 cm, (6 to 7 inches), of liquid inside the DeAerator during the degassing process. This amount of liquid is necessary to lubricate the impeller mechanism.



Figure 3 - The DeAerator System, From Left to Right: Model 2100, Storage Tank, Moisture Trap, and Vacuum Pump

4.2 Degassing

After the tank has been filled pinch off the filling tube and evacuate the tank for 30 to 60 seconds before turning on the DeAerator motor. Initially a large amount of bubbles will be produced, the number will decrease until, after about 3 to 5 minutes, “bumping” should begin. If glycol or oil is being degassed the time may be longer. Also, **if excessive foaming is observed, creating a danger of liquid being sucked into the vacuum pump, it may be necessary to temporarily release the vacuum by opening the second vacuum tube connection to the DeAerator.** Or shut off the vacuum tube leading to the pump. The vacuum in a dry DeAerator should be around 5 to 8 Torr. However, with water vapor in the DeAerator the best vacuum will be around 20 Torr.

“Bumping” occurs when the dissolved gasses reach a gas content of around 0.3 to 0.6 ppm. It is best described as a hard knocking or slapping sound accompanied by the jumping up and down of the liquid inside the DeAerator and cavitation around the impeller producing a flashing appearance. Allow this “bumping” to proceed for about a minute then pinch off the vacuum tube, turn off the vacuum pump or aspirator, and switch off the motor. For most civil engineering and soils laboratory applications a total running time of 5 minutes is sufficient.

Retain the vacuum inside the DeAerator until such time as the liquid is ready to be dispensed - this will prevent re-aeration of the liquid. Dispense the de-aired liquid into a suitable storage vessel, (see section 5). Try not to agitate the liquid during this process. And take measures to see that air cannot reach the de-aired liquid, (see section 5).

5 STORAGE TANKS

Storage of a degassed liquid must be done in a way that prevents air from reaching it. For storage of degassed liquids over long periods of time a thick-walled glass carboy can be used.

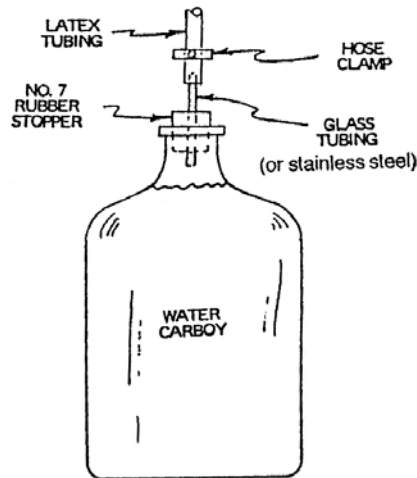


Figure 4 - Glass Carboy for Long-term Storage of Degassed Liquids

The carboy should be filled leaving a small space above the liquid that can be evacuated. This space will accommodate any expansion of the liquid due to temperature changes. Pull as high a vacuum as possible and then seal using a hose clamp.

The procedure can be applied to partially filled carboys but the danger of implosion will exist, so first test the empty carboy by wrapping it in cloth to contain the glass shards should the carboy implode when the test vacuum is applied. Temperature variations can be minimized, by placing the storage vessels in the refrigerator.

For short term storage plastic vessels can be used. Nylon is better than polyethylene or polypropylene since it is less permeable to gasses. Make sure the vessel is completely full.

A better solution for transportation and storage of degassed liquids is to use the type of expansion tank normally found in residential or commercial heating systems, (for example Amtrol Model WX-102), (see figure 6).

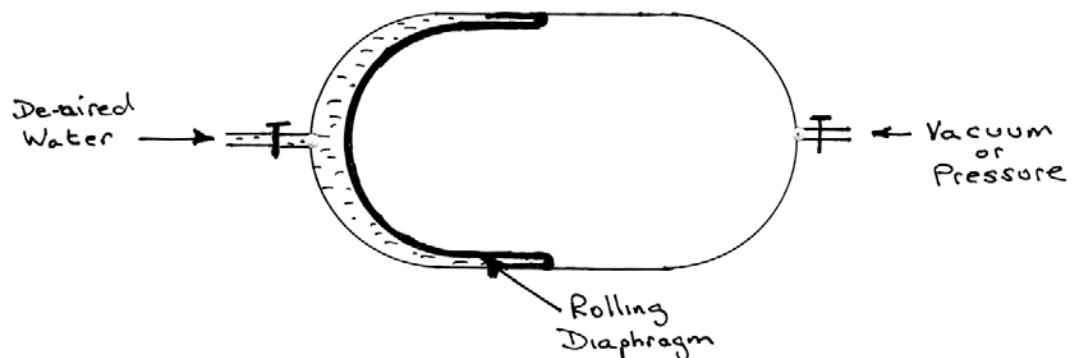


Figure 5 - Storage Tank

This type of tank incorporates a rolling rubber diaphragm, which separates one end of the tank from the other. The Amtrol Model WX-102 will hold up to 10 liters of de-aired fluid.

These tanks can be obtained from Geokon or from a local heating and plumbing supply house. The tanks supplied by Geokon have additional valves to facilitate the filling, dispensing and storage processes. **Please note that the rubber membrane is permeable to air such that after a few days any stored de-aired water will no longer be de-aired.** To prevent this from happening, the non-liquid side of the tank should be kept under a vacuum during storage.

5.1 Storage tank filling instructions

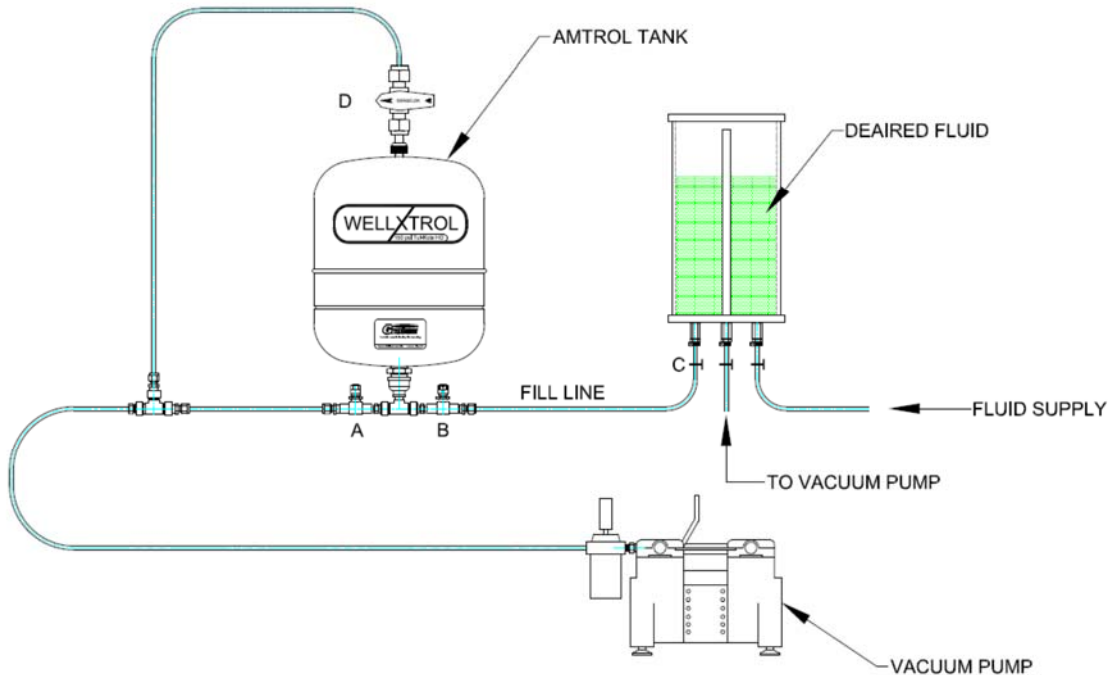


Figure 6 - Apparatus for filling a storage tank

Starting with the DeAerator full of de-aired fluid and under a vacuum at the top of the DeAerator:

Connect the fill tubing supplied, as shown in the sketch above... one leg to the top of the storage tank and one leg to Valve A on the bottom of the tank. The third leg of the Tee connects to the vacuum pump. Attach the fill line, supplied, from Valve B to the discharge line on the DeAerator.

Begin by de-airing both sides of the storage tank and the fill line with the discharge line at the bottom of the DeAerator pinched off at C. Open both valves A and B. switch on the vacuum pump. When the bladder tank and fill lines are completely de-aired **close Valve A and close Valve D**

Release the vacuum above the de-aired fluid inside the DeAerator and leave this vacuum line open to atmosphere. Open the pinch valve, C, and allow the de-aired fluid to flow from the DeAerator into the bladder tank. When the fluid level in the DeAerator is near the bottom, close Valve B and pinch off Valve C.

Remove the filling tubes or, if required, leave them in place to de-air another batch of fluid inside the DeAerator. Repeat the procedure until the bladder tank is full. The bladder tank is now filled with de-aired fluid and the top of the tank is under a vacuum.

To reclaim de-aired fluid from the storage tank connect to the filling valve at the base of the storage tank, **open Valve D** to release the vacuum, and allow fluid to drain from the tank by gravity. To speed up the process the top of the tank may be pressurized, (**pressure not to exceed 100psi**). An extension tube is supplied which can be connected to the top of the tank and, at its outer end, has a fitting to which a bike pump can be attached.

6 MAINTENANCE

6.1 Cleaning the Tank

The tank should be cleaned from time to time if there are signs of deposits on the inside. The tank is freed by removing the four bolts holding the Top Plate. When removing the bolts note the number of washers on each bolt that are trapped between the underside of the Top Plate and the top of the Tie-rods. There is one washer on the upper side of the Top Plate.

Clean the tank using only soap or dish-washing type detergent, Windex is good. Do not use products that will chemically attack or scratch the acrylic plastic.

After cleaning make sure that the upper and lower gaskets are seated correctly. A small amount of silicone type O-ring lubricant on the gaskets will enhance their sealing capabilities. When tightening the Tie-rod bolts be sure to replace the washers in their correct numbers and locations. It should be possible to tighten the Top Plate hard against the Tie-rods, with sufficient squeeze of the gaskets, without causing excessive bending of the Top Plate. Excessive bending could lead to cracking.

6.2 Checking for Leaks

If “bumping” does not occur then either the vacuum pump or aspirator is not working properly or the tank is leaking. The pump or aspirator function can be checked, simply by connecting to a vacuum gage. If it is suspected that the tank is leaking, then fill the tank with water and exert a vacuum without switching on the impeller. Any leak should show up as a persistent source of bubbles. To check the Top Plate, after evacuation, pinch off the vacuum tube and disconnect it from the vacuum pump, then tip the DeAerator upside down. Drain the vacuum lines of any water after this procedure. If the large gaskets are leaking, try tightening the Tie-rod bolts, or remove the gaskets and grease lightly with silicone O-Lube. If the leak is around one of the fittings replace the O-ring with a new one, supplied with the accessories.

6.3 Fittings and Hardware

All bolts on the DeAerator are 18-8 stainless steel. When tightening the fittings with O-rings in the Bottom Plate it is important not to over-tighten. Over-tightening can crack the Acrylic plate and cause leaking. Just hand-tighten and then give an extra half turn on the fitting or bolt.

6.4 Restrictor Plates

Should the Restrictor Plate Assembly become loose, it can be re-tightened as follows:

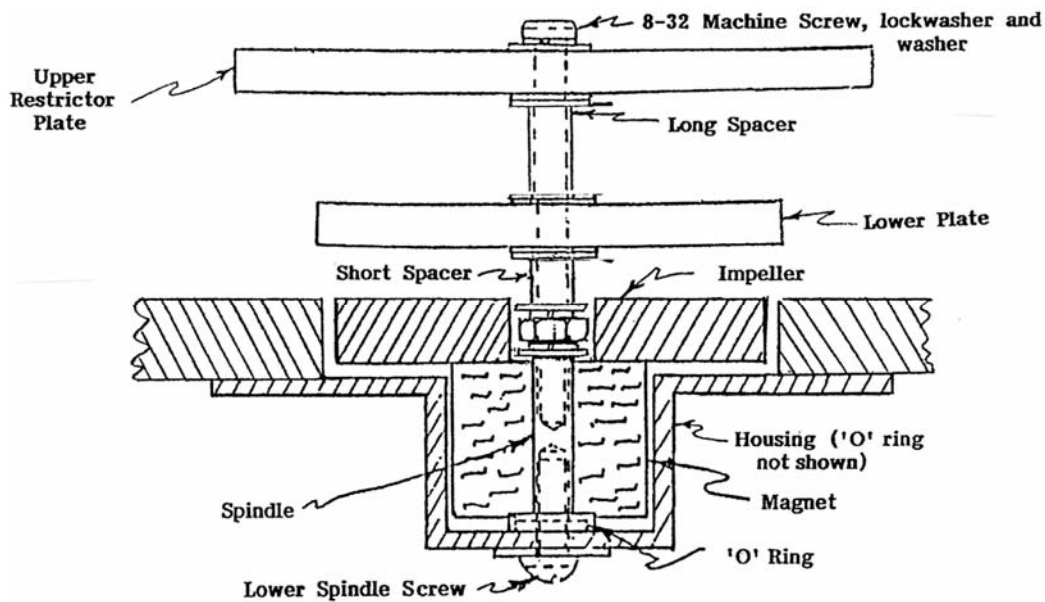


Figure 7 - Restrictor Plate Assembly

Remove the Top Plate and tank, grip the upper Restrictor Plate and turn until resistance is felt. Turn only a little bit further until the lock washer is compressed. Do not over-tighten. Too much torque can cause the spindle to turn and maybe break the seal at its base. **Do not use a screwdriver.**

If a leak develops at the spindle base remove the top plate and tank, unscrew the four black tie-rods from the base channels, and the four screws holding the acrylic base plate to the motor mounting. The spindle can then be accessed and re-tightened,

6.5 Vibrations

If a grinding noise is heard when the motor is switched on then the impeller may be resonating because of a slight amount of play between the hole in the impeller and the Spindle shaft. The grinding can be removed by folding a short length of Teflon tape, (1/2") over and around the spindle shaft.

6.6 Vacuum pumps

Maintain the oil level inside the vacuum pump. Remove contaminated oil on a regular basis. A good vacuum pump is Welch ILMVAC, Model 2561-50.

6.7 Storage of the DeAerator

If the DeAerator is to be stored for a long length of time, disassemble the tank, clean and re-assemble, or rinse with distilled water. Remove the pinch clamps from the rubber hoses so that they do not stick together.