

CONTINENTAL NH₃ EQUALIZER A-EQ-2000

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- CAUTION -

Carefully read and familiarize yourself with this entire manual before installing and operating the EQUALIZER. Heed all warnings, cautions, and notices. *Ammonia is a wonderful tool but, like fire, it is a deadly master.* Practice extreme caution and wear protective clothing and goggles whenever handling any NH₃ apparatus.

CONTINENTAL NH₃ EQUALIZER A-EQ-2000

Installation Notes and Theory of Operation

SEVERAL THINGS TO CONSIDER FIRST

1. To install the Equalizer to the tool bar, the EQ-100 mounting adaptor must be bolted at a place where service to the quick coupler will not impede its performance.

Note: Use only 1-1/4" quick couplers. Do not use 1". The 1-1/4" couplers are more efficient and will increase flows by approximately 12% in normal application. Thus the Equalizer will supply about 10% more vapor free NH₃ at the highest output.

IMPORTANT

2. The inlet of the Equalizer must be positioned in such a way as to allow the 1-1/4" hose from the back-seated safety ball valve to remain in a straight line to the quick coupler (this allows the normal flexing between the tool bar and the NH₃ nurse tank). Improper installation could cause problems with the safety coupler. (See coupler instructions from the safety couplers' manufacturer.)

Warning: Do not install any safety coupler of any kind directly to the Equalizer. Such installation could restrict the coupler's straight line pull and prevent it from functioning properly.

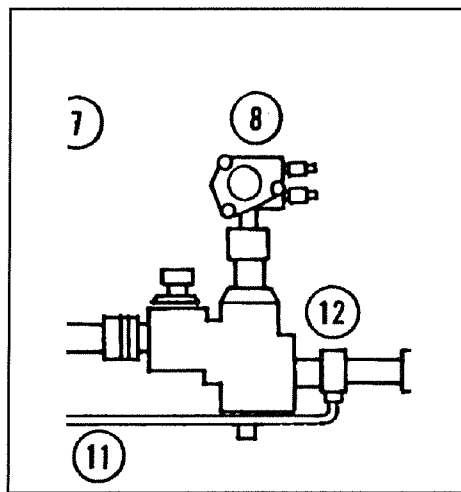


Fig. 1

3. The Equalizer utilizes a 1-1/2" (tapered) pipe threaded adaptor between the 90 degree mounting sweep elbow and the heat exchanger. This allows for different angles of positioning between the heat exchanger inlet and sweep elbow outlet. Also, the rugged ductile iron sweep elbow can easily support the weight of any directly attached meter.

4. Since the Equalizer has its own strainer screen, any screens downstream of the Equalizer should be removed. Also, **it is critical that the A-416 adaptor be installed to the outlet of the meter in order to provide manifold pressure feedback to the Equalizer (see Fig. 1 , "12")**. If there is a shutoff down-stream of the meter, the A-416 adaptor must be installed to the outlet of the shutoff.

THE EQUALIZER (HEAT EXCHANGER)

Just what is the Equalizer? What does it do? Why invest in an "internally discharged heat exchanger" as opposed to the other kind(s). What are the advantages? Disadvantages? What happens to the 2-1/2% NH₃ required to refrigerate the remaining 97-1/2% in order to accomplish vapor free liquid ammonia? Where do you put it and why?

First, we must understand a little about anhydrous ammonia. It consists in one part nitrogen, 82% by weight, and three parts hydrogen, 18% by weight. NH₃ is a gas and is only in a liquid form when the temperature drops below -28 degrees Fahrenheit or when it is sufficiently compressed in a pressure vessel.

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Installation Notes and Theory of Operation

Approximately 840 parts vapor must be compressed to form one equal part liquid. Due to its very high expansion rate and B.T.U. content, NH₃ is an excellent refrigerant. Unfortunately, this same high expansion rate makes it very difficult for us farmers to apply it accurately...

All refrigerants have something in common—the temperature and pressure are in direct proportion. If the pressure drops (For example, opening an NH₃ meter will drop the pressure.), the temperature drops also, but to do this, the liquid must give up energy! This means that it must boil or vaporize.

The liquid to vapor ratio at sea level (or stated another way, “at one atmosphere”) is 840 to 1 (840/1). However, inside a pressure vessel at 100# pressure, the ratio is lower: approximately 200 to 1 (200/1). If only as little as 1% of the ammonia vaporizes, by the time it reaches the metering point, the NH₃ is actually 50% liquid and 50% vapor. All that nitrogen is still there, YES. But what you really have is a metering nightmare!

Simply put, NH₃ does not behave like water.

EQUALIZER? A HEAT EXCHANGER? WHY?

Electronic meters use turbines or paddle wheels to determine how much NH₃ passes through a fixed piping system. They are quite accurate but only when a pure, vaporless liquid is present at the turbine blade or paddle wheel point.

Unfortunately, as we have seen in the discussion above, there is vapor in the NH₃ applicator system. In fact, about 1% of the liquid will vaporize during the ammonia flow from the tank dip tube to a metering point. 1% liquid when expanded to vapor at 100# tank pressure will occupy approximately 25% to 30% of the delivery chamber. At 50# tank pressure this 25% increases to 50% (This phenomena is known as Boyle’s law: 3222/1482). This explains why manual meters apply almost 1/3 less at 50# as compared to 100# tank pressure.

Sir Isaac Newton discovered, that in order to cool ammonia to -28 Fahrenheit, you must vaporize an amount of liquid equal to the amount of vapor you wish to cool. This holds true for applicator systems whether they are of the traditional mechanical type we’ve used for years or a system using “exhaust type” heat exchangers or even using the new Equalizer. You simply cannot cheat mother nature.

In order to reduce the amount of vapor at the turbine and/or metering points, heat exchangers have been utilized. The Equalizer is an internally discharged evaporative heat exchanger. Meaning: it takes approximately 1-1/2% of the system’s liquid NH₃ to cool the remaining 97-1/2% liquid plus the 1% that has already vaporized (at the meter point)

In other words, it internally vaporizes (evaporates) about 1-1/2% of the incoming liquid in order to refrigerate the remaining liquid and condense the 1% vapor already in the system back to a liquid. The result is total liquid arriving at the turbine or metering point.

CONTINENTAL NH₃ EQUALIZER A-EQ-2000

Installation Notes and Theory of Operation

THE EQUALIZER VS OTHER TYPES OF HEAT EXCHANGERS

#1) Remember, liquid and vapor are saturated from start to injection.

#2) Existing heat exchangers (“exhaust type”) use the cooler downstream temperature from the throttle point to refrigerate the vapor back to a liquid. Unfortunately, the heat removed in the heat exchanger creates vapor in the lines in front of the manifold. How much vapor? At least as much vapor as was removed in the heat exchanger. All that the “exhaust type” heat exchangers do is rob Peter to pay Paul. Since the energy used in these heat exchangers must be repaid, the vapor must show up again - and it does so at the manifold(s), regardless of whether one uses electronic or manual meters. Exception: using three or four of the hoses after the manifold. These hoses will have more vapor than a hose not run through the heat exchanger. This does not mean that less total NH₃ is delivered out either hose, just more vapor. The end result: a system still fraught with poor distribution problems.

#3) The Equalizer’s internal discharge design passes approximately 2-1/2% of the product into the intercooling coils and then vents it out two hoses which are placed behind 2 or 4 knives. That’s a disadvantage, but a great advantage is gained since this 2-1/2% bypasses the manifold altogether. 2-1/2% by weight when expanded would occupy 85% to 95% of the area in the manifold chamber! All our tests show that vapor is the big bad villain which causes all sorts of distribution problems. However, when this 2-1/2% is removed from the system, the liquid to vapor ratio at the manifold increases significantly (IE. high liquid/low vapor) and distribution improves substantially. This is especially true when Vertical Dam Manifolds are used in conjunction with the Equalizer.

EQUALIZER, A RECAP

To recap our discussion so far: the Equalizer passes approximately 2-1/2% of the output through the internal refrigerating coils. The purpose? Well, to eliminate all vapor at a given point (EG. the turbine). Regardless of whether you use electronic or manual meters, it still requires approximately 1-1/2% liquid NH₃ to be boiled (vaporized) in order to reliquify the approximately 1% lost to vapor. This loss to vapor occurred during the flow of NH₃ from the nurse tank through the system (valves, hoses, QDC, filters, etc.) to the meter. 1% by weight equals 20%-30%-40% even 50% by volume. This increase in volume of vapor is dependent on system pressure and inhibits a meter’s output. As stated earlier: we all know that meters apply much less at 50# tank pressure than 100# tank pressure.

Boyle’s law? Example: Take a given amount of NH₃ applied through a system. It takes the same amount of energy to move the same amount of product to the same point at 50# tank pressure as at 100# tank pressure. However, Boyle’s Law states, if a gas’s unit pressure is decreased in half, the volume doubles in size. So the vapor is much larger and occupies more space, thus greatly inhibiting output. But does 1% really cause that much of a problem? By weight it may be only 1%, yet it becomes 25% to 35% by volume at 100# tank pressure. Therefore a drop in half to 50# would result in a doubling to 50% to 60% by volume at the meter point.

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Installation Notes and Theory of Operation

THE MANUAL ORIFICE EQUALIZER: EQ-2000

Why Orifices?

The EQ-2000 has four orifices (.040-.062-.093-.101). Example: .040 orifice will supply about 4900# N per hour of clear ammonia at 50# tank pressure [Continental fitting - 1" hose - 1-1/4" safety coupler - 1-1/4" back seated safety ball valve]. But, at 100# tank pressure, the same orifice supplies about 4600# N per hour of clear ammonia. Reference to the EQ-2000 chart shows that any one orifice will discharge a constant amount of NH₃ through the intercooling coils. You must match your output to your tank pressure according to the EQ-2000 chart to ensure that approximately 2-1/2% of the output will pass through the Equalizer (to cool the remaining 97-1/2% into a clear liquid).

Remember, this is two and one-half percent by weight! But when expanded into vapor at the manifold, well, that could be 60-70% or more by volume (space occupied). [Our tests prove that the SVD manifolds increased output a whopping 50% at 50# tank pressure.] Less vapor means much better distribution with the Vertical Dam Manifolds or any other manifold.

Logically speaking, mismatched orifices [larger than necessary to cool a given amount of NH₃] will result in 3% and larger amounts passing into the dump lines in a liquid form, but that's not all bad. Even 4% split between 4 knives would still be far less wasteful than what the average distribution problems produce today. Furthermore, the gain of liquid to vapor ratio in the manifold would put you way ahead in distributing NH₃ evenly.

Let's face it even distribution across the field means increase in yields AND PROFITS!

For more information, contact your local Continental products distributor, or call us direct at 1-800-537-5642.

— NOTICE —

While the data represented in this publication are reliable and verified by our own testing, Continental NH₃ cannot be held responsible for actual results in the field. There are so many possible variations from one applicator system to another. These variations can have a significant impact on actual outputs. The best way to achieve good results is to make a test run first and then adjust accordingly.

EQ-2000 ORIFICE CHART

Range of #Nitrogen Related to Tank PSI and Choice of Orifice Size

	100 PSI	75 PSI	50 PSI
R-101 = A (RED)	*****		5500 - UP
R-093 = B (GREEN)	4800 - UP	6200 - UP	*****
R-062 = C (BLUE)	4500 - 4920	3600 - 6325	4800 - 5622
R-040 = D (GOLD)	0 - 4600	0 - 3690	0 - 4920

Orifice Selection Procedure

1. Determine desired pounds Nitrogen per hour application rate.
2. Determine likely tank pressure (PSI)
3. Find Tank PSI listed at top of chart that comes closest to your determination.
4. Directly under selected PSI, find application range that includes your desired rate.
5. Directly to the left of selected application range find the recommended orifice.

EXAMPLE: Desired rate = 5000# Nitrogen per hour; Likely Tank PSI = 50PSI;
Therefore, the recommended orifice = R-062 (Blue).

**** Note: If the desired application rate can be produced by two different orifices, choose the smaller one.*

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CONTINENTAL NH₃ EQUALIZER A-EQ-2000

Maintenance Instructions

I. Maintenance schedule:

DAILY: Bleed EQUALIZER at the end of each day's use (see proper bleed sequence below).

SEASON: At the end of each season, flush unit with clean ammonia. Clean both strainer and dump screens. Lubricate dump shut off seat retainer stem. Inspect dump shut off diaphragm and replace if damaged or worn.

II. WARNING: Practice extreme caution when disassembling any part of the EQUALIZER even after you think all ammonia has been bled off! Any accumulated super cooled ammonia still laying inside the unit could suddenly vaporize and spray an unwary operator.

As a minimum precaution, follow the safety recommendations below:

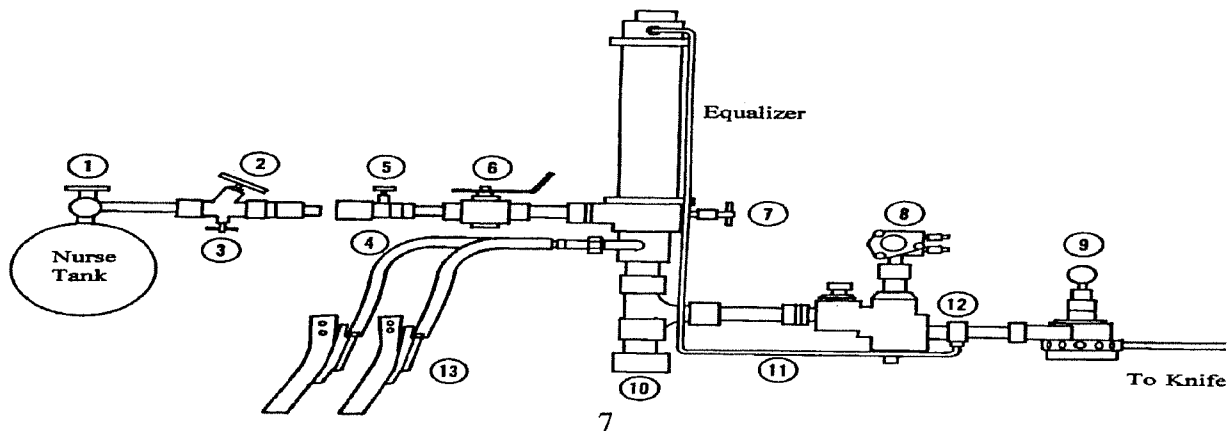
1. Have up-to-date training in maintenance and first aid procedures regarding NH₃ apparatus.
2. Wear proper gloves and goggles and other necessary protective equipment or clothing.
3. Have plenty of emergency water nearby.
4. Always stand up wind from bleed valves when opening.
5. When bleeding system, follow proper sequence (see below).

III. Procedures

A. To change dump orifice (EQ-DO-xxx) or clean dump orifice screen (EQ-900):

1. Follow proper bleed sequence in strict order:

- 1) Shut off all tank and hose line valves (see below "1" & "2").
- 2) Close safety ball valve on EQUALIZER ("6").
- 3) Bleed all hoses ("3" & "5").
- 4) Open meter and allow to drain for several minutes ("8").
- 5) Open bleed valve on EQUALIZER ("7").



CONTINENTAL NH₃ EQUALIZER A-EQ-2000

Maintenance Instructions

IMPORTANT: Do not reopen safety ball valve until you are completely finished any work on the EQUALIZER and have reassembled everything.

2. After making sure all ammonia has been evacuated, unscrew dump orifice plug from bonnet and clean screen or replace plug as desired.
3. Screw new or cleaned orifice into bonnet.
4. Close all bleed valves before reopening the safety ball valve, tank and hose end valves.

B. To replace dump diaphragm assembly (A-EQ-630) and/or shut off stem guide(EQ210):

1. Bleed Equalizer according to sequence above (see procedures III.A.1.).
2. After making sure all ammonia has been evacuated, remove the four bonnet cover screws (01-2520-100) and then remove the bonnet cover (EQ-03) and spring (41-90).
3. Carefully remove diaphragm assembly. Replace if worn or damaged.
4. Lubricate shut off stem of diaphragm assembly before reinstalling.
5. In order to replace shut off stem guide (EQ-210), use a 1" socket to unscrew. Screw on new guide with gentle force being careful not to strip the threads by over tightening.
6. After replacing the diaphragm line up holes in diaphragm with bonnet cover holes. Replace bonnet cover shut off spring and assemble with the four screws.
7. Close all bleed valves before reopening the safety ball valve, tank and hose end valves.

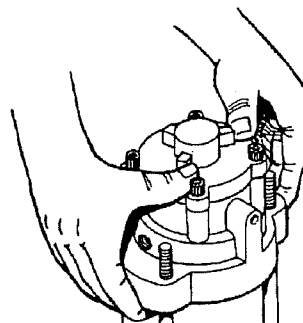
C. To access the internal dump screen (EQ-910) and/or dump shut off valve (EQ-211):

1. Bleed unit in proper sequence (see above III.A.1.)
2. Remove the three main bonnet retainer (EQ-5020) and lock washers (EQ-LW50).

CONTINENTAL NH3 PRODUCTS

Maintenance Instructions

3. Disconnect pressure feedback line (EQ-911).
4. Remove main bonnet assembly (EQ-01) by pulling up evenly on all sides of the bonnet.
5. To remove the dump shut off valve, use a 1" socket. Inspect seal (EQ-8116) and replace if worn or damaged.
6. Remove screen and clean.



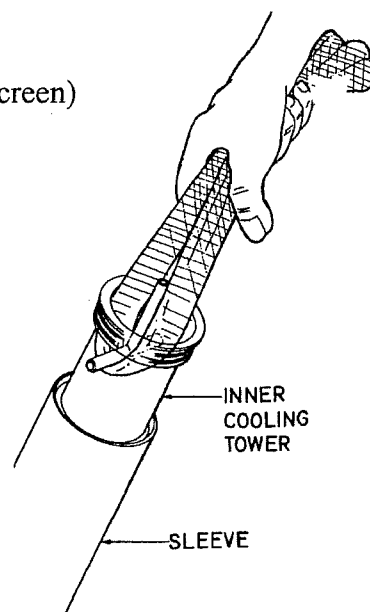
NOTE: When replacing the dump shut off valve, assemble the dump screen to the valve first. Then screw the valve into the main bonnet. This should prevent the screen from cutting the seal (EQ-8116) when assembling the valve to the main bonnet.

7. Inspect bonnet-to-outer-tube seals (EQ-8242) and replace if worn or damaged. Lubricate seals before reassembling bonnet.
8. Reassemble bonnet to unit, applying even pressure to all sides of bonnet. Assemble lockwashers and nuts and torque to approx. 15 ft lbs.
9. Close all bleed valves before reopening the safety ball valve, tank and hose end valves.

D. Removing and reassembling cooling towers.

1. Follow steps 1 - 4 of procedure C (access internal dump screen) above.
2. To remove the innermost towers (EQ-400 and EQ-200):
 - a. Wrap a rag around the vapor charge tube tee and pull upward with a strong steady pull. You may also need to gently rock the tube in a circular motion to get it to release. Usually both inner towers come out together.

NOTE: DO NOT USE VISE GRIPS OR PLIERS!!
These may damage the vapor charge tube tee!



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Maintenance Instructions

- b. Remove the middle aluminum tube by gripping this tube with your hand and continuing to pull on the rag which is wrapped around the vapor charge tube tee.
3. To remove outer tower (EQ-201):
- a. After removing the inner towers, grab the sides of the outer tower with your hands. Pull upward and at the same time gently rock the tube back and forth.
4. To reassemble towers:
- a. Inspect all o'ring seals and replace if worn or damaged.
 - b. Lubricate all o'ring seals.
 - c. Slide middle aluminum tower (EQ-200) over the innermost tower (EQ-400) until it bottoms out against the lip of the stainless steel bonnet (bonnet is located on the end of the EQ-400 with the vapor charge tube tee).
 - d. Install the assembled inner towers into the lower body (EQ-02) until they bottom out in the body. Hand pressure is all that is needed, **DO NOT USE ANY SORT OF HAMMER!**
 - e. After installing the inner towers, install the outer tower (using hand pressure only) until it bottoms out of the lower body.
 - f. Reassemble main bonnet (EQ-01) following steps 8 & 9 in procedure C (access internal dump screen) above.

CONTINENTAL NH₃ EQUALIZER A-EQ-2000

Maintenance Instructions

PROCEDURES REGARDING ADDITIVES

1. It is highly recommended that no additives (KN₃, N-Serve, etc.) be used in the Ammonia. Such additives may corrode the internal aluminum components of the EQUALIZER.

The EQUALIZER internally evaporates NH₃. If there are additives, an effect similar to boiling away salt water in a pot occurs. As you probably have noticed, when salt water is boiled away, a mineral deposit is left on the inner surfaces of the pot. When ammonia contains additives, a deposit of the additive is left behind when evaporation occurs. This deposit may clog up critical orifices and produce scale on the inner tubes which will greatly reduce the efficiency of the unit. These deposits may also corrode aluminum if not regularly cleaned.

2. If you insist on using additives, then the following maintenance procedures must be strictly observed in order to qualify for Continental's 1-year warranty:
 - a. Flush the EQUALIZER unit after every 5 tankfuls of NH₃ application (see flushing procedure below).
 - b. At the end of each fertilizer season, disassemble EQUALIZER and thoroughly clean internal tubes, screens, dump orifices, and dump shutoff valve (see maintenance directions pages 7-10 above).
 - c. Keep an accurate maintenance record. If a warranty claim should become necessary, a copy of the maintenance record must be submitted along with the claim.

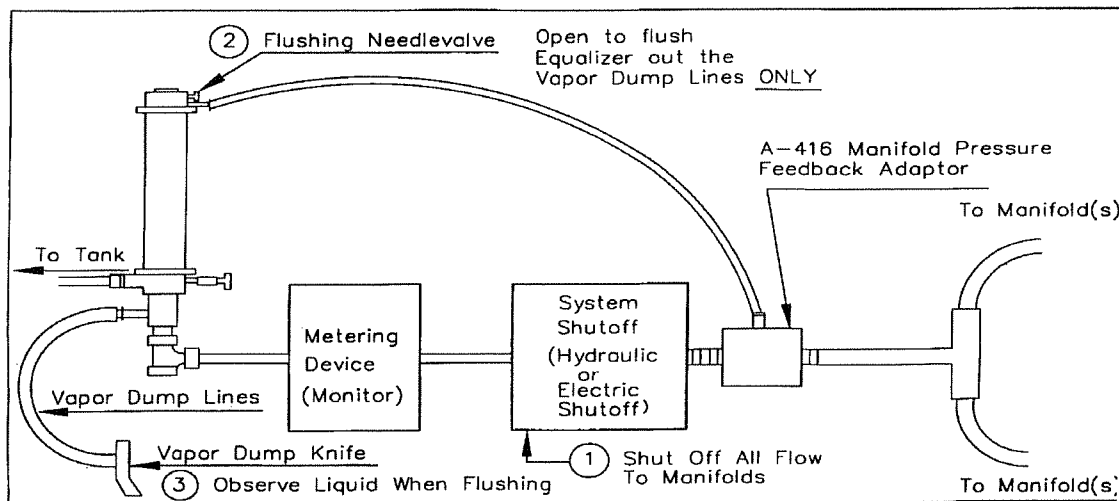
3. Flushing procedure: **FIRST, PUT ON GLOVES AND GOGGLES!**

- a. Face tractor with toolbar into the wind. *Always stand up wind from the vapor dump knives.*
- b. Wear appropriate goggles, gloves and protective clothing.
- c. Have plenty of emergency water nearby.
- d. With the system shutoff ball valve (the one closest to the manifolds) in the off position, turn on all other valves as if to begin application (see diagram below).

CONTINENTAL NH₃ EQUALIZER A-EQ-2000 Maintenance Instructions

3. Flushing procedure continued...

- e. Turn on the flushing needle valve (see "2" in diagram below).
- f. Hydraulically raise tool bar up high enough to be able to observe the vapor dump knives. **Stay up wind from these knives!**
- g. When you observe liquid coming out of the vapor dump knives, allow flushing to continue for about 60 to 90 seconds.
- h. Turn flushing needle valve to off position. Flushing should stop in about 2 minutes. *[If flushing continues to occur, then something is wrong. Shut down application system according to recommended procedures and consult with Continental or a qualified serviceman before continuing application.]*
- i. Lower tool bar, turn off all valves, and bleed EQUALIZER unit according to directions on page 7 above.



- NOTICE -

Failure to adequately flush and clean the EQUALIZER may allow the inner cooling tubes to clog up with crystalline deposits. The only effective remedy is to replace these tubes. Tubes made defective by the accumulation of deposits are not covered under warranty and are costly to replace.

CONTINENTAL NH₃ EQUALIZER A-EQ-2000
COMPONENTS LIST (see diagram)

<u>Item #</u>	<u>Part Number</u>	<u>Description</u>
1.	01-2520-100	Bonnet Cover Screws (3)
2.	EQ-03	Bonnet Cover
3.	41-90	Dump Valve Spring
4.	A-EQ-630	Dump Diaphragm Assembly
5.	EQ-210	Dump Shutoff Stem Guide
6.	EQ-8112	Dump S/O Stem Guide Seal
7.	EQ-5020	Bonnet Retainer Nuts (3)
8.	EQ-01	Main Bonnet
*	*	*
10.	EQ-910	Bonnet Screen
11.	EQ-8116	Dump Shutoff Valve Seal
12.	EQ-211	Dump Shutoff Valve
13.	EQ-8242	Outer Tube Seals (4)
14.	EQ-402	Studs (3)
14a.	EQ-LW50	Stud Lock Washers (3)
15.	EQ-8232	Lower Body to Inner Tube Seals (2)
16.	EQ-02	Lower Body
17.	7550	Dump Outlet Hose Barbs (2)
18.	09-83-F	Strainer Screen
18a.	A-09-41	Strainer Screen Guide
19.	09-73	Union Seal
20.	09-18X	1-1/4" Half Union
21.	09-19X	1-1/4" Union Nut
22.	A-411	Bleeder Valve
23.	EQ-8225	Lower Body to Adapter Seals (2)
24.	EQ-800	Lower Body to Adapter Gasket
25.	EQ-202	Lower Body Adapter
26.	EQ-04	Mounting Sweep Elbow
*	*	*
*	*	*
29.	EQ-8143	Inner Tube Bonnet Seals (2)
30.	EQ-400	Inner Tube
31.	EQ-200	Middle Tube
32.	EQ-201	Outer Tube
33.	EQ-DO-"size"	Dump Orifice Plugs (4)
34.	EQ-8014	Dump Orifice Tip Seal
35.	EQ-8114	Dump Orifice Head Seal
36.	EQ-900	Dump Orifice Screen
37.	A-400	Hydrostatic Relief Valve

