

## Basics of NEUTEK Extractor/Dryer Operation

Before NEUTEK' s discovery of Extractor/Dryer technology the only equipment available to remove water were the mechanical inventions: the aftercooler, the refrigerator dryer, and the absorption dryer. All of that type of equipment used electric energy and operated on the same engineering principle but with different methods to remove the water. NEUTEK designed a way to remove water without using any electrical energy using a unique combination of principals not used by any of the historic mechanical equipment.

### Engineering Principles

In aftercoolers, refrigerator dryers, and absorption dryers, the engineering principle has always been the same. The idea is to slow down the air velocity which will give the equipment a longer time to retain the air in order to work on it, but their methods of operation are different.

Aftercoolers are the cheapest mechanical units and are simple heat exchangers and work much like an automobile radiator does to cool the engine water. Refrigerator dryers are heat exchangers combined with freezers and are the next step up in price. They work much like a household refrigerator to chill the air.

Absorptive dryers are the most expensive to buy and operate. They contain chemicals over which the air passes. These

chemicals absorb the water and hold it. Eventually these chemicals become saturated with the water and must be dried out before they can be used again or regenerated. For that reason these driers are also called regenerative or desiccant dryers.

The more time that aftercoolers, refrigerator dryers, and absorption dryers can retain the air, the more efficient they become. For that reason, aftercooler and dryer makers installed large sized inlet ports and smaller sized outlet pipes to slow down the air velocity and hold it in the mechanical unit for a longer time.

Compressor makers fit large outlet ports on their units to match up with the standard mechanical equipment. Large outlet ports also make the buyer think that there is a greater volume of air coming from his compressor than is actually coming out. These port sizes are shown in tables 1, 2, and 3.

Table 1.

COMPRESSOR OUTLET PORT SIZES AND FLOW RATES

<u>Pipe Thread</u>	<u>KW</u>	<u>CFM</u>	<u>N1/mi n</u>
PT 3/4	7.5	35	1,000
PT 1	15	77	2,200
PT 1-1/2	22	116	3,300
PT 1-1/2	37	201	5,700

Table 2.

AFTERCOOLER PORT SIZES AND FLOW RATES

<u>Aftercooler</u>		<u>Fitted to</u>		
<u>Port Sizes (In)</u>		<u>Compressor Size</u>		
<u>Inlet</u>	<u>Outlet</u>	<u>KW</u>	<u>CFM</u>	<u>N1/mi n</u>
1/2	1/2	1.5	7.8	220
3/4	1/2	7.5	35	1,100
1-1/2	3/4	22	77	3,300
1-1/2	1	37	116	5,700
2	1	55	300	8,600
2	1	75	434	12,000
3	1-1/4	110	636	18,000

Table 3.

Pipe			
<u>Thread</u>	<u>CFM</u>	<u>N1/mi n</u>	<u>KW</u>
1/2	4	120	0.75
1/2	13	360	2.2
1/2	30	850	7.5
3/4	53	1,500	11
1-1/2	117	3,300	22
1-1/2	212	6,000	37
2	429	12,000	75
3	707	20,000	125
4	1,095	31,000	150
4	1,519	43,000	220
6	2,296	65,000	370

REFRIGERATOR DRYER PORT SIZES AND FLOWRATES

NEUTEK Unique Principles

The NEUTEK Extractor/Dryer works on a completely different engineering principle. NEUTEK uses high speed air to remove the moisture. The high velocity of the air actually wrings the water out of the air. To help create a higher velocity the inlet and outlet ports on the NEUTEK Extractor/Dryer are a little bit smaller than the outlet port on compressors and are usually smaller than the pipes on which they are installed as shown in table 4 summarized in table 6.

Sometimes end users are concerned that this smaller ports size is reducing or choking the air flow and that the total plant air output will be reduced. This is not actually the case and

the user sometimes needs to see the actual flow rate possible through the port at the operating pressure desired.

The airflow rates shown in Table 5 clearly show that even though the NEUTEK Extractor/Dryer uses smaller port sizes than the compressor, the after cooler, the refrigerator dryer, or the absorptive dryer ports, the volume of air which is possible to pass through the NEUTEK unit is usually more air than the compressor can produce.

The NEUTEK units are sized to a flow rate which is optimum to remove liquid water, liquid oil, and dirt from the airstream. For that reason the NEUTEK units are rated lower than the actual amount of air which is possible to pass through the unit.

Table 4.

<u>EXTRACTOR/DRYER PORT SIZES AND FLOW RATES</u>		
Flow Rate	NEUTEK	
	Extractor/Dryer	
CFM	Models	Port size
50	NT-105	1/4
50	NT-106	3/8
50	NT-107	1/2
80	NT-110	1/2
80	NT-111	3/4
150	NT-120	1
250	NT-140	1-1/4
500	NT-180	2
Maximum working pressure 9.9kg/cm <sup>2</sup>		

Table 5.

AIR FLOW THROUGH ORIFICES

<u>Pressure</u>	<u>Orifice Size-Inches</u>				
	(Flow Rate-CFM)				
<u>PSI</u>	<u>1/4</u>	<u>3/8</u>	<u>1/2</u>	<u>3/6</u>	<u>1</u>
80	86	193	343	757	1371
90	95	214	379	839	1518
100	105	235	416	920	1664
125	127	287	508	1124	2033
150	150	339	600	1328	2401
200	196	443	795	1735	3138

  

<u>Pressure</u>	<u>Orifice Size-Millimeters</u>				
	(Flow Rate-Liters/Second)				
<u>BAR</u>	<u>1</u>	<u>5</u>	<u>15</u>	<u>20</u>	<u>40</u>
5	0.901	22.49	203.3	361.5	1441
6	1.051	26.32	236.6	419.8	1682
7	1.201	29.99	269.9	479.8	1915
8	1.351	33.82	304.0	539.8	2165
10	1.649	41.32	371.5	659.7	2648
12	1.949	48.81	438.2	779.7	
15	2.399	59.90	538.1	957.9	

Sizing the NEUTEK Unit

It is usually necessary to estimate the volume of air consumed by the paint when fitting a NEUTEK Extractor/Dryer in addition to taking just the size and rating of the compressor. Some compressors run under capacity while others are run over capacity. When the compressor is running near capacity, then the NEUTEK unit should be up-sized to provide more element surface area to work on the air. When the compressor is running at a low continuous output, then the NEUTEK unit should be down sized to help accelerate the air. If the compressor is running

intermittently but near its capacity when it does run, then the NEUTEK unit should be sized according to the tables, here and in the literature.

This up-sized or down-sized is done according to the operating conditions in the paint. The NEUTEK unit is a very practical solution to the problems of water, oil, and dirt in compressed air and some common sense using the above guidelines should be used when suggesting a unit for a compressor mounting.

Table 6.

AFIERCOOLER DRYER & NEUTEK FLOW RATES

Aftercooler & dryer		Flow Rate		NEUTEK	
Flow	Inch			Extractor/Dryer	
M/min	Port size	HL/min	CFM	Models	Port size
1400	1/4	1,400	50	NT-105F	1/4
1400	3/8	1,400	50	NT-106F	3/8
1400	1/2	1,400	50	NT-107F	1/2
2200	3/4	2,200	80	NT-110F	1/2
2200	3/4	2,200	80	NT-111F	3/4
4200	1-1/2	4,200	150	NT-120F	1
7000	1-1/2	7,000	250	NT-140F	1-1/4
14000	2	14,000	500	NT-180F	2

NEUTEK Mounted at the Compressor

NEUTEK Extractor/Dryers were originally designed to clean up the air and remove the water only at the point-of-use. Larger models were later designed to be installed at remote locations

to remove the condensates and also near the compressor to pre-clean the air before it entered the mechanical units so that the mechanical units could work longer between overhauls and. NEUTEK units were also used as a back-up for added protection to keep the plant running should the mechanical equipment break down.

Later, engineers found that Extractor/Dryers could be used as stand alone units without any mechanical units provided that the NEUTEK units was installed at a point where the compressed air temperature was close to the ambient room temperature. Because all the pip work is metal and acts as a heat sink, the air soon cooled naturally within a short distance from the compressor.

As a practical method of installation, engineers found that the air temperature from a screw compressor fell to about 30 degree Celsius (86 F) after about 15 meters of distance so they installed the Extractor/Dryer at that point provided that it was easy to reach and service.

If a 15 meter distance was not available, or such a location not convenient, then a 15 to 20 meter (45 to 60 foot) length coil of copper pipe or rubber hose was installed between the compressor and the Extractor/Dryer to created the distance for cooling. Aboard ships a shorter length coil of hose or pipe were put into a drums of water. These drums acted like an

aftercooler.

Whenever the compressed air temperature is close to ambient room temperature, the Extractor/Dryer is very efficient. If Extractor/Dryers are to be used with a compressor, then table 7 should be used as a point of reference to select the appropriate size.

Table 7.

NEUTEK MOUNTED AT THE COMPRESSOR

<u>Nl/min</u>	<u>Compressor</u>			<u>NEUTEK</u>
	<u>CFM</u>	<u>HP</u>	<u>KW</u>	<u>Extractor/Dryer</u> <u>Recommended</u>
41	1.5	1/4	0.2	NT-105\NT-106\NT-107
75	2.75	1/2	0.4	NT-105\NT-106\NT-107
105	3.7	3/4	0.6	NT-105\NT-106\NT-107
125	4.4	1	0.75	NT-105\NT-106\NT-107
148	5.42	1	0.75	NT-105\NT-106\NT-107
190	6.7	1	0.75	NT-105\NT-106\NT-107
220	7.8	2	1.5	NT-105\NT-106\NT-107
260	9.2	2	1.5	NT-105\NT-106\NT-107
300	10.6	2.5	1	NT-105\NT-106\NT-107
350	12.4	3	2.25	NT-105\NT-106\NT-107
500	17.6	4	3.0	NT-105\NT-106\NT-107
525	18.5	4	3.0	NT-105\NT-106\NT-107
680	24.0	5.5	4.1	NT-105\NT-106\NT-107
750	26.6	5.5	4.1	NT-105\NT-106\NT-107
900	32.0	7.5	5.5	NT-105\NT-106\NT-107
1,200	42.4	10	7.5	NT-110\NT-111
1,900	69.0	15	11	NT-110\NT-111
2,500	88.0	25	18.5	NT-120
2,757	101.0	20	15.0	NT-120
4,000	141.0	40	30.0	NT-120
4,580	168.0	30	22.0	NT-140
7,634	279.0	50	37.0	NT-140
6,000	212.0	60	45.0	NT-140
7,000	247.0	75	55.0	NT-140
8,500	300.0	90	65.0	NT-180
10,200	612.0	100	75.0	NT-180
12,300	434.0	125	90.0	NT-180
16,000	565.0	150	110.0	NT-180

NEUTEK Extractor/Dryers can be mainfolded together and be used with large compressors and large flow rates. To mainfolded, the main line is split and half the air is diverted to one of two NEUTEK units. The NEUTEK outlet ports are mainfolded together back into the main line. This is a very practical

installation technique, when designed with the appropriate shut off valves, because it allows maintenance workers to change elements at any time without shutting off the plant air supply.

### The NEUTEK Drying Method

The Extractor/Dryer drying method is the combination of:

Coalescence-Water droplets and oil mists are made to collide and collect on fibers and grow in size until they fall into a reservoir for continuous removal.

Micro Vortises - Air is made to spin creating small tornadoes with vacuums in the center. Water mists are drawn into the center and exploded into vapors.

Law of partial gas pressure - Water is absorbed into fibers until the relative humidity falls below 100% (when the air is warmer) at which time the water is evaporated into the air as a vapor.

Absorption - oil mists are absorbed and trapped in the fibers of the depth element.

These methods are all combined in the NEUTEK all-in-one-unit which requires no electricity or outside energy to operate.

The only requirement is to wash the 1st element once a year and to replace the 2nd element every 4 to 6 months or about every 1,000 operating hours as required. The actual frequency of change depends on how much oil and dirt contamination is

reaching the Extractor/Dryer. The 2nd element must be changed when it becomes saturated with oil.

### Cost Comparison to other dryers

The most common mistake is to compare the NEUTEK Extractor/Dryer to the cost of an air filter. They are not used as air filters. They are used to remove the water, oil, and dirt particles from compressed air.

The second most common mistake is to compare the NEUTEK Extractor/Dryer to the price of a moisture trap. They are not used as moisture traps. Extractor/Dryers remove the water and oil continuously by venting it out through the weep drain or auto drain. They work well when installed after a moisture trap. They remove the oil, moisture, and dirt that passes through the moisture trap.

The third most common mistake is to compare the NEUTEK to a coalescer filter or to a cyclone filter. Coalescers are about 65% efficient when the air is smoothly flowing. Cyclones filter are about 75% efficient when the air is smoothly flowing. When both a Coalescer and a Cyclone are used together in-line their ultimate efficiency is about 85% provided that the air is flowing smoothly. These efficiencies become much lower if the air is pulsating or stopping or starting during the day. Unfortunately, pulsating air is most commonly encountered in daily operation .

NEUTEK Extractor/Dryers are 99.99% effective all the time. They are 99.99% effective in smoothly flowing air and 99.99% effective in pulsating air. The unique surge reservoir chamber is able to capture and retain large pulses of water and expel all the water as it is collected.

60% of all Extractor/Dryers are sold to clean, dry and condition the air just before the air is used at the point-of-use. 20% of NEUTEK units are sold to clean, dry, and condition the air in-line such as when an air supply line enters a different building. 20% of Extractor/Dryers are mounted at the compressor.

The cost to buy and run a NEUTEK unit is lower than any competitive product when accurate comparisons are made.

The smaller size Extractor/Dryers do the job of 2 or 3 competitive units in combination. Models 103 to 110 replace:

A Coalescing filter, An Oil Mist filter and A Particulate filter.

The NEUTEK models are more efficient at water removal than the combination of these three types of units. The initial cost, the replacement element costs, and the maintenance service costs are higher for the combination of three units than for the single NEUTEK all-in-one-unit.

The larger size Extractor/Dryers do the job of the 3 types of mechanical dryers. Models 110 to 180 replace:

The Aftercooler and the Refrigerator dryer

The Aftercooler and the Absorption dryer.

The initial cost, the electrical running costs, and the maintenance service cost are higher for the mechanical units than for the single NEUTEK all-in-one-unit. 7 August 1990