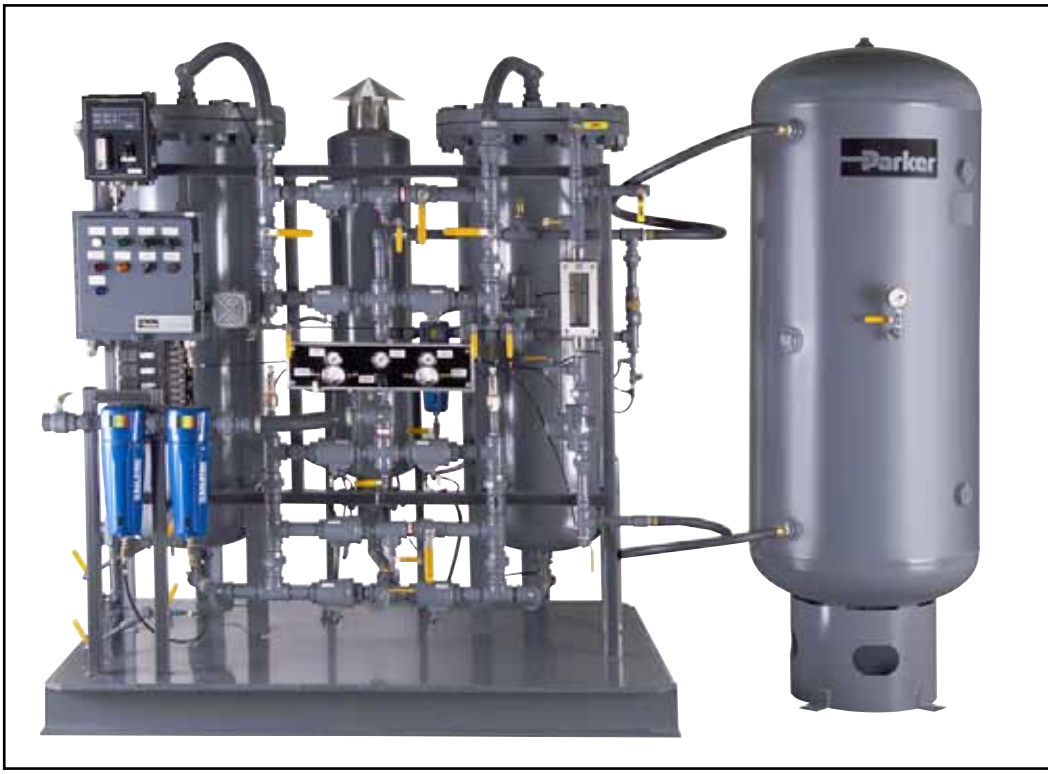
Boiler Layup

Market Application Publication

Background:

Boiler cycling (i.e. startup and shut-down) is more common in today's challenging business environment, primarily due to instability of natural gas prices and volatile energy demand. As cycling increases, proper layup of your Heat Recovery Steam Generator (HRSG) becomes much more critical. Problems associated with improper boiler layup include corrosion and pitting on both the gas & water sides of the HRSG, maintenance issues, startup delays and water chemistry delays. Nitrogen is an essential tool in helping to alleviate these issues, and has become the preferred technology since it doesn't introduce foreign chemicals to the boiler. A nitrogen generator, which separates nitrogen and oxygen from a compressed air supply, can often be the most cost effective way to supply this nitrogen.



Features and Benefits:

- Price of our nitrogen is constant. Supplier Nitrogen is subject to pricing increases, rental agreements, hazmat fees, delivery surcharges, local & state taxes, etc. A nitrogen generator offers long term price stability.
- Your cost increases relative to usage with bulk, dewar or cylinder nitrogen. Costs decrease as usage increases with a nitrogen generator.
- Nitrogen has a very low boiling point, and is continuously evaporating when supplied as liquid in bulk or dewars. It can cost thousands of dollars if these gases are not recaptured.
- A nitrogen generator eliminates the contracts required from bulk gas suppliers. No more automatic renewals, automatic increases or 1-year written notice for contract termination.
- Ease of installation. Pipe in compressed air and pipe out Nitrogen. Contrast this with the installation requirements for a bulk tank, including a concrete pad, fence and significant square footage.
- Complete start up and testing procedure at the factory prior to delivery.
- Very little maintenance or monitoring required once system is up and running. Simple and straightforward operation.
- Proven technology with numerous references available. Over 10,000 successful generator installations.

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Application:

A nitrogen blanket can be used in both the wet & dry layup of a HRSG. During wet layup, which is typically used for outages lasting <30 days, nitrogen is used to purge and blanket the steam spaces, often including the super-heaters and reheaters. To minimize the amount of nitrogen required, it is best to inject it when drum pressure is between 2-5 psig. During dry layup, which is typically used for outages lasting > 30 days or shorter outages where freezing could occur, it is extremely important to thoroughly drain the unit and completely dry all surfaces. This helps to prevent corrosion, and will minimize issues during startup. A 5 psig nitrogen blanket (often through the drum vent) is the preferred method to ensure that surfaces remain dry and oxygen does not enter the unit.

Case Study:

In many combined cycle facilities, nitrogen is used during both short term and long term boiler layups. In a wet (short-term) layup, the HRSG is capped with nitrogen to maintain pressure between cycles. During dry (long-term) layup, the HRSG is purged and blanketed with nitrogen to protect the boiler tubes and other sensitive equipment from moisture. Nitrogen was being used in this fashion at Salt Valley Generating Station – Lincoln Electric System.

Boiler cycling and inadequate boiler layup caused corrosion and oxygen pitting related issues that produced delays at startup. These issues can produce leaks, corrosion fatigue (CF) and stress corrosion cracking (SCC). Proper boiler layup, utilizing nitrogen cylinders to blanket the HRSG was also becoming cost prohibitive. To solve these issues, Salt Valley Generating Station installed a Parker Hannifin nitrogen generator for use during HRSG shutdown.

The Parker Hannifin nitrogen generator, designed to deliver a steady flow of gas at 99.9% purity, provided many improvements at Salt Valley. It eliminated the requirement for nitrogen cylinders, which can be expensive (on a cost/cf basis) and difficult to move within a facility. Inspection of the HRSG revealed that oxygen pitting and corrosion was minimized or completely halted. Startup times were decreased by 60 minutes during wet layup and 6-8 hours during dry layup. This reduced the corresponding startup costs by as much as $45,000, depending on the cost of Natural Gas.

Specifications and Ordering Information:

Flow Rates (SCFH)

% Nitrogen	DB-5	DB-10	DB-15	DB-20	DB-1200	DB-1600	DB-1900	DB-2500	DB-4000
99.999	33	66	99	132	186	248	295	389	622
99.995	74	148	222	296	522	696	826	1088	1741
99.99	141	281	421	561	630	840	997	1312	2100
99.95	204	409	613	817	951	1268	1505	1981	3170
99.9	240	480	720	960	1077	1435	1703	3343	3590
99.5	345	689	1034	1378	1635	2178	2585	3402	5445
99	416	831	1247	1663	1995	2652	3150	4150	6640
98	499	998	1496	1995	2445	3250	3860	5088	8138
97	570	1140	1710	2280	2800	3732	4430	5836	9330
96	630	1259	1889	2518	3050	4066	4540	5984	9574
95	694	1387	2081	2774	3300	4400	5220	6880	11010

Principal Specifications - Models DB-5, DB-10, DB-15, DB-20

Model Number	DB-5, DB-10	DB-15, DB-20
Feed Pressure	110 psig	110 psig
Temperature	80°F	80°F
Ambient Pressure	1 Atm.	1 Atm.
Maximum Pressure	140 PSIG	140 PSIG
Temperature Range	60°F - 105°F	60°F - 105°F
Dewpoint	40°F atmospheric dewpoint or better	40°F atmospheric dewpoint or better
Residual Oil Content	Trace	Trace
Particles	<.01 micron	<.01 micron
Atmospheric Dewpoint	-58°F (-50°C)	-58°F(-50°C)
Commercially Sterile	Yes	Yes
Particles >.1 micron	None	None
Suspended Liquids	None	None
Recommended Inlet Pressure (Min.)	110 psig (7.6 barg)	110 psig (7.6 barg)
Max Inlet Pressure	140 psig (9.7 barg)	140 psig (9.7 barg)
Max Outlet Pressure (Based on nominal conditions and standard 60 gallon nitrogen tank)	80 psig	DB-15: 80 psig @ 95-99.99% Purity DB-20: 80 psig @ 93-99.99% Purity 70 psig @ 95-94% Purity
Min. / Max. Ambient Temperature	40°F/95°F (4°C/35°C)	40°F/95°F (4°C/35°C)
Dimensions	28.5"L x 32.25"D x 78"H	28.5"L x 50"D x 78"H
Weight (with tank)	620 lbs (DB-5), 830 lbs (DB-10)	1240 lbs (DB-15), 1450 lbs (DB-20)
Inlet/Outlet	1/2" NPT/ 1/2" NPT	1" NPT/3/4" NPT
Electrical Requirement	120VAC/60Hz, 1.5 Amp	120VAC/60Hz, 1.5 Amp

Principal Specifications - Models DB-1200, DB-1600, DB-1900, DB-2500 and DB-4000

Dual Bed Nitrogen Generator	DB-1200	DB-1600	DB-1900	DB-2500	DB-4000
Atmospheric Dewpoint	-58°F (-50°C)	-58°F (-50°C)	-58°F (-50°C)	-58°F (-50°C)	-58°F (-50°C)
Particles > .1 micron	None	None	None	None	None
Suspended Liquids	None	None	None	None	None
Recommended Inlet Pressure	110 psig (7.6 barg)	110 psig (7.6 barg)	110 psig (7.6 barg)	110 psig (7.6 barg)	110 psig (7.6 barg)
Max Outlet Pressure	80 psig	80 psig	80 psig	80 psig	80 psig
Min/Max Ambient Temperature	40°F/95°F (4°C/35°C)	40°F/95°F (4°C/35°C)	40°F/95°F (4°C/35°C)	40°F/95°F (4°C/35°C)	40°F/95°F (4°C/35°C)
Inlet Port Size	1-1/2" NPT (female)	1-1/2" NPT (female)	2" NPT (female)	2" NPT (female)	2" NPT (female)
Outlet Port Size	1" NPT (female)	1" NPT (female)	1-1/2" NPT (female)	1-1/2" NPT (female)	1-1/2" NPT (female)
Electrical Requirements	120VAC/60 Hz	120VAC/60 Hz	120VAC/60 Hz	120VAC/60 Hz	120VAC/60 Hz
Dimensions	78"w x 480"d x 98"h (198cmx122cmx254cm)	78"w x 48"d x 92"h (198cmx122cmx234cm)	72"w x 54"d x 101"h (183cmx137cmx257cm)	72"w x 54"d x 125"h (183cmx137cmx318cm)	84"w x 72"d x 138"h (213cmx183cmx351cm)
Shipping Wt.	3800 lbs. (1,724 kg)	3800 lbs. (1,724 kg)	4300 lbs. (1,724 kg)	6500 lbs. (1,951 kg)	7100 lbs. (2,404 kg)

Specifications and Ordering Information:

HFX Series Flow Rates and Pressure Correction

Flow Rates (SCFH) @ 100 psig @ 68°F							Pressure Correction Factors (at Indicated Operating Pressure (PSIG)									
Model	**95**	**96**	**97**	**98**	**99**	**99.5**	**58**	**73**	**87**	**101**	**116**	**130**	**145**	**160**	**174**	**190**
HFX-1	40	33	26	16	11	---	.52	.65	.86	1	1.15	1.35	1.44	---	---	---
HFX-3	148	120	95	70	42	---	.54	.68	.85	1	1.14	1.3	1.43	---	---	---
HFX-5	279	229	176	131	76	---	.52	.65	.85	1	1.14	1.34	1.43	---	---	---
HFX-7	452	360	283	209	120	---	.53	.66	.86	1	1.14	1.32	1.43	---	---	---
HFX-9	752	600	452	330	201	---	.44	.65	.85	1	1.1	1.3	1.4	---	---	---
HFX-11	1201	992	780	572	248	---	.44	.65	.85	1	1.2	1.4	1.6	---	---	---

Principal Specifications - HFX Series Membrane Nitrogen Generators

Model Number	**HFX-1, HFX0-1**	**HFX-3,HFX0-3**	**HFX-5, HFX0-5**	**HFX-7, HFX0-7, HFX-9, HFX0-9, HFX-11, HFX0-11**
Atmospheric Dewpoint	-58°F (-50°C)	-58°F (-50°C)	-58°F (-50°C)	-58°F (-50°C)
Commercially Sterile	Yes	Yes	Yes	Yes
Particles > 0.01 micron	None	None	None	None
Suspended Liquids	None	None	None	None
Min/Max Operating Press.(1)	60 psig/145 psig	60 psig/145 psig	60 psig/145 psig	60 psig/145 psig
Max. Press. Drop (at 95% N_2, 125 psig)	10 psig	10 psig	10 psig	10 psig
Recommended Ambient Operating Temperature	77°F (25°C)	77°F (25°C)	77°F (25°C)	77°F (25°C)
Min/Max Inlet Air Temp.	40°F/122°F (2°C/50°C)	40°F/122°F (2°C/50°C)	40°F/122°F (2°C/50°C)	40°F/122°F (2°C/50°C)
Recommended Inlet Air Temperature	77°F (25°C)	77°F (25°C)	77°F (25°C)	77°F (25°C)
Electrical Requirements (2)	None (2)	None (2)	None (2)	None (2)
Dimensions	12.8"w x 7.5"d x 16.3"h (32cm x 19.1cm x 41cm)	16"w x 16"d x 50"h (41cm x 25cm x 91cm)	16"w x 16"d x 50"h (41cm x 25cm x 91cm)	24"w x 20"d x 69"h (61cm x 51cm x 175cm)
Shipping Wt.	38 lbs. (17.3 kg)	75 lbs. (34 kg)	106 lbs. (114 kg)	250 lbs. (114 kg)

Notes:

1 Maximum operating pressure in Europe is 8 barg.

2 No electrical power required unless used with an electrical accessory, e.g., an oxygen analyzer.

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