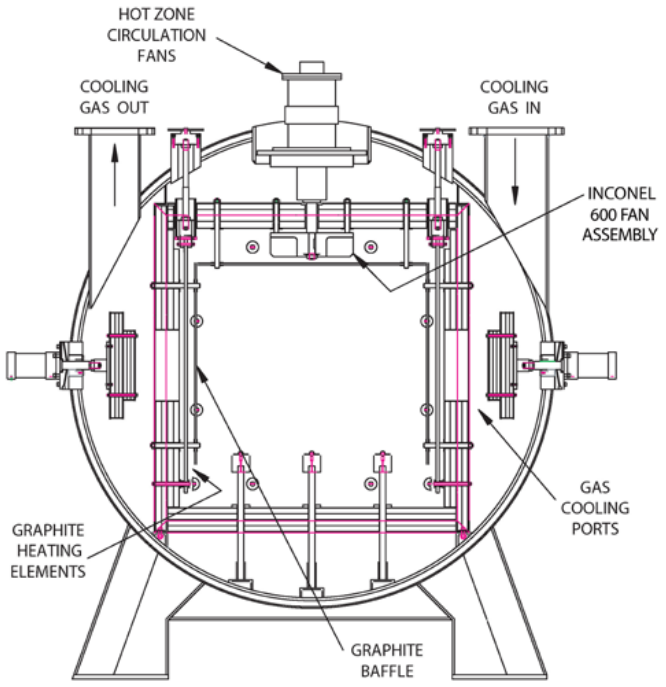
VACUUM GAS NITRIDING AND MORE

SOLAR MANUFACTURING

MODEL HFL-3648* VACUUM GAS NITRIDING FURNACE HAS PROVEN TO BE A HIGHLY VERSATILE FURNACE

Originally engineered for gas nitriding in a vacuum furnace, the advanced automated controls and the unique hot zone design has allowed us to add other capabilities such as bright annealing, tempering and oxide coatings. This provides the end user with the excellent advantage of multiple applications for in-house requirements.



FRONT VIEW

VACUUM GAS NITRIDING

The furnace was designed and developed over several years to replace traditional retort type gas nitriding equipment with the objective of improving and shortening the process cycle time while still providing better overall results on case depth and white layer control.

The work zone of the furnace measures 30"h x 36"w x 48"d and incorporates graphite band elements and high purity graphite felt insulation for energy conservation and heating to

temperatures up to 1400°F. Two top mounted Inconel 600 fan assemblies are provided for uniform atmosphere gas re-circulation during the heating and nitriding phase and for greatly improving cooling gas distribution during the cooling phase. Fully automated Solarvac Polaris recipe management and furnace control system in conjunction with the Super Systems Inc (SSI) gas nitriding controls, provide sophisticated algorithm nitriding gas flow rates and atmosphere analysis.

The nitriding processes improves wear and anti-galling properties by increasing the hardness of the surface of the parts. The advantage of case hardening by nitriding compared to other surface hardening process such as carburizing, is the relatively low temperature the nitriding process is performed (700°F – 1200°F). The low processing temperature eliminates the need to quench the alloy, significantly reducing part distortion. By precisely and accurately programming the nitriding potential (or percent dissociation), repeatable results are guaranteed, and cycle times are reduced by as much as 50%. The reduction in process times is possible with the low mass hot zone and gas cooling system that allows for rapid heating and cooling when compared to conventional retort nitriding thus allowing for faster work turn-around. Additionally, the vacuum pumping system quickly purges the nitriding furnace from air rather than purging the atmosphere with nitrogen or ammonia. Therefore vacuum purge is faster and does not require the substantial amount of gas to safely heat the furnace compared to traditional retort nitriding.

Table 1 illustrates many of the excellent results achievable in this gas nitriding furnace for various alloys. These results further demonstrate the typical case depths, minimal white layer structure and the short cycle times required to achieve these results.

OTHER APPLICATIONS FOR THIS FURNACE

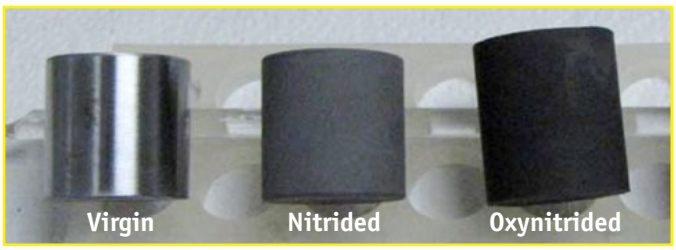
Because of the unique graphite hot zone design, gas re-circulating system, and excellent gas and temperature control features incorporated on this furnace, additional tests proved that this equipment is more capable than gas nitriding alone. This furnace is also capable of bright annealing and bright tempering of various ferrous and non-ferrous alloys in half the time required in other equipment. By using a programmed protective hydrogen/nitrogen atmosphere for these cycles, we were able to minimize the possibility of alloying element evaporation that might occur during the process. This is especially critical for zinc, lead, and magnesium in certain alloys. Because the furnace uses hydrogen to facilitate bright, oxide free results, and hydrogen is generated during the nitriding process, the furnace is equipped with a hydrogen safety system which includes an oxygen sensor, fail safe valving, and a furnace purging system.

Annealing of Brass Tubing

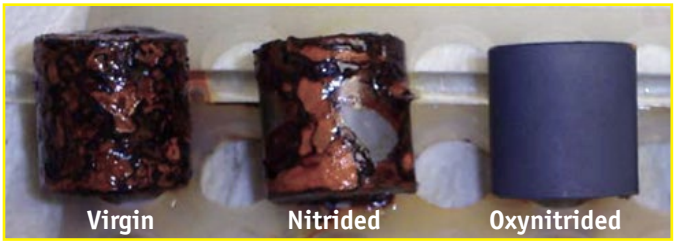
OXIDE APPLICATIONS

This furnace is also capable of controlled oxidation processes. Pre-oxidation is primarily performed at the beginning of the nitriding cycle to facilitate the nitriding process, guaranteeing uniform and consistent nitriding, eliminating the need of abrasive blasting. A post oxidation process on parts that were nitrided (oxynitride) or non-nitrided is also available to produce a form of iron oxide (magnetite Fe304) that yields additional corrosion protection properties and esthetical appearance.

SALT SPRAY TESTING OF OXYNITRIDED H-13



Before salt spray testing



After 156 hours of salt spray

TABLE 1 - GAS NITRIDING RESULTS

Material	Nitride Case Depth Requirement (inches)	Nitride Case Depth Results to 50 HRC (inches)	Surface HR 15N Post GN	Solar Cycle-GN56			White Layer Results (inches)
				Nitriding Cycle (hr)	Temperature	Total Cycle Time (hrs)	
4140	0.005	0.007	89.3	12	980°	16	0.0003
H-13	0.005	0.008	93.5	12	980°	16	0.0003
A-2	0.005	>0.015	92.3	12	980°	16	0.0002
4150	0.005	0.009	87.5	12	980°	16	0.0004
Nitralloy 135	0.005	0.008	91.8	12	980°	16	0.0006
P-20	0.005	0.007	90.2	12	980°	16	0.0004

We would be pleased to offer a quotation on this very special furnace. Please contact one of our technical sales representatives for further information on any aspects of this process or equipment.

SOLAR MANUFACTURING

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