SECO/WARWICK

Aluminium Annealing Furnaces

www.secowarwick.com

SECO/WARWICK provides custom engineered aluminium coil and foil annealing furnaces with capacities ranging from single coil modular furnaces to multi-zone furnaces with tight zone control. We have the experience, knowledge and talent to manufacture efficient furnaces with exceptional temperature uniformity and unique charging techniques to fit the most demanding application. SECO/WARWICK continues to develop technologies to improve equipment performance and efficiency. Two significant improvements for coil/foil processing include:

- Vortex® Flow Jet Heating System that reduces cycle time by taking advantage of the high heat transfer produced through convection heating. The perfect solution for coil annealing.
- Mass Flow design, especially dedicated for foil annealing, to protect load surfaces that are vulnerable to damage during high atmosphere flow.

SECO/WARWICK coil annealing multi zone furnaces

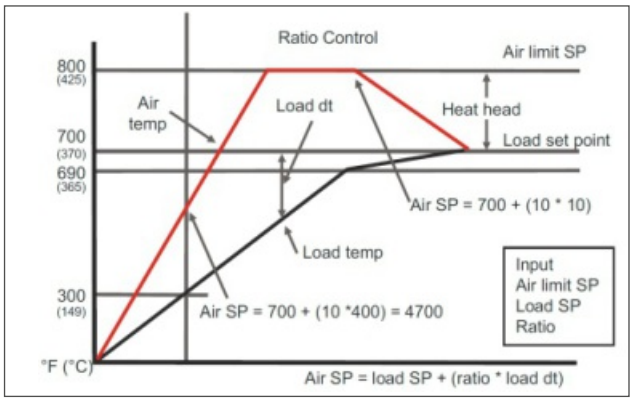
Single zone annealing furnaces

Furnace Efficiency

Further efficiencies are realized with SECO/WARWICK thermal head, air-to-work ratio control system, which uses separate load and air thermocouples in each control zone.

Because the load temperature is constantly monitored, a thermal head is maintained without risk of overheating the load. When the load approaches metal set point, the air temperature is reduced in direct proportion to the rate of rise in load temperature.

Therefore, the maximum amount of thermal head is maintained for the maximum amount of time, resulting in the shortest possible heating time. To further enhance the control system, an adjustable ratio system is also available and is most applicable when varying coil sizes are being annealed.



Air-to-work ratio control Consult SECO/WARWICK for the adjustable ratio system

To maximize efficiency, as well as protect coils from dusting or ceramic fiber contamination, SECO/WARWICK developed and uses a proprietary mesh and mortar insulation system which not only increases insulation efficiency by 15-20%, but also simplifies maintenance. Our insulation system starts with several millimeters of board-type insulation covere by a ceramic fiber blanket. A stainless steel wire mesh covers the entire insulating surface and is coated with a high-temperature mortar, which provides a rigid surface. If insulation damage occurs, it is much easier to repair than stainless steel liner sheets. To further enhance furnace efficiency, SECO/WARWICK designs radiant tubes to achieve maximum tube life.

Temperature Uniformity

SECO/WARWICK annealing furnaces exploit several different designs to ensure temperature uniformity. SECO/WARWICK holds patents for innovations on controlling airflow recirculation over various size loads, increasing heat transfer and uniformity. Our furnaces incorporate both vertical airflow with specifically designed vertical baffles on each side of the load, or the high-velocity directed mass flow system. In either case, the vertical baffles improve air stream uniformity and separate the load from direct heat radiation. Radiant tubes for either gas-fired burners both recuperative and autorecuperative or electric heating elements provide indirect heating, protect the load from direct heat radiation, and maximize temperature uniformity.

With large coils, the temperature uniformity is governed by load configuration. In very large coil applications and where tight temperature tolerance is required, SECO/WARWICK designates two temperature-control zones for each recirculation fan. This field-proven design compensates for differing coil characteristics, combustion performance and loading practices.

Bypass cooler reduces fin maintenance and keeps performance at peak levels

Vortex® Jet Heating System

Aluminium annealing requires an advanced convective heating system to obtain the shortest possible cycle without any loss of quality in the material. Quality problems typically appear at the strip edges, and are represented by non-uniform material properties like hardness, and discolorations of the strip surface, as in the case of 5xxx and 7xxx alloys caused by Mg- or Mn-bleeding, cracking of residual milling oil from coil degreasing, or coil surface melting. These problems are caused by overheating at the coil edge resulting from non uniform impingement of the air flow.

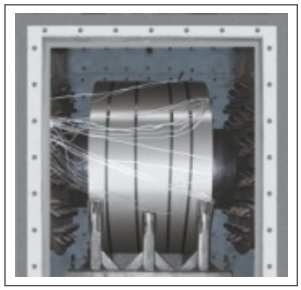
The governing parameter describing the temperature uniformity of a convective heating system is the ratio of maximum to minimum heat transfer coefficient (HTC). This parameter limits the heat up time since the smaller the HTC ratio the higher the average temperature that can be obtained without exceeding the maximum tolerable local heat transfer.

The Vortex® Flow Jet Heating System incorporates arrays of 4 round inclined nozzle jets that generate a spiral vortex motion of air that results in high heat transfer without producing hot spots in the coil. The high volume flow of this nozzle system in conjunction with a unique semi-axial fan design allows the coil to be heated more uniformly by a larger mass of atmosphere. The effective thermal conductivity in a strip coil is much lower in the radial direction than in the axial direction, therefore, the most effective way of heating the coil is through the edges of the coil wraps. The difference between the thermal conductivity for the two directions is caused by the heat insulating effect of the gas and milling oil layers in the coil between the strip layers.

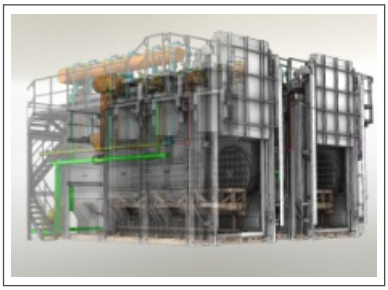
Advantages

Analysis of the infrared picture, equally scaled, indicates that a more uniform surface temperature can be achieved by using the new Vortex® Flow Jet Heating System. The coil surface temperature uniformity profiles present an overview of temperature uniformity for the entire heat up cycle. These profiles demonstrate that a better surface uniformity is achieved using the vortex nozzle system. The HTC ratio calculation based on the above data is 1,25 for the Vortex® Nozzle system. For aluminium alloys of lower thermal conductivity, this parameter is expected to be even higher.

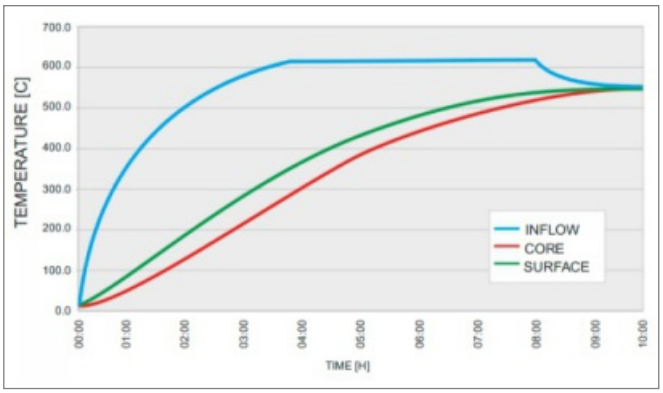
- Reduced heat-up time without local overheating
- Improved uniformity of material properties
- Minimizes local cracking and staining of milling oil
- Reduced electrical consumption because the fan operates at a lower speed rather than a higher volume flow

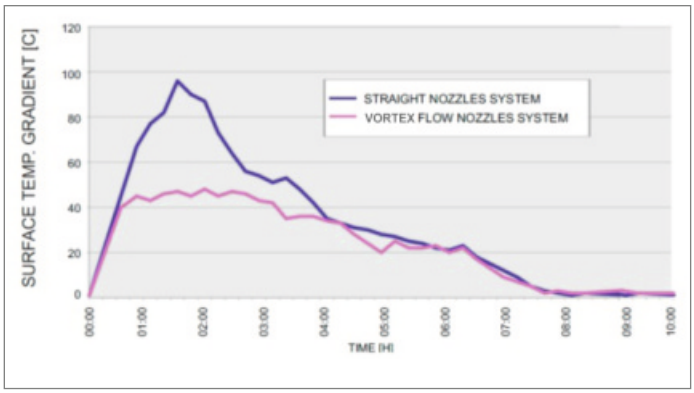


High Convection Vortex Flow system installed in the furnace



Coil Annealing Furnace





Temperature uniformity profiles

Bypass Coolers

SECO/WARWICK provides a proprietary bypass cooler design for annealing furnaces. Cooling under a protective atmosphere for either metallurgical or handling considerations is very important in this application. The coolers use an internal bypass arrangement which limits the temperature of the atmosphere going through the heat exchangers to 175°C. This prevents baking of the volatized rolling oil on the fins of the heat exchanger. The coolers are designed to provide plunge, programmed, or auxiliary cooling and are available in standard or custom sizes. The coolers can be rear or side mounted according to space availability. Additionally, multiple coolers can also add a bypass cooler to an existing annealing furnace. SECO/WARWICK currently has over 100 of these coolers in operation in coil and foil annealing applications.

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