



Aluminum Annealing Furnaces

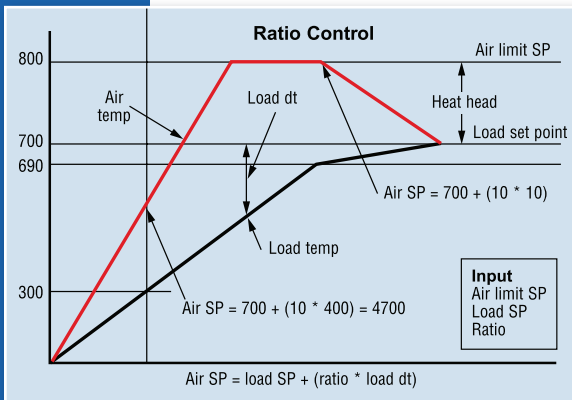




Rod annealing/homogenizing furnace



Single zone annealing furnaces



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



SECO/WARWICK's hot car

SECO/WARWICK provides custom-engineered aluminum 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.

We continue to develop technologies to improve equipment performance and efficiency. Two significant improvements for coil/foil processing include:

- The High Volume Mass Flow design protects load surfaces that are vulnerable to damage during high atmosphere flow
- The Vortex Jet Heating System™ reduces cycle time by taking advantage of the high heat transfer produced through convection heating

Furnace Efficiency

Further efficiencies are realized with SECO/WARWICK's 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 available and is most applicable when varying coil sizes are being annealed.

To maximize efficiency, as well as to protect coils from dusting or ceramic fiber contamination, SECO/WARWICK developed and uses a mesh and mortar insulation system, which not only increases insulation efficiency by 15-20% but also simplifies maintenance. Our insulation system starts with several inches of board-type insulation covered 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's 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 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 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.

Vortex Jet Heating System

Aluminum 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 such as 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, which 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.

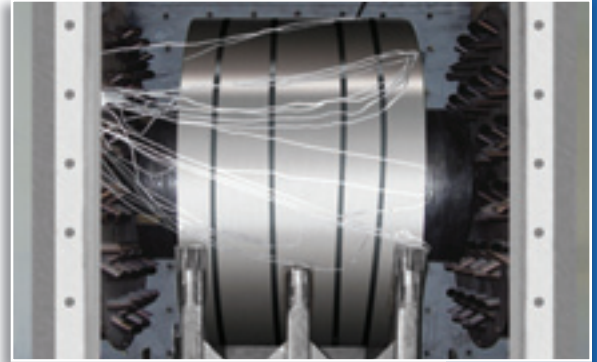
The effective thermal conductivity in a strip coil is much lower in the radial direction than in the axial direction; therefore, the most effective way of heating the coil is through the edges of the coil wraps. The difference between the thermal conductivity for the two directions is caused by the heat insulating effect of the gas and milling oil layers in the coil between the strip layers.

Advantages

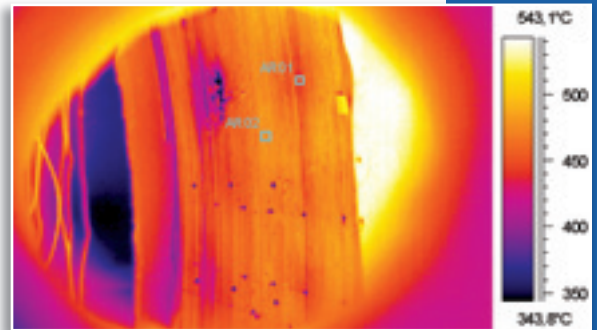
The coil surface temperature uniformity profiles present an overview of temperature uniformity for the entire heat up cycle. These profiles demonstrate that a better surface uniformity is achieved using the vortex nozzle system.

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.

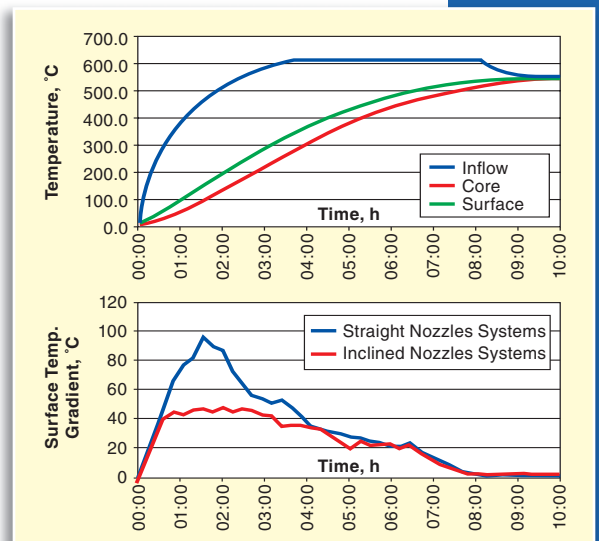
- Reduced heat-up time without local overheating
- Improved uniformity of material properties
- Minimizes local cracking and staining of milling oil
- Reduced electrical consumption because the fan operates at a lower speed rather than a higher volume flow



High Convection Vortex Flow System installed in furnace



Infrared picture of coil heat up using the Vortex Flow nozzle system



Temperature Uniformity Profiles



Bypass cooler reduces fin maintenance and keeps performance at peak levels



Load Handling

SECO/WARWICK manufactures both hot and cold load cars along with tray and elevator hearth designs. The hot car is totally enclosed in the furnace, exposing the wheels to furnace temperatures and must be positioned in the furnace using a special car mover or fork truck. With the cold car design, developed by SECO/WARWICK, the load car actually serves as the furnace hearth and offers several advantages. The car wheels are subjected to much lower temperatures, thus both initial and maintenance costs are reduced. With this design, no fork truck or special car mover is necessary because the car has its own onboard drive system. Tray style and elevator hearth furnaces are available to minimize floor space and improve productivity.

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 350°F (177°C). This prevents baking of the volatilized 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 be used to achieve faster cooling. SECO/WARWICK 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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The latest design, materials and equipment specifications should be obtained from the company before any reliance is placed on the enclosed, since changes may occur due to product improvement.