Bulletin SW-170.1

Furnaces for Forging

SECO/WARWICK

Heat Treating Equipment Applications for Electric Resistance Heating and Natural Gas Fired Heating Treating Equipment

Car furnace used in forging application

Rotary Hearth Furnace

Roller Hearth Solution Heat Treat and Age Oven

SECO/WARWICK manufactures a wide variety of heat treating furnaces and quenching systems for forging and forging dies. Electrically heated furnaces are available for air, atmosphere and vacuum processes utilizing sinuous loop, bayonet, silicon carbide, molybdenum and graphite heating elements that are lower in capital costs when compared with induction heating. Many furnace arrangements heated with natural gas/propane combustion systems are available, which can save money in overall utility costs. Vacuum High Pressure Gas Quench furnaces provide optimum results for heat treating, gas quenching, and tempering H-13 die steels. SECO/WARWICK can provide gas, salt, and liquid (water, oil & synthetic mediums) quenching systems as stand-alone units or as an integral component to the complete heat treatment system. All SECO/WARWICK furnaces feature PC/PLC control systems that provide precision temperature management for optimum uniformity and work seamlessly with plant management systems.

SECO/WARWICK provides heat treating equipment for precipitation hardening, solution annealing, stress relieving, annealing, austentizing, quenching and tempering iron, nickel and cobalt-based heat resistant alloys. Atmosphere equipment is designed for all sizes of forgings for batch and continuous production. Typical systems are special box furnaces, rotary hearth, roller hearth, continuous pusher, integral quench, and car furnaces. SECO/WARWICK can provide protective atmosphere generators for producing exothermic (Exogas®) and endothermic (Endogas®) gases on-site instead of leasing processed gas. Quenching systems may be provided as a fast cool air blast chamber, stand-alone or intregral salt or liquid (water, oil or synthetic) tank complete with heating and mixing as required. Charge and discharge tables along with loaders and transfer mechanisms are available for efficient material handling.

Aluminum Preheat, Solution Heat Treating and Aging (Ageing)

Solution Heat Treatment systems are available for small or large volume production of aluminum parts. Roller hearth and conveyor furnace systems have been developed for numerous applications and are available with both spray and immersion tank quenching systems. Aluminum preheat systems for forging have been manufactured to process large billets from approx. 30 inches (762 mm) in diameter up to 7 feet (2,134 mm) long. Furnace systems can be developed for batch, semi-continuous or continuous operation.

SECO/WARWICK

Vacuum Furnaces/High Pressure Quench

For forging dies, the Universal HPQ™ Vacuum High Pressure Quench furnace with isothermal cooling is the ideal equipment choice for heat treating H-13 tool steel. Programmable cooling of H13 hot-work tool steel dies during vacuum heat treatment overcomes the problems associated with conventional heat treatment, cracking, and distortion. Customers using this system have consistently met GM Die Insert Material and Heat Treat Specification and the Ford Die Insert Material and Heat Treating Performance Requirement Specification.

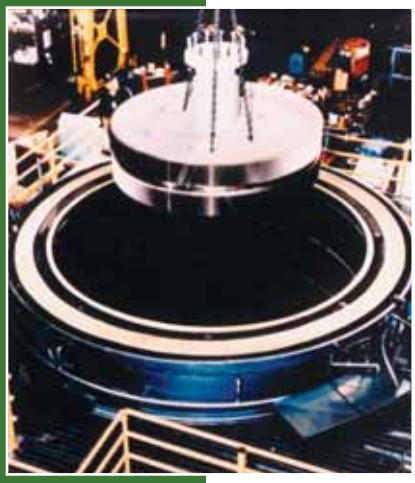
10 BAR HPQ used specifically for vacuum heat treatment of H-13 die material

The Forging Process

The forging process refers to shaping metal by heating it and then hammering or rolling it. Forging has been in use as a metal working process since around 4000 BCE in Egypt and Asia. Smaller parts may be forged cold; larger parts, hot.[1]
Forged components are characterized by their strength and overall quality as compared with other processes.[2]

Metal	Characteristic	Application
Aluminum	• Readily forged • Combines low density with good strength-to-weight ratio	Primarily for structural and engine applications in the aircraft and transportation industries where temperatures do not exceed 400°F
Magnesium	• Offer the lowest density of any commercial metal	Usually employed at service temperatures lower than 500°F, but certain alloys provide short-time service to 700°F
Copper, Brass, Bronze	• Well-suited to forging • Electrical and thermal conductivity	Important for applications requiring corrosion resistance
Low-Carbon and Low-Alloy Steels	• Low material cost • Easily processed • Good mechanical properties • Varied response to heat treatment gives designers a choice of properties in the finished forging	Comprise the greatest volume of forgings produced for service applications up to 900°F
Microalloy/ HSLA Steels	• Low material cost • Cost benefit derived from simplified thermomechanical treatment • Equivalent mechanical properties to many carbon and low-alloy steels	Various automotive and truck applications including crankshafts, connecting rods, yokes, pistons, suspension and steering components, spindles, hubs, and trunions
Special-Alloy Steels	• Permit forgings with more than 300,000 psi yield strength at room temperature	Used in transportation, mining, industrial, and agricultural equipment, as well as high-stress applications in missiles and aircraft
Stainless Steel	• Corrosion-resistant	Used in pressure vessels, steam turbines, and many other applications in the chemical, food processing, petroleum, and hospital services industries. Used for high-stress service at temperatures up to 1,250°F and low-stress service to 1,800°F and higher
Nickel-Base Superalloy	• Creep-rupture strength • Oxidation resistance	Service in the 1,200-1,800°F range. Structural shapes, turbine components, and fittings and valves
Titanium	• High strength • Low density • Excellent corrosion resistance • Alloys offer yield strengths in the 120,000 to 180,000 psi range at room temperatures	Used primarily in the temperature services to 1,000°F. Configurations nearly identical to steel parts are forgeable and 40% lighter in weight. Aircraft-engine components and structurals, ship components, and valves and fittings in transportation and chemical industries
Refractory Metal	• Include columbium, molybdenum, tantalum, and tungsten and their alloys • Enhanced resistance to creep in high-thermal environments	High-temperature applications involving advanced chemical, electrical, and nuclear propulsion systems and flight vehicles
Beryllium	• Light, hard, and brittle • Increasingly used as an alloying material • High melting point • Special forging techniques have been developed to process beryllium in sintered, ingot, or powdered form	Used primarily in nuclear, structural, and heat-sink applications
Zirconium	• Corrosion-resistant	Produced in relatively limited quantities and used almost exclusively in nuclear applications

Forging definition: [1]http://education.yahoo.com/reference/encyclopedia/entry?id=17377, 7/28/05 [2]Forging Chart compliments of the Forging Industry Association (FIA), www.forging.org.



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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.