



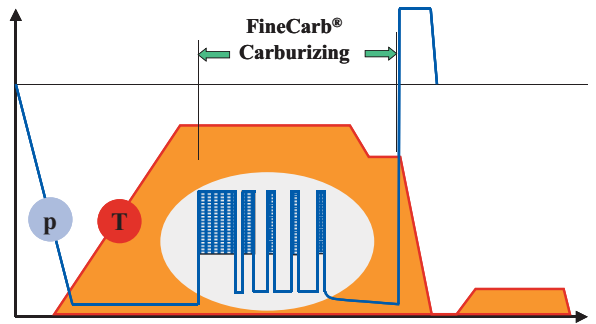
Vacuum Carburizing Furnaces



Single, Double & Multi Chamber Furnace

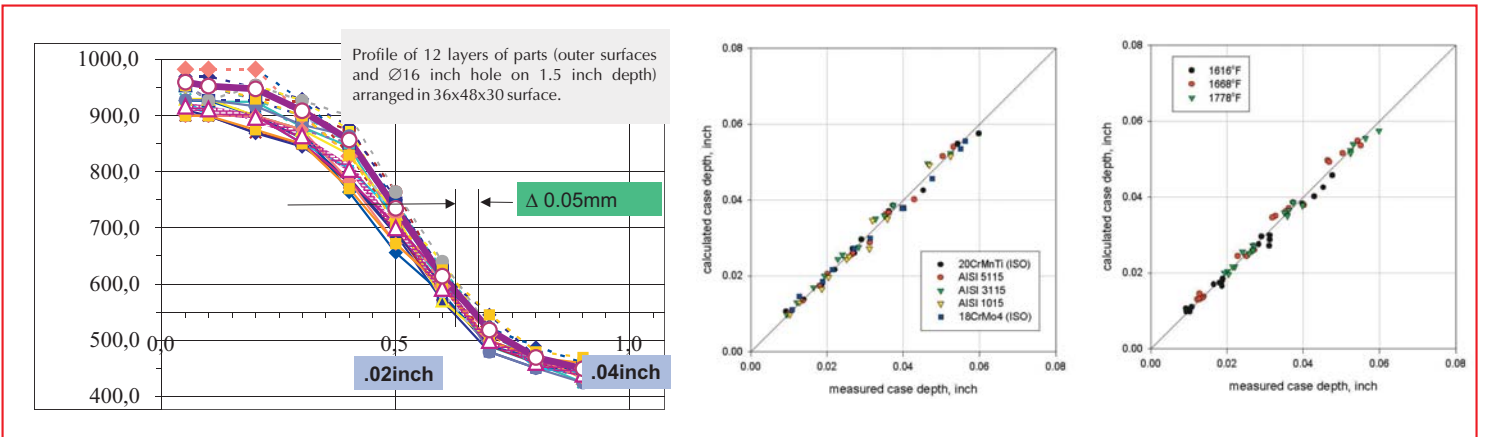
V-405

Typical *FineCarb*TM vacuum carburizing cycle



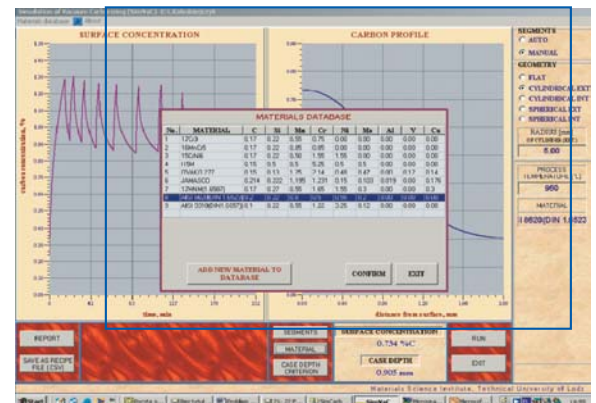
*FineCarb*TM is a precision vacuum carburizing process:

- Repeatable carburizing results according to pre-programmed parameters, Uniform case depth across a load

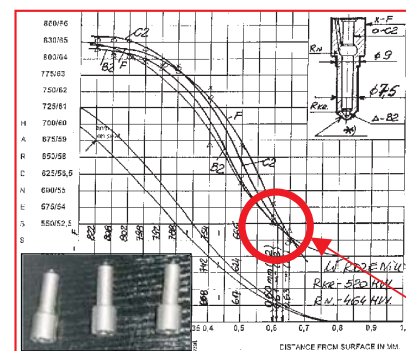


- Optimum, step-by-step process programming procedures separated into carburizing, diffusion and pre-cooling for hardening stages to obtain the required carbon content and hardness profiles depending on steel grade and carburized part geometry

- Capacity to process mixed parts with various packed densities and materials

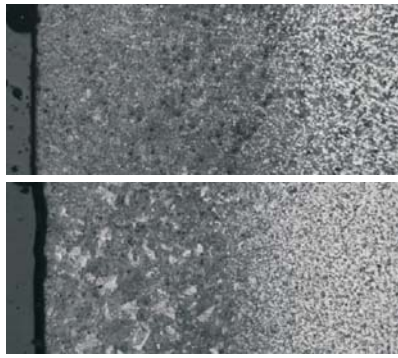


- Unique carburizing atmosphere (*patent pending*), assuring uniform case depth over all surfaces (including hollows and recesses), clean load surface and elimination of by-products including tar and soot (no aromatic rings formation or polymerization)



- Elimination of intergranular/internal oxidation (which may occur during gas carburizing and vacuum carburizing in acetylene)
- Automatic control of carrier gas flow according to load size and process stage
- Record process parameters and heat treatment results

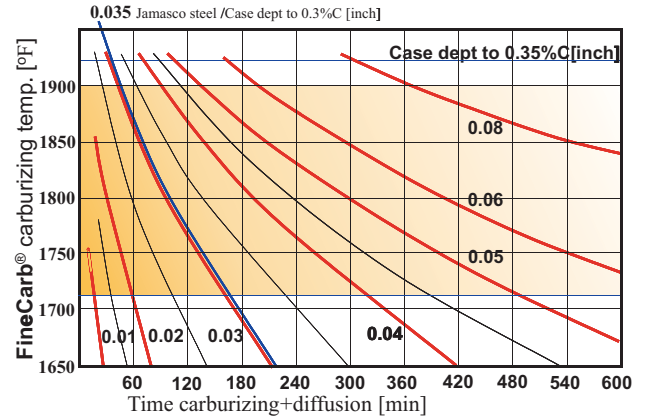
Reduction of grain growth, critical for high-temperature carburizing



FineCarb® proces

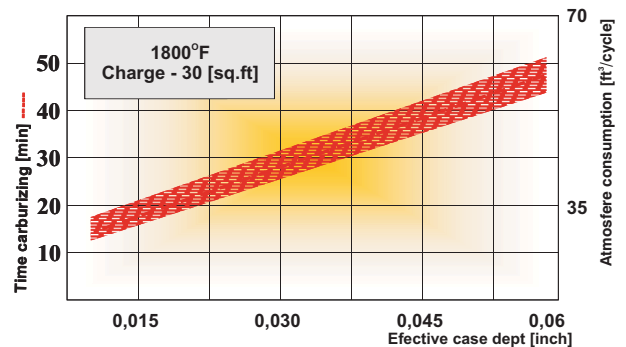
Standard Vacuum Carburizing

1800°F



Vacuum carburizing is the preferred alternative to traditional carburizing methods

- Higher process temperatures up to 1980°F (1900°C) resulting in faster diffusion stages
- Flexibility in furnace operation including pre-programmed temperature changes that are required for pre-cooling in hardening or for pearlitization
- Automated furnace controls
- Bright and clean load surfaces
- No carbon monoxide (CO) in effluent gases
- Fast start of cold furnace (no conditioning or activation required as typical for vacuum furnaces); the furnace can be switched off for weekends,
- Low consumption of carburizing agent, permanent supply is not required
- No heat or gas emissions to environment, furnaces can be installed in-line with other processing machines; no special fire-protection requirements as to working area or building
- Compact design, requires less shop floor space

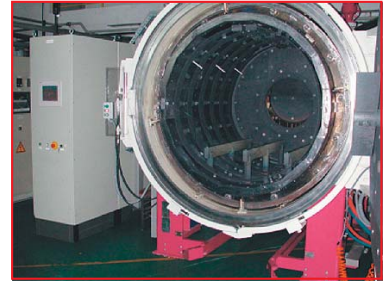


Vacuum carburizing with gas quenching eliminates many of the operational limitations of traditional oil quench systems

- Control of cooling rate by changes of gas pressure and blower motor speed
- Uniform cooling conditions; minimized and predictable distortion; especially important for new steel grades with improved hardenability where single chamber furnaces or modular systems can be used
- Ability to quench HSLA, O2, 52100 and similar steel grades
- Clean and dry heat treated loads; no quench fluid disposal
- Simple and safe procedures compared to oil quenching operations

SECO/WARWICK's Universal HPQ™ vacuum furnaces

- Compact design, reduced installation area, ease of operation and maintenance, high efficiency with low energy and cooling gas consumption
- Single chamber furnaces and processing modules with cylindrical heating chambers and wide band side wall heaters arranged around a load provides for excellent temperature uniformity as well as fast and uniform heating loads with various configuration, cross sections and packing density
- Innovative nozzle cooling system with five side cooling gas inflow and outflow of hot gases in single point guarantees extremely fast and uniform cooling rates suitable for vacuum carburizing with subsequent gas quenching of high alloyed steels within widely applicable cross sections
- Convection-aided heating system, *ConFlap™*, improves heating rate and uniformity in dark radiation areas
- Ergonomic arrangement of furnace controls and components facilitates operation and maintenance of furnace systems



SECO/WARWICK Universal HPQ™ VACUUM FURNACES

Single chamber furnaces type VPTN

- 10, 12, 15 and 20 bar cooling gas pressures
- Standard sizes with vacuum carburizing option



- Standard sizes with vacuum carburizing option

Uniform Zone Size MLH (inch)	Hearth Capacity (lbs)
16 x 24 x 16	450
24 x 24 x 16	900
24 x 36 x 24	1300
36 x 48 x 32	2600

Quenching capability of VPTN furnaces (example):

- -900 lbs of \varnothing 1" bars made from 8620 steel were quenched in VPT 24/36/24 furnace at 10 bar N₂. Cooling rate measured at bare core was of range 10⁰F (5.5⁰C/s) measured at ~1300⁰F (700⁰C)

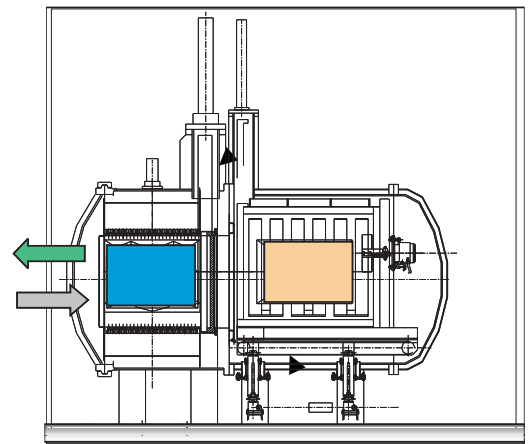


Vacuum VPTN furnaces are useful for vacuum carburizing and gas quenching of modern steel grades with improved hardenability, e.g. 3115, 18CrNi8 (DIN), 20NiMoCr6 (DIN), 23MnCrMo5 (Jamasco), 27MnCr5 (DIN), Ovak 277, M50 Nil, Pyrowear 675, etc.

In addition, Universal HPQ™ furnaces are used for other vacuum carburizing / gas quenching processes including carburizing of stainless steels, HSS and other tool steels, regeneration of machine parts, etc.

Double chamber furnaces 2NVPT

- 10, 15 and 20 bar cooling gas pressures,



- Standard sizes vacuum carburizing option

Uniform Zone Size MLH (inch)	Hearth Capacity (lbs)
24 x 36 x 24	1300
24 x 36 x 32	1300

The separate cooling chamber, ColdCam™, provides extremely high cooling rates of 22°F/s (12°C/s) measured at ~1300°F (700°C) in the cores of 1" bar made from 8620 steel. The range of heat treated steels can be therefore extended by 16MnCr5 (DIN), 8620, 9310, 9315, 5120, 14NiCrMo13-4 (DIN), 21NiCrMo2 (DIN)

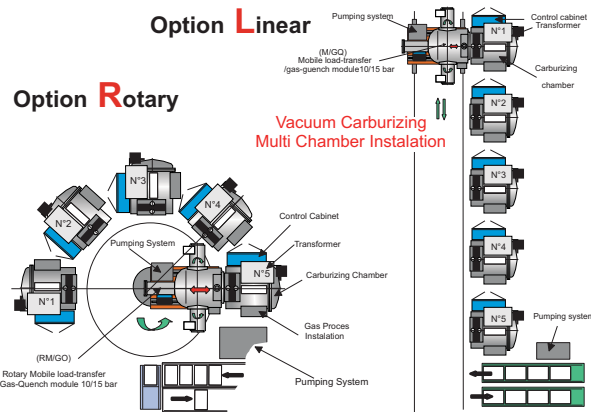
Double chamber furnaces can be also used for hardening of parts made from 52100 steel and for larger cross sections O2, L2, 4140, 4142, 5120, and 5140.

For carburizing and quenching of low alloyed steels or parts with large cross sections where gas cooling rates are too slow SECO/WARICK offers two- or three-chamber furnaces with integrated oil quenching chambers.

Uniform Zone Size MLH (inch)	Hearth Capacity (lbs)
24 x 36 x 24	1300
30 x 48 x 24	1800

Multi-Chamber Installations with ColdKam™ Gas Quenching Chambers

- 10, 15 and 20 bar cooling gas pressures (ColdKam™ Chamber)



- Standard sizes vacuum carburizing option:

Uniform Zone Size MLH (inch)	Hearth Capacity (lbs)
24 x 36 x 24	1300

- Available arrangements: Rotary / Linear (max. 5 process chambers.)

Control system



- The Furnace Control System contains standard Programmable Logic Controller (PLC) and Industrial Computer (IPC).
- Furnace operation sequence is controlled from PLC.
- An IPC is used for process set-up, data storage, exchange and transmission.
- Colour Touch Screen operator panel allows for fast and precise control of the furnace operation.
- Built-in equipment for interconnections with and external communication network (LAN) and telephone line for data exchange, remote monitoring and diagnostics.
- The IPC computer is equipped with standard components like Processor, HDD, RAM, CD-ROM, FDD and color printer for recorded data, trends and report printing.
- Multilevel access protects the furnace from an unauthorized operation and realizes the operating supervision.
- The control system presented above is not only easy in use, reliable, open and flexible, but it enables also real-time data logging, data exchange and processing, and may be customized according to local requirements and customer needs.



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