

# **SECO/VACUUM**

*The North American Vacuum Furnace Company*



## **Lose the Flames**

**SUPER IQ™ “Smart IQ Gas Carburizing”**

Mark Hemsath  
Director of Nitriding & Super IQ  
Sept 17<sup>th</sup>, 2019

Thank you for logging on to learn more about SUPER IQ – Smart Gas Carburizing. Based on the registrations, I saw people from all over the world and we have a nice crowd. Thank you for your interest! We will make this Webinar short since this is an INTRODUCTION of this unique and new technology. However, we will send a follow-on email from me and you can always feel free to communicate on any topic with me. As a note, SECO/VACUUM is the North American division for SECO/WARWICK for not only vacuum furnaces, low pressure carburizing, and gas nitriding, but now SUPER IQ Gas Carburizing.

---

## About the speaker – Mark Hemsath

- 30+ years in Furnaces and Heat Treating
- Five years as SECO/WARWICK North American Gas Nitriding Furnace Product Manager
- Worked on Vertical Integral Oil Quench Vacuum Furnace designs early in career.

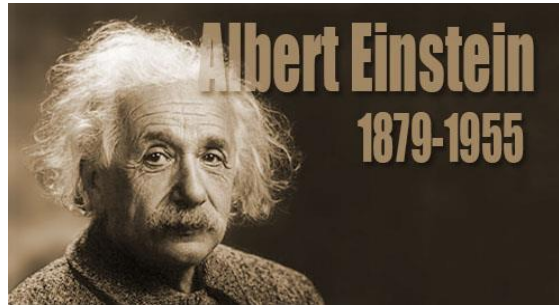
**SECO/VACUUM** *The North American Vacuum Furnace Company*

Long history in equipment and building and designing furnaces. Many experiences in nitriding – Ion and Gas. Began career in Oil Quench Design.

---

## Sage Advice.....

“Everything should be as simplified as far as possible,  
but no more.”



**SECO/VACUUM** *The North American Vacuum Furnace Company*

You might notice our theme – SMART. We strive to make the complex simple.! Keeping it simple is actually much harder than one might think. I see so much equipment that does not look like Einstein created it, but, rather, Rube Goldberg. Equipment should be simple so it functions reliably. Super IQ is a simplification.

---

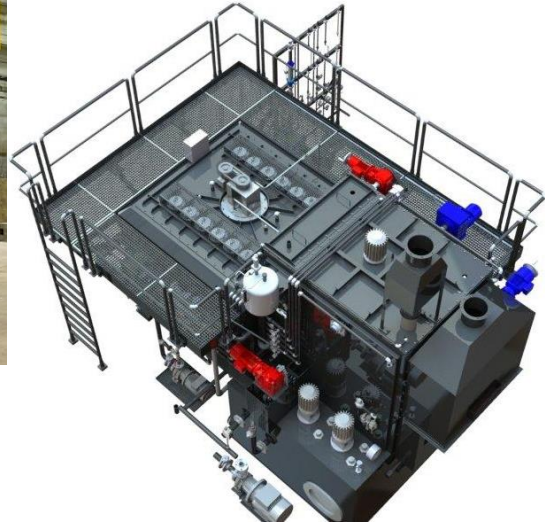
# The Struggle is real - SIMPLE

- ✧ Gas Atmosphere Carburizing
- ✧ Vacuum Hardening vs Conventional Through Harden
- ✧ Low Pressure Carburizing

**SECO/VACUUM** *The North American Vacuum Furnace Company*

To design the Super IQ Furnace, we wanted to get away from Gas Atmosphere Carburizing due to its complexity. We wanted the simplicity of vacuum through hardening and on/off furnace operations (no conditioning and no idling times) and we wanted the simplicity and quality of LPC.

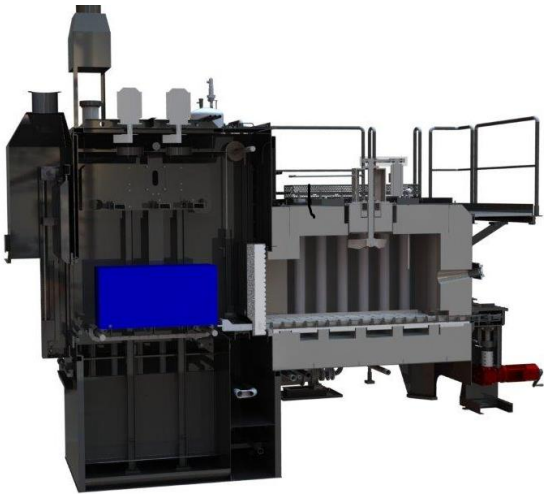
## Conventional Atmosphere IQ Furnace



**SECO/VACUUM** *The North American Vacuum Furnace Company*

Standard atmosphere sealed quench furnaces are all very similar. The quench is rather simple and the whole system operates in endothermic atmosphere which is 40% Hydrogen and 20% CO.

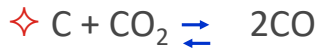
Yesterday's Technology



**SECO/VACUUM** *The North American Vacuum Furnace Company*

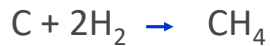
But, this is yesterday's technology.

# Vacuum Hardening - SIMPLE



No CO or CO<sub>2</sub> in Vacuum

(Boudouard reaction)



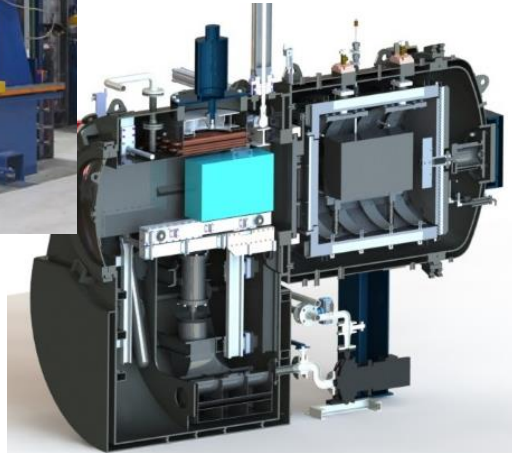
No H<sub>2</sub>O and no H<sub>2</sub> in Vacuum

◇ Endothermic Gas has the above constituents

**SECO/VACUUM** *The North American Vacuum Furnace Company*

Gas Atmosphere carburizing is not simple. You use, in most cases, Endothermic gas. Then you have to figure out the carbon potential needed to get the carbon to flow into the steel. The art is well know, but assuring exact results is difficult – there are over 180 reactions – its fun!. For through hardening it is even more difficult. With a gas atmosphere, you have to balance the need to not carburize vs de-carburizing. In a VACUUM atmosphere these gas transport phenomenon do not hold. There is no decarb in vacuum.

## Standard Vacuum Oil Quench



**SECO/VACUUM** *The North American Vacuum Furnace Company*

Modern TODAY is LPC and Vacuum Oil Quench, which we offer!! We call it CASEMASTER Evolution. From the LPC chamber to the oil quench transport is under vacuum. This means the quench must withstand vacuum (and even some pressure for gas cooling). These are great furnaces, but the special quench design cost more. Aerospace has been the target market for this technology and we have dozens of installations.



---

## SMART IQ - What is Needed:

- ✧ The Productivity of Atmosphere Gas Carburizing and low ownership cost.
- Quality of Vacuum Heating and LPC
- Simplicity of standard Oil Quench – standard oils, standard construction.

**SECO/VACUUM** *The North American Vacuum Furnace Company*

We need the productivity of the standard gas atmosphere furnace, but we want the quality of vacuum heating. We also want the simplicity of the smart design of a standard oil quench.

---

## CASEMASTER® Evolution success:

- ✧ LPC is the way to Carburize
- Vacuum Heating is the way to Through Harden
- When Vacuum and Oil Quenching is NEEDED. However, the furnace costs more to make.

**SECO/VACUUM** *The North American Vacuum Furnace Company*

---

## SMART IQ – Market Position:

- ✧ Aerospace Vacuum Oil Quench is double cost of standard Gas carburizer.
- ✧ Standard Gas Carburizer needs added Endo Generator.
- ✧ Price Point is needed in-between these two furnaces

**SECO/VACUUM** *The North American Vacuum Furnace Company*

Gas Carburizing furnaces are very competitively priced. High tech vacuum LPC with vacuum oil quench is around 2x price for the larger sizes. Gas Carburizing furnaces need an endo generator with maybe one generator feeding two furnaces. The Super IQ needs no generator. Our price point is between the two furnace styles making the Super IQ very attractive.

---

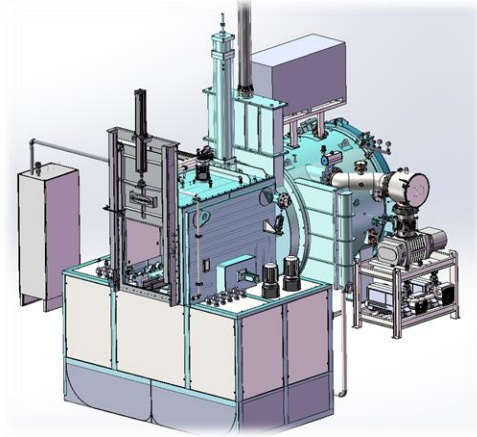
# The answer is Vacuum and Nitrogen

- ✧ To prevent Decarb.
- ✧ To prevent IGO
- ✧ To save process gases
- ✧ To eliminate Endo Gas
- ✧ To use LPC
- ✧ To lose the flames
- ✧ Safety

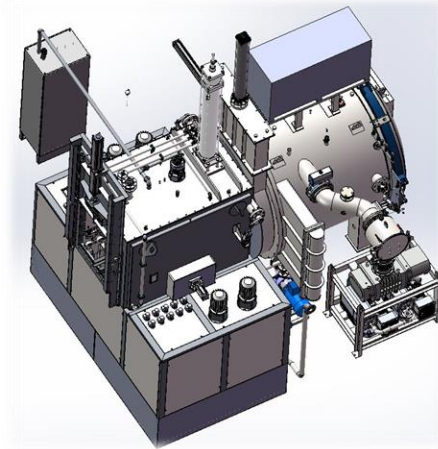


**SECO/VACUUM** *The North American Vacuum Furnace Company*

## MODEL SIQ-17 (36" W X 36" H X 48" D)



Simple Quench

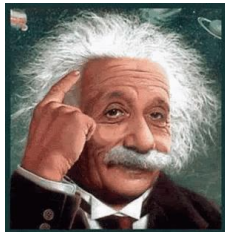


Furnace w/Vacuum

**SECO/VACUUM** *The North American Vacuum Furnace Company*

ONE SIZE!! We selected 36.36.48 3300 lbs. We wanted to eliminate transferring in Vacuum or transferring in Endo Gas. Therefore, we must transfer in inert nitrogen. The nitrogen prevents any flames, being devoid of oxygen. IT WORKS!

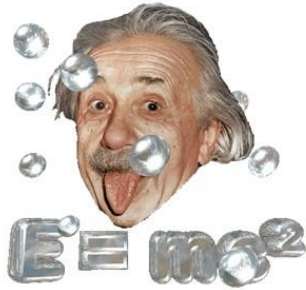
SECO/ANSWER = SUPER IQ™



**SECO/VACUUM** *The North American Vacuum Furnace Company*

Simply. We call it SUPER IQ. Notice it looks like a standard quench furnace from the front door. Brilliant

SMART IQ = SUPER IQ™



**SECO/VACUUM** *The North American Vacuum Furnace Company*

Turn it around and it is a vacuum vessel for quality and productive Low Pressure Carburizing. From this view it looks like a vacuum furnace. What were the technical challenges?

# TESTS CONFIRM SUPER IQ™

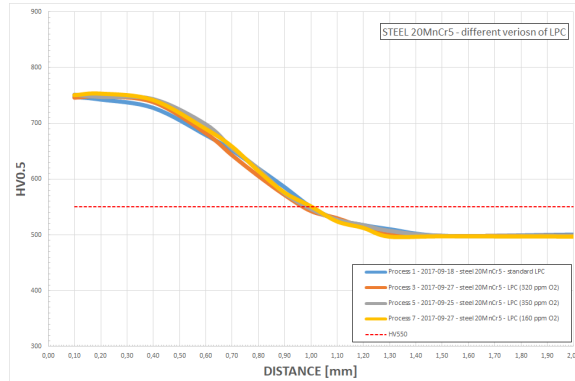


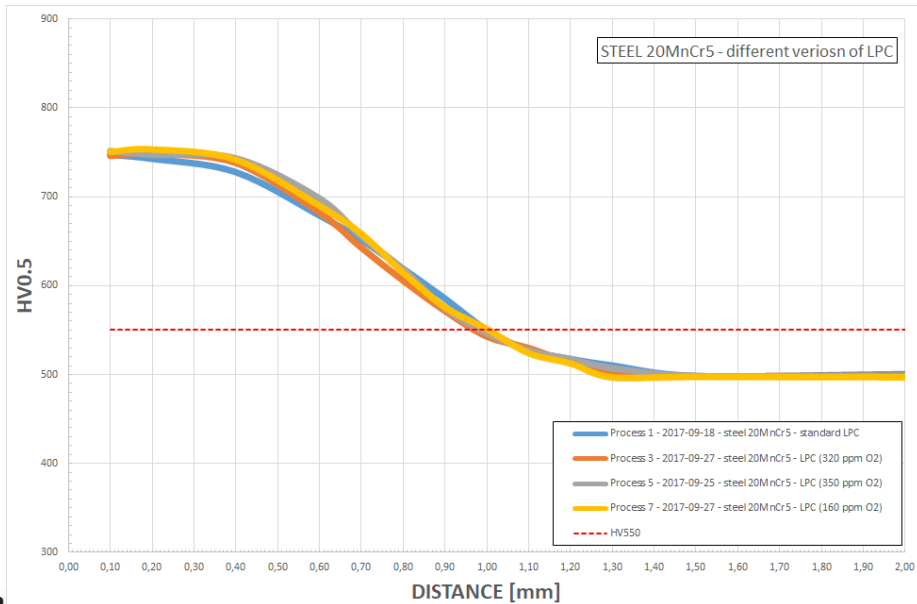
Figure : Verification of process under varying levels of oxygen contamination (3 – 350 ppm O<sub>2</sub>). SAE 5120 or 20MnCr5 steel grade. Surface hardness was greater than 62 HRC on all samples.

**SECO/VACUUM** The North American Vacuum Furnace Company

Our tests confirmed the concept. The samples stayed clean. We even added some Oxygen to the nitrogen to simulate contamination and the short transfer times to oil did not show any degradation. Hardness was all within specifications.



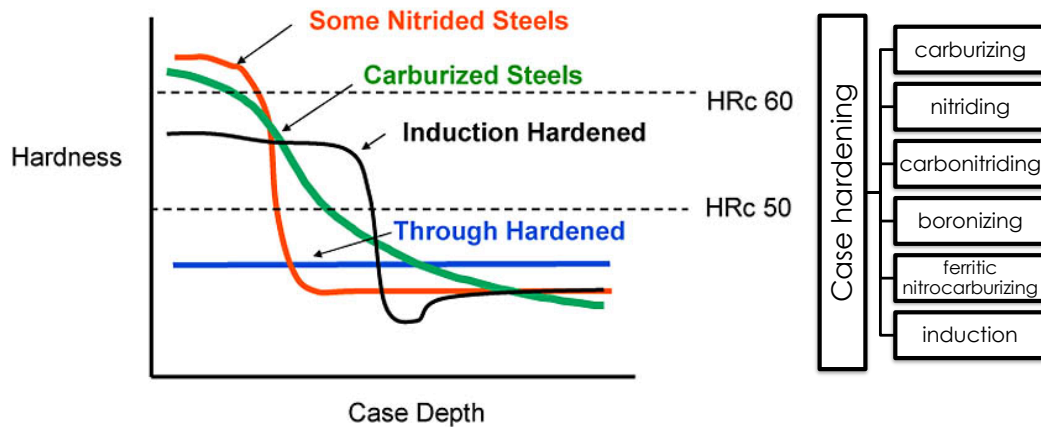
# TESTS CONFIRM SUPER IQ™



**SECO VACUUM** The North American Vacuum Furnace Company

A closer look at trials where we varied the oxygen contamination.

## WHY DO WE DO CARBURIZING?



**SECO/VACUUM** The North American Vacuum Furnace Company

Carburizing is a very desirable process. Layers can be much harder than with through hardening.

## LPC PRODUCTIVITY INCREASE

Effective Case Depth [mm]	LPC carburizing time					
	925°C	950°C	980°C	1000°C	1020°C	1040°C
0.50	1h 23m	57min	39 min	30 min	24 min	19 min
1.00	5h 30m	3h 50m	2h 35m	2 hours	1h 35m	1h 15m
2.00	22 hours	15h10m	10h 20m	8 hours	6h 10m	4h 50m
Time relation	100 %	69 %	47 %	36 %	28 %	22 %

Tab.1. Carburizing time of 16MnCr5 for the given case depth with criterion of 0.35%C, at particular temp.

**SECO/VACUUM** *The North American Vacuum Furnace Company*

With the Super IQ furnace design, Going up in temperature is NOT a problem with the equipment!! 925C = 1700F, 950C = 1740F, 980C = 1800F, 1020C = 1870F 1mm = .040"

Through harden and process materials of all grades, including tool steels are now possible with NO degradation of the furnace life!!.

---

# The answer is LPC and Nitrogen

- ✧ To carburize faster – higher temps.
- ✧ To prevent IGO
- ✧ To save process gases
- ✧ To eliminate Endo Gas (CO)
- ✧ Excellent Uniformity and Quality
- ✧ To lose the flames
- ✧ Turn it on, Turn it off!!



**SECO/VACUUM** *The North American Vacuum Furnace Company*

To carburize the SMART IQ Super IQ way means LPC and nitrogen transfer.

## Standard Quench Oils, Nitrogen and Acetylene, Share Loader



**SECO/VACUUM** *The North American Vacuum Furnace Company*

Standard quench oils. Available bulk nitrogen gas, acetylene for carbon and even the possibility to share the loader with existing furnaces!!

LOSE THE FLAMES



**SECO/VACUUM** *The North American Vacuum Furnace Company*

LOSE THE FLAMES, go Super IQ.

---

# SMART IQ – SUPER IQ™

✦ First Unit is running!! Can be seen in Eastern PA

✦ INTRODUCTORY PRICING!! Ask for a quote.

✦ Pricing good for THIS YEAR

**SECO/VACUUM** *The North American Vacuum Furnace Company*

We are quoting and accepting orders!

---

**SECOVISORY**  
*Heat Treat Advisory Council*



**SECO|VACUUM** *The North American Vacuum Furnace Company*

Our team can help you fit our furnaces into your plant. The Super IQ can be placed next to standard gas carburizers and use their loading system, or we can provide the loading mechanism. Either way, LOSE THE FLAMES, go Super IQ.



---

## SHARE THE LOADER



**SECO/VACUUM** *The North American Vacuum Furnace Company*

Our team can help you fit our furnaces into your plant. The Super IQ can be placed next to standard gas carburizers and use their loading system, or we can provide the loading mechanism. Either way, LOSE THE FLAMES, go Super IQ.

---

**SECOVISORY**

*Heat Treat Advisory Council*

**SECO/VACUUM has one of  
the largest and most diverse  
product offerings on the  
market.**

**We have experience!**

**SECO/VACUUM** *The North American Vacuum Furnace Company*

# SVT VACUUM BUSINESS

CASEMASTER  
EVOLUTION



MULTI  
CHAMBER



**SECO/VACUUM** *The North American Vacuum Furnace Company*

VECTOR



UNICASE MASTER



# SVT VACUUM BUSINESS

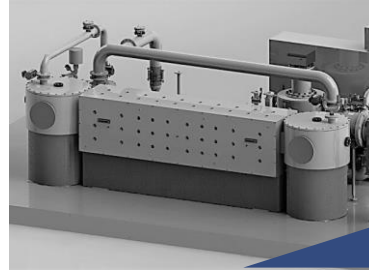
SUPER IQ



SPECIAL CUSTOM



NITRIDING



4D QUENCH

**SECO/VACUUM** *The North American Vacuum Furnace Company*

---

## Contact Us.....

**SECO/VACUUM**

*The North American Vacuum Furnace Company*

Mr. Mark Hemsath

E-mail: [mark.hemsath@secovacusa.com](mailto:mark.hemsath@secovacusa.com)

Tel: 419.356.3500

SECO/Vacuum Technologies

180 Mercer Street

Meadville, PA 16335

[www.SecoVacUSA.com](http://www.SecoVacUSA.com)

**SECO/VACUUM** *The North American Vacuum Furnace Company*