THERMAL PROCESSING FOR AUTOMOTIVE SEATING COMPONENTS:

The Essential Guide

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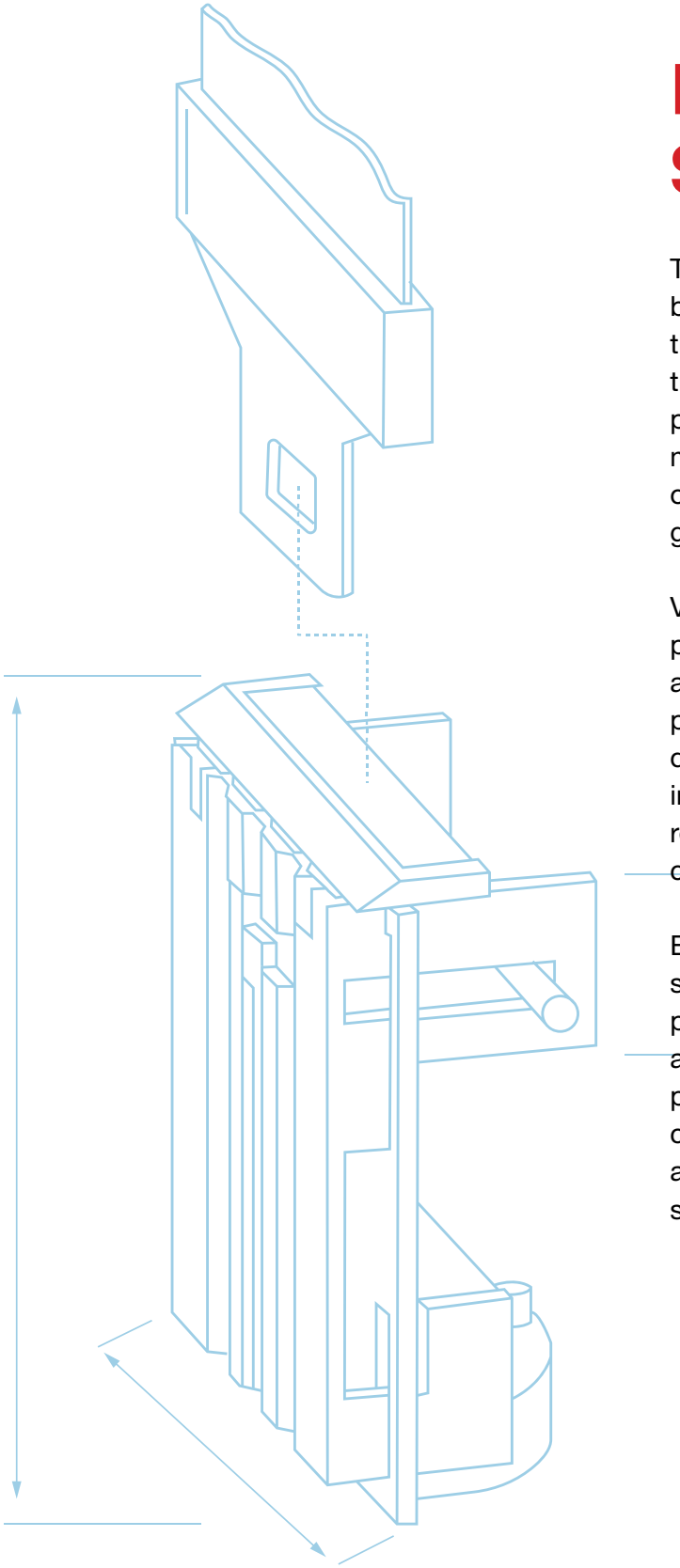

EXECUTIVE SUMMARY

The advent and increasing adoption of electric vehicles have brought a wave of change to the automotive industry and the commercial heat treating industry as a result. Many heat treaters are beginning to see demand drop for traditional powertrain components as new fuel technology enters the market. However, while the internal combustion engine may one day become a thing of the past, the automotive seat isn't going anywhere.

Vehicle seat components are considered safety critical parts because they need to be tough enough to survive a crash—if they fail, a driver or passenger can be injured, possibly critically. Automotive seat recliners are typically designed to carry between 2,000 and 4,000 Newton meters in the event of a crash. Auto seats are also high-precision, requiring exceptionally tight tolerances due to the way the components of parts such as recliners engage.

Because of this, seat components are required to meet stringent thermal processing specifications so they will perform properly under everyday use and especially during a collision. In this article, we will discuss the key thermal processes used for automotive seating components, how common materials respond, and how Paulo's datagineering approach yields repeatable results that OEMs and tiered suppliers can count on.

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KEY THERMAL PROCESSES

Case Hardening

Case hardening diffuses carbon or carbon and nitrogen into the surface of a metal from the atmosphere within a furnace at high temperatures. Adding carbon or carbon and nitrogen to the surface of steel hardens a metal object's surface while allowing the metal deeper underneath to remain softer, creating a part that is hard and wear resistant on the surface while retaining a degree of flexibility with a softer, more ductile core. This softness and ductility are what create toughness in parts because it allows them to respond to stress without failing. Case hardening is a general term for this heat treating method. Depending on the materials and specifications for the part, we apply a variety of case hardening techniques including carburizing, carbonitriding, and ferritic nitrocarburizing (FNC).

Carbonitriding

During carbonitriding, parts are heated in a sealed chamber well into the austenitic range—around 1,600 degrees Fahrenheit—before nitrogen and carbon are added. Because the part is heated into the austenitic range, a phase change occurs and carbon and nitrogen atoms can diffuse into the part. Carbonitriding is used to harden surfaces of parts made of relatively inexpensive and easily machined or formed steels, which we often see in automotive metal stampings. This process increases wear resistance, surface hardness, and fatigue strength.

Ferritic Nitrocarburizing (FNC)

FNC is a case hardening technique that uses heat, nitrogen and carbon to toughen up the exterior of a steel part, improving its durability, decreasing the potential for corrosion in parts, and enhancing their appearance. FNC is unique in

that it offers case hardening without the need to heat metal parts into a phase change (it's done at between 975 and 1,125 degrees Fahrenheit). Within that temperature range, nitrogen atoms can diffuse into the steel but the risk of distortion is decreased. Due to their shape and size, carbon atoms cannot diffuse into the part in this low-temperature process—however, carbon is necessary in the FNC process to generate desirable properties in the intermetallic layer.

Neutral Hardening

Also called through hardening, neutral hardening is a very old method for hardening steel that involves heating the metal to a specified temperature and then quenching it in oil to achieve high hardness/strength. In this process, the primary concern is increasing hardness throughout the part, as opposed to generating specific properties between the surface and the core of the part.

All of the metal components of a seat belt, including seat belt loops, seat belt tongues, and seat belt buckles, are neutral hardened. Specifications typically dictate that these components are hardened to up to 200 kilopounds per square inch (ksi).

Because seat belt components are visible to the end consumer, the cosmetics of these parts are important in addition to their mechanical properties. It's important to keep the furnace free of soot and to thoroughly clean the parts both before and after heat treatment. Proper cleaning readies the part for secondary processing, ensuring the success of activities like polishing and chrome plating.

15K+ lives saved by seatbelts each year in the U.S.

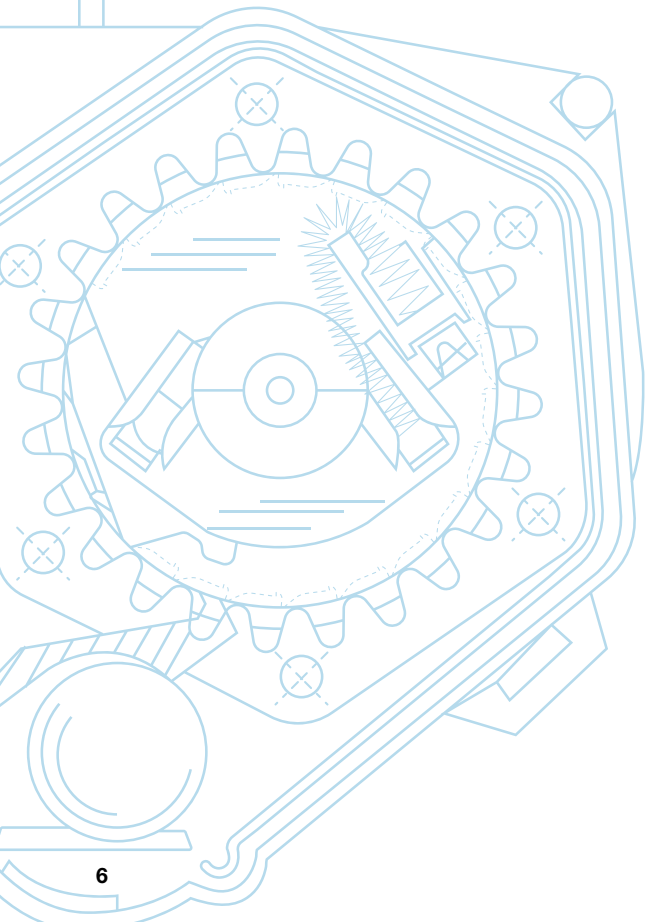
SAFETY-CRITICAL SEATING COMPONENTS

PARTS & MATERIALS WE PROCESS

The steels used for different automotive seating components vary depending on the part they're being used for.

Seat Recliners

Because seat recliners are critical safety parts as car seats must survive impacts during accidents and help to protect the driver and passengers, they are required to meet very stringent levels of surface carbon. The recliner's characteristics must balance strength, ductility, weldability, and wear. Striking the correct combination of steel and heat treatment is essential.



Generally, these components are case hardened (either carburized or carbonitrided) typically using one of the following materials:

1010 carbon steel. 1010 is a plain carbon steel with 0.10% carbon content, fairly good machinability, and relatively low strength.

1020 carbon steel. 1020 carbon steel is known for having good formability and a desirable combination of strength and ductility. It can be hardened or carburized.

1018 carbon steel. 1018 is a free machining grade carbon steel that is widely available around the world. Some manufacturers consider it the best option for carburized parts with a good combination of toughness, strength, and ductility.

10B21 boron steel. Boron steels are becoming more popular in the automotive industry due to their excellent heat treat response.

4130 alloy steel and 8620 alloy steel. Alloy steels are more responsive to heat treatment than plain carbon steels, so the thermal processing specifications for parts made from these materials are often adjusted to account for the material's innate properties.

Seat Latches

High-strength seat latches are usually made from the following materials:

4140 and 4130 alloy steels. 4140 alloy steel is one of the most common materials used in manufacturing. For seat latches and hooks, 4140 and 4130 will be neutral hardened to increase its strength and hardness throughout due to the high performance and precision required of these parts.

7+ common types of seatbelts used

1050 carbon steel. 1050 is a medium carbon steel that contains 0.470-0.55% carbon content. Carbon steels are a less expensive choice when compared to alloy steels such as 4140 or 4130.

Seat Frames and Brackets

Seat frames (also known as seat brackets) give car seats their shape using slender pieces of steel joined together to form the skeleton of the seat. These components are often made from boron steels such as 10B21 or 15B24. Although as recently as 25 years ago, boron steels presented challenges with manufacturability, steel mills have, over time, solved these issues, and can today cast, form, and roll form them as readily as other steels. Boron steels are a good choice for seat brackets because they are only marginally more expensive than other steels used in seating but have a significantly higher hardenability, meaning they can be case hardened in less time than other steels to the get the same results—creating savings in both time and expense. Because of these advantages, boron steels are becoming increasingly prevalent in the auto industry.

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FULL-SERVICE THERMAL PROCESSING FOR AUTOMOTIVE

Our commercial thermal processing services for automotive extend far beyond seating components. We have a comprehensive range of capabilities and a vast equipment array that allows us to provide high-precision heat treating for brake rotors, engine components, and more.

Recliners

Low-Carbon Steel:

1010, 1020, 1018, 10B21, 8620

Through Hardening Steel:

4130

Latches

Medium-Carbon Steel:

1050

Through Hardening Steel:

4140, 4130

Carburizing Steel:

1018 and 10B21

Frames & Brackets

Carburizing Steel:

10B21, 15B24, 4130, 5120

Brake Rotors

Gray Cast Iron:

30, 35, 40

Engine Components

Carburizing Steel:

5120, 4118, 8620, 9310

High-Carbon Steel:

1074, 1090, 52100

Through Hardening Steel:

4130, 4140, 5160, 6150

Approvals & Certifications

ISO 9001:2015 · IATF 16949 · CQI-9 · CQI-11 · CQI-12 · Ford · gm

HYUNDAI · HONDA · TOYOTA · KIA · TESLA

AUTOMOTIVE SEATING COMPONENTS

DATAGINEERING FOR THERMAL PROCESSING

Paulo's proprietary datagineering approach integrates the best people, science, data, and technology, resulting in unmatched quality and speed in thermal processing for precision automotive seating components.

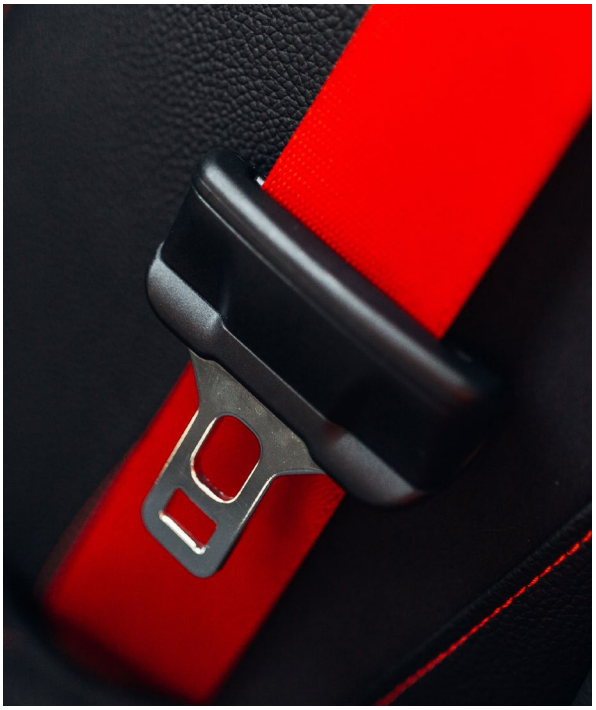
Precision Processing of Safety-Critical Parts in a Continuous Belt Furnace

For automotive seat components, Paulo typically makes use of a continuous belt furnace for superior part-to-part temperature uniformity, increased throughput, reduced changeover times, and part loading flexibility. In the continuous belt furnace, ensuring that parts reach the proper austenitizing temperature is a chief concern. That's why many of Paulo's control systems are aimed at maintaining correct temperatures for processing your parts, including:

Controlling how parts are positioned and loaded. Many heat treaters rely on employees to load parts manually onto the belt furnace, which can lead to inconsistencies in load rates and part overlap, and as a result, improper heat treatment. Any parts that happen to overlap will suffer from masking, where one part laying atop another partially shields the one below from the furnace's heat, resulting in only partial heat treatment. This issue can extend turnaround times to account for reprocessing, and even worse, may cause improperly treated parts to enter your supply chain. To combat this risk, Paulo employs an automated loading system that ensures consistent load rates and controls part overlap. In some cases, we have designed custom fixturing in-house that parts can be loaded into by hand to prevent nesting and ensure proper heat exposure on all part surfaces.

Measuring and controlling furnace temperature. Properly processing your parts the first time is what allows a commercial heat treating partner like Paulo to deliver on tight turnaround times and keep up with high volumes. That's why we measure furnace temperature in the continuous belt furnace in four different zones so we can get a clear picture of what is happening with your parts during processing—this gives us scientific certainty that proper heat treatment has taken place.

Measuring and controlling furnace firing rates. Furnace firing rates must be optimized to properly process your parts. The Paulo Belt System (PBS) verifies and adjusts furnace temperatures to prevent fluctuations in heat. If issues are detected, the process will automatically stop and parts will be quarantined until the issue is resolved. These measures prevent any out-of-spec parts from leaving our facility, reducing your risk for part failure, recalls, and other ramifications.



Verifying part temperatures as they exit the furnace. Using an infrared temperature gun, we measure how hot parts are as they exit the furnace. This is a CQI-9 standard that helps verify that parts achieved the targeted temperature while in the furnace and allows us to quickly identify any potentially defective parts.

Monitoring carbon content in the furnace atmosphere. If carbon levels are incorrect (either too high or too low) during processing, the parts will not gain the targeted surface hardness or may even lose hardness and durability through decarburization. Most commercial heat treaters only control and measure carbon from one location inside the furnace. Paulo monitors carbon across three furnace zones. If improper carbon levels are detected, alarms sound, processing is stopped, and parts are quarantined. This monitoring is crucial to proper treatment of the parts.

1B+ seatbelts manufactured annually around the world

Process Design and Automation

Paulo is highly adept at delivering excellent repeatability for parts with even the most stringent specifications. We can also help manufacturers develop new recipes or optimize existing recipes for parts with the largest in-house metallurgy team of any commercial heat treater in the industry. We can run experiments with different materials, heat treatment methods, quench media, agitation, and any other variables, to create the part with the exact properties required for it to function as needed.

For all parts we process, our recipes are programmed directly into our equipment using PICS, so your process runs automatically, using safeguards to ensure correct production every time. And once the part is treated, Paulo ensures it is cleaned and handled properly, to ensure it's ready for any secondary processing such as polishing or chrome plating.

AUTOMOTIVE SEATING COMPONENTS

EXPERIENCE THE DATAGINEERING DIFFERENCE

If you are experiencing challenges with your current heat treatment partner, working on new or updated part designs, or simply need help meeting your throughput needs, Paulo can help. We'll connect you directly with a Paulo thermal processing expert who can assist with your needs, from simple to complex, and yield unparalleled results in quality and precision for your automotive parts. To connect with a Paulo expert to discuss your heat treating needs or request a quote, contact us.

YOUR PARTNER IN AUTOMOTIVE HEAT TREATING

Paulo has a long history of proven success working with leading car makers and tiered suppliers around the world. With high-precision heat treating capabilities, we're ready to help you identify and resolve issues that a previous heat treater may have had to bring your parts to spec and provide a vital link in your supply chain.

Let's solve your greatest challenges together. Connect with a Paulo expert today to start a quote and drive your next heat treating project forward.

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