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Infrared Curing of Automotive Refinish Coatings for Electric Vehicles

SPRING 2022

INDUSTRIAL FINISHES
Automotive and Industrial Coatings

40 °C	104.0 °F
50 °C	122.0 °F
60 °C	140.0 °F
70 °C	158.0 °F
80 °C	176.0 °F
90 °C	194.0 °F
100 °C	212.0 °F

CELSIUS TO FAHRENHEIT CONVERSION TABLE

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The performance of an electric vehicle (EV) strongly depends on the functionality of its high-voltage battery pack, a component heavily influenced by temperature. The temperature of battery systems for electrical-drive vehicles directly affects both vehicle performance and long-term battery durability.

Autobody shops are discovering that painting and curing refinish coatings applied on EVs can be a bit tricky - especially curing - due to the heat sensitivity of the battery packs. The challenge is that all EV manufacturers have temperature limitations for their vehicles' battery packs, and all are different. Even the same manufacturer could have different limitations for their different models.

The problem is that conventional convection spray booths (which are used by most autobody shops) result in temperatures that are right at the limit of virtually all manufacturers' recommendations. This is usually right around 140 degrees Fahrenheit (60 degrees Celsius).Furthermore, curing by convection heat will heat-up the entire vehicle, including the interior parts, and not specifically the surface section of the vehicle where the coating is applied.

EXCESSIVE HEAT EXPOSURE TO THE BATTERY PACK CAN CAUSE THE FOLLOWING DEGRADATION OF BATTERY COMPONENTS, LEADING TO A LOSS OF BATTERY CAPACITY

As technology changes and EVs gain in popularity, new information and best practices emerge for bodyshops.

So, what can a bodyshop do to eliminate the potential issues with electric vehicle battery packs?

The answer is infrared curing!

Infrared curing, which has been readily available for many years, has a distinct advantage over convection oven heat curing: It does not penetrate more than a few millimeters past the surface of the vehicle. Hence, the heat absorbed by interior parts, including the battery pack, is very minimal. The temperature at the coating surface could easily be 140-180 degrees Fahrenheit, while the temperature 2 inches underneath will be less than 100 degrees Fahrenheit.

Interestingly, medium-wave infrared is superior to short-wave infrared due to it's ability to penetrate even less deeply. Medium-wave infrared radiation is absorbed by the coating, which is by far the most efficient curing method. Infrared curing systems from US Autocure utilize medium-wave infrared for this reason.

INFRARED RADIATION DOES NOT PENETRATE MORE THAN A FEW MILLIMETERS PAST THE SURFACE OF THE VEHICLE.

With their heat-sensitive battery packs, EV repairs need US Autocure to help keep batteries and sensitive electronic components safe and functioning optimally.

WHAT ARE THE OEMS SAYING?

As more electrified vehicles hit the streets, more of them will hit each other! Sophisticated EVs often require collision repair guidance directly from OEMs, particularly as applies to battery technology.

OEMs have different estimates of the temperature at which their battery packs risk damage. Some OEMs may allow higher temperatures for shorter periods or lower temperatures for a longer time.

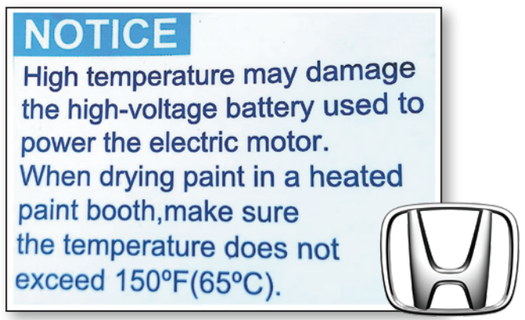
Ford Motor Company recently issued guidance regarding their EVs and hybrids. According to Ford, "during refinish operations, temperature must be set at or below 140 degrees F for no more than 45 minutes. Jobs that require heat in excess of 140 degrees F or bake times longer than 45 minutes will require the high voltage batteries be removed during the curing process."

Audi recommends that its EVs stay below 70 degrees C (160 degrees F)) and bake no longer than 90 minutes. **Mazda** says no more than 60 degrees C (140 degrees F) but has no recommended time limit.

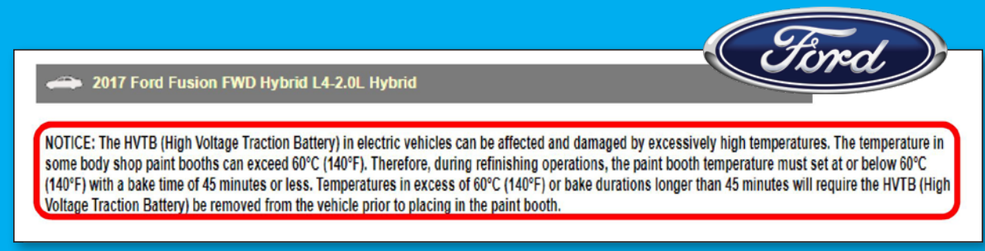
Jaguar/Land Rover, Porsche, and **Mercedes-Benz** permit 80 degrees C (176 degrees F) for an hour. (**Porsche** suggests 60 degrees C for two hours as an alternative.) **Tesla** specifies 165 degrees F (74 degrees C) for a maximum of 45 minutes.

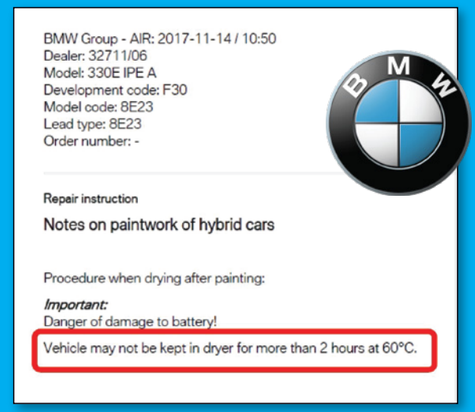
Honda's lithium-ion battery pack stows beneath the rear seat. During operation, battery temperature is controlled by a forced-air fan that draws air from the cabin into the battery pack.

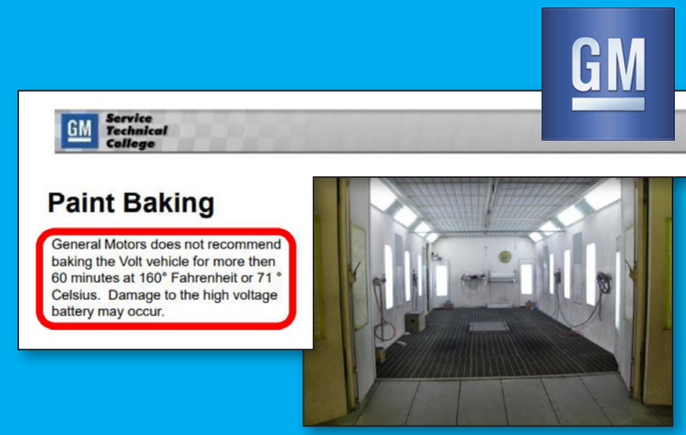
But that fan (and most cooling systems) won't help if the EV is subjected to the heat of a paint oven set at 150 degrees or higher. **Honda** puts the warning label in a place where the repair shop cannot miss it while moving the car.

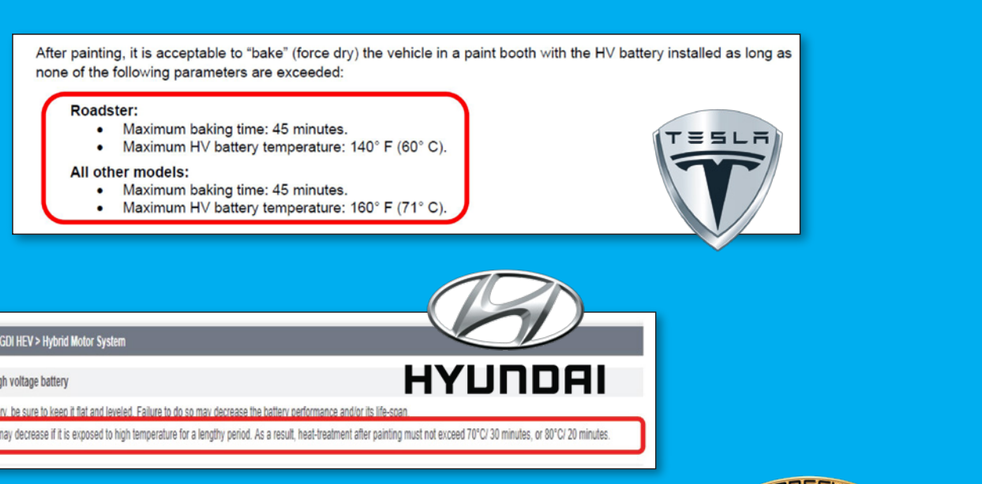


> ***While there are slightly different thresholds of damage by battery chemistry and cell configuration, all batteries, including traditional lead-acid 12-volt batteries can be damaged by excessive heat. In the case of modern lithium-ion hybrid batteries, heat-related damage can span a range of outcomes, depending on the temperatures involved and the time of exposure.***
>
> ***Excessive heat can damage many areas of a lithium-ion battery pack in different ways. A common damage scenario is essentially degradation of active lithium and other materials in the battery cells resulting in a loss of cell capacity, while an associated increase of internal electrical resistance can reduce the rate of cell output or power.***
>
> **- Honda Motor Co.**

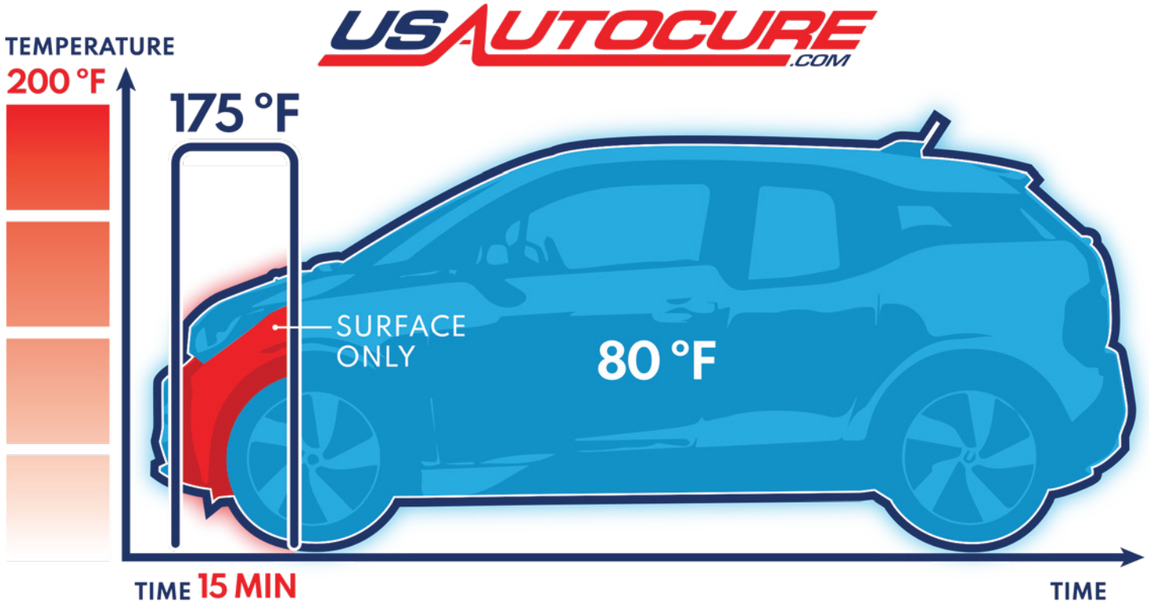








TIME vs. TEMP vs. HEAT PENETRATION



TIME vs. TEMP vs. HEAT PENETRATION

EXPOSURE TO HIGH TEMPERATURES OVER TIME CAN HINDER BATTERY PERFORMANCE

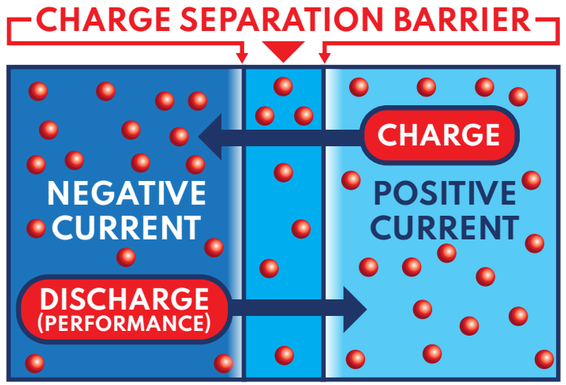
With traditional oven-bake curing, you can raise the temperature and reduce the time, but you are only trading one potentially harmful effect for another. Lowering the temperature and increasing the time will also not offset possible battery damage. There are no trade-offs.

Medium-wave infrared curing heats up near instantaneously, achieving curing temperatures quickly. Energy is absorbed by the coating on the specific substrate area, and very little heat penetrates the substrate or spreads elsewhere throughout the vehicle. Shorter cure times result in less total potential exposure.

Just what type of damage might occur?

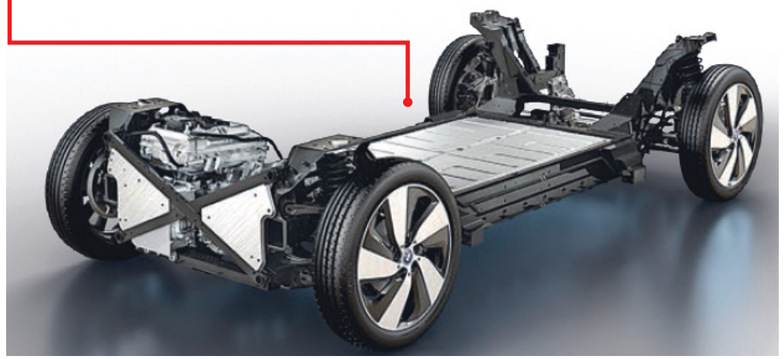
In modern Lithium batteries, high temperatures can break down the barrier between positive and negative charges. This has two unappealing impacts. Since ions can no longer flow freely, the battery will take longer to charge and may no longer charge to 100%.

Additionally, since ion flow is restricted in both directions, the vehicles' acceleration and overall performance may be compromised.



Heat may damage the barrier separating negative and positive currents. Ionic movement from one side of the barrier to the other allows the battery to charge and allows the vehicle to perform during discharge. If the barrier is compromised, these ions co-mingle, hurting the batteries' ability to charge/discharge.

Battery trays reside in the EV's "skateboard" chassis. In traditional convection cure booths, they cannot be protected from heat.



Directed infrared energy is focused on the specific area of repair. Very little heat is transferred elsewhere.

WHAT ABOUT BATTERY COOLING SYSTEMS?

EVs typically employ some type of battery cooling system (such as fans) to help control temperatures. These cooling systems may be damaged and should not be relied upon to cool the batteries during the repair process. Furthermore, many repairs will require disconnecting or disabling the batteries. If cooling systems require power to operate, they will be of no help cooling the batteries during repairs.

ONBOARD TATTLE-TALE SYSTEMS

Modern vehicles are communicating with the outside world non-stop, and many contain data collection features that rival an airline's black box. If recommended battery temperatures are exceeded, not only do most EVs capture the data, but many will communicate that automatically to the OEM where it is recorded.

PANEL REMOVAL

Removing a body panel for paint and curing is often mentioned as an appealing EV repair method. Many EVs utilize an increasingly complex system of clips, adhesives, fasteners, and welds. The use of carbon fiber is becoming more prevalent. Pulling panels is more time consuming and isn't as straightforward as it used to be.

DOESN'T IT GET HOT OUTSIDE?

Blacktop parking lots in Palm Desert get hot. Why is a spray booth a concern, and not hot temperatures in general?

According to Honda, "Vehicles should not experience temperatures detrimental to the battery in normal use. The record high in Death Valley stands at 134 degrees (Fahrenheit), and even that is well below the 150-degree temperature noted on the warning sticker."

Parking lot fender-benders are more common than summertime day trips to Death Valley.

High temperature's negative impact on battery packs may occur incrementally. Continued gradual exposure over time may have cumulative effects in terms of the batteries' longevity and performance.

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THE CASE FOR FLEETS

The fastest-growing EV market segments include fleet and commercial vehicles- and we're just getting started.

For example, Amazon has 10,000 electric delivery vehicles on the road in 2022, and they intend to raise that number to 100,000 by 2030. FedEx intends to convert their entire fleet to EVs by 2040.

Rental car fleets are a increasingly electric. Additionally, recreation vehicle (RV) manufacturers such as Thor Industries are introducing electric-powered motorhomes as well as travel trailers that include lithium battery packs.

The change is coming quickly.

Fleet, commercial vehicle, and RV repair can be a profitable markets for body shops. With medium-wave infrared curing from US Autocure, shops enjoy distinct advantages:

- Protection of battery packs from excessive heat
- Dramatically shorter key-to-key cycle times, which is especially essential when repairing revenue-generating commercial vehicles

DON'T FORGET SENSITIVE INTERIOR COMPONENTS

Comfort and convenience electronic components can make up to 20-25% of the overall cost of an EV. Electronics in modern EVs are so sensitive that many include sophisticated electronic cooling systems or thermal barriers to help protect from excessive heat. For example, most wireless entertainment systems will start to show damage at approximately 80 degrees Celsius/176 degrees Fahrenheit.

Drivers love the infotainment options that today's cars, trucks, and SUVs offer. Protecting these delicate systems from heat during the repair process is a challenge for body shops. Directed energy through infrared curing can help protect these costly systems from damage.

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From our family to your family, Industrial Finishes has been proudly supporting the collision repair industry for 60 years. We have been fortunate to grow profitably with our customers during that time, and we appreciate the opportunity to work with you.

Our core values of integrity, knowledge and service have been the cornerstone of building long-term partnerships with our customers. We have experienced people working inside and outside to support your needs. The depth of our team, our collaborative solutions and our mindset of continuous improvement make us the partner of choice.

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