20 MULE TEAM BORAX™

Inside electric vehicles: The borate connection

We are responding to the world's growing demand for battery materials

U.S. Borax is helping to solve critical world problems on our shared journey to decarbonization. Our California Operations are a global leader in the supply and science of borates, which the world needs for the global energy transition, and specifically, as it transitions to wider use of electric vehicles, or EVs.

We supply about 30% of the world's refined borates and has a proud history spanning more than 150 years. Borates have many varied uses in the manufacture of EVs – and are essential to EV efficiency, safety, and overall performance.

Take a look around this EV to see where borates are used.

A Borates added to aluminum and steel make the **car body and alloy frame** stronger and more resistant to corrosion.

B EV design often calls for light weight **body panels** made from plastic, reinforced by textile fiberglass incorporated with borates.

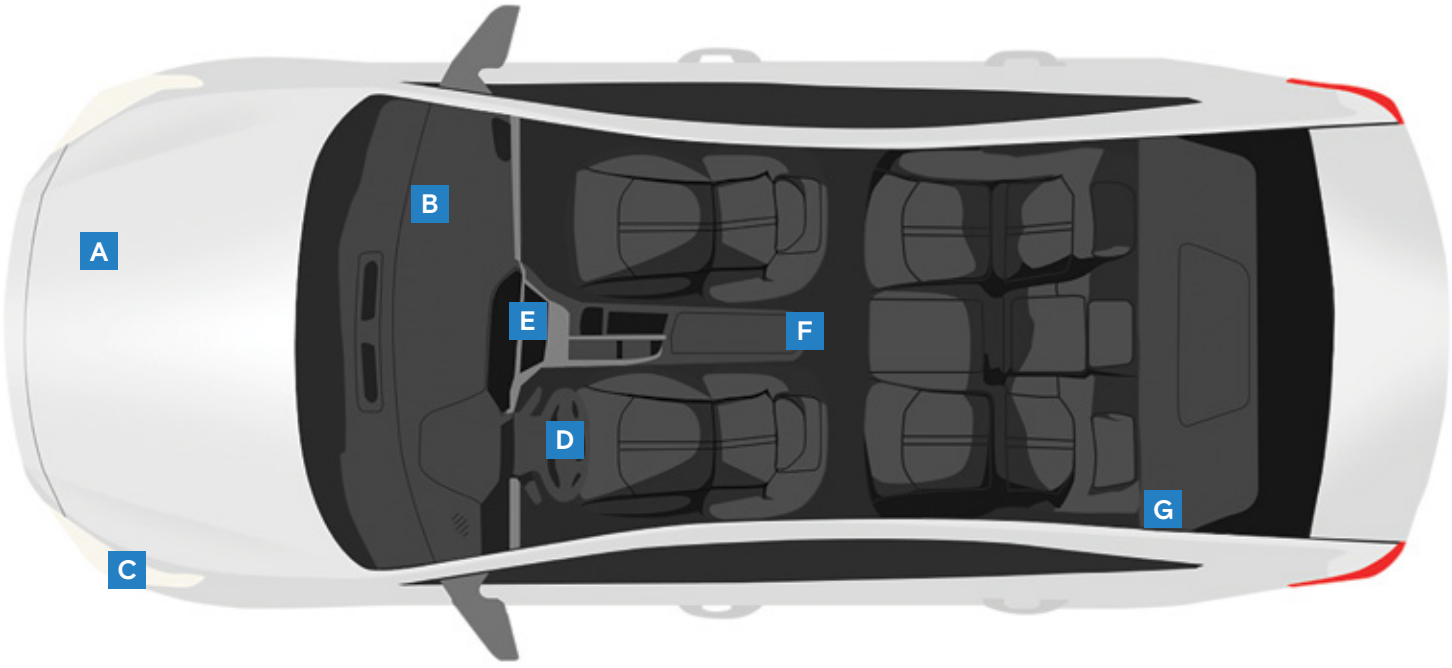
C Borosilicate glass, made from silica and boric oxide, is used in sealed **headlights** and halogen bulbs due to its strength.

D A mixture of elemental boron and potassium nitrate powder activated by electronic sensors helps **airbags** inflate immediately upon impact.

E Specialized borosilicate glass forms thin, light screens and is favoured in the production of in-car **touch screen displays** with navigation and entertainment features.

F Borates are often added into the materials used for interior **carpets and upholstery** due to their fire-retardant properties, which can slow down the spread of flames and enhance safety in the event of a fire.

G EVs use various materials to insulate against heat and noise, creating a quieter and more comfortable driving environment. Borates are an essential ingredient in the **insulation** fiberglass and are used as a flame-retardant additive to non-woven materials to prevent the insulation from igniting and burning.



20 MULE TEAM BORAX™

As you can see, the versatility and unique properties of borates make them valuable in enhancing various aspects of EV technology, from energy storage to safety and comfort.

We have always been on the forefront of borate technology, research, and development. Now, we are responding to the world's growing demand for battery materials.

Borates are an important part of our growing battery materials solution.

RIGHT: A close-up view of tincal—commonly known as borax—that is mined at our operations in California.

H The **EV battery pack** has numerous components containing borates, including the anode, cathode, electrolytes, thermal interface material, and battery housing.

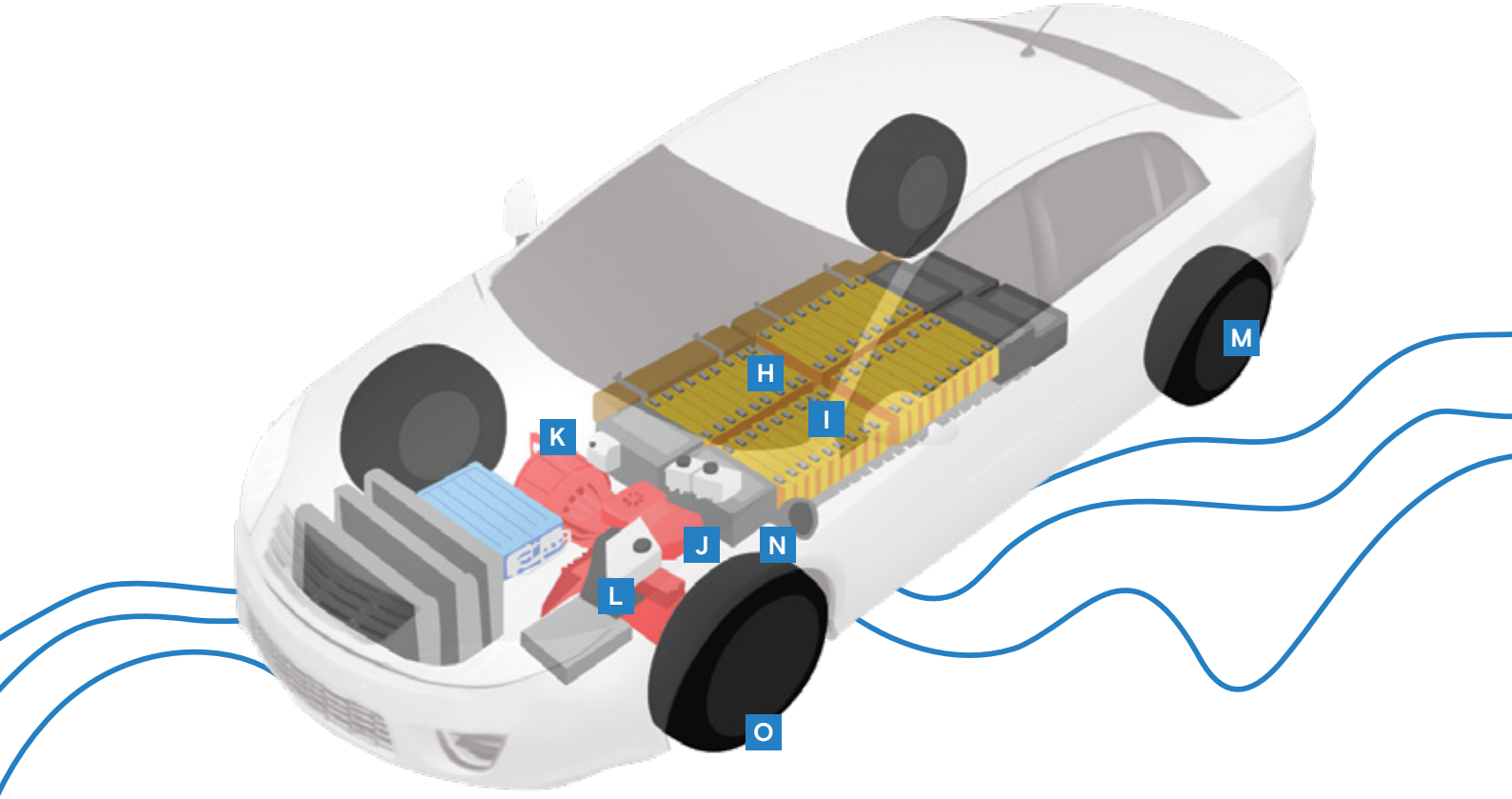
I Borate-based electrolytes in EVs' **lithium-ion batteries** are used to enhance conductivity, leading to better low-temperature performance, faster charging and extended overall battery life. Research suggests that borates may improve the stability and safety of lithium-ion batteries, reducing the risk of overheating and fires.

J Borates are found in a wide array of flame-retardant additives used in components of the EV **electrical system**. This is especially important for EVs because they contain more wires, cables, and connectors than non-electric cars together with a higher fire risk battery.

K Boron is an essential ingredient in neodymium (NdFeB) magnets, commonly used in EV **motors** and regenerative braking systems thanks to their high energy transition efficiency, high strength, and stability.

L Borate-based **engine coolants** and antifreeze can help regulate the temperature of various EV components, such as the battery and power electronics. Borates offers superior coolant performance, corrosion protection and pH stability.

M Borate esters are used in some **brake** fluids to lower the boiling point of the fluid to prevent a loss of brake power. Borates are used in brake pads too.

N Borate-based materials are used in EV **charging infrastructure**, such as in ceramic materials for charging connectors. Borates help reduce wear and tear, create a secure and efficient connection between the EV and charging infrastructure, minimise maintenance requirements, and reduce fire risks.

O Adding zinc borate to a **tire's** rubber composition creates a strong, durable adhesion to the metallic rim.