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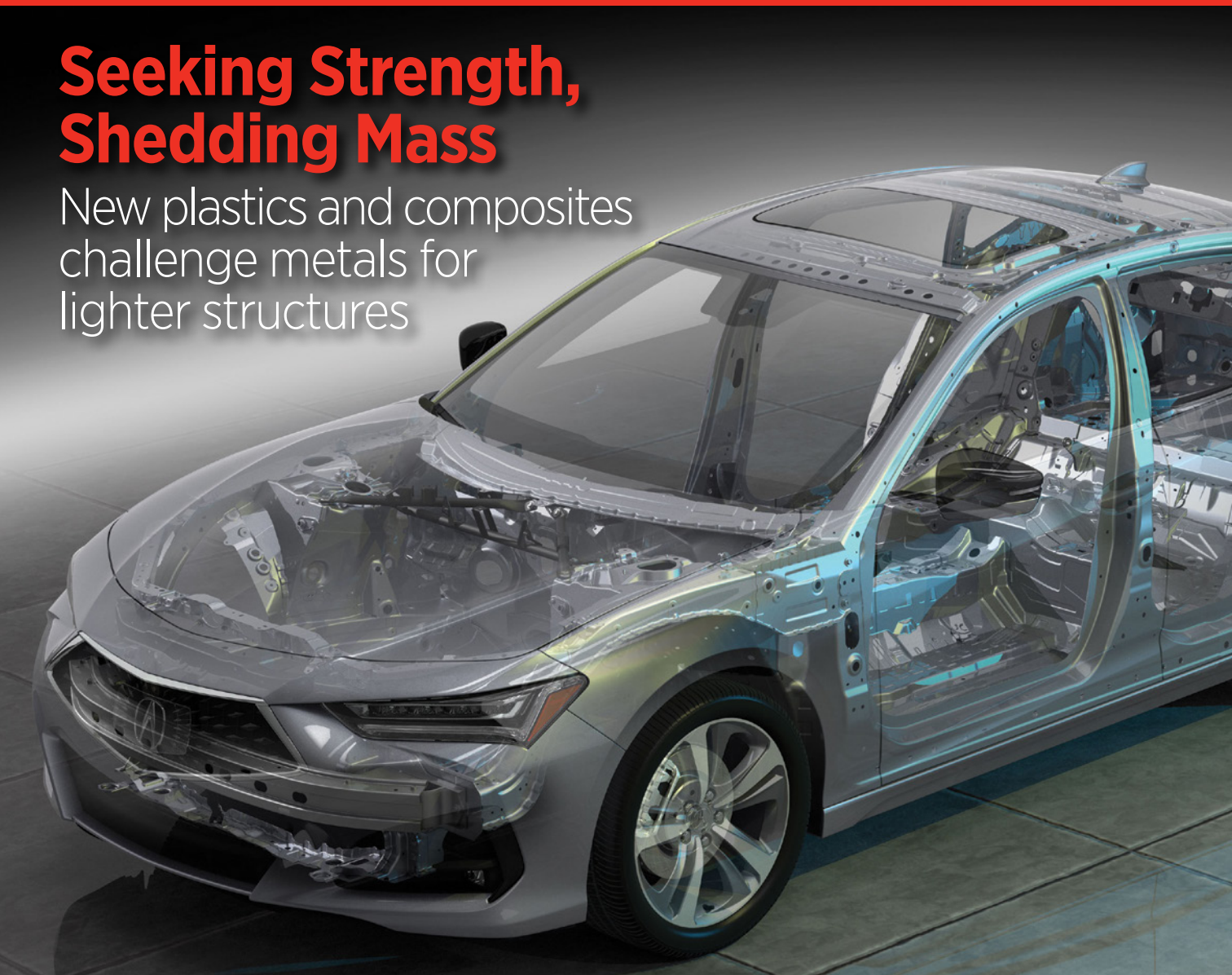


Seeking Strength, Shedding Mass

New plastics and composites challenge metals for lighter structures

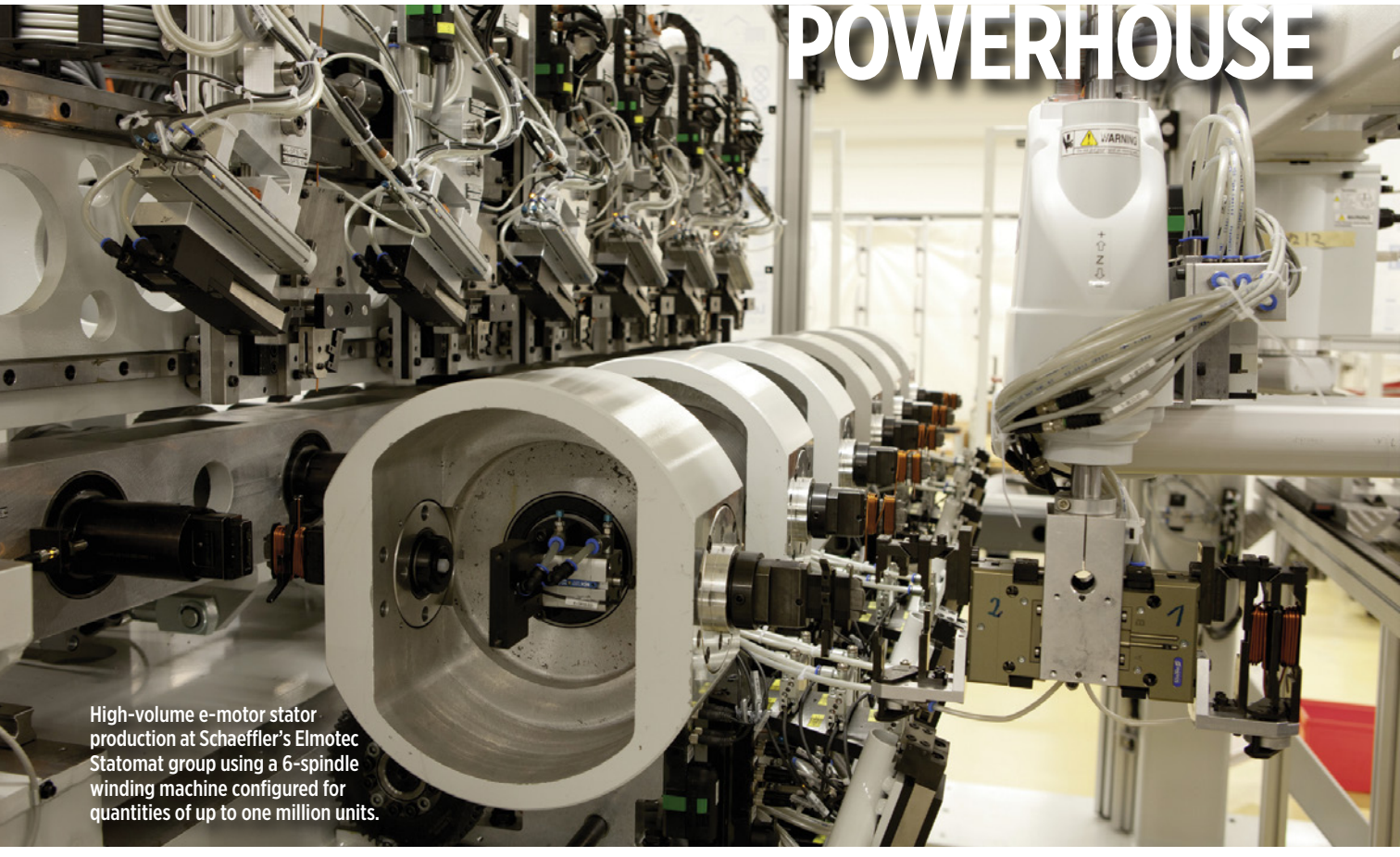
Schaeffler's Dan Sayre talks e-motors

Laurie Harbour Q&A

Altair Lightweighting awards

September 2021 autoengineering.sae.org

Schaeffler builds an e-motor POWERHOUSE



High-volume e-motor stator production at Schaeffler's Elmotec Statomat group using a 6-spindle winding machine configured for quantities of up to one million units.

ELMOTEC STATOMAT GMBH

Armed with state-of-the-art manufacturing and a history of innovation, Schaeffler Group is attacking the e-mobility space, says Daniel Sayre.

by Lindsay Brooke

The vehicle-electrification trend has caused the industry's "traditional" suppliers to bring new strategies, tactics and investment to meet a growing tide of EV development programs. Some long-serving companies have had to scramble and essentially reinvent themselves. For others, including 75-year-old **Schaeffler Group**, the transition has been more seamless. Schaeffler notably read the forecasts correctly and has been steadily building e-mobility muscle as it positions itself for the electric future.

"E-mobility technology is new in some ways, but the methods to implement it in production are the same as they've always been," noted Daniel Sayre, director of the eMotor and PEU [power electronic] business unit at Schaeffler North America, based in Wooster, Ohio. "We're just configuring our many 'building blocks,' some of them a century old such as our bearings, in new ways."

For Schaeffler, which invented the needle-roller bearing in 1946, much of the basic development process used for the company's extensive range of products for combustion-engine powertrains and industrial applications does not change for electrification, Sayre told SAE Media. The engineering organizations responsible for simulation, design, prototyping and testing aren't fundamentally changing for EVs — "they're just learning another new product," he said.

Winding up the assets

Anticipating the global "all in" on EVs, Schaeffler created its fast-growing E-Mobility Group in Wooster to serve as a center of expertise for the Americas that is diving deep into electric motors, e-axles, fuel cells, actuators and related technologies.

Electric motors were a fairly dormant technology for the past century but reawakened over the last decade by the modern electric vehicle. "The advancement curve for e-motors is shaped like a hockey stick, as we focus on greater power density and efficiency while remaining cost competitive," Sayre explained. "This means advancements in material utilization and in industrialization. These are extremely critical and are things that Schaeffler, with our vertical integration, legacy technologies such as bearings and clutches, and global footprint, does very well."

He said the well-honed systems approach to development and

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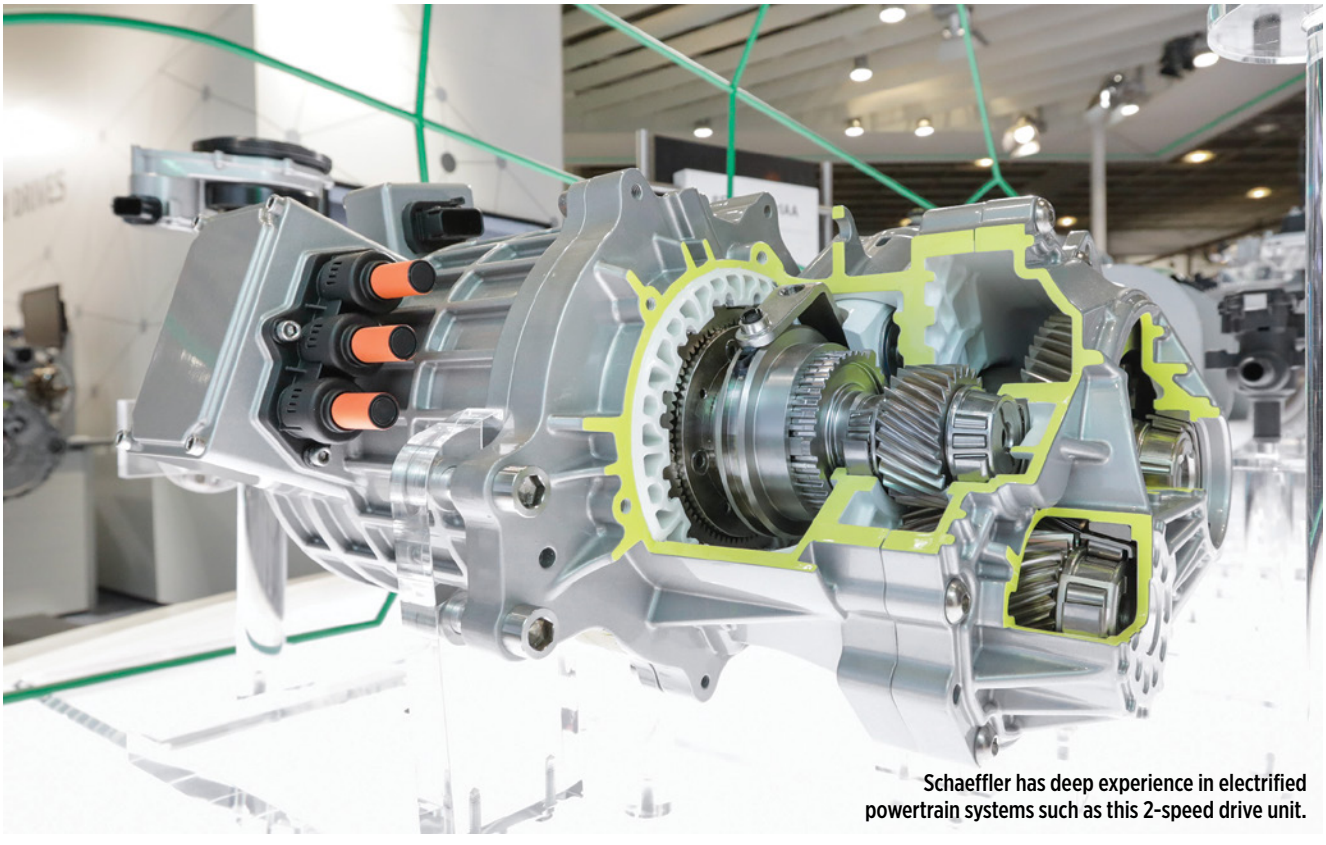

Schaeffler has deep experience in electrified powertrain systems such as this 2-speed drive unit.

production enables Schaeffler to optimize the many pieces in its product portfolio that, when combined, help create superior electric vehicles. "We're focusing on motor types and topologies that fit both niche and wide-ranging vehicle applications, as well as being able to adapt to whatever the customer needs, in terms of selling production machines, components or full assemblies."

A key asset in that focus is **Elmotec Statomat**, a Karben, Germany-based manufacturer of production machinery for mass production of electric motors. Schaeffler acquired Elmotec, as it's known in house, in late 2018 as part of its e-mobility strategy. The purchase came roughly two years after Schaeffler acquired **Compact Dynamics GmbH**, a specialist in electric-drive concept development — a new building block in the e-mobility game plan.

Elmotec is considered a leader in winding technology that, according to Schaeffler AG CEO Klaus Rosenfeld, is vital to "the industrialization of electric motor construction within our company," enabling it to "close the last remaining technology gap in the production of rotors and stators."

While its primary focus had been on stator-winding machinery, Elmotec's innovations also led it into wave winding technology, considered a leading field of future development for electric mobility. Compared to other winding schemes, wave winding does not tie the coil ends to an adjacent commutator bar after each coil is completed. Instead, coils are wound so that a coil under one pole is connected to a coil 180 electrical degrees away, which is under a like pole. This allows one pair of brushes to commutate two pairs of poles. Benefits include increased power density, efficiency and more efficient high-volume production.

"We now have capability to do winding, stamping, magnet insertion and control the entire e-motor manufacturing process," Sayre noted. "We see multiple levels of the e-motor assembly process; our customers currently are approaching this at different levels of in-house versus supplied components. We supply from the 'machine level' all the way up to full powertrain systems. Having that approach allows us to control quality."

IWM opportunities

Schaeffler has been an active sponsor and supporter of Formula-E and other emergent electrified-motorsports series, which Sayre claims have provided engineering learnings to go along with the corporate visibility.

With the electrifed-powertrain supply space getting crowded, the growing list of players are looking to differentiate themselves in ways that will benefit OEMs. For Schaeffler's drive into e-motors, "there isn't a 'killer app,' so to speak," Sayre said. "Instead of one specific product, we're remaining adaptable and flexible to best

SCHAEFFLER GROUP

North American e-motors director Dan Sayre sees opportunities in in-wheel motors.

serve the many different vehicle applications — passenger-car, high-performance, commercial. We want to have our offerings match those applications within the package constraints, absolute power and torque requirements, specific NVH and cost targets. We have different technologies in our e-motor topology offerings, as well as our locations and production methods, to adapt to whatever the customer needs for their specific application."

One area of e-motor development that continues to interest Sayre's team is in-wheel motors (IWMs; see August 2021 *Automotive Engineering* cover story). Schaeffler is considered a leader in the field, and Sayre is excited about the technology's market opportunities, such as local delivery and robocabs.

"We've been working on IWMs for over a decade with multiple prototypes and demo vehicles, and we're working on some related business," he said, detailing the vehicle applications where in-wheel drive makes the most sense for transporting cargo or people — especially at lower speeds. IWMs offer greater vehicle maneuverability in tight spaces and moving the powertrain out to the corners optimizes the vehicle's load floor, he explained.

"In our chassis and wheel-bearing simulations, we've taken the lessons learned and applied them to our in-wheel drive product," he said. "And we've actually gone to the point of testing our development vehicles with curb strikes where we've bent the road wheel but did not damage the in-wheel motor. Industry is seeing more use cases for IWMs, as people see more demonstrations of this topology and we take out mass, cost and size in future development."

Looking forward 10 years, Sayre sees even greater competition in the e-mobility space, and a Schaeffler Group that "will have a much larger team than today to meet the industry's significant growth on e-mobility and electrification." ■

SCHAEFFLER GROUP