The drive forward: **Pioneering solutions for the next generation of Mobility needs**

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With a growing global population and increased technology advancements in the automotive space, it is expected that the mobility sector will undergo a number of significant changes over the next twenty years. While it is unclear which individual changes will prevail in the transition, trends such as autonomous driving, shared economy, electrification and wider powertrain advancements will all lead to interesting challenges for both original equipment manufacturers (OEMs) and the supply chain.

As auto makers continue evolving, extending internal combustion engine configurations with additional hybrid or battery electric options, some believe that the need for lubricants will ultimately decline. The opposite argument can be easily made that vehicle lubricants will play a more critical role in the performance and protection of a growing and diverse vehicle car park worldwide, with many new challenges and opportunities.

At ExxonMobil, we are continuously assessing the performance demands of new powertrain technologies, including hybrid vehicles and electric motors, working with leading vehicle manufacturers from around the globe. Leveraging our 150 years of lubricant innovation, we are focused on testing and evaluating various formulations to deliver maximum engine protection and performance.

Hybrid and battery electric vehicle needs

The multi-decade trend of increasing efficiency for the internal combustion engine (ICE) will continue across the global car fleet today and into the visible future. Reduced vehicle emissions targets will mean lubricant formulators and base stock producers will continue to seek even more innovative solutions to squeeze out the remaining efficiencies or manage new fuels and new surface materials within the ICE and hybrid combinations.

While hybrid vehicles (HV) utilise a combination of an electric motor and an internal combustion engine, therefore still requiring quality engine oils, battery electric vehicles (BEV) are only powered by a battery pack and do not require the same engine oils. New thermal management requirements are emerging as battery power densities increase and charge times reduce to satisfy the convenience and range expectations of consumers.

Both BEVs and HVs still require lubricant technology that provides the same benefits as traditional vehicle lubricants, such as wear protection and oxidation resistance as well as specialised benefits including electrical conductivity, thermal management and material compatibility. With an ever increasing drive for efficiency in the powertrain, the innovation space within this multi powertrain scenario is both

challenging and exciting to the lubricant formulators at ExxonMobil.

The growing demand for electric vehicles means lubricant manufacturers will need to develop an entire new class of fluid technology that not only delivers the same benefits of lubricants designed for combustion engines, but also caters to elements unique to BEVs and HVs. This will become especially important as electric motor designs in new generations of BEVs and HVs continue to increase in efficiency and power density.

As BEVs and HVs continue to evolve with new technologies and materials, OEMs will focus on delivering next generation vehicles that are even more efficient, more powerful and last even longer. The BEVs and HVs of tomorrow will likely be lower in weight, and have higher horse power and voltage – in turn, they'll generate even more heat. Fluids and lubricants should not be an afterthought in the design factor for the new generation of BEVs and HVs, where cooling capabilities and material compatibility will be essential.

Lubricant evolution

Given their larger batteries and electrical systems, BEVs and HVs operate at higher voltages that can lead to electrical issues. Hence, how well a fluid insulates or conducts electrical current is a critical design parameter for these new lubricant formulations. Engineering the right balance of base fluid and additive chemistry to deliver the right level of electrical conductivity is essential to the protection of BEV and HV powertrain components.

Many new generations of BEVs and HVs will feature higher efficiency and higher power density electric motors. This equates to higher levels of heat generated. Failure to manage this excessive heat can cause damage to the powertrain components and electronics, as well as potential fire safety concerns. As BEVs and HVs continue to evolve and become more common, innovative approaches to fluid engineering and thermodynamics will be necessary in order to provide the level of thermal stability and heat transfer required for the BEV and HV fluids of tomorrow.

The material compatibility of BEV and HV fluids is also important as lubricant manufacturers work to develop solutions that address electrical conductivity and thermal stability. With the presence of special plastics, resins, coatings, and other unique electrical system materials, properly balanced formulations with the composition of these materials in mind will help avoid any unwanted effects. While it's important to protect mechanical components and prevent overheated systems, it's also essential to ensure that these materials are properly preserved as well.

Staying ahead of the curve

As we look ahead and consider the transition scenarios within the mobility sector, it's clear that new technology for base fluids and additive components, along with precisely engineered finished fluid formulations, are needed to achieve optimum performance and protection for the vehicle fleets of tomorrow.

At ExxonMobil, the team is committed to expanding our decades of experience formulating and developing lubricants to take on the new mobility challenges. Today, ExxonMobil is the largest manufacturer of fluids for HVs, and OEMs are already turning to our Mobil technology automatic transmission fluids for use in today's BEVs. We will sustain our lubricants technology focus well into the future with new fluid technology projects and resources already in place and progressing.

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