General Motors-Holden's Ltd.

INFORMATION BULLETIN

ELECTRIC VEHICLES

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Electric Van

The zinc-nickel oxide battery breakthrough is also important to GMC Truck & Coach Division, which is building 35 electric-powered vans in U.S. Department of Energy demonstration projects for American Telephone and Telegraph Company.

Twenty vans, each powered by 36 Delco lead-acid batteries, have been delivered to AT&T's Pacific Telephone Company subsidiary in Culver City, California, for telephone installation and repair work. They have an urban range of 40 miles and a top speed of 50 miles per hour. The batteries, stored under the van floor, are recharged nightly.

The electric vans have performed satisfactorily and fit in well with Pacific Telephone's short-range use—from 15 to 20 miles per day. The zinc-nickel oxide battery would extend these vans' range to about 100 miles. Experience with these vehicles will help GMC to develop smaller electric vans for possible production later in the 1980s.

The electric vans, like the Electrovette, are essential to more than the development of battery technology. They provide on-road operating experience with other electric vehicle components that must be proven before electrics go into full production. These include motors, speed-controllers, charging equipment, and other drive-train components.

FIELD TEST OF ELECTRIC VANS. GM has supplied twenty electric-powered vans to the Pacific Telephone Company in a U.S. Department of Energy demonstration program. These vans, powered by lead-acid batteries, have an urban range of 40 miles and a top speed of 50 miles per hour. The batteries are recharged nightly.

Lithium-Iron Sulfide Battery

As the zinc-nickel oxide battery begins to move out of the laboratory and onto the road, General Motors continues its research on a high-temperature lithium-iron sulfide cell which could be the "next generation" electric-vehicle battery. In 1979, the cell's durability improved markedly—to approximately 16,000 hours and more than 750 cycles, at over 800°F. Performance remained high: at about the 4-hour discharge rate, energy density was 90 W·h/kg.—over 3½ times that of conventional batteries. Under a continuing GM-U.S. Department of Energy contract, researchers also improved the iron sulfide electrode's discharge characteristics.

The high cost of materials, a significant problem, remains the focus for future efforts.

Electric Vehicle Safety

Electric vehicles are expected to begin to play an increasingly important role in the nation's transportation system in the second half of the 1980s. General Motors expects to be at the forefront of this technology with an electric car that will be suitable for commuter and shopping trips. Another possibility is a light-load, short-haul commercial vehicle

The special design and operating characteristics of electric vehicles may make it inappropriate to require them to meet the same federal safety regulations which other vehicles must meet. Some existing rules such as high-speed tire performance may not even be desirable in the case of electric vehicles.

On the other hand, electric vehicles pose some unique concerns, such as the potential hazard of high voltage levels, safe battery charging practices, and battery behavior during collision. In view of these concerns, electric vehicle safety regulations must be carefully developed to assure that they offer appropriate protection without being unduly design restrictive. Premature or needlessly rigid requirements could dampen initiative and innovation. Electric vehicle safety regulation should be allowed to evolve, just as electric vehicle technology will evolve through the 1980s.

ELECTRIC VEHICLES

General Motors' plans to begin offering electric vehicles in the mid-1980s came a step closer to reality in September, 1979 with the announcement of a major advance in the development of zinc-nickel oxide batteries for automotive application.

Pound for pound, a zinc-nickel oxide cell can store 2 to 2½ times the energy of a conventional lead-acid cell. But researchers, until recently, have been unable to make the zinc electrodes durable enough to meet the needs of an urban passenger vehicle. Since battery replacement represents the largest element of electric vehicle operating cost, improvements in durability are critical.

GM's achievement, the result of a ten-year research and development effort, centers on developing electrodes which do not deteriorate and lose capacity and power after relatively few recharges, thereby providing the longer battery life that has been needed. Researchers are now working to improve this durability under battery-discharge conditions which simulate actual urban driving.

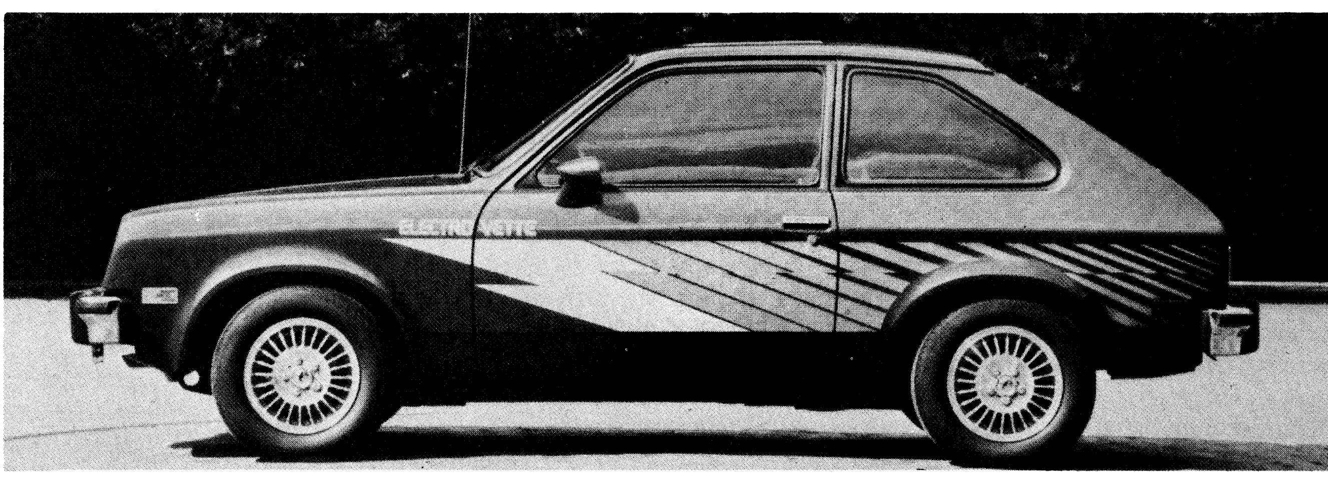
Energy density, another key battery characteristic, relates to the vehicle's expected range. A conventional lead-acid battery has an energy density of about 26 watt-hours per kilogram (W·h/kg). The new zinc-nickel oxide cells, by comparison, exceed 50 W·h/kg. and GM's goal is to reach 70 W·h/kg. At the same time, General Motors is expanding efforts to develop a reliable and cost-effective powerpack for electric passenger vehicles.

General Motors demonstrated a new version of the Electrovette, a test-bed vehicle built on an experimental chassis with a Chevrolet Chevette body, now being powered by the new zinc-nickel oxide batteries. Beneath the Electrovette's hood are seven major components: a 240-volt DC motor; the system's "brain," an on-board signal-control processor; a "chopper" or voltage regulator, to vary motor speed; a motor current-smoothing reactor; a transformerless 110/220-volt AC charger; a gear box; and a 12-volt battery to power auxiliary systems.

At present, a zinc-nickel oxide electric vehicle costs more to operate than a Chevette. By the time electric vehicles are ready for the market, however, they may be competitive on life cycle operating costs. In addition to progress on batteries, GM must also continue development of motors and other necessary components to make electrics economically feasible.

Electric vehicles can fill an important, special niche in the nation's transportation system, but it is unlikely that they will replace conventional gasoline or diesel vehicles for general use.

Electric vehicles are clean—they have no exhaust emissions. But their primary advantage is that they can help take the pressure off petroleum, as long as electricity can be generated from other fuels—coal, nuclear power, or hydropower.



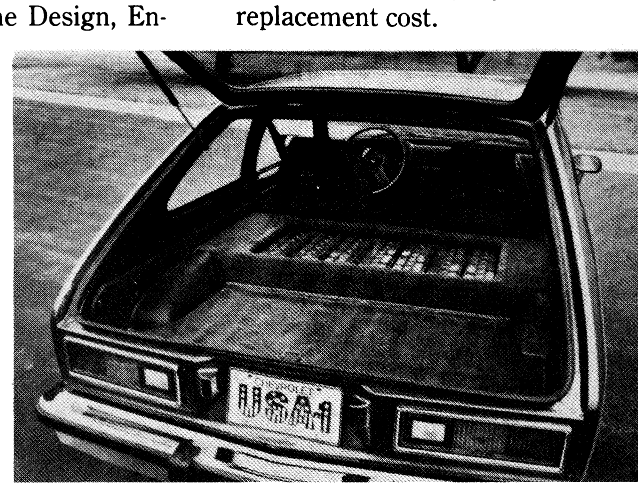
EXPERIMENTAL ELECTRIC VEHICLE. This is the GM Electrovette, a rolling test bed currently being used to evaluate advanced zinc-nickel oxide batteries and propulsion systems developed by General Motors.

Project Center Status for Electrics

In January 1980, General Motors followed up its battery breakthrough by establishing a new Electric Passenger Car Project Center at the GM Technical Center in Warren, Michigan to design and engineer a small battery-powered urban passenger car. For a number of years, GM's electric-vehicle program has been the responsibility of several divisions and staffs. The "Project Center" concept, successfully used to design a number of GM's passenger cars and vehicle systems, brings talent together from all over the Corporation. Most recently, it was used to design and engineer the popular 1980 "X"-body compacts.

The Electric Passenger Car Project Center will involve passenger-car divisions, necessary component divisions, Fisher Body and GM Assembly Divisions, and the Design, Environmental Activities, Engineering, Research, Financial, Marketing, and Procurement, Production Control and Logistics Staffs.

General Motors' goal for the mid-1980s is to introduce a small personal electric vehicle for urban and commuter use—with a top speed of around 50 mph, a range of 100 miles, and reasonable battery cycle life and replacement cost.



ELECTRIC BATTERY PROGRESS. This size comparison illustrates progress made on GM's new zinc-nickel oxide batteries, located at the left. The new battery pack is only half as large, and at 900 pounds, weighs less than half as much as the conventional lead-acid battery pack at the right. On a pound-for-pound basis, the new cells can store more than twice the energy of the lead-acid cells. These batteries are shown installed in the rear of the Electrovette.