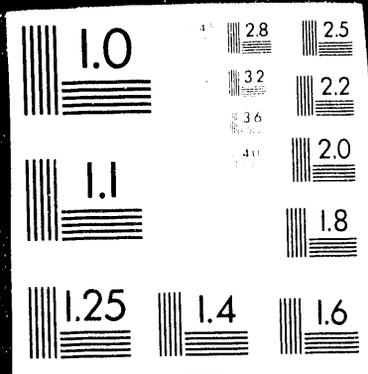


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DOE/ID/13048--T

Electric G-Van Demonstration and Commercial Assessment Project

Final Report

DOE/ID/13048--T1

DE93 009057

Bruce D. Braga^a

Published December 1992

a. Electric Power Research Institute

**Prepared for the
U.S. Department of Energy
Assistant Secretary for Conservation and Renewable Energy
Under DOE Idaho Field Office
Grant DE-FG07-911D13048**

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ELECTRIC G-VAN DEMONSTRATION AND COMMERCIAL ASSESSMENT PROJECT

Grant No. DE-FG07-911D13048
Final Report

The Electric Power Research Institute was awarded this grant to continue the joint effort initiated by EPRI, and VEHMA International to proceed beyond the prototype phase of the electric G-Van development. The goal of EPRI and VEHMA was to develop a market for the electric G-Van, and to distribute them to commercial fleet operators.

The objective of this project was to produce G-Vans in a production facility that would be comparable to the GMC Truck internal combustion engine Vandura Van produced by General Motors in quality, reliability, durability and safety. An initial market assessment/demonstration phase of sixty (60) vehicles was to be undertaken, with the ability to expand production volume quickly to meet market demands.

The following is a brief description of each task of this grant and the actions taken by EPRI to complete them:

Task 1: Project Management (Part-funded)

Due to the complexity of the project, EPRI's Project Manager drew support internally, as well as externally from the Contractor (VEHMA). The project required coordination with several major subcontractors, mainly:

General Motors Truck
Chloride EV Systems (U.K.)

Vandura Gliders
Propulsion Systems

Due to the size of the project, VEHMA appointed a project manager who was responsible for all aspects of setting up the production facility and producing a quality product. The project manager was approved by the EPRI Project Manager.

Deliverable: One-day project reviews were held monthly by VEHMA, and quarterly informal letter progress reports were furnished to the EPRI Project Manager. These quarterly progress reports were then delivered to the Department of Energy.

Task 2: Design Engineering

EPRI was given the responsibility to insure that VEHMA corrected all vehicle nonconformances that were uncovered in the prototype and test vehicles.

Deliverables: A vehicle price list as a function of production volume was delivered by VEHMA and is available upon request. A pilot vehicle test procedure is on file at EPRI and is available upon request. Design status was included in the informal quarterly reports.

Task 3: G-Van Sales, Service, Warranty, and Liability Insurance Administration

VEHMA developed a comprehensive customer support program which included the following:

- An 800 telephone number "Hot Line"
- Operator and Maintenance Manuals
- Two day training course for operators and maintenance personnel.
- Technical assistance is supplied to the customer by telephone, Service Bulletins (as required), and technical personnel to the customer's site (as required). In addition, EPRI has established four Regional EV Centers at major utility sites:

Consolidated Edison of New York
Houston Lighting & Power
Sacramento Muni. Utility District
Pennsylvania Power & Light

- Two separate warranties cover the G-Van. GMC components are covered under the normal GMC warranty package, and the electric components installed by VEHMA are covered under a warranty that includes CEVS drive system. A parts depot has been established by VEHMA, and customers receive parts delivery generally within 24 hours.
- Liability insurance coverage has been negotiated between General Motors and VEHMA, in accordance with the General Motors supplier agreement.

- A buyers training program and sales agreement has been developed by VEHMA. The sales agreement is actually a formal sales contract.

Deliverables: The following documents are on file at EPRI:

- Vehicle Service and Warranty information
- Buyers Sales Agreement
- Training Program

Task 4: Vehicle Production

Upon production of the electric G-Van, EPRI delivered one G-Van to DOE's designated site (York Technical College).

A total of 130 G-Vans were produced at the Conceptor Industries facility, (VEHMA subsidiary).

DOE Site Operators were given preferred treatment as far as vehicle deliveries were concerned. No delivery complaints from Site Operators were received at either EPRI or VEHMA.

Task 5: Final Report

The report format requested by DOE was by individual chapters for each task. Do to the brevity of the report, this was not considered to be necessary.

CONCEPTOR INDUSTRIES INC.

SEPTEMBER, 1990

CONCEPTOR ELECTRIC G-VAN

OPERATIONS GUIDE

C O N T E N T S

1	Introduction - Conceptor Electric G-Van
2	Vehicle Brochure
3	Vehicle Options - 1991 Model Year
4	Vehicle Ordering Procedure
5	Service Information and 'Hotline'
6	Service/Warranty Report Form
7	Upfitting - Notes for Bodyshops/Customisers/Users
8	Training Courses
9	Warranty
10	Recommended Spares for Scheduled Maintenance
11	Tools and Equipment (Standard and Special)
12	Charger
13	Charger Installation
14	Monoblocs (Battery Pack)
15	Battery Watering Records
16	Traction Motor
17	Traction Controller
18	Delivery and Commissioning (Acceptance Inspection Checklist)
19	Operator's Manual
20	Notes

INTRODUCTION - CONCEPTOR ELECTRIC G-VAN

Description

The Conceptor Electric G-Van will be the first electrically powered, certified vehicle (complying with Federal Motor Vehicle Safety Standards), to go into line production in North America. The production build of the vehicle commenced in September 1990.

The Electric G-Van is designed by Vehma International of which Conceptor Industries Inc. is the manufacturing division. The basis for the vehicle is a General Motors 'G' van shell, produced on the existing 'G' van production line, and an electric propulsion system developed in England from the GM Griffon by Chloride Limited EV Systems Division.

In terms of vehicle systems, the steering and brakes are power assisted using an electric motor with control box. The optional A/C system is also powered by its electrical motor with control box. The heater is energised using diesel fuel. A newly designed range selector is installed using standard GM driver controls. The new transmission is a single speed, forward and reverse, gear driven unit of 1.85:1 ratio. A new axle of conventional design but with rear facing differential, and a new propshaft are installed.

The interior is identical to a regular production 'G' van except for the instrument cluster which houses some different gages. All interior controls are located in identical positions to the conventional vehicle.

The exterior is visually identical except for the battery pack which is secured to the underfloor between the front and rear wheels. A substantial ground clearance of 7" is maintained.

Two subframes are added to the vehicle. The front subframe assembly bolts to existing engine mount locations (front) via new mounting brackets and to an existing crossmember (rear). It is rubber mounted to isolate shock loadings from the components. The rear subframe assembly mounts to existing underfloor rails (front) and to existing bumper bracket locations on the underfloor rails (rear). The traction motor and transfer case assembly are rubber mounted to the subframe.

Secured to the front subframe are the vehicle controller, the P/S-P/B motor with its control box, the heater, the range selector and the optional A/C module and all appropriate wiring harnesses.

Secured to the rear subframe are the traction motor, the transfer case, the heater fuel tank and all appropriate wiring harnesses.

The battery pack is secured to front hanger brackets which are welded to the existing underfloor rails and to rear hanger brackets which are bolted to existing underfloor mounting locations. The rear hanger brackets also act as supports for the fronts of the rear leaf springs.

The top speed of the Electric G-van is 52 m.p.h. (governed - refer to Operator's Manual). The vehicle range will vary depending on driving conditions, but is 60 miles for the J227a 'C' Urban Cycle at a test weight of 7800 pounds, with battery temperature at 25 deg C. The payload is approximately 1500 pounds for the cargo version and approximately 900 pounds for the passenger version with a gross vehicle weight of 8600 pounds for each version. The full cargo volume as provided by the conventional vehicle is available because the battery pack is installed below the floor.

The vehicle's normal electrical equipment takes its supply from a 12 volt auxiliary battery (mounted under the hood) which is maintained at the correct state of charge by the vehicle controller. New electrical harnesses have been designed and existing ones modified to tie in with the drive system.

Battery pack charging is carried out by means of an off-board Chloride charger. A charge takes approximately 8 hours depending on the state of charge of the pack. 'Opportunity charging' may take considerably less time - refer to Conceptor Operator's Manual.

The Electric G-van provides smooth, stepless control of speed and is designed for frequent start/stop operation. No warming up of the propulsion system is required prior to moving off.

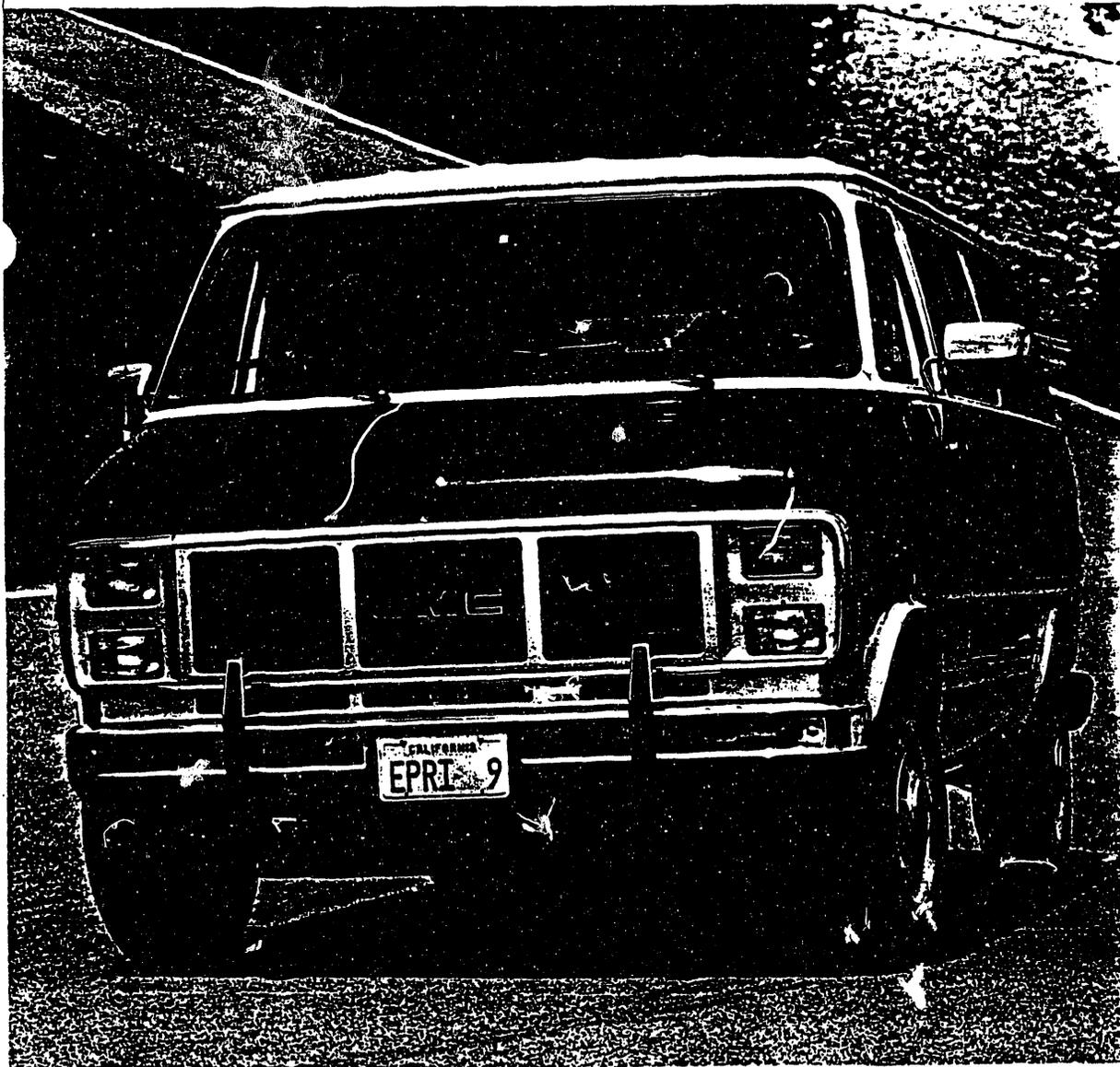
For further information, refer to the Conceptor Operator's Manual and the GMC Truck Owner's Manual.

VEHICLE BROCHURE

(brochure to follow)

Electric G-Van

EPRI



ELECTRIC
POWER
RESEARCH
INSTITUTE

THE G-VAN: AMERICA'S ELECTRIC FLEET VEHICLE

With the Electric G-Van under development; final engineering in preparation for its 1990 market debut, the Electric Power Research Institute (EPRI) is achieving a long-term goal of creating a viable alternative to gasoline-powered vehicles.

The G-Van is being developed by EPRI; Vehma International, a Magna International Company; Chloride EV Systems; and General Motors Corporation; with support from Southern California Edison Company. This van will be the first American-made, modern electric vehicle (EV) to be produced in volume and distributed through a nationwide network.

ENHANCED TO COMPETE

The G-Van is based on the proven technology of the GM Griffon—a British-made electric van that has logged over seven million miles in fleets around the world. Enhanced features and capabilities such as those described below give the G-Van a competitive edge in commercial van fleets, the most promising market for early EVs.

- An improved lead-acid battery and upgraded propulsion system enable the G-Van to match the Griffon's performance while providing a 26% volume increase and several new features. The proof-of-concept G-Van achieved a 60-mile range per charge in simulated city driving, a top speed over 52 mph, and acceleration from 0 to 30 mph in under 13 seconds.
- In response to feedback from Griffon users, the G-Van will be equipped with such standard features as electrically driven power steering and power brakes and independent front-wheel suspension.

- Air conditioning and customized interiors will be some of the options offered to help the G-Van meet the comfort standards of the North American market.
- To be available in cargo van and passenger wagon models, the G-Van will be suitable for a variety of fleet applications.

BENEFITS FOR SOCIETY

In addition, the G-Van—like all EVs—will offer benefits to society as a whole. This clean, quiet vehicle should help alleviate the air quality and noise problems that continue to plague major urban areas.

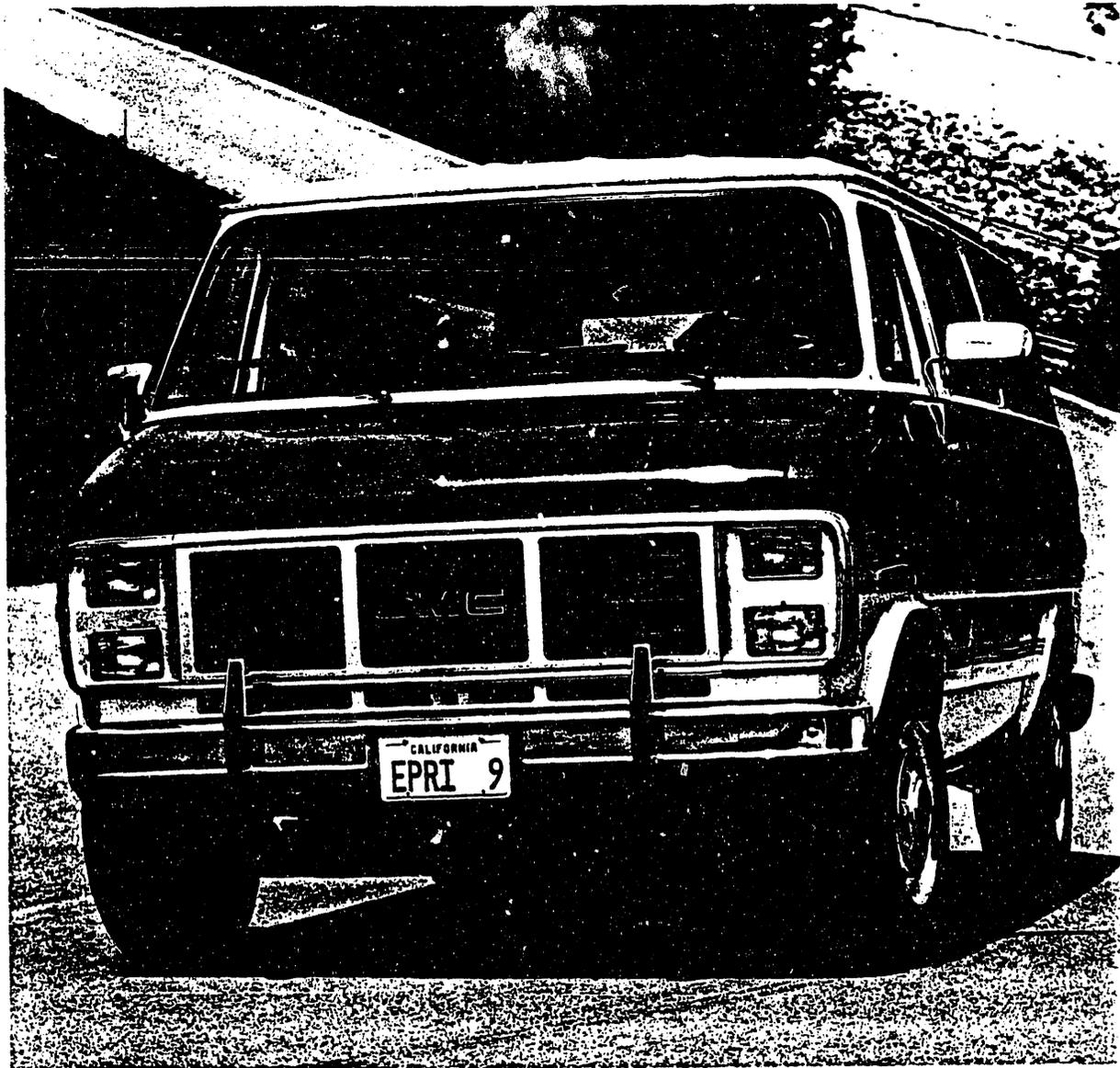
Further, increased use of electrically powered transportation can ease the nation's dependence on imported oil and thereby improve the U.S. trade balance. Because most EVs will be charged overnight using off-peak power, EV-electricity consumption will help lower the average cost of electricity to the customer.



Employees at Southern California Edison load cargo into an Electric G-Van.

Electric G-Van

EPRI



ELECTRIC
POWER
RESEARCH
INSTITUTE

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Employees at Southern California Edison load cargo into an Electric G-Van

COMMERCIAL FLEETS: A PROMISING MARKET NICHE

Several factors make the G-Van an ideal vehicle for large commercial van fleets:

- The G-Van's range and payload capacity allow it to perform the tasks assigned to almost 40% of the vehicles in these fleets.
- The G-Van can be recharged after-hours when off-peak electricity should be available at lower cost. And most fleet vans are parked in central garages overnight, which would facilitate battery recharging.

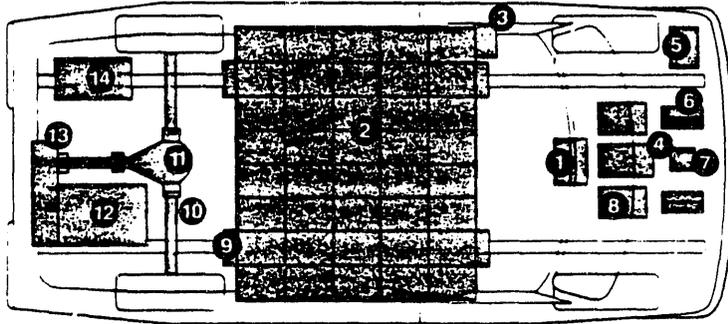
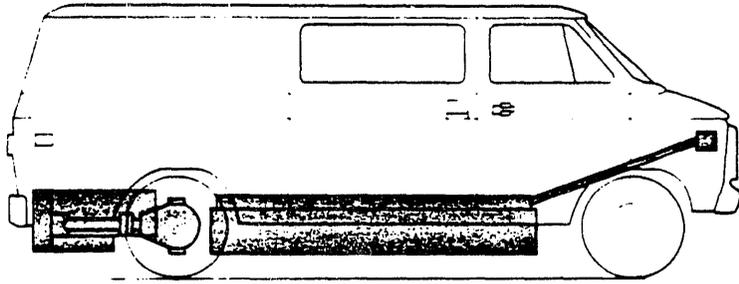
- Routine maintenance for the G-Van can be performed by regular fleet technicians after a short training course.
- G-Van operating costs should be lower than those for conventional vans—an important factor for fleet managers.

A recent survey in the top 30 U.S. markets showed considerable promise for the G-Van, indicating that it could replace over 161,000 vans in these markets alone. More than half the

managers questioned said they would be willing to try EVs, citing lower maintenance, longer service life, air quality benefits, and freedom from gasoline-price increases as some of the deciding factors.



Production Vehicle



- 1 Traction motor controller
- 2 Detachable battery pack
- 3 Battery pack fuse junction box
- 4 Electrically controlled power steering and power brakes
- 5 12-volt auxiliary battery
- 6 Battery pack watering-venting system
- 7 Battery pack charging plug
- 8 Liquid-fueled heater
- 9 4-point battery attachments
- 10 Heavy-duty springs
- 11 Rear axle
- 12 Electric-traction motor
- 13 Gear-drive single-speed transmission
- 14 Heater fuel tank

Technical Information*

Dimensions (in inches)

Wheelbase	125
Overall length	202
Overall width	79
Overall width with mirrors	90
Overall height	82
Ground clearance to battery tray	8
Front tread	75
Rear tread	78
Interior height	46
Interior width at floor	70
Wheelhouse length	36
Width between wheelhouses	60

Weights (in pounds)

	Cargo	Passenger
Gross vehicle weight	8,600 lbs	8,600 lbs
Payload**	1,550 lbs	5 passengers
Curb weight	7,050 lbs	7,672 lbs

Performance Data

Range:***	35 mph constant speed	90 mi
	Simulated city driving	60 mi
Top speed		52 mph
Acceleration time (0-30 mph)		13 sec
Energy consumption (wall plug)		.94 kWh/mi
Stopping distance from:		
	30 mph	52 ft
	50 mph	168 ft

*The technical information is based on concept vehicles and may differ from information for production vehicles.

**Vehma hopes to achieve an 8-passenger level before the production-vehicle launch.

***Range cited was achieved in a vehicle without air conditioning.

CHLORID

E L E C T R I C G - V A N O P T I O N S

VANDURA OPTIONS

Air Conditioning
Bumpers, Chrome
Glass, Fixed Rear Door
Glass, Body 6 Windows
Glass, RH Body Side 2 Windows
Glass Package, Fixed
Glass Package, Swing-Out
Grille, Deluxe Front Appearance
Lighting, Auxiliary
Mirrors, Stainless Steel Dual Below-Eye-Line
Radio, AM/FM ETR Stereo with Seek and Scan
Radio, AM/FM ETR Stereo with Cassette and Seek/Scan
Radio, AM/FM ETR Stereo with Cassette and Seek/Scan
and Graphic Equaliser
Radio, delete
Seat, Front Auxiliary
Seats, Custom Vinyl Highback Bucket
Sound Insulation Package
Barrier Wall

RALLY/RALLY STX OPTIONS

Air Conditioning
Door, Sliding Side
Glass, Deep Tinted
Lighting, Auxiliary
Mirrors, Stainless Steel Dual Below-Eye-Line
Paint, Deluxe Two Tone
Radio, AM/FM ETR Stereo with Seek and Scan
Radio, AM/FM ETR Stereo with Cassette and Seek and Scan
Radio, AM Stereo/FM ETR Stereo with Cassette and Seek and Scan
Radio, delete
Seats, Custom Vinyl Highback Bucket
Seats, Custom Cloth Highback Bucket
Seats, Custom Cloth Reclining Bucket

COLOUR AVAILABILITY

Frost White, Woodlands Brown (metallic), Light Blue (metallic),
Burgundy (metallic), Royal Blue (metallic), Midnight Black,
Apple Red, Emerald (metallic), Wheat, Steel Gray (metallic)

OTHER OPTIONS

additional Charger (weatherproof), additional Watering Trolley
page 1 of 1

ORDERING PROCEDURE

- 1 Customer to contact either;

Vehma International Inc.,
521 Newpark Blvd.,
P.O. Box 149
Newmarket
Ontario L3Y 4X7
Canada

phone: (416) 836-4611 fax: (416) 836-9784
Contact: Mike Nishimura

OR

Electric Vehicle Development Corporation (EVDC)
20823 Stevens Creek Blvd.,
Suite 440
Cupertino
California 95014
U.S.A.

phone: (408) 253-5262 fax: (408) 253-9704
Contact: Jerry Mader

- 2 Sales Agreement issued by Vehma International Inc. to Customer/Buyer.
Once Sales Agreement signed, all future Buyer contact to be with Vehma/Conceptor.
- 3 Once the vehicle build is complete Vehma will notify the appropriate GM Bailment Office of vehicle delivery to dealer.
- 4 Bailment Office will;
- register the vehicle
 - remit applicable sales tax to the state
 - notify the dealer that the above has taken place and remit payment for dealer prep.
- 5 Dealer will forward all appropriate documents to the Buyer and the Buyer will remit payment to Vehma/Conceptor via the Bailment Office.
- 6 Vehma/Conceptor will remit appropriate payment (taxes etc.) to the Bailment Office.
- 7 Order complete.

S E R V I C E I N F O R M A T I O N

SERVICE SUPPORT

Conceptor and GM will provide a coordinated approach to service support in North America. Experience gained from service support offered by Chloride on the Griffon program in North America has proved valuable in setting up the Conceptor structure.

GM will be responsible for servicing all GM parts through existing service agreements between the owner/operator and the local GMC Truck dealership. Where no service agreement exists, Conceptor can assist, either in locating dealerships or in discussions with the dealership staff. In some cases owner/operators will have existing arrangements with their GMC Truck dealerships which allow them to carry out their own routine servicing and warranty work. They will be able to continue to do so with their electric G-vans after consulting their dealerships. GM will be issuing information to all GMC Truck dealerships in the U.S. explaining the basic differences between the electric G-van and the conventional vehicle.

The owner/operator, after undergoing mandatory basic and advanced training courses provided by Conceptor, will be responsible for routine maintenance and servicing of non-GM parts once certified. Conceptor will provide continued assistance, via a toll-free telephone number, to answer any questions relating to service and warranty. Conceptor will be responsible for warranty of all non-GM parts on the vehicle which includes the complete propulsion system.

The Service Manager for the production electric G-vans will be based at the production facility in Newmarket, Canada. He will be assisted by several service technicians based in Canada, the U.S. and Britain.

The Watts line toll-free telephone number (hotline) has been installed in the Newmarket office for customers requiring special assistance with their vehicles. All such calls related to service and maintenance as well as all warranty claims will be handled through this main service office. Spare parts distribution will also be handled from this location. Customers will be guaranteed delivery of all replacement parts (except a battery pack assembly) within 48 hours. It is intended that spare parts will be stored at designated EV Regional Centres in the U.S. as well as at the production facility. A Detroit location will also be utilised for spares storage. Dispatch authority for all spares will be issued from the main service office.

For customers in both Canada and the U.S. requiring assistance,
the hotline number is 1-800-263-8395

It is vital that all service/maintenance and warranty related calls are placed through the main service office. This will ensure a well organised and streamlined approach to customer service.

ROUTINE MAINTENANCE

Regular routine maintenance is primarily confined to topping up the main battery pack, using the watering trolley, every 3 weeks or after 15 charges. At least one watering trolley is required for each operating location. Refer to Conceptor Operator's Manual and to Warranty section (in this Guide) covering submission of watering records as a condition of the Warranty. Refer to GMC Truck Owner's Manual (Section 6) for other routine maintenance.

Refer to Conceptor Operator's and Service Manuals and GMC Truck Light Duty Service Manual and Light Duty Maintenance Schedule for all scheduled servicing and maintenance.

ELECTRIC G-VAN SERVICE/WARRANTY REPORT FORM

The purpose of this procedure is to illustrate the importance of completing service/warranty report forms as fully as possible. It should be followed with reference to the attached numbered example. The numbers relate to the following descriptions;

- 1 Conceptor VIN number must be entered to facilitate tracking and distribution of the vehicle information
- 2 Odometer reading must be entered to facilitate subsequent fault analysis and warranty record check
- 3 The date on which the work was carried out must be included
- 4 The job number must always be included - if you do not have a job number phone the service hotline to obtain one
- 5 Enter vehicle type
- 6 Enter Owner/Operator name
- 7 Full address not necessary - town/depot location is adequate
- 8 Copy marked 'Conceptor' goes to the Vehma/Conceptor Service Department for record and distribution purposes

Copy marked 'part' must accompany the part whether it is held by the owner/operator for inspection or shipped back to the Vehma/Conceptor Service Department

Copy marked 'Operator' goes to the vehicle owner/operator

Copy marked 'Technician' stays with the Service Technician
- 9 It is important that the Service Technician is aware of the reason for the service call and that he records this fact for reference purposes
- 10 This space should be used to note the User's description of the fault and will be made available either by the Vehma/Conceptor Service Department or directly by the owner/operator - accuracy is very important - the Service Technician's description must not be included here

- 11 All details of the 'fault found' and 'action taken' must be concisely recorded in this space
- 12 Components used and removed must be itemised using the
to correct description, quantities, part numbers and serial
19 numbers
- 20 The time spent working on each category as listed must be included
- 21 List components not itemised above
- 22 Signatures and printed names must be included from both the
to service technician and the owner/operator
25
- 26 If further action needs to be taken by the service technician this box needs to be marked
- 27 If advice is required this box needs to be marked
- 28 If owner/operator requires written confirmation this box needs to be marked
- 29 The service report number is already designated on all service/warranty report forms

The Service/Warranty Report form must be completed giving all relevant information. The more complete the form, the more effective it will be in ensuring a well organised and streamlined service operation.

The forms should be completed as close to the time the service work is being carried out as possible to ensure accuracy.

Some sections may be completed prior to arrival at the vehicle location.

After arrival, obtain first: Job Number (4 above), second: Conceptor VIN Number (1 above) and third: Odometer Reading (2 above).

Finally, complete the Service/Warranty Report form before leaving the owner/operator and ensure that the original and all copies are distributed to the relevant parties (leaving the 'operator' copy with the owner/operator).



ELECTRIC VAN SERVICE/WARRANTY REPORT

Conceptor Industries Inc., 521 Newpark Blvd., P.O. Box 149, Newmarket Ontario, L3Y 4X7 Canada Tel: (416) 836-4611 Fax: (416) 836-9784

OFFICE USE

Build #

P. O. #

USER'S DESCRIPTION OF FAULT, IF ANY

10

REASON FOR SERVICE CALL

USER'S REQUEST 9

SERVICE CONTRACT

CONCEPTOR REQUEST

FAULT FOUND / ACTION TAKEN

11

COMPONENTS USED

ITEM QTY | PART NO. | SERIAL NO.

12 13 14 15

COMPONENTS REMOVED

ITEM QTY | PART NO. | SERIAL NO.

16 17 18 19

The condition of the equipment disclosed in this report is our opinion of the condition at the date of inspection based on our experience and the tests carried out by our technicians at that time. However since the life of the equipment is dependent upon many factors outside our control including the nature of the usage and the quality of the servicing and maintenance which the equipment receives this report does not constitute a guarantee or warranty as to the remaining useful life of the equipment or to its continued fitness for any particular purpose.

SIGNATURES
Service Technician

Owner/Operator

PRINT NAME
Service Technician

Owner/Operator

22

23

24

25

Vehicle Identification No. (Conceptor VIN)

1

Odometer Reading

2

Date

3 4

Vehicle Type

5

Cargo

Passenger

Owner/Operator

6

Vehicle Location

7

TIME SPENT HOURS MINS OFFICE USE

Cells/Monoblocs

Cell/Battery Connectors

Watering System (vehicle)

Watering System (trailer)

Vehicle Controller

Traction Motor

State of Charge Indicator

Charger

P/S - P/B Motor / Controller

Transfer Case

Axle / Propshaft

A/C System

Heater / Heater Fuel System

Range Selector

Other

21

Further Action Necessary by the Service Engineer

26

Service Engineer requires advice

27

User requires

28

29

SERVICE REPORT NO.

NOTES FOR BODYSHOPS/CUSTOMISERS/USERS

The Electric G-Van is designed as a production vehicle with vehicle and drive train forming an integrated and optimised system.

Changes to the vehicle should be made with caution.

Take note of all safety precautions included in the Conceptor Operator's Manual and GM Owner's Manual and observe warning labels on the vehicle.

Disconnect the main battery pack and 12 volt auxiliary battery before any modification work is carried out. Always turn the ignition to the 'fully-off' position before disconnecting the main battery pack.

Remove the main battery pack from the vehicle before any cutting, drilling, or other modifications are carried out to the floor area, or before any welding is carried out on the vehicle. The battery pack should be removed by using approved procedures. The battery and vehicle watering and venting system pipes may contain acidified water and potentially explosive gases. Care should be exercised when disconnecting pipes to avoid contact with fluid drips. Always fit vyon vents and connector assemblies to the battery watering pipes when disconnected from the vehicle watering pipes.

Maintain the main battery pack in a good state of charge if the vehicle is not used for extended periods or if it is removed from the vehicle. Use only the approved Chloride charger specified for the vehicle with its charger cable. Do not charge the battery pack off the vehicle without first fitting vyon vents and connector assemblies. Ensure that battery pack is charged in a well ventilated area. Do not disturb or move the battery pack while on charge. Keep sparks and flames away from the battery pack when it is being charged - no smoking.

Do not violate the body sealing system (door seals, window seals etc.) Seal thoroughly any floor modifications - the floor separates the main battery pack from the vehicle interior and occupants and is a significant part of the overall safety of the vehicle and drive system.

Take note of payload, gross vehicle weight and front and rear axle/tire ratings.

Protect all electrical equipment during modifications such as drilling and ensure that equipment is not contaminated by foreign matter. If the vehicle drive system or any components are damaged in any way, ensure that only authorised components are used to replace parts which have been damaged.

Do not make structural alterations to the vehicle. The vehicle is designed as an integrated structure.

Do not change the position or length of power cables from the main battery pack to the controller.

Do not add additional electrical loads and instrumentation systems to the 12 volt auxiliary battery or the main battery pack or fit any electrical/electronic systems or instrumentation systems in the vehicle that could cause interference with the electronic control system.

Do not carry out welding in the vehicle without removing the main battery pack and disconnecting the 12 volt auxiliary battery. Remove the 12 volt auxiliary battery if welding in its vicinity.

Refer to the Operator's Manual for correct jacking procedures.

Do not use paint drying ovens. Some of the vehicle equipment could be damaged by excessive temperature or long oven drying times.

Do not change the type or rating of the wheel and tire equipment.

Do not make any modification to the main battery pack tray.

SAFETY PRECAUTIONS - SUMMARY

1. VOLTAGE

The main battery pack has a high system voltage (216 volts d.c.) and is potentially hazardous. The highest safety standards have been applied to the design of the equipment and its installation. Service and repair of any part of the high voltage system must only be carried out by Vehma certified personnel.

2. ISOLATION

Before working on the vehicle always ensure that the main battery pack and the 12 volt auxiliary battery are disconnected. Always turn the ignition switch to the 'fully-off' position before disconnecting the main battery pack. Always disconnect the charger before disconnecting the main battery pack.

3. WATERING SYSTEMS

The watering and venting system pipes may contain acidified water and potentially explosive gases. Take care when disconnecting pipes and always fit nylon vents and connector assemblies to the main battery pack when it is removed from the vehicle. Always fit nylon vents and connector assemblies when charging the main battery pack removed from the vehicle.

4. WELDING

No welding should be carried out on the vehicle before the main battery pack and if necessary the 12 volt auxiliary battery have been removed. The main battery pack should be removed by trained personnel only, using authorised procedures and equipment.

5. JACKING

Do not attempt to jack up the vehicle at any locations other than those specified in the Operator's Manual.

6. FUSES

Fuses should only be replaced by trained personnel and care should be taken to ensure that any replacements are of the correct type and rating.

7. LABELS

Attention should be given to all warning labels and safety equipment.

8. HANDBOOK/MANUAL

Further information can be found in the Conceptor Operator's Manual supplied with every vehicle. Additional copies may be obtained from Vehma on request.

TRAINING COURSES

The basic and advanced training courses are mandatory for all owners/operators of production electric G-vans.

Training courses will take place in close sequence to the production electric G-vans being delivered. Courses will be held either at a designated EV Regional Centre or at the customer's facility.

One person from each customer may attend both courses provided he/she is a qualified electrician/electrical technician. More than one person from each customer may attend either course, provided at least one person, who is a qualified electrician/electrical technician, attends both courses.

It is recommended that those people who will be responsible for servicing and maintaining their company's electric G-Vans attend the basic course as well as the advanced course.

Training courses are included in the purchase price of the first 60 production vehicles. The training courses consist of a half day basic course limited to 12 people (3 per customer maximum if course held at a regional centre), to run in sequence with a one and a half day advanced course limited to 6 people (2 per customer maximum if course held at a regional centre).

The following sheet outlines the contents of the courses and who should attend.

Basic and advanced certificates will be issued to all who successfully complete their respective courses.

Driver and service training instructors attending the courses on behalf of the owners/operators will also be issued with certificates as well as course instructional materials.

TRAINING COURSE OUTLINES

The outline of the training courses is as follows;

Basic Training Course (limited to 12 people - 3 per customer maximum if course held at a regional centre) primarily for drivers/operators and management personnel involved with vehicle operations as well as driver and service training instructors

- inspect the vehicle - questions and answers
- review of the Operations Guide
- introduction to vehicle
- slide presentation
- description of vehicle systems, and the 4 major assemblies
- review of safety precautions
- service support and warranty
- description and in-depth discussion of operator's manual
- brief review of service manual and of tools and equipment
- review of acceptance inspection checklist
- drive the vehicle

Advanced Training Course (limited to 6 service technicians - 2 per customer if course held at a regional centre) - in-depth review of service manual with discussions re: maintenance and inspections of the following;

- battery pack
- traction motor
- P/S-P/B motor and controller
- A/C system
- vehicle controller
- charger
- transfer case
- axle and propshaft
- range selector
- heater and heater fuel system

Practical diagnostics will also be carried out by the service technicians attending the advanced course, hence the numbers limitation.

If you have any questions, please telephone:

Ron Mitchell, Service Manager, Electric Vehicle Program

(416) 836 - 4611

1991 ELECTRIC G-VAN WARRANTY

OWNER'S/OPERATOR'S NAME

STREET ADDRESS

CITY, STATE, COUNTRY

VEHICLE IDENTIFICATION NUMBER
(CONCEPTOR VIN)

DELIVERY DATE

MILEAGE AT DELIVERY

This limited warranty, covering your new vehicle, should be kept with the vehicle and made available to Service Technicians qualified by Conceptor Industries Inc. if Conceptor warranty work is needed. The GMC 1991 Light Truck Warranty and Owner Assistance Information booklets should also be kept with the vehicle and made available to a GMC Truck Dealership if GM warranty work is needed. Tires are warrantied separately by the tiremaker - refer to GMC 1991 Light Truck Warranty booklet.

WHAT IS COVERED

Repairs covered This warranty covers repairs to correct any vehicle defect related to material or workmanship noted during the "Warranty Period".

Warranty Period The warranty period for all coverages begins on the date the vehicle is first delivered and continues for the period indicated below under 'Warranty Period for GM Parts' and under 'Warranty Period for Conceptor Parts'. It covers the complete vehicle except those items listed under 'What is not covered' shown below.

Corrosion Coverage Refer to GMC 1991 Light Truck Warranty booklet

Obtaining Repairs To obtain warranty repairs on GM parts, take the vehicle to a GMC Truck Dealership within the "Warranty Period" and request the needed repairs. To obtain warranty repairs on Conceptor parts within the "Warranty Period" call the 'Hotline' phone number: 1-800-263-8395 and request the needed repairs. A reasonable time must be allowed for the dealership/service technician to perform necessary repairs. A list showing the major GM and Conceptor components is shown below.

Warranty Period for GM Parts All GM manufactured or supplied parts on the electric G-van including but not limited to those listed below are warrantied by General Motors under the "New Truck and Chassis Limited Warranty" as stated in GMC Truck's "Warranty and Owner Assistance Information Booklet". This warranty is for 36 months or 50,000 miles. It includes a \$100 deductible after the first twelve months or twelve thousand miles.

- heater components as supplied with GM shell
- frame and bumper parts
- steering including gear housing and all internal parts, power steering pump, steering shaft, tie rods, seals, steering column,
- front suspension and axle, rear shocks,
- wheels,
- brake assemblies, brake lines,
- auxiliary battery (12 volt battery as fitted to GM shell),

continued.....

- lighting systems and cab electrical,
- doors including locks, window regulators, hinges, seals,
- seats,
- interior trim

Warranty Period
for Conceptor
Parts

All Conceptor manufactured or supplied parts, including but not limited to those listed below, are warrantied as being free from defects in material and workmanship for a period of twelve months, unlimited mileage. Extended warranties are available - see below.

- transfer case
- range selector
- traction motor (all parts including cables but excluding routine brush and filter replacement.)
- traction controller including all associated cables and connectors and integral DC-DC converter
- battery pack including tray, monoblocs, electrical connections and watering/gas management system
- underbody power wiring harness
- P/S-P/B motor
- P/S-P/B control box
- A/C motor (if equipped)
- A/C control box (if equipped)
- compressor (if equipped)
- condenser (if equipped)
- rear axle and leaf spring assemblies,
- propshaft
- charger including output cable and plug
- watering trolley

Extended Warranties Extended warranties for Conceptor manufactured or supplied components, including but not limited to those listed above, are available as an option at the time of purchase

- 1) an additional 12 month warranty, commencing at the expiry of the initial warranty, unlimited mileage, for US\$650 per vehicle excluding battery pack OR for TBA per vehicle including battery pack **
- 2) an additional 24 month warranty, commencing at the expiry of the initial warranty, unlimited mileage, for US\$950 per vehicle excluding battery pack OR for TBA per vehicle including battery pack **

** to be resolved no later than OCT 20, 1990
CONCEPTOR INDUSTRIES INC. page 3 of 8

Warranty Applies This warranty is for Conceptor vehicles registered and normally operated in Canada or the United States.

Warranty Repairs In the interest of customer satisfaction, Conceptor Industries Inc. may offer exchange service on some vehicle components. This service is intended to reduce the amount of time your vehicle is not available for use due to repairs. Components used in exchange service may be new, remanufactured, reconditioned or repaired, depending on the component involved and will be uniquely identified. All exchanged components meet Conceptor Industries Inc. standards and will be covered under this warranty for ninety (90) days or for the remainder of the original warranty period whichever is greater.

Component Exchanges Also, in cooperation with worldwide efforts to control suspected ozone-depleting agents, the latest EPA guidelines strongly support the capture, purification and reuse of automotive air conditioning refrigerant gases. As a result, any repairs to the sealed portion of your air conditioning system (if equipped) may involve the installation of purified reclaimed refrigerant.

Black Box Components Black box components (Conceptor) are the propulsion system controller, the power steering/power brake control box and the air conditioning control box (if equipped). These components are sealed units at the production plant. Access to these components is restricted to designated service technicians qualified by Conceptor Industries Inc..

Battery Pack Watering Record Cards Battery pack watering record cards supplied with each new vehicle as a glove compartment publication must be completed by the customer and returned to Conceptor Industries Inc. after every top-up (3 weeks or 15 charges). This will enable Conceptor to review the condition of the battery pack on a constant basis and act as preventive maintenance. These cards are self-addressed and postage paid. Refer to Conceptor Operator's Manual for top-up details.

Component Retention Components which have been replaced under warranty must be retained by the customer for a minimum period of 3 months for inspection by Conceptor qualified service personnel.

CONCEPTOR INDUSTRIES INC. page 4 of 8

Component Responsibility	GM will be responsible for any Conceptor component that ceases to function as a direct result of a GM installed component. Similarly, Conceptor will be responsible for any GM component that ceases to function as a direct result of a Conceptor installed component.
After-Manufacture "Rustproofing"	Refer to GMC 1991 Light Truck Warranty booklet
Warranty Service	Refer to GMC 1991 Light Truck Warranty booklet for GM related parts. For Conceptor parts or questions relating to component warranty responsibility, call the 'Hotline' phone number: 1-800-263-8395 For your records, the service technician qualified by Conceptor Industries Inc. will provide a copy of the warranty repair order, listing all warranty repairs performed.
Pre-delivery Service	All electric G-vans will undergo a thorough inspection at the production facility prior to shipment to the customer. All checks applicable to each vehicle will require signing off by production staff. Every effort is made to minimise and indeed eliminate potential vehicle damage during shipment, however in the event damage has occurred, completion of the acceptance inspection checklists is critical. These Checklists will be required to be completed by all customers - one per vehicle. As training courses will take place simultaneously with delivery of production electric G-vans, service technicians qualified by Conceptor will be able to assist customers with completion of these forms.
Vehicle Mileage at Delivery	Refer to GMC 1991 Light Truck Warranty booklet.
Vehicle Alteration	Refer to GMC 1991 Light Truck Warranty booklet. Further to the above reference, Conceptor has a document entitled "Notes for Bodyshops/ Customisers/Users" which is available on request from the production plant (address at the end of this warranty).
Production Changes	Refer to GMC 1991 Light Truck Warranty booklet. Conceptor Industries Inc. reserves the right to make changes in vehicles built and/or sold

continued.....

by them at any time without incurring any obligation to make the same or similar changes on vehicles previously built and/or sold by them.

Customer
Satisfaction
Procedure

Refer to GMC 1991 Light Truck Warranty booklet. Further to the above reference, your satisfaction and goodwill are important to Conceptor Industries Inc. Normally, any problems with the sales transaction or the operation of your vehicle will be resolved by Conceptor's Sales or Service Departments. Sometimes however, despite the best intentions of all concerned, misunderstandings can occur. If your concerns have not been resolved to your satisfaction, contact the Vice-President of Marketing, Planning and Administration at the production facility (telephone number at the end of this warranty document).

State Warranty
Enforcement Laws

Refer to GMC 1991 Light Truck Warranty booklet.

Special Policy
Adjustment Programs
Beyond This
Warranty Period

Refer to GMC 1991 Light Truck Warranty booklet.

WHAT IS NOT COVERED

Tires

Tires are warrantied separately by the tire maker - refer to the 1991 GMC Light Truck Warranty Booklet.

Damage due to
accidents, misuse,
or alteration

Damage caused by: collision, fire, theft, freezing, vandalism, riot, explosion or objects striking the vehicle; misuse of the vehicle such as driving over curbs, overloading, racing or other competition; and alterations of the vehicle are not covered. In addition, coverages do not apply if the odometer has stopped or been altered. Proper vehicle use is discussed in the GM Owner's Manual and Conceptor Operator's Manual.

Damage or corrosion due to environment, chemical treatments or aftermarket products

Damage caused by airborne fallout (for example; chemicals, treesap etc.), stones, hail, flood, windstorm, lightning, the application of chemicals, sealants or any other product subsequent to manufacture, are not covered.

Damage due to lack of maintenance or use of wrong fuel, oil or lubricants

Damage caused by failure to follow the requirements of the Maintenance Schedule: failure to follow Maintenance Schedule intervals, and failure to use or maintain proper levels of fluids, fuel, oil and lubricants recommended in the GMC Owner's Manual and recommended in the Conceptor Operator's Manual are not covered. Proof of proper maintenance is the owner's responsibility including submission of battery watering records (50 record cards supplied with each new vehicle). Keep all receipts and make them available if questions arise about maintenance.

Maintenance

Cleaning and polishing, lubricating, replacing filters, brushes, ceramic vents, and brake linings as well as performing other normal maintenance services detailed in the GMC Maintenance Schedule and GMC Owner's and Conceptor Operator's and Service Manuals are not covered and are the owner's expense.

Extra Expenses

This warranty does not cover any economic loss or extra expenses including (without limitation), payment for the loss of time or pay, inconvenience, storage, loss of vehicle use, vehicle rental expense, lodging, meals or other travel cost.

OTHER TERMS: This warranty gives you specific legal rights and you may also have other rights which vary from state to state or province to province.

General Motors and Conceptor Industries Inc. do not authorise any person to create for it any other obligation or liability in connection with these vehicles. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE APPLICABLE TO

continued.....

THIS VEHICLE IS LIMITED IN DURATION TO THE DURATION OF THIS WRITTEN WARRANTY. PERFORMANCE OF REPAIRS AND NEEDED ADJUSTMENTS IS THE EXCLUSIVE REMEDY UNDER THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY. GENERAL MOTORS AND/OR CONCEPTOR INDUSTRIES INC. SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM BREACH OF THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY.*

* Some states do not allow limitations on how long an implied warranty will last or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

Production Facility Address:

Conceptor Industries Inc.,
521 Newpark Blvd.,
Newmarket
Ontario L3Y 4X7
Canada

telephone: (416) 836-4611

RECOMMENDED SPARES

The following items represent a list of Conceptor maintenance spares which are recommended for customer purchase, in order to correctly maintain their vehicles and conform with warranty requirements;

Part #	Description	Quantity (per vehicle)
EG 900001 S	brush (traction motor)	4
EG 900003 S	ceramic flame arrestor	4
EG 900055 S	filter assy (traction motor intake)	1
EG 900033 S	brush and spring kit (P/S-P/B motor)	1
EG 900032 S	brush (A/C motor)	4

Further to the above, the following list represents consummables which will be required;

Description	Quantity
Pure Water (see below for specification)	as required
SAE-75 W90 gear lubricant (transfer case)	as required
80W90 to API class GL5 gear lubricant (rear axle)	as required

Pure Water Specification (distilled or de-ionised water)

Impurity	Maximum Concentration (parts per million)
Iron as Fe	5
Chloride as Cl	10
Manganese as Mn	0.1
Copper as Cu	5
Ammoniacal Nitrogen as Nh3	10
Nitrogen Oxides as N	3
Total fixed residue (as sulphated ash)	150

Many impurities introduced into a cell with the topping-up water remain there permanently and increase with each topping up. It is therefore necessary to use water in which the impurities do not exceed those given above, otherwise battery life will be shortened.

NOTE: The above list does not include GM maintenance spares - consult the GM manuals.

RECOMMENDED TOOLS AND EQUIPMENT LIST FOR
ELECTRIC G-VAN SERVICE AND MAINTENANCE FACILITY

Standard Service Tools

- Automotive Hoist capable of lifting a GM 'G' van (8600 GVW)
NOTE: hoist must provide clearance for removal and replacement of the following;
 - battery pack (battery tray and monoblocs with associated wiring harnesses and connectors as a complete assembly)
 - front subframe assembly (with axle complete)
 - rear subframe assembly

- A 'clear floor' type with adjustable swing arms is recommended [it should be ensured that the swing arms adequately clear the corners of the battery tray - the dimensions of the tray are 60.5" long (excluding attachment brackets) by 65" wide]

- Automotive tools for regular GM 'G' van servicing
- Soldering gun for terminal repair
- Rear axle jacks/stands
- Multimeter [such as a Fluke Model # 8021B (8 switch, 200 Ω to 200 M Ω AC/DC audible warning)]

Special Service Tools

Part Number	Description	Quantity (per service facility)
EG 900300	Battery Lift Table	1
EG 900301	Front Lift Table (front subframe and axle)	1
EG 900302	Rear Lift Table (rear subframe or rear axle)	1
EG 900304	Lift Table Package (comprising EG 900300, EG 900301 and EG 900302 noted above)	1
EG 900305	Vehicle Auxiliary System Test Unit	1

Part Number	Description	Quantity (per service facility)
EG 900306	P/S-P/B Control Box Test Unit (and A/C Control Box Test Unit)	1
EG 900307	AMP Connector Tool Kit	1
EG 900308	Packard Terminal Tool Kit	1
EG 900309	Watering Trolley	*
EG 900310	Battery Charger (weatherproof)	*
EG 900312	Field Resistance. Test Lead +ve	2
EG 900313	Field Resistance Test Lead -ve	2
EG 900314	Brush Wear Gage (traction motor)	2
EG 900315	Dummy Field Connector	2
EG 900315	Vyon Vent with Connector Assy	8
EG 900316	Charger Adaptor Cable	1
EG 900317	Main Battery Low Light Tester **	2
EG 900318	Ignition Light Tester **	2
EG 900319	State of Charge Gauge Tester **	2

* additional chargers or watering trolleys may be required to be located at remote sites to cater for special vehicle routing or remote service and maintenance requirements

** indicates not required if Vehicle Auxiliary System Test Unit is available

NOTE: Special GM tools are not listed above - refer to GM Service Manual

CHARGER

The Chloride Electro Networks Ferroresonant charger has been specifically designed for use with lead acid motive power batteries marketed by Chloride EV Systems.

The model type 108V0205M2 has been selected from the wide range of CEN chargers for use in conjunction with 108 cell battery systems.

The charger incorporates the microcomputer Controller EV-05 which employs dv/dt and di/dt technology. It can deliver the correct charge regardless of battery age, temperature, or degree of discharge, terminating charge automatically. Features include automatic top up charging, variable delayed start and many failsafe characteristics.

Exterior dimensions of the weatherproof charger are:

height: 30.75" width: 31.0" depth: 25.0"

(product sheet to follow)

CHARGER INSTALLATION

PHYSICAL LOCATION

Charging areas should be clean and dry. The temperature of the charging room should be between 32 deg F. (0 deg. C.) and 113 deg. F. (45 deg. C.). Combustible materials, open flames and smoking should not be permitted near or in the charging room.

A battery on charge will emit explosive gases. Ventilate the charging room to prevent gas accumulation.

MOUNTING

The SERIES 5 standard charger cabinets are designed for bench, floor or wall mounting. Mounting holes are provided on the frame for bolting to a bench, floor or wall bracket mounting (wall brackets are optional).

INPUT POWER CONNECTION

The SERIES 5 battery charger is shipped from the factory connected for 240 volts AC, single phase, 60 Hz Input. A 'STOP' label, located near the service entrance hole, indicates this factory set input voltage.

CAUTION: Verify that the AC electrical service is disconnected at the breaker before attempting to install the AC wiring to the charger and that the charger is disconnected from the traction battery (main battery pack).

The AC input terminals are identified by a red on white AC INPUT sticker located on the contactor case or input lugs. The AC input cable is to be connected to the proper AC INPUT terminals within the charger cabinet.

A green, grounding wire is to be connected from the Grounding Terminal within the charger cabinet to the service system ground. The Grounding terminal is identified by a green on white Ground Terminal Label on the Red Terminal Board within the charger. If a system ground is not available, the charger frame must be connected to a driven ground rod in accordance with National and Local Electrical Codes. Proper application and tight terminal connections are important in avoiding future problems.

If the SERIES 5 charger is to be used at a different AC voltage other than 240 volts AC, the charger must be adjusted to operate for the different AC service.

Refer to the charger operation manual for additional information.

BATTERY 3ET205

CHLORIDE EV SYSTEMS

This compact, low-profile 6 volt monobloc unit has been specifically developed for high performance commercial vehicle applications, incorporating the latest high energy density tubular positive plate technology based on that used in the already well proven Chloride Classic 25 range of traction cells.

Monobloc units are built into packs using welded and encapsulated terminals for complete reliability. The 3ET205 is fitted with the Autofil centralised watering system, used extensively on Chloride traction cells, enabling the battery pack to be topped-up in-situ.

Battery Specification

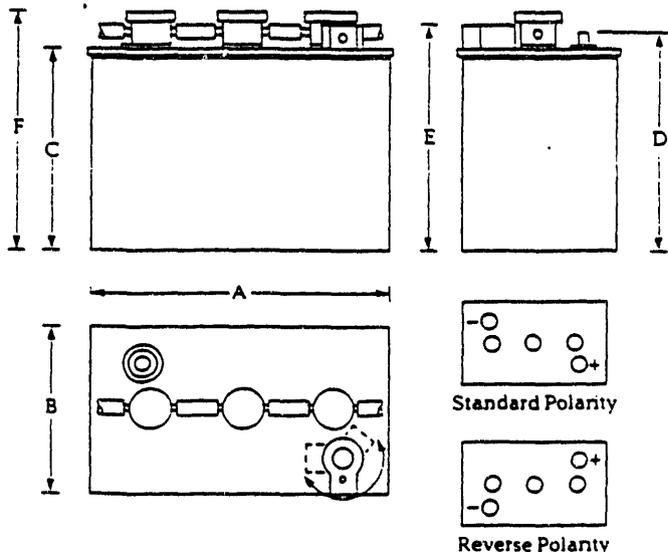
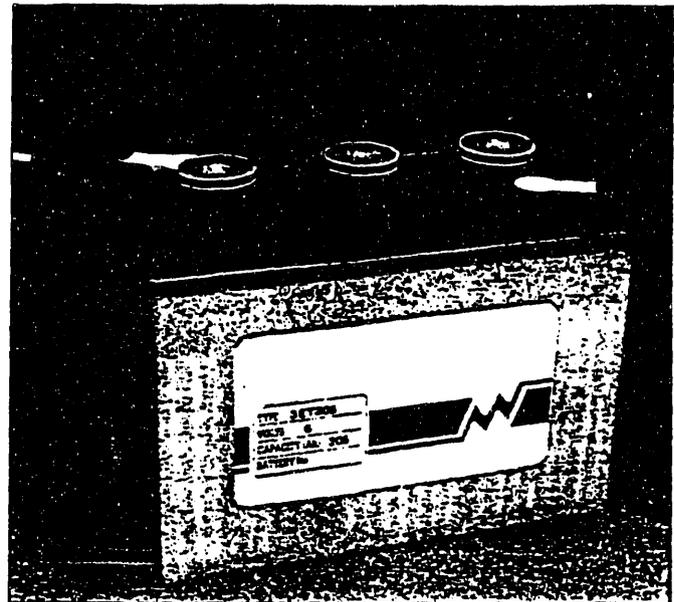
3ET205

Ah Capacity 3 hr rate	186
5 hr rate	205
Energy Density 3 hr rate	34 Wh/kg
5 hr rate	38 Wh/kg
Weight	32.0 kg

Maximum Dimensions (mm)

A	B	C	D	E	F
317	185.5	214	234	239	250

Manufactured by CMP Batteries Ltd.



Chloride Limited
 EV Systems Division
 Unit 1, Padgets Lane,
 South Moons Moat Industrial Estate,
 Redditch, Worcestershire B98 0RA, England
 Telephone: 0527 28016 Fax: 0527 28901

CHLORIDE

BATTERY WATERING RECORDS

Battery watering records are vitally important from the owner/operator's point of view. They are proof that regularly scheduled maintenance is being carried out on his vehicle's battery pack. They also constitute part of the necessary documentation if any warranty claim should arise (refer to Warranty section in this guide).

There are two topping-up record forms attached. Both forms need to be completed at each watering of the pack on each vehicle.

One is a pre-paid post card. It should be mailed after each topping-up, once the following information has been completed;

- i) vehicle identification number (Conceptor VIN)
- ii) operator
- iii) vehicle number
- iv) location
- v) date when topped up
- vi) mileage/kilometre reading
- vii) water used in litres for a) street side and b) curb side
- viii) owner/operator's signature

NOTE:The above information does not take long to complete.

The other form is for the owner/operator's use. It is a continuing record of water used in each of his particular vehicles. Service technicians will request to inspect this document in the event of a warranty claim.

ELECTRIC VEHICLE BATTERY PACK TOPPING-UP RECORD CARD

Conceptor Industries Inc., 521 Newpark Blvd., P.O. Box 149, Newmarket Ont., L3Y 4X7 Canada Tel: (416) 836-4611 Fax: (416) 836-9784

NOTE: For Maintenance Supervisor The vehicle's battery pack should be topped-up <u>after 15 charges</u> or <u>every 3 weeks</u> just after they have been fully charged.	This card should be used to record the amounts of water used in each half of the battery by observing and noting down the initial and final water levels in the Autofil Trolley
---	---

VEHICLE IDENTIFICATION NO. _____ Vehicle no. _____
(CONCEPTOR VIN)
Operator _____ Location _____

Date when topped-up	*Mileage/Kilometre reading (*delete)	Water used (in litres)		User's signature
		street side	curb side	

Proof of proper maintenance is the owner's responsibility including submission of the Topping-Up Records to the Vehma Service Department. In the event of a warranty claim for premature battery failure, Vehma personnel will be required to examine all topping-up records prior to agreeing to any warranty settlement.

PLEASE POST THIS CARD IMMEDIATELY WHEN COMPLETED
(POSTAGE WILL BE PAID BY LICENSEE)



**CONCEPTOR INDUSTRIES INC.
C/O 288 SOLACE DRIVE
HOWELL
MICHIGAN 48843
USA**

TRACTION MOTOR

The model type N200ML012 is a separately excited DC motor for high performance electric vehicles. Designed for use with the Mk 5 electronic controller this motor is built to give smooth trouble-free service under arduous stop/start city traffic conditions. Compact and lightweight for a motor of this power, it has been planned for volume production and minimal cost.

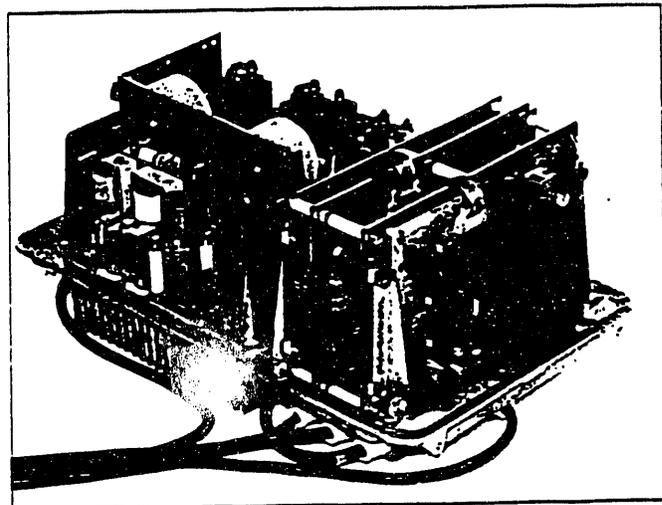
(product sheet to follow)

TRACTION CONTROLLER MK 5 CHLORIDE EV SYSTEMS

Electrical Specification

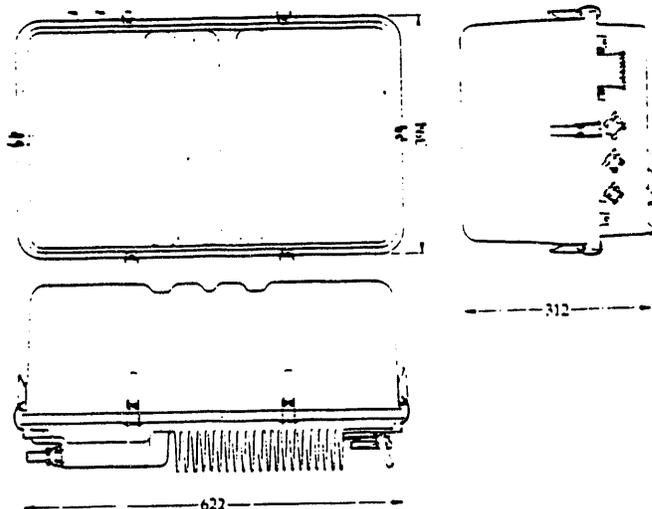
Battery Voltage	216v nominal
Power Output	42 kW (typical motor output)
Battery Circuit inductance	16 μ H max
Armature Circuit Inductance	0.2 mH min
Field Resistance	5 ohms at 20°C nominal
Operating Temperature	-20°C to +40°C
Storage Temperature range	-40°C to +55°C
Weight	45 kg
Mounting Position	In adequate air flow shielded from direct water spray
Driver Control Function	Ignition Switch Standard key Forward/Reverse 3 position switch Accelerator & Brake Signals Potentiometers -1k ohm \pm 20%
Driver Information	Signals are provided for: Traction Battery State of Charge Traction Battery - low voltage
Safety Features	Safety interlocks, for both power and signal circuits are standard features.
Terminations	Cables to Battery and Motor are terminated in flying leads. Signal terminations are through an automotive type Packard connector.
DC-DC Converter	Integrated electronic converter to charge vehicle 12v battery at up to 30 amp

Manufactured by Chloride Electro Networks,
a division of Chloride Power Electronics Inc.



This electronic pulse controller uses transistor choppers to control the motor armature and field current. The unit has been specifically designed to operate in a traction environment controlling the energy flow between the traction battery and the separately excited motor. The unit permits accurate control of drive and regenerative torque, the latter down to near zero speed.

A high degree of flexibility is built into the control electronics which allows the detailed motor power-speed curve to be tailored to customer requirement.



Chloride Limited
EV Systems Division
Unit 1, Padgets Lane,
South Moons Moat Industrial Estate,
Redditch, Worcestershire B98 0RA, England
Telephone: 0527 28016 Fax: 0527 28901

CHLORIDE

DELIVERY AND COMMISSIONING

Training courses will take place in close sequence to the production electric G-vans being delivered. Courses will be held either at a designated EV Regional Centre or at the customer's facility. Chargers will be shipped direct from the manufacturer in New York state to each customer prior to delivery of the vehicles.

It is suggested that commissioning of the vehicles takes place soon after the customer has successfully completed the training courses. This will ensure that those personnel who have completed the courses will more quickly become familiar with their vehicles.

ACCEPTANCE INSPECTION CHECKLIST

The owner/operator must be thoroughly conversant with the Conceptor Operator's Manual before completing the following checklist. All items listed below must be initialled by the customer or the customer's representative, signed and dated in the space provided and returned to Conceptor within six weeks of delivery of the vehicle(s).

One acceptance inspection checklist per vehicle must be completed and signed. The Conceptor service technicians, if at the customer site, will be able to assist with completion of these checklists. The Service Manager will also be able to assist on the hotline.

Failure to return the signed checklists within the above specified period may nullify the warranty.

- 1 Check vehicle against purchase order specification.
- 2 Inspect vehicle for damage during shipping.
- 3 Check charger, watering trolley (where required) and any spare parts against purchase order specification. Check for damage during shipping.
- 4 Check literature supplied; i) Conceptor Operator's Manual
ii) Conceptor Warranty iii) GMC Truck 1991 Owner's Manual
iv) GMC Truck 1991 Light Duty Maintenance Schedules booklet
v) GMC Truck 1991 Light Duty Warranty and Owner Assistance Information booklet vi) Webasto DW 80 Heater Manual.
- 5 Check operation of charger with vehicle - refer to Conceptor Operator's Manual and charger operation manual.
- 6 Check operation of watering trolley with vehicle (after 3 weeks or 15 charges) - refer to watering trolley instructions attached to trolley.
- 7 Check vacuum integrity of battery watering circuit.

8 Check fluid levels; power steering, power brakes, rear axle, transfer case, windshield washer, heater fuel.

9 Check tire pressures (when tires are cold);

front - 80 p.s.i.,
rear - 80 p.s.i.

10 Check operation of vehicle equipment and controls;

Lights - sidelamps, headlamps, stop lamps, turn lamps, interior lamps

Warning Lights - high beam, turn, hazard, low heater fluid, daytime running (where applicable), battery pack low voltage, ignition, brake system, safety belt reminder

Instruments/Gages - speedometer, odometer, state-of-charge, heater fluid temperature, auxiliary battery voltmeter, heater fuel

Controls and Equipment - horn, windshield wipers, windshield washers, heater, air conditioning if equipped

11 Test Drive, checking the operation of the following;

Selector lever - park, forward, neutral, reverse

Brakes - service brake (pedal), parking brake

SOC (state of charge) gage

Further to the above, ignition and door key numbers should be recorded in case of loss.

Signature of Customer
/Customer's Representative

Date

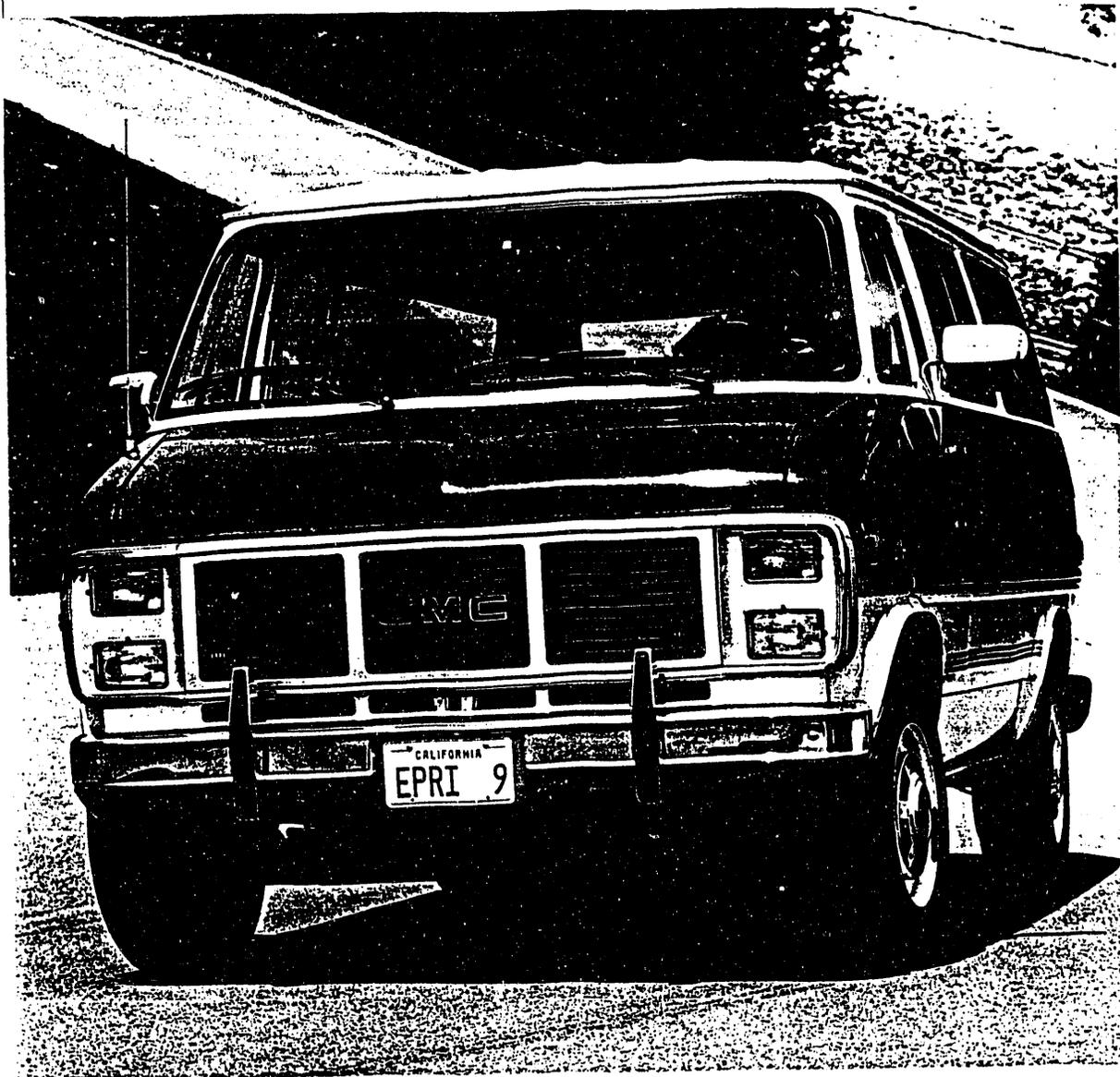
Owner/Operator

Location

NOTES

Electric G-Van

EPRI



ELECTRIC
POWER
RESEARCH
INSTITUTE

THE G-VAN: AMERICA'S ELECTRIC FLEET VEHICLE

With the Electric G-Van undergoing final engineering in preparation for its 1990 market debut, the Electric Power Research Institute (EPRI) is achieving a long-term goal of creating a viable alternative to gasoline-powered vehicles.

The G-Van is being developed by EPRI; Vehma International, a Magna International Company; Chloride EV Systems; and General Motors Corporation; with support from Southern California Edison Company. This van will be the first American-made, modern electric vehicle (EV) to be produced in volume and distributed through a nationwide network.

ENHANCED TO COMPETE

The G-Van is based on the proven technology of the GM Griffon—a British-made electric van that has logged over seven million miles in fleets around the world. Enhanced features and capabilities such as those described below give the G-Van a competitive edge in commercial van fleets, the most promising market for early EVs.

- An improved lead-acid battery and upgraded propulsion system enable the G-Van to match the Griffon's performance while providing a 26% volume increase and several new features. The proof-of-concept G-Van achieved a 60-mile range per charge in simulated city driving, a top speed over 52 mph, and acceleration from 0 to 30 mph in under 13 seconds.
- In response to feedback from Griffon users, the G-Van will be equipped with such standard features as electrically driven power steering and power brakes and independent front-wheel suspension.

- Air conditioning and customized interiors will be some of the options offered to help the G-Van meet the comfort standards of the North American market.
- To be available in cargo van and passenger wagon models, the G-Van will be suitable for a variety of fleet applications.

BENEFITS FOR SOCIETY

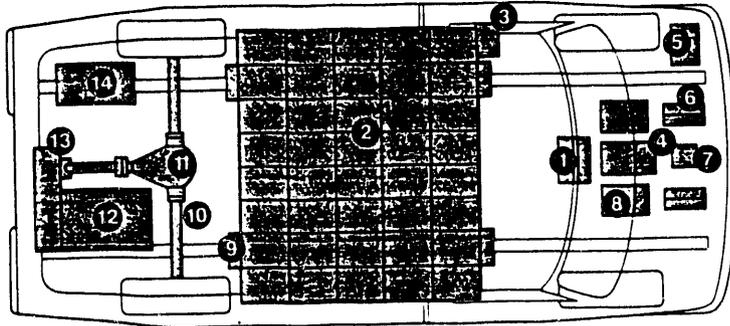
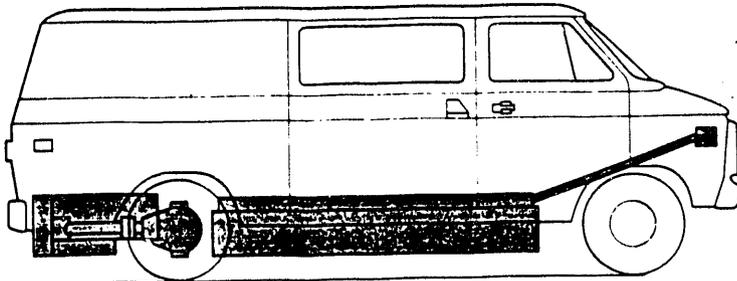
In addition, the G-Van—like all EVs—will offer benefits to society as a whole. This clean, quiet vehicle should help alleviate the air quality and noise problems that continue to plague major urban areas.

Further, increased use of electrically powered transportation can ease the nation's dependence on imported oil and thereby improve the U.S. trade balance. Because most EVs will be charged overnight using off-peak power, EV-electricity consumption will help lower the average cost of electricity to the customer.



Employees at Southern California Edison load cargo into an Electric G-Van.

Production Vehicle



- 1 Traction motor controller
- 2 Detachable battery pack
- 3 Battery pack fuse junction box
- 4 Electrically controlled power steering and power brakes
- 5 12-volt auxiliary battery
- 6 Battery pack watering-venting system
- 7 Battery pack charging plug
- 8 Liquid-fueled heater
- 9 4-point battery attachments
- 10 Heavy-duty springs
- 11 Rear axle
- 12 Electric-traction motor
- 13 Gear-drive single-speed transmission
- 14 Heater fuel tank

Technical Information*

Dimensions (in inches)

Wheelbase	125
Overall length	202
Overall width	79
Overall width with mirrors	90
Overall height	82
Ground clearance to battery tray	8
Front tread	75
Rear tread	78
Interior height	46
Interior width at floor	70
Wheelhouse length	36
Width between wheelhouses	60

Weights (in pounds)

	Cargo	Passenger
Gross vehicle weight	8,600 lbs	8,600 lbs
Payload**	1,550 lbs	5 passengers
Curb weight	7,050 lbs	7,672 lbs

Performance Data

Range:***	35 mph constant speed	90 mi
	Simulated city driving	60 mi
Top speed		52 mph
Acceleration time (0-30 mph)		13 sec
Energy consumption (wall plug)		.94 kWh/mi
Stopping distance from:		
	30 mph	52 ft
	50 mph	168 ft

*The technical information is based on concept vehicles and may differ from information for production vehicles.

**Vehma hopes to achieve an 8-passenger level before the production-vehicle launch.

***Range cited was achieved in a vehicle without air conditioning.

CHLORIDE



Electric G-Van prototypes will be used in a field evaluation program at Southern California Edison, Los Angeles Department of Water and Power, and other utilities beginning in the summer of 1989. The manufacturers will refer to data from the field evaluation if vehicle improvements are needed.

**LESS MAINTENANCE.
LOWER COSTS**

The G-Van is expected to require less routine maintenance than conventional vehicles. This is largely because the G-Van propulsion system, with fewer moving parts and longer-lasting components, is inherently more reliable than conventional propulsion systems. And electric component maintenance has been simplified by streamlined procedures and improved equipment:

- An on-board charger automatically charges the battery in 8 to 10 hours.
- A specially designed "Autonil" system completes battery watering—required once every three weeks—in 15 to 20 minutes without supervision.

- The battery pack design includes a multi-point attachment system that allows rapid and easy removal of the pack for occasional maintenance inspections.

Final costs for the G-Van are still being determined. Estimated fuel costs for EVs are about 4.5 cents per mile (assuming 0.94 kWh/mile and 5 cents/kWh) compared to 9.5 cents per mile for conventional vans (assuming 10 miles/gallon and 95 cents/gallon). Data from the Griffin experience show that G-Van maintenance costs should be appreciably lower than those for conventional vans.

EPRI



GMC

EVDC

SCE Southern California Edison Company

Lead battery • Lead acid battery • Head acid battery • Head acid battery
 Steering power • Steering power • Steering power • Steering power
 Brake power • Brake power • Brake power • Brake power • Brake power
 Speed transmission • High speed transmission
 On-board charger • Off-board charger • Off-board charger
 150 lb payload • 1550 lb payload • 1550 lb payload • 150 lb payload
 Passenger spaces • Passenger spaces • Passenger spaces • Passenger spaces
 25 in wheel base • 125 in wheel base
 Speedometer • Speedometer • Speedometer • Speedometer • Speedometer
 Direction signals • Direction signals • Direction signals • Direction signals • Direction signals
 Hazard flashers • Hazard flashers • Hazard flashers • Hazard flashers • Hazard flashers
 Windshield wipers • Windshield wipers • Windshield wipers • Windshield wipers • Windshield wipers
 Sun visor • Sun visor • Sun visor • Sun visor • Sun visor
 Ashtray • Ashtray
 Interior mirror • Interior mirror
 Interior lamp • Interior lamp
 Side mirrors • Side mirrors
 Water heater • Water heater
 Sliding door • Sliding door
 Headlamp • Headlamp • Headlamp • Headlamp • Headlamp • Headlamp

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