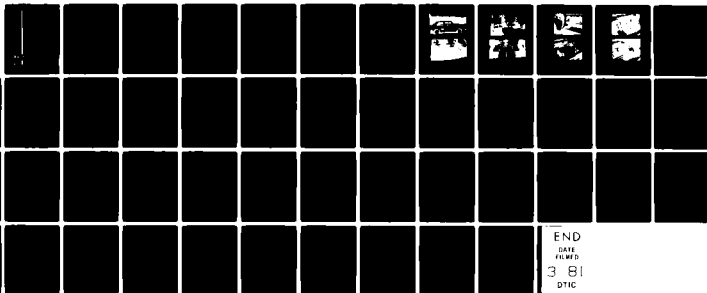


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Report 2314

VERIFICATION AND PRODUCT-IMPROVED TESTS OF THE
SOUTH COAST TECHNOLOGY R-1 ELECTRIC RABBIT

by
Edward J. Dowgiallo, Jr.
Ivan R. Snellings
William H. Blake

November 1980

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U.S. ARMY MOBILITY EQUIPMENT
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PREFACE

Michael E. Johnson, P.E., of VSE Corporation was responsible for aspects of calibration of the signal conditioning circuits and recording instruments as well as data tabulations, plotting, and preparation of the report.

James A. Queen and Calvin T. Bushrod of the Environmental and Field Division, Product Assurance and Testing Directorate, assisted in vehicle operation and data collection.

The report was prepared to document work sponsored by the United States Government. Neither the United States nor its agent, the United States Army, nor any Federal employees, nor any of their contractors, sub-contractors, or their employees, makes any warranty, express or implied, or assumes any legal liability to responsibility for the accuracy, completeness, or usefulness of any information apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

The views, opinion, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation.

This vehicle was tested to determine its conformity to the Department of Energy, "Performance Standards for Demonstrations." The results reported herein show the nominal capability of the vehicle when the standards are exceeded but the maximum capability of the vehicle when it failed to meet the standards. The vehicle may exceed the performance reported herein in actual use. It also may have safety features and amenities not required by the Department of Energy Standards.

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CONTENTS

Section	Title	Page
	PREFACE	iii
	ILLUSTRATIONS	v
I	INTRODUCTION	1
II	DESCRIPTION OF TEST VEHICLE	1
III	TEST RESULTS	6
IV	VERIFICATION EFFICIENCY	9
V	PRODUCT-IMPROVED TEST RESULTS	9
	ABBREVIATIONS USED	13
	APPENDICES	
A.	PERFORMANCE STANDARDS FOR DEMONSTRATIONS	14
B.	MI RADCOM ACCEPTANCE TEST OF PRODUCT- IMPROVED ELECTRIC VEHICLES	15
C.	SCT ELECTRIC RABBIT SUPPLEMENT TO VOLKS- WAGON OWNER'S MANUAL	19
D.	VEHICLE DATA SUMMARY SHEET	28
E.	EXPERIMENTAL BATTERY CHARGING MEMORANDUM	32
F.	ELECTRIC AND HYBRID VEHICLE VERIFICATION PROCEDURES	33

ILLUSTRATIONS

Figure	Title	Page
1	R-1 Electric by SCT	2
2	Propulsion Battery Compartment	2
3	Propulsion Batteries, Battery Covers Removed	3
4	Propulsion Batteries, Battery Compartment Cover Removed	3
5	Vehicle Interior, Showing Operator Controls and Indicators	4
6	Engine Compartment, No Covers Removed	4
7	Engine Compartment, Controller Covers Removed	5
8	Engine Compartment, All Covers Removed	5
9	Simplified On-Board Charger Schematic	7

VERIFICATION AND PRODUCT-IMPROVED TESTS OF THE SOUTH COAST TECHNOLOGY R-1 ELECTRIC RABBIT

I. INTRODUCTION

The US Army Mobility Equipment Research and Development Command is tasked with the responsibility for the testing and evaluation of electric and hybrid vehicles for the Department of Energy, under provisions of Public Law 94-413. Performance Standards for such vehicles are defined in Title 10, Chapter II, Article 475 of DOE Rules and Regulations, dated 3 July 1978. These rules and regulations are published in the Federal Register, Part V, dated 30 May 1978 (see Appendix A).

MERADCOM has tested several such vehicles under this program and has published performance reports on these vehicles as unrestricted public information. Because the vehicle was certified by the manufacturer to meet DOE performance standards it was tested by MERADCOM. This report presents acceptance and verification test results.

II. DESCRIPTION OF TEST VEHICLE

The vehicle described in this report, designated the R-1 Electric, is an electrified Volkswagen Rabbit, manufactured by South Coast Technology, Inc., Santa Barbara, California (Figure 1). The test vehicle has been modified by elimination of the rear seats to provide room for the 18 6-V ESB batteries used for propulsion energy storage (Figures 2, 3, and 4). The ESB Model XPV-23 batteries supplied with the test vehicle have 23 plates each and the battery assembly is rated at 162.5-Ah capacity at the 75-A rate. There is also an auxiliary 12-V Globe Union battery under the hood. This battery is rated at 93-Ah and is used for the vehicle lights, windshield wipers, and all other nonpropulsion electric functions.

With the exception of the batteries in the rear passenger compartment, the vehicle interior is little changed from the standard VW Rabbit (Figure 5). At the far right of the dashboard, an ammeter occupies the slot normally used for a car radio.

Propulsion power for the test vehicle is provided by a Siemens Model 1GV1 electric-drive motor at the rear of the engine compartment (Figures 6 and 7), against the bulkhead or firewall. This motor is a shunt-wound d.c. motor, rated at 17 kW and 22.8 hp.

The electric controller used by the test vehicle is a Model SCT-1, EHV Systems Controller that provides armature current limiting and transistorized chopper field control. The controller is shown in Figure 6 with its cover in place and in Figure 7 and 8 with cover removed.

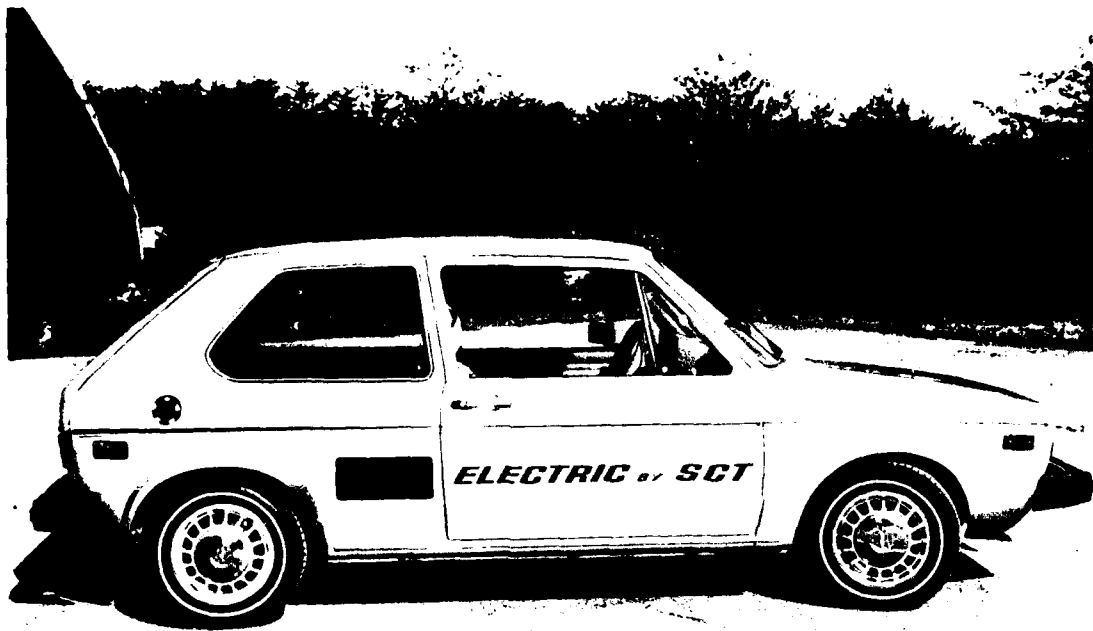


Figure 1. R-1 Electric by SCT.



Figure 2. Propulsion battery compartment.



Figure 3. Propulsion batteries, battery covers removed.

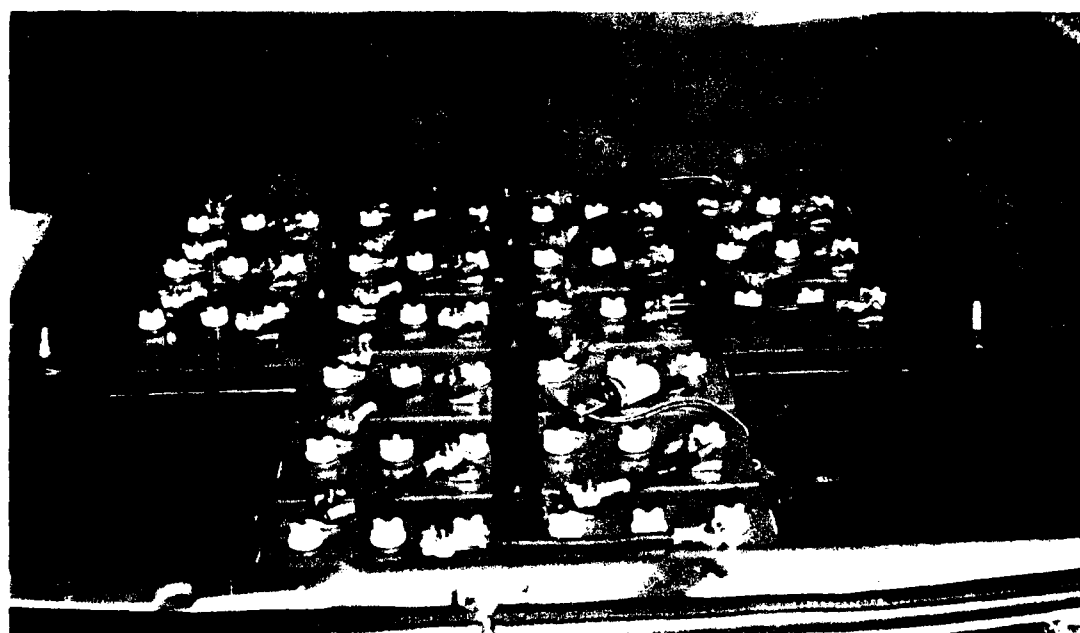


Figure 4. Propulsion batteries, battery compartment cover removed.



Figure 5. Vehicle interior, showing operator controls and indicators.

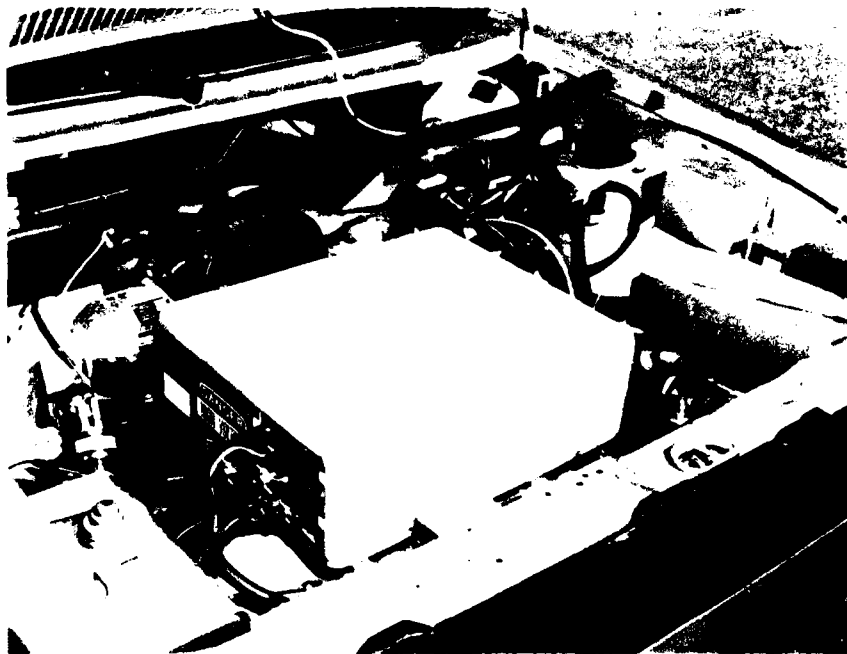


Figure 6. Engine compartment, no covers removed.



Figure 7. Engine compartment, controller covers removed.



Figure 8. Engine compartment, all covers removed.

The test vehicle has driveline ratios of 3.9 (differential), 3.45 (first gear), 1.94 (second gear), 1.37 (third gear), and 0.97 (fourth gear). The vehicle has independent coil-spring suspension front and rear, McPherson struts in front, and trailing-arm suspension in rear. Curb weight of the test vehicle is 1415 kg (3120 lb). Gross weight is designed for 1645 kg (3626 lb), allowing 227 kg (500 lb) for driver, passenger, and payload. The vehicle tested by MERADCOM was equipped with a temporary transformerless 120 V.a.c. charger. This charger is to be replaced and subsequent vehicles of this type are scheduled to have 220 V.a.c. chargers. A simplified schematic of the on-board charger is given in Figure 9.

The test vehicle is equipped with front-wheel disc and rear-wheel drum brakes as well as regenerative braking.

Detailed data on the test vehicle are given in Section III and Appendices B and C. The MERADCOM Vehicle Data Summary Sheets are in Appendix D, and the Exide XPV-23 Battery Charging procedure is given in Appendix E.

III. TEST RESULTS

The following are the results of verification test and are referenced to the DOE performance standards of paragraph 475.10 for demonstrations criteria:

- a. **Acceleration.** The test vehicle accelerated to 50 km/h in 11.0 s.
- b. **Gradeability at speed.** At 25 km/h the test vehicle can traverse a 13.1-percent grade, based on calculation from acceleration tests.
- c. **Gradeability limit.** The test vehicle can start and climb (forward) on a 38.7-percent grade for at least 20 s at 80-percent DOD, based on drawbar pull tests. Reverse gradeability has been calculated at 35.6-percent based on reverse-gear ratio of 3.17:1 and forward first-gear ratio of 3.45:1.
- d. **Forward speed capability.** The vehicle maintained 80 km/h for 78 min on the MERADCOM test track. The track is 2.057 km (6750 ft) long, with a downhill 3-percent grade for 274 m (1200 ft) and an uphill 5-percent grade for 227 m (750 ft). The remainder of the track is flat within about ± 1 percent.
- e. **Range.** 38.7 mi (SAE -J227 a/C cycle, 113 start/stops).
- f. **Battery recharge time.** The test vehicle battery assembly consisting of 18 Exide XPV-23 batteries could not be fully recharged within 10 h by the temporary 120 V.a.c. on-board charger supplied. The charger in this vehicle is to be replaced by a transistor chopper controlled battery charger in early 1980.
- g. **Recharge Control.** Recharge control is by a presetable timer.

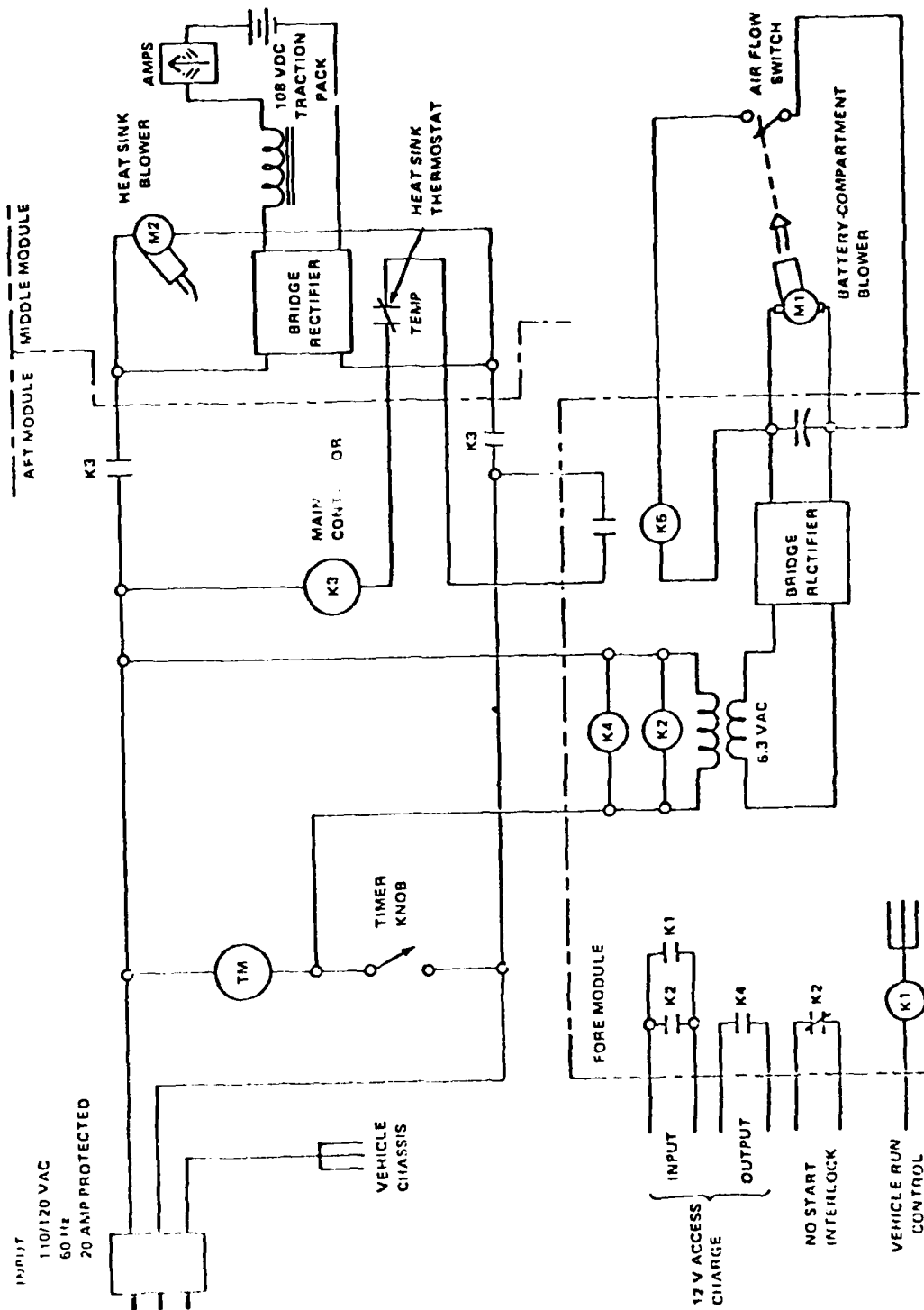


Figure 9. Simplified on-board charger schematic.

h. **Energy consumption.** The only non-electrical energy used by the test vehicle is that consumed by the gasoline-fueled heater.

i. **Battery life.** Because of test period time limitations, no longevity tests for the batteries could be performed. The Exide XPV-23 batteries are covered by the ESB Corporation's standard 12-month warranty.

j. **State-of-charge meter.** The test vehicle is equipped with a state-of-charge indicator. According to manufacturer's information, the meter gives a state-of-charge reading based on instantaneous battery voltage and current values. The indicator itself is in the fuel gauge position of the Rabbit instrument cluster, which now shows battery state-of-charge rather than fuel quantity.

k. **Odometer.** The test vehicle is equipped with an odometer.

l. **Passenger comfort heater.** The test vehicle is equipped with a gasoline-fueled hot-air heater, VW Model 2457, rated at 2000 Btu.

m. **Documentation.** The test vehicle came with user and maintenance manuals. Not provided were mechanical and electrical parts lists.

n. **Emissions.** No emissions tests were performed on the test vehicles.

o. **Safety.** The Department of Transportation (DOT) is performing these evaluations; however, the following limited checks were performed by MERADCOM:

(1) The test vehicle propulsion batteries and circuitry are isolated from the vehicle chassis (ground).

(2) DOT is checking compliance with Safety Standards 208 and 301.

(3) The test vehicle battery caps are apparently not the flame-arrestor type. DOE has clarified the intent of this standard emphasizing the "To inhibit battery explosions" property of battery caps and emphasizing the battery compartment ventilation standard.

(4) The test vehicle is provided with an enclosed battery compartment inside the vehicle. This compartment is forced-air ventilated by a 50-ft³/min rated fan which pulls outside air into the battery compartment and exhausts it outside the vehicle; 50 ft³/min replaces the air in the battery compartment approximately 20 times each minute which should be adequate to keep the hydrogen concentration below 4 percent, the threshold of an explosive mixture.

(5) The test vehicle's clutch and transmission can be disconnected from the electric propulsion system in an emergency.

(6) For parked temperature effect, the test vehicle was hot-soaked for an 8-h period at 50°C and subsequently cold-soaked for an 8-h period at 25°C. After the hot-soak, the vehicle operated properly. However, after the cold-soak, a problem with the ignition switch did not allow the vehicle to be started. The manufacturer determined the problem to be a defective switch. The switch was replaced and the problem did not reoccur following the cold-soak test. Moisture caused a controller board failure which was corrected by coating the board with a water-resistant compound.

IV. VERIFICATION DEFICIENCY

A parts list was not available at the time of the test.

V. PRODUCT-IMPROVED TEST RESULTS

The MERADCOM/DOE acceptance tests for the product-improved "2X4" (two vehicles each by four manufacturers) are based on the minimum contracted performance requirements (see Appendix B).

Acceptance Test Results:

- a. Range SAE-J227a "B" cycle on level $\pm$ 1-percent terrain: 60 km (37.4 mi), 176 cycles.
- b. Range at vehicle speed of 70 km/h (44 mi/h): maintained speed for 78 min on MERADCOM test track, with a 5-percent grade.
- c. Gradeability: The vehicle can move up a 38.7-percent grade for 20 s based on calculations from the results of a drawbar pull test.
- d. Speed on a 10-percent Grade: The vehicle achieved 39 km/h (24 mi/h) on a 10-percent grade based on calculations from maximum acceleration test data.
- e. Acceleration Time for 0-48 km/h (0-30 mi/h): The vehicle accelerated to 48 km/h (30 mi/h) in 11.0 s.
- f. Rechargeability from 80-percent DOD in 8 h with 220 VAC 30-A Charger: The vehicle is not equipped with a 220 VAC charger, and its batteries could not be fully recharged in 8 h with the temporary 120 VAC on-board charger.
- g. Braking, straight-line, wet and dry (FMVSS), and brake operability without electric power: The vehicle's brakes can be operated without electric power.

Stopping distance requirement: The force applied to brake control shall not be less than 66.9 N (15 lb) nor more than 669 N (150 lb) (FMVSS).

Vehicle Speed	Maximum Distance for Passenger Cars
64.36 km/h	29.28 m
80.45 km/h	45.75 m

The vehicle displayed the following braking characteristics (brakes dry):

Velocity	Distance	Brake pedal pressure
64.4 km/h (40 mi/h)	28.6 m (94 ft)	459.4 N (103 lb)
80.4 km/h (50 mi/h)	41.0 m (134 ft)	645.3 N (145 lb)

h. Hand brake holding on 30-percent grade, forward and reverse: The vehicle was placed on a 30-percent grade, forward and reverse. The hand brake held the vehicle.

The following inspections were made on the test vehicle only to ascertain the manufacturer's effort to comply with the operating and nonoperating safety design requirements. These are observations only and should not be construed as tests.

a. Nonoperating Safety Design Requirements:

- (1) Batteries in the test vehicle can be accessed for service.
- (2) The Electric Rabbit has a safety interlock so that the vehicle cannot be operated while charging, but it does not have charging warning lights on the dashboard.

b. Operating Safety Design Requirements:

- (1) The mechanical clutch between the motor and the transmission in the test vehicle can act as an emergency power-disconnect.
- (2) The test vehicle is provided with energy-absorbing bumpers.
- (3) The test vehicle is provided with a dual-braking system.

c. **Heater/Defroster:** The test vehicle is provided with a gasoline-fueled hot-air heater/defroster ESPAR EBERSPACHAR Model 2547 with an output of at least 2000 Btu/h.

d. **Battery Compartment Design Requirements:**

(1) The test vehicle battery compartment has a ventilating system rated to provide 50 ft³/min of air during charge.

(2) Batteries in the test vehicle have battery retainers.

(3) Batteries in the test vehicle are provided with a cover.

(4) The Electric Rabbit does not have battery wash-down drains.

e. **Traction Motor Protection:**

(1) The test vehicle has a drive-motor cooling fan.

(2) The test vehicle provides access for drive-motor brush maintenance

(3) The test vehicle has a drive-motor overheat warning light.

f. **Controller and Power Conditioner Protection:**

(1) The test vehicle is provided with an overcurrent-warning ammeter, an overcurrent fuse, and a high-current cutout circuit.

(2) The test vehicle traction batteries are in a fiberglass enclosure insulated from ground (floating) for safety and fault protection.

g. **Driveline Performance:**

(1) The test vehicle was tested with its tires inflated to the manufacturer's recommended pressures (32 lb/in², front, and 36 lb/in², rear). Performance and handling at these settings were satisfactory.

(2) The test vehicle exhibits good steering control with full-speed braking.

(3) No drive-line problems were encountered with the test vehicle.

h. **Driver Comments:** The R-1 Electric by SCT drives and shifts well, and the vehicle has a tight turning radius. Also, the Electric Rabbit has good accessibility for the batteries and control electronics. However, the electric motor in the vehicle idles at such high revolutions per minute that one must slip the clutch to move in slow traffic at less than about 8 mi/h. This characteristic will probably produce accelerated

clutch wear and require replacement more often than is required in a conventional VW Rabbit.

Product-Improved Test Results Below Requirements:

The temporary 120-Va.c. charger delivered with the test vehicle does not have a 220-Va.c., 30-A capability and is not capable of fully recharging the battery assembly from 80-percent DOD within 8 h.

ABBREVIATIONS USED

A	Ampere
Ah	Ampere-hour
DOD	Department of Discharge
DOE	Department of Energy
DOT	Department of Transportation
ESB	Electric Storage Battery; ESB, Inc. (Exide)
FMVSS	Federal Motor Vehicle Safety Standards
hp	Horsepower
kg	Kilogram
km	Kilometer
km/h	Kilometers per hour
kW	Kilowatt
m	Meter
MERADCOM	US Army Mobility Equipment Research and Development Command
mi/h	Miles per hour
N	Newton (equivalent pound force)
R-1	Research, No. 1
SAE	Society of Automotive Engineers
SCT	South Coast Technology, Inc.
VW	Volkswagen

APPENDIX A

PERFORMANCE STANDARDS FOR DEMONSTRATIONS

Subpart B Minimum Levels of Performance

475.10 Minimum levels of performance for personal use vehicles.

The following minimum levels of performance are required with respect to any personal-use vehicles purchased or leased pursuant to section 7 (c) of the Act.

a. **ACCELERATION.** The time required to accelerate from rest to 50 km/h shall not exceed 15 s.

b. **GRADEABILITY AT SPEED.** The grade which can be traversed up at 25 km/h shall be at least 10 percent.

c. **GRADEABILITY LIMIT.** The grade on which the vehicle can start and climb for 20 s either backward or forward shall be no less than 20 percent.

d. **FORWARD SPEED CAPABILITY.** The speed which can be maintained for 5 min shall be 80 km/h.

e. **RANGE.** The distance which the vehicle can be operated with vital accessories on or equivalent shall be:

(1) For an electric vehicle at least 50 km on the SAE J227a/C cycle.

(2) For a hybrid vehicle; at least 200 km on the SAE J227a/C cycle.

f. **BATTERY RECHARGE TIME.** The vehicle shall be capable of satisfying the range requirement of 475.10 (e) above, after being recharged for no more than 10 h by use of an on-board charger. At the start of this recharge the vehicle shall have 80-percent discharged batteries as specified by the vehicle test conditions and procedures of 475.3. The onboard charger shall be compatible with an electric power outlet of 110 V or 220 V a.c., as specified by the vehicle manufacturer.

g. **RECHARGE CONTROL.** The vehicle shall have a recharge control which is adequate to meet the requirements of energy, life, and safety as such requirements are stated by these performance standards.

h. **ENERGY CONSUMPTION.**

(1) For an electric vehicle, the maximum amount of nonelectrical energy consumed shall be that used for operation of the accessories only.

(2) For a hybrid vehicle, nonelectrical energy consumed shall not exceed 1.3 MJ/km and shall also not exceed 75 percent of total energy consumed for propulsion and vital accessories, based on being fully loaded on a driving schedule of 33 km at 75 km on SAE J227a/C cycle plus 33 km at 75 km/h (higher heating value of gasoline taken as 32.7 MJ/l) and with vital accessories on.

i. BATTERY LIFE.

(1) The vehicle shall be capable of at least 75 percent of the range specified in 475.10 (c) after 12 m or 15,000 km of normal use, whichever occurs first.

(2) The vehicle shall be capable of 100 percent of the acceleration and gradeability specified in 475.10 (a), (b), and (c), for all test conditions and procedures specified by 475.3, for 12 m or 15,000 km of normal use, whichever occurs first.

(3) The batteries shall, if necessary, be repaired or replaced by the vehicle manufacturer at no cost to the user of the vehicle in order to meet requirements of (1) and (2) of 475.10 (i).

j. STATE-OF-CHARGE METER. The vehicle shall have a state-of-charge meter for the propulsion battery system or other means of providing an indication of remaining range.

k. ODOMETER. The vehicle shall have an odometer.

l. PASSENGER COMFORT HEATER. The vehicle shall have a passenger comfort heater available as an option.

m. DOCUMENTATION. Adequate user manuals, maintenance (service) manuals, and parts lists shall be provided.

n. EMISSIONS. The vehicle shall comply with all applicable Federal emissions regulations for motor vehicle.

o. SAFETY, CRASHWORTHINESS, DAMAGEABILITY, CRASH AVOIDANCE AND HAZARDS

(1) The vehicle shall comply with all applicable Federal regulations for motor vehicles concerning safety, crashworthiness, damageability, crash avoidance, and hazards, unless a waiver or modification is obtained from the Department of Transportation.

(2) Until the Department of Transportation issues regulations which cover the same subjects, the vehicle shall also have the following performance characteristics:

(a) The electric propulsion circuit shall be electrically isolated from other conductive portions of the vehicle.

(b) The vehicle shall be capable of undergoing the test procedure of Federal Motor Vehicle Safety Standards 208 and 301 with all battery materials remaining outside the passenger compartment.

(c) Vehicles with battery caps or battery vents shall have flame barrier provisions to inhibit battery explosions.

(d) Ventilation shall be adequate within the battery compartment to maintain the concentration of hydrogen below 4 percent by volume during vehicle operation (including charging and maintenance).

(e) The vehicle shall have a device which provides for the positive disconnection of the battery and which is operable from the normal operator position.

(f) The vehicle shall be capable of being parked for up to 8 h in temperatures of -25°C to 50°C and subsequently operated at any temperature within this temperature range without damage to the vehicle or hazard to persons.

APPENDIX B

MERADCOM ACCEPTANCE TEST OF PRODUCT-IMPROVED ELECTRIC VEHICLES

The following tests were to be performed on each of the four vehicles delivered to MERADCOM, not necessarily in the order given:

1. Minimum Range, SAE-J227a, "B" Cycle - 60 km (37.5 mi).
2. Minimum Cruising Speed - 70 km/h (44 mi/h) for 5 min.
3. Minimum Gradeability - 30-percent for 20 s at about 2 km/h drawbar pull (1.25 mi/h).
4. Minimum Speed on 10% Grade - 24 km/h (15 mi/h).
5. Acceleration 0-48 km/h (0-30 mi/h) - 11 s or less.
6. Rechargeability from 80% DOD* - 8 h maximum with 220 V.a.c., 30 A maximum charger current.
7. Braking Straight Line, Wet and Dry - FMVSS, and check of whether brakes can be operated without electric power.
8. Hand Brake Test- Hold on a 30% grade, forward and reverse.

The following will be inspected for visible design intent to meet contract requirements:

Nonoperating Safety Design Requirements-

1. Ability or inability to access the battery for service.
2. Presence or absence of a disabling interlock and/or a safety warning light for the vehicle while charging (note manufacturer's specifications).

Operating Safety Design Requirements-

1. Presence or absence of an emergency power disconnect if the vehicle does not have a transmission or clutch (note manufacturer's specifications).

* Procedure - cells will be equalized; fully discharged; fully charged; discharged at the manufacturer's recommended rate to 80% DOD; recharged with the vehicle 220 V.a.c. Charger for 8 h; and, finally, fully discharged to determine if capacity is adequate to 80% DOD.

2. Presence or absence of energy absorbing bumpers.
3. Presence or absence of a dual-braking system.

Defroster/Heater-

1. Presence or absence of a defroster/heater system (note manufacturer's specifications).

Battery Compartment Design Requirements-

1. Presence or absence of ventilation system for use during charge and discharge cycle.
2. Presence or absence of battery retainers.
3. Presence or absence of battery cover.
4. Presence or absence of option to provide for battery heating during cold weather.

Traction Motor Protection-

1. Presence or absence of a traction motor cooling system (note manufacturer's specifications).
2. Presence or absence of
 - (a) Access for brush maintenance.
 - (b) Overheat warning system (note manufacturer's specifications).

Controller and Power Conditioner Protection-

1. Presence or absence of overcurrent protection of power system (note manufacturer's specifications).
2. Presence or absence of unsafe overcurrent warning system (note manufacturer's specifications).

Safety aspects of the following cannot be visually ascertained.

1. 48 km/h barrier crash.
2. Steering control with full-speed braking.

APPENDIX C

SCT ELECTRIC RABBIT

SUPPLEMENT TO

VOLKSWAGEN RABBIT OWNER'S MANUAL

INTRODUCTION

The information provided in this supplement applies only to aspects of your Electric Rabbit which are different from a conventional gasoline- or diesel-engine Rabbit. Consequently, please read the Rabbit owner's manual first. In those areas in which you will need additional or different information for the Electric Rabbit, you will find a section number noted at that point in your owner's manual. Refer to the corresponding section in this supplement for the needed information.

1. INSTRUMENT PANEL

The instrument panel layout of the Electric Rabbit is the same as that of the Rabbit Deluxe with the following exceptions (refer to the illustration and table on p. 17 of the Rabbit manual):

Motor temperature warning light.

Main contactor warning light.

Motor temperature gauge.

Tachometer.

High beam/turn signal/indicator lights and auxiliary battery warning light.

State-of-charge indicator.

Motor current meter.

1.1 Tachometer

The tachometer indicates motor speed. The gearshift should be used to keep motor speed between 2000 and 4000 r/min (See Section 8, *Driving Techniques*).

A. State-of-Charge Indicator: When the needle enters the red area at the bottom, there is a reserve of approximately 10% of the maximum battery capacity (i.e., 3 to 5 miles of driving).

B. Motor Temperature Gauge: The motor temperature gauge indicates the internal temperature of the motor casing. If the motor temperature reaches the red zone (above 115°C), the motor current limit will be automatically reduced from approximately 300 A to approximately 150 A. The car may still be driven; however, it will have only about half its normal power. Reduce speed before the red zone is reached to prevent this situation from happening.

If the motor temperature reaches 135°C, it will be shut down entirely to prevent damage. Pull off the road, shut off the ignition, and depress the HAZARD switch. Wait until the motor has cooled down, restart, and check to see that the motor cooling blower is operating.

1.2 Warning Lights

Auxiliary battery warning light lights up when voltage on auxiliary battery drops below 10 V. Return as soon as possible to a location at which the battery pack can be recharged. (See Section 7.2, *Battery Charging*.)

Motor temperature warning light lights up if motor temperature reaches 135°C. Motor should shut down automatically when this occurs. If it does not, pull off the road, and depress the HAZARD switch. Wait until the motor has cooled down, restart, and check to see that the motor cooling blower is operating.

Main contactor warning light EGR indicates that main contactor is off. When starting, the key must be kept in the start position, with the clutch depressed, until the light is out. The main contactor may go off and the light come on if the motor current exceeds 400 A. This may happen as a result of attempting to accelerate or climb a steep grade in too high a gear, or not disengaging the clutch when the car is brought to a stop. (See Section 8, *Driving Techniques*.) If this occurs, the motor will stop. The clutch must then be depressed, the key turned off momentarily, and the motor restarted with the key. Since the steering column can be locked with the key in the off position, do not attempt a restart unless the car is stopped.

1.3 Ammeter

The ammeter indicates the current being drawn, in hundreds of amperes, by the motor. Plus values indicate that the motor is driving the car, and minus values indicate that it is braking the car and charging the batteries through the regenerative braking. A red zone is provided from 200 to 300 A. Drive so that the current is not in this range except for short periods of time. Driving for extended periods with the current in excess of 200 A can result in blowing the motor protection fuse or overheating the motor. It also shortens battery life.

2. STARTING

Before starting, check to see that the gearshift lever is in neutral. To start, depress the clutch pedal fully and turn the ignition switch all the way to right. Keep the switch in that position until the main contactor comes on (EGR light goes out). Note: Both seat belts must be buckled to start the car.

3. OPERATING RANGE

The hints given on p. 31 of the Rabbit manual for obtaining good fuel economy also will help obtain the maximum possible operating range from the Electric Rabbit.

4. CLIMATE CONTROLS

Heater and Controls (C) (Refer to illustration on p. 38 of the Rabbit manual).

A gasoline hot-air heater is installed in place of the normal engine hot-water heater. The heater is turned on by the knob control "C" being turned to position 1. This is the only position in which the heater will operate. 0, 11, 111 positions are off positions. There is also a thermostat setting which is controlled by the lever B, "Temperature Control Level." This operates only if the heater control is in the "on" position (position 1). The heater is also controlled by the ignition switch. It will not operate with ignition off.

Gasoline is used to fuel the heater. The fuel tank is located in the front motor compartment (upper front left corner). The tank capacity is 1 U.S. gallon, which should provide 12 h of heater operation. Regular or No-Lead may be used.

The heater blower keeps on operating after the heater is turned off until the heating element is cooled down to about 40°C (105°F) and blown clear of residual gases (cleaning cycle).

Note: Turn off heater before the ignition switch is turned off to allow heater to go through its cleaning cycle.

5. FUSES AND RELAYS

Fuses are identical to those shown on p. 46 of the Rabbit manual, with the following exceptions:

In the main fuse box, position 10 is not used and position 15 is used for the heater fuse (15 A).

Additional fuses and their locations are as follows:

1. Motor protection fuse (200 A, dual-element time delay) in battery compartment.
2. Converter output fuse (15 A) located in small box on left hand side, under hood, directly above wheel well.
3. Motor cooling blower fuse (20 A) in line fuse holder, right hand side, under hood.
4. Instrumentation fuse (1/2 A) in line fuse holder, right hand side, under hood.

5. Charger control unit fuse (10 A) in line fuse holder, right hand side, under hood.

6. Fuse box in charger control unit (located in rear compartment on right hand side, near forward end of wheel well) contains the following:

Position 1 Converter input fuse (3 A) (CAUTION 108 Vd.c.).

Position 2 Charger control unit input fuse (1/2 A) (CAUTION 120 Va.c.)

Position 3 Blower/charger interlock fuse (1/2 A).

Position 4 Battery compartment blower (5 A).

6. TIRES

Maintaining correct tire pressures and wheel alignment is essential to obtaining optimum performance and operating range from the Electric Rabbit. Recommended cold inflation pressures are 32 lb/in² front, 36 lb/in² rear.

When replacing tires, always select tires with a maximum inflation pressure of at least 36 lb/in² and a load rating of at least 1025 lb at 36 lb/in².

7. BATTERIES

The Electric Rabbit has a total of 19 batteries: 18 6-V batteries which provide the energy to propel the vehicle, and a 12-V battery which provides power for motor control, lights, windshield wipers, and so forth. The propulsion batteries are located in a compartment behind the seats, and the 12-V battery is located under the hood.

7.1 Checking Battery Fluid Level

Electrolyte level of all batteries should be checked at least once a month, and distilled water added as required. To obtain access to the propulsion batteries, the three individual hatches on the battery compartment cover may be removed, or the entire cover may be unlatched and removed. If the entire cover is not removed, a syringe or similar device will have to be used to reach the cells which are not directly under the hatch openings.

The entire battery compartment cover may be removed through the rear hatch of the car by bringing it straight back through the lowest part of the rear hatch. Prior to removal of the cover, the following must be done:

Remove spare tire.

Remove hose clamp and disconnect battery compartment exhaust hose (rear of compartment).

Unsnap carpet section over blower box (right front of compartment).

Disconnect blower flange bolts.

7.2 Battery Charging

The Electric Rabbit is provided with an on-board charger for the propulsion batteries. The 12-V battery is charged by a converter which operates off the propulsion batteries; consequently, the 12-V battery is charged as the propulsion batteries are charged.

The charger operates from a normal 120-V line with a circuit breaker of at least 20-A rating. Before plugging the charger in, set the timer to the "OFF" position (red band). The plug for the charger is located under the fuel filler cap. After plugging the charger in, set the timer (14 h if the batteries are nearly discharged; less otherwise, in approximate proportion to the extent of discharge). You will detect a delay in the charger coming on until the blower has started and is venting the battery compartment. The blower automatically comes on to remove hydrogen gas from the battery compartment. Therefore, it is not necessary to remove the battery compartment hatches or cover while charging the batteries.

For maximum battery life, the following should be adhered to:

Do not allow the batteries to become completely discharged before recharging.

Do not consistently overcharge the batteries. The batteries bubble and generate gas as they approach full charge. Try to time the recharge interval so that the charger shuts off shortly (within an hour or so) after the batteries begin to gas. It is, however, necessary to give the batteries an equalizing charge periodically. This means that, after every five or ten charges, the charging process should be continued well past the gassing point to make sure that all the batteries are brought up to the same level of charge. On these occasions, it is well to check several cells with a hydrometer to make sure they are all near 1.275 specific gravity at the end of charge.

Note: the charger supplied is sensitive to line voltage. If you find that it trips a breaker when charging discharged batteries, add one or more additional length of extension cord between the charger and the wall plug.

THE BATTERY CHARGER IN THIS VEHICLE IS AN INTERIM UNIT THAT WILL BE RETROFITTED IN THE NEAR FUTURE WITH A NEW MORE ENERGY AND WEIGHT EFFICIENT UNIT. UPON AVAILABILITY AND COMPLETION OF TESTING, THE NEW UNIT WILL BE PROVIDED AND INSTALLED BY SCT.

8. DRIVING TECHNIQUES

Accelerating

In accelerating from a stop, it is not necessary to depress the accelerator as the clutch is engaged. Simply engage the clutch smoothly and gradually, and then depress the accelerator to raise the car's speed. *Always* start in first gear; otherwise, there is a risk of drawing too much motor current, which may cause the main contactor to go off, shutting down the motor. (See Section 1.2, 'Main Contactor Warning Light'.)

From approximately 1800 r/min up to about 4500 r/min, the motor produces constant power. Above 4500 r/min, the power decreases. Consequently, attempting to accelerate more quickly by 'revving' the motor up in each gear is fruitless. Shifts may be made at any speed between 3000 and 4500 r/min, although for smoothest shifting, the following may be used as a guide:

1st gear to 2nd gear	3200 r/min (15 mi/h)
2nd gear to 3rd gear	2600 r/min (21 mi/h)
3rd gear to 4th gear	2600 r/min (30 mi/h)

Do not shift at speeds much below these speeds; otherwise, the motor speed will drop to less than 1800 r/min after the shift is completed, and there is a danger of drawing too much current.

To obtain maximum operating range, keep the motor current below 200 A (out of the red zone on the ammeter) if traffic conditions permit.

Steady Driving

While driving at a constant or near constant speed in traffic, keep the motor speed between about 3000 and 4000 r/min. This is an efficient operating range for the motor. In addition, the motor provides good braking capability in this range, so that if traffic slows down, the car can be slowed down without using the service brakes (if the rate of slowing down is not too great). Do not drive steadily at speeds in excess of 55 mi/h. This results in excessive battery drain and the possibility of motor overheating.

Braking

With the accelerator in the up position, the motor of the Electric Rabbit provides much more effective braking than the compression braking of a conventional engine. This occurs as long as the motor speed is above about 1800 r/min, and is particularly effective at speeds in excess of 3000 r/min. By downshifting to keep the engine speed above 3000 r/min while decelerating, and by paying careful attention to the traffic flow and anticipating slow-downs, it is often possible to avoid using the service brakes entirely except for the last few feet to stop.

CAUTION: Do not allow the motor speed to drop below 1800 r/min, with the clutch engaged, in any gear while braking. Under these conditions, the motor will keep driving the car forward, thereby reducing the effectiveness of the service brakes, and also drawing excessive current from the batteries. In first gear, disengage the clutch when the motor speed drops below 1800 r/min (about 8 mi/h).

By making good use of the braking ability of the motor, it is possible to extend the operating range of the car, since the motor returns electrical energy to the batteries in the braking mode. In addition, the life of the service brakes is extended.

Driving on Hills

When driving uphill, keep the current out of the red zone as much as possible, particularly if the grade is very long. Unless the motor speed drops below 1800 r/min, do not downshift. The car will not go any faster in the lower gear. If the speed drops below 1800 r/min, downshift and reduce speed to avoid drawing excessive current and having the main contactor go off.

When descending a hill, use the motor for braking. Shift into a gear which will allow you to maintain the desired speed without using the service brakes. Generally, the motor will provide adequate braking in a gear which provides 3000 to 4000 r/min at the desired road speed.

Parking

Always set the parking brakes firmly when parking the car. The electric motor provides no braking capability when it is at rest. Therefore, leaving the transmission in gear is ineffective in keeping the car stopped on a grade. For protection on steep grades, in addition to that supplied by the parking brake, turn the wheel into the curb or, in the absence of a curb, block the wheels.

Restarting After 'Stall'

As noted previously, excessive current drain will cause the main contactor to go off, shutting down the motor. This condition is similar to stalling a car with a conventional engine. To restart, it is necessary to depress the clutch, turn the key to the 'off' position (left all the way), and then to start position (right all the way) until the main contactor warning light (EGR) goes out. Because of the possibility of locking the steering when the key is switched off, it is safest to come to a complete stop before attempting to restart.

Passing

Passing should be done with extreme care. Although the performance of the Electric Rabbit is excellent by electric vehicle standards, and adequate to stay with the flow of traffic, the maximum performance is much lower than that of most conventional cars. *Familiarize yourself fully with the acceleration ability of the car before attempting any passing maneuvers on two-lane roads.* After such familiarization, undertake such maneuvers only with the greatest caution.

9. TECHNICAL DATA

Motor: Siemens Model 1GV1, separately excited

Rated current 150 A

Max. current 320 A

Maximum power (as installed) 25 kW (33.5 hp)

Speed range 1800-4500 r/min

Controller:

FHV Systems Model SCT-1

Transistorized field chopper

Motor startup with series resistor and contactors

Control circuitry (includes armature current limiting, motor overtemperature protection, motor overcurrent protection)

10. IMPORTANT SAFETY INFORMATION

When the 120 V.a.c. line is plugged into the charger inlet, the vehicle chassis becomes earth ground (green wire, third prong on receptacle). This is a safety feature which insures that the vehicle chassis cannot become *HOT* should a circuit fault occur on the vehicle.

However, the following precautions must be followed while charging:

1. Do not attempt to troubleshoot *any* problem while the vehicle is "on charge."
2. Do not attempt to start the vehicle while "on charge." There is a no-start interlock in the system to prevent starting.
3. Do not remove any metal covers while charging.

In general,

Do not remove controller cover.

Do not remove plastic converter cover.

Do not remove charger control box covers (3 located in rear right hand side of vehicle).

without first

Unplugging the 120 V.a.c. input line and

Removing the main battery pack 200-A fuse.

Also, use extreme caution around components marked with a 110 V label.

APPENDIX D

VEHICLE SUMMARY DATA SHEET

1. Vehicle Manufacturer Name and Address

South Coast Technology, Inc.
15001 Commerce Drive
Dearborn, Michigan 48120

2. Vehicle Description

Name: R-1 ELECTRIC by SCT
3-DOOR HATCHBACK
Availability: May 1979
Price: TO BE DETERMINED

3. Vehicle Weight

Curb Wt: 1415 kg (3120 lb)
Passenger Wt: 90.7 kg (200 lb)
Driver Wt: 90.7 kg (200 lb)
Payload Wt: 45.4 kg (100 lb)
Gross Wt: 1645 kg (3626 lb)

4. Vehicle Size

Wheelbase: 2.4 m (94.5 in.)
Length: 3.94 m (155.3 in.)
Width: 1.61 m (63.4 in.)
Headroom: 0.91 m (36 in.)
Legroom: 1.04 m (41 in.)

5. Auxiliaries & Options

No. Lights: 18
a. HEADLAMPS
b. FRONT & REAR SIDE MARKERS
c. FRONT & REAR TURN SIGNALS
d. TAIL LIGHTS
e. BACKUP LIGHTS
f. STOP LIGHTS

Windshield Wipers: Yes
Windshield Washers: Yes
Defroster: Yes
Heater: Yes

Radio: No.
Fuel Gage: Yes
Ampmeter: Yes
Tachometer: Yes
Speedometer: Yes
Odometer: Yes
No. Mirrors: 2 (1 INSIDE, 1 OUTSIDE)
Power Steering: No.
Power Brakes: No.
Transmission Type: 4-SPEED MANUAL

6. Propulsion Batteries

Type: LEAD-ACID
Manufacturer: ESB, MODEL XPV-23
No. of Modules: 18 6-V
No. Cells: 54 2-V
Battery voltage: 108-V
AH Capacity: 162.5-AH
Battery Size: .264 m (10.4 in.)L x .183 m (7.2 in.)W
x .288 m (11.34 in.)H
Battery Wt: 29.48 kg (65 lb)
Battery Rate: 75 A-130 min

7. Auxiliary Battery

Type: LEAD-ACID
Manufacturer: GLOBE UNION
No. Cells: 6 2-V
Battery Voltage: 12-V
AH Capacity: 93-AH
Battery Size: 0.304 m (12 in.)L x 0.175 m (6.9 in.)W
x 0.52 m (9 in.)H
Battery Rate: 20-h
Battery WT: 21.32 kg (47 lb)

8. Controller

Type: CONTRACTOR/STARTING
RESISTOR (ARMATURE)
Manufacturer: EHV SYSTEMS
Voltage Rating: 108
Current Rating: 400-A ARMATURE
10-A FIELD
Size: 0.38 m (15 in.) x 0.51 m
(20 in.) x 0.15 m (6 in.)
Weight: 14.5 kg (32 lb)

9. Propulsion Motor

Type: d.c. SHUNT
Manufacturer: SIEMENS
Insulation Class: F
Voltage Rating: 130-V
Current Rating: 150-A
Rating: 17-kW (22.8-hp)
Max. 5 Min Rating: 33.6-kW (45-hp)
Size: 0.35 m (13.8 in.) Dia (Max)
x 0.455 m (17.9 in.) L (overall)
Weight: 88.45 kg (195 lb)
Rated Speed: 2200 r/min
Max Speed: 6700 r/min

10. Body

Type: HATCHBACK SEDAN
Manufacturer: VOLKSWAGEN
No. Doors: 3
Type: ALL HINGED
No. Windows: 8
Type: VENT: PIVOTING; FRONT
REGULATOR: REMAINDER: FIXED
No. Seats: 2
Type: INDIVIDUAL
Cargo Volume: 0.466 kg³ (16.5 ft³)
Cargo Dimensions: 1.37 m (54 in.) L x
1.22 m (48 in.) W x 0.279 m (11 in.)
H (Min) x 0.508 m (20 in.) (Max)

11. Chassis

Type Frame: UNITIZED
Manufacturer: VOLKSWAGEN
Type Material: STEEL
Modifications: BATTERY COMPARTMENT
Type Springs: COIL/COIL
Type Shocks: TELESCOPING HYDRAULIC
Axle Type Front: INDEPENDENT McPHERSON
Axle Type Rear: INDEPENDENT TRAILING ARM
Axle Manufacturer: VOLKSWAGEN (REAR MODIFIED BY SCT)
Driveline Ratio: 3.90 (DIFF.), 3.45 (1st), 1.94 (2nd), 1.37 (3rd), 0.97 (4th)
Type Brakes Front: DISC
Type Brakes Rear: DRUM
Regenerative Brakes: YES
Tire Type: STEEL-BELTED RADIAL
Manufacturer: CONTINENTAL

Size: 175/70 SR13
Pressure: 220 kPa (32 lb/in²) FRONT 248 kPa
(36 lb/in²)
Rolling Radius: 0.264m (10.4 in)

12. Battery Charger - INFORMATION TO BE PROVIDED PRIOR TO DELIVERY

Type: TRANSFORMERLESS
Manufacturer: SCT INC.
On or Off Board: ON
Input Voltage: 120 V.a.c.
Peak Current: 20-A MAX
Recharger Timer: 14 h
Size: 3 MODULES
Weight: 20 lb TOTAL
Automatic Turn Off: YES

APPENDIX E

EXPERIMENTAL BATTERY CHARGING MEMORANDUM

XPV-23 Batteries

Charging Procedure Using Lester Charger*

Type 324-30-TP-12

If the state-of-charge after vehicle test is unknown, it can be estimated from specific gravity measurement. The following values are a rough guide for estimating charge time at 30 A and 5 A, when exact data on integrated ampere-hour output are not available.

Sp. Gr. at 77°F/25°C	Charge Time at 30 Ah	Charge Time at 5 Ah
1.120 or less	4	14
1.170	3	10
1.200	2	9
1.200	0	12

Battery temperature should be 95°F/35°C or lower at start of charge and shall not exceed 120°F/49°C during charge. If temperature exceeds 120°F/49°C cool to 95°F/35°C, then resume charge. Monitor total voltage during the 30-A charge period. Terminate high rate charge if the uncorrected voltage exceeds the maximum allowable for the temperature measured in the warmest battery. The battery will normally accept more than 80% of previously discharged ampere-hours before reaching this limit.

Level cells only at end of 30-A charge period. Occasionally record individual battery voltages and temperature at end of 5-A charge.

At intervals of 20 cycles or if full charge specific gravities differ by more than 0.030 in a battery equalize by charging 16-18 h at 5 A after end of 30-A charge period.

* Provided by ESB Technology Company

APPENDIX F

ELECTRIC AND HYBRID VEHICLE VERIFICATION PROCEDURES

BACKGROUND

DOE is required by Public Law 94-413 to issue performance standards for vehicles used in the Electric and Hybrid Vehicle (EHV) Market Demonstration. On 30 May 1978 DOE published a final rule in the Federal Register (Vol. 43, No. 104) promulgating the first Performance Standards. This rule was effective on 3 July 1978 and prescribed minimum performance standards for electric and hybrid vehicles to be purchased or leased for the first phase of a demonstration program under the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976. Performance Standards are updated from time to time and the current rule was published in the Federal Register on 12 February 1980 (Vol. 45, No. 30).

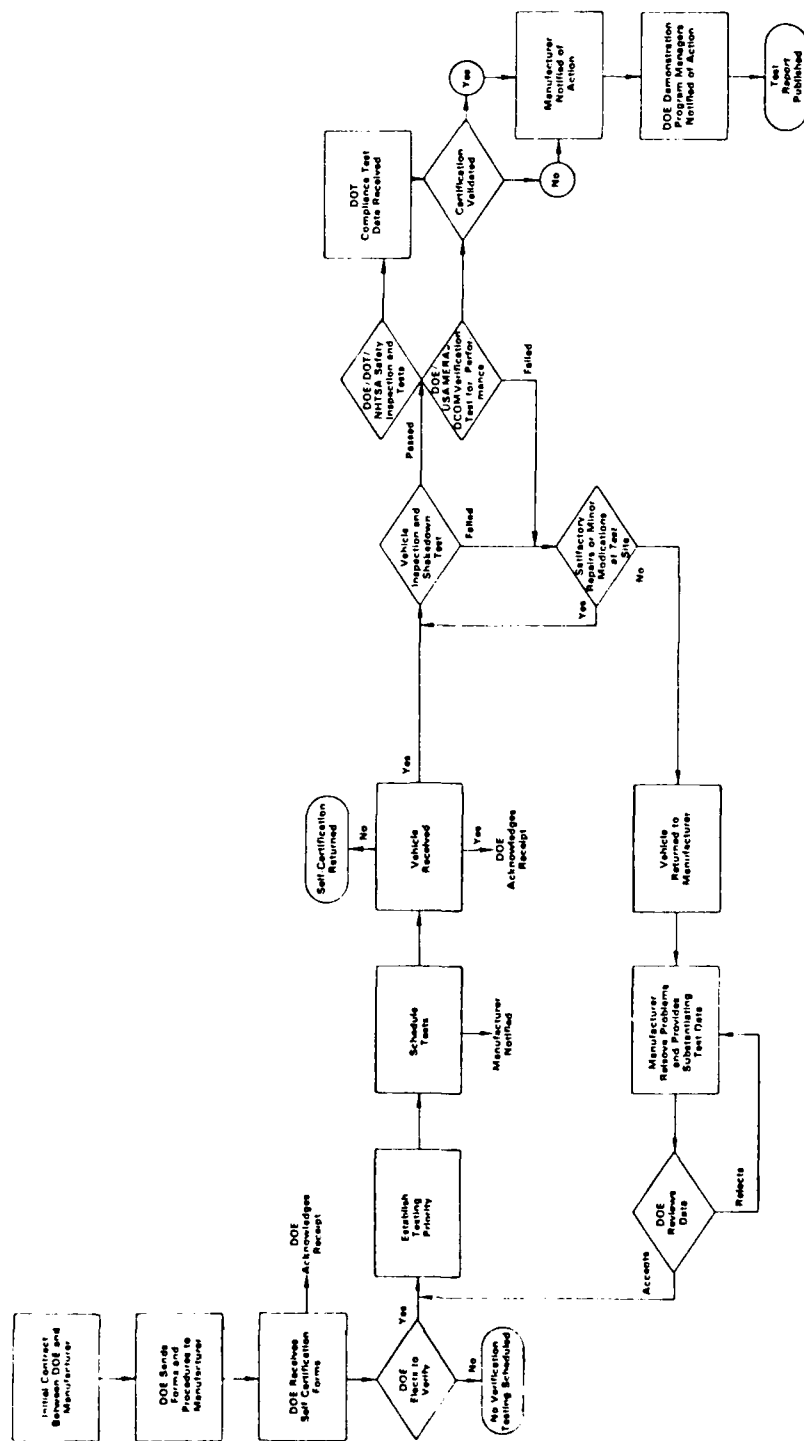
Manufacturers who certify that their vehicles meet the latest requirements of the DOE Performance Standards may offer those vehicles for the DOE Market Demonstration Program. DOE reserves the right to verify, by independent test, the manufacturer's self-certification. The test procedures for DOE performance tests are based on SAE Test Procedure J227a. Safety inspection and testing services are provided by the Department of Transportation/National Highway and Traffic Safety Administration (DOT/NHTSA) through an interagency agreement. Performance testing is performed by the US Army Mobility Equipment Research and Development Command (MERADCOM) through an interagency agreement. During verification testing, vehicle component or subsystem failures will be immediately brought to the attention of the manufacturer. Repeated or multiple component or subsystem failures experienced during test are grounds for invalidating the self-certification of the vehicle for purpose of the DOE Market Demonstration Program.

CERTIFICATION PROCESS

A manufacturer may certify an existing vehicle as meeting the DOE standards (which include applicable NHTSA safety standards by reference) at any time by submitting a letter of certification and providing the required data on the vehicle to the Department of Energy Director of Electric and Hybrid Vehicles Division or his designee. See chart on following page for certification and verification procedures.

VERIFICATION PROCESS

- DOE-Sponsored Performance Tests by the US Army MERADCOM.
- DOE-Sponsored Safety Inspection by DOT/NHTSA.



Electric and Hybrid Vehicle Self-Certification and Verification Procedures

- DOE-Sponsored Safety Compliance Testing by the Research Division of DOT/NHTSA.

- DOE/NHTSA Safety Compliance Test (independent of DOE).

One important principle followed by DOE during testing is to allow the Test Facility Manager to work with manufacturers to overcome the normal problems that occur during inspection and testing. To ensure impartial treatment of manufacturers during the test sequence, limits have been set for the Test Facility Manager concerning how many vehicle component or subsystem failures can be allowed before certification is invalidated. DOE will objectively evaluate the impact of all failures during the testing phase so that vehicles are not unfairly penalized for minor and easily correctable failures. The Test Facility Manager, however, has an obligation to conduct the testing thoroughly and to adhere to a tight schedule.

Manufacturers may be notified from time to time by the Test Facility Manager of potential and actual problems. When these problems do not involve component or subsystem failures, where failure is defined as a vehicle being below the required standard, such notification would not necessarily invalidate the certification.

TEST FACILITY SCHEDULING GUIDELINES

Vehicles will be scheduled for testing by the Test Facility Manager on a first-come, first-served basis, with certain exceptions as noted below. Scheduling is dependent upon the ability of the manufacturer to provide a vehicle for testing. The Test Facility Manager will request the manufacturer to provide a certified vehicle for testing within the 60-day period, the self-certification will be returned and the vehicle will be removed from the self-certification list.

The primary function of verification testing is to ensure that vehicles available to the Market Demonstration Program fully satisfy the applicable DOE Performance Standards. For this reason, it is necessary to establish a set of priority testing categories for vehicles selected or being considered for selection by demonstration site operators. The categories are listed below in decreasing order of priority for testing:

1. Certified vehicles which have not been verified but have been purchased by and delivered to site operator.
2. Certified vehicles purchased by but not delivered to site operator for demonstration.
3. Certified vehicles that have been modified subsequent to verification testing and have been delivered to site operator.

On request by DOE, the manufacturer will furnish DOE with technical information about each modification in sufficient detail to determine if verification tests are

needed.*

4. Certified vehicles that are being considered for purchase by a site operator.
5. Certified vehicles that are available for test but are not under consideration by a site operator.

Vehicle test schedules are sensitive to the requirements of the Market Demonstration Program, and rescheduling by the Test Facility Manager may be required to meet changing needs. Vehicles delivered late or taken out of test because of operational failure may be rescheduled on a lower priority basis by the Test Facility Manager with approval of the DOE Test Manager. On-site rectification of a vehicle problem by the manufacturer within a 5-working-day period described below avoid the necessity for rescheduling.

VEHICLES MODIFICATION/REPAIR GUIDELINES

The guidelines provided in this section are for use by the Test Facility Manager. Exceptions to these guidelines require the approval of the Director of the DOE Electric and Hybrid Vehicles Division or his designee. The intent of these guidelines is to facilitate the establishment of a clear basis for validating a manufacturer self-certification. Subsystem failures may raise questions as to the relevance of the results of the validation testing. It is also important that the test facilities not be used for development and test engineering. Vehicles that experience repeated failures of the same component or subsystems must be upgraded before verification testing can be rescheduled. Rescheduling will be contingent on the submission and acceptance of evidence, obtained by the manufacturer through testing, that the cause of failure has been corrected. The Test Facility Manager will determine when significant repairs should be and have been made.

VEHICLE MODIFICATIONS/REPAIRS ON OR NEAR THE TEST FACILITY

A. Only those modifications or repairs that can be completed within 5 working days by the manufacturer or his designee will be allowed. If repairs cannot be completed within this period, the vehicle must be removed from the test facility unless DOE programmatic requirements dictate that it is in the best interests of the Government that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

B. All failures requiring repair, whether significant or insignificant, will be recorded by the Test Facility Manager or his designee. For all repairs, the manufacturer must submit (to the Test Facility Manager) written explanation of the failure modes and the corrective action taken within 15 days after completion of corrective action.

* The manufacturer is responsible for notifying the DOE Director of the Electric and Hybrid Vehicle Division or his designee of all modifications to the production configuration.

Failed components or subsystems must be replaced by an identical part except in those cases where the component or subsystem design is inadequate. In the latter case, the manufacturer may substitute a readily available component or system when the manufacturer can provide assurance of improved reliability and performance.

C. Three on-site repairs to correct a significant powertrain failure are allowed. A fourth failure will invalidate the vehicle certification, and the Facility Manager will order the vehicle to be returned to the manufacturer unless DOE programmatic requirements dictate that a waiver be granted by the Director of the Electric and Hybrid Vehicles Division or his designee.

D. Subject to overriding priority considerations, testing will be resumed as soon as repairs are completed.

VEHICLES RETURNED TO THE MANUFACTURER BECAUSE OF FAILURE IN TEST

A. A letter invalidating the certification will be issued to the manufacturer, and DOE will notify site operators of the invalidation. A report including the vehicle failures will be provided by DOE to members of the public requesting such a report. Vehicles that are part of the Market Demonstration Program (based on the manufacturer's self-certification) which fail the verification tests will have their certifications invalidated until successful correction of the defects is completed. Future funding to site operators for the invalidated vehicle model will be suspended until corrections are completed.

B. A one-time voluntary withdrawal of a vehicle from test by a manufacturer to correct a problem is allowed for a period not to exceed 60 days. The vehicle will be rescheduled for testing based on priorities at the time of resubmittal. No action will be taken to invalidate the certification during the voluntary withdrawal period unless there is a clear case of user safety involved or the manufacturer fails to offer the vehicle for test after 60 days.

C. Before a vehicle can be resubmitted for testing, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division, or his designee, appropriate evidence that modifications and/or repairs have been made. The manufacturer must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards.

D. Repaired vehicles returned by the manufacturer may be required to undergo the complete series of verification tests regardless of the portion of testing completed prior to invalidation of certification. The Test Facility Manager with the approval of DOE will determine the necessity for such retesting.

GROUNDS FOR INVALIDATING CERTIFICATION

1. A vehicle will be returned to the manufacturer after four significant powertrain failures or a single powertrain failure that cannot be corrected, and its certification will be invalidated.
2. A vehicle that fails to meet applicable DOE Performance Standards will have its certification invalidated. (The standards include documentation and warranty provisions.)
3. A vehicle that fails to comply with applicable DOT/NHTSA Safety Regulations will have its certification invalidated.
4. If a manufacturer fails to commit to and follow a reasonable schedule (defined in the following section) to provide a vehicle for testing when requested by DOE, the vehicle will have its certification invalidated.

SUMMARY OF RESPONSIBILITY OF MANUFACTURERS

Manufacturers must self-certify their production vehicles to participate in the DOE Market Demonstration Program. They must also commit to a reasonable schedule to provide a vehicle for verification testing upon request from the DOE designated Test Facility Manager. If this delivery cannot be made within 60 days after receipt of such a request, the self-certification letter will be returned and the vehicle will be removed from the self-certified list.

Manufacturers must provide *required and necessary information to document the vehicle configuration:*

- Vehicle Summary Data Sheets.
- Operator's Manual, and
- Service and Maintenance Manual including a parts list.

This information may be in draft form, but it must be complete enough to be useful should any mechanical or electrical difficulty develop in the vehicle.

The manufacturer will notify the Director of the Electric and Hybrid Vehicles Division or his designee of all modifications to previously verified production configuration within 30 days of the sale of such modified vehicles to DOE site operators. If it is requested, the manufacturer shall furnish the DOE Test Manager with technical information about each modification in sufficient detail to determine if reverification tests are needed.

For vehicles receiving an invalidation of certification, the manufacturer must provide to the Director of the Electric and Hybrid Vehicles Division appropriate evi-

dence that modifications and/or repairs have been made and must also provide substantiating test data to show that the vehicle can meet all DOE Performance Standards prior to resubmittal of the vehicle for test. Following successful verification testing, vehicles already in DOE site-operator fleets must be modified and/or repaired in the same manner as the vehicle successfully tested. A modification and/or repair schedule acceptable to the Director of the Electric and Hybrid Vehicles Division must be developed and followed by the manufacturer as a condition for validation of the manufacturer's certification.

DOE NOTIFICATION DOCUMENTATION

DOE will notify manufacturers of actions taken during the verification testing process, including but not limited to:

- Receipt of self-certification.
- Notification of vehicle failure.
- Validation or invalidation of certification.
- Final Test Report.

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