PHEVAmerica

U.S. Department of Energy Advanced Vehicle Testing Activity

Base Vehicle Description

Make: Ford
Model: Escape PHEV Year: 2010
VIN: 1FMCU49369KB61181
Number of Passengers: 5
Hybrid Configuration: Power-split

2010 Ford Escape Advanced Research Vehicle

VEHICLE SPECIFICATIONS

Weights
Delivered Curb Weight: 3941 lbs
Vehicle Test Weight: 4280 lbs
Distribution[8] F/R: 55.4%/44.6%
GVWR: 4720 lbs
GAWR F/R: 2440/2400 lbs
Payload[9]: 779 lbs
Performance Goal: 400 lbs

Engine
Model: 2.5 L Atkinson I-4
Output: 155 hp @ 6000rpm
Configuration: Inline 4
Displacement: 2.5 L
Fuel Tank Capacity: 15 gal
Fuel Types: Gasoline and E-85 (All vehicle testing was done using E-85)

Electric Drive System
Battery Manufacturer: Johnson Controls-Saft
Battery Type: Lithium-Ion
Number of Cells: 84
Nominal Cell Voltage: ~3.6V
Nominal System Voltage: 302V
Nominal Pack Energy: 12 kWh
Electric Motor: 94hp @ 5000rpm

Charge System:
Input Voltages: 120V
Required Breaker Current: 15 Amp
Max Charger Power Output: 1.5 kW
Charger Plug Type: NEMA #5-15
80% Charge Time: 4-5 Hrs
100% Charge Time: 6-8 Hrs

VEHICLE TEST RESULTS

Charge Depleting:
Acceleration 0-60 MPH
Time: 10.5 seconds
Acceleration 1/4 Mile
Time: 18.6 seconds
Maximum Speed: 83.2 MPH
Acceleration 1 Mile
Maximum Speed: 100.6 MPH

Charge Sustaining:
Acceleration 0-60 MPH
Time: 10.6 seconds
Acceleration 1/4 Mile
Time: 18.6 seconds
Maximum Speed: 82.8 MPH
Acceleration 1 Mile
Maximum Speed: 101.9 MPH

Brake Test @ 60 MPH
Distance Required: 145.1 ft

Fuel Economy with A/C Off[1]
Cold Start Charge Depleting[2]:
Fuel Economy: 119.7 MPG
AC kWh Consumed[7]: 0.282 kWh/mi
Charge Depleting[3]:
Average Fuel Economy: 119.2 MPG
AC kWh Consumed[7]: 0.253 kWh/mi
Charge Sustaining[4]:
Fuel Economy: 33.8 MPG

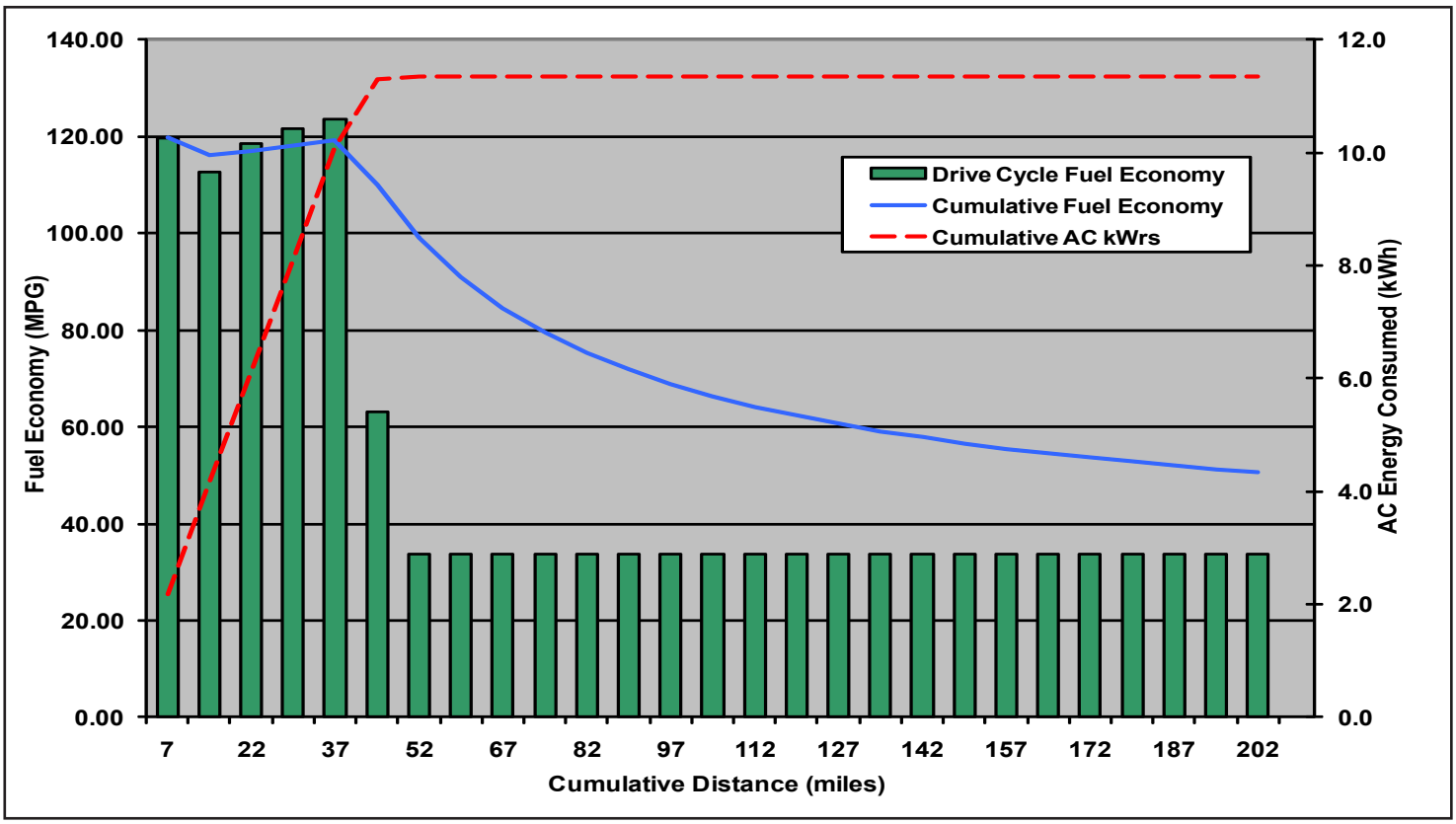
Fuel Economy with A/C On[1,5]
Cold Start Charge Depleting[2]:
Fuel Economy: 20.5 MPG
AC kWh Consumed[7]: 0.122 kWh/mi
Charge Depleting[3]:
Average Fuel Economy: 21.1 MPG
AC kWh Consumed[7]: 0.076 kWh/mi
Charge Sustaining[4]:
Fuel Economy: 17.7 MPG

UDDS Fuel Economy[6]			HWFET Fuel Economy[6,10]		
Distance (miles)	Fuel Economy (mpg)	AC Energy Consumed (kWh)[7]	Distance (miles)	Fuel Economy (mpg)	AC Energy Consumed (kWh)[7]
10	118.5	2.85	10	53.0	1.80
20	116.8	5.49	20	56.6	3.37
40	116.0	10.50	40	58.0	6.38
60	90.7	11.34	60	55.3	9.48
80	76.6	11.34	80	51.4	11.11
100	68.0	11.34	100	47.2	11.13
200	50.9	11.34	200	38.7	11.13

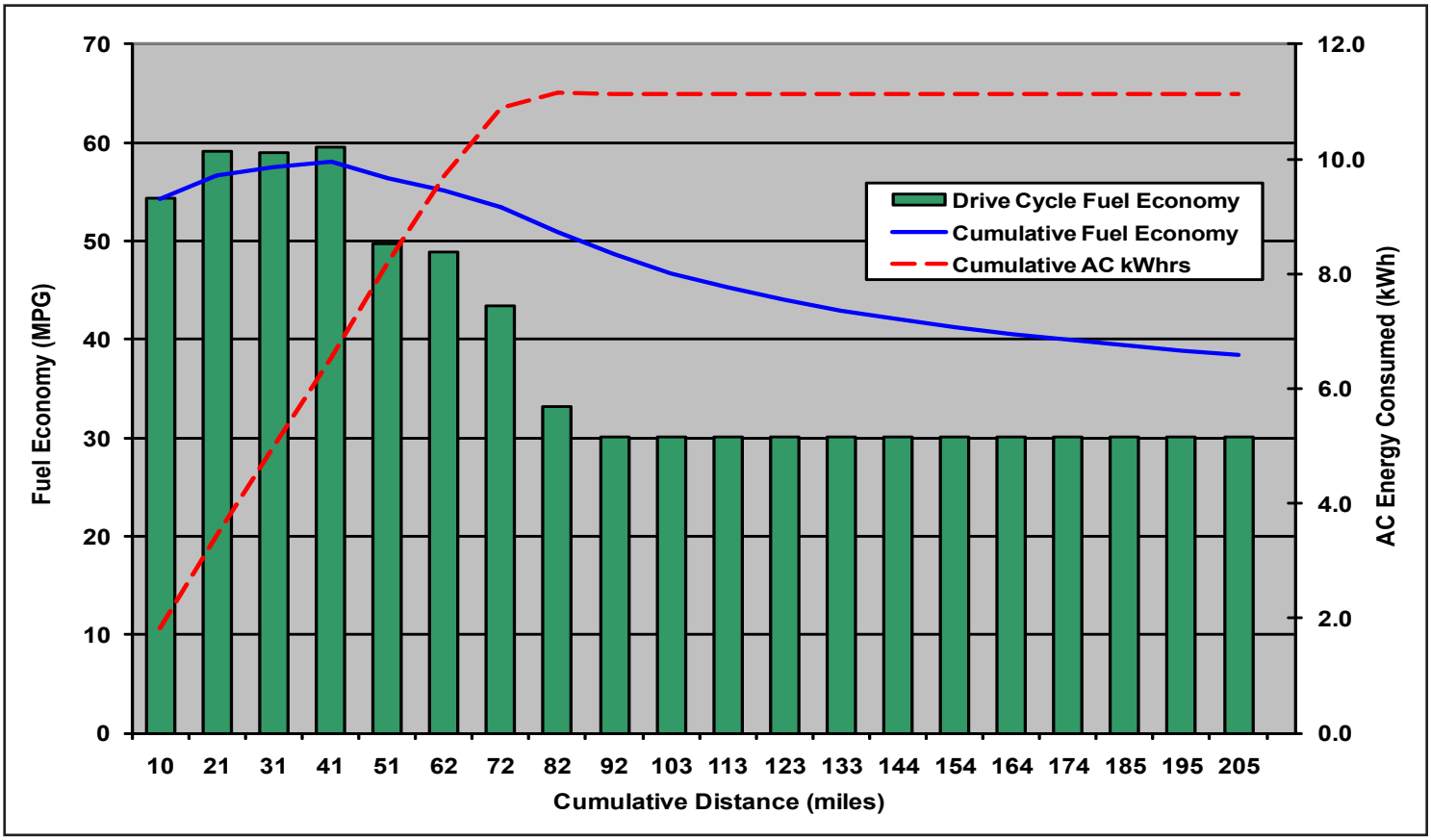
TEST
1. Cumulative fuel economy over EPA standard urban drive (UDDS) cycle.
2. Vehicle soaked at ambient temperature while off for a minimum of 12 hours prior to testing.
3. Average non-cold start, charge-depleting fuel economy.
4. Value determined from average charge-sustaining fuel economy tests with appropriate energy correction calculations.
5. A/C on coldest setting with full blower power. Engine-driven A/C compressor.
6. Calculated cumulative fuel economy values without A/C, includes cold start.
7. Cumulative AC energy based on measured charge efficiency: 74%.
8. As measured from delivered curb weight.
9. Not including driver.
10. Cumulative fuel economy over EPA standard highway (HWFET) drive cycle.

This vehicle meets all HEV America Minimum Requirements listed on back of this sheet
Values in red indicate the Performance Goal was not met. All Power and Energy Values are DC unless otherwise specified.

Urban Driving Cumulative Fuel Economy at Range



Highway Driving Cumulative Fuel Economy at Range



This vehicle meets the following PHEVAmerica minimum requirements:

(1) Vehicles shall comply with Federal Motor Vehicle Safety Standards applicable on the date of manufacture and such compliance shall be certified by the manufacturer in accordance with 49 CFR 567. Suppliers shall provide a completed copy of Appendix A and Appendix B with their proposal, providing vehicle specifications and the method of compliance with each required section of 49 CFR 571. If certification includes exemption, the exemption number issued by the National Highway Transportation Safety Administration (NHTSA), the date of it's publication in the Federal Register and the page number(s) of the Federal Register acknowledging issuance of the exemption shall be provided along with Appendix B. Exemptions for any reason other than non-applicability shall not be allowed.

(2) Vehicles shall be certified under current California Air Resources Board (CARB) or Environmental Protection Agency (EPA) regulations.

(3) Suppliers shall supply Material Safety Data Sheets (MSDS) for all unique hazardous materials the vehicle is equipped with, including RESS batteries or capacitors, and auxiliary batteries.

(4) Suppliers shall provide recycling plans for batteries and other vehicle hazardous materials including how the plan has been implemented.

(5) All vehicles shall comply with the FCC requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, "Unintentional Radiators."

(6) Vehicles shall have a minimum payload of at least 400 pounds.

(7) For conversions, OEM GVWR shall not be increased. For conversion vehicles, Suppliers shall specify the OEMs gross vehicle weight rating (GVWR).

(8) For conversions, OEM Gross Vehicle Axle Weight Ratings (GAWR) shall not be increased. Suppliers shall provide axle weights for the vehicle as delivered, and at full rated payload.

(9) Tires shall be subject to the following requirements:

- Tires provided with the vehicle shall be the standard tire offered by the HEV Supplier for the vehicle being proposed.
- Tires shall correspond to the requirements of the placard installed in accordance with 49 CFR 571.109, 110, 119 and 120, as applicable.
- Suppliers shall specify manufacturer, model and size of the standard tire.
- Tires sizes and inflation pressures shall be in accordance with the requirements of the placard.
- At no time shall the tire's inflation pressure exceed the maximum pressure imprinted upon that tire's sidewall.
- The tire shall be operable across the entire operation/load range of that vehicle.
- Replacement tires shall be commercially available to the end user in sufficient quantities to support the purchaser's needs.
- Tires provided as original equipment by the HEV manufacturer shall not have warranty restrictions in excess of those of the tire's manufacturer, unless the Supplier is the sole warrantor for the tires.
- If the vehicle may be equipped with more than one standard tire, this information shall be provided for each type/manufacturer of each standard tire.

(10) Seating capacity shall be a minimum of 1 driver and 1 passenger. Suppliers shall specify seating capacity (available seat belt positions) for their vehicle. For conversion vehicles, if the vehicle's seating capacity is changed from that specified by the OEM on their FMVSS placard, the seat(s) being added or abandoned shall be modified as required by 49 CFR 571.207, et al, and a new FMVSS placard installed as required by 49 CFR 567, 568 or 571, as applicable.

(11) For conversion vehicles, the OEM passenger space shall not be intruded upon by the Rechargeable Energy Storage System (RESS) or other conversion materials.

(12) The vehicle shall have a parking mechanism.

(13) The controller/inverter shall limit the minimum RESS battery discharge voltage to prevent degradation of battery life, and should limit the maximum regeneration voltage to prevent external gassing of the batteries.

(14) Vehicles shall comply with the requirements of 49 CFR 571.105.S5.2.1, or alternatively, 49 CFR 571.105.S5.2.2 for parking mechanisms.

(15) Vehicles shall be capable of completing rough road test (ETA-HTP-005) including (1) driving through standing water without damage and without battery to chassis leakage current exceeding 0.5 MIU per UL Standard 2202, and (2) standing for extended periods in extreme temperatures without damage to or failure of the vehicle or its systems.

Vehicle shall be capable of completing all AVTA tests without repairs exceeding a cumulative total of 72 hours.

(16) Vehicles shall be capable of completing two (2) Urban Dynamometer Driving Schedules (UDDS) followed by two (2) Highway Fuel Economy Driving Schedules in all charge depleting modes to obtain the fuel/energy efficiency. Testing will be conducted with the vehicle loaded to its design curb-weight plus 300 pounds.

(17) Suppliers should provide a detailed description of the RESS battery pack, battery pack voltage, number of battery modules and summary of previous performance tests. If different, customer available and battery available DOD ratings shall both be provided.

(18) Batteries shall comply with the requirements of SAE J1718.

Vehicles shall not auto-start the engine to charge the batteries while the vehicle is parked and the key switch is in the OFF position.

RESS batteries shall meet the requirements of NEC 625-29(c) or (d) for charging in enclosed spaces without a vent fan. The vehicle shall be labeled as not requiring ventilation for charging (or have the appropriate classification label from a UL-recognized Testing Laboratory).

(19) For vehicles with RESS system voltages of 48 volts and higher, batteries or capacitors and their enclosures shall be designed and constructed in a manner that complies with 49 CFR571.305. For vehicles with RESS system voltages below 48VDC, batteries or capacitors, and their enclosures, shall be designed and constructed in accordance with the requirements of SAE J1766. Further, irrespective of RESS system voltage, batteries or capacitors, and electrolyte will not intrude into the passenger compartment during or following FMVSS frontal barrier, rear barrier and side impact collisions, and rollover requirements of 49 CFR 571.301. Suppliers shall provide verification of conformance to this requirement.

(20) Concentrations of explosive gases in the battery box shall not be allowed to exceed 25% of the LEL (Lower Explosive Limit). Suppliers shall describe how battery boxes will be vented, to allow any battery gases to escape safely to atmosphere during and following normal or abnormal charging and operation of the vehicle. Battery gases shall not be allowed to enter the occupant compartment.

Batteries shall comply with the requirements of SAE J1718. and at a minimum shall meet the requirements of NEC 625-29(c) or (d) for charging in enclosed spaces without a vent fan.

(21) If a Supplier provides a vehicle with parallel battery packs, the Supplier shall provide detailed information on the equipment and charging algorithms required to prevent the parallel strings from becoming unbalanced.

(22) Flywheels and their enclosures shall be designed and constructed such that there is complete containment of the flywheel energy storage system during all modes of operation. Additionally, flywheels and their enclosures shall be designed and constructed such that there is complete containment of the flywheel energy storage system during or following frontal barrier, rear barrier and side impact collisions, and roll-over requirements of 49 CFR 571.301. Suppliers shall provide verification of conformance to this requirement.

(23) Vehicle suppliers shall provide the battery warranty provided including the procedures for making a warranty claim to the end user,

(24) If a Battery Management System is provided, the Supplier shall provide a description of the BMS operation.

(25) For vehicles using fuels other than gasoline, manufacturers shall indicate compliance with appropriate and applicable standards from SAE, NFPA, etc. [e.g., for vehicles using Compressed Natural Gas as fuel, manufacturers should indicate compliance with NFPA 52, "Compressed Natural Gas (CNG) Vehicular Fuel Systems Code," as well as 49 CFR 571.303 and 304.].

(26) Rechargeable Energy Storage Systems (RESS) shall be battery, capacitor, or electromechanical flywheel technology-based as defined in SAE J1711.

(27) Vehicles shall not contain exposed conductors, terminals, contact blocks devices of any type that create the potential for personnel to be exposed to 60 volts or greater (the distinction between low-voltage and high voltage, as specified in SAE J1127, J1128, et al.). Access to any high voltage components shall require the removal of at least one bolt, screw, or latch. Devices considered to be high voltage components shall be clearly marked as HIGH VOLTAGE. These markings should be installed at any point the voltage can be accessed by the end user. Additionally cable and wire marking shall consist of orange wire and/or orange sleeving as identified in SAE-J1127.

(28) For propulsion power systems with voltages greater than or equal to 48VDC, the system shall be isolated from the vehicle chassis such that leakage current does not exceed 0.5 MIU.

Charging circuits for RESS battery systems with voltages greater than or equal to 48VDC shall be isolated from the vehicle chassis such that ground current from the grounded chassis does not exceed 5 mA at any time the vehicle is connected to an off-board power supply.

(29) The automatic disconnect for the RESS batteries shall be capable of interrupting maximum rated controller/inverter current. The Supplier shall describe the automatic disconnect provided for the main propulsion batteries.

(30) The vehicle shall be prevented from being driven with the key turned on and the drive selector in the drive or reverse position while the vehicle's charge cord is attached. Additionally, the following interlocks shall be present:

- The controller shall not initially energize to move the vehicle with the gear selector in any position other than "PARK" or "NEUTRAL;"
- The start key shall be removable only when the "ignition switch" is in the "OFF" position, with the drive selector in "PARK;"
- With a pre-existing accelerator input, the controller shall not energize or excite such that the vehicle can move under its own power from this condition.

(31) The grid-connected charger shall be capable of recharging the RESS to a state of full charge from any possible state of discharge in less than 12 hours, at temperatures noted in Section 5.5, as applicable. The preferred recharge time should be less than eight (8) hours.

The charger shall be fully automatic, determining when "end of charge" conditions are met and transitioning into a mode that maintains the main propulsion battery at a full state of charge while not overcharging it, if continuously left on charge.

(32) The RESS charger shall be onboard the vehicle and shall use 120V or 208/240V single-phase 60-Hertz alternating current service, with an input voltage tolerance of ±10% of rated voltage. Input current for charges operating at 120 V shall be compatible with 15-ampere circuit breakers. Input current for chargers operating at 208V and 240V shall be compatible with 40-ampere circuit breakers.

Personnel protection systems shall be in accordance with the requirements of UL Standard 2202 and shall be determined based upon RESS charger input voltages. All personnel protection systems shall meet the requirements specified in the applicable sections of UL2231-1 and 2231-2.

(33) The RESS charger shall have a true power factor of 95 or greater and a harmonic current distortion of ≤20% (at rated load).

(34) Regardless of the charger used, the charger shall conform to the requirements of UL Standard 2202.

(35) Suppliers shall specify all optional equipment required to meet the requirements of this Vehicle Specification. The installation of options shall not relieve Suppliers of meeting other "shall requirements."

(36) Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics.

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