

## 2010 Smart fortwo mhd – VIN 6476

### Advanced Vehicle Testing – Baseline Testing Results



#### VEHICLE SPECIFICATIONS

##### Vehicle Features

Base Vehicle: 2010 Smart  
Fortwo MHD  
VIN: WME4513341K406476  
Seatbelt Positions: 2  
Standard Features:  
    Air Conditioning  
    Power Locks  
    Power Steering  
    Power Brakes  
    Power Windows  
    Cruise Control  
    Front Disc Brakes  
    Rear Drum Brakes  
    Rear Wheel Drive  
    Anti-Lock Brakes  
    Traction Control  
    Air Bags  
    AM/FM Stereo with CD player

##### Weights

Design Curb Weight: 1,818 lb  
Delivered Curb Weight: 1,742 lb  
Distribution F/R (%): 44/56  
GVWR: 2,244 lb  
GAWR F/R: 968/1,452 lb  
Payload<sup>1</sup>: 426 lb  
Performance Goal: 400 lb

##### Dimensions

Wheelbase: 73.5 in  
Track F/R: 50.5/54.5 in  
Length: 106.1 in  
Width: 61.4 in  
Height: 60.7 in  
Ground Clearance: 6.25 in  
Performance Goal: 5.0 in

##### Tires

Manufacturer: Continental  
Model: ContiproContact  
Size: Front - P155/60/R15  
Rear - P175/55/R15  
Pressure F/R: 29/29 psi  
Spare Installed: No

##### Engine

Model: 12V DOHC  
Output: 59 hp @ 5800 rpm  
Configuration: Inline Three-Cylinder  
Displacement: 1.0 L  
Fuel Tank Capacity: 8.7 gal  
Fuel Type: Unleaded Gasoline

##### Battery

Manufacturer: Varta  
Type: Valve-Regulated Lead-Acid  
Number of Modules: 1  
Weight of Pack: 39 lbs  
Pack(s) Location: Under passenger  
foot well  
Nominal Module Voltage: 12 V  
Nominal System Voltage: 12 V  
Nominal Pack Capacity: 60 Ah  
CCA Rating (SAE): 680A

## PERFORMANCE STATISTICS

### Acceleration 0-60 mph

Measured: 18.7 s

Performance Goal: 13.5 s

### Maximum Speed

At ¼ Mile: 66.0 mph

At 1 Mile: 79.8 mph

Performance Goal: 70 mph at one-mile mark

### Braking from 60 mph

Controlled Dry: 117 ft

### Gradeability (Calculated)

Maximum Speed @ 3%: Unavailable<sup>2</sup>

Maximum Speed @ 6%: Unavailable<sup>2</sup>

Maximum Grade: 36.1%

### Dynamometer Results w/o Accessories<sup>3</sup>

Cycle Fuel Economy, Idle-Stop Disabled: 50.2 mpg

Cycle Fuel Economy, Idle-Stop Enabled: 51.1 mpg<sup>4</sup>

Driving Range: 445 mi<sup>4,5</sup>

### Dynamometer Results w/Accessories<sup>3,6</sup>

Cycle Fuel Economy, Idle-Stop Disabled: 36.1 mpg

Cycle Fuel Economy, Idle-Stop Enabled: 37.1 mpg<sup>4</sup>

Driving Range: 297 mi<sup>4,5</sup>

### TEST NOTES:

1. Payload does not include driver weight.
2. Unable to calculate due to manual transmission shifts.
3. Dynamometer results based on SAE J1634 methodology and drive cycles, consisting of: Cold Start UDDS, Hot Start UDDS, and HWFET cycles.
4. Idle-Stop system enabled.
5. Value calculated based on fuel economy and fuel tank size.
6. Accessories represented by air conditioning on maximum with full blower.

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.

This vehicle meets the requirements of HEVAmerica vehicle Technical Specification (R1) as follows:

- (1) Vehicles shall comply with Federal Motor Vehicle Safety Standards (FMVSS) 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 its 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) Suppliers shall supply Material Safety Data Sheets (MSDS) for all unique hazardous materials the vehicle is equipped with, including Energy Storage System (ESS) batteries or capacitors, and auxiliary batteries.
- (3) Suppliers shall provide recycling plans for batteries and other vehicle hazardous materials including how the plan has been implemented.
- (4) All vehicles shall comply with the Federal Communications Commission (FCC) requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, "Unintentional Radiators."
- (5) Vehicles shall have a minimum payload of at least 400 pounds.
- (6) For conversions, Original Equipment Manufacturer (OEM) gross vehicle weight ratings (GVWR) shall not be increased. For conversion vehicles, Suppliers shall specify the OEMs GVWR.
- (7) 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.
- (8) Tires shall be subject to the following requirements:
  - Tires provided with the vehicle shall be the standard tire offered by the hybrid electric vehicle (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.
- (9) 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.
- (10) For conversion vehicles, the OEM passenger space shall not be intruded upon by the ESS or other conversion materials.
- (11) The vehicle may utilize a single-speed, multi-speed automatic, manual transmission, or a Continuously Variable Transmission (CVT), and shall have a parking mechanism.
- (12) The controller/inverter shall limit the minimum ESS battery discharge voltage to prevent degradation of battery life, and should limit the maximum regeneration voltage to prevent external gassing of the batteries.
- (13) 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.
- (14) If different, customer available and battery available Department of Energy (DOE) ratings shall both be provided.
- (15) 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. For vehicles capable of off-vehicle charging (OVC), ESS 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 an Underwriters Laboratory (UL)-recognized Testing Laboratory).
- (16) For vehicles with ESS system voltages of 48 volts (V) and higher, batteries or capacitors and their enclosures shall be designed and constructed in a manner that complies with 49 CFR 571.305. For vehicles with ESS system voltages below 48 volts direct current (VDC), batteries or capacitors, and their enclosures, shall be designed and constructed in accordance with the requirements of SAE J1766. Further, irrespective of ESS 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.
- (17) 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.
- (18) 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.
- (19) 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.
- (20) 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 (CNG) as fuel, manufacturers should indicate compliance with NFPA 52, "CNG Vehicular Fuel Systems Code," as well as 49 CFR 571.303 and 304.].
- (21) ESS shall be battery, capacitor, or electromechanical flywheel technology-based as defined in SAE J1711.

- (22) Vehicles shall not contain exposed conductors, terminals, contact blocks or devices of any type that create the potential for personnel to be exposed to 60V 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-J1673.
- (23) 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 ESS 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.
- (24) The automatic disconnect for the ESS batteries shall be capable of interrupting maximum rated controller/inverter current. The Supplier shall describe the automatic disconnect provided for the main propulsion batteries.
- (25) 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.
- (26) If the vehicle is capable of off-board recharging of the ESS, the charger shall be capable of recharging the ESS 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 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.
- (27) If the vehicle is capable of off-board recharging of the ESS, the chargers 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 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 ESS system voltages. All personnel protection systems shall meet the requirements specified in the applicable sections of UL2231-1 and 2231-2.
- (28) If the vehicle is capable of off-board recharging of the ESS using a 208/240V charger, chargers shall have a true power factor of .95 or greater and a harmonic distortion rated at 20% (current at rated load).
- (29) Regardless of the charger type used, the charger shall conform to the requirements of UL Proposed Standard 2202.
- (30) The installation of options shall not relieve Suppliers of meeting other "shall" requirements.
- (31) Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics.
- (32) Vehicles shall be capable of completing the HEV America 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 HEV America tests without repairs exceeding a cumulative total of 72 hours.

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