Ultra Light Vehicle (ULV) Research Prototype

U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC)

**PERFORMANCE @ GVW (MODEL PREDICTIONS)**
- **Top Speed**: 74 mph
- **Speed on 5% Grade (Initial/Cont)**: 45/38 mph
- **Acceleration 0 – 30 / 0 – 50 mph**: 5.1/16.2 s
- **Vertical Step**: 18 inches
- **NATO Lane Change**: > 45 mph
- **Lateral Acceleration**: 0.54 g's
- **Gradeability Longitudinal/Side Slope**: 60%/40%
- **NRMM Cross Country Speed/% No Go**: 25 mph/18.2%

**ULV ARMOR AREAL DENSITY % IMPROVEMENT OVER RHA (BALLISTIC PREDICTIONS)**

**UNDERBODY PROTECTION**
- Mines
- Improvised Explosive Device
- Improvised Explosive Device
- Rocket Propelled Grenade
- Small Arms Fire

**SILENT OPERATION @ GVW (MODEL PREDICTIONS)**
- **Battery SOC**: 80%-20% 100%-0%
- **Silent Watch**: 4.38 hours 7.3 hours
- **Electric Range**: 12 miles 21 miles

**SUB-SYSTEM DESCRIPTIONS**
- **Subaru Boxer Horizontally-Opposed Turbo Diesel Engine Maximum Power**: 175 hp
- **Rated Engine Torque**: 260 lb-ft
- **JP8, 30 gallon tank**

**MODEL PREDICTIONS and ESTIMATES**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td><strong>Length</strong>:</td>
<td>199 inches</td>
</tr>
<tr>
<td><strong>Width</strong>:</td>
<td>95.7 inches</td>
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<tr>
<td><strong>Ride Height</strong>:</td>
<td>81 inches</td>
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<tr>
<td><strong>Transport Height</strong>:</td>
<td>72 inches</td>
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<tr>
<td><strong>Wheelbase</strong>:</td>
<td>134 inches</td>
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<tr>
<td><strong>Ground Clearance</strong>:</td>
<td>5 to 23 inches</td>
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<tr>
<td><strong>Interior Volume</strong>:</td>
<td>171 ft³</td>
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<tr>
<td><strong>Curb Vehicle Weight</strong>:</td>
<td>13,916 pounds</td>
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<tr>
<td><strong>Payload</strong>:</td>
<td>4,284 pounds</td>
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<tr>
<td><strong>Gross Vehicle Weight</strong>:</td>
<td>18,200 pounds</td>
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<tr>
<td><strong>Axle Weight (Front/Rear)</strong>:</td>
<td>43%/57%</td>
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<tr>
<td><strong>Crew Seating</strong>:</td>
<td>4 + 1 Gunner</td>
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<tr>
<td><strong>Range (35mph, flat)</strong>:</td>
<td>337 miles</td>
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**EPA DOT Fuel Economy Estimates**

- **Combined Fuel Economy**: 14.7 mpg
- **EPA Combined Calculations**: 14.7 mpg
- **Harford Paved Terrain**: 12.9 mpg
- **Munson Gravel Terrain**: 17.0 mpg
- **Churchville B Trails Terrain**: 13.1 mpg
- **Tactical Idle at 10kW Export**: 1.27 gph

**EPA Combined Fuel Economy Rating**

- **Payload-Ton-MPG**: 14.7
- **MPG**: 6.86

**Contract # W91CRB-10-C-0089**. Contract was awarded competitively per Federal Acquisition Regulations. Citation of manufacturing or trade name does not constitute an official endorsement or approval of the use thereof.

tardec.army.mil/ulv

**LiquidSpring Compressible Liquid Adaptive Suspension System**: 18 inches of travel, with integrated elastomeric jounce bumper

**Hutchinson Wheels**: Aluminum, 20” diameter X 11” wide, 40mm positive offset, 335mm bolt circle, 8 hole pattern.

**Mickey Thompson Tires**: Baja ATZ Radial, 40X14.5R20LT – 4800 lbs load capacity at 65psi

**Service Brakes**: Outboard mounted, hydraulic, master cylinder push rod, 380mm carbon-ceramic rotors, six piston calipers

**Parking Brake**: Caliper type

**Jankel**: Blast Limiting Attenuation Seats
The Ultra Light Vehicle (ULV) Research Prototype program enabled the creation of an integrated technology demonstrator vehicle focused on the program’s four primary objectives. 

Primary Objectives:
1) Protection: Comparable to MRAP FoV
2) Performance: 14,000 lbs CVW
3) Payload: 4,500 lbs
4) Price: $250k at 5k QTY

Secondary Objectives:
1) Performance: TARDEC-Selected Tactical Vehicle Mobility Requirements

The ULV is an Office of the Secretary of Defense (OSD) funded science and technology effort to explore the art of the possible in survivability technology in order to inform and enhance future production programs. This project partnered with nontraditional defense contractors to access commercial markets, developing solutions and novel approaches that push the limits of a lightweight, low cost, highly survivable vehicle. The high risk/high reward and fast paced (16 months) contract included a mix of innovative, advanced technologies and COTS-based products. The ULV is neither ready nor intended for actual production, and validation testing for performance and survivability will continue into 2014.

The final design includes a contractor designed steel-base occupant-centric cab with the front and rear steel frames extending directly from the cab creating a monocoque structure without a traditional frame. The majority of the vehicle systems attach directly to the front and rear frames. The cab includes lightweight composite armors and various blast attenuating and occupant safety technologies with multi-egress options. The suspension is compressible liquid with a full 18 inches of travel, using long/short arm design offering mobility over rough terrain. The hybrid drive system eliminates the need for under-cab drive components, thus allowing the underbody geometry to present clean load shedding surfaces in a blast event. Drive redundancy consists of two electric drive motors, one front and one rear (only one of which is required for motion), each directly coupled to a differential, and driving planetary geared hubs with a single speed. The planetary geared hubs keep weight to a minimum by reducing the half-shaft torque requirement, keeping each traction motor centrally located between each wheel set, and providing high drive efficiency. The engine/generator "gen-set" mounted in the front provides the continuous power, while the battery mounted in the rear provides power surge and energy storage capability. The combination offers power redundancy, as only one energy source is required for motion, and the battery is capable of moving the vehicle on electric power alone (capable of 10+ mile range on battery alone).

Within the schedule, it was not possible to include all Government Furnished Equipment (GFE) specified in the secondary research objectives. Careful scrutiny of the full menu of GFE led to decisions to eliminate older electronic equipment in favor of a lower weight system with full Internet Protocol control options, improved integration, and focus on warfighter future needs (with warfighter input through Integrated Product Teams (IPT) as well as organized group evaluations). The ULV electronics package chosen for integration represents the full electronic suite capability that is present in similar fielded tactical vehicle fleets focused on using the newest electronic equipment. The use of a common integrated user interface for radio, shot detection, video, and GPS positioning resulted in a significant space and weight savings.

Finally, the nature of the organization and communication plan aided significantly in achieving the rapid design and build completion of the prototype vehicles. Specifically, the IPT structure established by the TARDEC ULV Research Prototype Team was populated by potential stakeholders in the various vehicle technical, performance, and programmatic categories.

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