Foreword

Thank you for purchasing an Internal Surge Tank. It will prevent fuel starvation during high performance driving conditions, without requiring extensive vehicle modifications. In addition, the fuel level switch provides advance warning of impending supply interruption, which will prevent engine damage due to lean combustion.

Please read this entire manual before beginning installation.

For additional product info, please visit coachmanperformance.com. If you experience any issues or need additional technical support, contact us at info@coachmanperformance.com or call 248-345-4902.

Winfield Coachman
Benefits

The Internal Surge Tank (IST) is a solution for fuel starvation during aggressive vehicle maneuvers.

The Problem
During maneuvers such as high-G cornering, the fuel in the main tank may slosh or “surge” away from the fuel pickup, setting off a chain of bad events:

1. Air is ingested into the system, decreasing the volume of fuel
2. The ECU can’t compensate and the mixture in the combustion chamber goes lean
3. The lean condition causes loss of power, increased combustion temps, and potentially detonation
4. Increased temps and detonation damage components, especially in turbocharged rotary engines

The Solution
The IST continuously scavenges fuel from the main fuel tank and deposits it in the reservoir. The volume of the reservoir and the flow rate of the lift pump are sufficient that it acts as a buffer against fuel surge. The high pressure fuel system enjoys uninterrupted supply, down to a virtually empty main fuel tank.

Advantages
The External Surge Tanks on the market also provide protection against fuel slosh, but the IST offers several key advantages:

- **Engine Protection** – the included Level Switch warns of impending fuel starvation so measures can be taken to prevent engine damage.
- **Packaging / Aesthetics** – the IST installs in the fuel tank, so it doesn’t require significant vehicle modification. Once installed, the car’s interior and exterior appearance are unaltered.
- **Fuel Cooling** – high performance fuel pumps can add heat the fuel. The IST is made of highly thermally conductive aluminum, which is immersed in the cool surrounding fuel of the main fuel tank, mitigating the issue.
- **Cost / Complexity** – a passenger compartment-mounted External Surge Tank requires a significant amount of plumbing, which is a large hidden expense.
- **Leak Avoidance / Occupant Safety** – the additional plumbing required for an External Surge Tank creates numerous potential leak paths, and some of them will be in the passenger compartment. Since the IST is fully contained within the main fuel tank, leaks aren’t a concern.
Product Description

System Architecture
The IST is constructed from an anodized aluminum reservoir that houses the industry-standard Bosch -044 Motorsport Fuel Pump. The pump continuously scavenges fuel from the OEM fuel tank and fills the reservoir. A supply port feeds the high pressure fuel system, and a return port deposits bypass fuel back into the reservoir.

Engine Protection
A Low Level Switch inside the IST warns of possible interruption to the fuel supply. If the fuel level inside the reservoir falls below approx. 20%, the switch changes state, which can be used to trigger a variety of safety features to prevent engine damage due to lean condition.

Fuel Cooling
High performance fuel pumps can add a significant amount of heat to fuel, and the limited volume of a swirl pot magnifies this concern. The immersion of the IST in the fuel tank and high thermal conductivity of aluminum resolve this issue by using the surrounding fuel to cool the contents of the surge tank.

Considerations
- The IST contains a Lift Pump; a separate Pressure Pump (not included) must be installed outside the fuel tank.
- A new OEM fuel level sender is included. It’s modified to fit and comes already installed in the IST. Since fuel level senders do sometimes wear and fail, this can be considered preventative maintenance.
- The IST Low Level Switch should be integrated into the engine control system in a way that provides automatic protection – it’s cheap insurance.

Specifications

<table>
<thead>
<tr>
<th>Reservoir</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>1.7L (internal volume of the reservoir, less volume of the lift pump)</td>
</tr>
<tr>
<td>External Dims</td>
<td>135mm X 180mm (Mounting Flange) X 335mm High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel Pump</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Bosch “-044” (FP200 Series, PN 0 580 254 044)</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>Greater than 300LPH at 13.5V and zero bar (free flow)</td>
</tr>
<tr>
<td>Current Draw</td>
<td>5A at 13.5 V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel Level Switch</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic</td>
<td>Closed circuit when reservoir full = NC or Open circuit when reservoir full = NO</td>
</tr>
<tr>
<td>Max Current</td>
<td>0.5A</td>
</tr>
</tbody>
</table>

| Fuel Compatibility | Gasoline with non-warranted Ethanol and Diesel capability |

<table>
<thead>
<tr>
<th>Fittings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>-8AN Male</td>
</tr>
<tr>
<td>Return</td>
<td>-6AN Male</td>
</tr>
</tbody>
</table>

Note1: 13.5V is a typical operating voltage when installed in a running vehicle. It accounts for alternator output at 13.8V, less 0.3V voltage drop due to circuit resistance.

Note2: From Bosch Tech Data: Bosch does not warrant these fuel pumps if used with Alcohol or Ethanol based fuels or fuel additives that are corrosive. With E26/E85 or Diesel fuel run-time max. 500 h.
# Parts

## Included

<table>
<thead>
<tr>
<th>ID</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Internal Surge Tank (IST) Assembly</td>
<td>1</td>
</tr>
<tr>
<td>1a</td>
<td>IST Module <em>(includes new, modified OEM fuel level sender)</em></td>
<td>1</td>
</tr>
<tr>
<td>1b</td>
<td>Mounting Screw, IST (M4 X 12mm Socket Cap Screw, A2 SS)</td>
<td>8</td>
</tr>
<tr>
<td>1c</td>
<td>Mounting Washer, IST (M4 Flat Washer, A2 SS)</td>
<td>8</td>
</tr>
<tr>
<td>1d</td>
<td>Mounting Screw, Connector Clip (M4 X 12mm Flat Head Screw, A2 SS)</td>
<td>2</td>
</tr>
<tr>
<td>1e</td>
<td>Connector Clip</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Lift Pump / Tank Level Harness – Vehicle Side (4-way)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>IST Level Harness – Vehicle Side (2-way)</td>
<td>1</td>
</tr>
</tbody>
</table>

## Not Included (Recommended for Full System Install)

<table>
<thead>
<tr>
<th>ID</th>
<th>Item</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Pressure Pump</td>
<td>Provide Pressurized Fuel to Injectors</td>
</tr>
<tr>
<td>11</td>
<td>Pump Bracket / Adapter</td>
<td>Physical Mounting</td>
</tr>
<tr>
<td>12</td>
<td>Misc. AN Plumbing</td>
<td>Route Fuel Through System</td>
</tr>
<tr>
<td>13</td>
<td>Fuse (Weatherproof)</td>
<td>Protect Fuel Harness Wiring</td>
</tr>
<tr>
<td>14</td>
<td>Relays (Weatherproof)</td>
<td>High Gauge Wiring Harness and Protection Logic</td>
</tr>
<tr>
<td>15</td>
<td>Wire (As Specified)</td>
<td>Fuel System / Protection Harnesses</td>
</tr>
</tbody>
</table>
Plumbing

This plumbing diagram captures the basics. Details can be seen in Sample System Installation Images.

System Operation

- Fuel from the OEM Fuel Tank is continuously pumped into the IST by the Lift Pump.
- Excess fuel in the IST spills through the Overflow Port back into the OEM Fuel Tank. Under normal operation, the IST is constantly full up to the level of the Overflow Port.
- The IST Low Level Switch changes state when the fuel level falls below the preset level.
- Fuel is supplied to the OEM Fuel System by the Pressure Pump (not included).
- Unused fuel returns to the IST via the Return Line.
Wiring

The following schematic is a suggested arrangement, which will provide sufficient current capability to support the lift pump in the IST plus dual pressure pumps with minimal voltage drop.

IST Low - Protection / Warning
When the fuel level in the IST is low, starvation is imminent. In this schematic, the low level signal is used to disable the EBC and illuminate a dash-mounted Warning Lamp. Various other safeguards can be implemented, such as interrupting the signal to the Boost Control Solenoid or switching to a "safe MAP" in the ECU.
**IST Low Level Switch - State Diagram**

**Basic Logic:** To effectively use the IST Level Switch to protect the engine, it must have the correct logic to support your specific installation.

If we use that example in the above wiring diagram, we want the Switch to be Closed when the IST is Full (Normal Mode) so the Boost Controller will be powered and allow enhanced performance. This requires an NC (Normally Closed) switch configuration.

<table>
<thead>
<tr>
<th>IST Condition</th>
<th>Switch Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full (Normal Mode)</td>
<td>Open</td>
</tr>
<tr>
<td>Empty (Safe Mode)</td>
<td>Closed</td>
</tr>
<tr>
<td>NO (Normally Open)</td>
<td>NC (Normally Closed)</td>
</tr>
<tr>
<td>NC (Normally Closed)</td>
<td>NO (Normally Open)</td>
</tr>
</tbody>
</table>

If you specify the required switch configuration – either NO or NC – when ordering your IST, it will arrive with the correct logic. If not, you may need to reverse the logic by inverting the float (see Installation Instructions). In all cases, the logic should be verified before the fuel tank is installed to avoid wasted effort. Note that the IST will be in the Empty condition when the logic is checked, so the NC configuration we reviewed above would present an Open switch.

**Combined Logic:** It may be desirable to include one or more additional safety switches in the circuit for items such as low level in an auxiliary injection system, etc. The following guidelines should be used:

- The circuit will be much simpler if all switches employ the same configuration – i.e. all NO or all NC

- Switches in NC configurations should be wired in series so any switch that opens due to an abnormal condition will break the circuit and cause the system to enter Safe Mode

- Switches in NO configurations must be wired in parallel so any switch that closes due to an abnormal condition will close the circuit and cause the system to enter Safe Mode
Installation Instructions - IST

1. Disconnect the negative battery terminal.

2. Remove the Fuel Sender Access Panel in the Rear Hatch Area.

3. Disconnect:
   - 3.1 Ground
   - 3.2 Electrical Connector
   - 3.3 Vent Line
   - 3.4 Fuel Supply Line
   - 3.5 Fuel Return Line
   - 3.6 Filler Neck Ground Strap
     (not shown in wheel well)

4. Remove the Fuel Tank
   - 4.1 Raise the Vehicle
   - 4.2 Drain Remaining Fuel
   - 4.3 Remove the Fuel Tank

5. Remove the OEM Pump Assembly.
6. Remove the OEM Fuel Sump.
   6.1 It must be cut before it will fit through the access hole. Tin snips are a good tool for this.
   6.2 There is also a small fuel sump retainer tab welded to the bottom of the fuel tank. It must be
   removed to avoid interference with the fuel level sender. Bend this back and forth until it breaks free.

7. Verify IST Low Level Switch Logic and Operation.
   7.1 Prior to installation, the IST in the upright position will simulate the IST Low or “Safe” condition.
   7.2 Using a multimeter, verify the switch condition (either closed or open) is what you desire – see “IST
   Low Level Switch – State Diagram”
   7.3 Invert the IST and confirm the logic reverses.
   7.4 If the logic needs to be reversed the IST must be opened:
     7.4.1 Remove the Qty. 5 torx head screws that retain the top cap assembly.
     7.4.2 Unclip the internal wire harness from the 4-way connector.
     7.4.3 Remove the lower C-clip from the IST Low Level Switch.
     7.4.4 Invert the float.
     7.4.5 Reassembly is the reverse.
8. Install the Internal Surge Tank (IST).
   8.1 Slide the IST through the flange hole. The fit is very tight, and may require some finesse; be patient and careful not to chafe the wires on the fuel level sender.
   8.2 Install Qty. 7 IST Mounting Screws and Washers (1b,c) around the perimeter, excluding the hole by the “RETURN” label. Mount the OEM ground clip under one of the screws.
   8.3 Install the Connector Clip Mounting Screw and Connector Clip (1d,e) in the remaining hole.
   8.4 Slide the 2-way IST Level Connector into the Clip until it locks in place.

9. Connect Plumbing and Electrical, per diagrams.

10. Reinstall Fuel Tank
Test / Startup

A. Before adding fuel, test the operation of all sensors by cycling the key to “Run”:
   A.1 The Lift Pump in the IST and the external Pressure Pump will both run for a few seconds, then stop, same as OEM.
   A.2 The Fuel Low Light will illuminate.
   A.3 The Fuel Level Gauge will descend from Full to Empty.
   A.4 The IST Low Safety Feature will be triggered (if not, the logic in the level switch may need to be reversed)

B. Add fuel.

C. Cycle the key from “Off” to “Run” a few more times to prime the system.

D. Start the vehicle.

E. Idle and general driveability should be unaltered.
Sample System Installation Images

Installation of the Pressure Pump on the rear crossmember

• An adapter was made to adapt the fuel pump bracket to the existing hole in the crossmember
• Pump Inlet: A -8AN 90° hose end / -8AN to M18X1.5 adapter with 18mm Dowty Seal
• Pump Outlet: 12mm banjo to -6AN adapter with original Bosch 044 check valve
• Adaptation to OEM 5/16” hard lines (return shown): -6AN to 5/16 Compression Adapter

• 10AWG Fuel System Power Harness
  - 40A continuous rating to support lift pump in IST + dual pressure pumps (future upgrades)
  - Mounts beneath the vehicle; no need to remove interior trim
  - Draws power from the starter solenoid and routes beneath the fuel line bundle for protection
  - Actuated by the OEM fuel pump signal = identical operating states
  - Weatherproof components (fuse holder and relay)
• Pressure Pump Wiring / Install