Part Number: IST_RX7-8485

Application: 1984 – 85 Mazda RX-7 with Carbureted Engine*
*The fuel tanks installed in injected vehicles have a welded-in metal sump that interferes with the IST; either the sump must be removed or a tank from a carbureted vehicle must be substituted.

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, a low level switch provides advance warning of impending supply interruption, which may 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. As the name implies, it mounts inside the OEM fuel tank.

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, displacing 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 engine components

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
External Surge Tanks 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 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** – an External Surge Tank requires a significant amount of additional 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 may 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 surge tank 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 mounting flange must be welded to the fuel tank by a competent welder.
- The IST contains a Lift Pump; a separate Pressure Pump (not included) must be installed outside the fuel tank.
- The OEM fuel level sender must be modified so it won’t interfere with the IST; this is accomplished by bending the float arm.
- The IST Low Level Switch should be integrated into the engine control system in a way that provides active protection (i.e., doesn’t require driver action) – it’s cheap insurance.

Specifications

<table>
<thead>
<tr>
<th>Reservoir</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>1.5L (internal volume of the reservoir, less volume of the lift pump)</td>
</tr>
<tr>
<td>External Dims</td>
<td>102mm X 152mm (Mounting Flange) X 283mm High</td>
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</table>

<table>
<thead>
<tr>
<th>Fuel Pump</th>
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<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>
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</table>

<table>
<thead>
<tr>
<th>Low 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>

Note 1: 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.

Note 2: 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 / Tools

### Included

<table>
<thead>
<tr>
<th>ID</th>
<th>Item</th>
<th>Quantity</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Internal Surge Tank (IST) Assembly</td>
<td>1</td>
</tr>
<tr>
<td>1a</td>
<td>IST Module</td>
<td>1</td>
</tr>
<tr>
<td>1b</td>
<td>Mounting Flange</td>
<td>1</td>
</tr>
<tr>
<td>1c</td>
<td>Mounting Screw (M5 X 12mm Socket Cap Screw, A2 SS)</td>
<td>10</td>
</tr>
<tr>
<td>1d</td>
<td>Mounting Washer (M5 Flat Washer, A2 SS)</td>
<td>9</td>
</tr>
<tr>
<td>1e</td>
<td>O-Ring (Buna-N, 3” ID X 3-3/16” OD X 3/32” W)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Mounting Flange Spacer</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Vent Fitting (M12 X 1.5 Nut)</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Vent Adapter (12mm Banjo to 6mm Hose Barb Kit)</td>
<td>1</td>
</tr>
<tr>
<td>4a</td>
<td>Banjo to Hose Barb Adapter (12mm Banjo to 6mm Hose Barb)</td>
<td>1</td>
</tr>
<tr>
<td>4b</td>
<td>Banjo Bolt (M12 X 1.5)</td>
<td>1</td>
</tr>
<tr>
<td>4c</td>
<td>Crush Washer (M12)</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Lift Pump Harness</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Low Level Harness</td>
<td>1</td>
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### Not Included

<table>
<thead>
<tr>
<th>ID</th>
<th>Item</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>4mm Hex Bit</td>
<td>Remove / install Mounting Screws</td>
</tr>
<tr>
<td>8</td>
<td>Torque Wrench, Small Scale</td>
<td>Install Mounting Screws</td>
</tr>
<tr>
<td>9</td>
<td>Jig Saw</td>
<td>Cut hole for Mounting Flange</td>
</tr>
<tr>
<td>10</td>
<td>Drum Sander / Drill</td>
<td>Size hole for Mounting Flange</td>
</tr>
<tr>
<td>11</td>
<td>Wire Wheel / Drill</td>
<td>Remove Paint for Weld Prep</td>
</tr>
<tr>
<td>12</td>
<td>Black Paint</td>
<td>Fuel Tank Touch-up</td>
</tr>
<tr>
<td>13</td>
<td>TIG Welder</td>
<td>Install Mntg Flange and Vent Adapter</td>
</tr>
<tr>
<td>14</td>
<td>Misc. Plumbing and Wiring</td>
<td>As required</td>
</tr>
</tbody>
</table>
Plumbing

This diagram shows a typical installation.

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.
The lift pump operates continuously just like the pressure pump, so the same power source can be used for both. Check the current capability of the circuit. Although the IST will only consume 5A, this additional load may overtax the existing pressure pump wiring.

The 14 gauge wires that supply the lift pump are redundant. A single 14 gauge wire is more than sufficient for the current load.
Protection Alternatives

The IST’s Low Level Switch can be used in various ways to protect the engine from fuel starvation. The following are just a few of the options. Active alternatives are preferable because they don’t rely on driver attentiveness.

Alt 1: Programmable ECU Safe Mode (Active)
If the ECU detects low fuel level in the IST, it will revert to a “safe mode”, where the following actions would typically be taken to avoid engine damage:

- Decrease boost
- Retard ignition timing
- Increase injector pulsewidth

Alt 2: Electronic Boost Controller Deactivation (Active)
The EBC’s Boost Control Signal (shown) or Power (not shown) is wired through a relay, which is controlled by the IST’s Fuel Level Switch. If low fuel level is detected in the IST, the EBC’s Boost Control Signal will be interrupted and boost will return to the minimum level, as defined by the Wastegate Spring.

Alt 3: Warning Enunciation (Passive)
Low Fuel Level in the IST activates a warning light or buzzer.
Low Level Switch - State Diagram

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

If we take Protection Alternative #2 (Electronic Boost Controller Deactivation) as an example, we want the Switch to be Closed when the IST is Full (Normal Mode) so the relay will be energized and the Boost Control Signal will be allowed to pass through to the Boost Control Solenoid and enhance performance. This requires an NC (Normally Closed) switch configuration.

<table>
<thead>
<tr>
<th>IST Condition</th>
<th>Full (Normal Mode)</th>
<th>Empty (Safe Mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Level Switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>Open (Normally Open)</td>
<td>NC (Normally Closed)</td>
</tr>
<tr>
<td></td>
<td>Closed (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

**WARNING:** Ensure the tank is fully purged of fuel and vapors before cutting or welding!

1. Mounting Flange Preparation
   1.1 Remove the qty 10 Mounting Screws [1c] and Flat Washers [1d] that retain the Mounting Flange [1b] to the IST Module [1a].
      *Note: The screws are coated with anti-seize prior to shipment to prevent galling and achieve the correct clamp load. Do not remove.*
   1.2 Remove the O-Ring [1e] from the Mounting Flange [1b].

2. Cutting the Mounting Flange Hole
   2.1 Cut out the OEM fuel sender flange with a jigsaw or similar, staying as close to the outer perimeter of the flange as possible.
   2.2 Lay the Mounting Flange [1b] on the top of the plateau, centered laterally, and as forward as possible, so as to avoid interference with the internal baffle (Figure 1). Scribe around the perimeter.

   2.3 Cut to the inside of the scribe line with a jigsaw.
   2.4 Use a large drum sander to gradually enlarge the hole to the scribe line. Test fit the Mounting Flange [1b] frequently. Any size drum sander less than 4” will work, although larger sizes make it easier to create a smooth opening.
   2.5 The Mounting Flange [1b] should fit tight within the completed hole.
   2.6 Remove the paint surrounding the hole with a wire brush or similar.
   2.7 Bend the wire arm of the OEM Fuel Level Sensor so that it won’t interfere with the IST through its full arc of travel. *Note: This will have a negligible impact on fuel level readings.*
   2.8 Remove the OEM Fuel Level Sensor.

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**Figure 1**

- Internal Baffle
- Front of Car
- OEM Flange
- 4” X 6” Cutout for IST Mounting Flange
- Vent Fitting
- 4¼”
3 Drilling the Vent Hole

3.1 Measure approximately 4 ½” forward from the Mounting Flange Hole and centered on the plateau.
   
   Note: The exact location isn’t important as long as it’s at the high point of the tank.

3.2 Drill a ½” hole (Figure 1).

3.3 Remove the paint surrounding the hole with a wire brush or similar.

3.4 Vacuum debris from the tank.

4 Welding


4.2 Insert the remaining six (6) screws to protect the threads from weld splatter and debris.

4.3 Drop the Mounting Flange [1b] into the hole, such that the Spacers [2] are in contact with the top of the tank. The flange is symmetrical, so the orientation doesn’t matter.

4.4 Tack the Mounting Flange in place at multiple points (Figure 2).

4.5 Remove the Spacers [2] and re-install the screws.

4.6 Place the Vent Fitting [3] over the hole drilled in step 3.2.

4.7 Weld around the full perimeter of both the Mounting Flange [1b] and the Vent Fitting [3].

   Note: The Mounting Flange is 304SS, 13mm thick, which is necessary for strong, warp-free mounting. It does, however, make welding challenging, since the tank sheet metal will heat much faster than the flange. This job should be performed by a highly skilled welder with experience in TIG and 300-series stainless steel.
5 Final Tank Prep

5.1 Remove the screws and washers from the Mounting Flange [1b]. *Note that discoloration from welding is normal and will not affect strength or corrosion resistance.*

5.2 Check the upper surface for any protrusions. Sand smooth if present. Remove any debris from the o-ring gland.

*Note: Sealing takes place between the bottom of the o-ring gland and the underside of the IST Module. This is a very robust joint, which won’t leak, as long as the surfaces are relatively smooth.*

5.3 Mask the Mounting Flange [1b] and Vent Fitting [3], then paint to match.

6 Verify Low Level Switch Logic and Operation.

6.1 Prior to installation, the IST in the upright position will simulate the IST Low or “Safe” condition.

6.2 Using a multimeter, verify the switch condition (either closed or open) is what you desire – see “Low Level Switch – State Diagram”

6.3 Invert the IST and confirm the logic reverses.

6.4 If the logic needs to be changed, the IST must be opened:

6.4.1 Remove the Qty. 5 torx head screws that retain the top cap assembly.

6.4.2 Unclip the internal wire harness from the 4-way connector.

6.4.3 Remove the lower C-clip from the IST Low Level Switch.

6.4.4 Invert the float.

6.4.5 Reassembly is the reverse.
7 Component Installation

7.1 Re-install the OEM Fuel Level Sensor.

7.2 Re-install the O-Ring [1e] into the gland in the Mounting Flange [1b].

Note: *It may be necessary to stretch the O-Ring between your hands until it relaxes enough to stay in the groove.*

7.3 Lower the IST Module [1a] into the Mounting Flange [1b], with the supply and return fittings facing forward in car. Place the Ground Wire at the same position as received. Insert and **Hand tighten** the ten (10) Mounting Screws [1c] and nine (9) Mounting Washers [1d] removed in step 5.1.

Note: There is no washer used at the ground screw attachment point.

7.4 Check for even clearance between the IST Module [1a] and the Mounting Flange [1b] around the full perimeter. If so, proceed to the next step; if not, remove the IST Module [1a] and re-seat the O-Ring [1e].

7.5 Torque the ten (10) Mounting Screws [1c] to 60 in-lb / 5 ft-lb.

Note: *A small torque wrench is preferred due to its greater accuracy at low torque levels.*

7.6 Install the Vent Adapter [4] in the Vent Fitting [3], taking care to install one Crush Washer [4c] above the Banjo to Hose Barb Adapter [4a] and one below. Orient the hose barb forward in car.

8 Plumbing / Electrical

8.1 -8AN Supply Fitting: Route to the inlet of the pressure pump, which must be mounted external to the fuel tank.

8.2 -6AN Return Fitting: Route to the return from the Fuel Pressure Regulator.

8.3 Vent: Route to the vehicle fuel tank vent system.

Note: *This adapter mimics the OEM setup in that it does not include a rollover fuel cutoff function. For safety, this provision must be included somewhere in the system.*

8.4 Fuel Pump Power: This should be powered by a low impedance battery source capable of supplying 5A. The red and blue leads are positive; the black and gray are negative. The flying ring terminal is the Housing Ground and must be fastened beneath one of the 10 Mounting Screws. A safety cutoff switch should be included to open the circuit in the event of an impact.

8.5 Fuel Level Switch: Both leads are provided, and there is no polarity. The max current is 0.5A, and the logic is explained earlier in “Low Level Switch – State Diagram”. This important safety feature can be wired in any number of ways to prevent damage caused by fuel starvation.