## Failure Mode and Effects Analysis

### (Design FMEA)

### Item

<table>
<thead>
<tr>
<th>Function</th>
<th>Potential Failure Mode</th>
<th>Potential Effect(s) of Failure</th>
<th>Potential Cause(s)/Mechanism(s)</th>
<th>Recommended Action(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>System</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subsystem</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>X: Component: Connector System</td>
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<tr>
<td></td>
<td>Model Year/Vehicle(s): 42 VOLT SYS</td>
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<tr>
<td></td>
<td>Core Team: Refer to workgroup list</td>
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</tr>
</tbody>
</table>

### Potential

- **Failure**
  - **Excessive voltage drop**
  - **Overheating**

### Potential Effect(s)

- **Reduced voltage to loads**
  - **8 decreased normal force**
  - **End-of-line check test**
  - **Partially backed-out connector**
  - **Partially backed-out terminal**
  - **Loss of asparities (terminal interface)**
  - **Environmental conditions**
  - **Material properties**

### Potential Cause(s)/Mechanism(s)

- **Normal force**
  - **Partially backed-out terminal**
  - **Environmental conditions**
  - **Material properties**

### Recommended Action(s)

- **End-of-line check test**
- **Partially backed-out connector**
- **Partially backed-out terminal**
- **Loss of asparities (terminal interface)**
- **Environmental conditions**
- **Material properties**

### Additional Notes

- **System handles rated electrical current with maximum voltage drop of (50mV), for up to xxx sec. over and ambient temperature range of -40°C to 80°C.**
- **Voltage drop spec. referenced to end-of-conditioning status, including Meet stds. for underhood environment (corrosion resistance) Must withstand 25G/0.37g spec. for vibration Must satisfy thermal cycling spec.**
- **Terminal not connected**
- **Open circuit**
  - **7 excessive mating force**
  - **Broken connector latch**
  - **Inadequate connector latch**
  - **Damaged terminal**
  - **Improper terminal orientation**
  - **Excessive mating force**

- **Maintains mechanical integrity doesn’t support cable load**
- **Open, short, or intermittent circuit, or overheating**
  - **Inadequate material selection (housing or terminal)**
  - **Inadequate strain relief**
  - **Inadequate material selection (housing or terminal)**

- **Unmated connectors**
- **Open circuit overheating**
- **Reduced voltage to loads**
  - **Partially backed-out connector**
  - **Partially backed-out terminal**

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<table>
<thead>
<tr>
<th>Item</th>
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<th>Potential Failure Mode</th>
<th>Potential Effect(s) of Failure</th>
<th>C</th>
<th>Potential Failure Code</th>
<th>D</th>
<th>Potential Cause(s)/Mechanism(s)</th>
<th>O</th>
<th>Current Design Controls</th>
<th>R.</th>
<th>Recommended Action(s)</th>
<th>Action Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Prevents accidental shorting of positive to negative or to ground</td>
<td>Increased voltage drop</td>
<td>O</td>
<td>Excessive current draw</td>
<td>D</td>
<td>Overheating</td>
<td>O</td>
<td>Design Dependent - to be identified for each design.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>mate/unmate connections - under load (less than 10 amps for a minimum of 50 cycles)</td>
<td>Reduced mechanical retention force</td>
<td>O</td>
<td>Open, short or intermittent circuit</td>
<td>D</td>
<td>Broken connector latch</td>
<td>O</td>
<td>Inadequate connector latch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Unmate force is excessive</td>
<td>O</td>
<td>Can’t disconnect battery</td>
<td>D</td>
<td>Permanent damage to the system</td>
<td>O</td>
<td>Cold welds at the interface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prevent reverse connections</td>
<td>Reverse connections are made</td>
<td>O</td>
<td>Damage to vehicle electrical system.</td>
<td>D</td>
<td>Inadequate polarization or indexing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prevent 12 volt to 36 volt connections</td>
<td>Wrong connections are made</td>
<td>O</td>
<td>Damage to vehicle electrical system.</td>
<td>D</td>
<td>Inadequate indexing</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Prevent connection to different battery chemistry technology (indexing required at positive only)</td>
<td>Wrong connections are made</td>
<td>O</td>
<td>Damage to battery</td>
<td>D</td>
<td>Inadequate indexing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

Potential Failure Mode and Effects Analysis (Design FMEA)

System: __________
Subsystem: Connector System
Component: __________

Model Year/Vehicle(s): / 42 VOLT SYS

Potential Cause(s)/Mechanism(s): Design Dependent - to be identified for each design.

Recommended Action(s): Inadequate polarization or indexing

Action Results: Inadequate polarization or indexing

Prepared by: M. Andrew
FMEA Date (Orig.): 2000.02.16
Rev.): 2010.02.16

Prevented accidental shorting of positive to negative or to ground:
- Excessive current draw
- Overheating

Prevent reverse connections:
- Reverse connections are made
- Damage to vehicle electrical system.

Prevent 12 volt to 36 volt connections:
- Wrong connections are made
- Damage to vehicle electrical system.

Prevent connection to different battery chemistry technology (indexing required at positive only):
- Wrong connections are made
- Damage to battery
### Potential Failure Mode and Effects Analysis (Design FMEA)

**System**: System

**Subsystem**: Connector System

**Component**: Connector System

**Model Year/Vehicle(s)**: 42 VOLT SYS

**Key Date**: October 2000

**Prepared by**: M. Andrew

**Prepared Date**: 2000.02.16

**FMEA Date (Orig.)**: 2000.02.16

**FMEA Date (Rev.)**: 2010.02.16

**Design Responsibility**: Workgroup

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<th>Responsibility &amp; Target Completion Date</th>
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<tr>
<td>Prevent customers access with standard jumper cables on the connection system</td>
<td>Alligator style jumper cables can be attached</td>
<td>Damage to the vehicle electrical system</td>
<td>Failure</td>
<td>Allows for alligator style jumper cable attachment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disconnect under XX electrical load</td>
<td>Damage to connection system</td>
<td>Overheating</td>
<td>Failure</td>
<td>Excessive arcing - Impact will be design dependent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75 N maximum mating force requirement</td>
<td>Requires more than 75 N to mate</td>
<td>Cannot mate connection</td>
<td>Alignment assurance</td>
<td>Damaged terminals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75 N maximum unmating force (minimum locking strength of 110 N) USCAR 5.4.2.4</td>
<td>Requires more than 75 N unmating force</td>
<td>Excessive unmating force</td>
<td>Terminal latch disengages before the connector unmates</td>
<td>Inadequate terminal retention feature</td>
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</tr>
<tr>
<td>Maintain stable cable routing orientation</td>
<td>Cable out of desired position</td>
<td>Damaged battery cable</td>
<td>Inadequate mechanical positioning feature</td>
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</tr>
</tbody>
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