

Model: Model S, Model X

Vehicle System: 16 - Battery System

Region: All

Tech Note: High Voltage Battery Evaluation Form, Comprehensive

Tech Notes are announcements that help to communicate and track new information about Tesla Service concerns. Such concerns may or may not be VIN specific. These instructions assume knowledge of motor vehicle and high voltage electrical component repairs, and should only be executed by trained professionals. Tesla Motors assumes no liability for injury or property damage due to a failure to properly follow these instructions or for repairs attempted by unqualified individuals.

This Tech Note supersedes TN-14-16-002 R1, dated 6-Feb-15. Each content change is marked by a vertical line in the left margin. Discard the previous version and replace it with this one.

NOTE: This form is only intended to evaluate the internal and external state of a battery that is suspected to have damage. Use this form for situations including, but not limited to:

- Low HV Battery electrical isolation
- Vehicle collision
- Evidence of water ingress
- External damage
- Battery crate damaged during shipping

NOTE: If the battery is not suspected to have any internal or external damage, use TN-13-16-006, "High Voltage Battery Return Tag" instead.

A copy of this completed evaluation form and the appropriate hazardous goods regulatory paperwork must be included with a HV Battery when it is shipped. Regulatory paperwork requirements vary by country and mode of transportation.

Complete each section of this evaluation form in order. If at any point the evaluation determines that the HV Battery might not be stable, discontinue the evaluation and immediately move the battery to a safe location. Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.

⚠ WARNING: An HV battery poses a significant high voltage and electrocution risk if the outer enclosure or safety circuits have been compromised or have been significantly damaged. Only technicians who have been specially trained in High Voltage Awareness and Tesla battery systems are permitted to perform this procedure or utilize this Evaluation Form. Proper personal protective equipment (PPE) and insulating HV gloves with a minimum rating of class 00 (500V) must be worn any time a high voltage cable is handled. Refer to TN-15-92-003, "High Voltage Awareness Care Points" for additional safety information.

⚠ WARNING: If the battery or vehicle displays signs of escaping gases, smoke, flames, excessive heat, sparks, or arcing, contact the local emergency department and refer to the Model S First Responder Guide, available at <http://www.teslamotors.com/firstresponders> and/or TN-13-16-007, "Lithium-Ion Battery Emergency Response Guide, Model S and Model X". Gases or smoke exiting a lithium-ion HV battery are likely flammable and could ignite at any time.

⚠ WARNING: Avoid contact with gases escaping from the battery. Vented gases might irritate the eyes, skin, and throat. Vent gas temperatures can exceed 600°C (1,110 °F). Contact with hot gases can cause burns.

 **WARNING:**

- Inspect or repair a vehicle that has an unstable battery outdoors or within easy access to the outdoors.
- If a battery has been determined to have a coolant leak, do not pressurize its cooling system.
- Store damaged HV batteries at least 15 m (50 ft) away from flammable materials, structures, other vehicles, and other HV batteries.
- Do not store standalone HV batteries below -20 degrees C (-4 degrees F).
- Do not store standalone HV batteries for over 10 days above 35 C (95 degrees F).
- Do not charge or discharge a standalone HV battery below 0 degrees C (32 degrees F).
- Do not store standalone HV batteries for over 30 days at full state of charge (SOC) or completely discharged.
- Do not charge a damaged or potentially unstable HV battery.
- Do not weld near HV batteries.
- If the HV battery shows signs of instability or appears to be compromised, discontinue this evaluation. Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.

The following special tools are required for this procedure:

- Laptop with Windows XP or Windows 7, and Toolbox installed
- Non-contact infrared thermometer
- PCAN dongle
- BATTERY COOLANT DRAIN AND FILL DEVICE ASSEMBLY (TPN: 1022922-00-A)
- HARNESS,LOGIC,HVBAT,SERVICE,STYLE2 (TPN: 1014593-00-A)
- One of the following low current 12 V power supplies for the HV battery service harness:
 - POWER SUPPLY,DC,12W,12 V,1A (U.S./Canada) (TPN: 1018917-00-A)
 - POWER SUPPLY,DC,12W,12 V,1A,EU (TPN: 1018921-00-A)
 - POWER SUPPLY,DC,12W,12 V,1A,UK (TPN: 1019489-00-A)
 - POWER SUPPLY,DC,18W,12 V,1.5A,UNIVERSAL (TPN: 1020510-00-A)

Inspection Using Toolbox

1. In Toolbox, open the “Battery Shipping” panel.

NOTE: This also opens the Serial Number panel.

2. Fill in the information from the “Battery Shipping” panel and “Serial Number” panels.


Battery Shipping Panel	
OK To Ship By Air:	Red <input type="checkbox"/> Green <input type="checkbox"/>
OK To Ship By Land:	Red <input type="checkbox"/> Green <input type="checkbox"/>
Energy Remaining until empty:	kWh
Max SOC:	%
Internal Isolation fault:	Red <input type="checkbox"/> Green <input type="checkbox"/>
Isolation value:	kOhm
Max module temp:	DegC
Lifetime Discharged Energy:	kWh
Min CAC:	%

Serial Number Panel
Battery Serial Number:
Battery Date of Manufacture:
Battery Age:


3. Check the status of the “OK To Ship By Land” or “OK To Ship By Air” status indicators. If the indicator for the desired method of shipping is red, discharge the battery in the vehicle:

NOTE: In some situations, it is not possible to discharge the HV battery in the vehicle. These include after airbag deployment and certain battery failure modes. If the battery cannot be discharged in the vehicle, continue this procedure to check for damage and discharge the battery once it has been removed from the vehicle.

- a) Ensure that the vehicle is in Park.
- b) Place chocks on both rear tires.

 **WARNING:** To prevent unintentional vehicle movement, ensure that the tire chocks are properly secured before proceeding to the next step.

- c) Open the driver's door. While standing outside the vehicle, reach inside and buckle the driver's seatbelt.
- d) Use a pen or screwdriver shaft to manually close the latch assembly on the driver's door while it is open.

 **CAUTION:** The latch is fully closed when it clicks twice. Leave the driver's door open during the rest of this procedure. To prevent damage to the latch, put a sign on the door to alert others not to close the door.

- e) Step on the brake pedal.

- f) Shift into Neutral.
- g) On the touchscreen, touch **CONTROLS > E-BRAKE & POWER OFF > PARKING BRAKE**. Ensure that the parking brake is on.
- h) On the touchscreen, touch **DEFROST** twice to set the climate control to max defrost mode. Ensure that the cabin temperature settings are set to **HI**.
- i) Open all door windows and sunroof (if equipped) to prevent excess heat build-up in the passenger compartment.
- j) Monitor the "SOC MAX UNSCALED" value. When the value is less than 30%, proceed to the next step.
- k) Step on the brake pedal.
- l) Shift into Park.
- m) Turn off the climate control.
- n) Pull the driver's door handle to release the door latch.
- o) Unbuckle the driver's seatbelt.
- p) Remove the tire chocks.
- q) Disconnect the laptop from the vehicle.

On-Vehicle Inspection

1. Raise and support the vehicle (refer to Service Manual procedure 10000205).
2. Carefully inspect the battery and surrounding area for evidence of a previous thermal event. Evidence might include, but is not limited to:
 - Smoke residue
 - Discoloration or deformation of paint, metal, or plastic
 - Melted seals
 - Metallic splatter
 - Abnormal odor

Is there evidence of a prior thermal event? YES NO

3. Examine the exterior of the HV Battery for signs of a rupture or disassembly. A rupture is the mechanical failure of a cell container or the HV Battery case, resulting in exposure or spillage, but not ejection, of solid materials. Disassembly is similar to rupture, but solid matter from any part of the HV Battery system has been physically detached.

Is the case opened such that the internal components are exposed? YES NO

Is there evidence of disassembly? YES NO

- Carefully inspect the side rails of the HV Battery for evidence of coolant or electrolyte leakage (Figure 1). Electrolyte evaporates quickly but can leave behind signs of discoloration (Figure 2). Electrolyte can also appear as gelatinous residue (Figure 3). If coolant or other liquid is identified, closely inspect the area to determine if the source of the liquid is internal or external to the battery.

Electrolyte has a strong and distinct sweet smelling odor. Do not confuse electrolyte smell with the smells of other liquids such as coolant, transmission oil, engine oil, windshield washer fluid, etc.

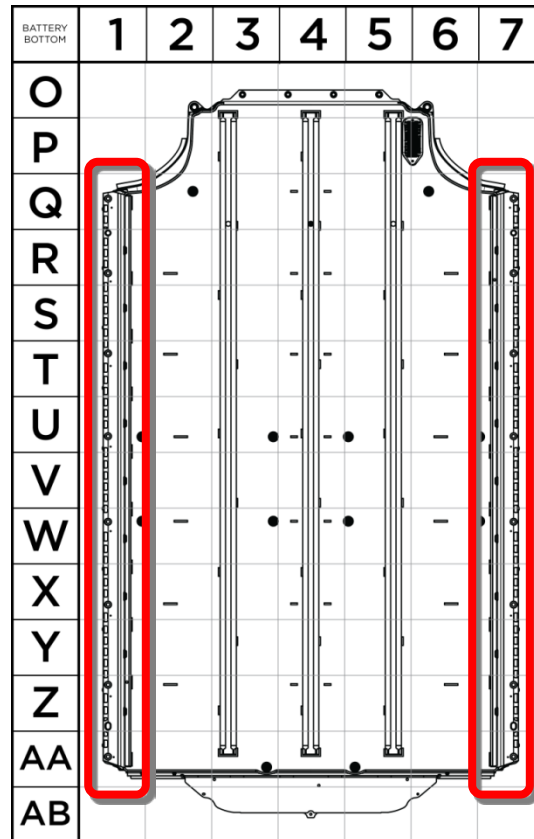


Figure 1



Figure 2 (Discoloration due to electrolyte leakage)

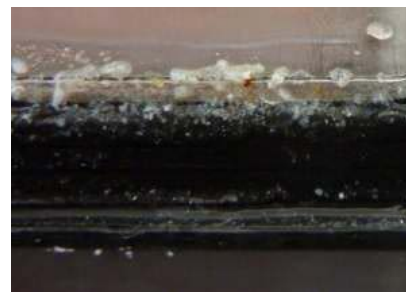


Figure 3 (Electrolyte can look like gelatin)

Is there evidence of electrolyte or coolant leakage? (This does not include residual coolant dripping from the external coolant connection) YES NO

5. Check the underside of the battery for any dents, tears, or other damage. If any damage is noted, take pictures of any damage and include them with this document. Mark any damaged areas on the charts at the end of this document.

Was the vehicle in a collision where airbags were deployed? YES NO

If yes, describe the collision:

Attach photos showing the damage to the vehicle.

If the vehicle has been involved in a front or rear collision, remove the underhood storage unit (**Model S:** Refer to Service Manual procedure 15240701; **Model X:** Refer to Service Manual procedure 15240702) and/or the mid aero shield (refer to Service Manual procedure 12030502). Check the front and/or rear of the HV battery for damage (Figure 4). Take pictures of any damage and include them with this document. Mark any damaged areas on the charts at the end of this document.



Figure 4

Measure the depth of any dents or scratches in the HV Battery enclosure. Measure using a set of calipers, or a ruler and a non-conductive dowel pin. The allowable limits are that any dent, scratch, puncture, or tear has a depth of less than 3.0 mm and that no dent, scratch, puncture, or tear creates an opening to the inside of the HV Battery that a liquid could enter.

Are there any dents, scratches, punctures, or tears in excess of the allowable limits? YES NO

If YES, depth of puncture: _____ mm

If yes, attach photographs of all physical damage.

⚠ WARNING: If any yes boxes are checked in the On-Vehicle Inspection section, the battery might not be stable. Discontinue this evaluation and move the battery to a location that is:

- Free of flammable and combustible materials
- Secured from public access
- At least 15 m (50 ft) from undamaged HV batteries
- At least 15 m (50 ft) from other vehicles
- Downwind of occupied structures within 15 m (50 ft)

For example, a fenced, uncovered yard is an appropriate safe location. Immediately after moving the battery to a safe location, Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.

Off-Vehicle Inspection

1. Remove the HV battery from the vehicle (refer to Service Manual procedure 16010102).
2. While removing the HV Battery from a crate or vehicle, note any abnormal sounds or movement. Abnormal internal sounds might indicate broken pieces, which allow for internal movement or rattles. Severe external damage might result in no rupture of the enclosure, but might still suggest loss of mechanical integrity of internal components.

Are there any rattles or internal movement? YES NO

⚠ WARNING: If there are any rattles or internal movement, the battery might not be stable. Discontinue this evaluation and move the battery to a location that is:

- Free of flammable and combustible materials
- Secured from public access
- At least 15 m (50 ft) from undamaged HV batteries
- At least 15 m (50 ft) from other vehicles
- Downwind of occupied structures within 15 m (50 ft)

For example, a fenced, uncovered yard is an appropriate safe location. Immediately after moving the battery to a safe location, Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.

3. Check the low voltage and high voltage Rapid Mate connectors for damage, corrosion, moisture, damaged seals, or cracks in the plastic housings (Figure 5).



Figure 5 (High voltage Rapid Mate connector shown)

Is there any damage or water intrusion at the high voltage Rapid Mate connector? YES <input type="checkbox"/> NO <input type="checkbox"/>
Is there any damage or water intrusion at the low voltage Rapid Mate connector? YES <input type="checkbox"/> NO <input type="checkbox"/>

NOTE: If Toolbox showed an internal isolation fault, perform the following steps before shipping the Battery:

- a) Discharge the Battery to below 30% Max SOC.
- b) Remove the umbrella valves.

Check for Moisture Accumulation

If Toolbox showed low isolation resistance, take pictures to document signs of moisture accumulation in and on the battery. Otherwise, skip to the next section.

NOTE: It is important to take pictures when the battery is removed because the time that elapses between battery removal, shipment, and failure investigation makes it likely that evidence of moisture intrusion will be lost or contaminated.

1. Take a picture of the underside of the insulating blanket, showing the imprint of the top of the battery and any rust stains (Figure 6).



Figure 6

2. Check the fuse cover and surrounding area. Take pictures of this area if there are any traces of moisture.
3. Take pictures of any corrosion found on the top cover (Figure 7). Take close-up pictures of any corroded fasteners (Figure 8).



Figure 7



Figure 8

4. If any battery fasteners are corroded, check the underside of the vehicle for dents, corrosion, or other damage. Take pictures of any damage.
5. Newer batteries have a split in the front of the center spine fastener channel that can collect liquid (Figure 9). If there is any liquid pooled up in this channel, take a picture of this area.

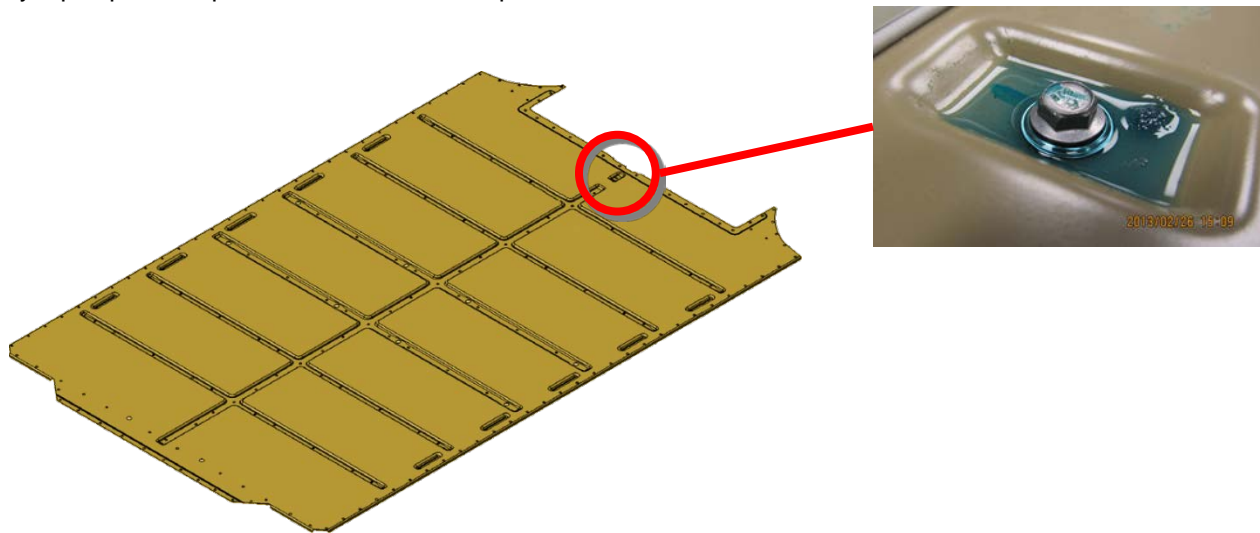


Figure 9

Check Battery Temperature

Follow this procedure to determine if the HV Battery is continuing to generate heat internally after removal from the vehicle. Damaged or opened cells might result in rapid heating, the release of flammable vapors, and the spread of self-heating and thermal runaway reactions to neighboring cells.

1. Remove the insulating blanket from the top of the battery.

2. Ensure that the HV battery is at ambient temperature, in a location with stable temperatures. For example, the battery should not be in direct sunlight or near a heating or air conditioning duct.
3. Connect the laptop with Toolbox to the HV battery, using the HV battery service harness and 12 V power supply. If Toolbox cannot communicate with the battery, check the HV battery service harness and the 12 V power supply for proper connections and function. If Toolbox still cannot communicate with the battery, the battery might not be stable. Discontinue this evaluation. Move the battery to a safe location and contact Tesla, as described in the warning at the end of this section.
4. Open the Battery Shipping panel. Record the Max Cell Temp.

Max Cell Temp (start of test):	DegC
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5. Record the ambient air temperature.

Ambient air temperature:	Degrees C
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6. Use a non-contact infrared thermometer to measure the top surface of the battery enclosure at the indicated locations (Figure 10). Record the highest measured temperature.

NOTE: If the pack has any mechanical damage, also measure within 300 mm of the damaged area.

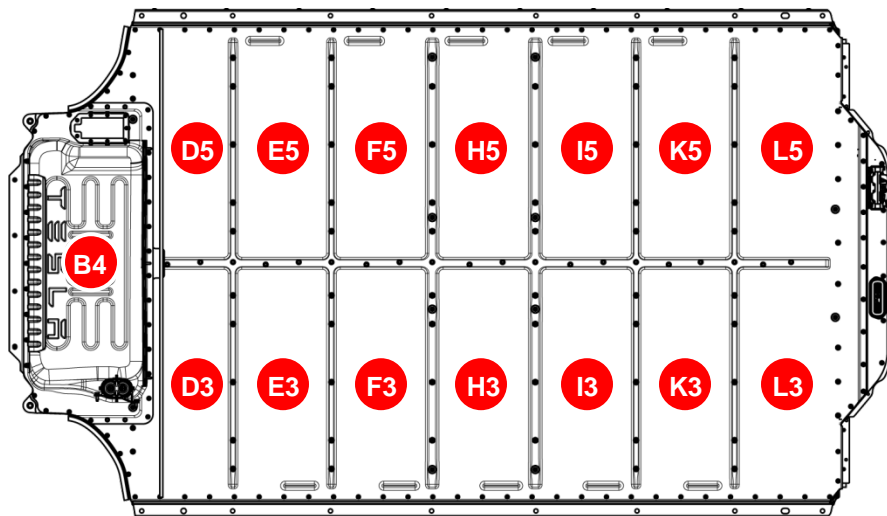


Figure 10

Highest battery enclosure temperature (start of test):	Degrees C
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7. Wait approximately 1 hour.
8. Record the Max Cell Temp reported by Toolbox.

Max Cell Temp (after 1 hour):	DegC
Ambient air temperature (after 1 hour):	DegC

9. Use a non-contact infrared thermometer to measure the same locations on the top of the battery enclosure. Record the highest measured temperature.

Highest battery enclosure temperature (after 1 hour):	Degrees C
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10. If any recorded temperatures are above 60 degrees C (140 degrees F), the battery might not be stable. Discontinue this evaluation. Move the battery to a safe location and contact Tesla, as described in the warning at the end of this section.
11. Compare the highest battery enclosure surface temperature at the start of the test to the highest battery enclosure temperature after 1 hour. If the later measurement is more than 2 degrees C (3.5 degrees F) above the starting temperature, the battery might not be stable. Move the battery to a safe location, as described in the warning at the end of this section.
12. Compare the Max Cell Temp to the ambient air temperature. If the Max Cell Temp is higher than the ambient air temperature, continue to step 13. Otherwise, skip to the next section.
13. Compare the Max Cell Temp at the start of the test to the Max Cell Temp after 1 hour. If the later measurement is more than 2 degrees C (3.5 degrees F) above the starting temperature, the battery might not be stable. Discontinue this evaluation. Move the battery to a safe location and contact Tesla, as described in the warning at the end of this section.

⚠ WARNING: If any steps in this section require moving the battery to a safe location, the battery might not be stable. Discontinue this evaluation and move the battery to a location that is:

- Free of flammable and combustible materials
- Secured from public access
- At least 15 m (50 ft) from undamaged HV batteries
- At least 15 m (50 ft) from other vehicles
- Downwind of occupied structures within 15 m (50 ft)

For example, a fenced, uncovered yard is an appropriate safe location. Immediately after moving the battery to a safe location, Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.

Discharge the Battery

1. If the battery was not already discharged in the vehicle, refer to the Battery Shipping panel in Toolbox. Check the status of the “OK To Ship By Land” or “OK To Ship By Air” status indicators.

2. If the indicator for the desired method of shipping is red, discharge the battery using one of the following methods:
 - Tesla Charger/Discharger Tool. Refer to Service Manual procedure 16010600 or 16010700.
 - Load bank with capacitor box.
 - Install self-discharge firmware. In Toolbox, select Views > HV Electronics > HV Bleed.

NOTE: If the airbags were deployed and the HV battery is not damaged, the battery should be discharged to 20% or less SOC. If the airbags were deployed and the HV battery is damaged, it should be discharged to 10% or less SOC.

If Toolbox cannot communicate with the battery, check the HV battery service harness and the 12 V power supply for proper connections and function.

⚠ WARNING: If Toolbox still cannot communicate with the battery, the battery might not be stable. Discontinue this evaluation and move the battery to a location that is:

- Free of flammable and combustible materials
- Secured from public access
- At least 15 m (50 ft) from undamaged HV batteries
- At least 15 m (50 ft) from other vehicles
- Downwind of occupied structures within 15 m (50 ft)

For example, a fenced, open yard is an appropriate safe location. Immediately after moving the battery to a safe location, Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.

3. Once the battery has been properly discharged, record the following values from the battery shipping panel:

OK To Ship By Land:	Red <input type="checkbox"/>	Green <input type="checkbox"/>
OK To Ship By Air:	Red <input type="checkbox"/>	Green <input type="checkbox"/>
Min Cell State Of Charge:	%	

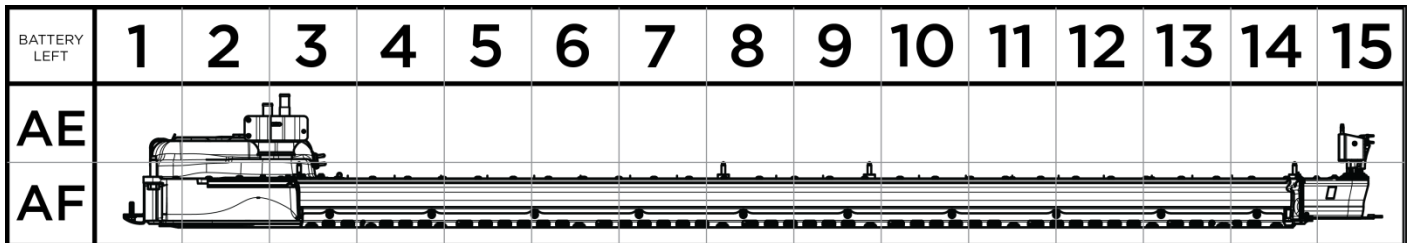
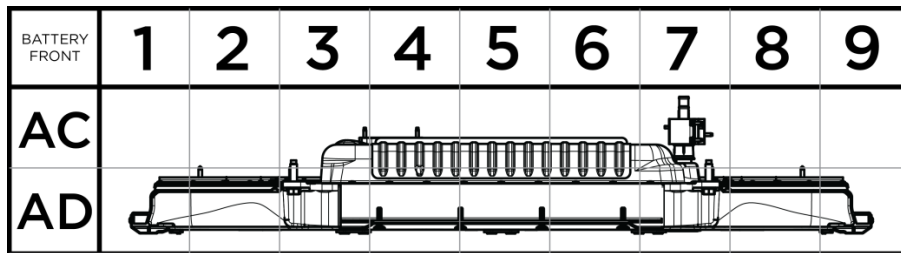
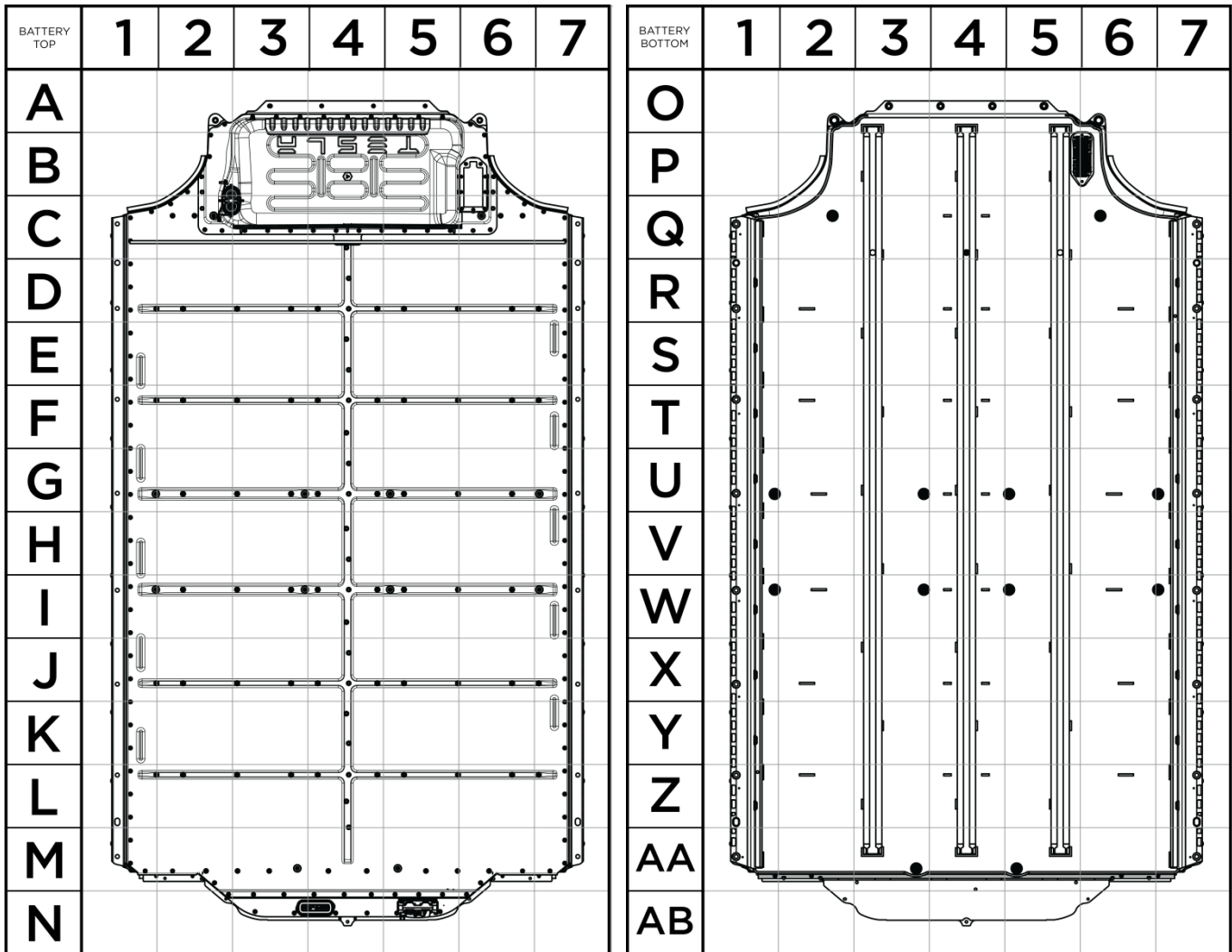
Remove Coolant

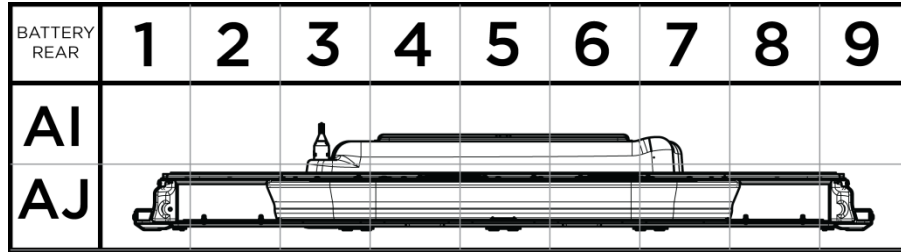
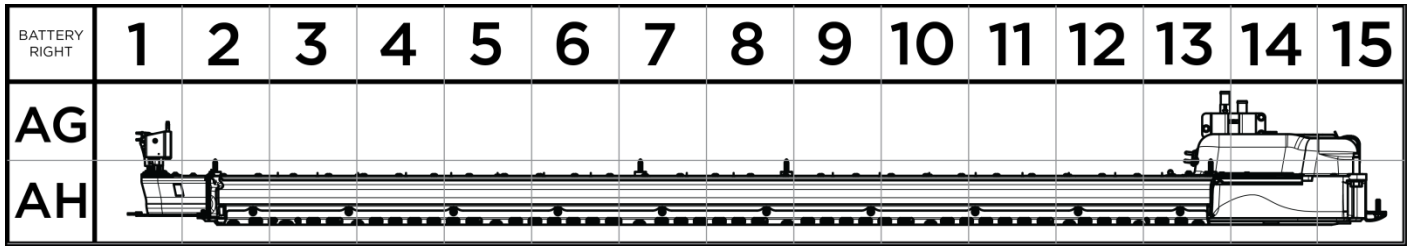
1. If there is no evidence of coolant leakage, drain the coolant from the battery (refer to Service Manual procedure 16010005).

⚠ WARNING: If there is an internal coolant leak, do not pressurize the battery cooling system. Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.

Record Physical Damage

1. Use these diagrams to record any physical damage to the battery.





Protect Connectors and Prepare for Shipping

1. Install a coolant Rapid Mate cover (TPN 1005706-00-C) on the coolant connector.
2. Install an HV battery Rapid Mate safety cover (TPN 1016196-00-A) on the high voltage connector.
3. Install a LV Rapid Mate safety cover (TPN 1016197-00-A) on the low voltage connector.

NOTE: If either Rapid Mate safety cover is not available, cover the connector with 3M 2480S masking tape or 3M 471 vinyl tape.

4. Create an MRB record for the battery.

Conclusion

NOTE: The battery is not suitable for transportation or use inside a Tesla vehicle if any section of this form indicates that the battery might not be stable.

The HV battery is suitable for transportation or use inside a Tesla vehicle: <input type="checkbox"/>
The HV battery is not suitable for transportation or use inside a Tesla vehicle: <input type="checkbox"/> Tesla Service Centers should escalate a Toolbox session, as appropriate; all others should contact Tesla at the phone number listed at the end of this document.
Tesla Part Number:
Tesla Serial Number:
VIN (if available):
Form Completed By:
Telephone Number:
Service Center:
Signature:
Date:

Print a copy of this completed evaluation form and either include it with the appropriate hazardous goods regulatory paperwork when the battery is shipped or keep it to return to Tesla if the battery is not suitable for transportation.

Tesla Emergency Contact Information

For emergency contact information for any countries not listed, see <http://www.teslamotors.com/contact>.

Country	Telephone Number
United States of America	Toll Free: 1-877-79TESLA (1-877-798-3752)
Andorra	Toll: +31 (0)13 799 9501
Australia	Toll Free: 1 800 64 6952 Local: + 61 2 8015 2834
Austria	Toll Free: 0800 88 0992 Local: 07208 80470
Belgium	Toll Free: 0800 29 027 Local: 03 808 17 82
Bulgaria	Toll: +31 (0)13 799 9504
Canada	Toll Free: 1-877-79TESLA (1-877-798-3752)
China	Toll Free: 400 910 0707

Country	Telephone Number
Croatia	Toll: 013 799 9505 Local: 017 776 417
Cyprus	Toll Free: 08007 7318 Local: 022 030915
Czech Republic	Toll Free: 080008 4048 Local: 0228 882 612
Denmark	Toll Free: 80 71 1024 Local: 898 869 84
Estonia	Toll: 013 799 9509 Local: 0880 3141
Finland	Toll Free: 0880 055 2084 Local: 075 3263818
France (+Corsica)	Toll Free: 0800 94 1029 Local: 09 70 73 08 50
Germany	Toll Free: 0800 589 3542 Local: 08921 093303
Gibraltar	Toll: +31 13 799 9513
Greece	Toll Free: 0800 848 1169 Local: 02111 984867
Hong Kong	Local: + 852 3974 0251
Hungary	Toll Free: 0800 88052 Local: 01 700 8549
Iceland	Toll: +31 13 799 9516
Ireland	Toll Free: +1 800 90 2905 Local: 01 513 4727
Italy (+Sicily/Sardegna/Vat. City)	Toll Free: 800 596 815 Local: 069 480 1252
Japan	Toll Free: 0120 975 214
Latvia	Toll: +31 13 799 9519 Local: 067 859 774
Lithuania	Toll: +31 13 799 9521 Local: 0521 40649
Liechtenstein	Toll: +31 13 799 9520
Luxembourg	Toll Free: 8002 2538 Local: 27 86 14 16
Malta	Toll: +31 13 799 9523 Local: 02778 1126
Monaco	Toll: +31 13 799 9524
Netherlands	Toll Free: 0800 020 0160 Local: 013 799 9525
Norway	Toll Free: 800 11 093 Local: 23 96 02 85
Poland	Toll: 022 307 26 45
Portugal	Toll Free: 0800 180 343 Local: 030 880 5628
Romania	Toll: +31 13 799 9530 Local: 0316 301 257
San Marino	Toll: +31 13 799 9531
Slovakia	Toll: +31 13 799 9532 Local: 023/300 26 43
Slovenia	Toll: +31 13 799 9533 Local: 08 288 00 33
Spain	Toll Free: 0900 800 324 Local: 0911 98 26 24
Sweden	Toll Free: 020 88 92 68 Local: 0775 88 80 36
Switzerland	Toll Free: 0800 002 623 Local: 061 855 30 21
United Kingdom	Toll Free: 0800 756 9960 Local: 0162 845 0660

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