Subject: Re: [EVDL] Isolation of the power circuit - reasons for and against?
Date: 8 September 2008 5:46:41 PM
From: Evan Tuer, evan.tuer@gmail.com

On Mon, Sep 8, 2008 at 7:52 AM, Ian Hooper <evdl@zeva.com.au> wrote:
Hi all,

I'm part of a group currently working towards updating the national regulations for road-legal electric vehicles in Australia, and the group's opinion is currently divided on the subject of whether the power circuit should be isolated from the vehicle body.. So I'm hoping to get some *technical* reasons for and against this from any experts in the field!

First, on terminology - "Power circuit" is a bit ambiguous. With EVs, it's more usual to say traction battery / traction power circuit. "Power" might be confused with the mains power used to run the battery charger.

Some people believe it should be isolated, because then you can't get a shock from touching any one point in the power circuit and the vehicle itself.

Agreed. It avoids or mitigates several less obvious problems as well.

Others believe they should have a common ground so the potentials are known, and so that there is a predictable voltage potential across the insulation in the motor (i.e between the motor windings and the motor housing).

It's not a good enough reason to counter the other reasons for keeping it isolated, IMO.

Low-resistance paths will eventually develop, usually in the motor (on a DC vehicle) while driving. If you've connected the pack to the chassis elsewhere, this is likely to develop into high current faults and which can damage the controller or motor.

With flooded batteries in a conversion vehicle, you also have the problem of leakage between the pack and the chassis. Again, if you've intentionally connected it at one point, you could well get "leakage" from another battery to the chassis (or even insulation damage from a cable rubbing or being crushed) : possibly a fire risk and at least it will cause corrosion or balance problems.

There is also the problem of detecting such faults. If the pack is connected to the chassis at some point, you can't automatically detect a leakage current - the first you will know about it is when a serious problem develops.

Finally, there's the issue that people expect high voltage battery systems to be isolated, just because this is common practice in many fields, not least electric vehicles. Doing it differently is a hazard in itself, because people don't read warning labels..

I'm of the opinion that the power circuit should be isolated but with a ground leakage detector between the power circuit and the vehicle body, so you actually know if there is a ground fault in the circuit.

The Peugeot/Citroen EVs are like this. I don't know if it needs to be a requirement but it's definitely useful to alert you to a minor problem (e.g. brush dust build up or water in a fuse holder) before it becomes a major one.

Subject: Re: [EVDL] Isolation of the power circuit - reasons for and against?
Date: 8 September 2008 3:04:53 PM
From: Bill Dube, billdube@killacycle.com

The traction wiring is always isolated from the body of the car. If you make a regulation that requires that it is not isolated, non of the manufacturers will sell their car in Oz. It is a requirement that the traction wiring be isolated in most other countries.

Isolated traction wiring is like a double insulated appliance. The safety is enhanced.

If you connect one end of the traction pack to the body of the car, a ground fault anywhere in the system will cause serious plasma. It will be impossible to protect the battery pack from going up in plasma in the case of a ground fault if you ground one of the ends of the pack. You double the chances of a plasma fire in an accident if you ground one end of the pack.

If a ground fault occurs, you can easily detect it and warn the operator that it has occurred.

If you accidentally touch the traction wiring, and it is otherwise isolated, you will not get a shock at all, even if you touch the car body too. If the traction wiring is NOT isolated, the person that touches the traction wiring accidentally may not live to tell about it.

Subject: Re: [EVDL] Isolation of the power circuit - reasons for and against?
Date: 9 September 2008 6:13:46 AM
From: Jeff Major, jff_mjr@yahoo.com

Hi Ian,

Keep it isolated by all means. Even lower voltage battery powered industrial trucks, like fork lifts, require isolated traction circuits. This is an UL (Underwriter's Labs) spec in the US, I believe. See if you can get a copy of UL 583 UL Standard for Safety Electric-Battery-Powered Industrial Trucks. Or maybe the Down Under equivalent.

Regards,

Jeff M

Subject: Re: [EVDL] Isolation of the power circuit - reasons for and against?
Date: 9 September 2008 10:18:57 PM
From: leeahart@earthlink.net

Chris Zach wrote:
I have a pack with a very small amount of leakage between about the center of the pack (150 volts) and frame ground. It's very low (2ma or so)

2ma isn't "very low". It's enough to kill under the wrong circumstances. The leakage limit for medical electronics is 0.5ma, which is considered low enough to be safe even for invalids or children, or conditions like wet skin.

The usual 5ma limit is considered the most you can allow under normal conditions (a normal healthy person, able to move himself quickly out of

contact, skin not wet, etc.). Your 2ma is most of the way there.

So, I would find the cause of this 2ma leakage, and fix it if possible. It might be electrolyte on the battery tops, carbon dust in the motor, a failed component somewhere, etc.

Besides safety, there's another reason to fix it. This DC leakage current will cause corrosion at the terminals or body parts it is flowing between. The battery terminal and/or chassis mounting point will rot away over time.

If one put a resistor at the center of the pack to frame ground to bleed off this charge, is that defeating the purpose of a true isolated pack? If a ground fault did happen the resistor would vaporize immediately or I could put a 150 volt 1a DC rated 10k AIR fuse along with it.

A large value resistor between pack and ground (100k or more) is relatively common. This value is high enough so you can't get a deadly current through it (100k is 1ma with a 100v pack). But it's low enough to bleed off any static charge or minor leakage currents.

Systems that have this resistor also usually sense the voltage across it (or current in it) to detect ground faults. If such a fault is detected, it shuts down the system. The resistor isn't usually connected in just one place in the pack; there's one at each end, or one that gets switched alternately to each end. That way it detects a ground fault no matter where it occurs in the pack.