

Safe conversions: Chassis Thoughts

10/29/2009 Version 1 David Kerzel

I look at converted vehicles and see a wide range of safety consciousness and workmanship. These vehicles are being converted for a number of reasons and with wide expectations. Most conversions are done by an individual at home who is learning as they go. My concerns are is the resulting car safe when parked, when it is being shown to other enthusiasts, when it is being driven, and when its time has past. None of these items are difficult or overly expensive. If done well will show an extra level of attention to detail and safety that the builder should be proud of.

Recently I have seen on a number of message boards postings about getting converted vehicles inspected by the State Police or the state DOT. Most of them seem to go well and describe similar areas of interest for the inspector.

Good construction and wiring should be evident, this should not look like something built in a few hours at the junk yard.

Electrical connections need to be done with care, using proper size wires and appropriate terminal lugs. All connections and devices need to be electrically touch safe, either by insulation or by being located in a secondary protective enclosure. Traction voltage wires need to be color code orange so everyone knows what dangerous. There needs to be a main disconnect that can be found for emergency shutdown that the driver can operate. Warning decals are needed to remind people of the hazards

One of the important things will be Gross Vehicle Weight. This is the weight of the vehicle, fuel, all passengers (150 LB, 68Kg each), and cargo. When the donor vehicle was designed, it was engineered to function at the original GVW.

Depending on the inspector or the inspection guidelines GVW is an important number not to exceed. The breaks, the suspension, the energy absorbing parts of the car are based on this weight. If this weight is maintained the original car safety and handling should be maintained.

If in the conversion process you eliminate the back seat so only 2 front seat passengers can travel the weight for the lost passengers can now be batteries but the GVW should not be exceeded.

Many converters begin the project with the assumption the GVW will be significantly more after conversion. This is probably true for conversions with heavy lead based battery systems. There are a number of reasons to avoid these heavy batteries in addition to weight but our focus here is the chassis. Extra attention needs to be given to using the highest energy density (KW/Lb) batteries that fit in the projects budget.

The batteries need to be securely mounted in the vehicle. Frames that prevent the batteries from moving and clamps or straps to keep them in the frame are essential. These battery supports not only need to keep the batteries in position in normal use but also if there is ever a collision. The battery supports need to be able to provide 10G of restraint, left, right, forward, back, and up or down. If you have a battery that weighs 40Lb (18Kg), the 10G of restraint is 400LbF (180Kg or 1780Newtons). That is a lot of force and if there are 8 batteries in the rack it needs to restrain all 8 or 3200LbF (14KN). Most frames I have seen were flimsy and not mounted to the vehicle well enough for forces of this level.

Most builders are willing to add a vacuum pump to keep the power Breaks. The breaks are part of the safety system and sized on GVW. Many builders change the brakes to aftermarket brakes that are larger diameter and have better stopping characteristics. If you maintain GVW this should not be needed unless you are increasing power and speed.

If you choose an AC motor system regenerative braking will be available. The regenerative action recovers kinetic energy, and slows the vehicle. It can be set up to be as intense as forward acceleration but this may cause stability issues because only 2 wheels are doing the brake action. It is possible to link the regenerative action torque with the brake pedal so it combines with the friction breaks. If you use regenerative braking, the controller should activate the brake lights to let others know you are slowing down,

Power steering was designed into most modern cars to aid at low speed because of the weight. Eliminating the power steering changes the original characteristics of the car and impacts the overall safety. Many newer cars use electric power steering pumps. Some are external others are integrated into the steering rack. These pumps

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use a lot of 12 volt current often 60Amps but they have controllers that regulate pump pressure based on speed and stop the pump if you are not turning. We know the car will not end up significantly lighter and this is an important feature to implement if possible

Cabin environment needs some consideration. If you are someplace that gets cold, you need heat. Some of us are spoiled by air conditioning. Regardless thought needs to be given about how the windshield will be kept fog free on a cool morning. A heater that works with the original ductwork and ventilation valves will take care of it.

Batteries regardless of type and traction voltage wiring do not belong in the cabin with people. Batteries could burst or release gases, wires could overheat and smoke. Keep yourself and possible passengers safe.