

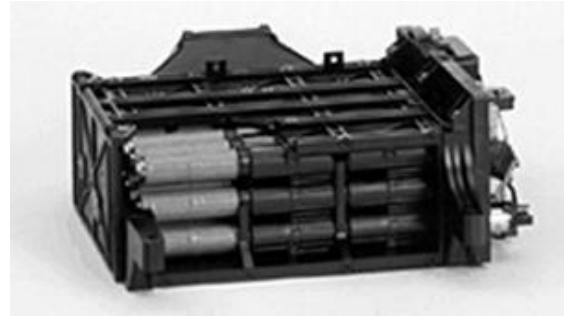
Ima batteries, chargers and dischargers

The Insight Ima motor system and battery is one of the keys to the vehicles ability to perform well and give such good mpg. The Ima electronics and motor is significantly over engineered, and rightly maintains that great Honda record of reliability and hackability.



Insight Ipu compartment

The Ima battery is perhaps the only slight weak link in the chain. It is made up of 120 special D size Panasonic 6.5ah Nimh cells assembled into groups of six cells (sticks), these sticks are connected in a series string, packaged into a sturdy plastic case with fan cooling. It gives a nominal 144v pack voltage, and approximately 750wh useable capacity. Each stick is fitted with a Ptc thermistor strip to detect individual overheating cells. The pack is also fitted with four Ntc thermistors for pack level temperature control. The battery is managed by a dedicated module called the Bcm (Battery control module) this is in constant communication with the Mcm (Motor control module) and dictates how the battery is used. The high dc voltages associated with the battery must be treated with respect and appropriate safety measures taken when working on the system.



Insight Ima battery

Battery failure

Unfortunately the Ima battery is an expensive part, costing around \$2000 to replace. When it becomes weak, unbalanced or unreliable it makes a significant hit on the cars day to day mpg figures. Symptoms of a weak, unbalanced or dying battery include Ima error codes, failure to start from autostop, increased background charging, reduced Ima assist or regeneration, reduced capacity, and regular positive and negative recalibrations. Recalibrations are when the Soc (state of charge gauge) on the dashboard rises (positive) or falls (negative) abruptly. Occasional recals as we will call them are ok, but anything more often than once a month should be treated as a potential warning sign. Recals are generally an indication that the battery is out of balance. As it is comprised of 120 cells in series, each with individual manufacturing tolerances, each cell does not remain in perfect equilibrium with the others. Unfortunately (unlike some other hybrids) the Insight Bcm does not have a way of rebalancing the cells once they go out of balance. In fact it continues to push them hard, and the out of balance cells suffer more speeding there eventual failure. The batteries also suffer significantly more in hot climates, and cars ideally should not be left out all day in baking sunshine.

Maintaining the battery can be accomplished with quite simple equipment, especially if done before significant degradation symptoms appear. Repairing it however after failure is much more difficult, with the

additional hazard of high voltages during disassembly to be contended with.

How do I maintain my Ima battery?

The key to maintaining the Ima battery is to exercise it, by occasionally taking it out of it's comfort zone, and performing grid charging and discharging to remove voltage depression and memory effects. In normal use the car only allows the battery to operate within a 20-80% capacity zone. We aim to exercise it gently within the full 0-100% range during our charging and discharging process.

This significantly improves capacity and performance in the majority of packs if carried out before serious problems appear.

In order to implement this maintenance regime the owner needs to install a simple grid charger and discharger. There are a number of commercial options available from Insight enthusiasts and suppliers, these range from cheaper manual devices, to expensive feature rich automated systems.

Grid Charger

This article will not describe how to build, install or connect a grid charger or discharger, as that information is available on the www.insightcentral.net forum. However in brief a common simple grid charger is a mains powered device constructed from a number of constant current and constant voltage led driver power supplies. For the main battery charger a pair of constant current led drivers connected in series, with a combined output of around 300-350ma at about 180v maximum is the aim. A separate 12v constant voltage supply of around 500ma is also required to drive the battery cooling fan. It is imperative the battery is cooled during charging as the cells will generate heat once full.

The aim is to gently charge the Ima battery for a long period of time to top balance all the cells. This will take from between 24-36 hours depending on the state of charge of the

battery before starting the process. It is not imperative to monitor the time accurately but the charger is not a device which should be attached and operating permanently. Charging in this low current way slowly fills all the cells to 100% capacity and balances them.

Some packs will see a significant improvement in performance from simply performing this single balancing charge, and owners may not need to proceed to the next step of discharging the pack.

Grid charging should ideally be performed as soon as recals start to occur. It should not be used excessively though, as on healthy packs it can exacerbate some memory effects. There is a delicate balance to be struck between charging and discharging, battery longevity and pack performance. Once every 3 months should be considered a maximum for simple grid charging.

Discharger

If grid charging alone does not improve the pack, then it's time to try discharging. This is accomplished by connecting a low current resistor load across the pack along with a cheap multimeter, and letting it discharge until the voltage drops to a pre determined cut off point. A cheap ceramic resistor of about 500 ohms and 100w capability is ideal. It will gently discharge the pack, and the current will taper as the battery voltage falls. It can take anything from 6-18 hours to discharge the pack, and this should be monitored with the multimeter and stopped once the voltage falls to around 120v (approx 1v per cell)

Once the discharge is complete you simply charge the pack again for 24-36 hours, and it should have improved considerably. It is important to remember the pack should be charged fully before the discharge phase is initiated.

Cycling

Repeated charging and discharging is called cycling, and can be useful when the battery proves resistant to a single charge/discharge /charge cycle. You add additional cycles onto the process and take the battery down to lower and lower voltages. 120v, 100v and 80v are reasonable discharge voltages to aim for. Taking the voltage down even lower can be considered as a last chance for packs that stubbornly refuse to improve. If this deep cycling does not improve the pack then it needs disassembling for further examination and stick replacements.

Battery disassembly and stick replacement.

Fixing a battery that has not responded to grid charging and discharging is not a simple process. It is time consuming, complex, and ultimately if used sticks are swapped in, not likely to lead to a very great result. A lot of Ima battery suppliers (including myself) do not offer a repair service based on second hand stick swapping due to the very variable results that are obtained. For reasons of reliability and consistent performance we usually swap all the sticks for a set of new matched warranted ones.



Insight battery sticks

Sticks in packs, and cells in those sticks can fail for a number of reasons. Some in very high mileage vehicles simply wear out and reach the end of their cycle life. Others leak electrolyte, reduce in capacity, go open or short circuit, or develop high internal resistance.

Sometimes obvious failures can be detected by measuring the voltages of the sticks. When one stick differs significantly in voltage from the others (indicating a cell failure) it can be swapped for a known good one. Other problems are much more subtle and can only be pinpointed with analysis of every stick, capacity, internal resistance, high current charge/discharge performance, and self discharge rate. The suitable equipment and time required makes such analysis only suitable for those with lots of time and spare sticks to work with. Second hand sticks added to different packs also have to be matched as closely as possible with the others. This is difficult, and ultimately leads to the pack going out of balance in use quite quickly. Regular use of the grid charger / discharger will be required to try and keep it functioning.

Conclusion and future developments

Every long term insight owner should have a grid charger discharger system to maintain their Oem Nimh pack in optimum condition, and give it the maximum possible useful life.

The future however beckons and as time marches on our cars may soon have a new lease of life with massively improved retro fit lithium packs. These are being worked on right now by expert owners and enthusiasts, and will ultimately deliver huge increases in capacity and power. They will make the Insight a true plug in hybrid with a 150mpg capability.