

## **A brief explanation of high frequency impedance testing technology**

The high frequency impedance (HFI) testing technology developed by Argus overcomes two significant shortcomings of conventional testing technology, such as load testers and conductance testers. First, load testing can detect an obviously failed battery, but provides very limited information about the capacity of a battery that hasn't failed. Second, conductance testing is very good at determining present capacity, but tests can be performed only when the battery is functionally off line.

Argus' HFI technology uses the same basic principal that AC conductance testing uses: calculate a capacity value by measuring the internal resistance or conductance (the inverse of internal resistance) of the battery. However, accurately measuring internal resistance is more easily said than done.

Conventional conductance testing involves injecting a low level (very close to 12V) AC signal into the battery and measuring the battery's voltage and current response. From this response a conductance value can be calculated using Ohm's Law. Because this approach relies on measuring small voltage fluctuations around the nominal voltage of the battery, the results of a test can be significantly distorted by any electrical noise from a connected system. Noise will be generated by a connected ignition system and by the duty load or a charger if they are connected and running.

In contrast, the HFI approach applies a series of very short duration (millisecond) high current loads to the battery. By measuring the change in battery voltage during each of these high frequency and high intensity loads, the internal resistance of the battery can be determined and the present capacity can be calculated. The voltage of the battery can swing dynamically up and down as demanded by the duty load or charger. Because the duration of the impressed load is so short and the internal resistance is determined by the CHANGE in battery voltage over such a short period of time, it does not matter if there is a dynamic duty load (or a charger) applied to the battery.

What does this mean? HFI testing can be applied to test a battery while the battery is being used. It can determine the present capacity of the battery without needing to take the battery system off-line. It can also be used as a 'gas-gauge' to show how much energy is remaining in the battery and when it should be charged.

The Argus AA Series Models 300-500 use HFI technology for capacity testing, and battery failure.