GFCI (**Ground Fault Circuit Interrupter**) protection is a system that shuts down the protected electric circuit -- opens it -- when it senses an unexpected loss of power, presumably to ground. GFCI protection devices constantly monitor and compare the amount of power flowing from the panel on the hot or phase wire and the amount returning on the neutral wire. Any time the returning power drops even slightly below the amount being supplied, the protection device will trip and open the circuit.

A GFCI (see Fig. 1) is the only protection device designed to protect people against electric shock from an electrical system. Because of this, we need to understand what a GFCI is, how it works, and what its limitations are.

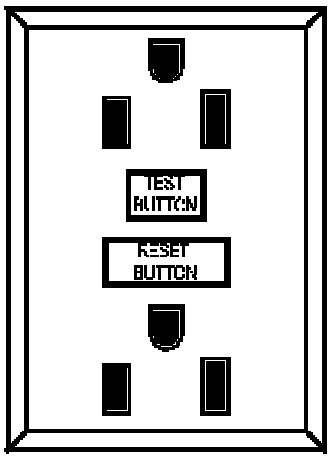

Fig. 1

The first requirement for GFCI protection appeared in the National Electrical Code (NEC) in 1971 and became effective January 1, 1973. The requirement only included exterior receptacles and swimming pool circuits. The rest were added over the next twenty years. Wet bars, the latest addition, were first included in the 1993 NEC.

We need only to look to the NEC for the definition of a GFCI. The NEC defines it as "a device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the over current protective device of the supply circuit."

A GFCI protection device operates on the principle of monitoring the imbalance of current between the circuit's ungrounded (hot) and grounded (neutral) conductor. It does not monitor the grounding conductor, and so it will still operate in a circuit without a ground. GFCI devices, including receptacles and circuit breakers, work by passing both the hot wire and the neutral wire through a sensor - such as a differential transformer - and connecting the sensor to a solenoid or relay that opens switch contacts built into the power conductors inside the device.

GFCIs are designed to protect us against a ground fault, which is an unintended loss of power to ground -- possibly through a person. The regular grounding system protects the equipment that is attached (or plugged in) to the circuit against a ground fault in it. GFCI devices are designed to protect people, not equipment.

In a typical 2-wire circuit, the current returning to the power supply will be equal to the current leaving the power supply (except for some small leakage). If the difference

between the current leaving and returning through the current transformer of the GFCI protection device exceeds 5mA (5 milliamps), the solid-state circuitry opens the switching contacts and de-energizes the circuit. This will always happen as long as the GFCI is in working order. However, GFCIs fail more often than most people think and when a GFCI protection device fails, the switching contacts remain closed, and the device continues to provide power - but no protection.

According to a study conducted by the American Society of Home Inspectors (ASHI) published in IAEI News, November/December 1999, 21% of GFCI circuit breakers and 19% of GFCI receptacles tested did not provide GFCI protection. Yet, the circuit remained energized! In the examined cases, failures of the GFCI sensing circuits were mostly due to damage to the internal transient voltage surge protection that protect the GFCI sensing circuit. This damage resulted from voltage surges from lightning and other transients. In areas of high-lightning activity, such as Southwest Florida, the failure rate for GFCI circuit breakers was more than 57%.

One final thought on GFCI protection: Press the test feature of the GFCI protection device to ensure it works. These are excellent devices when properly wired. However, never assume a GFCI protection device is operational unless you test it!

RECOMMENDATIONS FOR HOMES CONSTRUCTED PRIOR TO 1971

If you are living in a home built before the introduction of GFCI, it is recommended that you hire a certified, licensed electrician to replace the non-GFCI receptacle outlets with GFCI-protected types in the locations listed below. The cost of replacing existing non-GFCI receptacle outlets is minimal compared to the safety they provide.

Receptacle outlets are required to be GFCI-protected in the following locations:

- Kitchen counter tops
- Bathrooms
- Within 6-feet of a wet bar sink
- Unfinished rooms in the basements used ONLY for storage and work area
- Garages
- All outdoor receptacle outlets
- Crawl spaces
- Rooftops
- Swimming pools
- Spas or hot tubs