

Locating Unshielded Electrical Wires

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Introduction

Electrical wires are usually concealed inside the walls or floors. While driving a nail or drilling in such walls and floors, there is always a risk of hitting a live electric wire resulting in injury or even loss of life.

There are some devices that are used to locate the electric wires inside walls or floors. Some of these devices can pinpoint the exact location of the wires. However, these devices cost thousands of dollars.

Zircon Studsensor Pro SL-AC, which is basically used as a stud finder, has an AC wire warning system that can be used to locate live electric wires inside walls and floors. This inexpensive equipment appears to have the potential of locating electric wires, is easy to use and could be a standard tool on a project site.

Currently, there is a research being carried out at Southern Illinois University at Edwardsville (SIUE) to check the reliability of this device. Data from Nepal and Mongolia will also be collected where concrete is the most commonly used material for construction purposes. These data will help us determine whether this equipment can detect live electric wires concealed in a variety of construction materials.

Product Information



The Studsensor Pro SL-AC

The Studsensor Pro SL-AC is a small tool, 6.07 in. (154 mm) long, 2.70 in. (68 mm) wide and 1.18 in. (30mm) deep. It weighs 5.7 oz (163 g) with battery. It uses a 9-V alkaline battery which is included with it. The estimated battery life is 1 year at 10 minutes per day. The operating temperature of this splash and water resistant tool is 20⁰ to 120⁰ F (-7⁰ to 49⁰ C) and its storage temperature is -20⁰ to 150⁰ F (-29⁰ to 66⁰ C.)

The equipment can be operated under two different modes – Stud Scan and Stud DeepScan mode – to locate studs behind walls and under floors. The AC Wirewarning system is active in both of these modes. This allows the user to determine the location of a live wire and thus avoid electrical hazards. The company claims that the AC position accuracy of a hot unshielded wire is within 6 in. (150 mm) for 90 – 250 V at 50 – 60 Hz. In typical drywall with Romex wiring, the equipment can detect wires up to 3 in. (76 mm) deep.

Lab Experiments

For the lab experiment, the equipment was used to locate live electric wires placed at varying depths (1, 2 and 3 inch) under different kinds of wall materials. Studs were also attached to the wall materials to create a similarity to the actual condition and to check whether the presence of studs near wires affected the readings in any way.



Locating Electrical Wire Behind Drywall



Locating Electrical Wire Behind Particleboard

Depth of wire from the outer surface of the wall material: 1 in. (25 mm)

Material	Variation of the located position to the actual position of the wire when the wire is close to [in. (mm)]		
	Steel	Wood	Midway between studs
? in. particle board (Sawdust)	$\frac{1}{2}$	$\frac{1}{4}$	0
$\frac{1}{2}$ in. particle board (Chips)	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
$\frac{3}{4}$ in. particle board (Chips)	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
? in. drywall	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$
$\frac{1}{2}$ in. plywood	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$
$\frac{3}{4}$ in. plywood	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$
$\frac{1}{2}$ in. foam insulation	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$

Table 1: Lab Experiment Data

Depth of wire from the outer surface of the wall material: 2 in. (50 mm)

Material	Accuracy of the indicated location from the actual location of the wire when the wire is close to (in.)		
	Steel	Wood	Midway between studs
? in. particle board (Sawdust)	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$
$\frac{1}{2}$ in. particle board (Chips)	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$
$\frac{3}{4}$ in. particle board (Chips)	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$
? in. drywall	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$
$\frac{1}{2}$ in. plywood	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{1}{2}$
$\frac{3}{4}$ in. plywood	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
$\frac{1}{2}$ in. foam insulation	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$

Table 2: Lab Experiment Data

Depth of wire from the outer surface of the wall material: 3 in. (75 mm)

Material	Accuracy of the indicated location from the actual location of the wire when the wire is close to (in.)		
	Steel	Wood	Midway between studs
? in. particle board (Sawdust)	½	½	¼
½ in. particle board (Chips)	½	½	½
¾ in. particle board (Chips)	½	½	½
? in. drywall	½	½	½
½ in. plywood	½	½	½
¾ in. plywood	½	½	½
½ in. foam insulation	½	½	½

Table 3: Lab Experiment Data

Field Experiments

The equipment was tested on the walls of a few residential buildings with typical partitioning materials used in the USA. It could locate the electric wires within 1 inch of the actual location of those wires. Currently, the equipment is being tested on concrete buildings in Nepal and Mongolia. Although solid data is yet to arrive, initial results from Nepal suggest that the equipment can locate electric wires in concrete without any reinforcement.

The equipment was also tested on the walls of the ‘Engineering Building’ at SIUE, where the wires are shielded, without any success. Also, the testing done on some of the concrete floors at SIUE yielded negative results.

Conclusion

For typical construction materials used in the USA (drywall, plywood, particle board), the Zircon Studfinder Pro SL-AC can locate electric wires without deviating more than 1 inch from the actual location. However, it should be noted that the equipment cannot locate wires that are shielded or are concealed in metal conduits. Also, the equipment does not work with reinforced concrete construction. The testing done on the walls and floors at SIUE helped confirm this fact.

Although, the equipment can locate unshielded live electric wires in most of the construction materials, it is always advisable to sue caution when working near an electric wire.

Reference

<http://www.zircon.com>