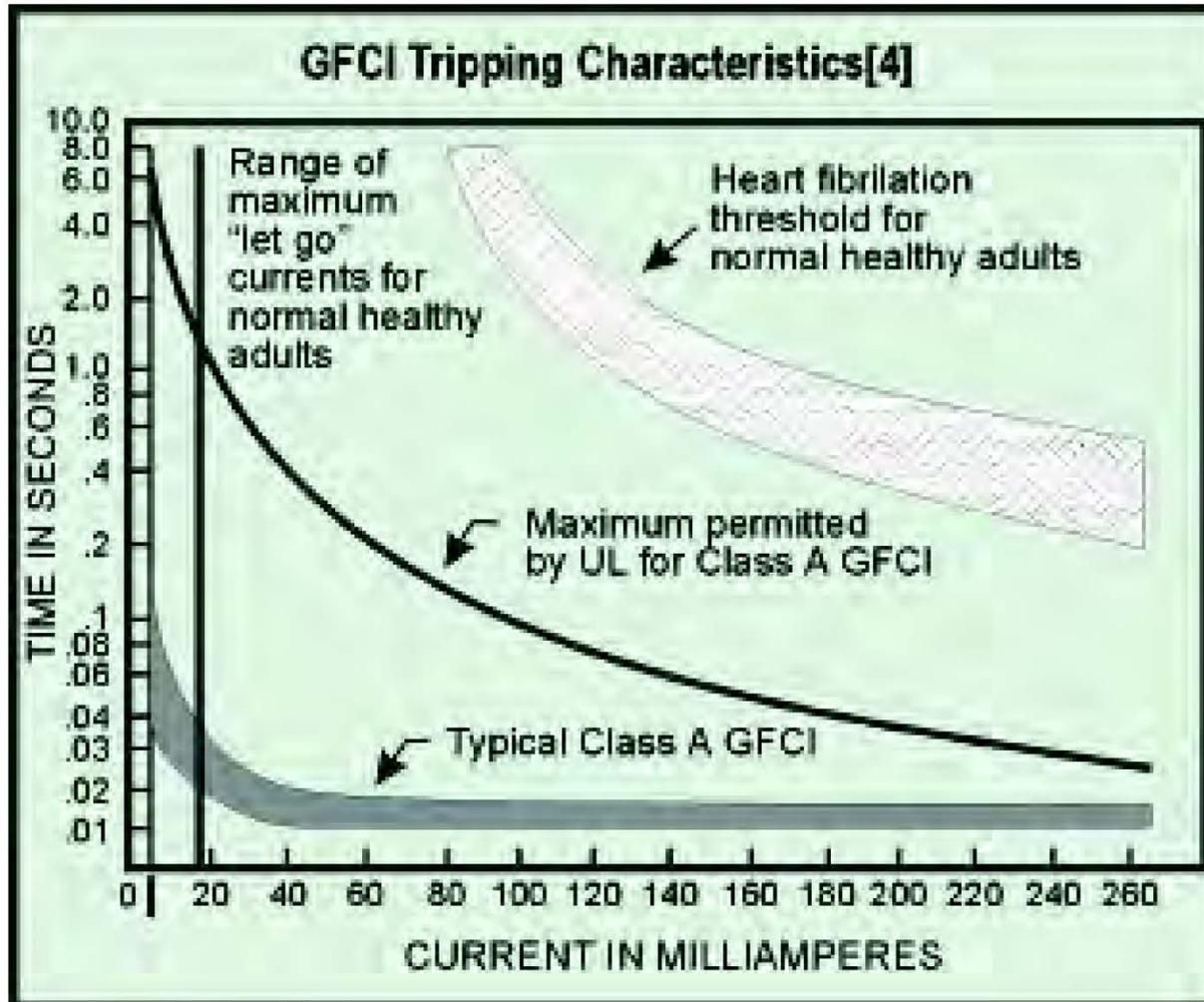
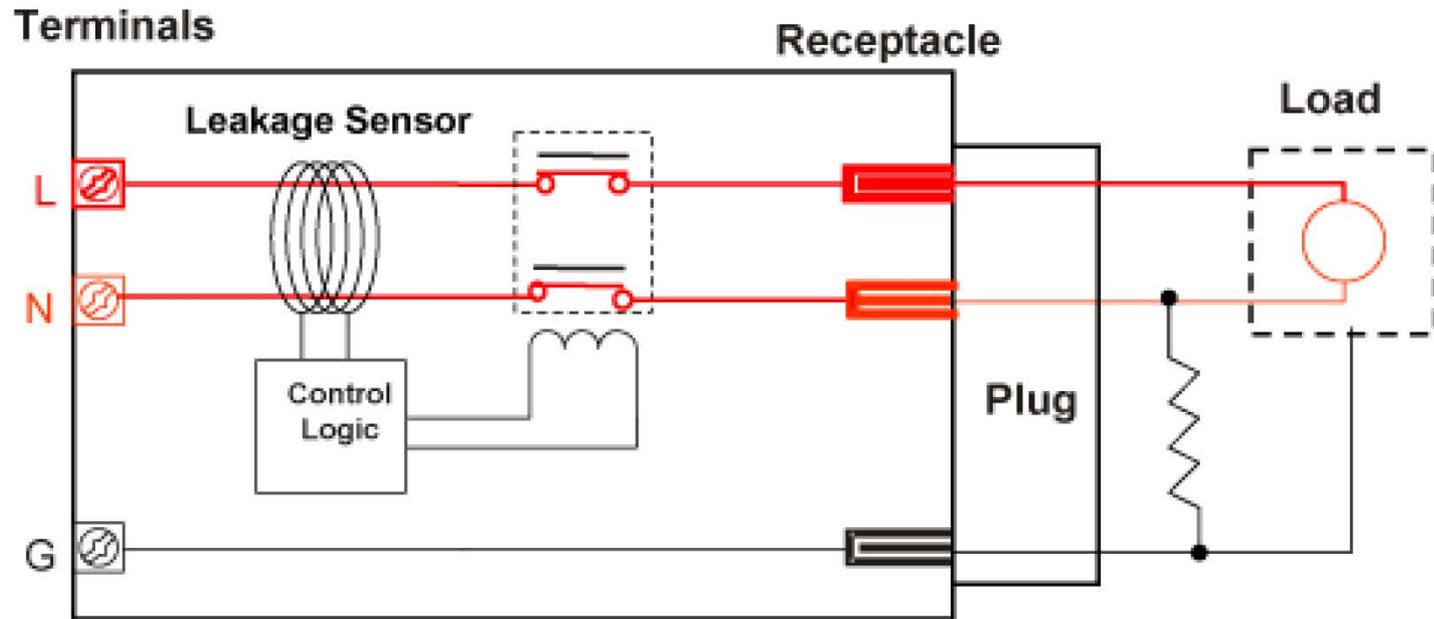


GFCI, AFCI

- GFCIs and AFCIs
- GFCIs prevent electrocution
- GFCIs prevent some fires

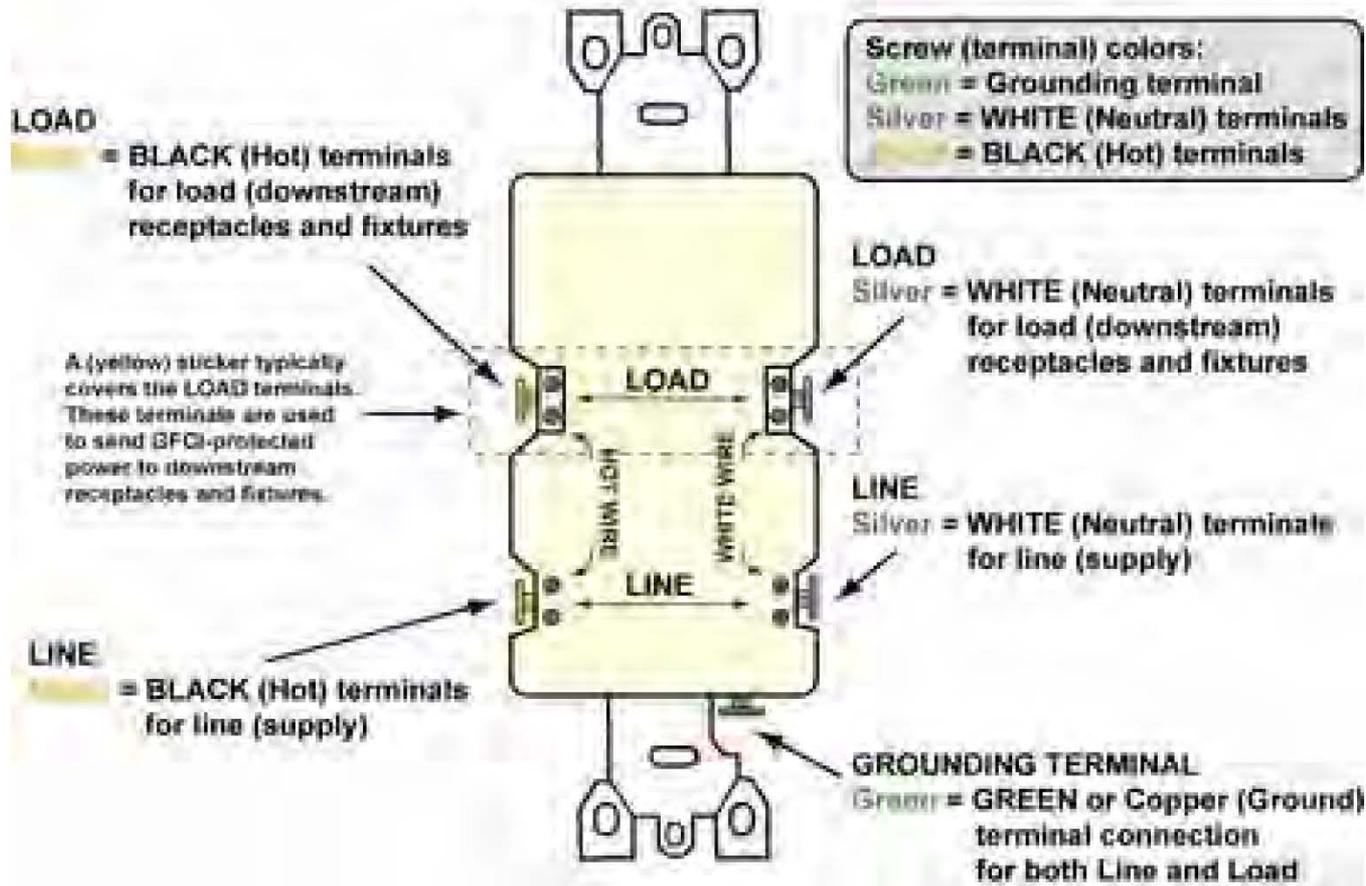
- GFCIs
- What leaves outlet must return
- 7 mA differential





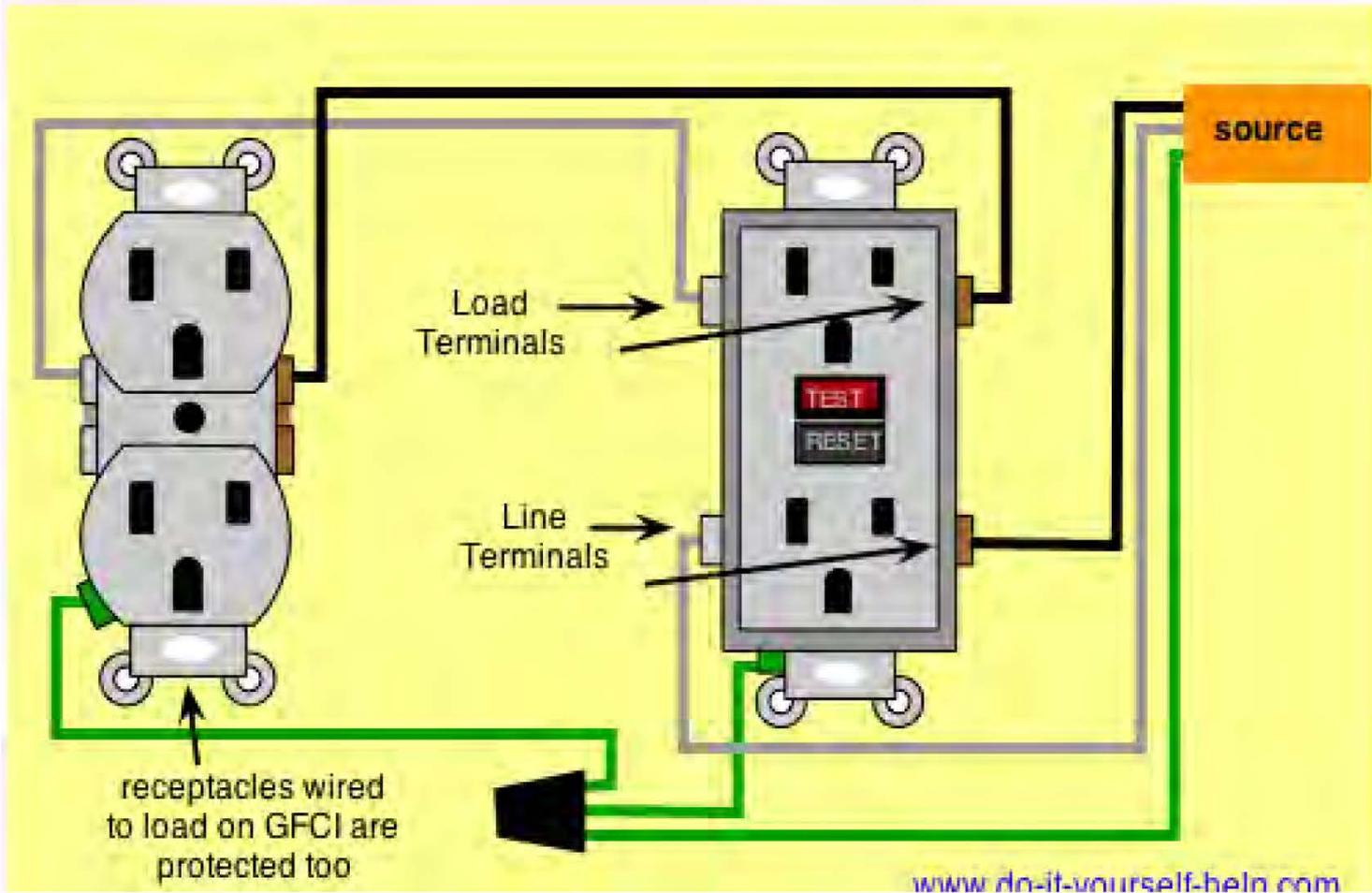
- The Toroid (Donut) sees any differential
- Current leaving generates a magnetic field
- Equal return current generates opposite field
- Fields cancel
- If unequal, then GFI trips

REAR (BACK)



- GFCIs can be in breaker box
- Also located in outlets
- Can protect downstream loads

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Locale for GFIs

- Wet areas
- Outdoors
- Kitchens
- Baths
- Garages

- GFIs help prevent fires
- If wires become leaky, and > 7 mA flows from hot to ground (that should NEVER happen), the GFI cuts off

- GFIs also deter arc mapping

Review paper GFIs and Fire Investigation

- AFCIs
- Arc Fault Circuit Interrupters

- Mandated by Code, 2002, in bedrooms
- Now ALL 120 volt 15 and 20 amp circuits to have AFCI protection
- EVEN smoke circuits

- Designed to detect arcing faults
- But, all motors with brushes routinely arc
- Very difficult to detect all arcs

- Series arc – limited energy, but unlimited time
- Parallel arc – large energy, very short duration as breaker trips

Blackboard on types of arcs

- Series arc – difficult to detect
- Parallel arc – easier to detect

- AFCIs are *ALWAYS* in breaker box
- AFCIs respond to 4 faults
 - Overcurrent
 - Short circuit
 - Arcing fault
 - Ground fault

AFCIs

- Have built in GFCI (GFI)
- Set at 10 mA or 30 mA (mfr dependent)
- MAY provide life safety
- IEC specs (Europe) call for 30 mA trip for ground fault

- AFCIs also deter arc mapping
- If an AFCI is found tripped, the AFCI does not tell you what fault occurred

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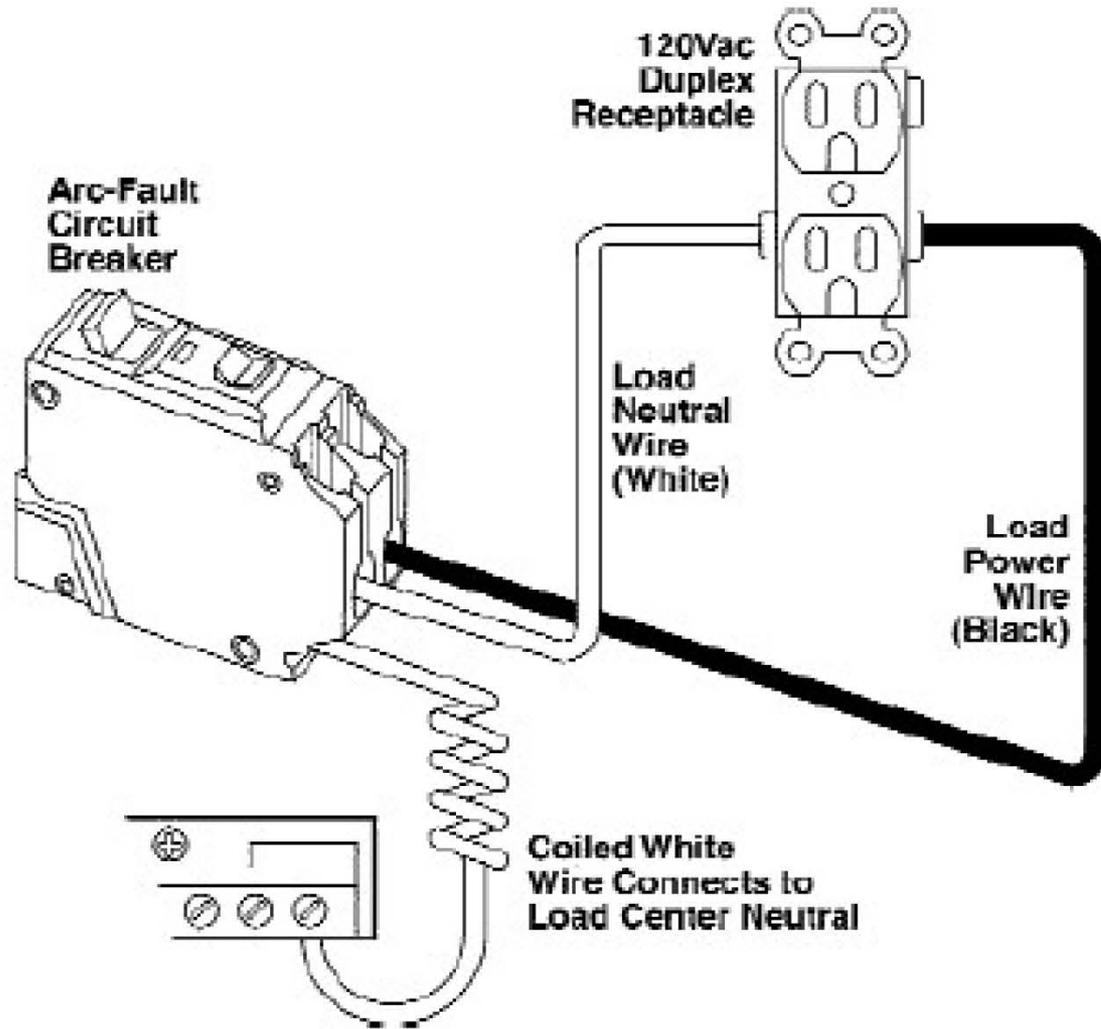


GOODSON INSIGHTS SERIES

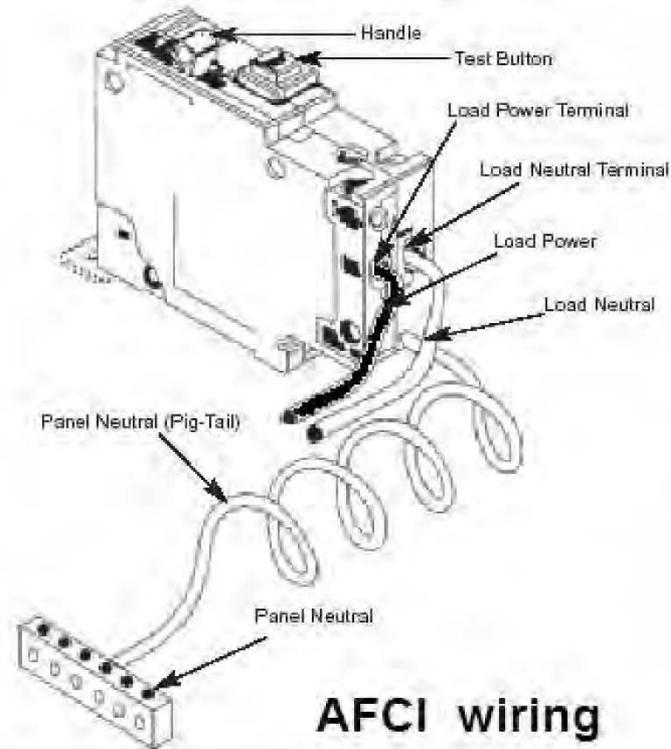


- AFCIs have white pigtail
- Pigtail **MUST** be connected to work
- Pigtail is neutral connection

GOODSON INSIGHTS SERIES



- Common Misconception
- Do GFCIs and AFCIs require a ground connection to work?
- **NO!!!**



- AFCIs and GFCIs DO require a neutral connection
- On a GFCI / AFCI breaker, the lack of a neutral will not keep the breaker from supplying power
- However, the electronics **WILL NOT WORK**

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Review wiring of breaker panel

Recessed Can Lighting Fluorescent Lighting

Recessed Can Lighting

- Normally thermally protected
- Wattage is important (*can be overbulbed*)
- 2 types
- IC – In Contact
- Non IC – Not In Contact

IC type



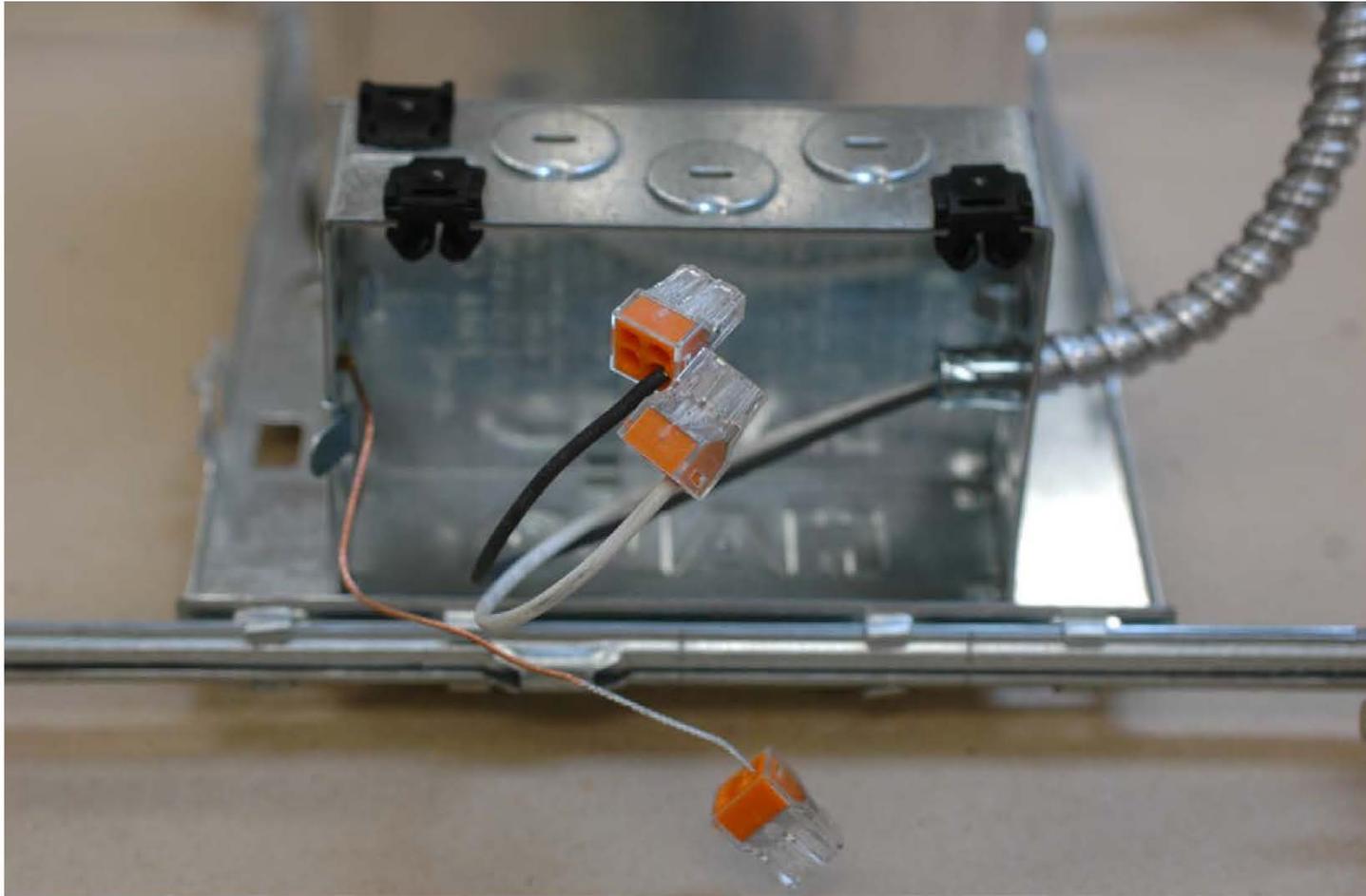
Recessed Can Lighting

- Most commonly either line voltage (120v) or low voltage (12v) Most common sizes are 6" or 4" housings
- Lamp wattage is usually based on the type of trim used
- Baffle or Ring Trim = 60w bulb
- Shower trim = 40w bulb

Recessed Lighting

- The newer ones are usually thermally protected
- Thermal protection is a bimetallic strip that will re-close the contact when it cools.
- Most common form of thermal protection is mounted to the housing and is monitoring the actual temperature of the housing.
- Another type of thermal protection is detecting the heat flux accumulated by overblown insulation. This type of thermal protection is mounted on the side junction box. Its operation assumes that the bulb / can will have the same overspray. If not, it is not effective in preventing fires.

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Non IC

- Should have 3" gap from all insulation
- No cellulose
- No fiberglass
- No foam
- No rockwool
- Gap required by NEC

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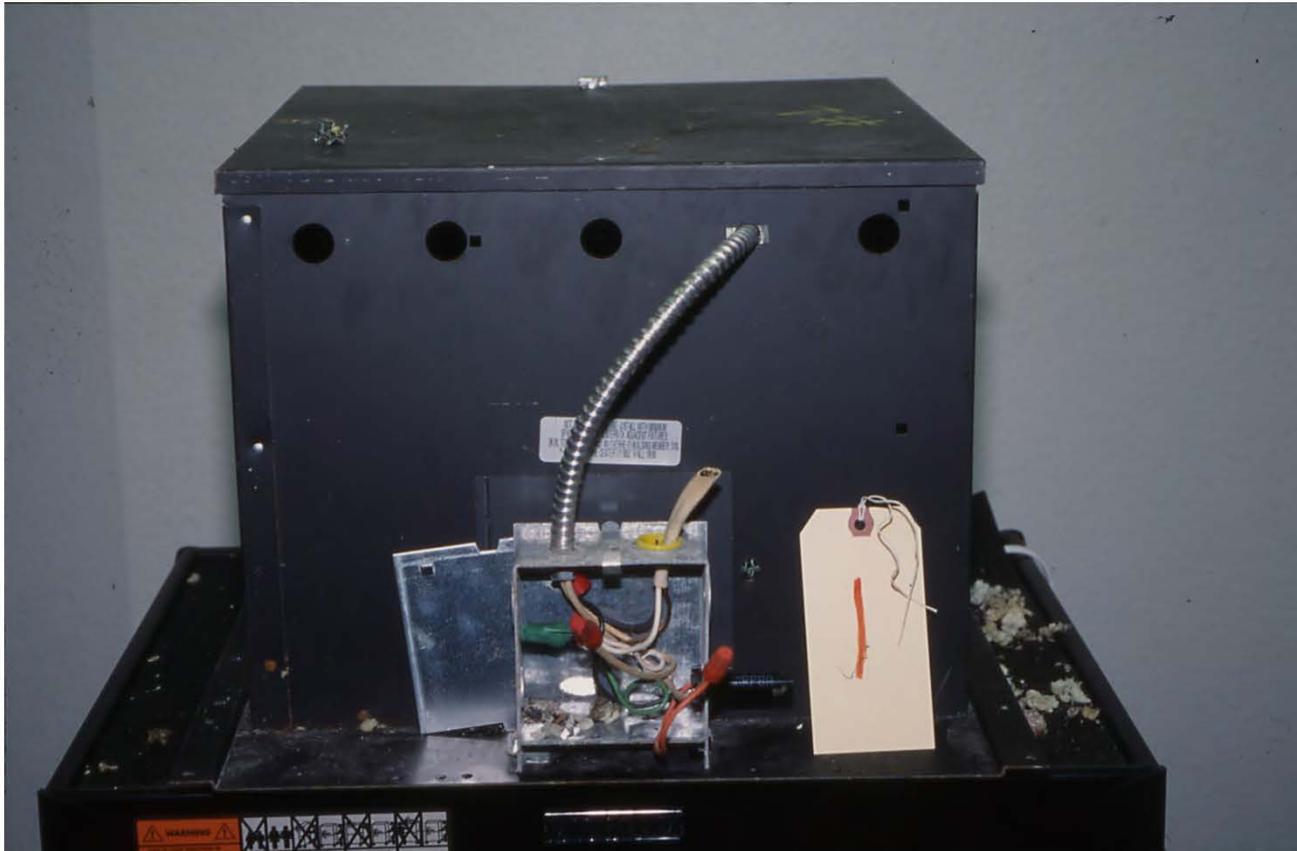


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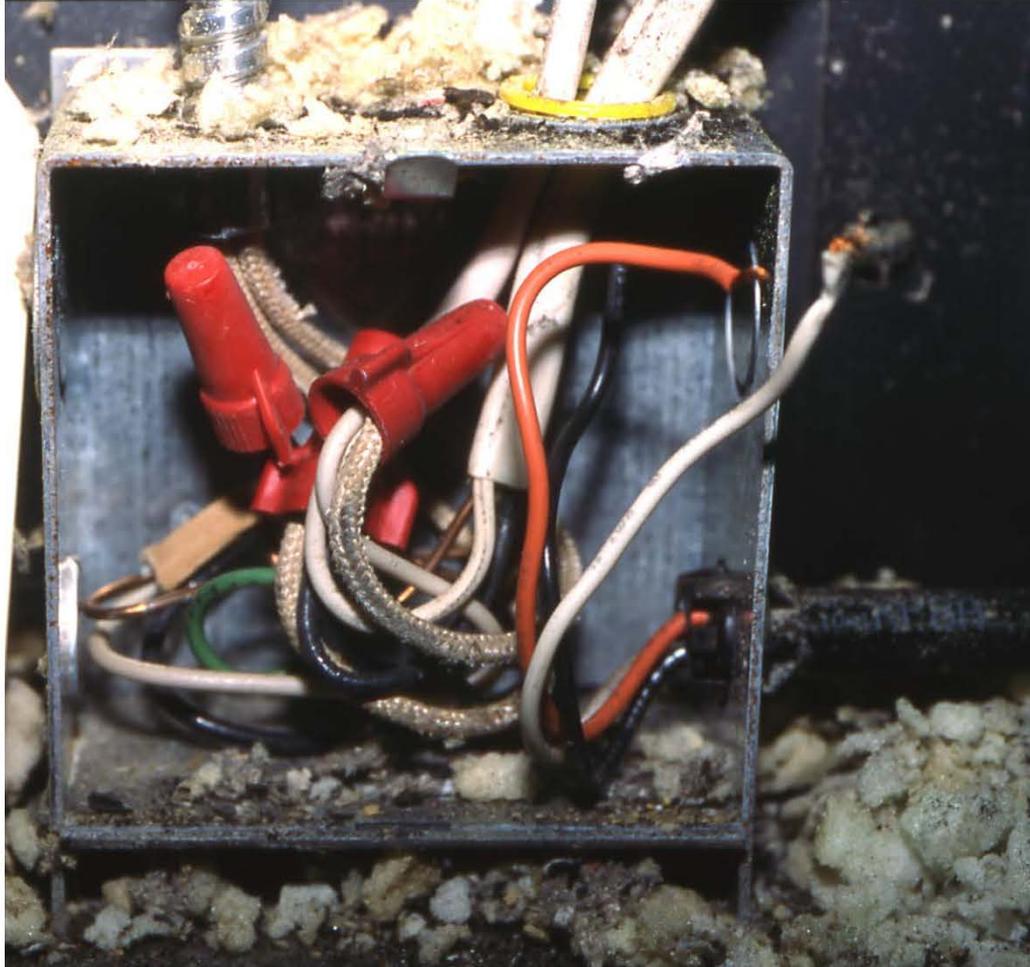
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Hx of fixture overheating

- 500 watt recessed can
- Bulb had been blinking off and on
- Can had been sprayed with foam
- Solution – remove the TP

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LV Recessed Can

- Voltage changed from 120 to 24
- Wattage must still be observed
- Insulation must still be observed

LV Recessed Can

- Fire started at can
- Interstitial space had been insulated
- Recessed cans added AFTER insulation
- TPs failed to work

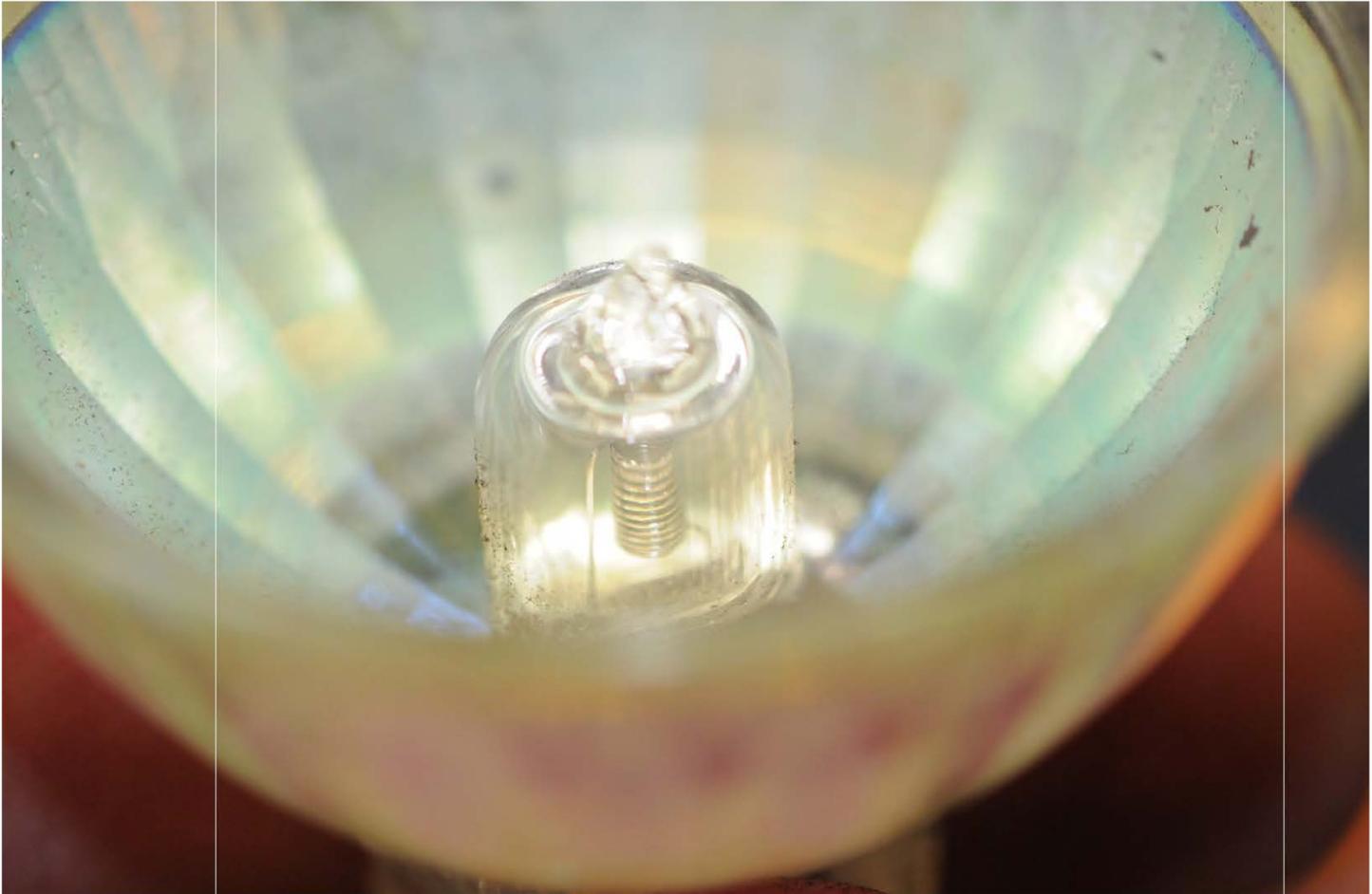
LV Recessed Can



Wattage

- Bulbs tested – 4 fixtures
- 1 at 30 watt
- 2 at 50 watt
- 1 at 75 watt
- Who changed bulb wattage?
- Fixture rated 50 watts

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TP Layout



TP Layout

- TP has its own heater
- TP responds to insulation accumulation
- TP heater was unsoldered

TP Design



TP Layout



New LV Can

- Taken from same house
- Had charred insulation present
- Was NOT involved in fire
- TP is outboard

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Different can, also insulated



TP Analysis

- TP to prevent fires
- Fire occurred
- Ergo, TP not working

TP Analysis

- 3 other TPs analyzed
- Not near fire
- No fire damage
- All 3 with charred cellulose insulation
- All 3 TPs not working

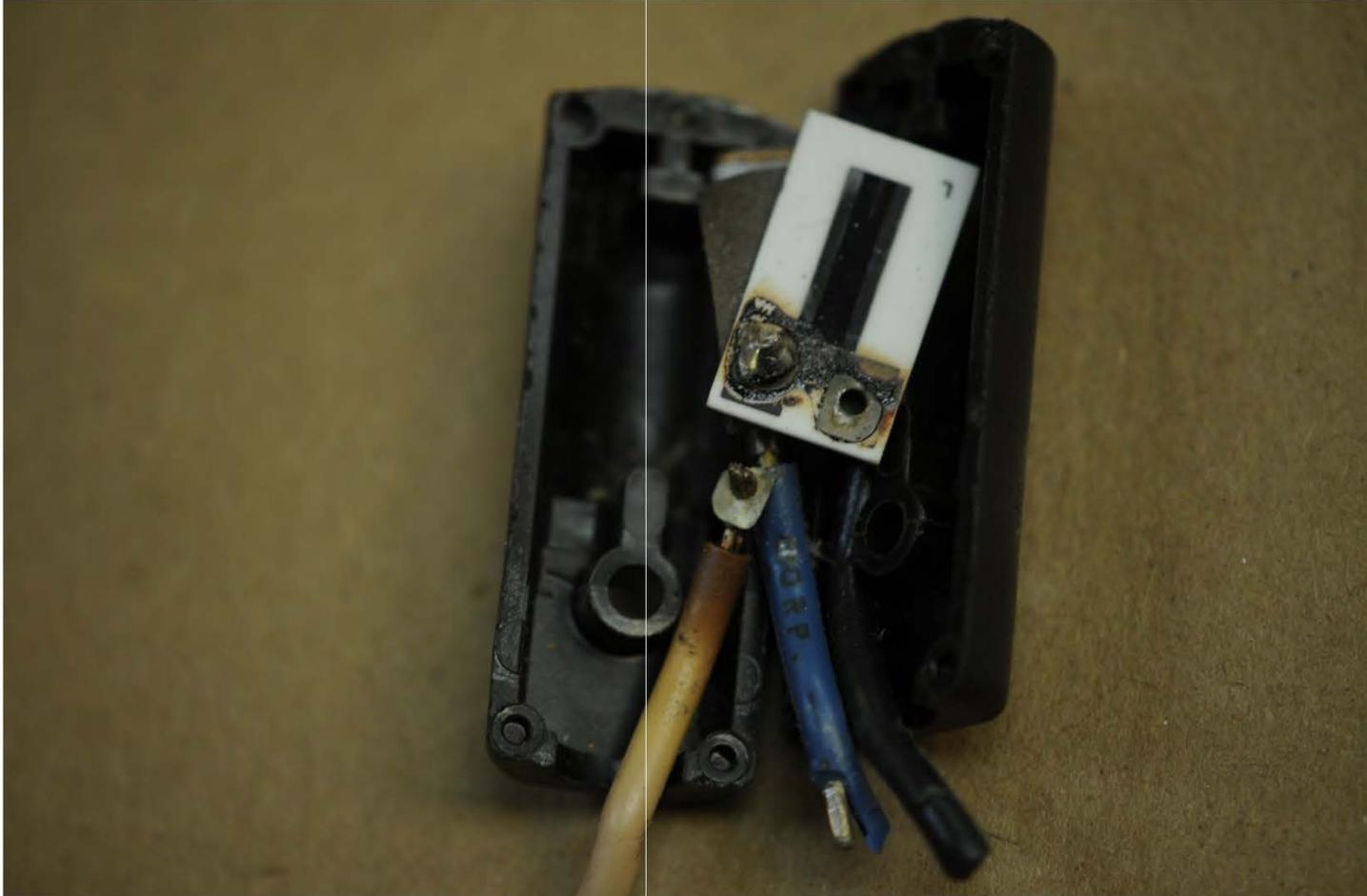
TP Analysis



TP Analysis

- Solder leads to heaters had become unsoldered

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Neutral Lead to Heater Unsoldered



Fluorescent Fixtures

Modern Fluorescent Fixtures

- Use electronic ballast
- Ballast switches at 40 to 60 KHz
- Arc can be present
- Arc will never quench due to switching speed
- Ballast uses high voltage
- Fixture will arc with bulb illuminated
- Fixture will catch fire at tombstone

Fluorescent Lighting

- Older fixtures use magnetic ballasts to operate a T12 lamps
- New fixtures use electronic ballasts to operate a T8 lamps
- Input voltages can differ depending on the fixture
- Usually connected with #14 or #12 branch circuit wiring

Blackboard

Mag and Electronic Ballast



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Bulb ON, Fixture Arcing



Arced Pins on Bulb



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Megger Testing

Megger Testing

- Megger – Megohm Meter
- Impresses High Voltage on Wiring
- Voltages can be 50 100 250 500 1000 or 2500

Megger Testing

- 2 Types of Meggers
- Hand Crank
- Battery Operated
- Doesn't matter for this class

- Finds marginal wiring
- Cannot detect nicks

- Paschen's Law
- Describes the minimum voltage necessary to arc in air

Demonstration
Megger Testing

Neon Signs

GFI Protected Secondary

Office building

- Two neon signs
- Both 'de commissioned'
- De commissioned by cutting off GTO leads to tubing
- Xformers left hot

Where 1 piece of GTO landed



End of GTO



Hole in lath, stucco



End of GTO



One of the xformers



RECIP **SENTRY**[®]
NEON TRANSFORMER

T. NO.	4B09N3-CB	DATE	11-2008
Hz.	60	W.	145
RI. V.	120	A.	2.3
C. V.	9000	SHORT CIRCUIT CURRENT M.A.	30
POWER FACTOR		E188431 T1	
NORMAL		L/N : L678199	

Complies with Secondary Ground-Fault
Protection Requirements in UL 2161.

OUTDOOR TYPE2

P CORPORATION JAPAN
MADE IN THAILAND

 **DANGER**
HAZARD

Xformer view

Created ground fault through wood



Problems

- Loose GTO ends
- Xformers left powered
- Xformers had no service switch

- Xformers – GFI didn't work on BOTH circuits

- Proper way to de commission is to disconnect primary

Poor Workmanship

We Are Lazy!!

No Outer Jacketing

- All exposed type NM is to be in jacket

GOODSON INSIGHTS SERIES



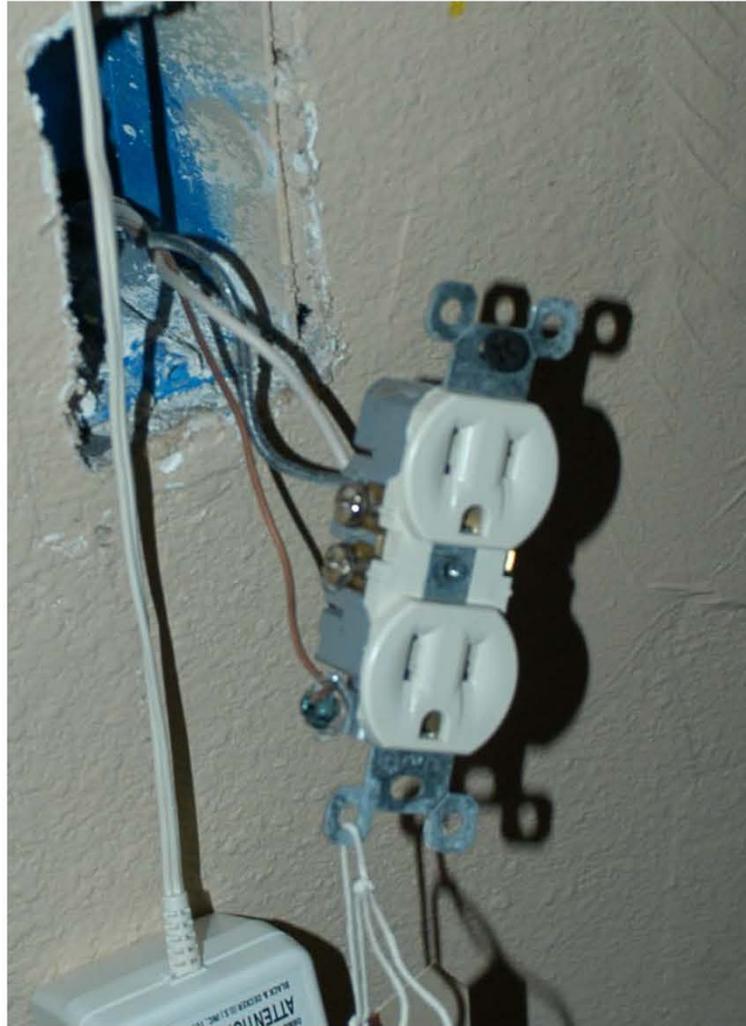
Lack of Bushings

- You don't run wires over sharp edges

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GOODSON INSIGHTS SERIES



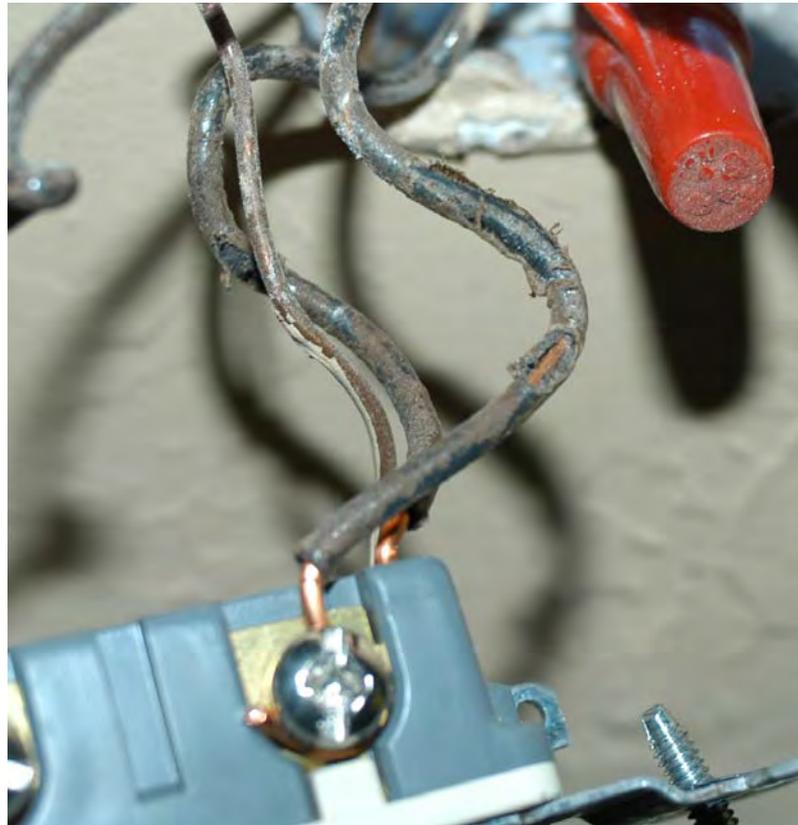
GOODSON INSIGHTS SERIES



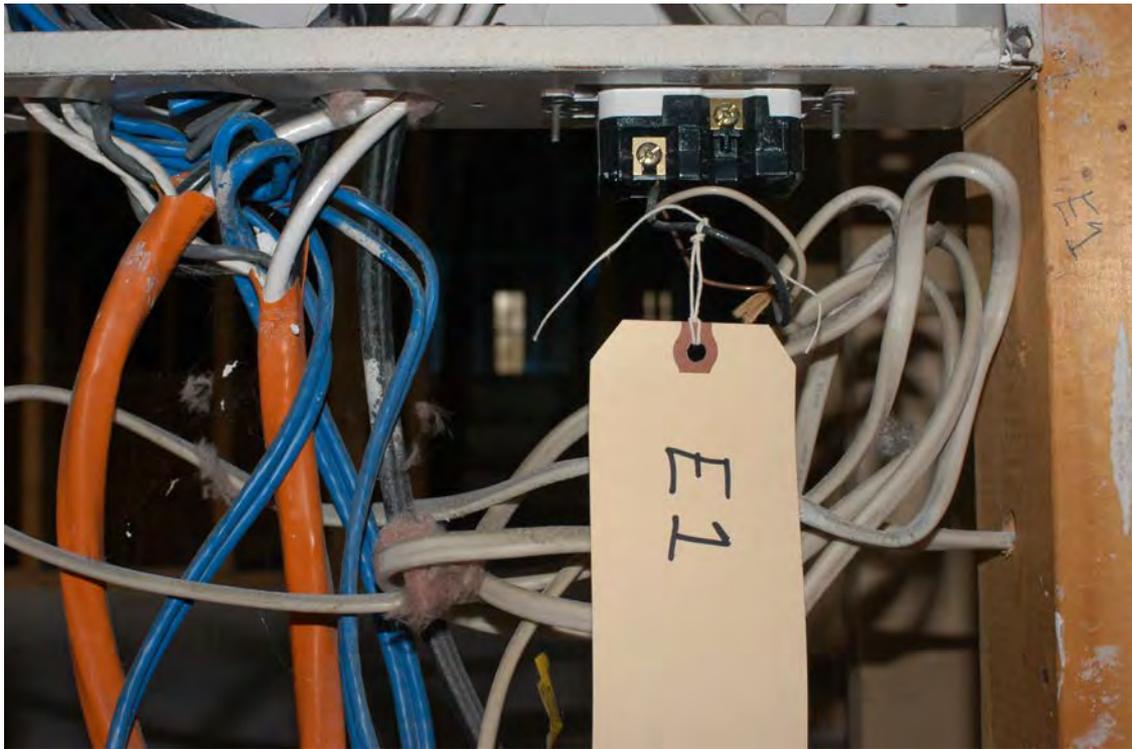
Nicked Wires

- You don't leave nicked wires

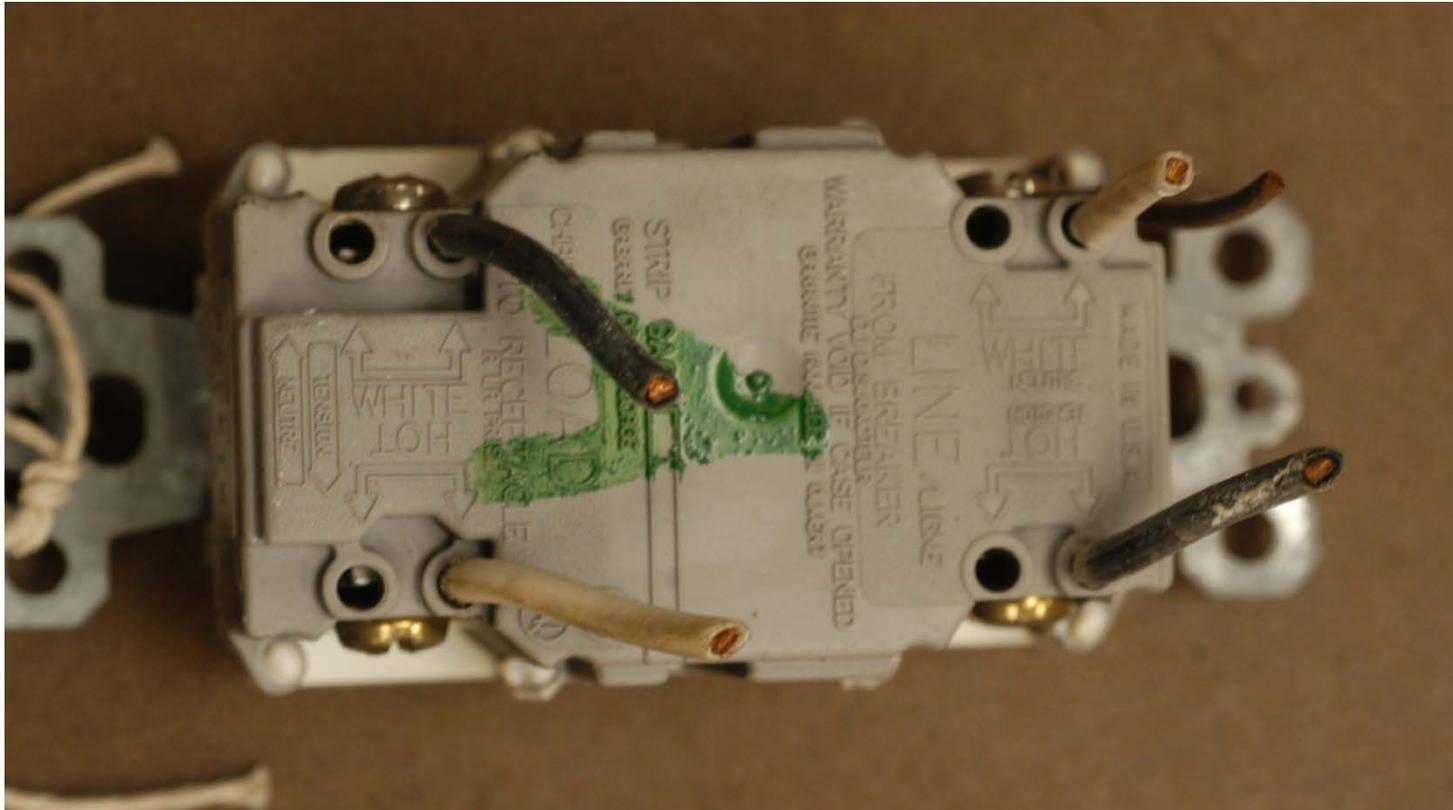
Nicked Wires



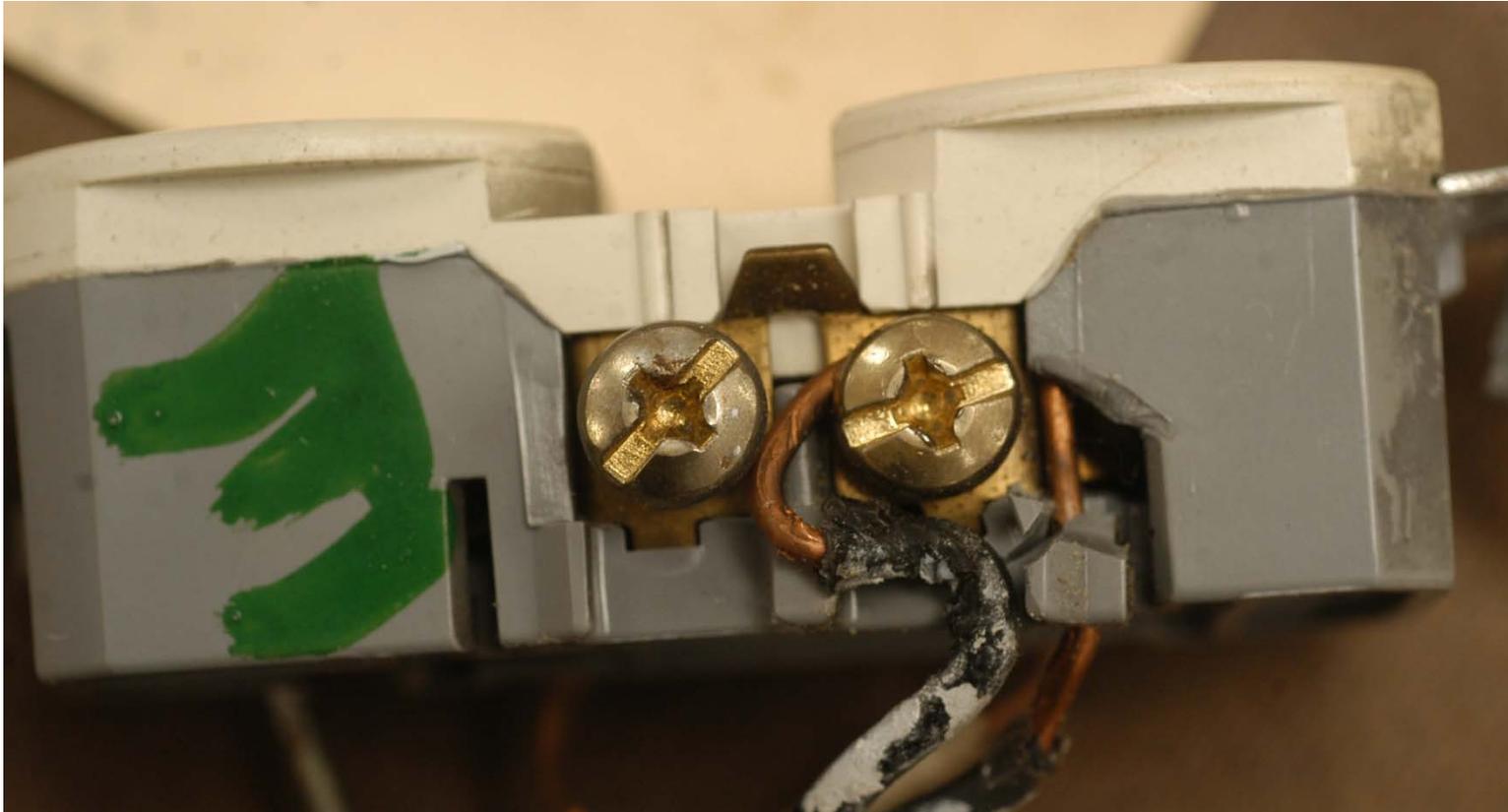
Lack of Bushing



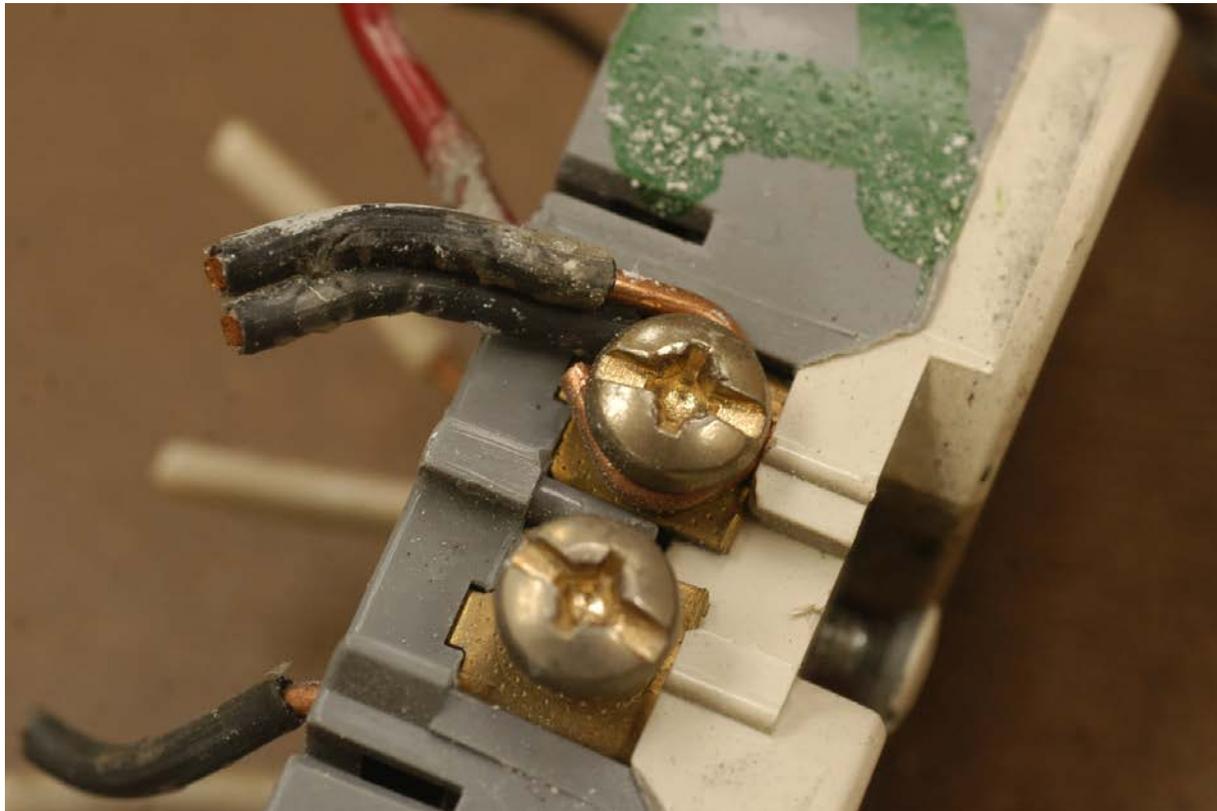
Wrong Polarities



Improper Torquing



Double Lugging



Modified Box



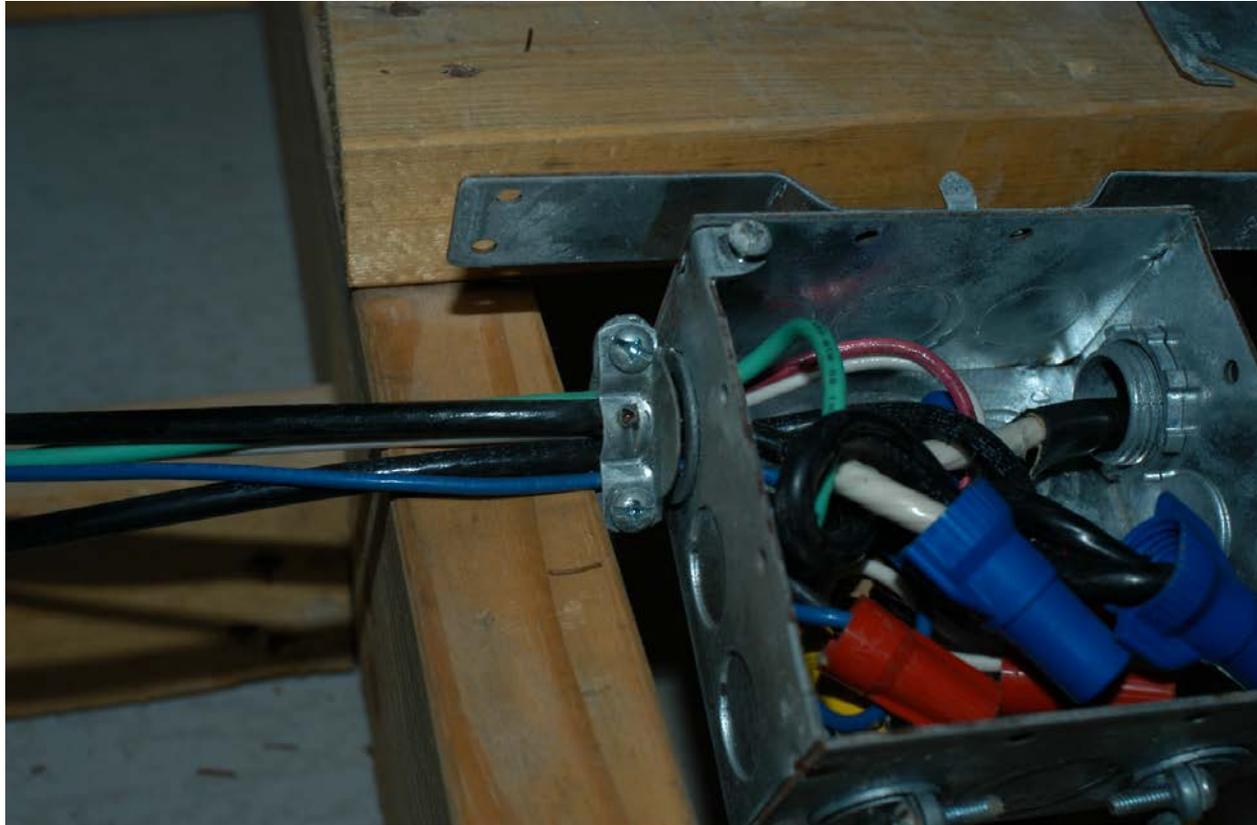
No Torque on Ground



No Box



No Conduit



No Conduit – Shorting Out

