

Circuit Tester Explanation

How does it work?

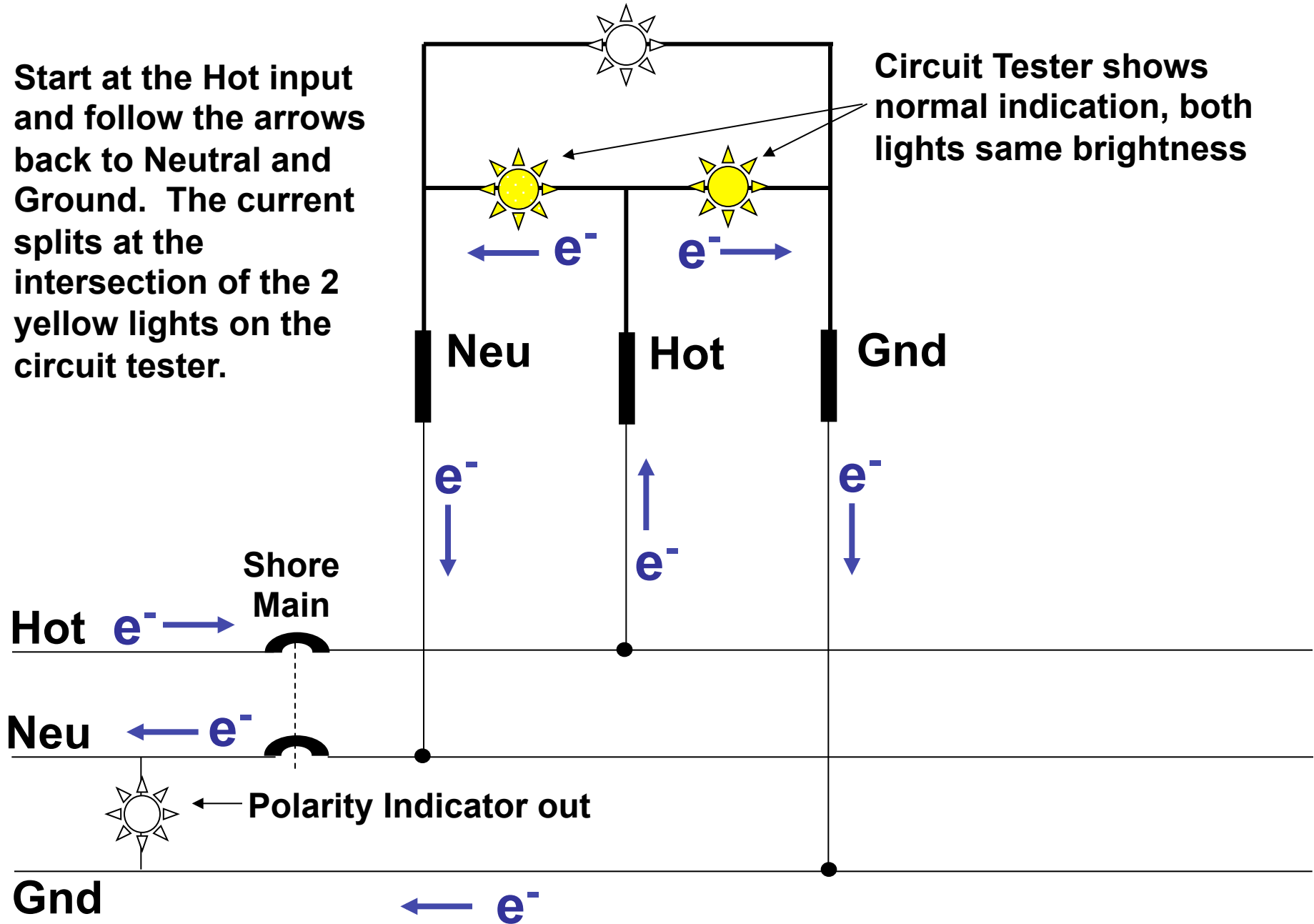
Capt. David Rifkin, qualitymarinesvcs@comcast.net

- Drawing 1 shows how the little circuit tester responds to a normal situation.
- The drawings show the circuit tester connected to the AC system downstream of the main breaker (i.e. plugged into an outlet)
- To understand this, start at the Hot input and trace the arrows all the way back to the Neutral and Ground. Note that the current splits at the intersection of the 2 yellow lights.
- Drawing 2 shows how the tester would respond to an open ground situation.
- Drawing 2a show how the tester would respond to Hot-Neutral reversal.
- The remaining drawings show how the tester can misrepresent actual fault conditions in an electrical distribution system.

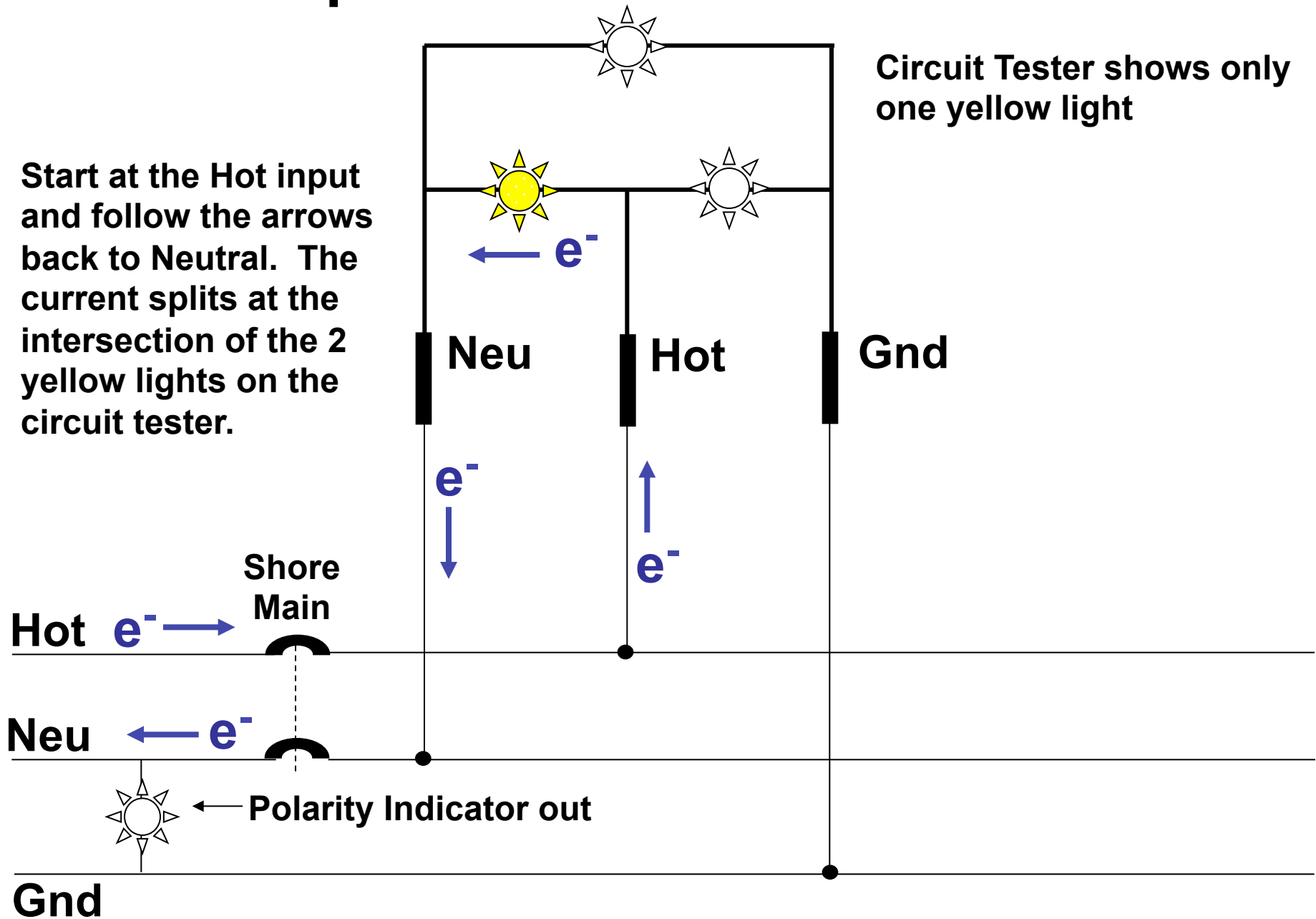
Normal Situation

Start at the Hot input and follow the arrows back to Neutral and Ground. The current splits at the intersection of the 2 yellow lights on the circuit tester.

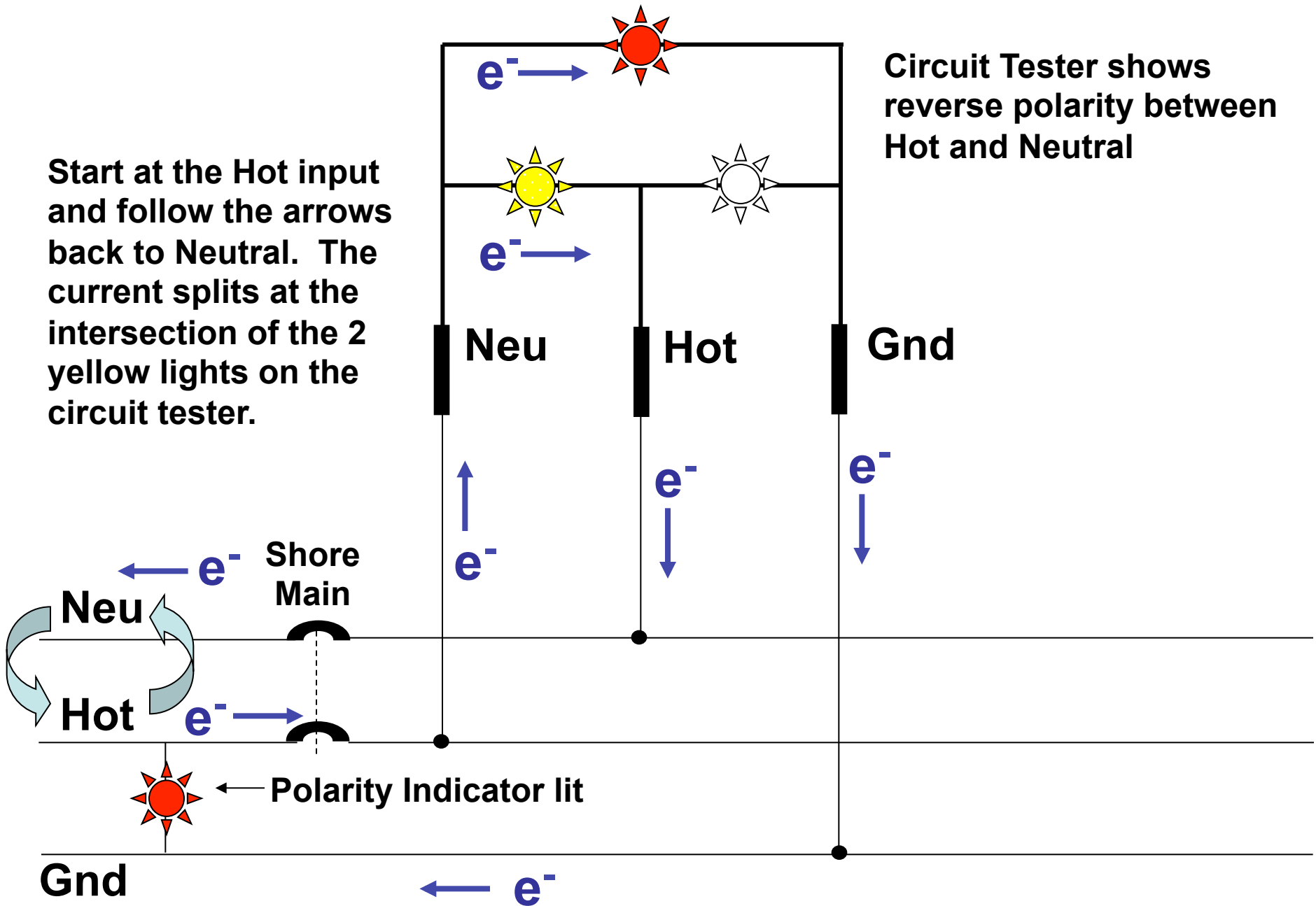
Circuit Tester shows normal indication, both lights same brightness



Open Ground Condition



Hot-Neutral Reversal



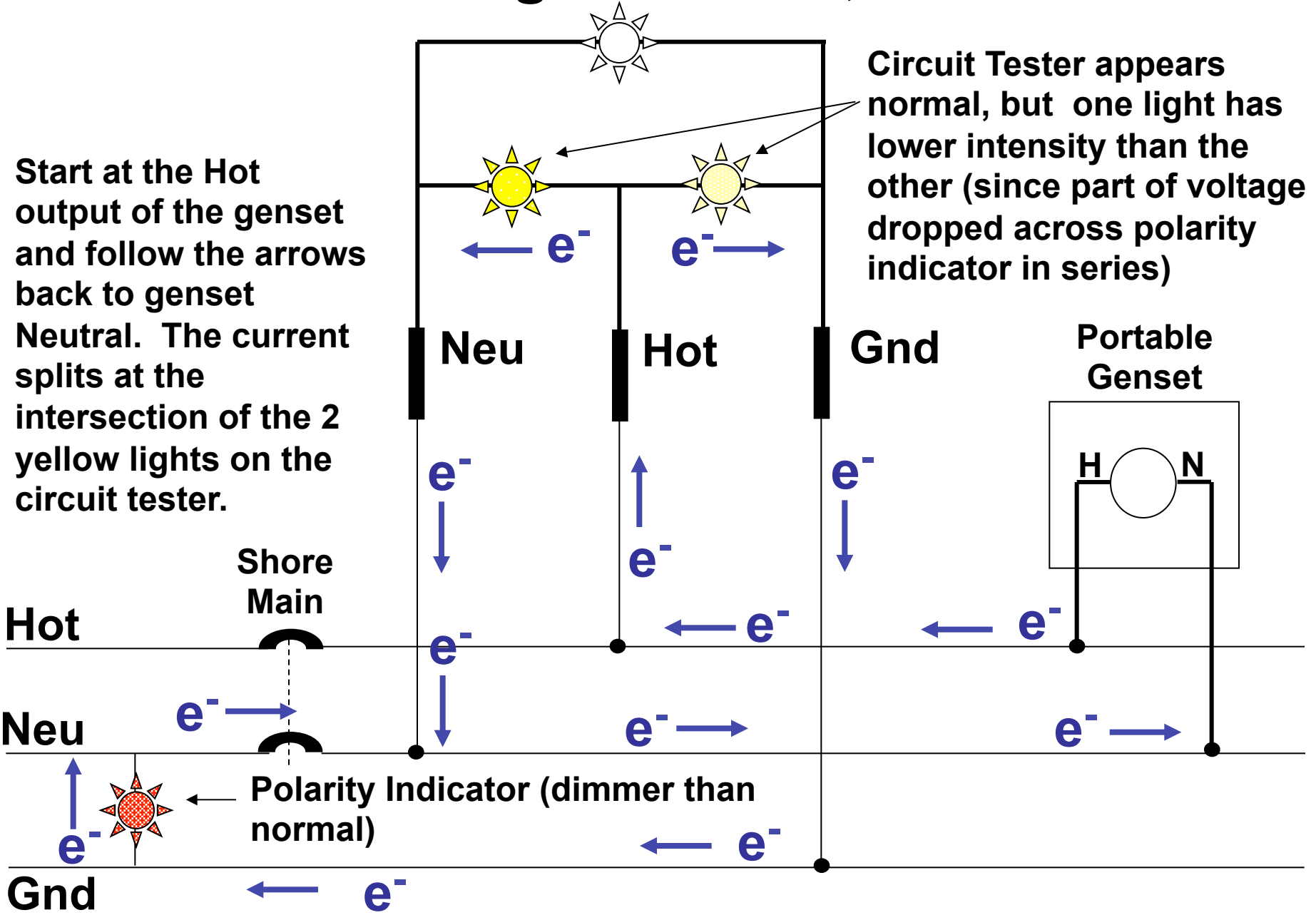
Improper Genset Wiring

- Drawings 3 and 4 explain how a missing ground-neutral connection at a portable electrical source (example shown is on a boat) can show up as a seemingly normal indication on one of the little circuit testers (3-light variety)
- The schematics show the circuit tester connected to the AC system downstream of the main breaker (i.e. plugged into an outlet)
- To understand this, start at the genset Hot and trace the arrows all the way back to the genset Neutral. Note that the current splits at the intersection of the 2 yellow lights.
- The “incorrect” drawing shows a portable generator hooked up, however the neutral of the genset has not been connected to the ground of the boat as required by ABYC E-11 for normal installations. Note that the AC main breaker is still shut providing a current path to the polarity indicator (shore cord was not attached).
 - This allows a path for current to flow through both circuit tester yellow lights as well as the polarity indicator light. Close observation would reveal that the polarity indicator light and one of the circuit tester lights will be a bit dimmer than normal (since they are in series and will have a lower voltage across them).

Improper Genset Wiring

- In drawing 4, the neutral has been properly grounded to the boat's ground system (shown schematically in the second drawing).
 - It should be obvious that this ground-neutral connection effectively shorts out the polarity indicator light, preventing it from lighting. Also note that the 2 yellow circuit tester lights will now glow equally bright since they have the same voltage drop across them.
- These diagrams show how the little circuit tester can appear to read a normal situation on a boat with a missing ground connection.
- *The best way to test for this condition is with the Ideal Industries SureTest Meter (I use model 62-154). This meter will tell you all the normal parameters of the the system (voltage, current, frequency, polarity, % voltage drop) as well as the impedances of each of the conductors, including ground. It will also tell you if you have no ground on the system, and if you have a nearby ground-neutral connection. I use this meter on every corrosion/electrical survey I do on a boat or on the docks.*
- Another way to test just for the loss of ground would be to plug a light bulb into a receptacle's hot and ground conductors. If there is no ground, this light bulb will not light. *The SureTest is a better way.*
- Be aware also that these little testers will not show a ground-neutral reversal nor will they give meaningful indications for multiple faults.

N-G Missing at Genset, Incorrect



Start at the Hot output of the genset and follow the arrows back to genset Neutral. The current splits at the intersection of the 2 yellow lights on the circuit tester.

Circuit Tester appears normal, but one light has lower intensity than the other (since part of voltage dropped across polarity indicator in series)

Shore Main

Portable Genset

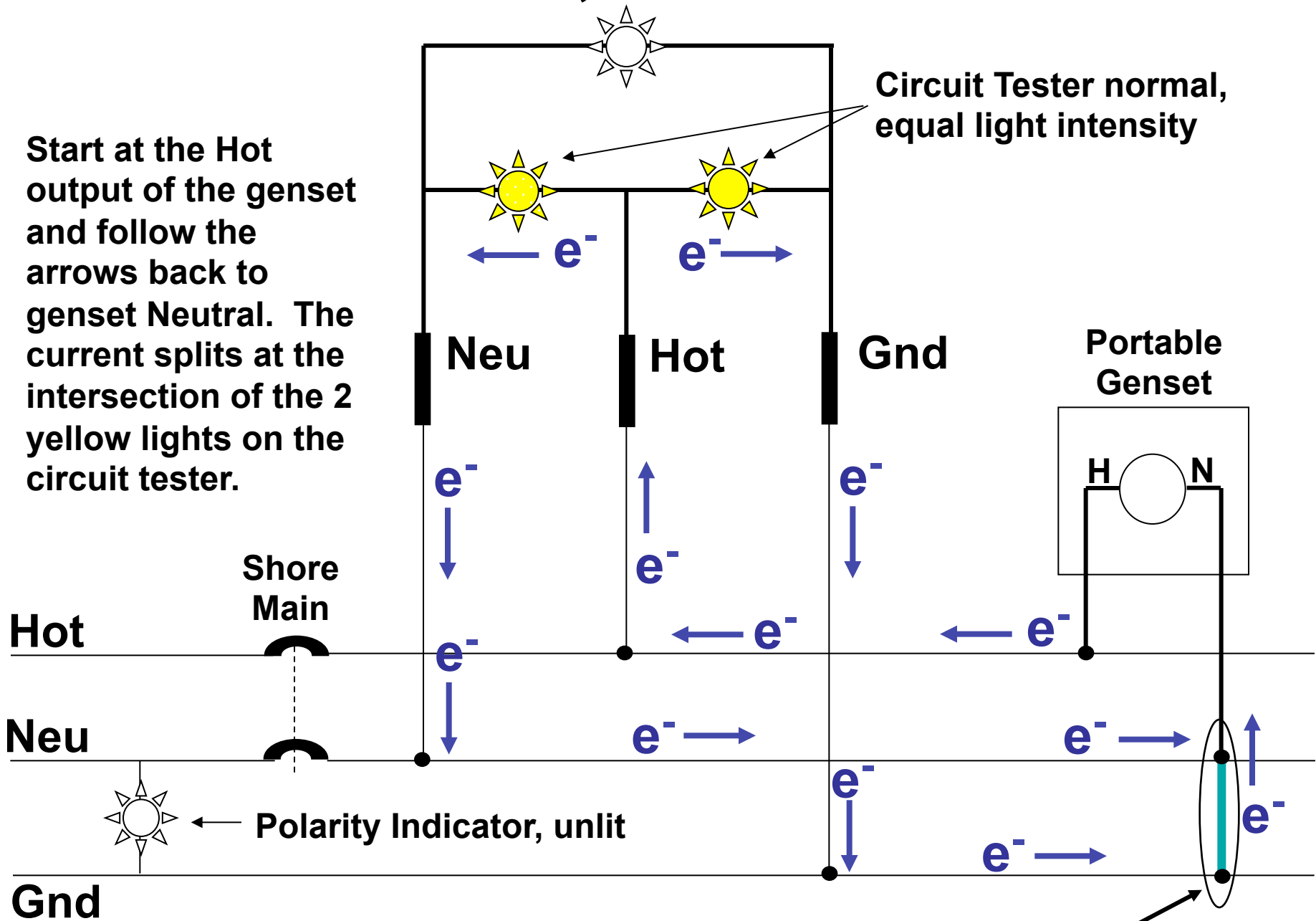
Polarity Indicator (dimmer than normal)

N-G at Genset, Correct

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Start at the Hot output of the genset and follow the arrows back to genset Neutral. The current splits at the intersection of the 2 yellow lights on the circuit tester.

Circuit Tester normal, equal light intensity



Ground-Neutral at Genset shorts out polarity indicator

Drawing 4

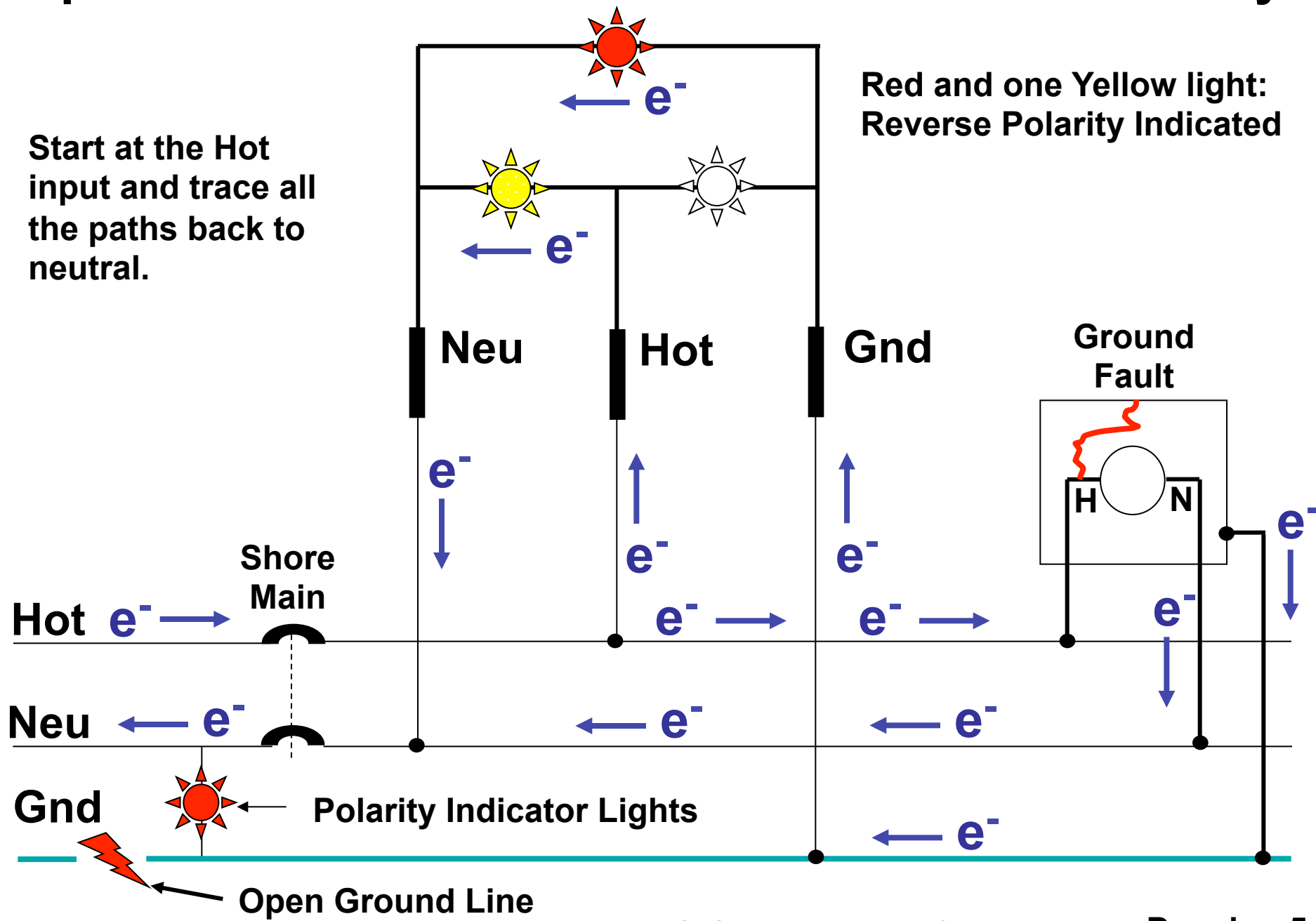
Open Ground and Ground Fault

- Drawings 5 and 6 show how the little circuit tester will indicate when it is plugged into a receptacle with an open ground in a system that also has a ground faulted component.
- The schematics show the circuit tester connected to the AC system downstream of the main breaker (i.e. plugged into an outlet).
- To understand this, start at the Hot conductor coming into the schematic at the left and trace all paths back to the neutral.
- The little tester will indicate a reverse polarity condition (Diagram 5).
- So, the answer might be to switch the polarity (reverse the hot and neutral connections on the pedestal) to fix the problem. When this is done, the little tester will then show a normal indication when in fact there are still 3 faults: a real reversed polarity, a ground fault and an open ground! (Diagram 6).

Open Ground & Ground Fault Indicate Rev Polarity

Start at the Hot input and trace all the paths back to neutral.

Red and one Yellow light: Reverse Polarity Indicated



Attempt to fix Reverse Polarity Indication

Hot and neutral were reversed to solve the reverse polarity indication from previous slide. This now gives correct polarity indication!!

