Technician License Course
Chapter 4
Propagation, Antennas and Feed Lines

Lesson Plan Module 10:

Practical Antennas

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The Dipole

A **dipole** is the basic antenna Element.

- A straight conductor with feed line connected at the center.
- A **Halfwave** Dipole is one half wavelength long.
  - Length (feet) = **468** / Frequency (MHz).
  - The number 468 converts meters to feet and makes the dipole 5% shorter than ½ wave to account for the effects of wire diameter, ground, and nearby objects.
  - 6 Meters ⇔ 52 MHz; L = **468** / 52 = 9 ft.

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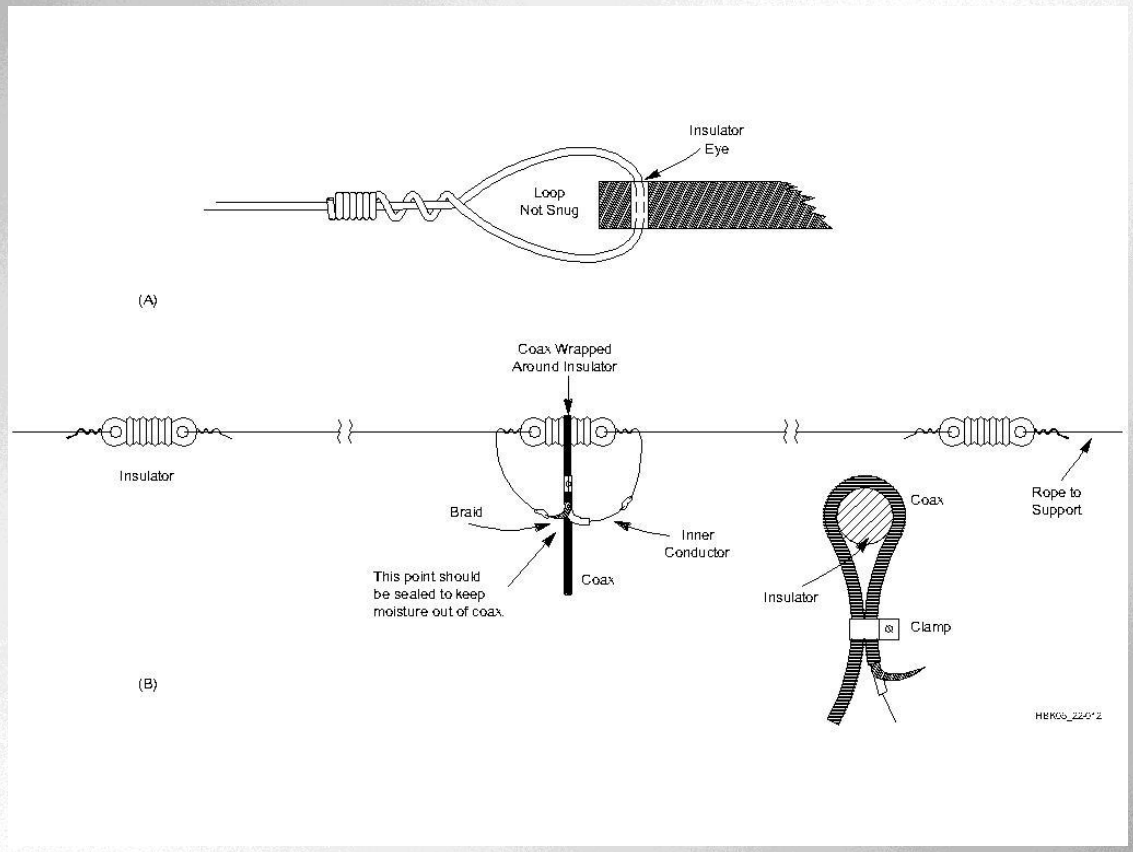
The Dipole


Insulator
Eye
Loop
Not Snug
(A)
Coax Wrapped
Around Insulator
Insulator
Braid
Inner
Conductor
This point should
be sealed to keep
moisture out of coax.
Coax
Coax
Insulator
Clamp
Rope to
Support
(B)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The Ground-Plane

Similar to a dipole that is oriented perpendicular to the Earth's surface (Radiator is **vertical**) .

Lower half of the dipole is replaced by the ground-plane which may be:

- Earth
- Car roof or trunk lid or other metal surface.
- Radial wires.

Length of the radiator in feet = **234** / Frequency (in MHz).

- 2Meters ⇔ 146 MHz; L = **234** / 146 = 1.60 ft.
- Multiply by 12 for L (inches) = 19.2 in.

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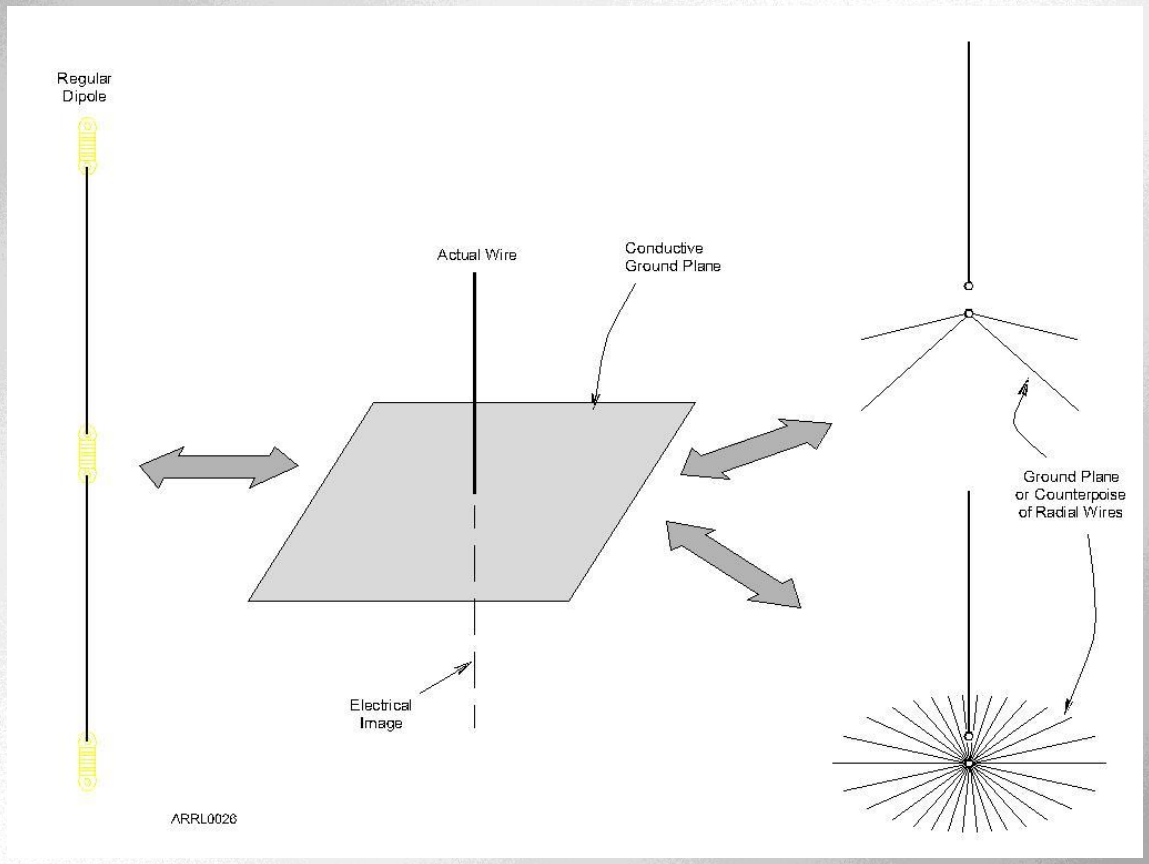
The Ground-Plane



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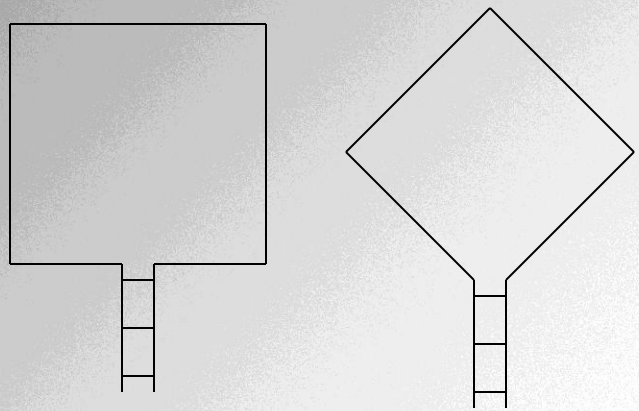
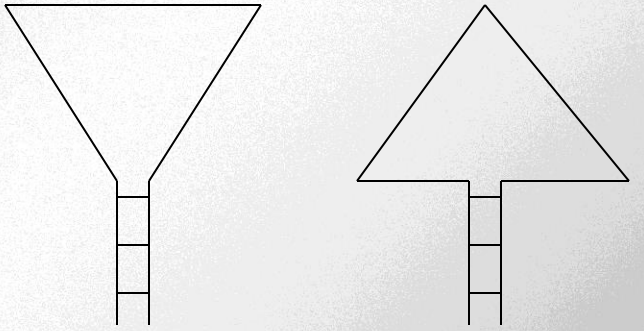
Loop Antennas – Variations

Loop perimeter is usually about one wavelength.

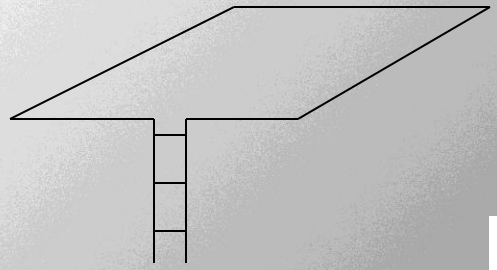


Quad Loops



Delta Loops

Length (ft) = 1005 / F(MHz)



→ Horizontal Loop

Directional (Beam) Antennas

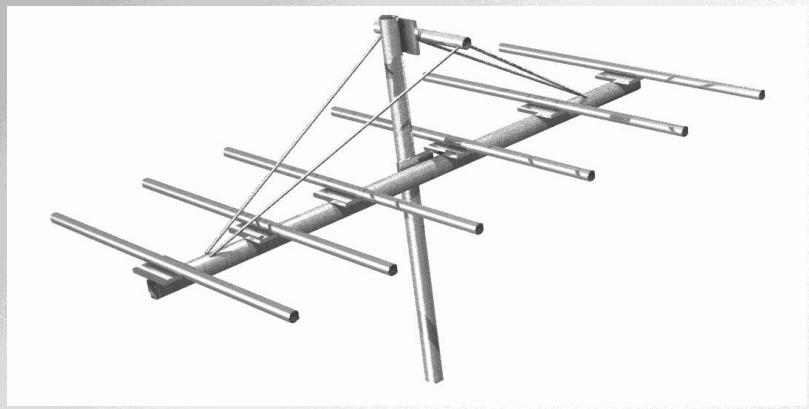
Beam antennas direct more RF energy in a desired direction. Improves both transmit and receive.

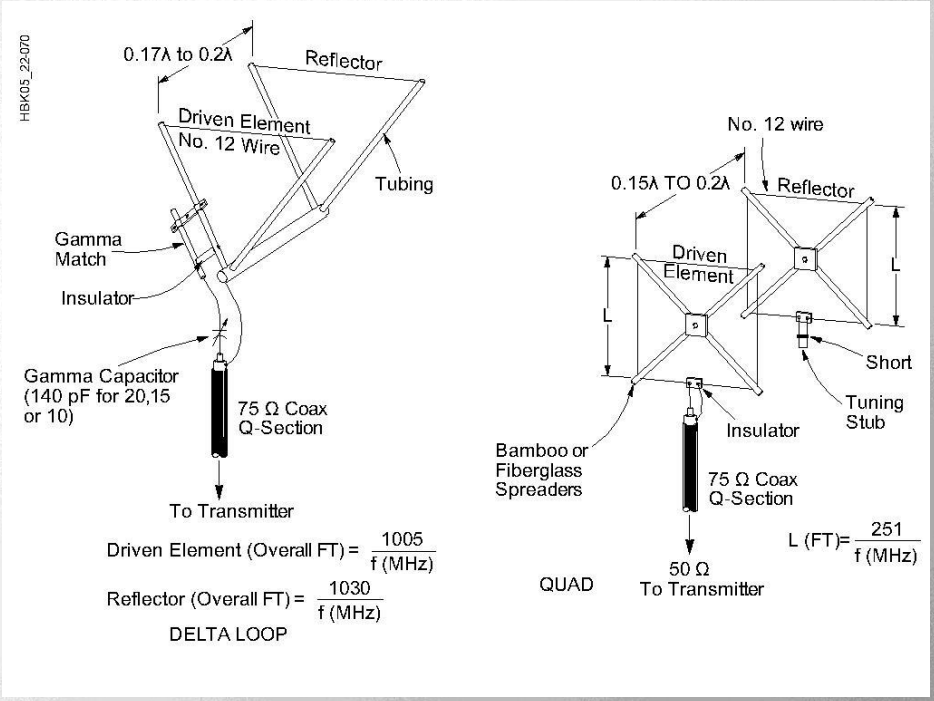
- Gain: An apparent increase in power in the desired direction
- Nulls or reduced gain in other directions.
- Can lower the angle of radiation.

Yagi – Straight parallel elements, Horizontal or Vertical

Quad or Delta – Loop elements.

Directional (Beam) Antennas





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Directional (Beam) Antennas

Directional antennas are made by combining driven and parasitic elements.

- **Driven** elements receive power from the feed line.
- **Parasitic** elements re-radiate power coupled from the driven element.
  - **Director** elements are usually shorter and on the side toward the desired direction.
  - **Reflector** element is usually longer and on the side opposite the desired direction.

Gain depends on number of elements and spacing.

Feed Line Devices

Devices placed between transmitter and antenna during operation:

- Balun – Reduces RF current on Coax shield.
- Filters to suppress harmonics.
- Antenna Tuner – Matches antenna impedance.
- SWR meter – Shows mismatch.
- Antenna switch to select antennas
- Duplexer if RX and TX frequencies are different

Equipment or devices for testing:

- Antenna analyzer
- Dummy Antenna – 50 Ohm load.

Types of Coax

RG-58 – Nominally ¼ inch, 50 Ohm

RG-59 – Nominal 5/16 in. 70 Ohm

RG-8 – Old type. ½ inch, 50 Ohm

RG-213 – New type. ½ in., 50 Ohm

RG-214 – Double shielded RG-213

Belden 8213

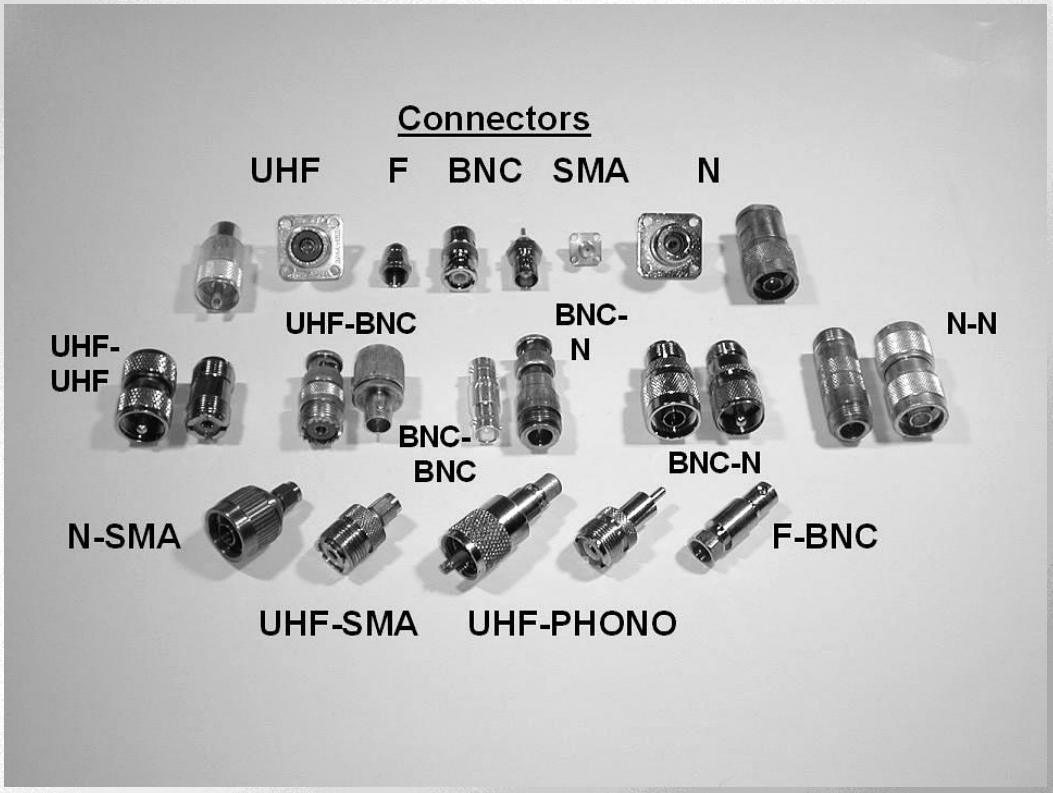
LMR-400

RG-174 – Small 1/8 in., 50 Ohm

Hardline – Low loss rigid coax

Coax Connectors

- UHF
  - SO-239 Jack
  - PL-259 Plug
- BNC
- N
- C
- SMA
- SMB
- Adapters



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Antenna Test Equipment

Impedance matching requires some simple test equipment.

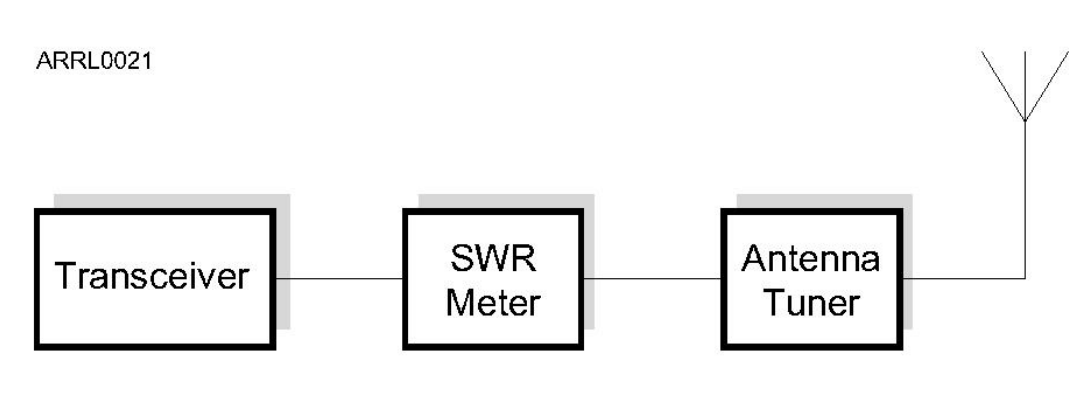
- SWR meter.
- Directional Wattmeter
- Dummy Antenna
- Antenna Analyzer
- Field Strength Meter

Some of these are built into a transceiver or tuner.

SWR Meter

The SWR meter is inserted in the feed line and indicates the mismatch that exists at that point.

You make adjustments to the antenna or a tuner to minimize the reflected voltage (minimum SWR).



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Antenna Tuner

One way to make antenna matching adjustments is to use an antenna tuner.

Antenna tuners are impedance transformers – they do not actually tune the antenna.

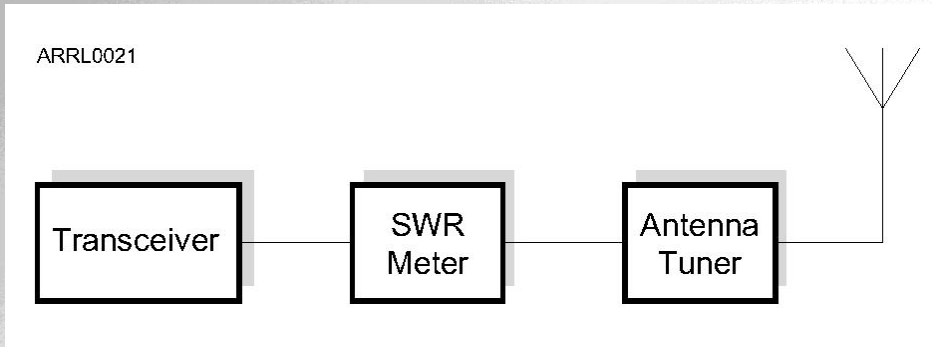
- Effective when used appropriately.
- Can make a bad antenna or feedline look good for the transmitter – the antenna is still bad.

Other ways to match antennas:

Change Antenna dimensions.

Matching Stubs

How to use an Antenna Tuner



While monitoring the SWR meter, make adjustments on the tuner until the minimum SWR is achieved.

- Use minimum value of Inductance and maximum value of Capacitance.
- Changing Inductance while transmitting can cause arcing.
- Log tuner settings for future use on this frequency.

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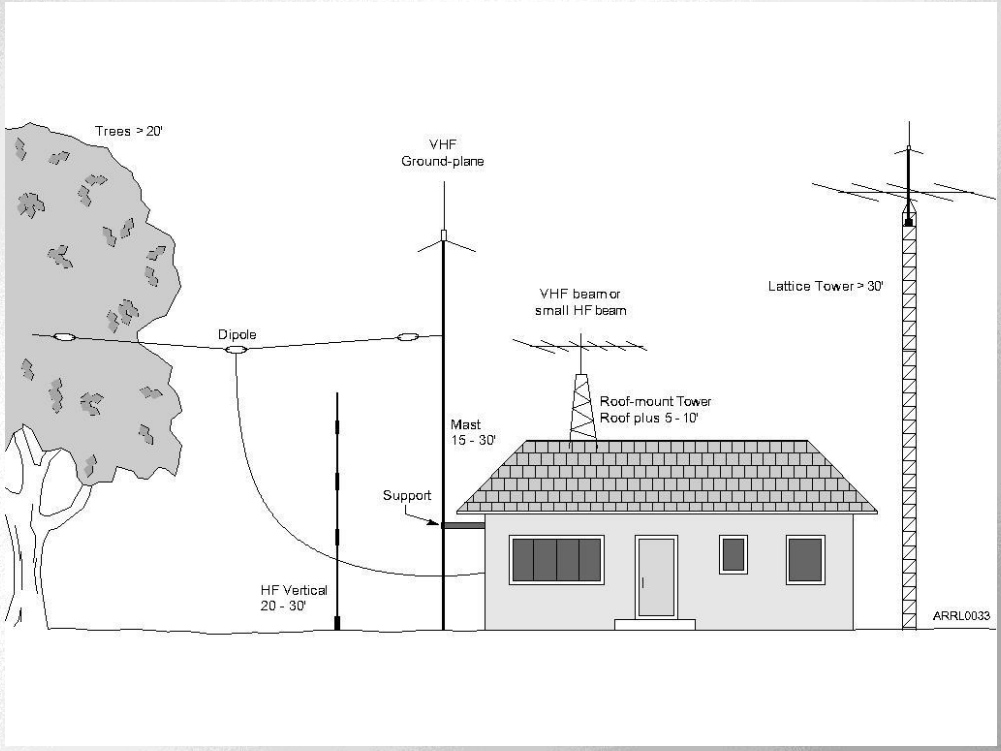
Antenna Supports

- Towers or masts.
- Buildings.
- Trees.
- Covenants and antenna restrictions must be considered.
- Indoors and Attic installations.



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Good and Bad Soldered Repairs

Antenna work sometimes requires soldering wires and connectors. Poor soldering results in failures.

A good solder connection is shiny with no cracks. The solder completely surrounds the wire. Good soldering requires several things:

- Proper Solder
- Proper Heat
- Clean Metal
- Good Mechanical connection
- Proper Cooling

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Poor Soldering Example 1

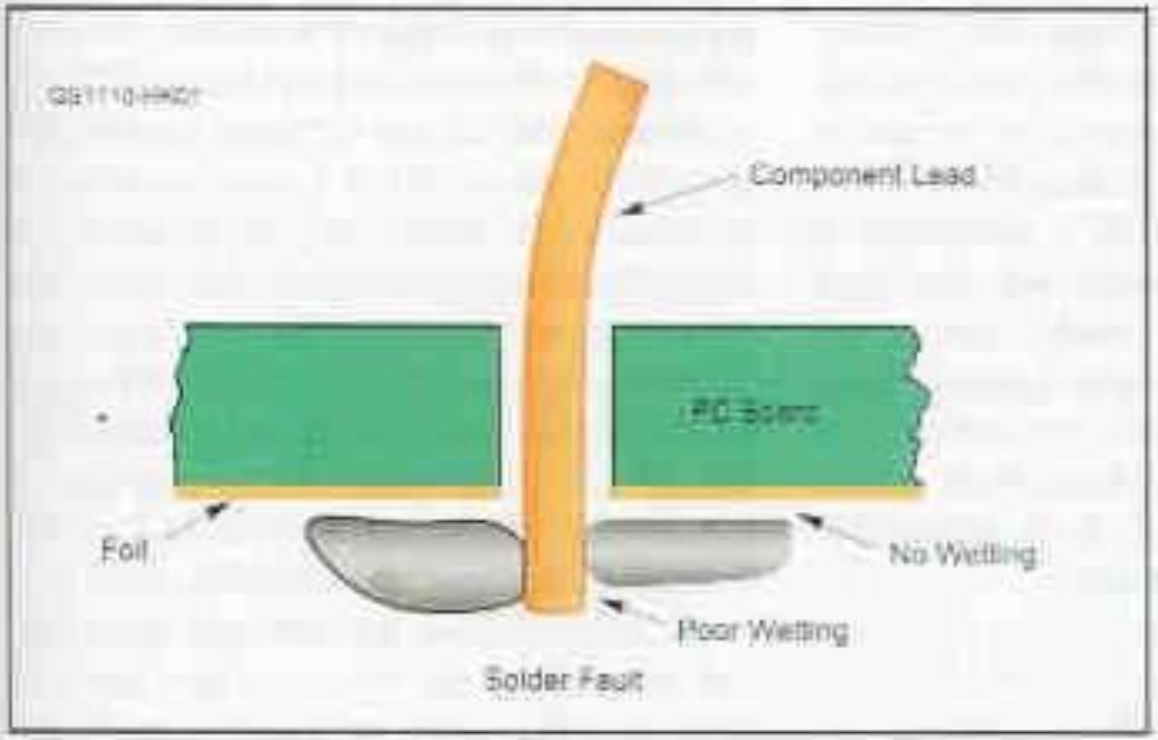

Figure 1 — This diagram shows how a lead may look soldered without actually providing an electrical connection between the component and foil.

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Poor Soldering Example 2

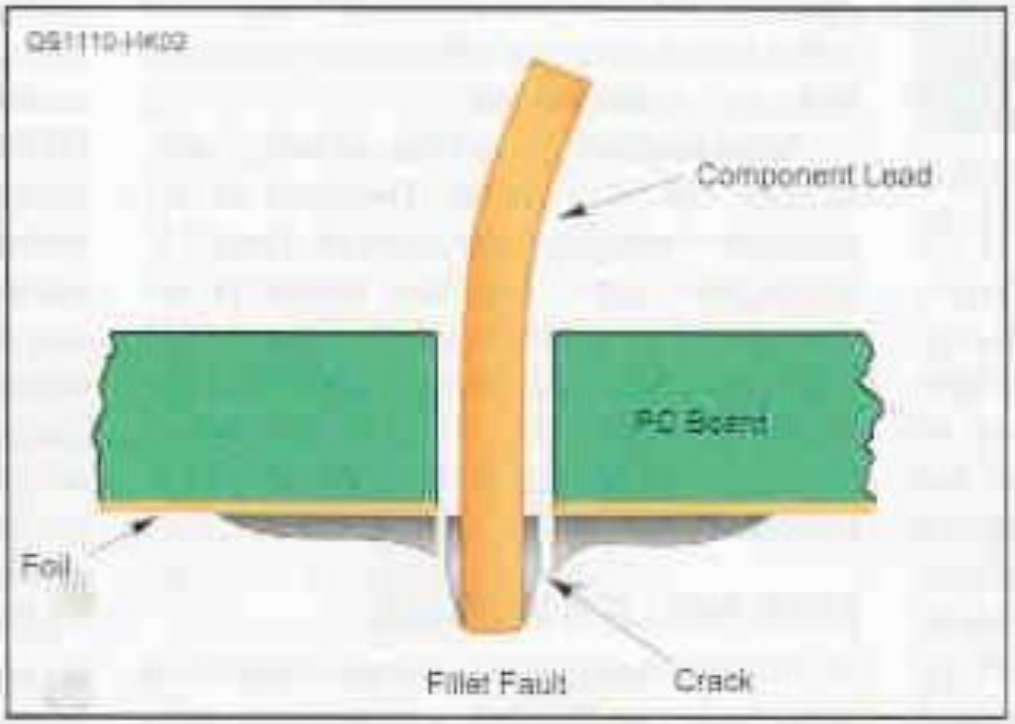

Figure 2 — This diagram shows what can happen if too much force is applied to a solder joint. Hairline fractures occur in the solder, electrically separating the lead from the foil.

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Poor Soldering Example 3

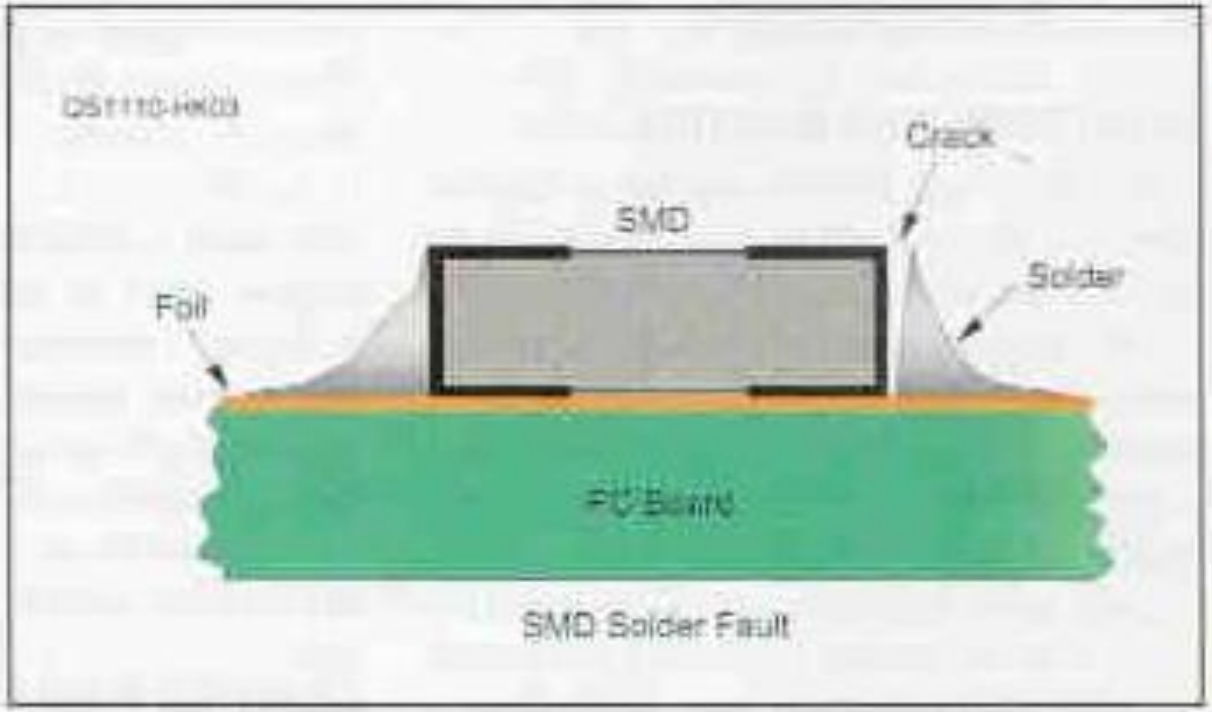

Figure 3 — When you are soldering SMD components, it is possible for the solder to build up, forming a gap between the component and the solder. Such a broken connection can be very hard to find.

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