



Technician License Course Chapter 4

Propagation, Antennas and Feed Lines

Lesson Plan Module 10: Practical Antennas



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The Dipole

Most basic antenna.

- Two straight equal length conductors, in line.
- Feed line connected at the center.
- Total length is $\frac{1}{2}$ wavelength.

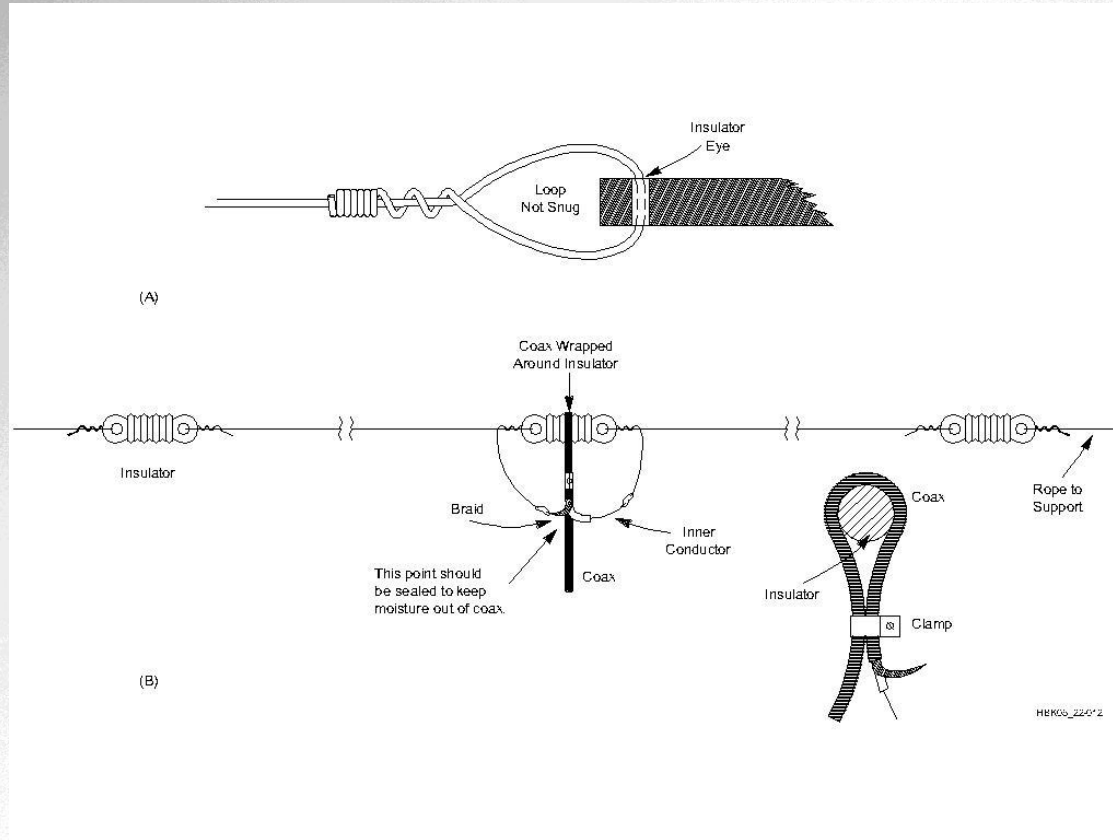
Length (feet) = $468 / \text{Frequency (MHz)}$.

- 10 Meters \Leftrightarrow 28.4 MHz; $L = 468 / 28.4 = 16.5$ ft.
- 6 Meters \Leftrightarrow 52 MHz; $L = 468 / 52 = 9$ ft.

The number 468 makes the dipole 5% shorter than $\frac{1}{2}$ wave to account for the finite wire diameter and end effects.



The Dipole



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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. Ground-plane may be:

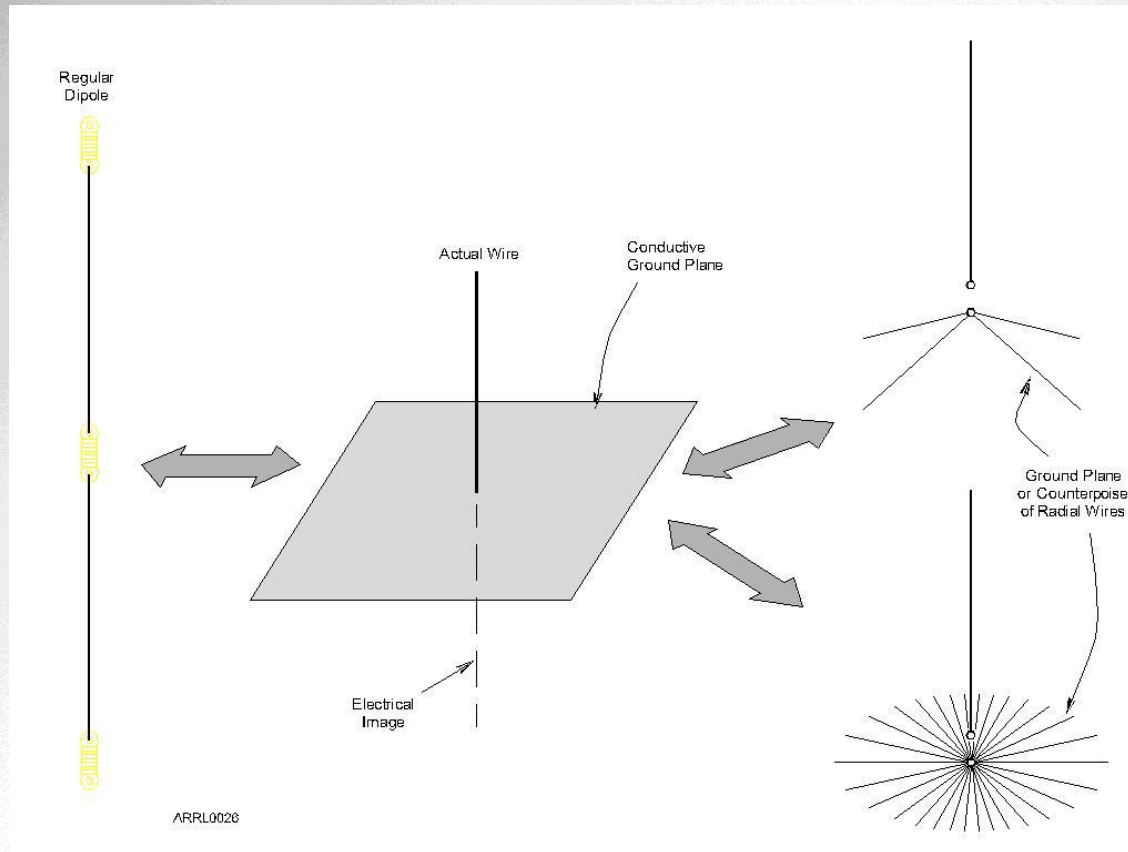
- Earth
- Car roof or trunk lid or other metal surface.
- Radial wires.

Length of the radiator in feet = $234 / \text{Frequency (in MHz)}$.

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



The Ground-Plane

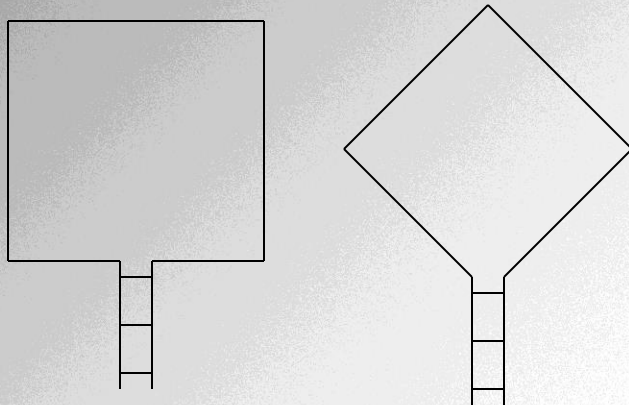


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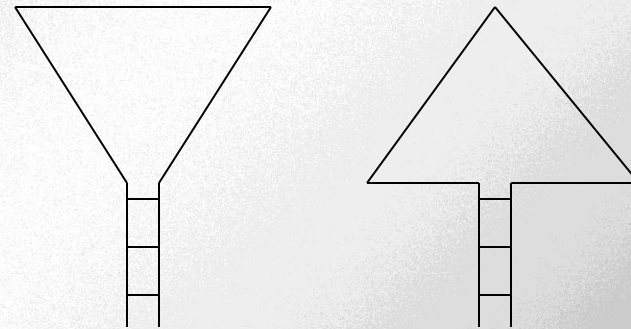


Loop Antennas – Variations

Loop perimeter is usually about one wavelength.

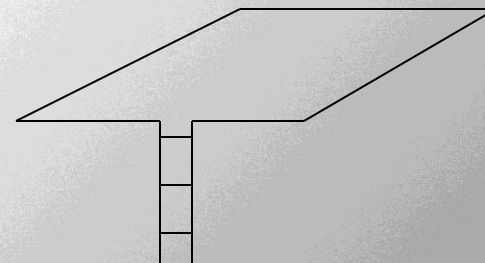


Quad Loops



Delta Loops

$$\text{Length (ft)} = 1005 / F(\text{MHz})$$



Horizontal Loop



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Directional (Beam) Antennas

Beam antennas focus or direct RF energy in a desired direction.

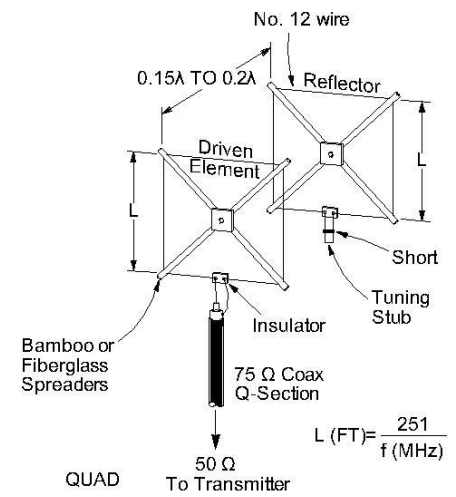
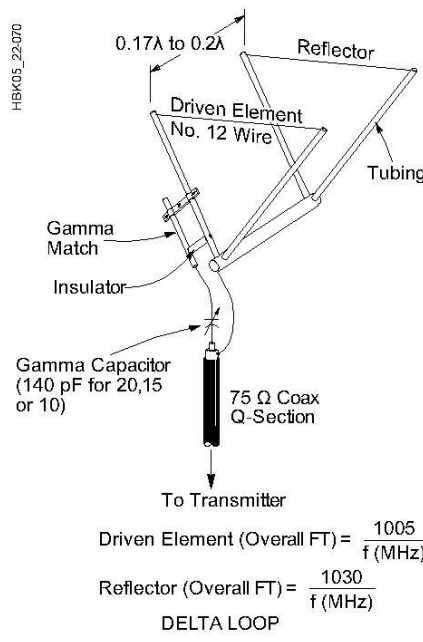
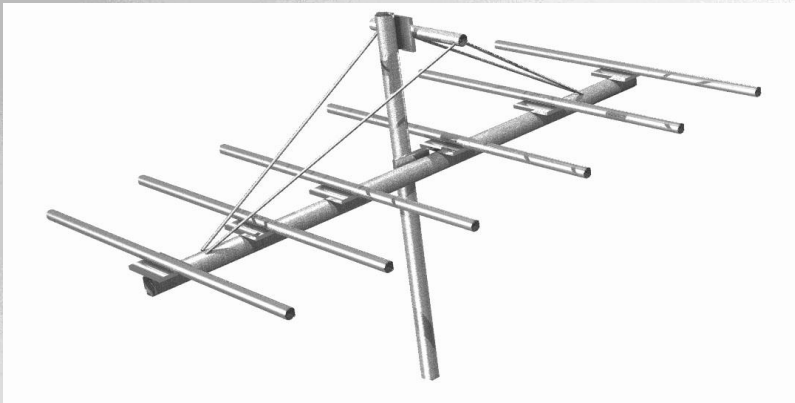
- Gain: An apparent increase in power in the desired direction
- Can improve both transmit and receive.

Multiple elements coupled together

- Yagi – Straight elements
- Quad or Delta – Loop elements.



Directional (Beam) Antennas



Directional (Beam) Antennas

Directional antennas are made by combining driven and parasitic elements.

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



Feed Line Devices

Equipment or devices placed in the feedline during operation:

- Antenna switch to select antennas
- Duplexer if RX and TX frequencies are different
- Filters to suppress harmonics.
- SWR meter
- Antenna Tuner – Really doesn't tune antenna
- Balun – Helps keep RF off outside of Coax

Equipment or devices for testing:

- Antenna analyzer
- Dummy Antenna – 50 Ohm load.



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Types of Coax

RG-58 – Nominally $\frac{1}{4}$ inch, 50 Ohm

RG-59 – Nominal $\frac{5}{16}$ in. 70 Ohm

RG-8 – Old type. $\frac{1}{2}$ inch, 50 Ohm

RG-213 – New type. $\frac{1}{2}$ in., 50 Ohm

RG-214 – Double shielded RG-213

Belden 8213

LMR-400

RG-174 – Small $\frac{1}{8}$ in., 50 Ohm

Hardline – Low loss rigid coax



Coax Connectors

UHF

SO-239 Jack

PL-259 Plug

BNC

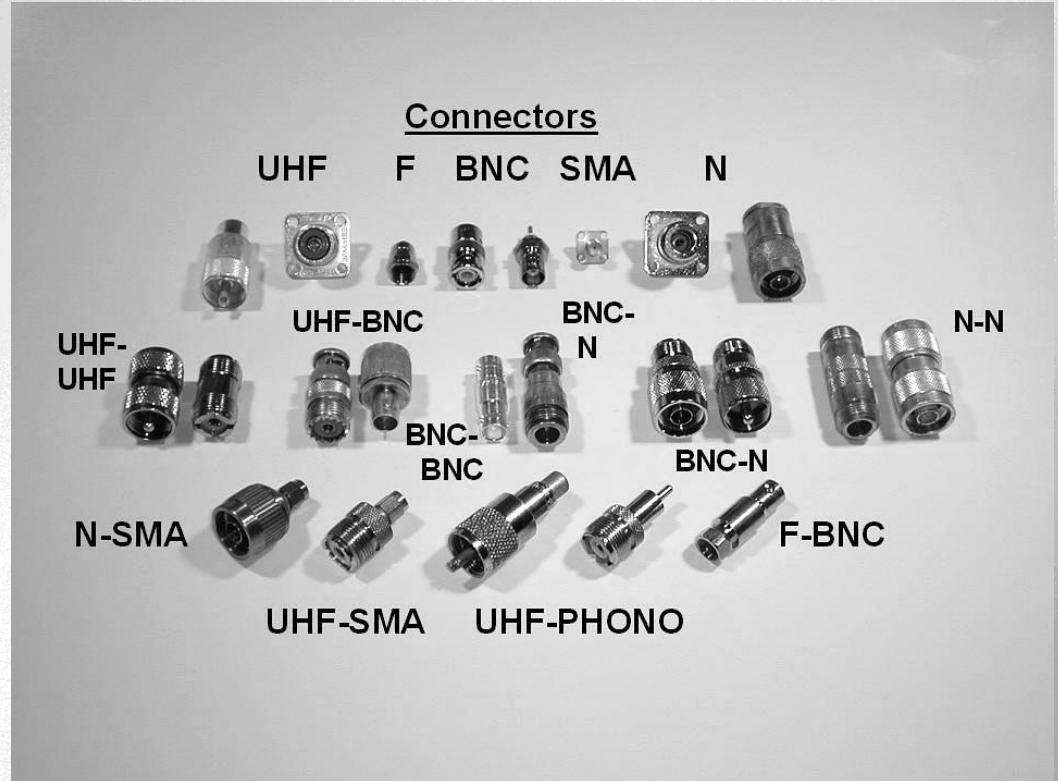
N

C

SMA

SMB

Adapters



Antenna Test Equipment

Proper impedance matching is important enough to deserve some simple test equipment as you develop your station repertoire. Some basic test equipment:

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

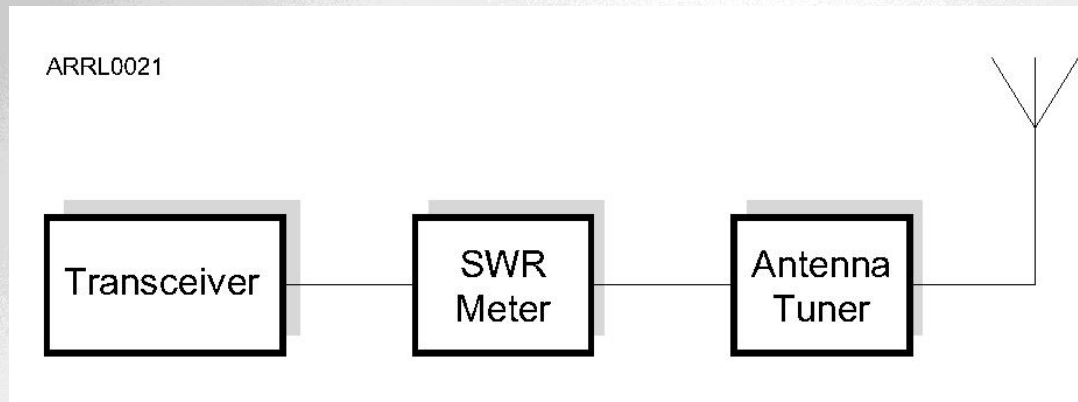
Some of these are built into transceiver or tuner.



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).



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.

- When used appropriately they are effective.
- When used inappropriately all they do is make a bad antenna or feedline look good for the transmitter – the antenna is still bad.

Other ways to match antennas:

Matching Stubs

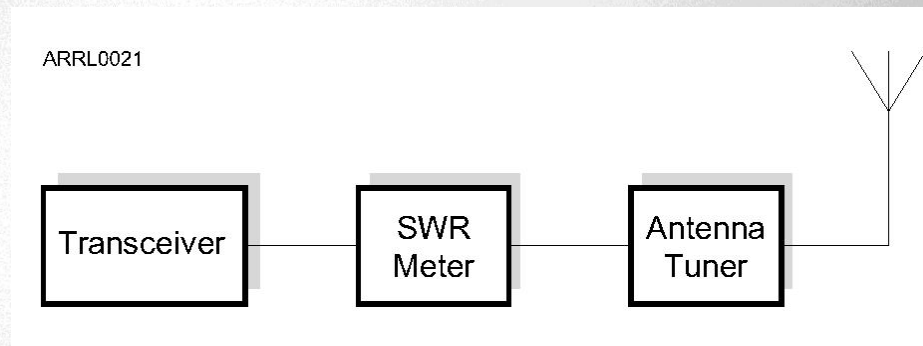
Change Antenna dimensions.



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.

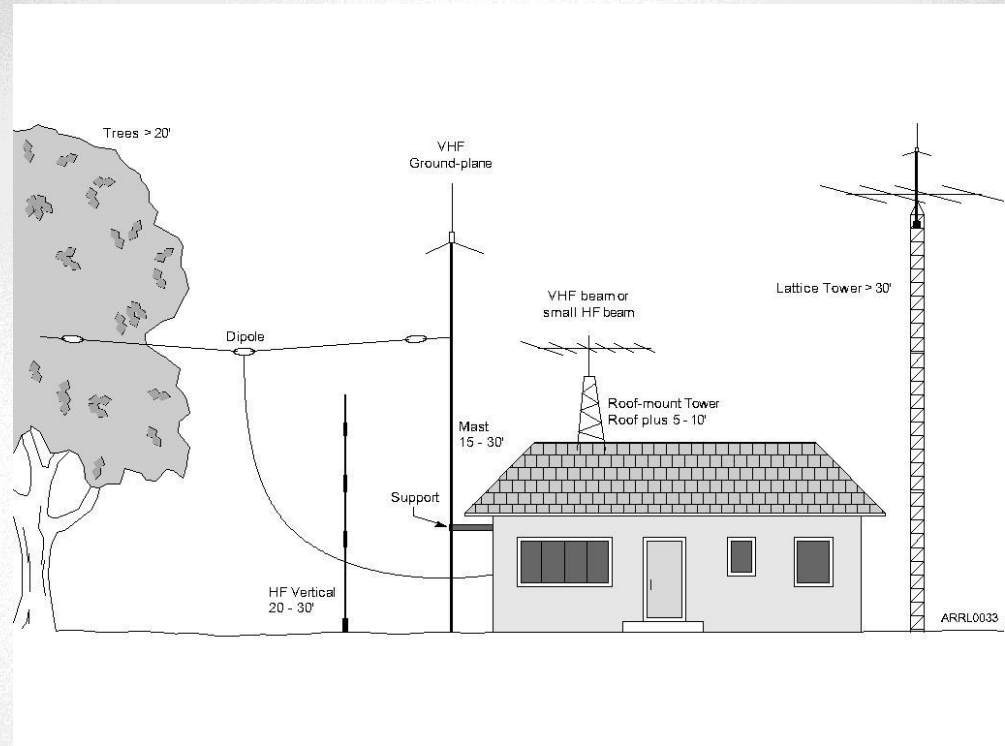


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Antenna Supports

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



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

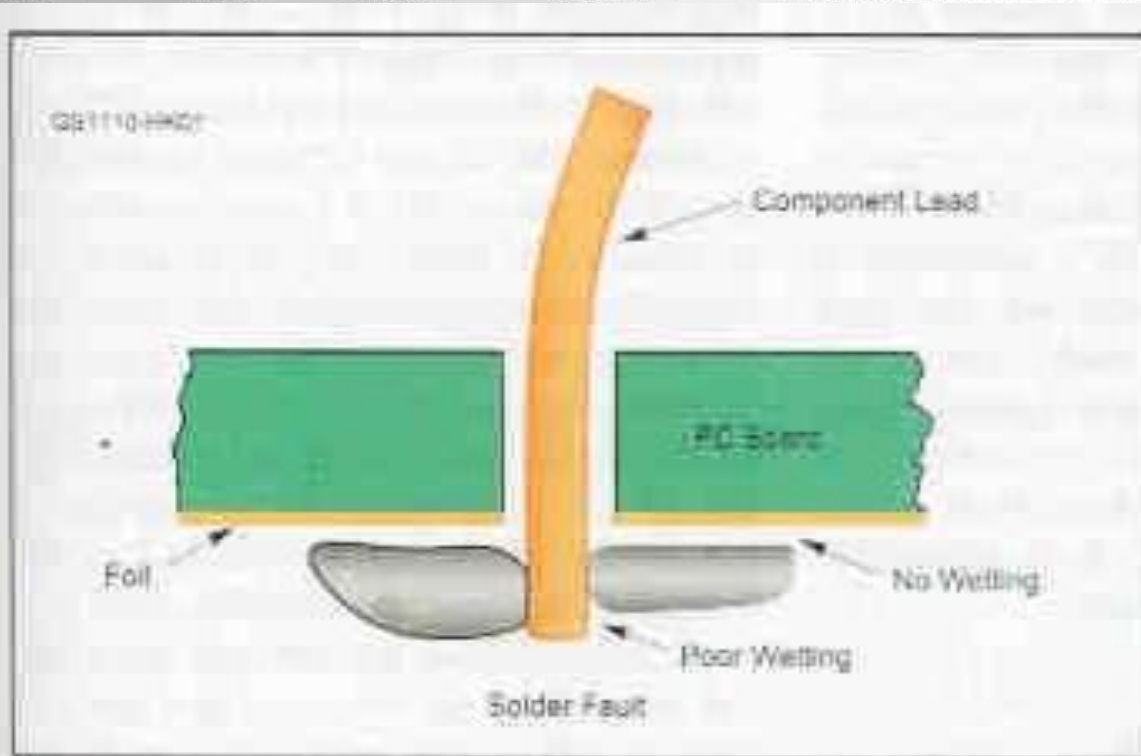


Figure 1 — This diagram shows how a lead may look soldered without actually providing an electrical connection between the component and foil.



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Poor Soldering Example 2

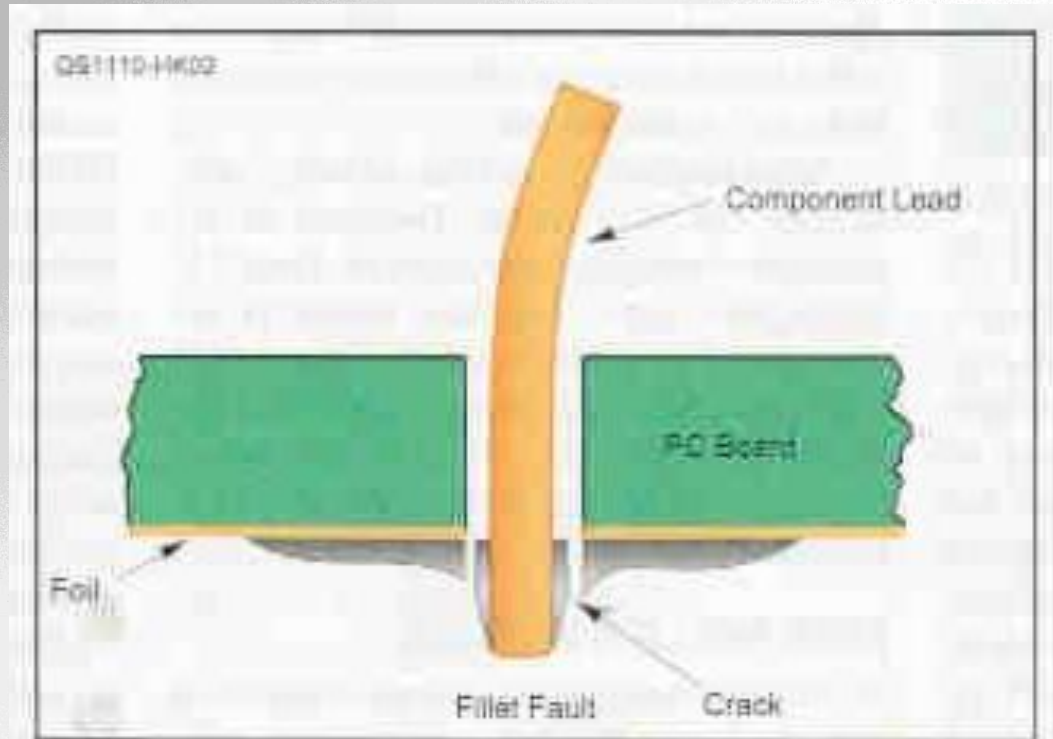


Figure 2 — This diagram shows what can happen if too much force is applied to a solder joint. Hairline fractures occur in the solder, electrically separating the lead from the foil.



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Poor Soldering Example 3

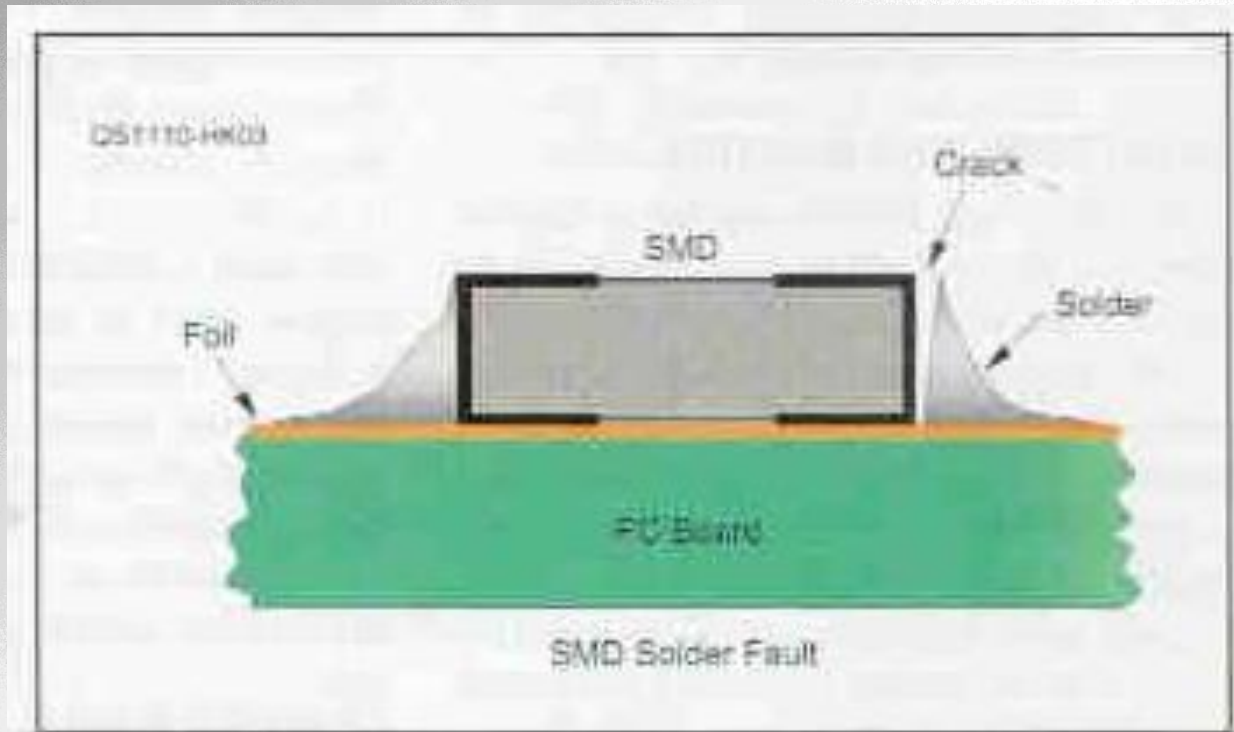


Figure 3 — When you are soldering SMD components, it is possible for the solder to build up, forming a gap between the component and the solder. Such a broken connection can be very hard to find.



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