

# Chapter 11

## Safety

Gordon, AH6DA

# Safety

- Three Hazardous materials:
  - PCBs (polychlorinated biphenyls) insulating oil used in electronic gear. (Transformers, High voltage capacitors, dummy loads, old equipment like amplifiers, etc)
  - Beryllium & Beryllium Oxide – used in copper alloys to stiffen it, Spring Contacts, duplexer fingers
  - Lead & Soldering – Solder is a mixture of lead and tin that is only dangerous when ingested or absorbed in the body
  - Carbon Monoxide – from generators or heating equipment during portable emergency operations

# RF Exposure

- Low level RF exposure is harmless
- RF exposure is dangerous when levels are high enough to affect body temperature
- RF radiation is non-ionizing, it does not have sufficient energy to break apart atoms and molecules

# RF Exposure

- **Power Density** – Is the intensity of the RF energy expressed in milliwatts per square centimeter
  - Increasing power levels increases power density
  - Increasing distance from an antenna lowers power density

# RF Exposure

- Absorption & Limits
  - The rate which energy is absorbed from the power to which the body is exposed is called the (SAR) Specific Absorption Rate.
  - SAR depends on the frequency, power density, average amount of exposure and the duty cycle of the transmission
  - Safe levels of SAR have been established by the FCC for amateurs in the form of “Maximum Permissible Exposure” (MPE)

# RF Exposure

- **Averaging & Duty Cycle**
  - Exposure to RF energy is averaged over fixed time intervals because the response of the body to heating is different for short duration and long duration exposures.
  - People in a Controlled environment are considered aware of their exposure and take precautions (power density limits are higher, averaging period is 6 minutes)
  - People in Uncontrolled environments are unaware of their exposure (the averaging period is longer, 30 minutes)

# Duty Cycle

The lower the transmission duty cycle (the less the transmitter is transmitting), the lower the average exposure.

Check Table 11-2 on page 11-5 for more details

Mode	Duty Cycle		Mode	Duty Cycle
SSB	20-40%		FM	100%
AM	25-100%		ATV	60-80%
AFSK	100%		SSTV	100%
CW	40%		Carrier	100%

# Estimating Exposure and Station Evaluation

You can perform the evaluation by actually measuring the RF field strength with calibrated field strength meters and calibrated antennas.

You can also use computer modeling to determine the exposure levels.

[http://hintlink.com/power\\_density.htm](http://hintlink.com/power_density.htm)

# Amateur Radio RF Safety Calculator

---

## Calculation Results

<b>Average Power at the Antenna</b>	200 watts
<b>Antenna Gain in dBi</b>	2.2 dBi
<b>Distance to the Area of Interest</b>	10 feet 3.048 metres
<b>Frequency of Operation</b>	28.410 MHz
<b>Are Ground Reflections Calculated?</b>	Yes
<b>Estimated RF Power Density</b>	0.7279 mW/cm <sup>2</sup>

	<b>Controlled Environment</b>	<b>Uncontrolled Environment</b>
<b>Maximum Permissible Exposure (MPE)</b>	1.1201 mW/cm <sup>2</sup>	0.228 mW/cm <sup>2</sup>
<b>Distance to Compliance From Centre of Antenna</b>	8.1291 feet 2.4778 metres	18.1155 feet 5.5216 metres
<b>Does the Area of Interest Appear to be in Compliance?</b>	yes	no

## Interpretation of Results

1. The power value entered into these calculations should be the average power seen at the antenna and not Peak Envelope Power (PEP). You should also consider feedline loss in calculating your average power at the antenna.
2. If you wish to estimate the power density at a point below the main lobe of a directional antenna, and if the antenna's vertical pattern is known, recalculate using the antenna's gain in the relevant direction.
3. Please also consult FCC OET Bulletin 65 Supplement B, the Amateur Radio supplement to FCC OET Bulletin 65. It contains a thorough discussion of the RF Safety regulations as they apply to amateur stations and contains numerous charts, tables, worksheets and other data to help determine station compliance.

**Perform another computation**

# The End, Almost

- Time to review using practice tests online and from the CD included with the course.
- If you are consistently passing with an 85% or better on multiple practice tests, you are ready for the real thing.
- Next week is the VE Test Session
  - Bring your original license and a copy to leave
  - Bring photo ID and \$15.00 CASH