

# Safety for Beginners



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# Emergency Phone Numbers

## **Two Vital Numbers to have in your phone and one frequency for your radio**

- ICE – under that label put an out-of-state emergency contact for you and your family. ICE stands for “In Case of Emergency.”
- Poison Control – 800 222 1222
- Program this in your radio NOAA weather: 162.55

# Just so you know

- This slide deck will be posted on the Comm Academy web site a few weeks from today.
- The last few slides in this deck have reference links – where I got this information or I found useful.
- PLEASE, Complete the survey. The survey has been updated to make it easier for you. We all want to know what you think about the Academy.

# Course Introduction

- Safety is an attitude which is gained through knowledge and best practices.
- Safety is Everyone's responsibility!
- Who/What are we trying to make “safe”?
  - Our family, friends, the general public, ourselves AND our equipment.
- This course will be for beginners; we will get through the basics. Then we'll have an advanced discussion only if we have time.

# Starting Point: my hand held

- What are the hazards of using this radio?

# Hazards of this HT

- Poke someone's (yours?) eye out.
- RF exposure (use speaker mic/headset)
- Operating in a dangerous place (RF field)
- Distraction (focused on listening and talking and lose situational awareness).
- Overcharge/drain the battery (fire/explosion)
- Heat
- Lightning rod?

# Less obvious Hazards

- **Just when you need it most, your HT might fail!**  
*i.e. YOU have a emergency but your radio doesn't work (when did you USE it last?)*
- **You might fail your HT** *i.e. don't have a spare battery, don't know how to program it*
- **You (and your HT) might interfere with Emergency Communications!**
- **You self deploy. (a very bad practice)**



# The five basic safety concerns/conditions

- 1 Grounding
- 2 Lightning
- 3 Electrical
- 4 RF Exposure
- 5 Field work – field day, emergency, public service.
- 6 Situational Awareness (bonus lesson)

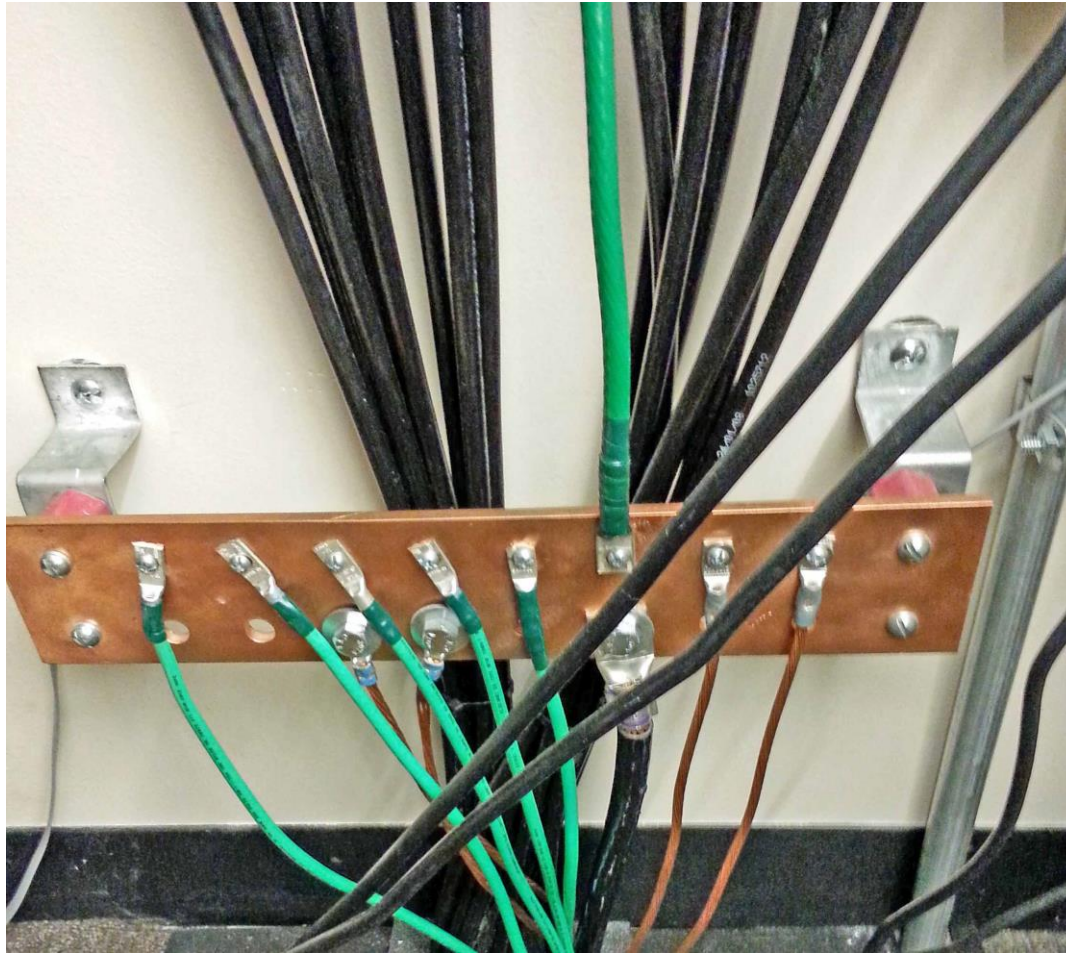
# Other safety concerns if time allows

- Physical Layout (trip, fall, or injury hazards)
- Antennas
- Towers
  - Rigging (guy lines strong enough?)
  - Engineering (wind load, base, antenna mounting)
  - Set Up (climbing)
  - PPE (Personal Protection Equipment)
  - Ground
  - Lightning
  - Lighting? Marking?
- Food and Water
- Shelter
- First Aid

# 1. Grounding - Electrical or “safety ground”

- Required by code – Ground ties to the neutral at one point.
- It’s good practice to have “one and only one ground” (Common Point Ground) - what does that mean? [Coax and Power Cord]
- Everything – all your equipment - should have a three-pronged plug. There are exceptions – battery chargers, some computers, land-line telephones.
- The safety ground is connected to the chassis of your equipment, and protects you if somehow a “hot” line connects to it.
- The concept of “balanced” – POTS (Plain Old Telephone Service)
- RF Ground – it’s tricky and advanced – touched on later
  - IF you have a tower, the tower’s ground and your shack’s ground should be connected together with buried copper strap.
  - If you are building or doing concrete work – consider an Ufer Ground.

# 1. Common Point Ground



# 1. Common Point Ground



## 2. Lightning Ground

- Where is this? What is there?



## 2. Lightning – A very advanced topic.

- Good news – there is a LOT of information out there
- Bad news – there is a LOT of information out there
- Scary news – lightning will grab ANYTHING to find ground
- Really scary news – lightning is FAST AND POWERFUL
- With ground(s) – SHORT and WIDE is what you want
- If you are pouring concrete – look at an Ufer ground.

## 2. Lightning Ground

- Complete this sentence: “Electricity follows the path of \_\_\_\_\_”



## 2. Lightning Ground

- Complete this sentence: “Electricity follows the path of least resistance.”
- Parallel Resistance

# 2. Lightning Ground

## – Practical discussion

- Handheld (sorry to say, but: YOU are the lightning ground!)
- Mobile (capacitive coupling to the ground)
- Base Station – single point ground panel
- Antennas/towers
  - Some antennas need a ground, some are “balanced”
  - Towers, mostly, are grounded
    - » Run ground wires/straps straight – no kinks – no sharp turns
    - » Good radials buried 6 to 18” below grade
      - 8 or more radials (4 if desperate)
      - Grounding rods along radials at intervals twice the length of the ground rod.
      - If you are pouring a concrete base – consider Ufer ground.
- Telephone lines – POTS (Plain Old Telephone Service) are balanced and NOT grounded, use special lightning arrestor.
- Speaking of lightning arrestors. . .

## 2. Lightning Arrestors

Eye Radio

98.6 Mhz

Juba, Sudan



## 2. Lightning Ground

- Wide copper straps – VERY straight (no kinks)



# 3. Electrical

- Power lines and towers/antennas
- Extension cords/Power Strips
  - Daisy chains
  - Mixed circuits (mixed ground?)
- Wire gauge – the right wire for the right current
- How to know how much power things take?
  - Look in the manual
  - Add up the fuses
  - Measure the current and use Ohm's law  $P=I \cdot E$

# 3. Electrical

- Surges and how to protect your station
  - Power strip with “surge protection” = junk (NOT recommended)
  - UPS (Uninterruptable Power Supply), typically, won’t protect you from fast surges
  - Power Conditioners \$\$\$\$ (expensive) and ### (heavy) and worth it!
- Don’t mix circuits
  - Example: Generator on the transceiver, “city” power on Power Amplifier
  - Example: Your shack has two separate circuit breakers for its outlets.
- Good Practices
  - Never work on anything “hot” – think before stripping wires
  - Plug in the power cord last
  - Unplug equipment (and put the plug in sight) before you work on it (sleeper circuits)
  - With High voltage (especially DC) – one hand behind your back
  - Remember what capacitors do – store energy
  - Electrical “lock-outs”

### 3. Electrical lockouts



# 4. Radio Frequency (RF) Exposure

- Remember this is a beginner's class
- That means beware of over-simplification.
- It also means there are a lot of opinions out there, and this course will give a general opinion.
- Safety is your responsibility, and you have to decide what is safe!



# 4. RF Exposure

- The Inverse Square Law is your friend. Power is attenuated (reduced) in an inverse square of the distance.
- Operate at the lowest possible power.
- Don't look into a wave guide or directive antenna used for UHF/SHF
- Don't operate transmitters or amplifiers with the cover off. Don't work around or on antennas when any of them are in use. Use lockouts if possible.

# 4. RF Exposure

- IF you are close to these power levels (at the antenna)– THEN do the math (see link (next slide) and the end of the slide deck)
  - 160 to 40 meters – 500 Watts PEP
  - 20 meters – 225 Watts PEP
  - 15 meters – 100 Watts PEP
  - 10 to 1.25 meters – 50 Watts PEP
  - 70 cm – 70 Watts PEP
- Beyond this point there be LAW &MATH!

# 4. RF Exposure

- [http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1\\_2.pdf](http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1_2.pdf)

# 5. Field Operations

- All of the safety concerns we have discussed apply to field operations as well. Some risks will increase.
  - Neatness becomes even more important
  - Increased likelihood of the General Public will also be at risk
    - Why does this matter? We chose to be hams, they didn't
  - Electrical could easily become tricky
    - More than one generator?
    - Alternative power such as solar/wind/batteries
  - Grounding
    - Generators, towers, operating positions all need to be properly grounded
  - RF Safety
    - Multiple stations operating means accumulation of RF exposure.
    - Antennas deployed much lower (less height) than at “home”, and potentially more dangerous. Public too close.

# 5. Field Operations

- Lightning
- **Food Safety**
- Trip and similar hazards
  - Power, coax, network cables
  - Guy lines
  - Antennas with eye-level elements (poking hazard)
- Untrained or distracted “helpers”
- Working with people you don’t know (names?)
- Generators
  - Fuel Storage and refueling procedures
  - Grounding
  - Access to (block it off)
- PPE (Personal Protection Equipment)
  - Gloves, Shoes, Hardhat?
  - Vests, goggles
  - Whistle

# Bucket List

- What do YOU want to discuss in more depth?
- **SITUATIONAL AWARENESS!**
- Ground
- Lightning Ground
- Electrical
- RF
- Field Operations
- Incident Command – Safety
- First Aid

# Resources

- **General**

- ARRL's "home" page on safety
- <http://www.arrl.org/safety>

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- **Electrical**

- From the ARRL antenna book
- <http://www.arrl.org/files/file/Technology/tis/info/pdf/AntBk.pdf>
- General ARRL page on electrical safety
- <http://www.arrl.org/electrical-safety>

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- **Grounding**

- <http://www.arrl.org/grounding>
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- About Ufer grounds
- [http://en.wikipedia.org/wiki/Ufer\\_ground](http://en.wikipedia.org/wiki/Ufer_ground)

# Resources

- **Lightning**
- ARRL's lightning safety page
- <http://www.arrl.org/lightning-protection>
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- Three good articles on lightning safety
- <http://www.arrl.org/files/file/Technology/tis/info/pdf/0206056.pdf>
- <http://www.arrl.org/files/file/Technology/tis/info/pdf/0207048.pdf>
- <http://www.arrl.org/files/file/Technology/tis/info/pdf/0208053.pdf>
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- **RF Safety**
- RF safety evaluation and exemption worksheets:
- [http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1\\_2.pdf](http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1_2.pdf)
- How to evaluate a Ham Station:
- <http://www.arrl.org/files/file/Technology/tis/info/pdf/CH5references.pdf>
- 
- **Safety in the field:**
- Nice article walking through field day RF safety
- <http://www.arrl.org/files/file/Technology/tis/info/pdf/9906048.pdf>



# Resources

- Railroad Lantern: Rail-Tek Supply  
[www.railteksupply.com](http://www.railteksupply.com) 1 888 338 7246

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