

THE **ARRL**

FIFTH EDITION

HAM RADIO LICENSE MANUAL



EVERYTHING YOU NEED TO GET YOUR FIRST HAM RADIO LICENSE!

- All questions and answer key, with detailed explanations, to help you pass your test and get on the air!
- For use with exams taken between July 1, 2022 and June 30, 2026.



Amateur Radio Technician Exam Preparation Course



ARRL
The National Association for
Amateur Radio®

Plan for Today

- Safety
- Studying for and Taking the Test

Electrical Hazards

- Shocks
- Burns
- Even small currents can cause serious problems

Table 7-1

Effects of Electric Current Through the Body of an Average Person

<i>Current (1 Second Contact)</i>	<i>Effect</i>
1 mA	Just Perceptible.
5 mA	Maximum harmless current.
10 - 20 mA	Lower limit for sustained muscular contractions.
30 - 50 mA	Pain
50 mA	Pain, possible fainting. "Can't let go" current.
100 - 300 mA	Normal heart rhythm disrupted. Electrocution if sustained current.
6 A	Sustained heart contractions. Burns if current density is high.

What health hazard is presented by electrical current flowing through the body?

- A. It may cause injury by heating tissue
- B. It may disrupt the electrical functions of cells
- C. It may cause involuntary muscle contractions
- D. All these choices are correct

Electrical Safety

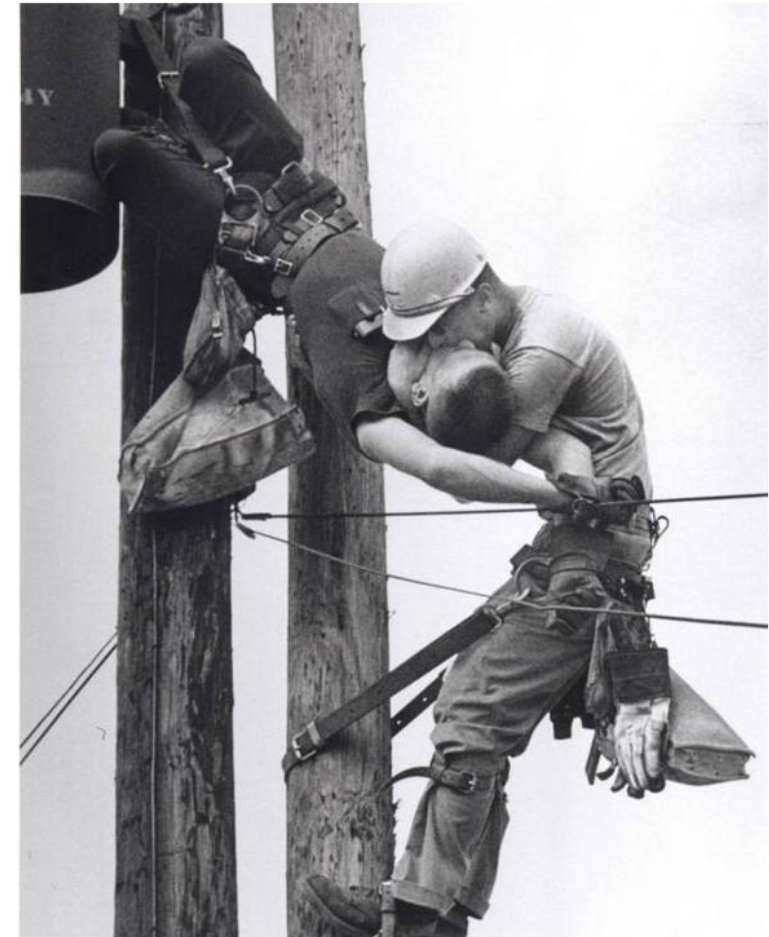
- Avoid contact with live circuits
- Most modern equipment is low voltage, low hazard
- Old equipment (like tube amps) can be high voltage and very hazardous

Mitigating Electrical Hazards

- Turn off power if possible!
- If power is required:
 - Remove jewelry
 - Wear insulating shoes
 - Avoid unintentionally touching circuits
 - Never bypass ***safety interlocks***
 - Warning: capacitors can hold a charge even when power is off
 - Storage batteries are dangerous when shorted
- Make sure equipment is grounded, has a fuse/breaker
- Around high-voltage circuits: keep one hand in pocket

Responding to Electrical Injury

- ***REMOVE POWER!!***
 - Make sure ON/OFF switches, breakers clearly marked
 - Don't become a victim yourself
- Call for help
- Also helpful: learn CPR and First Aid



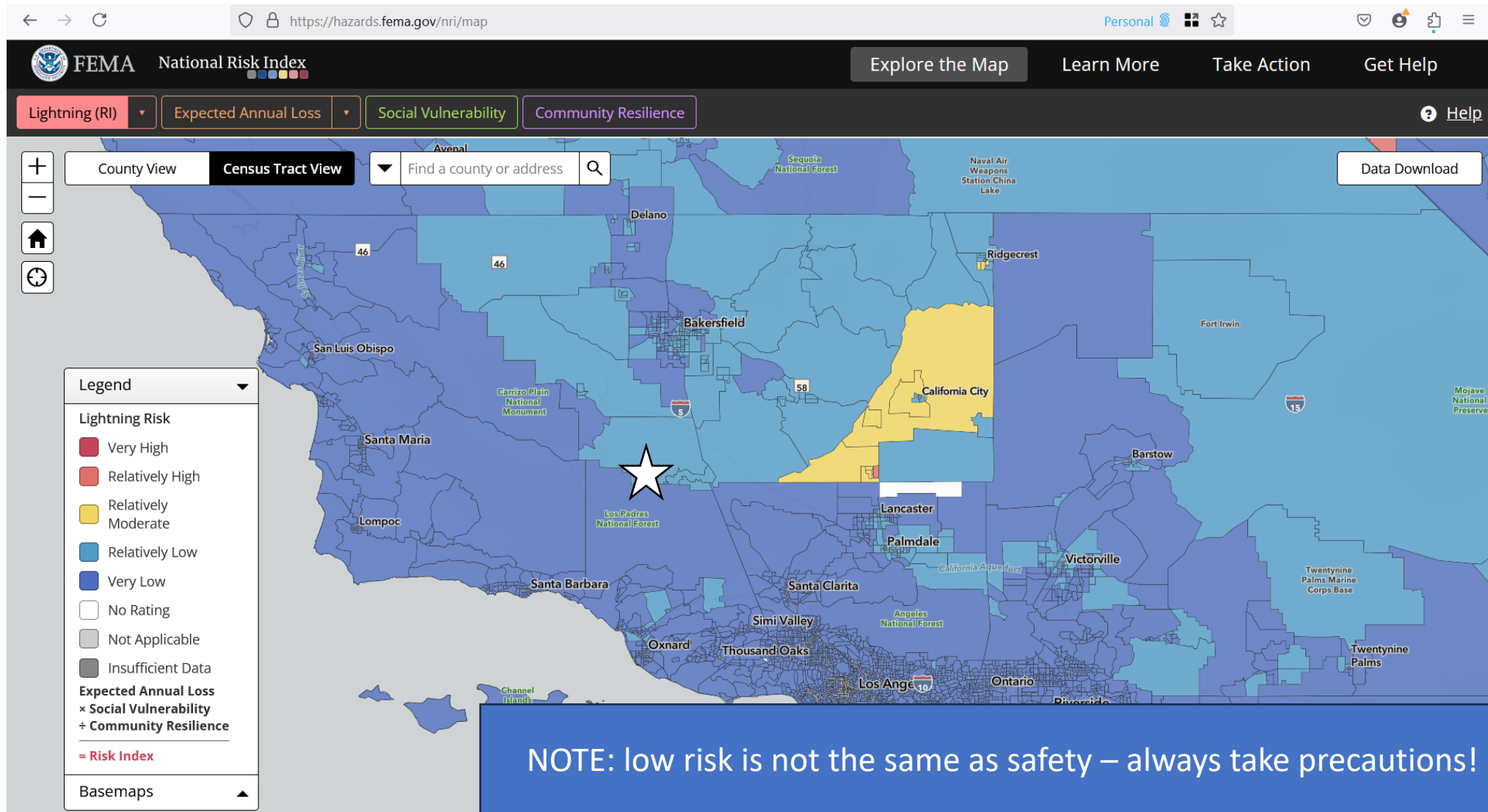
Rocco Morabito / Jacksonville Journal

Lightning Safety

- Antennas are not struck more frequently than trees/skyscrapers
- Ground all antennas
- Use lightning arrestors
- Disconnect antenna cables and power cords during storms
- Disconnect telephone lines from computer modems
- <https://arrl.org/lightning-protection>



Lightning Risk Here in PMC

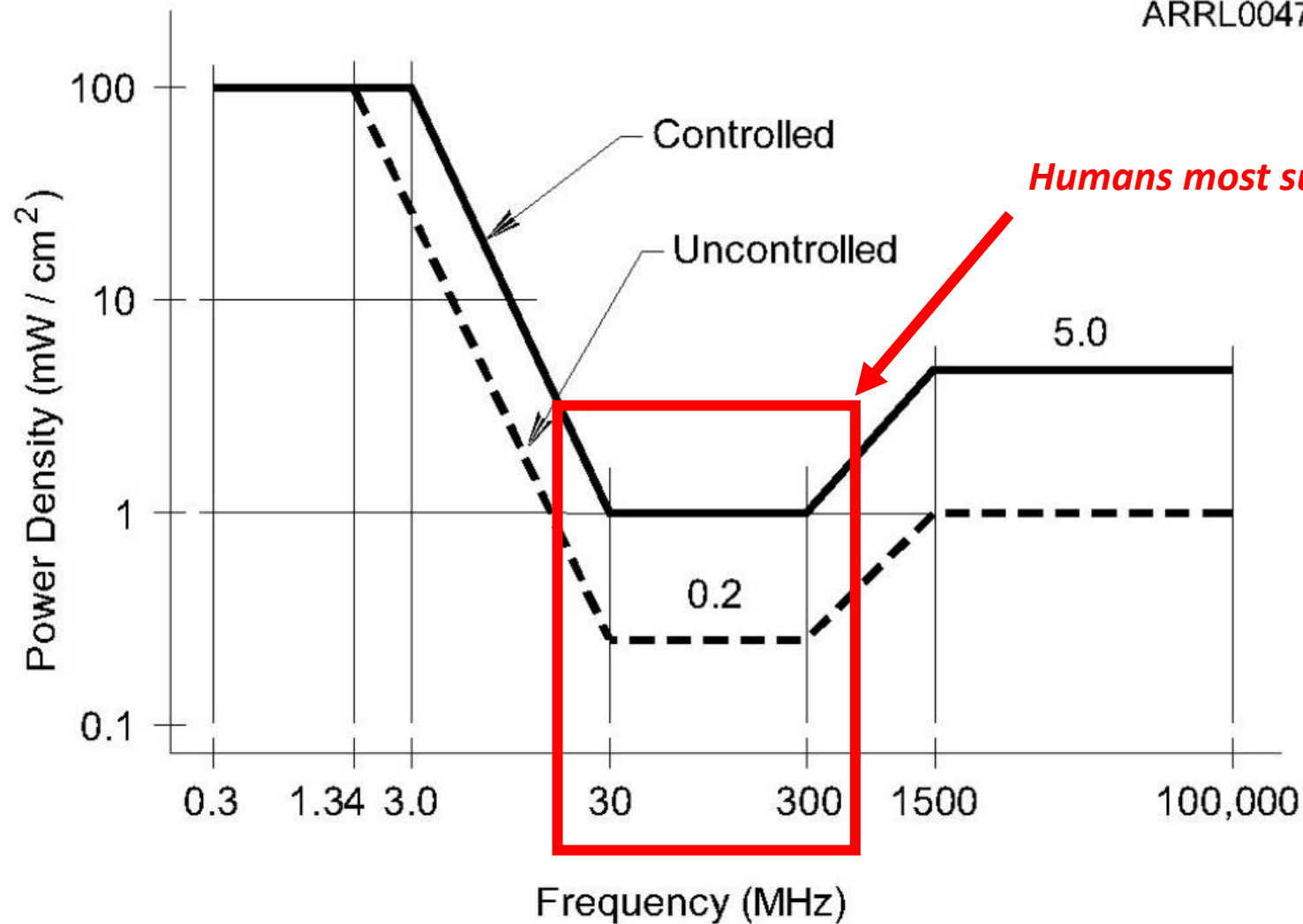


RF Exposure

- Radio is ***non-ionizing*** radiation, cannot cause genetic damage
- Exposure to high levels of RF can still cause problems
 - With precautions, RF exposure is minimal, not dangerous
- ***Thermal Effect:*** RF energy can heat body tissues
- Heating depends on RF intensity and frequency
 - Body parts act like antennas, absorbing RF
 - Some frequencies are absorbed more efficiently = increased risk
 - More caution prescribed for some frequencies
- ***Maximum Permissible Exposure*** based on averages over time
 - 6 minutes in controlled environments, 30 minutes in uncontrolled

Maximum Permissible Exposure

ARRL0047



Why do exposure limits vary with frequency?

- A. Lower frequency RF fields have more energy than higher frequency fields
- B. Lower frequency RF fields do not penetrate the human body
- C. Higher frequency RF fields are transient in nature
- D. The human body absorbs more RF energy at some frequencies than at others

Mode Duty Cycle Matters!

- ***Duty Cycle***

- The fraction of time the radio is transmitting
- Different modes have different typical duty cycles
 - Digital radio often very high
 - Talking on the radio often lower

- Higher duty cycle =

- Radio is transmitting more often
- Greater RF exposure

Operating Duty Factor of Modes Common

<i>Mode</i>	<i>Duty Cycle</i>
Conversational SSB	20%
Conversational SSB	40%
SSB AFSK	100%
SSB SSTV	100%
Voice AM, 50% modulation	50%
Voice AM, 100% modulation	25%
Voice AM, no modulation	100%
Voice FM	100%
Digital FM	100%
ATV, video portion, image	60%
ATV, video portion, black screen	80%
Conversational CW	40%
Carrier	100%

RF Power Density

- ***Power Density*** = amount of energy per unit area (usually mW/cm)
 - Power is denser closest to antenna, transmitter
 - Less dense further away
- Transmitter power: higher power = higher risk
- Antenna gain and proximity
 - Beam antennas focus available energy
 - Standing in the beam or near an antenna increases risk
- Mode duty cycle
 - More time at high power = higher risk

Do You Know What's Near Your Antenna?

- ***Controlled Environment***

- You know where people are standing relative to your antenna
- You can control people's/your exposure
- More power allowed because you can make adjustments to limit exposure

- ***Uncontrolled Environment***

- You have no idea or have no control of people near your antenna
- Less power is allowed: must assume worst-case scenario

Evaluating RF Exposure

- All fixed stations must perform an exposure evaluation
- At lower power levels, no evaluation required
- How to reduce RF exposure:
 - Reduce transmitter power
 - Move your antenna up and/or further away
 - Point a beam antenna away from people
- Always make sure people won't touch your antenna!
 - RF burns are very painful
 - *How will you minimize chances of RF burns?*

Who is responsible for ensuring that no person is exposed to RF energy above the FCC exposure limits?

- A. The FCC
- B. The station licensee
- C. Anyone who is near an antenna
- D. The local zoning board

Evaluation Thresholds

- Transmitting above these power levels requires an evaluation.
- How to perform an evaluation
 - Use the techniques outlined in the FCC's OET (Office of Engineering Technology) Bulletin 65
 - Measure the power density of your transmissions
 - Make computer models of your station

Band(m)	Power (W)
80, lower	500
40	500
20	225
10	50
2	50
1.25	50
0.7	70
0.23	200
0.13, higher	250

Which of the following is an acceptable method to determine whether your station complies with FCC RF exposure regulations?

- A. By calculation based on FCC OET Bulletin 65
- B. By calculation based on computer modeling
- C. By measurement of field strength using calibrated equipment
- D. All these choices are correct

Mechanical Safety

Driving with a Radio

- CA hands-free law is ambiguous about radio, may/may not be enforced
- Review the CA laws around this, cooperate with officers if stopped
 - Other states may have different laws; be aware as you travel
- Make sure equipment is secure, you can operate it safely
 - Loose radios in cabin become projectiles in a crash
 - Use remote control heads where possible, secure the body
 - Mount your radio so your attention is on the road

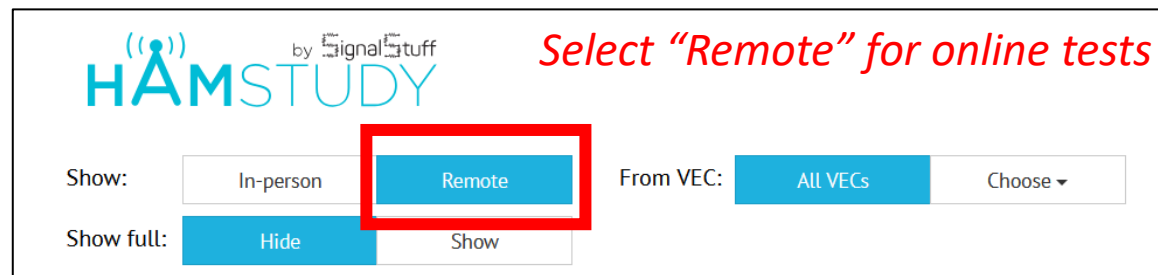
Radio Towers

- Installation
 - Make sure tower is clear of trees, power lines
 - If the tower falls, it must be more than 10 feet from a power line
 - Towers should use proper grounding techniques
 - Adhere to local building permits too
- Working on towers
 - **BUDDY SYSTEM** in case you need help. Never work alone.
 - Use proper clothing, hard hat, eye protection, climbing harness
 - Don't climb a crank-up tower supported by its cable
 - Use a gin pole to lift tower sections and antennas

Taking the Test

Taking the Test

- Taking the test in person
 - Bakersfield: <https://w6lie.org/get-your-license>
 - Next testing date: Friday May 9, 2025
 - Santa Clarita: <https://w6jw.org/testing>
 - Next testing date: Saturday May 17, 2025
 - Tehachapi: <https://ac6ee.org/get-your-license>
 - Next testing date: Saturday April 12, 2025
- Taking the test online
 - Search online: <https://hamstudy.org/sessions>



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Mar 23, 2025 (Sun)

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Reminder: Test Format

- 35 questions randomly selected from the pool of 300
 - All sections of the pool will have a couple questions
- You need to get 26 correct (74%)
- Multiple choice
 - Answer order is randomized
- Simple calculators allowed (no phones), but you don't really need one

Recommended Study Method

Our brains are very good at recognition.

1. Read the question
2. Read **ONLY** the correct answer
 1. If you do not know the correct answer, click “I don’t know”
3. If working on paper, highlight/underline/circle the correct answer
4. Repeat for the whole question pool

Review and take practice tests until you are regularly getting at least 90%
You’re ready to take the test!

Any questions?

- Radio office hours: 7-8pm Thursdays, Condor Room
- Monthly ham club meetings: 3rd Sunday, 1pm, Pavilion Room
- Email: kk6dzw@arrl.net
- Let me know when you pass your test!

